Gold in the Interwar Monetary System: Evolution of the Gold-standard Regime

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submitted for the degree of DPhil

To my parents
James and Roberta Urban

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Candidate: Scott Andrew Urban, St. Antony's College, Oxford

Submitted for the degree of DPhil, Hilary Term 2012

Short Abstract

This thesis is motivated by discrepancies between the modern account of currency policies in the 1930s and the policies described by a contemporary, Ragnar Nurkse. The former emphasises a newfound policy independence, the latter a continuance of gold-standard constraints. Main contributions are empirical results, application of existing methodologies to historical data, use of previously unpublished data, and new theoretical analysis.

Paper One presents evidence of persistent monetary conservatism in the 1930s. Statutory obligations to limit the supply of base money to a multiple of international assets were eased with the loss of gold convertibility (circa Britain's 1931 devaluation) but *eliminated* only in Germany, Italy and Greece. A central hypothesis of this dissertation is that collateralization of 1930s central bank money was standard practice, as before WWI.

Paper Two tests whether 1930s central banks were more willing to sterilize reserve losses compared to the gold standard. It finds the odds of sterilization indistinguishable except where banks enacted strict capital controls. A minority of 1930s central banks did so.

Paper Three applies the modern methodology of exchange-rate regime classification to interwar currency regimes. Post-gold observations are compared with the gold standard and observations preceding it. The results suggest that 1930s currencies were pegged, whereas the modern literature describes these as managed-floating.

The three papers provide support both for the modern literature and for Nurkse. They confirm the former's emphasis on a dysfunctional gold standard. Yet they modify this literature's description of the ensuing regimes; here they support Nurkse's criticism of 1930s central bankers' inability more aggressively to cast aside their golden fetters. This thesis suggests that such behaviour might reflect a contemporary reluctance to embrace more fully the concept of un-backed money, which if true might indicate an evolved practice of the gold standard.

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Long Abstract

This thesis is motivated by discrepancies between the modern account of currency policies in the 1930s and the policies described by a contemporary, Ragnar Nurkse. The former emphasises a newfound policy independence, the latter a continuance of gold-standard constraints. Main contributions are empirical results, application of existing methodologies to historical data, use of previously unpublished data, and new theoretical analysis.

Paper One offers a hypothesis for the apparent shortage of monetary policy freedom in the 1930s. Statutory obligations to limit the supply of base money to a multiple of international assets restrained expansionary open-market operations. These statutes, known as 'cover' provisions, were eased with the loss of gold convertibility but were *eliminated* only in Germany, Italy and Greece. Hence the anomaly, noted in the modern literature, that central banks despite leaving the gold standard were slow to expand the money supply. A central hypothesis of this dissertation is that collateralization of central bank money was standard practice, as it had been before WWI, and that this collateralization is important for understanding monetary policy in the 1930s.

The dataset in Paper One brings together a comprehensive interwar panel of cover limits in effect during the gold-standard years and the post-gold years. To the author's knowledge, no such compilation has been previously published. Paper One derives a theoretical relationship between the cover limit and the supply of base money, and shows how the former constrains the latter. This relationship is then tested empirically; the impact of a number of base-money-supply determinants is estimated in a variety of frameworks. All show a significant relationship between the cover limit and the provision of central bank money. The main contribution is to show that private demand for base money is unfulfilled in the presence of a cover limit.

Paper Two tests whether 1930s central banks exhibited greater willingness to sterilize the impact of reserve changes on the monetary base, compared to the gold standard. Using nonlinear estimation techniques, it finds that the odds of sterilization were

indistinguishable between banks off the gold standard and banks on the gold standard, *except when banks enacted strict capital controls*. Since only a minority of 1930s central banks enacted strict capital controls, the fettering of at least this dimension of policy seems minimally reduced in the 1930s. This paper confirms a key contention of the modern literature, that the gold standard as practiced in the interwar period was inherently deflationary, due to the asymmetric incentives to observe 'rules of the game'. According to Ragnar Nurkse, author of the League of Nations' review on the interwar currency system, such rules describe how pre-WWI central banks reacted to a loss or gain of gold and foreign exchange. Nurkse alleged that interwar central banks did not expand the monetary base automatically upon acquisition of gold or other international asset, whereas, he thought, pre-WWI central banks did.

Nurkse was not necessarily correct about the pre-WWI central banks. But the point of the modern literature is that he was only partly correct about interwar central banks: while a reserve-acquiring central bank need not expand domestic money upon a newly acquired reserve (i.e., it was free to sterilize such an acquisition and frequently did), a reserve-losing central bank had every reason to allow this loss to shrink the money supply, lest it violate the minimum coverage of domestic money with foreign reserves, as called for in statutory provisions known as 'cover limits'. Hence the system as a whole was likely to see a net contraction in the world supply of central bank money, engendering deflationary properties. Paper Two provides evidence for the existence of exactly these qualities. A major finding of the paper is that this asymmetry persisted into the post-gold period.

The dataset in Paper Two includes the monthly balance sheets of 31 central banks in the 1922-1939 period, notwithstanding gaps for countries engulfed in conflict, such as Spain after 1936. Paper Two also brings to light a dataset previously unused and unpublished: the weekly balance sheet accounts of 19 countries, recorded in hand-written journals at the Bank of England and available in incomplete form at the archive.

Paper Three applies the modern methodology of exchange-rate regime classification to assess empirically the nature of currency regimes in the interwar period. Two classification systems are utilised; both employ exchange-rate time series data for 48 countries at weekly frequency for the period 1919-1939, truncated in August 1939 to exclude the outbreak of war. The first classification tool measures the presence of pegged exchange rates. It applies the monthly methodology of a modern de-facto classification system, and innovates a continuous-time classification which can be segmented into

separate years to render a percentage observation of pegged exchange rates for an individual currency regime and for the world as a whole.

The second classification system assesses the overall flexibility of the currency regime. This methodology is based on the time-series properties of currency returns. Over the given horizon (one week), the distribution of returns in a floating exchange rate should approach normality, with a kurtosis statistic approaching 3. The distribution of returns in an inflexible currency regime will feature bigger tails and a preponderance of observations close to zero, thus generating excess kurtosis, i.e. kurtosis in excess of 3. By placing kurtosis of currency returns in the denominator and volatility of the exchange rate in the numerator, a flexibility index is complied for each currency, where higher values are associated with more-flexible or 'floating' regimes.

For both classification systems, off-gold observations are compared with the gold standard and with observations preceding it. The results suggest that 1930s exchange-rate regimes were pegged, whereas the modern literature often describes them as floating or managed floating. An aggregated index for the world as a whole suggests that these years features the same incidence of pegging and inflexibility as did the gold-standard years that preceded them and the Bretton Woods years that followed them.

All three papers utilise the author's classification of gold-standard observations at the weekly and monthly frequency for up to 48 currencies. The classification is based on Officer's 2008 annual classification. Within-year classification is based on the final observation of 1%-or-greater change in the exchange rate against the gold numeraire currency (e.g. the dollar) for the start of the gold standard, and the date of gold-standard violation reported by the League of Nations' in a 1940 retrospective tally as the end-date of the gold standard.

Another contribution is the interpretation of a contemporary source, the aforementioned Ragnar Nurkse. Nurkse's views on the interwar system are often cited as a standard-bearer for opinions against floating currencies. It has been inferred that Nurkse denigrated floating exchange-rate regimes in the 1930s. In fact he did no such thing. He was clear in observing that floating regimes (which he called "freely fluctuating") existed only in the interwar years preceding the gold standard. The regimes which followed the gold standard Nurkse described as "flexible" but with a very different intention behind the word as would be construed today. By "flexible currency", Nurkse had in mind the adjustable peg

regime which became a hallmark provision of the post-WW2 Bretton Woods system. This is different to the floating-currency regimes which replaced Bretton Woods.

The empirical results of the three papers provide support both for the modern literature and for Nurkse. They confirm the former's emphasis on a dysfunctional, internationally practiced gold standard. Yet they modify this literature's description of the ensuing regimes. Here the thesis provides support for Nurkse's criticism of 1930s central bankers' inability to more aggressively cast aside their golden fetters. This thesis suggests that such behaviour might reflect a contemporary reluctance to embrace more fully the concept of un-backed money, which if true seems to point to a weaker but persistent practice of a 'gold standard'.

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I spent many hours in the Bank of England Archive and am grateful for the access and support I received there. In particular I thank Sarah Millard. I also thank Kath Begley of the Bank of England library, who gave me access to, and assistance with, the Bank's holdings of interwar statistical publications. I am grateful too to the staff of Oxford's Bodleian Library, in particular the Social Sciences Library and the Official Papers Room. I extend my gratitude as well to the Nuffield and St Antony's College librarians.

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A note on terminology

The term "cover limit" in this thesis refers to the statutory minimum of the ratio of international reserve assets to domestic liabilities to be maintained by the monetary authority, the latter ratio being the "cover ratio".

The term "gold standard" in this thesis, except where otherwise stated, refers to the practice of generally free convertibility of the note issue for gold at the central bank or monetary authority.

The word "gold" in this thesis, unless otherwise stated, refers generically to actual gold metal bullion, certificates entitling ownership of such, and holdings of government securities convertible into a currency which itself is convertible into gold.

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Introduction

1. Historical background

Modern scholarship on the monetary and exchange-rate dynamics of the 1930s is contained in a monetary history literature encompassing the broader interwar period, in which the short-lived international gold standard is central.[1] This literature emphasises the dysfunctional qualities of that standard, and illuminates the role it played in making the Great Depression a contraction of global scale. This emphasis upended an earlier generation of literature which attributed the Great Depression to an insufficient fidelity to the ethos of the gold standard as well as to an abdication of leadership by the hegemonic trading power.[2] A central finding of the newer scholarship is the causal relationship between abandonment of the gold standard and initiation of economic recovery.[3]

The monetary regimes which replaced the gold standard are a secondary focus of the modern literature.[4] In part this is because of the centrality of the gold standard itself in the two decades of monetary history between the world wars. To the extent that the monetary norms of 1930s are characterised, they are seen as featuring greater independence and, often, floating or managed-floating exchange-rate regimes -- a.k.a. fluctuating currencies.[5]

This picture contrasts with a main contemporary account of the international monetary system of the 1930s. Ragnar Nurkse in his 1944 review of the interwar monetary arrangements paid great attention to the 1930s, as well as to the 1920s and the gold-standard years straddling these decades.[6] While acknowledging a newfound monetary independence of 1930s post-gold regimes, Nurkse highlighted the extent to which they remained constrained by a legacy of the gold-standard itself: the obligation to 'back' the domestic currency with international assets.[7] This might explain the hesitation, noted in

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[1] The canonical work of the modern literature is Eichengreen, B., *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939* (Oxford, 1992). See also Temin, P., *Lessons from the Great Depression* (Cambridge MA, 1989).
[2] See especially Kindleberger, C., *The World in Depression 1929-1939* (Berkeley, 1973).
[3] Eichengreen, B. and Sachs, J., 'Exchange rates and economic recovery in the 1930s', *Journal of Economic History* 45 (1985), 925-946.
[4] *Golden Fetters*, for example, devotes two chapters to the 1930s post-gold regimes.
[5] Eichengreen, *Golden Fetters*, 395.
[6] Nurkse, R., *International Currency Experience: Lessons from the Inter-war Period* (Princeton, 1944).
[7] *Ibid*, 12.

the modern literature, of post-gold monetary authorities more aggressively to expand the money supply.[8]

This thesis attempts to shed light on the operation of currency regimes after the fall of the gold standard in the 1930s, motivated by the discrepancy between the modern literature and the contemporary account of Nurkse. The foci are the obligation to maintain a minimum backing of base money ('cover ratio'), sterilization of reserve changes in a fixed exchange-rate setting ('rules of the game') and exchange-rate regime classification.

2. Data contribution

The thesis contributes a comprehensive accounting of central bank cover statutes from secondary sources. These have been transcribed by the author from contemporary publications. To the author's knowledge, the evolution of these cover statutes has not previously been compiled and presented in this detail. The cover statutes are standardized into a consistent form of cover.[9]

This thesis compiles a comprehensive dataset of interwar central bank balance sheets, transcribed by the author from contemporary secondary printed sources. These monthly data cover the period 1922-1939, with interruptions due to war or civil disturbance, e.g. Spain from 1936 and Italy from 1938. The main source for this dataset is the *Federal Reserve Bulletin*. This is augmented by League of Nations' *Monthly Bulletin of Statistics* and weekly issues of the *Economist*.

The thesis contributes the first transcription of an unpublished, hand-written dataset from the archives of the Bank of England. This is a set of accounting ledgers in which the Bank recorded the weekly balance sheet items of a group of central banks in the interwar period. The entirety of these ledgers have been photographed and transcribed by the author.[10]

The dissertation's three papers utilise the author's coding of gold-standard observations for 48 central banks in the 1919-1939 period down to the weekly frequency. The coding

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[8] Eichengreen, *Golden Fetters*, 288.

[9] Although the spirit of these statutes is uniform, their specification varied. The biggest distinction is between a 'cover' statute, which ties down the minimum ratio of foreign assets to sight liabilities, and a 'fiduciary' system, which requires all sight liabilities beyond a fixed quantity to be 100% backed by foreign assets. Appendix 2 of Paper One reports these statutes in detail. The algorithm for their standardisation is described in Paper One.

[10] Bank of England Archive, File OV3, "Bank returns by overseas central banks" (26 volumes).

algorithm begins with Officer's 2008 annual classification.[11] Subject to Officer's annual frequency, the gold standard begins upon the final observation of 1%-or-greater change in the exchange rate against the contemporaneous gold-standard benchmark currency (overwhelmingly the US dollar) and ends with the first violation reported by the League of Nations.[12]

3. New application of existing methodology

Exchange-rate regime classification

This thesis applies a modern methodology of exchange-rate regime classification to interwar data. It adapts the 2004 classification algorithm of Jay Shambaugh.[13] Whereas the IMF maintains de jure, self-reported classifications registered by its members, an entire literature has sprung up to infer the regime type on an empirical or de facto basis.[14] The Shambaugh 2004 methodology is appealing partly because it uses only exchange-rate data (widely available for the interwar period) and because it focuses specifically on identifying the presence of fixed exchange rates, as Nurkse contended existed in the 1930s. Shambaugh's 2004 methodology essentially requires 92% observance of minimally variant exchange rates in a given year (i.e. minimal change in 11 out of 12 months). This approach is applied in this thesis at a weekly frequency on a rolling basis. This continuous-time measurement can still produce a discrete, annual classification value: the algorithm assesses the 52-week trailing performance of the regime for each week of the year and reports, for each year, the percent of observations qualifying as pegged. This approach is important for the interwar period because the key regime shifts did not fall neatly between calendar years; the continuous-time assessment helps clarify the precise shifts of regimes. Whereas Shambaugh reports a binary figure -- pegged or un-pegged -- the figure produced here is an incidence of pegging in each year. It reports the percentage of observations within the year that truly reflected fidelity to the peg for the past 52 weeks.

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[11] Officer, L., "The Gold Standard", in Whaples, R., ed., The EH.net Encyclopedia (26 March 2008).
[12] League of Nations, *Statistical Year-Book 1939/40* (Geneva, 1940), 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves." The coding algorithm counts a violation of the gold standard ethos as an ending of the gold standard, whereas the League tabulation does not. France is an example. The reported date of "Official suspension of the gold standard" is after France's currently-recognised departure from the gold standard; the latter is reported under "Dates of changes" in gold parities (1 Oct 1936).
[13] Shambaugh, J., 'The effect of fixed exchange rates on monetary policy', *Quarterly Journal of Economics* 119:1 (Feb 2004), 301-352.
[14] The literature is the 'fear of floating' literature after the eponymous Calvo, G. and Reinhart, C., 'Fear of floating'. *Quarterly Journal of Economics* 117:2 (2002), 379-408.

Limited dependent variable econometrics

An econometric model of Ragnar Nurkse's conception of central banks' "rules of the game" is estimated in Paper Two.[15] Nurkse asked whether central banks observed 'rules of the game', by which he meant a willingness to manage central bank balance sheets in the interest of the international gold standard. Like his contemporaries, Nurkse took as an article of faith that pre-WWI central banks endogenized the balance sheet to the balance of payments. In other words, he assumed that the provision of central bank money was conditioned upon changes in international assets. Those banks losing reserves could be expected to withdraw an additional amount of domestic credit (a synonym for domestic assets); those gaining reserves could be expected to pyramid a multiple of domestic credit upon those new reserves.[16]

A limited dependent variable estimator is applied here to a dataset of 31 interwar central bank balance sheets in monthly observations and to an unbalanced, partially overlapping panel of 17 interwar central bank balance sheets in weekly observations. The dependent variable is an indicator variable taking the value of 1 if a rule is observed, else zero. The logit coefficients, when exponentiated, can be interpreted as odds ratios. These multiply the impact of the regressor on the regressand. With observations covering at most 1922-1939 (at weekly and monthly periodicity), the coefficients are estimated with statistical significance.

4. Methodological contribution

Lambda-Kurtosis Index

This thesis proposes a new methodology for measuring exchange-rate regime flexibility. Problems with existing methodologies are carefully identified. These stem from a lack of theoretical grounding, as acknowledged by principal contributors to this literature.[17] Many de facto classification methodologies rely on stylized notions of the time-series properties of the exchange rates produced by a given regime type. For example, many infer regime flexibility from exchange-rate volatility.[18] This results in numerous misclassifications and

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[15] Nurkse, *International Currency Experience*, 66.
[16] See Paper Two on the views of Keynes and the MacMillan Committee on the pre-WWI 'rules'.
[17] Most classification algorithms "do not correspond closely with theoretic concepts". Ghosh, A., Gulde, A. and Wolf, H., *Exchange Rate Regimes: Choices and Consequences* (Cambridge MA, 2002), 43, footnote 3.
[18] Methodologies which rely on measurement of currency-market intervention directly are also susceptible to flaws. Reserves data, the reflection of such intervention, are subject to obfuscation, low periodicity or

an abundance of caveats in classification algorithms. In particular, floating currencies with relatively stable quotes are sometimes misidentified as "crawling pegs" and fixed currencies with periodic devaluations are misidentified as "free floats". In the interwar period, the inference of regime-type from an exchange-rate volatility statistic is especially problematic since a central point of the contemporary literature is that regimes in the 1930s were either hard pegs or adjustable pegs.[19] The latter will produce a volatility statistic comparable to, or even exceeding, that produced by a floating currency.

The methodology proposed here is the Lambda-Kurtosis Index. It is premised on the dynamics of asset pricing in the foreign exchange market. In the absence of central bank intervention, currency returns at the daily or greater horizon approach normal distributions.[20] More specifically, their distribution should exhibit a lower kurtosis than for currency returns of an exchange rate subjected to heavy central bank intervention. Kurtosis is the ratio of the fourth cumulant to the square of the second cumulant, or the fourth moment around the mean divided by the square of the variance of the probability distribution.[21]

Paper Three differentiates the kurtosis statistic with respect to an additional observation of currency returns. Increases in kurtosis accrue either from observations that are moving far from the sample mean or from observations that are moving very close to it. A pegged or heavily managed regime produces just such types of currency-return observations, relative to a free-floating currency. The interventionist regime is producing lots of observations close to the mean and a few big ones far from the mean; the currency is allowed to take a one-time discrete movement up or down around a perceived new equilibrium, which equilibrium is again defended through heavy intervention. In the Lambda-Kurtosis Index,

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unavailability. Even where the data are perfect, they do not necessarily reveal the underlying regime type. A highly credible peg, for example, can be guided by central bank interest rate policy, so that reserve changes are minimal. A good example is the Danish kroner today, whose distribution of currency returns fulfils the Krugman 'target zone' model of the exchange rate. Krugman, P., 'Target zones and exchange rate dynamics', *Quarterly Journal of Economics* 106:3 (Aug., 1991), 669-682.

[19] See the discussion of Nurksean 'flexibility' in Paper One.

[20] In the early years of post-Bretton Woods floating experience, currency returns were thought to be non-normally distributed. More recently, analyses of returns from floating-regime pairs of currencies consistently report excess kurtosis approaching zero (i.e. kurtosis of 3, which comports with a normal distribution) as time horizons pass 24 hours. The former literature begins as early as Westerfield, J., 'An examination of foreign-exchange risk under fixed and floating rate regimes'. *Journal of International Economics* 7 (1977), 181-200. The latter literature includes Dias, A. and Embrechts, P., 'Modeling exchange rate dependence dynamics at different time horizons'. *Journal of International Money and Finance* 28:8 (December 2010), 1687-1705. See in particular Table 2, page 1692.

[21] Normality is not an important assumption in this index. It only requires that more-flexible regimes produce more normally distributed currency returns *relative* to less-flexible regimes.

the measured currency flexibility is low throughout this process (indeed, it is low *because of* this process), whereas a flexibility indicator based on currency volatility will identify this sample of data as generated by a highly flexible regime.[22]

Some pegged regimes, such as Denmark's today, have enough credibility as to not require foreign-exchange market intervention. Their credibility is founded on the demonstrated willingness of the monetary authority to follow the monetary policy of the monetary authority of the target currency. Here, the distribution of currency returns can be bimodal, consistent with the predictions of 'target zone' theory.[23] A kurtosis statistic for such a distribution is actually lower than for a normal distribution. The Lambda-Kurtosis Index addresses that potential by placing the volatility of the exchange rate in the numerator (specifically, the coefficient of variation of the exchange rate). In order to prevent this statistic from overwhelming the denominator, the numerator is raised to the 1/2 power. This is important because some floating currencies in some particularly quiescent periods in the foreign-exchange market will produce an extremely low level of volatility.

The new classification index succeeds in correctly identifying some modern regimes where the stylised version of modern de facto classification systems fail. Specifically, it identifies the Canadian regime as a free float (instead of a peg) and the HK dollar as a peg (instead of managed float).[24]

International monetary system classification

This dissertation reports an international monetary system classification, based on the aggregated classification of a majority of the exchange-rate regimes within it. To the author's knowledge, no such empirical classification of the international monetary system exists. This aggregation provides a highly stylized indicator of the exchange rate as an adjustment mechanism in the international monetary system. This is important, because if adjustment is not achieved through exchange-rate flexibility, it must be achieved through domestic prices and wages (as in the gold standard) or through provision of international liquidity (as envisioned in the Bretton Woods system). Paper Three reports an aggregation

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[22] Kurtosis of currency returns is not presently used in exchange-rate-regime classification to the author's knowledge. Eichengreen reports kurtosis of the exchange rate in levels (not in changes), but does not use it to assess regime type. Eichengreen, B., 'The comparative performance of fixed and floating exchange rate regimes: Interwar evidence', NBER *Working Paper* 3097 (Sept 1989).
[23] Krugman, 'Target zones', *op cit.*
[24] As demonstrated in Appendix Four of Paper Three.

of both types of currency-regime-classification methodologies across a very broad panel of regimes annually for most of the twentieth century.[25]

5. Theoretical contribution

Paper One, 'Persistent orthodoxy: Explaining 1930s monetary conservatism', develops a stylized central bank objective function appropriate for the 1930s. This objective function describes a central bank that seeks to fulfil a base money supply objective constrained by an exchange rate target and a boundary associated with collateralization of the currency. The latter argument is unusual in a central bank reaction function. Specifically, it posits the need for a central bank to maintain a cover ratio above the minimum required in statutory law. This is added to the money-supply and exchange-rate targets in recognition of a central hypothesis of this dissertation: that collateralization of central bank money was standard practice, as it had been before WWI, and that this collateralization is important for understanding central bank behaviour in this period.[26]

6. Empirical results contribution

Impact of the cover limit

Paper One is 'Persistent orthodoxy: Explaining monetary conservatism of 1930s central banks'. It analyses and reports the theoretical and empirical impacts of cover statutes on the supply of central bank money. According to the 1980s literature, such statutes ceased to have relevance for the conduct of monetary policy after the suspension of gold convertibility.[27]

The theoretical model developed here suggests how these statutory obligations could prevent the central bank from fulfilling the market's demand for base money, subject to the stringency of the cover limit and the quantity of foreign reserve holdings. An empirical application of the model to interwar data reports that the cover limit constrained base money supply with statistical and economic significance in the 1930s. This helps to clarify an anomaly noted in the 1980s literature: the reluctance of monetary authorities, upon

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[25] In Paper One, see Figures 12 and 13.
[26] A separate point, to which this dissertation is sympathetic but for which it does not marshal contemporary case evidence, is that central bankers embraced such collateralization all the more seriously after the suspension of gold convertibility, as both a reputational anchor and a bulwark of independence.
[27] Eichengreen, *Golden Fetters*, 292.

leaving the gold standard, forcefully to expand the money supply.[28] Rather than reflecting a policy inertia or a lack of confidence, such timidity seems to have been a natural product of the cover statutes.

There is some vindication in these findings for the viewpoint of Nurkse, who argued that the cover statutes unduly constrained economic activity in the 1930s.

Nurksean 'rule' disobedience

The results of Paper Two, 'Rules of the game for interwar central banks', support Ragnar Nurkse's observation that interwar central banks did not adhere to a super-sovereign policy rule in respect of balance-sheet management, as had been alleged of central banks during the classical gold standard (1872-1914), by Nurkse, Keynes and others.[29] The results add to Nurkse's own empirically derived results because they examine central bank balance-sheet data at the weekly and monthly frequency, compared to Nurkse's annual dataset, the coarse granularity of which Nurkse himself identified as a potential pitfall in his investigation.[30] The results also respond to Eichengreen's suggestion that Nurkse should have limited his tally of 'rules' behaviour to central banks actually on the gold standard. The results here suggest that, as Nurkse suspected, such distinction made no difference.[31]

'Golden Fetters rule'

A message of *Golden Fetters* is that central banks followed an asymmetric rule by which banks accruing international reserves need not allow these to expand the base money supply (much less multiply this expansion with an additional purchase of domestic assets, as would be consistent with a given 'cover' statute by which each unit of foreign exchange can support a multiple of its value in domestic liabilities), while banks *losing* an international reserve asset would predominately allow this loss endogenously to contract the base money supply, and perhaps might even exacerbate it with a wilful sale of domestic assets. The paper finds evidence of such behaviour, with high statistical and economic significance.

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[28] *Ibid*.
[29] By "super sovereign" I mean a rule which is followed by the monetary authority to maximize Pareto efficiency for the group of gold-standard central banks as a whole. See Paper Two on Keynes and the MacMillan Committee.
[30] Nurkse, *International Currency Experience*, 68.
[31] *Ibid*, 88.

An important finding is that adherence to this 'Golden fetters rule' survived the loss of gold convertibility. Contrary to the view of the 1980s literature, interwar central banks observed the same rules during the gold standard as after it. The only banks able to break free of them were those which comprehensively closed the capital account.

One of the independent variables in the regressions is the cover ratio: the ratio of international assets to sight liabilities. A key finding of this paper is that the cover ratio is strongly associated with the central bank's odds of observing the asymmetric rule. This provides a valuable insight into understanding why central banks, despite practicing fixed exchange rates, were able to resist the 1937-38 US contraction but not the 1929-30 US contraction, particularly if their rules behaviour did not change with the loss of gold convertibility. The answer, at least in part, seems to be contained in the cover ratio: those banks which could afford to resist their neighbour's contraction and deflation did so.

Even for the central banks coded as having closed capital accounts (according to the League of Nations tally in 1940), the results hint at a persistence of such orthodoxy.[32] This is suggested by the finding that, for this group, higher cover ratios *raise* the probability of rules observance. This probably reflects the fact that the classification of KA regime (FX convertibility) is extremely broad: it encompasses those which closed both current and capital account and those with only very porous capital controls.

Currency pegging in the 1930s

Paper Three, 'Exchange-rate regime classification in the 1930s', reports results that suggest that exchange-rate regimes were overwhelmingly pegged in the 1930s, whether judged by modern standards or in comparison with the three phases of interwar gold convertibility, i.e. before central banks took up gold convertibility, during gold convertibility, and after suspending gold convertibility.[33] This is a modification of the view in the modern literature, which can be termed the "Great Depression literature of the 1980s", whose canonical work is Barry Eichengreen's *Golden Fetters*.[34] The 1980s literature judges 1930s

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[32] League of Nations, *Statistical Year-book 1939/40* (Geneva, 1940), 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves."
[33] Two of these three phases can be further disaggregated by convertibility of the currency in the foreign-exchange market. See Figure 2 of Paper Two for a schematic diagram of gold- and fx-convertibility.
[34] Eichengreen, *Golden Fetters*, op cit.

regimes to be predominately of a 'managed floating' variety.[35] The regimes of the 1930s are classified on a par both with the gold standard that preceded them and with the Bretton Woods regimes that followed them, in the incidence of pegging and the measurement of regime flexibility.

7. Reinterpreting Nurkse

This dissertation provides some insights into the views of the greatest contemporary observer of the interwar international monetary system: Ragnar Nurkse. Nurkse today is often remembered for offering a damning critique of floating exchange rates in the interwar period. He used the words "currency chaos" to describe the 1930s.[36] Perhaps because of this, his review of the interwar period, contained in *International Currency Experience: Lessons of the Inter-War Period*, is seen as aligned in some ways with the judgement of the 1980s literature.[37] Specifically, Nurkse's book is interpreted as agreeing with the 1980s literature that the 1930s was a period of floating exchange rates, albeit with an active monetary authority, hence a 'managed floating' period compared to the early 1920s 'free float'. The key difference between these protagonists is Nurkse's disdain for floating currencies, and the 1980s literature's enthusiasm for them.

The discussion of 'Nurksean flexibility' in Paper Three contends that Ragnar Nurkse did not see the 1930s as a period of 'floating' or even 'managed floating' exchange rates. He described two kinds of regimes. One we would today call a 'hard peg', the other an 'adjustable peg', along the lines of the Bretton Woods system. The confusion arises from terminology. Nurkse uses the word "flexible" to describe an adjustable peg. Today, we would understand a "flexible" currency as one which is not pegged. When Nurkse mentions the "devaluation cycle of the thirties", he states that "the term devaluation is here used in the sense of exchange depreciation followed by some form of stabilisation -- rigid or flexible -- at a lower level."[38]

The primary focus of Nurkse's book is the deleterious effects of collateralization of money in the interwar period. His description, and condemnation, of the continuance of such

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[35] The results of Paper Three confirm the modern literature's view that early 1920s currency regimes were mostly 'floating'. They are as flexible as those of today (i.e. post-Bretton Woods), and the international monetary system is characterized by about the same incidence of pegging.
[36] Nurkse, *International Currency Experience*, 27.
[37] *Ibid.*
[38] *Ibid*, 122.

collateralization in the 1930s is one of the main motivations for this dissertation's investigation of the cover limit. According to the modern literature, the cover limit had no practical significance once the gold standard was suspended.[39] The results of Paper One suggest that they remained relevant.

International Currency Experience is foremost a plea that such collateralization should not be required in the new arrangements for the post-Second World War international monetary system. Nurkse's reasoning flows directly from his stand on the importance of fixed exchange rates. To Nurkse, collateralization requirements needlessly tie up much of the liquidity that would otherwise be available to maintain exchange-rate stability, "rather like saying that in order to ensure that there shall never be a shortage of taxicabs, a certain proportion of taxicabs in existence must always be standing on the ranks."[40] In the event, this aspect of Nurkse's advice was ignored at the Bretton Woods discussions. Cover limit requirements persisted into the 1960s.[41]

8. A view from the trilemma

The results of the three papers can be framed in the context of the macroeconomic policy trilemma. This is the policy identity which holds that a monetary authority cannot simultaneously peg the exchange rate, allow convertibility of the currency, and pursue an independent monetary policy. They must prioritize two of the three.[42] One implication of the findings of this dissertation is that central banks did not re-order their priorities in the 1930s to the extent implied by the 1980s literature.

Central banks under the gold standard by definition prioritized free convertibility of the currency and an exchange-rate peg. Because the pursuit of an independent monetary policy was inconsistent with these two priorities, central banks were unable to resist the deflationary forces emerging at the end of the 1920s. These were already firmly underway by the time of the US stock market collapse in October 1929. A steep fall in commodity prices preceding this date had already induced severe recession in some countries. The US

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[39] Eichengreen, *Golden Fetters*, 292.
[40] The quote is Robertson's. Nurkse, *International Currency Experience*, 95.
[41] Urban, S., 'International Currency Experience and the Bretton Woods System: Ragnar Nurkse as Architect', in R. Kattel, J. Kregel and E. Reinert, eds., *Ragnar Nurkse (1907-2007): Classical Development Economics and its Relevance for Today* (London, 2008).
[42] Obstfeld, M., Shambaugh, J. and Taylor, A., 'Monetary sovereignty, exchange rates, and capital controls: The trilemma in the interwar period,' *IMF Staff Papers* 51 (2004).

economic contraction in 1929 magnified this shock, and subsequent US contractions added to it.[43]

Only when central banks re-prioritised their policy settings in 1931 did countries begin to recover from the Great Depression. This is a central message of the 1980s literature. Specifically, by suspending convertibility of the currency into gold, central banks demoted currency pegging in order to promote policy independence.[44] Or so goes the story.

The results here suggest that the international monetary system after the gold standard did not feature such a novel reconfiguration of priorities.

An implication of this dissertation is that the regimes which did pursue a novel reconfiguration were those which reliably controlled currency convertibility. The main such country was Germany. It is important to note here that many countries attempted to control currency convertibility, but that in most cases these controls were not adequately strenuous to constitute a re-prioritisation in the trilemma. Moreover, for most countries, exchange controls were gradually loosened over the 1930s, so that by 1937, "outside of Germany, Italy and Japan, a substantial degree of relaxation of exchange control had been achieved."[45]

So, for most countries, currency pegs were maintained and policy was demonstrably no less dependent than in the gold standard.

This sounds counter-intuitive. It is empirically demonstrable that the countries which devalued first were the first to begin economic recovery.[46] As Paper Two argues, the source of such recovery might well have been the devaluation of the currency. From that point on, the policy regime was subject to the same stresses of the trilemma, modulated only by (a) the size of the shock hitting the international balance of payments, (b) the duration of the shock, and (c) the quantity of international reserves of the monetary authority relative to the overall central bank balance sheet. This became important when the world was subjected again to a significant US recession in 1937.

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[43] Eichengreen, *Golden Fetters*, Chapter 8: "Cracks in the façade", 222-257.
[44] Some, like Germany, demoted currency convertibility, keeping the currency peg, and promoting policy independence.
[45] Gordon, M., *Barriers to World Trade: A Study of Recent Commercial Policy* (New York, 1941), 87. See also League of Nations, *World Economic Survey 1938/39*, (Geneva, 1939), 197.
[46] Eichengreen and Sachs, 'Exchange rates and economic recovery', *op cit.*

With adequate reserves, the trilemma can be defied for a finite period. The results here suggest this is how the world achieved buoyancy in the face of the 1937-38 crisis. Reserves, rather than exchange-rate flexibility, explains nations' demand management in this shock. What differed from 1929-30 was not a new exchange-rate regime, but a higher reserve stockpile. According to the results of Paper Two, those higher reserve stockpiles also predicted a greater odds of counter-cyclical policy during the gold standard.

9. Money in perspective

The thesis suggests a reason why there was so much orthodoxy in the 1930s even in the absence of gold convertibility. This is due to the conceptualization of 'proper' provision of central bank money. Essentially, the world had not yet accepted the practice of un-backed central bank money. (Indeed, it was a long way from this, if the Bretton Woods system is anything to judge by.) Central banks sought to collateralize their liabilities in the 1930s just as they had done under the gold standard. They did this with a statutory requirement to hold a proportion of international assets in relation to domestic sight liabilities. Indeed with the suspension of gold convertibility circa 1931, they had all the more reason to take this collateralization seriously. Collateralization requirements were reduced at about the same time as devaluation, but not abandoned except in Germany, Italy and Greece. The empirical investigation of these requirements supports the notion that they had a bearing on the supply of central bank money.

Specifically, the theoretical work in this thesis shows how a central bank which minimises a loss function with these three arguments winds up providing less money than the private money market demands. The highly stylized and simplistic model shows in particular that central bank money supply is beholden to international reserve assets. By contrast, in a central bank free of concerns with collateralizing the currency, as is true of most today, the demand for money supply can be met by acquiring domestic assets to whatever extent necessary -- provided other policy targets are met, e.g. for inflation and growth rates.[47]

Collateralization of central bank money was standard practice in the pre-WWI period, resuscitated in the interwar period, and maintained in the 1930s. The motivation for central bankers to embrace such statutory obligations to collateralize the currency seems natural,

[47] For a recent discussion of currency collateralization, see Obstfeld, M., Shambaugh, J. and Taylor, A., 'Financial stability, the trilemma, and international reserves', *American Economic Journal: Macroeconomics* 2:2 (April 2010), 57-94.

as a bulwark of their autonomy and independence from government, particularly in the context of a lost commitment to convert the note issue into gold.

10. Evolution of the international monetary system

Remaining with this broader historical perspective, this dissertation can be interpreted as throwing some light on the evolution of the international monetary system. It raises the question of whether the gold standard was actually lost in 1931 with the nearly universal suspension of gold convertibility. If the gold standard can be understood as a commitment device to tie sight liabilities to base metal, then the gold standard survived. Statutory requirements to maintain a minimum in such ratios outlived gold convertibility, and continued to have an empirical impact on the provision of central bank money.

The gold standard underwent significant changes over the 1931 rupture. Yet this has been true of the gold standard from the beginning: it is an evolving standard. The over-arching pressure for evolution has been the need to economize on gold. This is inevitable in view of the contradiction inherent in the combination of an inelastic collateral (precious metal) and economic growth. Money is not 'neutral': wages are nominally rigid and debt is contracted in nominally fixed terms. Put differently, the income of the main factors of production, labour and capital, is contracted nominally. When the price level falls, as it must when the money supply is relatively inelastic but output rises, real wages and real debt burdens rise. Labour and capital are both 'priced' out of circulation. As a result, the deflation which is inherent to a gold standard is painful for the real economy. Even under the classical gold standard (1872-1914), this phenomenon was threatening to break up the entire system in much the way it did in the late 1920s.[48]

The gold standard throughout modern history has evolved, driven by the need to economize gold. When Britain debated resumption of the gold standard in the early decades of the nineteenth century, even those in favour of resumption saw the need to modify the standard in order to relieve the pressure of deflation.[49] As the century wore on,

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[48] Flandreau, M., Le Cacheux, J. and Zumer, F., 'Stability without a pact? Lessons from the European gold standard, 1880–1914', *Economic Policy* 13 (1998), 115–162.

[49] David Ricardo, although a fierce advocate of resumption, recognised the merits of gold economy, and proposed the gold-ingot modification, by which gold would be available for export or industrial use, but not as circulating coin. Parliament in 1819 enabled the Bank of England to convert its notes into gold either in coins or ingots at its discretion. The Bank successfully lobbied Parliament to require it to pay in coin only, and the economy suffered significant deflation. "The Bank's abandonment of the bullion standard was more assuredly a mistake." Viner, J., *Studies in the Theory of International Trade* (New York, 1937), 172-180.

the gold standard evolved from a gold coin standard to a gold bullion standard, where the central bank absorbed circulating gold in exchange for its own liabilities. A further economization came with substitution of gold-convertible foreign currency for gold itself. This was the 'gold-exchange' standard, and it went from an informal and widespread phenomenon before the first world war to a formally endorsed one after. There also came into practice a wide variety of 'gold devices' to limit the emission of gold, as well as a minimum quantity requirement for transactions in gold with the monetary authority.[50]

The loss of convertibility arguably falls into this evolutionary pattern. The emphasis here is on the word "evolution". The suspension of convertibility was not a conscious evolutionary step; it was reactive. It was not seen as permanent. In most of these cases, it was seen as a means of preserving the gold stock from total exhaustion in defence of the peg. Indeed, an interesting feature of the gold metal time series in many of the central bank balance sheets examined here is that gold convertibility was suspended long before the complete depletion of the gold stock.[51] Gold was still seen as important to collateralize central bank money. The perceived danger of un-backed money was still acute at this time. It is no surprise that with the end of the gold standard as conventionally defined, the ratio of gold in total foreign assets rose in the 1930s. Far from losing its lustre, gold became more appealing to the world's monetary authorities in the 1930s.

11. Weaknesses of this dissertation

This thesis does not discuss in great detail the possibility of other policy frameworks of central banks in the 1930s, such as price-level or inflation targeting.[52] Nor does it treat the central bank as optimising the stability of output or wages. It does not contain an account of the fiscal dynamics in which these banks operated. Moreover, it does not include an account of the banking system's holdings of gold and international assets, which could be important for the monetary authority itself, should it exercise suasion over these banks.

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[50] Redish interprets the emergence of un-backed money as the result of this drive for gold economy. Redish, A., 'Anchors aweigh: The transition from commodity money to fiat money in Western economies', *Canadian Journal of Economics* 26:4 (Nov., 1993), 777-795.

[51] This is consistent with the 'second-generation' models of currency crisis for modern economies, where the monetary authority gives up the peg long before it has exhausted the reserves. Obstfeld, M., 'Rational and self-fulfilling balance-of-payments crises', *American Economic Review* 76 (1986), 72-81.

[52] See Berg, C. and Jonung L., 'Pioneering price level targeting: The Swedish experience 1931-37.' *Journal of Monetary Economics* 43 (1999), 525-551. The finding is disputed in Straumann, T. and Woitek, U., 'A pioneer of a new monetary policy? Sweden's price level targeting of the 1930s revisited'. Institute for Empirical Research in Economics, University of Zurich, Working Paper 386 (August 2008).

The thesis cites only a few contemporary policy references to the importance of the cover limit. It does not present a single case of a policymaker referring to the cover limit in explaining the motivation to tighten policy or the reluctance more quickly to expand the money supply.

Finally, the thesis does not treat monetary aggregates above those of the monetary authority itself, i.e. base money, and thus does not discuss the role of the money multiplier in this period.

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Persistent Orthodoxy*

Explaining 1930s monetary conservatism

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ABSTRACT

Central banks upon suspending the interwar gold standard exhibited considerable restraint in expanding the money supply. The predominant modern scholarship generally attributes this to a gold-standard mindset. This paper shows that it reflected the gold cover constraint in central bank statutes, which outlived the gold standard itself except in Greece, Italy and Germany. It was a natural bulwark of central bank independence after the loss of gold convertibility. Incorporating the cover constraint in a central bank loss function, it can be shown that optimal holdings of domestic assets are less than would satisfy private money demand. A dataset of cover limits and balance sheets is compiled for 33 central banks for 1930-1936 to test whether the cover constraints had any empirical impact on the money supply. The results suggest they did, making cover limits an under-appreciated feature of 1930s central banking.

JEL codes N10, E51, E58

JEL keywords Monetary Policy, Monetary Standard, Economic History

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1. Introduction

Characterisation of monetary policy typically specifies a rule for setting the short-term policy interest rate. A well-known example is the Taylor Rule.[53] This is difficult to apply to the 1930s because policy interest rates exhibited little variation. Interest rates in the Great Depression were at their nominal floor or as close to it as the monetary authority felt comfortable. In these conditions, the central bank balance sheet itself becomes the policy tool. This paper derives an optimisation of the central bank's holdings of domestic assets, constrained by the need to fulfil an exchange-rate target and to limit the note issue to a certain multiple of gold.[54] The latter constraint is unusual in a policy loss function but arguably describes the conditions facing 1930s central bankers. Having lost the obligation to convert notes into gold, they maintained the currency's quantity linkage to gold, as a reputational device and a protection against the perceived dangers of 'unbacked' money.

The interwar period inherited the nineteenth-century ideal of what might be called 'collateralised' central bank money: money which the monetary authority is required to back, to a limited proportion, with international assets. This ethos stemmed from earlier failures of unbacked paper money, such as the French assignat, whose unlimited emission fuelled the first noteworthy hyperinflation in modern Europe.[55] Interwar policymakers had their own chastening examples of unbacked money in the German, Polish and other early post-WWI hyperinflations and implemented even stricter collateralisation requirements than did their nineteenth-century forebears.[56]

The most common interwar backing statute was the cover limit: a minimum ratio of international assets to base money. Also practiced were fiduciary limits, requiring emissions beyond a fiduciary maximum to be backed 100% with international assets.

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[53] Taylor, J. 'Discretion versus policy rules in practice,' *Carnegie-Rochester Conference Series on Public Policy* 39 (1993), 195-214.

[54] "Gold" is used here in the same sense as understood during the gold standard (both interwar and pre-WWI): actual gold or foreign exchange convertible into gold, including foreign exchange 'contingently' convertible, meaning convertible into a currency that although not currently convertible is expected to be convertible again without a devaluation. "International assets" in this paper is a synonym for gold. On the contingent conception of the gold standard, see Bordo, M. and Kydland, F., 'The gold standard as a rule: An essay in exploration', *Explorations in Economic History* 32:4 (October 1995), 423-464.

[55] Sargent, T. and Velde, F., 'Macroeconomic features of the French Revolution', *Journal of Political Economy* 103:3 (1995), 476.

[56] Quoting the 1931 *Second Interim Report* of the League of Nations, Nurkse (1944) wrote: "The reserve-ratio system was 'more generally adopted than before the war, and frequently in a more rigid form'." Nurkse, R., *International Currency Experience: Lessons of the Inter-War Period* (Princeton, 1944), 96.

Mixtures were also prescribed, as were variants specifying different backing for deposits and currency.[57]

Was such collateralisation still sought in the interwar years after the gold standard, i.e. in the 1930s? On one side is Nurkse, who blamed cover requirements for the global economic difficulties of the decade.[58] The principle of cover requirements, he wrote, "lost some of its prestige" with the downfall of the gold standard, but was not abandoned:[59]

> Cover requirements, though introduced and maintained for what may have been compelling reasons, effectively tied up large amounts of potential means of international settlement; they enforced, as it were, a practice of 'window-dressing' under which, while the shop might be empty (the 'surplus' reserve exhausted), the window had to be kept fully stocked for display.[60]

In the interwar period, only Germany, Greece and Italy suspended the cover requirements.[61] Nurkse's contemporary, the economist John Williams, in 1936 proposed the "abolition of central bank gold reserve requirements for notes and deposits":[62]

> In our present stage of monetary development, at least in the larger countries which have strong central banks, there is no reason why internal gold reserve requirements for notes or deposits should be allowed to impair a country's ability to withstand a run against its currency. Its entire gold stock should be put in its front window and specifically labelled as an international reserve.[63]

Of a different view is Eichengreen. Regarding the transition to a post-gold world, he writes:

> Few central banks moved quickly [upon abandoning the gold standard] to expand the supply of currency even though they were no longer inhibited by a binding gold cover constraint.[64]

These conflicting judgements about whether cover requirements were relevant after the gold standard might only be a disagreement on whether the requirements were tight

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[57] See Appendix 2 on page 165 for details.
[58] More so than floating currencies, which Nurkse in fact did not attribute to the 1930s. See *International Currency Experience*, 211.
[59] *Ibid*, 215.
[60] *Ibid*, 21.
[61] *Ibid*, 12. See also League of Nations, *Monetary Review 1937* (Geneva, 1937), 89, and US Federal Reserve, *Federal Reserve Bulletin* (July 1932 and July 1936).
[62] Williams, J., 'International Monetary Organization and Policy', in A. Gayer, ed., *Lessons of Monetary Experience: Essays in Honor of Irving Fisher* (London, 1937), 23-49 (34).
[63] *Ibid*, 36.
[64] Eichengreen, B., *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939* (Oxford, 1992), 292.

enough to affect policy. Suspension of the gold standard was frequently coupled with downward revisions to the cover limits (i.e. relaxations).[65] There was also an improvement in international liquidity in this period, with the marking-up of central banks' reserves upon currency devaluation. Liquidity was also boosted by the USA revaluation of gold in 1934 and by generalised price deflation. With the combination of looser cover limits and revalued reserves, cover requirements might not have been materially important after the suspension of gold convertibility.

This paper argues that cover limits and the concept of 'collateralised' central bank money not only survived the loss of gold convertibility in the 1930s but grew in importance. With the loss of gold convertibility, central bankers would have embraced the cover requirements all the firmer as a reputational bulwark. The cover requirements would have provided a measure of defence against governments otherwise eager to place debt at the central bank.

The predominant modern treatment of this period is contained in a group of literature which can be called the Great Depression literature of the 1980s. This literature, reviewed in the next section, comments on the surprising restraint of central banks in expanding the money supply once they had been relieved of the burden to convert notes into gold.

[65] Nurkse lists 9 relaxations of cover ratios and 3 eliminations. Appendix 2 on page 165 reports 16 relaxations and the same 3 eliminations. Nurkse, *International Currency Experience*, 97.

2. The Great Depression literature of the 1980s

Golden Fetters: The Gold Standard and the Great Depression, 1919-1939 is the most important of a group of mainly 1980s literature which changed the way modern scholars think about the Great Depression. Prior to this literature, conventional wisdom had faulted policymakers for insufficiently robustly defending the interwar gold standard, and thereby contributing to the Great Depression, e.g. by fomenting competitive currency devaluation and tariffs.[66] The Great Depression literature of the 1980s argued instead that the gold standard *exacerbated* domestic downturns and transmitted these globally, and that the key to recovery lay in abandoning the gold standard. This viewpoint is predominate.[67]

What monetary regime replaced the gold standard? *Golden Fetters* lists the possibilities:

> Once they had shed their golden fetters, policymakers had several new policy options available. They could expand the money supply. They could provide liquidity to the banking system at the first sign of distress. They could increase the level of government expenditure. They could take these actions unilaterally, without any need for assistance from foreign countries to neutralize the impact on the exchange rate.[68]

There was a hesitancy to do these things. While the collapse of the gold standard introduced new opportunities,

> the desire to initiate reflationary policies had to overcome other obstacles, notably fears that the end of the gold standard marked the beginning of a new inflationary era characterized by financial and political chaos. Much time was lost before this hesitation to take reflationary action was finally overcome.[69]

It is tempting to conclude that it mattered little whether a country stayed on gold or came off:

> More remarkable still, the same considerations [of price stability] continued to shape the actions of governments even in countries that had already abandoned the gold standard. There too policymakers worried that inconvertibility opened the door to inflation and financial chaos.

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[66] One example is Kindleberger, C., *The World in Depression: 1929-1939* (Berkeley, 1973).
[67] "Adherence to gold-standard policies led to a set of currency crises in 1931 that turned a bad recession into the Great Depression." Temin, P., 'Great Depression,' in S. Durlauf and L. Blume, eds., *The New Palgrave Dictionary of Economics*, 2nd Ed. (London, 2008).
[68] Eichengreen, *Golden Fetters*, 393.
[69] *Op cit*, 286.

> Hence the initial response of governments to their newfound freedoms was extremely cautious.[70]

This conservatism was reminiscent of the gold standard. And, just as it had been problematic for the international economy under the gold standard, so it was after the gold standard:

> The failure of economic activity to stabilize reflected not the rise of trade barriers but the tendency of supplies of money and credit to fall more rapidly in gold standard countries than they rose in countries with depreciated currencies.[71]

According to Eichengreen, this hesitancy was overcome by the time of the 1937-38 US recession, which forced US trade partners to exercise the new policy freedoms of the post-gold era:

> In 1937, contractionary monetary and fiscal policies produced another recession in the United States. ... But in contrast to the situation in 1929, this time other countries were not compelled by the gold standard constraints to follow America's example. Policy in other countries remained stimulatory, and the European economies continued along their stable upward path.[72]

Another canonical work of the 1980s Great Depression literature is Peter Temin's *Lessons from the Great Depression*. Temin describes a surprisingly conservative policy mindset in the absence of gold convertibility.[73] London's suspension of convertibility in 1931, he writes, "was a change in the price of pounds but not a change in the policy regime of Britain."[74] Post-gold policy was "even more tentative" than that of France, which came late in the decade.[75]

> Having experienced labor conflict and general strikes in the 1920s and abandoned the gold standard in 1931, Britain lost its taste for change. The Liberals and Labour were unable to bring support for socialist policies into a successful political coalition, and the National government maintained a semblance of fiscal and monetary orthodoxy. Britain, which had escaped the worst of the Depression, refused to promote recovery aggressively.[76]

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[70] *Op cit*, 288.
[71] *Op cit*, 290.
[72] *Op cit*, 349.
[73] Temin, P., *Lessons from the Great Depression* (Cambridge MA, 1989).
[74] *Op cit*, 99.
[75] *Op cit*, 125.
[76] *Ibid.*

Like Eichengreen, Temin sees this policy mindset as more injurious than the outbreak of tariffs: "Trade restrictions were harmful, just not as bad as conventionally thought."[77]

Temin takes a much narrower view than Eichengreen of the extent to which countries graduated from monetary conservatism after leaving gold convertibility. The break from orthodoxy occurred only in Germany and the United States, with the downfall of "deflationist" leaderships in 1933:

> The reversal of macroeconomic policy in the United States under Roosevelt and in Germany under Franz von Papen and then Hitler turned the economic tide in 1933.[78]

It was the expansion in these two economies which lifted the global economy. The key was the expectations-augmented Fisher relationship: expectations of deflation changed to expectations of inflation, pushing down real interest rates and finally relieving financial conditions:[79]

> Devaluation was only one dimension of a multifaceted new policy regime. During Roosevelt's First Hundred Days, the passive, deflationary policy of Hoover was replaced by an aggressive, interventionist, expansionary approach.[80]

In Germany, "Brüning's deflation was replaced by Papen's first steps toward economic expansion" in 1932.[81] These were "in the right direction, but they did not alter the perception of the policy regime."[82] That came in 1933:

> In order to stimulate recovery, the Nazis – like the Democrats in the United States – had to establish a startling new policy regime. To do so, they threw the baby out with the bathwater, destroying many of the socialist institutions of the Weimar republic. But they replaced them with their own institutions that performed the functions I have identified as socialism.[83]

Temin in a 2000 article with Eichengreen takes a broader view on how widespread was the move toward to an 'unfettered' policy regime:

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[77] *Op cit.*, 81.
[78] *Op cit.*, 89.
[79] The expectations-augmented Fisher equation holds that the real interest rate is approximated by the nominal rate less the expected rate of inflation. For a given nominal interest rate, an increase in inflation expectations is an easing in financial conditions. A formalisation of Temin's argument is Eggertsson, G., 'Great expectations and the end of the depression', *American Economic Review* 98:4 (2008), 1476-516.
[80] Temin, *Lessons from the Great Depression*, 97.
[81] *Op cit.*, 101.
[82] *Ibid.*
[83] *Op cit.*, 115.

> Our argument is that the mentality of the gold standard was integral to the ideology of the those segments of society that controlled economic policies, including central bankers and national politicians in Europe and the United States. This mentality was sustained through a discourse that reinforced its hold on those international classes. It shaped their interpretation of the Depression and led them to maintain the policies that intensified the economic slump. The world economy did not begin to recover when these people changed their minds; rather, recovery began when mass politics in its various guises removed them from office.[84]

What policies in particular were the unfettered central banks slow to pursue? Money supply expansion is conspicuous:

> In most industrial countries that abandoned gold, policymakers hesitated to initiate expansionary open-market operations to actively increase their money supplies and reverse the deflation of previous years.[85]

Explaining the hesitancy of 1930s central banks to conduct more expansionary open-market operations requires making a statement about the determinants of base money supply. The monetary policy literature has not paid great attention to this question. To the extent that money supply is questioned, the focus is the money-supply multiplier rather than the stock of base money.[86] Literature on the determinants of open-market operations is limited.[87]

One approach is to frame the central bank's balance-sheet management as an outcome of objectives typical of the interwar period. One of these objectives is to satisfy the market's demand for base money. Another is to peg the exchange rate.[88] A third is to hold the ratio of gold (or international assets generally) to base money comfortably above the statutory minimum. In an open-economy setting, it is clear that the first of these goals -- i.e. the

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[84] Eichengreen, B. and Temin, P., 'The gold standard and the Great Depression', *Contemporary European History* 9:2 (July 2000), 183-207 (185).
[85] Eichengreen, *Golden Fetters,* 288.
[86] "Theorists concerned with the money supply have … tended until recently to stick to the mechanical 'money multiplier' approach...." Johnson, H., 'Monetary theory and policy', *American Economic Review* 52:3 (June, 1962), 335-384 (357).
[87] "The balance-sheet concerns of central bankers is an area of research that has been left largely unexplored in the literature on monetary policy." Jeanne, O. and Svensson, L., 'Credible commitment to optimal escape from a liquidity trap: The role of the balance sheet of an independent central bank.' *IMF Working Paper* 04/162 (September 2004), 4.
[88] Pegging in this period was motivated by the first derivative of the exchange rate, not the absolute level. This is a contrast with modern pegged or heavily managed regimes, which are often pegged for reasons of the level, i.e. competitiveness. For a *de facto* assessment of 1930s exchange-rate regimes, see Urban, S., 'Classifying 1930s exchange-rate regimes', *Oxford Discussion Papers in Economic and Social History* 30 (May 2008).

conduct of adequately expansionary open-market operations -- can conflict with the other two. The central bank seeking to conduct expansionary open-market operations might be less willing to do so if simultaneously it faces depreciation pressure in the foreign-exchange market. Expansionary open-market operations might also conflict with the goal of keeping the cover *ratio* (i.e. the ratio of foreign reserves to base money) comfortably above the cover *limit* (i.e. the statutory minimum of the cover ratio). These conflicting goals are considered next in a formal loss-minimisation framework.

3. Determinants of the base money supply

Determination of interwar base money supply is modelled here as a loss-minimisation problem. As a first step, consider a central bank whose goal is to satisfy base money demand (M^*) while keeping an exchange-rate target (E^*). The bank minimises deviations of the base money supply (M) and the exchange rate (E) from each (symmetrically). With weights $\gamma_1 + \gamma_2 = 1$, the bank seeks to minimise the loss function

$$\mathbb{L} = \gamma_1(M - M^*)^2 + \gamma_2(E - E^*)^2 \tag{1}$$

with money expressed in units of domestic currency and the nominal exchange rate in units of local currency per foreign currency. Next, add the cover constraint. Let α be the current cover ratio, i.e. the ratio of international assets to central bank money, and $\bar{\alpha}$ the cover limit, i.e. the statutory minimum of the cover ratio. $C(\alpha)$ is a cost function rising in proximity of the cover ratio to the cover limit, when approached from above:

$$C(\alpha) = \frac{\bar{\alpha}}{\alpha} \tag{2}$$

Suppose $\bar{\alpha}$ is 40% and α is 45%. The bank can minimise the cost function by contracting domestic liabilities, which raises the cover ratio, which, as the denominator, reduces this term. The bank's objective function is now a minimisation of deviations from base money and exchange-rate targets and the cost associated with steering α too close to $\bar{\alpha}$ (from above):

$$\mathbb{L} = \gamma_1(M - M^*)^2 + \gamma_2(E - E^*)^2 + \gamma_3\left(\frac{\bar{\alpha}}{\alpha}\right) \tag{3}$$

The money-supply and exchange-rate arguments are targets, where deviations are symmetrically costly. The cover limit is a boundary that is costly to approach.[89]

Equation (3) provides a framework for thinking about central banking in the 1930s. Nurske argued that $\gamma_3 > \gamma_1$; excessive statutory emphasis on collateralisation prevented the central bank from fulfilling base money demand. In *Golden Fetters*, Eichengreen argues that, notwithstanding some initial hesitancy, $\gamma_1 = 1$ ($\gamma_2 = \gamma_3 = 0$):

[89] Analytically the solution is much cleaner when the cost function is assumed to be linear but the essence is preserved when the cost function is made nonlinear.

> Once they had shed their golden fetters, policymakers had several new policy options available. They could expand the money supply. They could provide liquidity to the banking system at the first sign of distress. They could increase the level of government expenditure. They could take these actions unilaterally, without any need for assistance from foreign countries to neutralize the impact on the exchange rate.[90]
>
> Ever since the United States suspended the convertibility of the dollar into gold in 1971, the major currencies have once again been permitted to fluctuate against one another much as they did in the 1930s.[91]

The data in Figure 1 suggest the extent to which countries made use of two policy variables in (3): the exchange rate peg E^* and the cover limit $\bar{\alpha}$.[92] The figure reports a volatility statistic for 35 countries leaving the gold standard, plus Spain. The more assertive policy steps align with stylised notions of policy heterodoxy during this period: Germany, Greece, Japan and Italy stand out. Figure 2 is a close-up of Figure 1 and reveals a consistency with stylised notions of 1930s currency blocs. For example, countries associated with the sterling bloc both devalued the peg and relaxed the cover limit, placing them on a ray from the origin. Gold bloc countries fall in a quadrant roughly bounded by 20% variation in both variables.

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[90] Eichengreen, *Golden Fetters*, 393.
[91] *Op cit*, 395.
[92] Actual exchange rates are equal to the exchange-rate target if the regime satisfies peg-classification criteria, as did most interwar regimes on or off gold. See Urban, 'Classifying 1930s exchange-rate regimes', *op cit*.

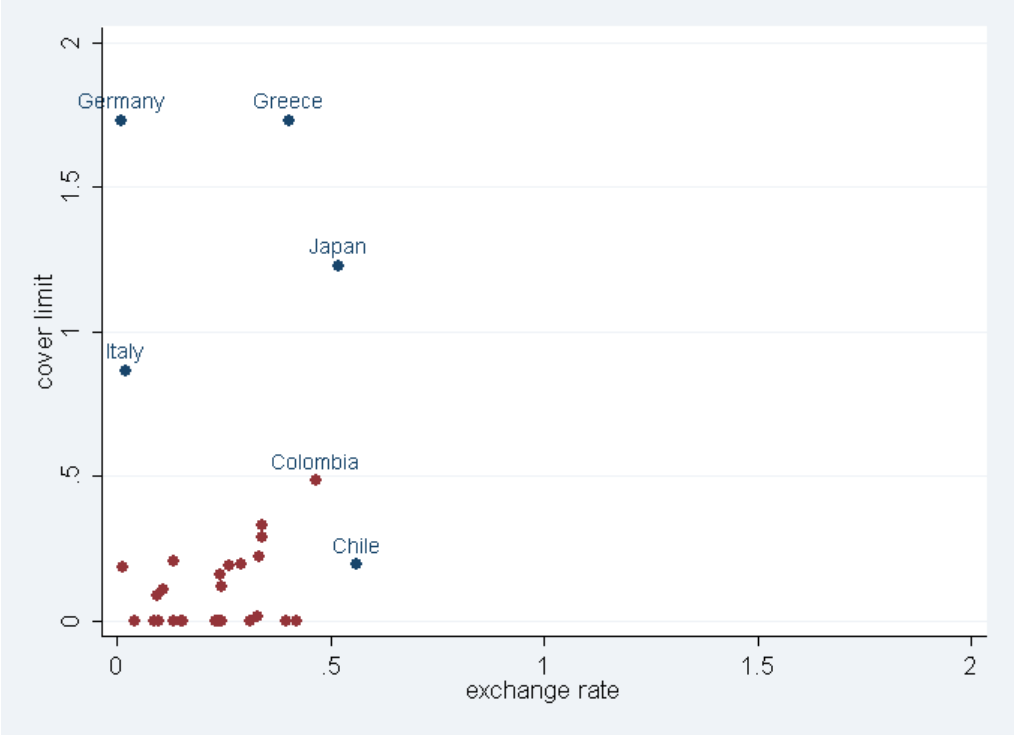

Figure 1: Coefficient of variation

Note: The exchange rate is a bilateral nominal index tracking the current gold-convertible currency, as described in Data and sources on page 47. The data encompass country-specific gold convertibility and post-convertibility, ending Aug-1939, as reported in Appendix 1 on page 60.

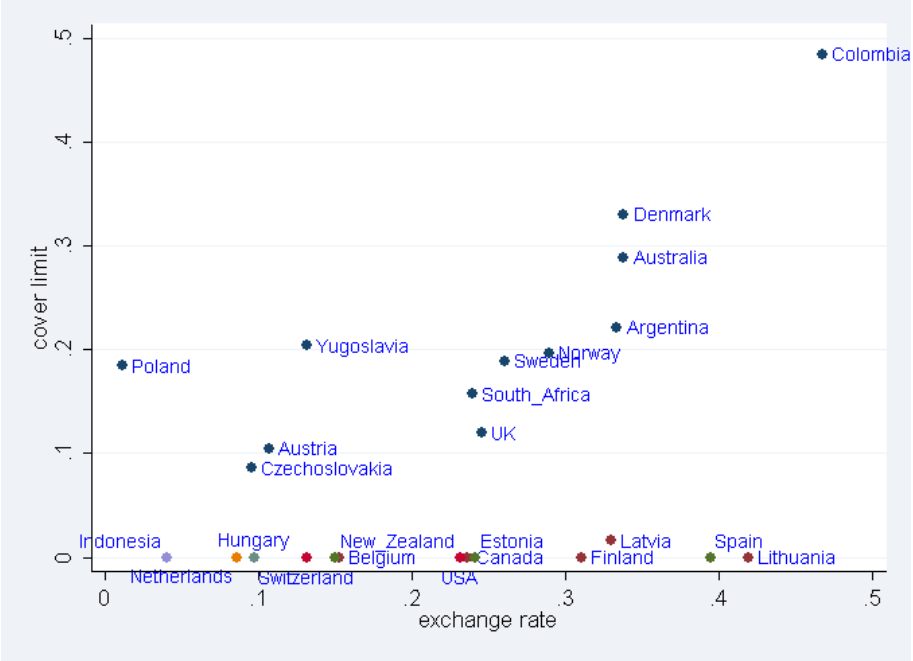

Figure 2: Zoom of Figure 1

Note: See notes for Figure 1.

Figure 1 and Figure 2 report substantial usage of the exchange rate and the cover limit in the departure from the gold standard. To understand how these contributed to base money supply, express the loss function in (3) in terms of the central bank balance sheet identity: $M + CBC \equiv D + ER$. Liabilities of the central bank constitute base money (*M*); this, plus central bank capital (*CBC*), equals domestic assets (*D*) plus foreign reserves expressed in local currency (*ER*). For simplicity, set aside *CBC*, so *M=D+ER*.[93] The first term in (3) is

$$[(ER + D) - M^*]^2 \tag{4}$$

and the second term is

$$\left[\left(\frac{M - D}{R}\right) - E^*\right]^2 \tag{5}$$

Because α is reserves/money, the third term can be written as $\bar{\alpha}/(\frac{ER}{ER+D})$, or

$$\frac{\bar{\alpha}(ER + D)}{ER} \tag{6}$$

Combine (4), (5) and (6) for the loss function expressed in balance sheet terms:

$$\mathbb{L} = (ER + D - M^*)^2 + \left[\left(\frac{M - D}{R}\right) - E^*\right]^2 + \frac{\bar{\alpha}(ER + D)}{ER} \tag{7}$$

The monetary authority's policy variable is domestic assets.[94] Hence, differentiate (7) with respect to *D*:

$$\frac{\partial \mathbb{L}}{\partial D} = 2(D - M^* + ER) - \frac{2(-E^* + \frac{-D + M}{R})}{R} + \frac{\bar{\alpha}}{ER} \tag{8}$$

Set (8) equal to zero for the first order condition, the minimum of the loss function, and solve for *D* to find the central bank's optimum quantity of domestic assets, $\widehat{D}$

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[93] Ignoring central bank capital is inconsistent with some historical and analytical approaches. See Flandreau, M., 'Pillars of globalization: A history of monetary policy targets, 1797–1997', in A. Beyer and L. Reichlin, eds., *The Role of Money: Money and Monetary Policy in the 21st Century* (Frankfurt, 2008), 208–43.

[94] The paucity of central bank policy interest rate variation was a feature of 1930s central banking, shifting emphasis to asset purchases. The reason is familiar from monetary policymaking in the OECD today: policy rates were at or near the floor of what was considered acceptable. Almunia, M., et al., 'From Great Depression to Great Credit Crisis: similarities, differences and lessons', *Economic Policy* 25:62 (April 2010), 219-265.

$$\widehat{D} = \frac{2EM - \bar{\alpha}R - 2EE^*R + 2EM^*R^2 - 2E^2R^3}{2E(1+R^2)} \tag{9}$$

Rewrite M as $D+ER$ and solve again for $\widehat{D}$

$$\widehat{D} = \frac{\frac{\bar{\alpha}R}{2E(1+R^2)} - \frac{ER}{1+R^2} + \frac{E^*R}{1+R^2} - \frac{M^*R^2}{1+R^2} - \frac{ER^3}{1+R^2}}{-1+\frac{1}{R^2}} \tag{10}$$

and simplify

$$\widehat{D} = \mathrm{M}^* - \frac{\frac{\bar{\alpha}}{E} + 2(\mathrm{E}^* + E(-1+R^2))}{2R} \tag{11}$$

If the currency regime is reliably pegged, then $E=E^*$, giving

$$\widehat{D} = M^* - E^*R - \frac{\bar{\alpha}}{2E^*R} \tag{12}$$

Equation (12) is partly a statement about the money supply in a fixed exchange-rate regime: domestic assets are the residual of base money demand M^* and foreign assets, E^*R. Unique in (12) is the third term on the right, containing the cover limit $\bar{\alpha}$. The optimum quantity of domestic assets is the amount needed to satisfy money demand (M^*), less the amount provided through foreign assets -- less an additional quantity which rises in the cover limit and falls in foreign reserve holdings. The higher the cover limit, the further the monetary authority falls short of fulfilling private base money demand.

A relationship between supply of base money and demand for base money is implied by (12) when the money supply target M^* is treated as the economy's demand for base money

$$M^* \equiv M^d \tag{13}$$

Base money supply is given by re-arranging (12) and recalling that $M = D + ER$

$$M^s = M^d - \frac{\bar{\alpha}}{2E^*R} \tag{14}$$

The cover limit precludes private money market equilibrium. One implication is deflationary pressure, as the private money market tries to reach equilibrium through lower nominal money demand. Accumulating reserves also alleviates the disequilibrium.

Note the key policy implication: as policy variables, neither of these are as immediately discretionary as those in the rightmost term in (14): the cover limit and the peg.[95]

Empirical application

To assess the importance of the cover limit for the money supply in practice, write nominal money demand from (13) as a function of the price level (*P*) and liquidity preference *L(·)* where *i* is the nominal interest rate and *Y* is real output[96]

$$M^d = P * L(i, Y) \tag{15}$$

giving the equilibrium condition

$$P * L(i, Y) = M^s + \frac{\bar{\alpha}}{2E^*R} \tag{16}$$

Take the log of (16) and solve for real money supply. Lower-case letters in (17) are the log of upper-case counterparts; *res* is the log of reserves, and *i* is the nominal interest rate:

$$m^s - p = y - i + e + res - \bar{\alpha} \tag{17}$$

The real supply of base money is rising in real output, the exchange rate (i.e. depreciation), and foreign reserves. It is falling in the nominal interest rate and the cover limit. In econometric form, (17) becomes

$$m^s - p = \gamma + \beta_1 y + \beta_2 i + \beta_3 e + \beta_4 res + \beta_5 \bar{\alpha} + \mu \tag{18}$$

where γ is a constant, β_n are the coefficients and μ is the error term.

Ideally, (18) would be estimated in a dynamic form, in view of the endogeneity concerns in this estimation. Unfortunately, the course granularity of the data precludes this approach. Some of the variables -- GDP and the cover limit -- are known only with annual frequency. A dynamic specification would be asking too much of the data at this low frequency.

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[95] Figure 2 on page 150 reported that both were used by members of the sterling bloc, whose economic out-performance in the 1930s was given prominent contemporary mention. See, for example, "Chapter 3: The Sterling Area", in Nurkse *International Currency Experience*, 47-65.

[96] McCallum, B. and Goodfriend, S., 'Demand for money: theoretical studies' in J. Eatwell, M. Milgate and P. Newman, eds., *The New Palgrave: A Dictionary of Economics* (London, 1987).

4. Data and sources

The first source for cover limits is the US Federal Reserve *Bulletin*, which reported cover statutes on three occasions in the interwar period: 1930, 1932 and 1936, covering 48 countries.[97] The second source is the League of Nations, whose *Monetary Review 1937* catalogued changes in cover limits over the 1930s.[98] Lastly, the Bank of England's internal ledgers of foreign central bank balance sheet conditions reported the cover limit in effect for each observation.[99] These three sources, for the 35 countries for which complementary data are available, constitute the dataset, containing 107 observations.

Cover limit

Disaggregation of each side of the balance sheet gives rise to a variety of cover specifications, summarized in Table 1. The most common is a minimum coverage of the monetary base by gold and foreign exchange; the count of such systems appears in column 3. The next most-frequent specification is coverage of notes by gold and foreign exchange (column 5). Columns 1 and 2 are not mutually exclusive with the rest of the columns. A statute might specify a maximum fiduciary (i.e. un-backed) issue (column 1), but variegated backing for subsequent liability emissions. Column 2 reports systems in which liabilities (typically notes) up to a fixed amount are backed by a certain minimum proportion of foreign assets, and liabilities beyond that are backed by a higher proportion. Column 9 reports systems in which notes and deposits had separate cover requirements, e.g. 50% gold backing for notes and 25% foreign-exchange backing for deposits.

Table 1: Cover limit arrangements reported in the Federal Reserve *Bulletin*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	fiduciary	tiered	covering m0 total		covering notes only		separate note, sight		mixed defined
			f.a.	au only	f.a.	au only	f.a.	au only	
in dataset	16	5	40	15	13	17	2	4	1
in *Bulletin*	16	6	47	17	26	21	5	5	4
% of total	10.9	4.1	32.0	11.6	17.7	14.3	3.4	3.4	2.7

Source: Compiled by the author from Federal Reserve *Bulletin* (August 1930, July 1932, July 1936).
Note: The table counts annual observations of each type of cover system reported. The first row counts observations used in the estimations in this paper, i.e. where other necessary variables are available. The second row reports all the observations. See text for descriptions.

[97] US Federal Reserve, *Federal Reserve Bulletin* (Washington DC), issues August 1930, 502; July 1932, 437-38; July 1936, 542-543.
[98] League of Nations, *Monetary Review 1937* (Geneva, 1937).
[99] Bank of England Archive, File OV3, "Bank returns by overseas central banks" (26 volumes).

Homogenizing the cover statutes

Heterogeneous cover specifications need to be converted into a homogenous measurement before estimation. In this paper, they are converted to total foreign assets (TFA) over m0 as in column 3 of Table 1 by the following algorithm.[100] Where the cover statute explicitly calls for a minimum coverage of notes and sight deposits (i.e. m0) and allows for coverage in gold and foreign exchange (i.e. TFA), this figure is entered directly into the dataset. Otherwise, translate the given cover limit into TFA/m0 cover limit *in the first observation*. In subsequent observations, multiply the translated TFA/m0 cover limit at t_0 by the proportionate change in the actual cover statute. For example, Danish statutes called for coverage of notes only. In the first observation, 1930, the statutory minimum was 50%. To derive the coverage of m0, divide the fully-backed note quantity (i.e. 50% of notes) by the monetary base, giving (0.5*360)/429*100=42% statutory cover of m0. By 1932, the note cover limit had dropped to 33.3%. The proportionate change between 1932 and 1930 (33.3/50) applied to the estimated 1930 TFA/m0 gives a 1932 TFA/m0 cover limit of 28%. The algorithm is the same for fiduciary and tiered systems: the estimated TFA/m0 cover limit is the ratio of the fully-backed quantity of liabilities to the total monetary base. This enters directly as $\bar{\alpha}$ only in the first observation. Subsequent $\bar{\alpha}$ are the prior observation multiplied by the proportionate change in the fiduciary limit (however, with prior value / present value).

Central bank assets

The dataset contains annual-average values for central bank assets derived from monthly data.[101] Foreign exchange, gold and sight liabilities of the monetary authority are from three sources. First is the US Federal Reserve, *Bulletin* (Washington DC, various issues), published monthly. Second is League of Nations, *Monthly Bulletin of Statistics* (Geneva, various issues). Third is *Economist* (London, various issues). All were transcribed by the author and checked for errors. Figures are in millions of local currency units. Gold is valued at the latest legal parity and foreign exchange reserves are valued at market exchange rates.

The January 1939 issue of the League of Nations *Monthly Bulletin of Statistics* (page 38) contains a notation to Table 17: Gold and certain Silver and Foreign Assets Reserves. It

[100] Precise cover provisions for each country and year are reported in Appendix 2 on page 165.
[101] The exception is Italy in 1936, where end-year values are used due to data availability.

reads: "Unless otherwise stated, the gold is expressed throughout in terms of the most recent legal parity prevailing in each country. Foreign asset reserves, on the other hand, are believed in most cases to be valued at cost price in terms of national currency." In most countries, gold was revalued on the central bank balance sheet to reflect the depreciation in the exchange rate. The *World Economic Survey 1938/39* reported:

> Since 1929 … the monetary value of gold reserves has been greatly increased by the devaluation of national currencies and the revaluation of central bank gold reserves. This process of revaluation has continued in every year since the revaluation of the gold reserves of the United States at the beginning of 1934. By March 1939, some 90% of the world's monetary gold had been revalued.[102]

Domestic assets are the residual of the monetary base and foreign assets. The latter are net of foreign liabilities where such data are reported. The monetary base is note circulation plus all sight deposits at the central bank, including those of the government.

Exchange rate

Having considered a variety of numeraires (US dollar, UK pound sterling and French franc), it is clear that, outside of the sterling bloc, most authorities are in fact pegging to the current gold-convertible currency. This paper uses an index of the bilateral exchange rate set to the value of 100 at an arbitrary date e.g. 1 January 1928. The index changes in proportion to the change in the current designated gold numeraire exchange rate. The latter is the US dollar from Jan-1919 to Dec-1932; the French franc until Dec-1935; and the US dollar until Aug-1939. The underlying bilateral rates are dollar-numeraire from Global Financial Data and the cross rates are computed by the author.[103]

Real output

The source for real output is Maddison (2009) except as noted in Table 2.[104] The estimations are all done in differences, which should alleviate concerns over heterogeneous sources.

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[102] League of Nations, *World Economic Survey 1938/39* (Geneva, 1939), 88-89.
[103] http://www.globalfinancialdata.com
[104] Maddison, A., 'Historical Statistics of the World Economy: 1-2006 AD', (2009) [Excel file].

Table 2: non-Maddison sources for real output

		units	source
Egypt	GDP	millions of 1913 Egyptian pounds	Yousef, T., 'Egypt's growth performance under economic liberalism: A reassessment with new GDP estimates, 1886-1945', *Review of Income and Wealth* 48:4 (December 2002), 561-579 (577).
Estonia	GDP	index 1930=100	Valge, J., 'Estonia's Gross Domestic Product in 1923-1938', *Akadeemia* 12 (2003), 2712-2735 (2720).
Indonesia	NNP	millions of 1938 guilders	Mitchell, B., *International Historical Statistics: Africa, Asia and Oceania 1750-2005* (Basingstoke, 2007) [5th ed.], 1079.
Peru	GDP	millions of 1970 PPP dollars	Oxford Latin American Economic History Database (OxLAD), based on Inter-American Development Bank, *Progress, Poverty and Exclusion: an Economic History of Latin America in the Twentieth Century* (Washington DC, 1998).
South Africa	GDP	millions of 1938 rand	Mitchell, B., *International Historical Statistics: Africa, Asia and Oceania 1750-2005* (Basingstoke, 2007) [5th ed.], 1062.

Prices and interest rates

Consumer price indices are from Global Financial Data. Where none are available, wholesale price indices are used. Interest rates are the short-term policy rate. Where not available, they are the Lombard rate. Both are sourced from Global Financial Data.

Gold standard

An indicator variable for the gold standard is coded according to the tabulation of Officer (2008).[105] For countries not covered by Officer, the gold standard begins in the year of exchange-rate stabilisation against the dollar and ends with the first violation of the gold-standard ethos, as catalogued in League of Nations, *Statistical Year-book 1939/1940* (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves." Figure 3 highlights the importance of an ethos-based classification. France is an example. The reported date of "Official suspension of the gold standard" is after France's currently-recognised departure from the gold standard; the latter is reported under "Dates of changes" in gold parities (1 October 1936).

[105] Officer, L., 'The Gold Standard', in R. Whaples, ed., *The EH.net Encyclopedia* (2008).

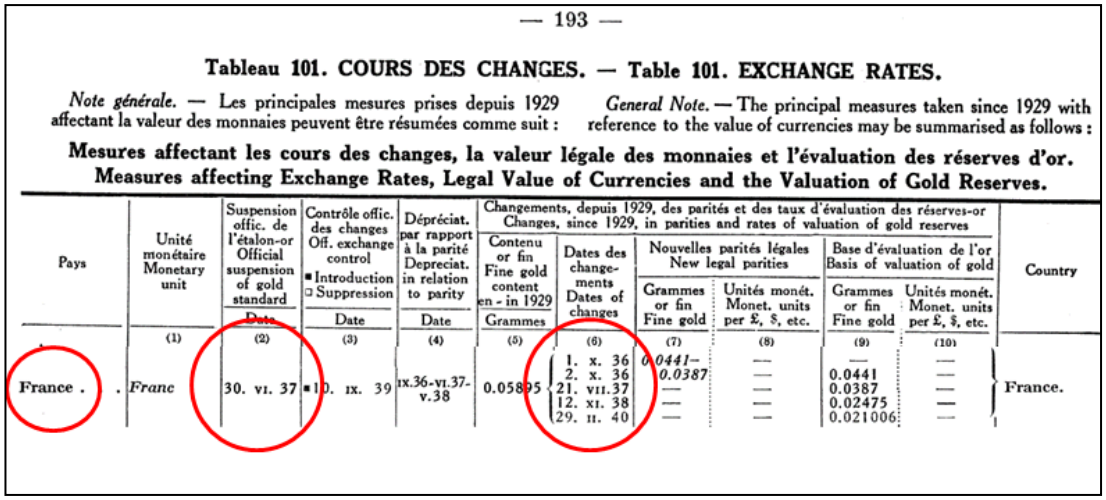

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Tableau 101. COURS DES CHANGES. — Table 101. EXCHANGE RATES.

Note générale. — Les principales mesures prises depuis 1929 affectant la valeur des monnaies peuvent être résumées comme suit :

General Note. — The principal measures taken since 1929 with reference to the value of currencies may be summarised as follows :

Mesures affectant les cours des changes, la valeur légale des monnaies et l'évaluation des réserves d'or.
Measures affecting Exchange Rates, Legal Value of Currencies and the Valuation of Gold Reserves.

Pays	Unité monétaire Monetary unit	Suspension offic. de l'étalon-or Official suspension of gold standard	Contrôle offic. des changes Off. exchange control ■ Introduction □ Suppression	Dépréciat. par rapport à la parité Depreciat. in relation to parity	Changements, depuis 1929, des parités et des taux d'évaluation des réserves-or Changes, since 1929, in parities and rates of valuation of gold reserves				Country
					Contenu or fin Fine gold content en - in 1929	Dates des changements Dates of changes	Nouvelles parités légales New legal parities		Base d'évaluation de l'or Basis of valuation of gold	
		Date	Date	Date	Grammes		Grammes or fin Fine gold	Unités monét. Monet. units per £, $, etc.	Grammes or fin Fine gold	Unités monét. Monet. units per £, $, etc.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
France .	. Franc	30. VI. 37	■ 10. IX. 39	IX.36-VI.37-V.38	0.05895	1. X. 36 2. X. 36 21. VII.37 12. XI. 38 29. II. 40	*0.0441–* *0.0387*	— — — — —	— 0.0441 0.0387 0.02475 0.021006	— — — — —	France.

Figure 3: Source for end-date of gold standard

Source: League of Nations, *Statistical Year-book 1939/1940* (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves."
Note: The table has been truncated to highlight France.

5. Results and interpretation

The estimated model of real base money supply is

$$m^s - p = \gamma + \beta_1 y + \beta_2 i + \beta_3 e + \beta_4 res + \beta_5 \bar{\alpha} + \mu \qquad (19)$$

where m^s is base money (sight deposits at the central bank plus currency in circulation), p is the price level, γ is a constant, i is the nominal short-term policy interest rate, y is real output, e is the nominal exchange rate, res is foreign reserves (gold and foreign exchange), and $\bar{\alpha}$ is the cover limit; u is the error term. All variables are in logs except i and $\bar{\alpha}$.

Table 3: OLS estimates. Dependent variable is Δ real base money [a]

	(a)	(b)	(c)	(d)	(e)
	pols	pols	xtfe	xtfe	pols
Δ cover limit [b]	-0.35***				
cover limit (level)		-0.18**	-0.33**	-0.35*	-0.17*
cover limit X gold std				0.83***	0.58***
Δ foreign assets	0.29***	0.22***	0.22***	0.17**	0.15***
Δ foreign assets X gold std				0.52***	0.43***
Δ real GDP	-0.71***	-0.45***	-0.50**	-0.66**	-0.46**
Δ real GDP X gold std				1.32***	0.65*
Δ exchange rate [c]	0	-0.12	-0.12	-0.08	-0.06
Δ exchange rate [c] X gold std				1.31	0.7
constant	0.07***	0.10***	0.15***	0.17***	0.11***
gold standard				-0.32***	-0.23***
observations	58	90	90	90	90
r2_adjusted [d]	0.320	0.244	0.259	0.447	0.476
cross-sectional units	n/a	n/a	33	33	n/a

*** p<0.01, ** p<0.05, * p<0.10

a) Δ(log of m0 – log of CPI)

b) As proportion (not percent). The change is between reported years: 1932/30 and 1936/32.

c) Exchange-rate index; tracks the gold numeraire; up=appreciation. See Data and sources on page 47.

d) r2_overall for the panel fixed-effects models (xtfe)

Table 3 reports the estimated coefficients from five regressions. The dependent variable in all is annual growth (log-change) in the real money supply.[106] All variables are in first-difference of annual log values. The exception is the cover limit, which in column (a) is the proportionate change from the previous *observation*, i.e. the 1936 value is the 1936 cover limit (as a proportion) minus the 1932 cover limit, and the 1932 value is the 1932 cover limit minus the 1930 cover limit. The regressions in columns (b) through (d) have the cover limit in levels, and thus more observations: 90 versus 58 for the cover limit in differences.

First-annual-differences for all the variables (bar the cover limit) ensure comparability of units: annual changes in log values are approximations of growth rates. The cover limits are proportion of international reserve assets to the monetary base. To address the presence of fixed effects in the undifferenced cover limit regressions, the data are time-demeaned in the regressions reported in columns (c) and (d).

To gauge the impact of suspension of gold convertibility, columns (d) and (e) report regressions in which the independent variables are interacted with an indicator for the gold standard. The data are time-demeaned in column (d) and pooled in column (e).

Results

Models interacted with indicator variables for the gold standard are reported in columns (d) and (e). Both of these reflect first-differenced data, so should be free of fixed-effects heterogeneity. However, the cover limit is not first-differenced, so the model in (d) adds time-demeaning to the first-differencing. In (d), a 10% increase in the cover limit is associated with a 3.5% fall in the real base money supply, consistent with the ex-ante theoretical prediction. What is striking is the result for the gold standard: a 10% increase in the cover limit is associated with a 4.8% *rise* in the real base money supply (0.48=0.83-0.35).

The impact of foreign reserves is also as predicted by the theoretical model. Again considering (d), a 10% increase in foreign reserves is associated with a 6.9% increase in real money supply during the gold standard, and a 1.7% increase thereafter.

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[106] The interest rate was insignificant and thus dropped from the model, allowing more observations since the interest rate is not available for all observations.

Baseline real money supply growth is negative during the gold standard and positive thereafter, as reported by the coefficient on the constant and its interaction term.

The exchange rate has no impact in any model and regardless of being on or off the gold standard, although the signs on the coefficients are as predicted by the theoretical model: an appreciation in the exchange rate is associated with a fall in real base money growth.

Interpretation

The surprise here is the impact of the cover limit during the gold standard. Arguably, this hints at the inappropriateness of specifying such an interaction. The theoretical model describes the interwar central bank policy regime, in which modification of the cover limit is a policy tool. Because this tool was exercised by most countries in tandem with suspension of gold convertibility, the data sample should not distinguish between gold-convertible and inconvertible observations. Instead, it should consider the full span of on-gold and post-gold observations. Such results are reported in columns (a) through (c). In (c), a 10% decrease in the cover limit increases the real money supply by 3.3%.

Strangely, higher real GDP growth is associated with lower real money supply growth. This might reflect the interwar affinity for asymmetric sterilisation. Countries which attracted reserves had a high propensity to sterilise them by contracting domestic assets, whereas countries losing reserves were more likely to allow such losses to contract the money supply or even to accentuate these losses with a sale of domestic assets.[107] Hence an economy experiencing export-led growth might exhibit lower money supply growth. For many countries, export growth accelerated with devaluations upon suspending the gold standard.[108]

There are problems with the estimations reported here. Chief among them is endogeneity: does real base money growth follow the right-hand-side variables, or does it cause them? If the latter is true, then the OLS estimators are biased and inconsistent. While there are reasons to be concerned, in general it is reasonable to expect money growth to be an outcome of these righthand-side variables. In a variety of econometric applications, growth estimations often confront this problem and the approach is generally treated with qualified confidence.

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[107] Nurkse, *International Currency Experience*, 106 and Eichengreen, *Golden Fetters*, 23.
[108] Nurkse, *International Currency Experience*, 129.

Another problem is the lack of a broader money aggregate and thus a role for the money multiplier. The private sector's demand for money includes that of the banking system, rather than purely base money. However, for a given money multiplier, the public's demand for broad money is directly proportional to the requirements for base money. More importantly, the model here looks at the situation from the view of the policymaker; base money is under the central bank's control, higher aggregates might not be.[109]

Historical context

These results are consonant with the practical emphasis of the time. The importance of 'backing' of central bank liabilities is clear in the coverage of several contemporary records. One is the financial press. The *Times* of London reported balance sheet items of a variety of central banks, along with the cover ratio. Likewise the *Economist* reported a rotating group of central bank balance sheets, and the cover ratio. Such reporting did not end with the suspension of the gold standard. To investors, it may have become more important.

Another contemporary accounting of the cover ratio is a set of ledgers maintained internally by the Bank of England, known internally as the "Red books".[110] These gave prominence to the cover ratio and were maintained on a weekly basis as a surveillance tool. Their archival record at the Bank of England describes them as forerunners of the IMF's international financial surveillance data, now known as the International Financial Statistics.[111]

It may be the case that these contemporary reports reflected slowness to change habits after the gold standard. It is difficult to say conclusively, partly because the world was not again pushed to the brink of reserve losses as was experienced in the months and years culminating in 1931. The 1937 US recession was reversed forcefully and sharply, in stark contrast to the 1929 US recession.[112]

The *Ninth Annual Report* (April 1938 - March 1939) of the Bank for International Settlements looks back upon the relationship between gold and the note issue. Of

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[109] If the banking system holds excess reserves, the central bank cannot affect the money supply multiplier because the minimum reserve ratio does not bind.
[110] Bank of England Archive, 'Bank returns of overseas central banks', *op cit.*
[111] The evolution of cover statutes recorded in the Red books is reported in Appendix 2.
[112] Both recessions are reviewed in Paper 2: Rules of the Game.

particular interest is “Section 3, Revaluation of Gold Reserves and Changes in Note Circulation”, which is quoted below at length:

> In addition to the countries mentioned above (United States, Belgium, Italy, Switzerland, France, Finland, Estonia, Hungary and the United Kingdom) a great number of others (e.g., Canada, the Argentine, Roumania, Japan and Latvia) revalued their gold holdings in recent years. In March 1939 about 90 per cent of the world's monetary stock of gold has thus been revalued…. Among the countries which have not revalued, the largest gold holdings are those of the Netherlands; the three Scandinavian countries -- Denmark, Norway and Sweden -- and several countries in the British Empire -- South Africa and India etc. -- are also in this group. Most of these countries have ample monetary reserves even at the old gold price and have, therefore, no immediate reason to revalue. An interesting development in recent months has been the action of the Finnish and British authorities in revaluing their gold holdings for the purpose of providing an increased backing at current values for the domestic note circulation.[113] (emphasis added)

The section goes on to say:

> Abandonment of the gold standard has not meant the abandonment of gold either as a means of settling balances between different countries or as the usual backing for the domestic circulation according to the cover regulations of central banks. More attention is no doubt paid to the Resolution of the London Conference of 1933 "that under modern conditions monetary gold is required not for internal circulation but as a reserve against central bank liabilities and primarily to meet extraordinary demands for payments caused by some disequilibrium on the foreign account". While the record volume of international gold movements shows the extent to which gold is being used for international settlements, recent enactments provide interesting examples of the connection still maintained between the gold reserve and the volume of notes in circulation.[114] (emphasis added)

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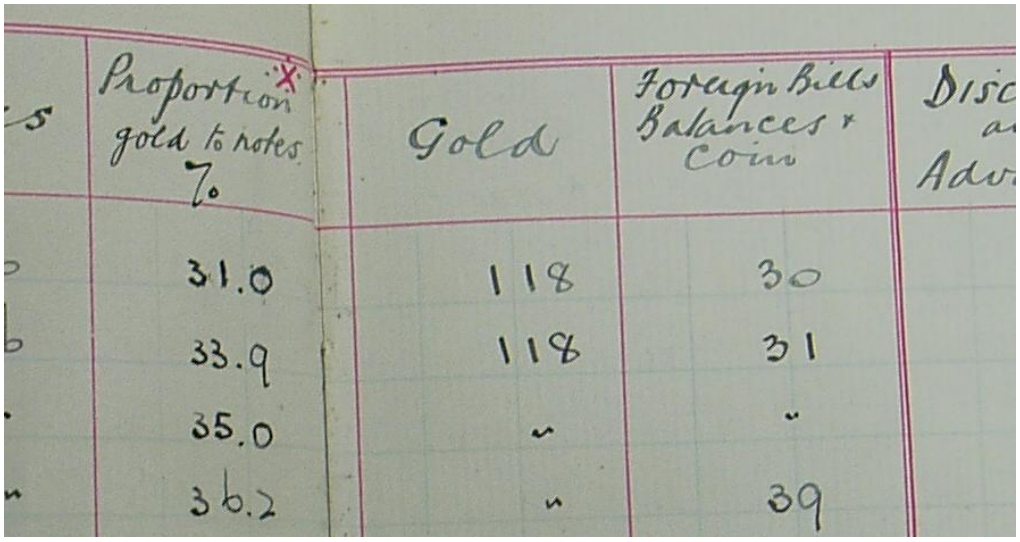
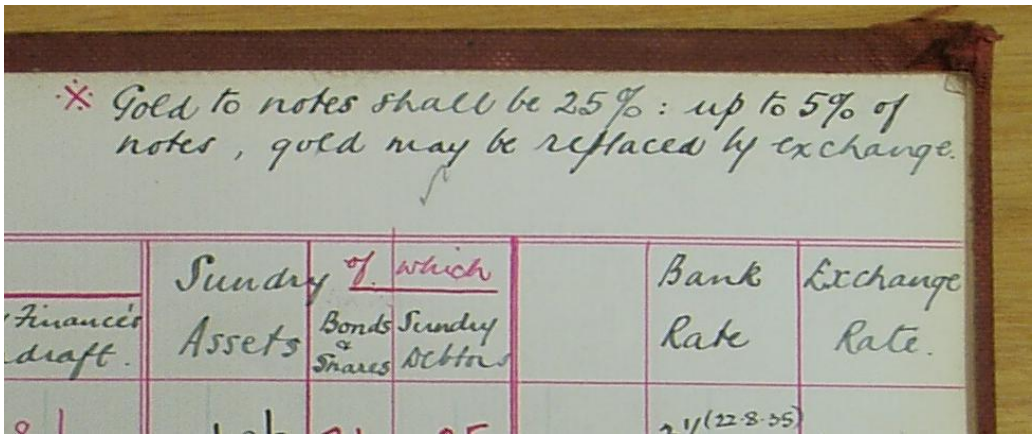
[113] Bank for International Settlements, *Ninth Annual Report* (April 1938 - March 1939) (Basle, 1939), 73.
[114] *Ibid*, 75.



	Proportion gold to notes %	Gold	Foreign Bills Balances & Coin	Disc a Adv
	31.0	118	30	
	33.9	118	31	
	35.0	"	"	
	36.2	"	39	

Figure 4: 'Red book' compilation of cover <u>ratio</u> ("Proportion") for Denmark, June 1936

Source: Bank of England Archive, 'Bank returns of overseas central banks', file OV3/9. Photo by the author.



※ Gold to notes shall be 25% : up to 5% of notes, gold may be reffaced by exchange.

	Sundry Assets	% which Bonds & Shares	% which Sundry Debtors		Bank Rate	Exchange Rate.
Finance draft.						
					2½ (22.8.35)	

Figure 5: 'Red book' note on cover <u>limit</u> for Denmark, June 1936

Source: See Figure 4.

The League of Nations wrote in 1938:

> It is of interest to analyse the causes of the increases in monetary supplies between 1929 and 1937. The supply of money depends primarily upon the gold reserves of the central banks; for it is on the basis of these reserves that notes are issued and cash reserves are made available to the commercial banks. But central-bank reserve ratios must also be taken into account, since an increase in the ratio of central bank reserves to liabilities will tend to offset an increase in the supply of gold.[115]

[115] League of Nations, *World Economic Survey 1937/1938* (Geneva, 1938), 97.

Greater international liquidity, as well as (selective) abandonment of the gold standard, enabled countries to resist the 1937 US recession, in contrast to 1929-31:

> Great liquidity was maintained in all the principal financial markets [in 1938]; and, in consequence, the recession which started in the middle of 1937 was not intensified, as had been the case in 1929 and 1930, by monetary deflation. In practically no country were any deliberate measures of monetary restriction undertaken; and the continuation of a policy of cheap and abundant monetary supplies assured one of the necessary conditions for a prompt recovery. Two important monetary developments since 1929 have made this change of monetary policy possible. In the first place, as will be seen in a later section of this chapter, the value of monetary gold reserves has been greatly increased in a number of countries, both through increased quantities of such reserves and also through the revaluation of gold reserves at higher prices in terms of the different national currencies. Secondly, the abandonment of the international gold standard, the institution of exchange stabilisation funds and, in some countries, the rigid control of the foreign exchanges have enabled the national monetary authorities to adopt policies of internal monetary expansion with less regard to possible repercussions upon their balances of payments with other countries.[116]

[116] League of Nations, *World Economic Survey 1938/1939* (Geneva, 1939), 85.

6. Conclusion

When central banks suspended convertibility of their liabilities into gold in the interwar period, they opened the possibility for a more expansionary monetary policy. Yet they were notably reluctant to do so. This seemingly paradoxical outcome is made less mysterious considering which countries expanded money the most boldly. Among them were Germany, Japan and Italy. These countries dramatically relaxed or eliminated the gold cover constraint in central bank statutes. This might provide an important insight into the practice of monetary policy in the 1930s.

This paper argues that statutory gold cover constraints, or "cover limits", survived the loss of gold convertibility and that it had a restraining influence on monetary policy. In fact, it was the loss of gold convertibility that elevated the importance of the cover constraint. It fortified the autonomy of central banks. This made reserve accumulation the route to monetary expansion. This indeed seems to be the case in the 1930s. Higher rates of reserve growth are associated with higher real base money growth. Theoretically this follows from the link between private demand for central bank money and the supply thereof; it was easier to achieve through reserve accumulation, due to the cover constraint.

There is some vindication here for Nurkse, who was critical of these statutory cover provisions in the 1930s, which he saw as a clear impediment to the settlement of international transactions without the need to resort to painful deflation and base money contraction (to free up the reserves needed for international settlement at fixed exchange rates). Nurkse's argument can be seen as a plea to central banks that such collateralisation of their money was no longer necessary. Yet central banks would have embraced it in part as a measure of autonomy.

The theoretical model and empirical results of this paper portray the gold standard as two-faceted. One facet is the traditional emphasis on convertibility of central bank liabilities into gold, with freedom of gold import/export. The other is collateralisation of these liabilities with a quantity of gold. This collateralisation was a natural emphasis for policymakers of the interwar period. Not only did they inherit the collective judgement of the nineteenth century over the danger of 'unbacked' paper money, they also had their own early post-WWI episodes of unbacked-money hyperinflations. The gold standard in 1931 arguably narrowed from a two-faceted to one-faceted standard.

Appendix 1: Coefficient of variation

bloc	country	cover limit	exchange rate	base money	cover ratio	n
gold	Belgium	0.00	0.15	0.29	0.20	155
	Estonia	0.00	0.24	0.28	0.28	171
	France	0.00	0.24	0.20	0.17	153
	Indonesia	0.00	0.04	0.23	0.07	84
	Latvia	0.02	0.33	0.25	0.38	201
	Lithuania	0.00	0.42	0.28	0.28	201
	Netherlands	0.00	0.09	0.28	0.09	178
	Poland	0.18	0.01	0.22	0.31	158
	Switzerland	0.00	0.13	0.47	0.16	177
	mean	*0.02*	*0.18*	*0.28*	*0.22*	*164*
	std. dev.	*0.06*	*0.14*	*0.08*	*0.10*	*35*
central Europe	Austria	0.10	0.11	0.12	0.47	170
	Czechoslovakia	0.09	0.10	0.10	0.10	84
	Germany	1.73	0.01	0.25	0.85	177
	Greece	1.73	0.40	0.28	0.31	84
	Hungary	0.00	0.10	0.16	0.38	84
	Italy	0.87	0.02	0.13	0.11	93
	Romania	0.00	0.95	0.22	0.20	84
	Yugoslavia	0.20	0.13	0.09	0.59	84
	mean	*0.59*	*0.23*	*0.17*	*0.38*	*108*
	std. dev.	*0.76*	*0.32*	*0.07*	*0.26*	*41*
sterling	Argentina	0.22	0.33	0.07	0.38	154
	Australia	0.29	0.34	0.29	0.26	170
	Chile	0.19	0.56	0.36	0.80	166
	Colombia	0.48	0.47	0.36	0.40	157
	Denmark	0.33	0.34	0.14	0.34	159
	Egypt	0.00	0.24	0.20	0.78	150
	Finland	0.00	0.31	0.32	0.22	188
	India	0.00	0.24	0.20	0.40	171
	Japan	1.23	0.52	0.23	0.26	116
	New_Zealand	0.00	0.15	0.73	0.50	160
	Norway	0.20	0.29	0.18	0.21	144
	Portugal	0.00	0.24	0.18	0.35	122
	South_Africa	0.16	0.24	0.52	0.23	177
	Sweden	0.19	0.26	0.42	0.24	201
	UK	0.12	0.25	0.12	0.56	177
	mean	*0.23*	*0.32*	*0.29*	*0.40*	*161*
	std. dev.	*0.31*	*0.11*	*0.17*	*0.19*	*22*
other	Canada	0.00	0.24	0.42	0.43	182
	Spain	0.00	0.39	0.07	0.08	164
	USA	0.00	0.23	0.34	0.34	201

Note: The table reports coefficient of variation, which is the standard deviation divided by the mean. The underlying data are monthly except for the cover limit, which is annual. The exchange rate is an index tracking the bilateral rate against the current gold-convertible currency, as described in Part 4. The span of observations is specific to each country; it covers the gold-convertible period and the post-gold period.

Appendix 2: Precise cover limit statutes by country and year

Cover limits as of July 1930

		qualifying assets (%)					
Country[1]	**Covered liabilities**	**gold only**	**gold and fx**	**silver (up to)**	**Taxable breach[2]**	**Escalator[3] to %, year**	**Details**
Albania	notes		33.3	Yes			Fx must not exceed 67%.
Australia	notes	25					
Austria	m0		24	Yes (1/5)	Yes	33.3, 1938	
Belgium	m0	30	40				
Bolivia	m0		50	Yes (1/5)	Yes		FX on sight in London or NY
Bulgaria	m0		33.3	Yes	Yes [c]		FX (net)
Chile	m0		50		Yes		FX on sight in London or NY
Colombia	m0	36	60		Yes		FX on sight only.
Czech.	m0	12.5	25		Yes	35, 1935	
Danzig	notes		33.3		Yes		Rises to 100% after a threshold. FX on sight in BoE.
Denmark	notes	30	50		Yes [c]		FX (net) on sight at central banks of Norway, Sweden and Germany.
Ecuador	m0		50		Yes		FX on sight in London or NY
Egypt	notes		50				100% FX in British gilts
Estonia	m0		40		Yes [c]		FX (net)
Finland (F)	m0	fixed	100				gold=300 million markka
France	m0	35					
Germany	notes	30	40		Yes		FX maturity < 15 days
Greece	m0		40		Yes [c]		FX (net)
Guatemala	notes sight other	12 7.5 30	40 25 100	Yes (1/30)			
Hungary	m0		24	yes	yes	33.3, 1939	
Italy	m0		40		yes		
Japan (F)	notes	100		yes (1/4)	yes [c]		
Java	m0	40		yes			
Latvia	notes		50				Rises at threshold.
Lithuania	notes	33.3					
Netherlands	m0	40		yes			
Norway (F)	notes	100			yes [c]		
Peru	m0		50				FX in London or NY.
Poland	notes	30	40	yes (1/20)	yes		
Rumania	m0	25	35				
S. Africa	m0	40		yes (1/12)	yes [c]		Silver < 1/12 of deposits.
Spain	notes low notes hi	38.8 48.5	45 60	yes (1/20)	yes [c]		(detailed thresholds)
Sweden (F)	notes	50			yes [c]		gold>= 150 mn kronor
Switzerland	notes	40					
UK (F)	notes	100			Yes [c]		

Source: US Federal Reserve, *Federal Reserve Bulletin* (August 1930), "Foreign Banking and Business Conditions; Legal Reserve Requirements of Foreign Central Banks", p. 502.
Notes: 1/ (F)iduciary system. Cover applies to stated liability in excess of: Finland: 1,200 million markka; Japan: 120 million yen; Norway and Sweden: 250 million kroner; UK: 260 million pounds. 2/ [C] with assent from government. 3/ Statutes call for a schedule of increasing cover limits.

Cover limits as of July 1932

		qualifying assets (%)						
Country [1]	**Covered liabilities**	**gold only**	**gold and fx**	**silver (up to)**	**Taxable breach**[2]	**Broad FX**[3]	**Escalator**[4] **to %, year**	**Details**
Albania	notes		33.3	yes		yes		Fx must not exceed 67%.
Argentina*	notes	36						Includes subsidiary coin.
Australia	notes		15				25, 1935	Fx on BoE.
Austria	m0		24		yes	yes	33.3, 1938	
Belgian Congo	notes	20	40					
Belgium	m0	30	40					
Bolivia	m0		50	yes (1/5)		yes		FX on sight in London or NY
Bulgaria	m0		33.3		yes [c]			FX (net)
Canada*	notes sight	100 10						Dominion notes and Deposits of Post Office Savings Bank
Chile	m0		35		yes		50, 9/1933	FX (net) on sight in London or NY
Colombia	notes sight		30 25	yes (1/2, for sight)	yes		40, post-emergency	FX on sight only.
Czech.	m0	15	30		yes	yes	35, 1935	
Danzig	notes		40		yes			
Denmark	notes	30	33.3		yes [c]		50, 7/1933	FX (net) on sight at central banks of Norway, Sweden and Germany.
Ecuador	notes sight	35 25						fixed note limit
Egypt	notes		50					100% FX in British gilts
Estonia	m0		40		yes [c]			FX (net)
Finland (F)	m0	fixed	100					gold=300 million markka
France	m0	35						
Germany	notes	30	40		yes	yes		FX maturity < 15 days
Greece								
Guatemala	notes sight other	12 7.5 30	40 25 100	Yes (1/30)				"Notes, less due from banks"
Hungary	m0		24	yes	yes	yes	33.3, 1939	
Ireland*	notes		100					Legal tender notes. FX in sterling notes or deposits.
Italy	m0		40		yes			
Japan (F)	notes	100		yes (1/4)	yes [c]			
Java	m0	40		yes				
Latvia	notes		50			yes		Rises at threshold.
Lithuania	notes	33.3						
Madagascar	notes		33.3	yes				
Morocco	notes	11						
Netherlands	m0	40		yes				
Norway (F)	notes	100			yes [c]			
Peru	notes deposits	50	50	yes (1/5)				FX only payable in gold in London or NY; or, up to 1/2 of reserve, in acceptances in gold-standard currencies
Poland	m0	30	40	yes (1/20)	yes			
Portugal	notes low notes hi	 100	30			yes		FX (net)
Rumania	m0	25	35					
S. Africa	m0	40		yes (1/12)	yes [c]			Silver < 1/12 of deposits.
Spain	notes low notes hi	38.8 48.5	45 60	yes (1/20)	yes [c]			(detailed thresholds)
Sweden (F)	notes	50			yes [c]			gold>= 150 mn kronor
Switzerland	notes	40						
UK (F)	notes	100			yes [c]			
Uruguay	m0	40						Govt credits abroad count as

		qualifying assets (%)						
Country [1]	**Covered liabilities**	**gold only**	**gold and fx**	**silver (up to)**	**Taxable breach[2]**	**Broad FX[3]**	**Escalator[4] to %, year**	**Details**
								gold up to a threshold. Notes below 10 pesos treated separately.
USSR	notes		25	yes	yes			Reserve may include platinum.
Yugoslavia	m0	25	35					

Source: US Federal Reserve, *Federal Reserve Bulletin* (July 1932), "Legal Reserve Requirements of Foreign Central Banks", pp. 437-438.

Notes:

Red (Green) indicates a relaxation (tightening) from the 1930 statutes. Red in country-only indicates new country covered.

1/ (F)iduciary system. Cover applies to stated liability in excess of: Finland: 1,200 million markka; Japan: 1,000 million yen; Norway and Sweden: 250 million kroner; UK: 260 million pounds, raised to 275 million on 1 Aug 1931 to expire 31 Aug 1933.

2/ C with assent from government.

3/ "Foreign exchange may be in any stable currency" ("not limited to gold-standard currencies" for Czech., Germany, Portugal).

4/ Statutes set out a schedule of increasing cover limits.

*"Argentine Conversion Office", "Canadian Minister of Finance", "Irish Currency Commission".

Cover limits as of July 1936

		qualifying assets (%)						
Country [1]	**Covered liabilities**	**gold only**	**gold and fx**	**silver (up to)**	**Taxable breach**[2]	**Broad FX** [3]	**Escalator** [4] **to %, year**	**Details**
Albania	notes		33.3	yes		yes		Fx must not exceed 67%.
Argentina	m0	22.5	25			yes		FX (net)
Australia	notes		25				(achieved)	Sterling only
Austria	m0		20		yes	yes	22, 1937	sight net of govt debt
Belgian Congo	notes	20	40					and subsidiary coin
Belgium	m0	30	40					
Bolivia	m0		50	yes (1/5)		yes		FX payable in gold on sight in London or NY
Bulgaria	m0		25					FX (net)
Canada	m0	25			yes [c]			
Chile	m0		50		yes		50, 9/1933	FX (net) payable in gold on sight in London or NY
Colombia	notes deposits		30 25		yes	yes	40, post-emergency	FX on sight only.
Czech.	m0	25			yes		(missed)	
Danzig	m0		30		yes			
Denmark	notes	20	25		yes [c]		(missed)	FX (net) at central banks. 15% must be gold at home.
Ecuador	m0		40					FX payable in gold only
Egypt	notes		50					Gold at home only; FX in sterling
El Salvador	m0		25			yes		
Estonia	m0		40		yes [c]			FX (net)
Finland (F)	m0		100			yes		
France	m0	35						
Germany	notes	30	40			yes		**suspended 7 July 1931**
Greece	m0		40					**suspended 26 Apr 1932**
Guatemala	notes sight	13.33 8.33	40 25	Yes (1/10)				Notes not to exceed 5x paid-in capital.
Hungary	m0		24	yes	yes	yes	(missed)	
India*	notes		40		yes [c]			Gold minimum, 85% at home. FX in sterling.
Ireland								
Italy	m0		40					**suspended 22 July 1935**
Japan (F)	notes	100		yes (1/4)	yes [c]			
Java	m0	40		yes				Part of reserve at home
Latvia	notes low notes hi		30 50			yes		Government note issue requires 25% gold backing.
Lithuania	notes	33.3						
Madagascar								
Morocco	notes	11	33.33					
Netherlands	m0	40		yes				80% of reserve at home
New_Zealand	m0		25		yes [c]			FX (net)
Norway (F)	notes	100			yes [c]			Gold at home
Peru	m0		50	yes (1/5)				FX payable in gold in London or NY; or, up to 1/2 of reserve in acceptances in gold-standard currencies
Poland **(F)**	m0	30			yes			Gold (net)
Portugal	notes low notes hi	 100	30					FX (net)
Rumania	m0	25	35					
S. Africa	m0	30		yes (1/12)	yes [c]			Half of gold at home. Silver < 1/12 of deposits.
Spain	notes low notes hi	45 60		yes (1/20)	yes [c]			Gold 97% at home. (detailed thresholds)
Sweden (F)	notes	50			yes [c]			Gold 85% at home.

		qualifying assets (%)						
Country [1]	**Covered liabilities**	**gold only**	**gold and fx**	**silver (up to)**	**Taxable breach**[2]	**Broad FX** [3]	**Escalator** [4] **to %, year**	**Details**
								Gold>= 150 mn kronor
Switzerland	notes	40						Gold at home.
UK (F)	notes	100			yes [c]			
Uruguay	m0	45						(complex)
USSR								
Yugoslavia	m0	20	25					Effective 21 Jan 1935.

Source: US Federal Reserve, *Federal Reserve Bulletin* (July 1936), "Legal Reserve Requirements of Foreign Central Banks", pp. 542-543.

Notes: Red (Green) indicates a relaxation (tightening) from the 1932 statutes. Red in country-only indicates new country covered.

1/ (F)iduciary system. Cover applies to stated liability in excess of: Finland: 1,200 million markka; Japan: 1,000 million yen; Norway: 250 million kroner; Sweden: 350 million kronor; Poland: 100 million zlotys; UK: 260 million pounds.

2/ [C] with assent from government.

3/ "Foreign exchange may be in any stable currency" ("not limited to gold exchange" for Argentina, Germany, Portugal).

4/ Statutes set out a schedule of increasing cover limits. * "British India"

Chronology and exact definitions of "Proportion" in Bank of England "Red Books"

Key to code:
A: gold/notes, A1: gold+silver/notes; A2: gold at home to note circulation; B: gold/m0; B1: gold+silver/m0; C: total reserves/notes; E total reserves to m0; F1 fiduciary gold only

country	year	code	specifics
Argentina	1928-1	n/a	No mention of proportion
Argentina	1935-6	n/a	The central bank "Commenced operations the 1st of June 1935."
Argentina	1935-6	E	Total reserves to M0 but no legal minimum noted
Austria	1925-1	E	"% of gold and foreign exchange to notes and immediate liabilities less government debt to be at least 20% in first five years." [January 7, 1925]
Austria	1927-10	E	"... 20% in 1st five years, 24% next five years, 28% next five years, and 33-1/3% in subsequent period." [October 1927]
Bolivia	1929-1	E	"Minimum proportion: gold and gold exchange must be 50% of sight liabilities"
Bolivia	1932-2	E	"... 35% ..."
Brazil	1928-1	n/a	(From 1928-1939, no mention of the proportion.)
Denmark	1927-1	C	[Jan 1927] Proportion must be 50% [details out of frame] (Raised from 33.3)
Denmark	1928-1	C	Jan 1928 begins to report proportion and gold-only proportion separately.
Denmark	1928-1	C	[1928] Cover assets include gold, subsidiary coin and deposits at Sweden, Norway and Germany central banks.
Denmark	1928-1	C	[1928] "Proportion of 'cover' to note circulation must be 50%, of which gold must be 30%, i.e. 30% of total cover"
Denmark	1931-9	n/a	[1931] "Export of gold prohibited 22nd September."
Denmark	1931-9	n/a	[1931] "Gold standard suspended 29th September."
Denmark	1931-10	C	[1931] "Royal decree of 13.10.31 reduced legal proportion (cover to note circulation) to 33.3% (of which gold must be 30%."
Denmark	1935-5	C	[May 1935] "33-1/3% of notes had formerly to be covered by Gold, Coin etc in 'Reserve' (Royal Decree 13-10-31). Since Sept. 1934 the National Bank has not published its proportion, which is shown in the Red Book for comparative purposes only."
Denmark	1936-6	C	[June 1936] "Gold to notes shall be 25%: up to 5% of notes, gold may be replaced by exchange. "
El Salvador	1935-1	B	[1935] Proportion column is added to the return, "Proportion %".
El Salvador	1939-1	B	[1939] "Proportion [metallic reserve to notes and sight deposits] %".
Hungary	1924-1	E	[1924] EXACTLY like Austria.
Hungary	1938-1	E	note: the 24% threshold ends 31/12/1938.
Hungary	1938-1	E	"Statutes amended 23 June 1938".
Hungary	1938-6	B	"As from 23/6/38 proportion to be calculated monthly as ratio of average of notes of private sight liabilities in previous month to average of metal reserves (and published in first [illegible] of month). Minimum 25%.
India	1935-1	F	[1935] "Not less than 40% of the total assets to be Gold Coin, Gold Bullion or Sterling Securities. Gold to be not less than 40 crores". 1 crore = 750,000 sterling.
Latvia	1923-1	n/a	[1923] No item for proportion.
Latvia	1926-1	C	[January 1926] "For Note Cover see statutes Article 13 and Weekly Return".
Latvia	1926-1	C	1926 "Up to 100 millions 50% cover must be gold or foreign exchange; rest bills."
Latvia	1927-1	C	[Jan 1927] A proportion column.
Latvia	1929-1	C	[1929] "Proportion: Gold and foreign balances to notes (state and

country	year	code	specifics
			bank)."
Latvia	1936-9	C	[27 Sept 1936] "Lat devalued and pegged at 25.2215 per sterling."
Mexico	1933-1	n/a	[1933] No column for proportion and no mention.
Mexico	1937-1	B	[1937] New column: "Proportion: Metallic reserve to total notes and sight liabilities." "At least 80% of metallic reserve must be in gold."
New_Zealand	1935-1	E	"Reserve proportion to notes and other demand liabilities"
Norway	1938-1	F	"Gold at home plus kr 325 mn less notes issued" (subsequently raised to 425)
Norway	1938-1		"Gold at home to notes and sight liabilities (for comparison only)"
Portugal	1924-1	n/a	[1924] no item for proportion; no mention of cover.
Portugal	1931-7	E	[July 1931] First column for proportion. "Gold and net foreign exchange to be 30% of total sight liabilities."
South Africa	1935-1	F	"Proportion -- Cash reserves to liabilities to public"
South_Africa	1937-1	F	[1937] "Proportion: Cash reserves to liabilities to public"
Sweden	1937-5	F	"Further amount (in Kr millions) which may be issued against the supplementary cover, without exceeding the limits of double the gold + 350 millio nKr (from 30 May 1935)". [May 22, 1937]
Sweden	1937-5	A	"Percentage of gold to notes after deducting the fiduciary issue of kr 350 mn (must not be less than 50%)." [May 22, 1937]
Switzerland	1925-5	C	"Proportion to notes in circulation of total reserve to be 40%" [5/23/1925]
Switzerland	1928-3	E	"Proportion of Gold, Silver (at its bullion value) and foreign exchange to notes and sight liabilities." [3/31/1928]
Switzerland	1929-1	A1	"Legal minimum [proportion of reserves] 40%, of which silver [illegible] must not exceed 1/5th i.e. 8%" [1/7/1929]
Switzerland	1930-4	A	"On 1st April 1930 the Law of 20th December 1929 came into force and the Gold Standard became effective in Switzerland. The pre-war parity is maintained and there was thus no revaluation of assets necessary. The new law provides, inter alia, a reserve of gold in Switzerland to be not less than 40% of the note issue. Silver's now omitted from the metallic reserve (silver écus are no longer legal tender) and thus the last traces of bi-metallism disappear. Notes may be redeemed in gold or foreign exchange but only gold may be held in the 40% reserve, see National Bank letter of 12.4.1930 and enclosures – also new law in statute file."
Switzerland	1936-9	A	"On 27th September 1936, the Federal Council passed a decree stating that: -- the National Bank was released from its obligations to repay its notes in Gold or Gold F/E, but it was obliged to maintain the legal cover at 40%. The National Bank was further commissioned to maintain the gold parity of the franc between 190 and 215 milli-grammes fine gold, which gave a depreciation of the franc amounting to approximately 30% (limits 25.94% to 34.55%). [October 7, 1936]
Switzerland	1938-7		"Ratio [of gold at home to notes] not ascertainable owing to non-disclosure of gold at home." [July 7, 1938]

Source: Bank of England Archive, 'Bank returns of overseas central banks', Reference number OV3 (26 volumes), 1923-1969.

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Rules of the Game for Interwar Central Banks*

Asymmetric sterilization in the 1930s

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ABSTRACT

'Rules of the game' during the gold standard was a notional obligation of central banks to allow the balance of payments to dictate the supply of base money. Nurkse (1944) attributed the collapse of the interwar gold standard partly to the failure of central banks to follow such rules. A key shortcoming in his work is the coarse granularity of data: he examined the link between international reserve changes and the money supply at an annual frequency. This paper employs a large dataset at monthly and weekly frequencies to assess the linkage between reserves and base money in the interwar period. Central banks were more orthodox than Nurkse realised. They also clung to such orthodoxy even after suspending convertibility into gold.

JEL codes F310 F330 N10 N12 N14
JEL keywords intervention, reserves, fixed exchange rates, gold standard, sterling area

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1. Introduction

A central bank's liabilities are backed by its assets, whether of domestic or foreign origin. In a rigid exchange-rate regime, changes in the central bank's foreign assets are determined by the external position. But the central bank can take a variety of stances on whether and how these changes affect the size of its liabilities -- central bank money. A highly orthodox stance, as was attributed to the gold standard, meant allowing the foreign asset changes to dictate changes to the balance sheet. A reserve loss would shrink it, an accumulation inflate it. Changes in the supply of central bank money under this stance are endogenous to the balance of payments. These were the 'rules of the game' as described by contemporaries.[117]

Central banks can flout the 'rules' by buying and selling domestic assets to offset changes in international reserves. Such operations were known to Ragnar Nurkse and his contemporaries as neutralization; they are today called sterilization.[118] Equation (1) is an identity for the central bank balance sheet. The central bank's liabilitites (cash in circulation, M, plus demand deposits, DD) plus central bank capital (CBC) are backed by net assets of domestic or foreign origin (NDA and NFA, respectively). The central bank can "neutralize" or "sterilize" the impact of a loss in net foreign assets (i.e. international reserves) by acquiring an equivalent domestic-currency value of domestic assets.

$$M + DD + CBC \equiv NDA + NFA \qquad (1)$$

Nurkse famously judged interwar central banks to have flouted the rules:

> ... the facts certainly suggest that throughout the inter-war period neutralization was the rule rather than the exception.[119]

However, Nurkse also acknowled that his data, at annual intervals, potentially masked higher-frequency observance of the 'rules'.[120]

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[117] This formulation of the 'Rules of the game' was put forth by the 1931 Macmillan Committee. Committee on Finance and Industry [Macmillan Committee], *Report Presented to Parliament by the Financial Secretary to the Treasury by Command of His Majesty* (London, 1931), 21.
[118] "Regardless of the exchange-rate regime, sterilized intervention may be viewed as an attempt to attain independent exchange-rate and money-stock targets in the short run." Obstfeld, M., 'Can we sterilize? Theory and evidence', *American Economic Review* 72:2 (May 1982), 45-50 (45).
[119] Nurkse, R., *International Currency Experience: Lessons of the Inter-war Period* (Princeton, 1944), 87-88.
[120] *Ibid*, 68.

Another problem with Nurkse's approach is highlighted by Eichengreen: Nurkse did not distinguish between rules observance on- and off- the gold standard. [121] Nurkse actually doubted whether being on or off gold made any difference to the incidence of sterilization:

> "...there is in fact no strong indication that the offsetting of changes in central banks' currency reserves was much less common before 1931 than after." [122]

This paper examines sterilization operations in monthly balance sheet accounts of 31 central banks in the interwar period, and weekly balance sheet accounts for a more limited number of countries. It estimates the odds of 'Rules' compliance (i.e. non-sterilization) conditional upon several factors, including gold convertibility.

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[121] Eichengreen, B., 'International monetary instability between the wars: Structural flaws or misguided policies?' NBER *Working Paper* 3124 (January 1991), 15.
[122] Nurkse, *International Currency Experience*, 88.

2. Rules of the Game

"Rules of the game" in respect of international monetary systems have had numerous interpretations. Keynes provides the predominate interwar interpretation. In *A Treatise on Money*, he refers to the United States and France in the interwar period

> "breaking the rules of the 'Gold Standard game' .... attracting large quantities of gold to their vaults without allowing this influx materially to modify their [credit] policy."[123]

This view was elaborated in the 1931 report of the Macmillan Committee, on which Keynes sat. The Macmillan report devotes considerable space to sterilization operations, namely in France and the United States in the final years of the 1920s, as these countries prevented gold inflows from expanding the base money supply. It portrays this as a perversion of the gold-standard ethos or 'rules' followed before World War I:

> The nineteenth century philosophy of the gold standard was based on the assumptions that (a) an increase or decrease of gold in the vaults of Central Banks would imply respectively a 'cheap' or a 'dear' money policy, and (b) that a 'cheap' or a 'dear' money policy would affect the entire price structure and the level of money-incomes in the country concerned. But, in the post-war world, neither of these assumptions is invariably valid.[124]

The report comments that gold in and of itself does not render an international gold standard sustainable. Instead, a particular policy ethos is required:

> In other words, there are "rules of the game" which, if not observed, will make the standard work with undesirable, rather than beneficial, consequences.[125]

The 'rules' of the nineteenth century are not spelled out -- but the assumptions are:

> Formerly, it was assumed that the efflux of gold itself produced a new equilibrium by altering the level of prices in the lending and receiving countries respectively and thus modifying, through an alteration in exports and imports and through the short money market, the debtor position of the first and the creditor position of the second. Gold standard countries were indeed supposed to meet each other half way, each altering its conditions sufficiently to produce the desired equilibrium.[126]

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[123] Keynes, J., *A Treatise on Money*, Vol. II (London, 1930), 306. He writes also that "…it may be too much to expect that these countries will voluntarily sacrifice what they believe to be their own interests."
[124] Committee on Finance and Industry, 21.
[125] *Ibid*, 23.
[126] *Ibid*, 83.

Nurkse adopted this definition in his official report on the interwar period, in which he cites the Macmillan Committee.[127] Commenting on the gold bullion standard before the First World War, in which bank deposits and paper currency replace gold coins as the predominate means of payment, Nurkse claimed that much more was expected of central banks than "the passive function of [convertibility]":

> Whenever gold flowed in, the central bank was expected to increase the national currency supply not only through the purchase of that gold but also through the acquisition of additional domestic assets; and, similarly, when gold flowed out, the central bank was supposed to contract its domestic assets also.[128]
>
> The chief methods to be used for changing the volume of domestic central-bank assets in accordance with [gold movements] were changes in the discount rate… and purchases or sales of securities in the open market on the central bank's own initiative.
>
> Such, in essence, were the "rules of the game" by which a central bank was to be guided in its domestic policy.[129]

Nurkse's "sign test" was a simple examination of whether domestic and foreign assets moved in the same direction on any given year, signifying conformity with the rules. Opposite movement meant that offsetting operations had taken place: either the monetary authority had expanded domestic assets in the face of a reserve loss or contracted domestic assets in the face of a reserve accumulation. Nurkse found that his sample of central banks routinely failed the sign test throughout the interwar period. [130]

So too did central banks in the Classical gold standard (1872-1914), according to Arthur Bloomfield's 1959 application of Nurkse's test to pre-194 central banks.[131] Bloomfield's conclusion was anticipated by some of Nurkse's interwar contemporaries – including the MacMillan Committee itself:

> …it may be asked whether the aim of Central Bank policy should not be to return to the more automatic working of the gold standard of pre-war days, when, as it is supposed, the Central Bank's discount rate was raised more or less as a matter of course when gold went out and lowered when gold came in. In fact, however, the

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[127] Nurkse, *International Currency Experience*, 67.
[128] *Ibid*, 66.
[129] *Ibid*, 67.
[130] *Ibid*, 69; 87-88.
[131] Bloomfield, A., *Monetary Policy Under the International Gold Standard: 1880-1914* (New York, 1959).

> automatic operation of the gold standard even then was more or less limited to the sphere of the Bank of England.[132]

This judgement stands to the present day:

> The ample disregard of central banks for the 'rules of the game' has come to be accepted as a fact of life of the classical gold standard.[133]

The modern literature, as represtend by Eichengreen in *Golden Fetters*, instead emphasises the inherent asymmetry of rules behaviour. The point is not that central banks ignored the rules, but that they observed them in one direction. Creditor countries needn't expand domestic assets upon receipt of gold, but debtor countries must contract upon loss of gold. These are the *de facto* rules which gave the overall system a deflationary bias. For Eichengreen and the modern literature, the end of gold convertibility freed central banks and the world monetary system from this asymmetry.

> Once they had shed their golden fetters, policymakers had several new policy options available. They could expand the money supply. They could provide liquidity to the banking system at the first sign of distress. They could increase the level of government expenditure. They could take these actions unilaterally, without any need for assistance from foreign countries to neutralize the impact on the exchange rate.[134]

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[132] Committee on Commerce and Industry, 125.
[133] Reis, J., 'An 'art', not a 'science'? Central bank management in Portugal under the gold standard, 1863–1871', *Economic History Review* 60:4 (November 2007), 712-741 (713).
[134] Eichengreen, B., *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939* (Oxford, 1992), 393.

3. Two interwar shocks

A useful dataset to demonstrate the Golden Fetters hypothesis would include both the 1929-31 and 1937-38 US recessions. The first occurred during the period of nearly universal note convertibility into gold, and the second in a period when this convertibility had been universally relaxed, either through outright suspension, large devaluation or the imposition of binding exchange controls. The earlier shock is well known. Less emphasised -- at least until lately -- is the 1937-38 US recession.

The US business cycle turned down sharply in 1937 and hit a trough in the third quarter of 1938.[135]

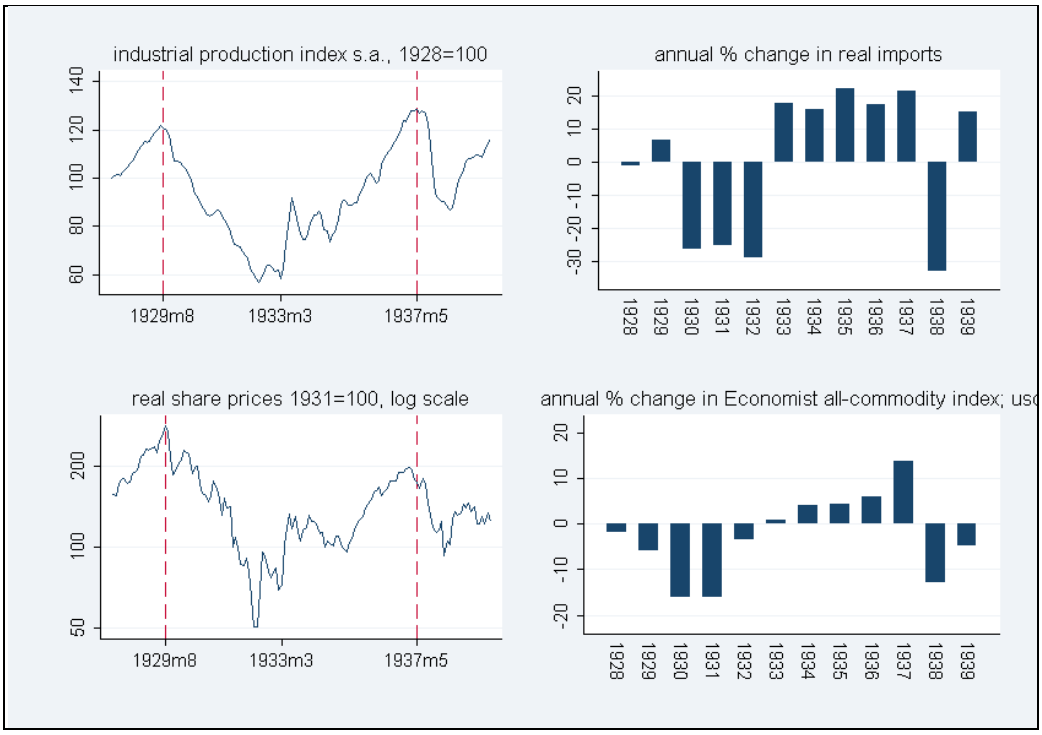

Figure 1: US economy in two cycles

Notes and sources: The dashed lines correspond to the start of US downturns, as reported by the NBER.
Industrial production is from the US Federal Reserve.
Share prices are from Global Financial Data, deflated by US CPI sourced from US Bureau of Labor Services.
Imports are from League of Nations, *Monthly Bulletin*, converted from local currency into US dollars at current exchange rates and deflated by US CPI.
The Economist commodity price index is from Global Financial Data.

[135] National Bureau of Economic Research, 'US business cycle expansions and contractions'.

Eichengreen blames policy mistakes for the 1937-38 recession. In addition to monetary tightening, the government oversaw a tightening in the fiscal stance, with the federal budget contracting by 2.3 percentage points of GNP in 1937 due largely to a new trust fund tax and the expiry of WWI veterans' bonus payments.[136] Whatever the cause, the implications for the international economy were no less striking in 1937-38 than in 1929-30. US real imports fell 50% in both shocks (measured peak-to-trough in each 24-month interval).[137] Real global commodity prices dropped 20% peak-to-trough in the 24 months containing 1937-38 compared to 10% (peak-to-trough) in the 24 months of 1929-30.[138]

Table 1: Two interwar shocks; GDP in top ten economies, 1990 USD billion

	1929	% change, 1929-1930	% change 1937-1938	1939	% change 1929-1939
USA	843	-9	-4	863	2
China	274	1	-2	n/a	
Germany	262	-1	8	375	43
UK	251	-1	1	301	20
India	242	1	0	257	6
Russia	238	6	2	430	81
France	194	-3	0	201	3
Japan	128	-7	7	204	59
Italy	125	-5	1	154	23
Indonesia	70	1	2	81	15
world ex-USA		-1	1		

Source: Maddison 2009

Despite its severity, the 1937-38 US recession did not produce a worldwide recession. Real GDP fell 4% in the USA in 1938 but expanded in the world as a whole.[139] Real money supply growth remained positive, albeit decelerating from 5.9% in 1936 to 1.9% in 1937.[140] How was the international economy spared a catastrophe? According to Eichengreen, a world without gold convertibility afforded policymakers a new flexibility:

> The explanation for the contrast [between 1937-38 and 1929-30] is straightforward. Liberated from the gold standard, other countries were not forced to match deflationary policies in the United States with their own deflationary initiatives. There was little tightening of monetary conditions outside the United States. The

[136] Eichengreen, *Golden Fetters*, 386.
[137] US imports sourced from League of Nations, *Monthly Bulletin of Statistics* (various issues), deflated by US CPI (source: US Bureau of Labor).
[138] Economist Global Commodity Price Dollar Index (source: Global Financial Data), deflated by US CPI (source: US Bureau of Labor).
[139] Maddison, 'Historical Statistics'.
[140] Rates of M1 growth, compiled from League of Nations (1939), tables 106 and 111.

> rate of growth of North American money supplies fell to zero in 1936-37, but in Europe money supplies continued to grow at nearly a 7 percent annual rate, down only slightly from 1935-36 levels.[141]

Eichengreen further cites rapid money supply growth in Latin America and the Far East, and a sharp divergence in industrial production between North America and Europe in 1937-38, in contrast to the industrial downturns experienced simultaneously during the 1929-32 cycle.[142]

Whatever else the source of international resilience to the 1937-38 US recession, the ability of central banks to maintain the money supply in the face of a downturn in such a large economy as the United States, and with such a sharp fall in global commodity prices, must indicate a rejection of the 'rules', particularly those of the asymmetric variety emphasised in *Golden Fetters*.

Whereas Nurkse thought that Rules observance was no different after suspension of convertibility, the modern literature sees the burden of convertibility as having a direct impact on money supply growth. In *Golden Fetters*, Eichengreen reports unweighted averages of money supply growth for 1930s central banks, grouped by the severity of their gold convertibility regime.[143] Those with the greatest burden of convertibility are countries which neither suspended convertibility, nor adopted exchange controls, nor depreciated the gold link. These were the Gold Bloc countries, including large economies such as France, Belgium, the Netherlands and Switzerland. Their post-1931 money growth figures are negative. Exchange-control countries and countries which suspended convertibility or depreciated their currency against gold exhibited positive money supply growth in the 1930s.

Yet these figures need not necessarily imply much about sterilization or Rules observance per se. First, Eichengreen reports growth rates of M1, which includes money created by commercial banks. Second, even if there was no change in the money multiplier, it could be that all groups followed the Rules, but the depreciators attracted reserves (and thereby expanded base money) and the Gold Bloc lost them (thereby contracting base money).

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[141] Eichengreen, *Golden Fetters*, 387.
[142] Eichengreen, *Golden Fetters*, 388.
[143] *Ibid*, 293, Table 10.1: Percentage change in M1 between ends of successive years.

4. Formal tests

The essence of 'Rules' is non-sterilization. Two formulations are possible: symmetric "Nurksean" rules and asymmetric "Golden Fetters" rules..

Definition 1: Nurksean rule

$$\Delta NDA * \Delta NFA > 0 \text{ subject to } |\Delta NFA| > 0$$

Domestic assets must change in the same direction as do foreign assets. The strict inequality in this definition captures the magnified endogeneity that Nurkse seems to require.. Central banks must actively exacerbate the base-money impact of a change in international assets.

Definition 2: Golden Fetters rule

$$\Delta NDA \leq 0 \text{ subject to } |\Delta NFA| > 0$$

The central bank does not sterilize a reserve loss but sterilizes (or fails to accentuate) a gain.[144]

For each definition of the Rules, this paper codes an indicator variable for instances of balance sheet changes which satisfy that rule. Summary statistics for these indicators provide the probability of adherence to the two rule types. To understand what factors conditioned their observance, the rule indicator variable is regressed on independent variables as set forth below.

1. Gold convertibility

Was Rules observance influenced by the gold standard (gold convertibility at the central bank, whether in bullion or in gold-convertible foreign exchange)?

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[144] For the system to be asymmetric, the central bank gaining foreign assets need not actually *contract* domestic assets -- it need only fail to expand them to the extent that would be allowable under the cover statutes. If the Bank of France, for example, could legally support three units of additional domestic money for each one unit of acquired reserves, its reluctance to do so would undermine worldwide liquidity, since, globally, reserve losses tended to contract a multiple of base money, but reserve gains expanded base money only proportionately or not at all. See Bernanke, B., 'The world on a cross of gold: A review of Golden Fetters: The gold standard and the great depression, 1919-1939', *Journal of Monetary Economics* 31 (1993), 251-267.

2. FX convertibility

Interwar periods off gold convertibility can be divided into 'open FX convertibility' regimes and 'restricted FX convertibility' regimes. Did this make a difference for Rules observance?

3. Pre-gold or post-gold

Was interwar gold-inconvertibility different in the period before the gold standard versus the priod after the gold standard -- i.e. in the early 1920s versus the 1930s?

Elements (1) through (3) suggest five essential types of interwar regime (Figure 2). These are the combinations of open and restricted foreign exchange, and the three chronological stages in interwar regime with respect to gold: "before" gold convertibility, "during" gold convertibility and "after" gold convertibility. In the estimations, regime type enters as an independent variable, with the gold standard (Group B in Figure 2) the excluded reference category.

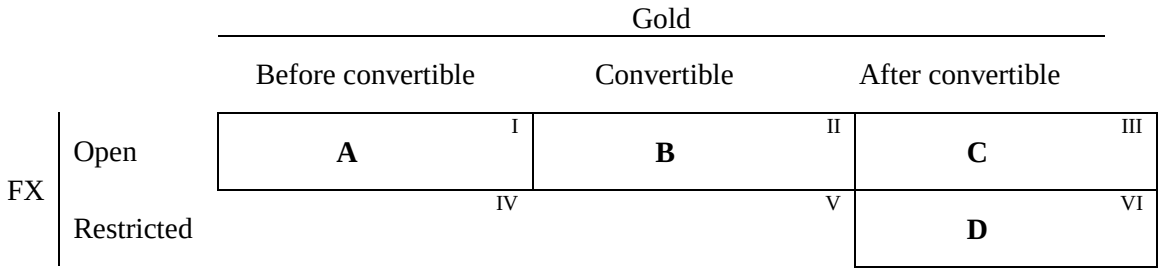

Figure 2: Interwar monetary regime taxonomy

Note: Each letter denotes a taxonomical category of interwar monetary regime. Cell number IV describes only 7% of pre-gold observations and is not included. Cell V is empty by definition.

4. Cover ratio

Statutory limitations on a bank's liabilities were a universal feature of interwar central banks. The purpose was to constrain the central bank in a similar way as the 'Rules' were intended. A fuller treatment of this topic is beyond the scope of this paper, but it suffices to say here that these provisions, generally known as 'cover limit' statutes, sought to tie down a central bank's base money to its holdings of international assets. These were relaxed with the suspension of gold convertibility but were not eliminated except in

Germany, Greece and Italy.[145] At progressively higher ratios of international assets to domestic liabilities, central banks operated with larger excesses above minimum statutory cover ratios, and thus might have felt increasingly free of Rules constraints.

To summarize: in the estimations that follow, the dependent variable is a particular rules formulation, where y=1 is rules compliance and y=0 is defiance. The righthand-side variables are the four relevant regime types, the cover ratio, and interactions between them. (See Appendix 1.)

[145] Nurkse, *International Currency Experience*, 12.

5. Data

The panel contains 31 countries covering a maximum of 1923-1939 in monthly frequency (Figure 3). Observations for 1939 are January-August inclusive to exclude the outbreak of WW2. Foreign exchange, gold and sight liabilities of the monetary authority are from three sources. First is the US Federal Reserve, *Bulletin* (Washington DC, various issues), published monthly. Second is League of Nations, *Monthly Bulletin of Statistics* (Geneva, various issues). Third is *The Economist* (London, various issues). All were transcribed by the author and checked for errors. Figures are monthly, in millions of local currency units. Gold is valued at the latest legal parity and foreign exchange reserves are valued at market exchange rates.[146] Domestic assets are the residual of short-term domestic liabilities less international assets.

International reserves are those of the central bank or monetary authority. Several countries launched currency-intervention funds with the proceeds from gold revaluation. The first intervention fund was Britain's Exchange Equalisation Account (EEA), set up in 1932.[147] This was joined by those of the United States (1934), Belgium (1935), and Switzerland, France and Holland (1936). Funds of less importance were set up in Canada and Argentina (1935); Spain, Latvia and Czechoslovakia (1936); Colombia and Japan (1937); and China (1939).[148] The author is aware of assets data only for the British EEA with monthly frequency. Unfortunately, even this source covers only discontinuous parts of the 1932-1939 period.

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[146] The January 1939 issue of the League of Nations *Monthly Bulletin of Statistics* (page 38) contains a notation to "Table 17: Gold and certain Silver and Foreign Assets Reserves". It reads: "Unless otherwise stated, the gold is expressed throughout in terms of the most recent legal parity prevailing in each country. Foreign asset reserves, on the other hand, are believed in most cases to be valued at cost price in terms of national currency."

[147] Incomplete EEA data are reported by Howson for parts of 1932-1939. Howson, S., *Sterling's Managed Float: The Operations of the Exchange Equalisation Account, 1932-39* (Princeton, 1980).

[148] Bloomfield, A., *Capital Imports and the American Balance of Payments 1934-39: A Study in Abnormal International Capital Transfers* (Chicago, 1950), 148.

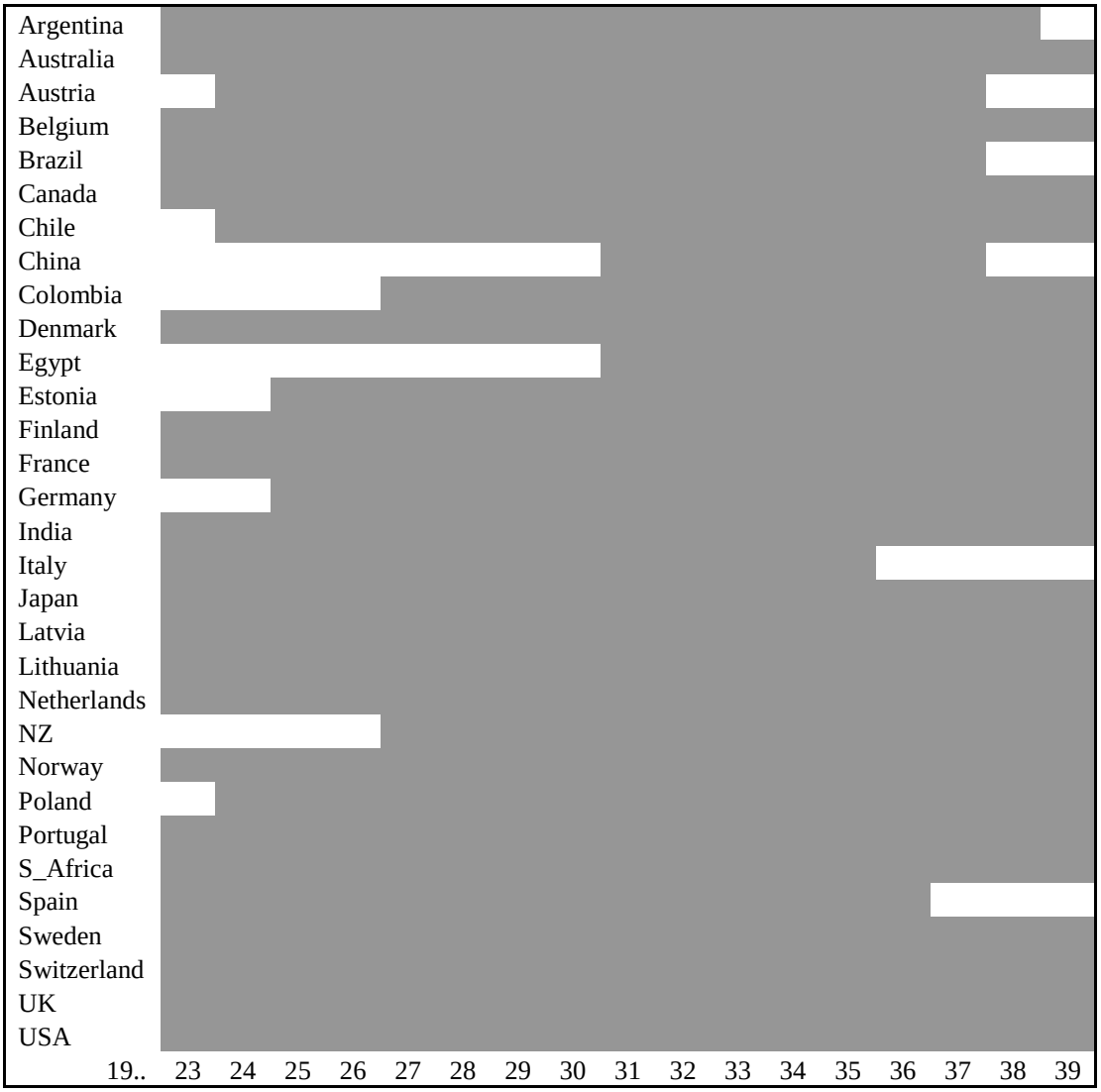

Figure 3: Coverage of monthly balance sheet data

Source: See text.

Hyperinflationary monetary regimes post-WW1 are excluded from the estimations. These are Austria prior to monetary reorganisation in February 1924, Germany prior to December 1924 and Poland prior to May 1924.

Gold convertibility and foreign-exchange convertibility

The interwar dataset is coded for observance of the gold standard. An observation is marked gold-convertible (i.e. on the gold standard) if it accords with Officer 2008.[149] Officer reports annual granularity; for monthly granularity, the gold standard begins with

[149] Officer, L. (2008), 'The Gold Standard', in Whaples, R., ed., The EH.net Encyclopedia [WWW document], URL: http://eh.net/encyclopedia/article/officer.gold.standard [accessed 10 June 2009].

the final observation of 1% or greater change in the exchange rate against the dollar. The monthly granularity for the ending date of the gold standard is taken from League of Nations, *Statistical Year-book 1933/1934* (Geneva, 1934), page 206: "Dates of principal measures affecting exchange rates". For later in the decade, the source is League of Nations, *Statistical Year-book 1939/1940* (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves." This lists devaluations and capital controls separately from "suspension" of the gold standard. In the author's dataset, convertibility is coded zero with the first of any violation of the gold-standard ethos: devaluation, fx control or suspension of convertibility.

Foreign exchange convertibility in the 1930s is coded 0/1 in accordance with League of Nations, *Statistical Year-Book 1939/40* (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, Legal value of currencies and the valuation of gold reserves." Regimes coded 0 are "restrictive" fx regimes, those coded 1 are "open" (Table 2).[150]

"Red books"

Estimations are also run on weekly data from the Bank of England Archive. The Bank of England's Overseas Group in the interwar period compiled weekly accounts of the central bank balance sheets of 18 UK trade partners. These accounting ledgers contain detailed entries for assets and liabilities, to inform the senior staff's surveillance of trading partner economies. In the contemporary parlance, they were "bank returns". Figure 4 is a snapshot of a return for Swedish assets, and Figure 5 reports the interwar coverage of these files. The Bank Archives database describes them as follows:

> These volumes, known as "red books", were used for collecting central bank balance sheet figures, normally weekly. For many years they were one of the major sources used by the Overseas Group in assessing the economic and financial developments in various countries. Only volumes containing some pre-1939 figures have been kept; some such volumes are missing. (Post-war figures for all

[150] "Restrictive" fx regimes could be subdivided into “mild” and “severe” exchange controls. Gordon (1941) identifies the former as characterised by “a general supervision of applications to purchase foreign exchange" (p. 62), citing the UK, Finland, USA, Belgium, Luxembourg and, until 1/1937, Japan and, until 5/1934, Italy (p. 61). “Severe” regulations “required the surrender of foreign balances accruing from exports.” (p. 65). These included Austria, Germany, Hungary, Argentina, Italy, Ecuador, Poland, Portugal, Chile, Bulgaria, Uruguay, and Denmark. By 1937, “outside of Germany, Italy and Japan, a substantial degree of relaxation of exchange control had been achieved.”(p. 87) In the estimations, such sub-division was pursued but made little difference to the results. Gordon, M., *Barriers to World Trade: A Study of Recent Commercial Policy* (New York, 1941).

countries were published in the IMF's "International Financial Statistics". The red books themselves were discontinued at various dates after the war.)[151]

Table 2: Months of interwar regime coding and data available

pre-gold, open fx			gold standard			post-gold, open fx			post-gold, restricted fx		
	months: coding	data		months: coding	data		months: coding	data		months: coding	data
China	201	81	Lithuania	154	154	Australia	116	116	Brazil	100	80
Spain	201	164	Netherlands	142	142	NZ	104	104	Germany	98	98
Japan	85	85	Switzerland	141	141	Egypt	96	96	Austria	97	79
Portugal	79	79	France	126	126	India	96	96	Chile	97	97
Italy	60	60	USA	123	123	Norway	96	96	Colombia	96	96
Norway	57	57	Poland	117	117	Sweden	96	96	Argentina	95	87
France	48	48	Latvia	106	106	UK	96	96	Latvia	95	95
Belgium	46	46	Sweden	105	105	Canada	95	95	Denmark	94	94
Poland	43	26	Belgium	101	101	Portugal	95	95	Estonia	94	94
Denmark	42	42	S_Africa	96	96	Finland	93	93	Japan	86	86
Argentina	39	39	Finland	93	93	S_Africa	81	81	Italy	64	16
Chile	35	23	Austria	91	91	USA	58	58	Lithuania	47	47
Australia	31	31	Canada	87	87	Belgium	53	53	Poland	41	41
Brazil	30	30	Estonia	82	77	Netherlands	36	36	USA	20	20
India	30	30	Germany	81	79	Switzerland	36	36	NZ	9	9
Colombia	25	0	UK	81	81	France	27	27	Finland	2	2
Egypt	25	25	Colombia	80	61	Argentina	22	22	Australia	1	1
Estonia	25	13	Egypt	80	54	Brazil	17	17	Belgium	1	1
NZ	24	8	Italy	77	77	Japan	7	7			
S_Africa	24	24	India	75	75	Denmark	2	2			
Switzerland	24	24	Chile	69	69						
UK	24	24	NZ	64	47						
Netherlands	23	23	Denmark	63	63						
Germany	22	0	Brazil	54	54						
Canada	19	19	Australia	53	53						
Austria	13	13	Norway	48	48						
Finland	13	13	Argentina	45	45						
			Portugal	27	27						
			Japan	23	23						
total	1288	1027	total	2484	2415	total	1322	1322	total	1137	1043
% of total		80	% of total		97	% of total		100	% of total		92

Notes and sources: The data are from the author's monthly dataset; see text for sources. In the first of each pair of data columns are months assigned to an interwar monetary regime, based on the coding algorithm in Part 5, 'Data'. The second numeric column reports the number of months for which the dataset contains a data observation.

There may be some selection bias in the Red Book data. Only an incomplete set remains, and it is possible that the lost volumes are associated in some way with the variables examined in this paper's estimations. Second, the Red Books might only include countries with which the UK had close trade relations and/or over which the Bank of England exercised some influence. If true, this means the sample is biased towards central banks with operational traits characteristic of Sterling Area central banks.

[151] Bank of England Archive, File OV3, "Bank returns by overseas central banks" (26 volumes).

An additional problem with using the Red Book data is the high frequency of the observations (i.e. weekly). There is little basis to expect that monetary authorities would manage their balance sheet at such a short interval.[152]

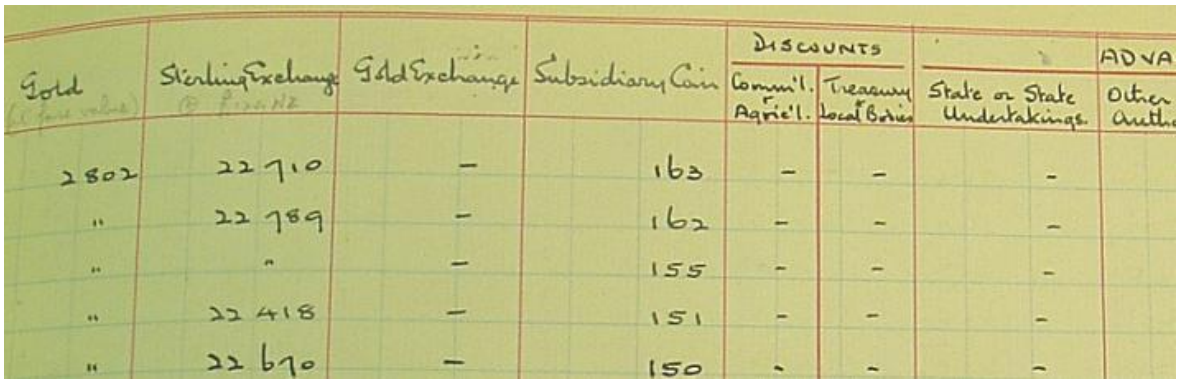

Figure 4: The "red book" for Sweden: a snapshot of assets

Source: Bank of England archive, file OV3/22. Photo by the author.

Table 3 reports summary statistics for domestic assets and international reserves for the monthly and weekly datasets, and for mutually inclusive subsets thereof (Figure 6).

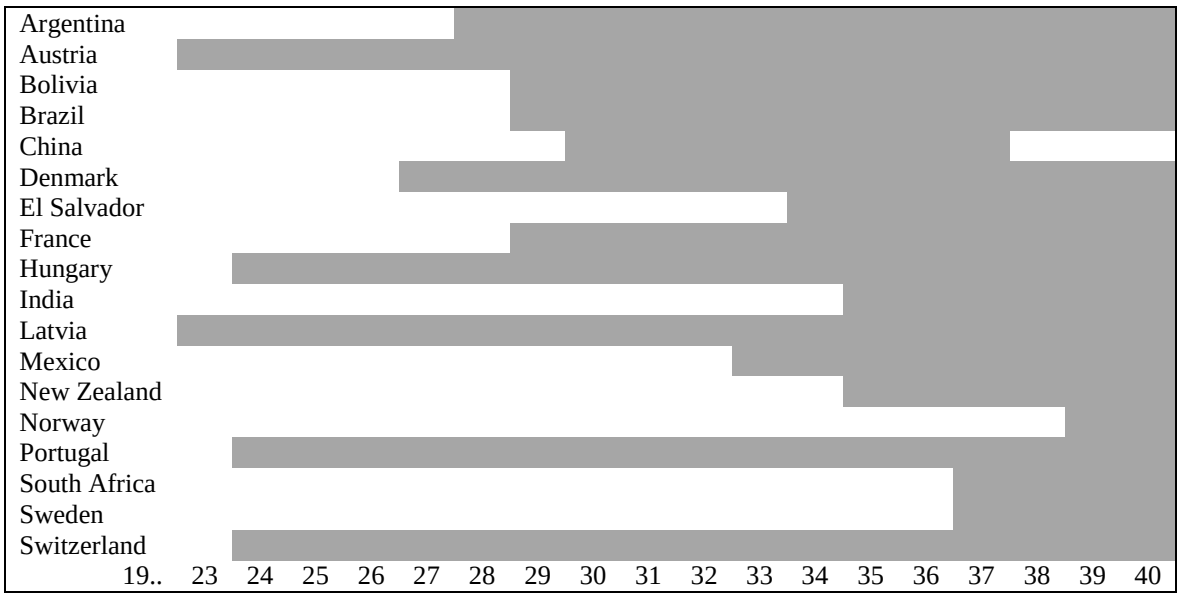

Figure 5: Coverage of 'red books' (weekly)

Source: Bank of England archive, file series "OV3".

[152] Except possibly for a currency board regime. But even in such a case, there is little reason to test for sterilization since a currency board by definition does not sterilize.

Table 3: Summary statistics for monthly and weekly data

	group 1: monthly dataset				group 2: weekly dataset			
	all observations				all observations			
	domestic assets	gold	foreign exchange	gold + fx	domestic assets	gold	foreign exchange	gold + fx
N	5793	5678	4441	5793	6743	6743	6743	6743
min	0	0.047	0.007	3.359	0	0	0	0
max	89274	97266	40614	97484	1036000	205000	349076	425086
kurt	3.08	2.84	3.28	2.81	3.10	5.76	2.84	2.57
skew	0.34	0.50	0.78	0.67	0.51	0.24	0.41	0.21
cv	0.53	0.53	0.82	0.53	0.51	0.57	0.71	0.40
p25	79	34	16	72	115	38	28	162
p50	317	209	59	323	655	383	211	691
p75	1207	634	379	1111	7045	5547	796	5887
	conforming observations				conforming observations			
N	1464	1372	1426	1464	5461	5461	5461	5461
min	0	0.047	1	4.365	0	0	0	6.93
max	89274	97266	40614	97484	89299	97266	33228	97972
kurt	2.40	4.66	2.68	2.79	3.12	6.68	2.72	2.32
skew	0.13	0.91	0.25	0.37	0.28	0.22	0.36	0.27
cv	0.41	0.43	0.58	0.41	0.44	0.55	0.64	0.37
p25	143	24	28	123	108	24	22	138
p50	362	173	116	343	278	173	95	404
p75	1596	906	530	1367	1505	910	560	1517

Notes and sources: Excludes 1920s observations prior to monetary reorganisation. See Figure 7 for explanation of "conforming observations". Kurtosis, skewness and coefficient of variation (cv) are the means of individually computed country statistics; all other data are pooled. See text for data sources.

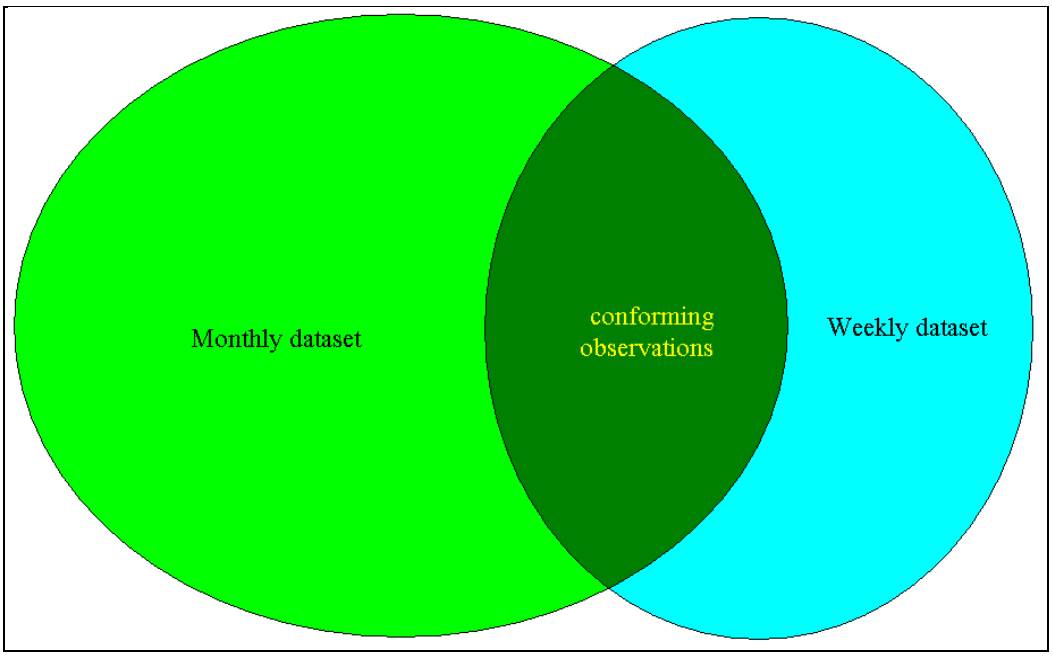

Figure 6: Venn diagram of overlapping observations

6. Results

Table 4 reports the probability of Nurksean rules observance was 41%, 9 percentage points higher than the figure reported by Nurkse.[153] Table 5 reports compliance based on weekly data; Nurksean rules are observed in 43% of observations. Eichengreen notes a problem with these figures: they should be limited to observations on the gold standard.[154] Table 4 and Table 5 report rules adherence for gold-standard observations separately: 39% in the monthly data; 45% in the weekly data. 'Golden fetters' rules were followed more closely, in 51% of monthly observations and 48% of weekly observations.

Table 4: Probability of Rules observance by regime type (%), monthly data

					post-gold	
Rule		Total	pre-gold	gold	open-fx	closed-fx
Nurksean	mean	41	43	39	39	37
	sd	8	16	17	20	18
	min	19	13	0	0	0
	max	62	73	96	85	53
	n (countries)	31	24	29	20	18
Golden Fetters (a)	mean	51	51	54	50	36
	sd	8	16	11	21	18
	min	25	18	41	0	0
	max	72	83	92	89	57
	n (countries)	31	24	29	20	18
Golden Fetters (b)	mean	44	33	49	45	29
	sd	8	16	9	18	16
	min	24	9	27	0	0
	max	61	61	71	70	49
	n (countries)	31	24	29	20	18

Notes and sources: See text for sources. The table reports the frequency of rules compliance, which is observations of rules compliance divided by qualifying observations * 100, calculated separately for each country. Qualifying observations are those with a foreign asset change. (a) Like Nurksean, excludes observations where Δdomestic assets=0 or Δforeign assets=0. (b) Golden Fetters=0 when Δforeign assets=0.

[153] Nurkse, *International Currency Experience*, 69. Arthur Bloomfield found 34% compliance with Nurksean rules in pre-WWI central banks. Bloomfield, *Monetary Policy*, 49.
[154] Eichengreen, 'International monetary instability', 15.

Table 5: Probability of rules observance (%), weekly ("Redbook") data

					post-gold	
Rule		Total	pre-gold	gold	open-fx	closed-fx
Nurksean	mean	43	45	45	50	42
	sd	5	12	7	20	6
	min	34	29	35	34	30
	max	52	54	55	100	46
	n	12	4	7	10	6
Golden Fetters (a)	mean	52	60	56	57	55
	sd	9	25	5	19	10
	min	39	35	49	39	42
	max	66	100	61	95	68
	n	12	5	7	10	6
Golden Fetters (b)	mean	48	60	50	54	50
	sd	8	25	7	19	9
	min	31	35	40	31	42
	max	62	100	60	89	62
	n	12	60	50	54	50

Notes and sources: See notes for Table 4.

Table 6 reports conditional maximum likelihood estimation results for the monthly dataset. Three model variants are attempted for each rule, for a total of 6 estimations (cols 3-5).[155] Figures are reported in odds ratios (=exp(beta)), which multiplies the odds impact of the regressor on the regressand. A ratio of 1 suggests no impact on the odds of the dependent variable being true (i.e. compliance with one of the rules types). A ratio above 1 suggests greater odds; a ratio below 1 lesser odds. The models in column (5) feature interacted terms. Because the gold standard is the excluded category, the impact of the cover ratio during the gold standard can be read directly from the result reported for "cover ratio". The odds impact of the cover ratio for a different regime (e.g. post-gold with open foreign-exchange convertibility, group "c") is given by exponentiating the sum of the logit coefficients for "cover ratio" and for the interaction between cover and the relevant regime (the logit coefficients are obtained by taking the log of the odds ratio). The goodness-of-fit measure (Pseudo-R2) is the difference in likelihood achieved by the model as a proportion of the initial likelihood.

Column 1 is the dependent variable: 'Nurksean'=1 if Δ nfa * Δ nda > 0 (else Nurksean=0), 'Golden Fetters rules'=1 if Δnda $\leq$ 0 and $|\Delta$ nfa$|$ > 0. (else Golden Fetters rules=0).[156]

[155] Instances of no change in domestic or foreign assets are coded 0; Nurkse coded these missing.
[156] These codings differ slightly from Nurkse's. Nurkse discards observations where Δdomestic assets=0 or Δforeign assets=0, whereas this paper codes such observations with a zero.

Table 6 reports poor performance in explaining adherence to the Nurksean rules. The best model achieves a 1.3% increase in log likelihood. In this model, reported in column (5), post-gold regimes (whether open- or restricted-fx) have greater than twice the odds of following Nurksean rules. The cover ratio increases the odds of Nurksean compliance for all regimes bar post-gold/closed-fx, where rules compliance falls with higher cover ratios.

Table 6: Nonlinear (logit) conditional fixed-effects estimates (monthly dataset)

(1)	(2)	(3)	(4)	(5)
Left-hand var.	Right-hand vars.	regimes	regimes + cover	regimes X cover
Nurksean rules	pre-gold (group a)	0.723***	0.816*	1.063
	post-gold, open KA (group c)	1.100	1.126	3.128**
	post-gold, restrict. KA (group d)	0.937	1.055	3.686***
	cover		1.032***	1.050***
	a X cover			0.992
	c X cover			0.966**
	d X cover			0.933***
	cover_sq		1.000***	1.000***
	a X cover_sq			1.000
	c X cover_sq			1.000**
	d X cover_sq			1.001***
	Obs	5742	5738	5738
	Countries	31	31	31
	Pseudo-R2	0.0023	0.0093	0.0124
Golden Fetters rules	pre-gold (a)	0.594***	0.734***	0.420***
	post-gold, open (c)	1.124	0.942	1.676
	post-gold, restrict (d)	0.503***	0.758***	0.308***
	cover		1.010**	1.003
	a X cover			1.023**
	c X cover			0.981
	d X cover			1.057***
	cover_sq		1	1.000*
	a X cover_sq			1.000*
	c X cover_sq			1
	d X cover_sq			0.999***
	Obs	5742	5738	5738
	Countries	31	31	31
	Pseudo-R2	0.0117	0.0230	0.0330

Notes: Figures are reported in odds ratios, =exp(beta). The odds ratio multiplies the odds impact of the regressor on the regressand. For example, a ratio of 1 suggests no impact on the odds of the dependent variable being true (i.e. compliance with one of the rules types). See text for rules definitions. Column 2 lists the righthand-side (independent) variables and goodness-of-fit. The latter is the improvement in log-likelihood as a proportion of the initial log-likelihood. Significance at 1% (***), 5% (**) and 10% (*) levels.

For the Golden Fetters rule, the goodness-of-fit measure achieves a 3.3% increase in explanatory power (col 5). Pre-gold regimes are economically and statistically

significantly less likely to be fettered compared to the gold standard. Likewise post-gold regimes with restricted capital accounts.

Open-capital account regimes after the gold standard are statistically no differently fettered than gold standard regimes. Indeed, the sign on the logit coefficient for post-gold/open-fx suggests greater fettering than the gold standard, though not with statistical significance.

The cover ratio had an impact only during the pre-gold and post-gold/closed-fx regimes: it increased the odds of fettered behaviour. To test whether this effect was asymmetric, Table 7 reports models estimated individually for each regime (A,B,C,D) where the cover ratio is interacted with an indicator variable for reserve loss (the variable codes 1 if reserves were lost, else zero).

As in Table 6, Table 7 reports that in pre-gold regimes (Group A) and post-gold, closed-fx regimes (Group D), increasing cover ratios are associated with a statistically significant increase in the odds of Golden Fettering. For the gold standard (Group B), an increase in the cover ratio reduces the odds of fettering if the reserve change is a loss. The same is true for post-gold, open-fx regimes.

Table 7: Nonlinear (logit) fixed-effects estimates; Reserve-loss interaction term

	pre-gold (A)	gold standard (B)	post-gold, open-fx (C)	post-gold, closed-fx (D)
cover	1.038**	1.021*	0.985	1.095***
NFA loss X cover	0.992	0.974***	0.961***	1.021
cover_sq	1	1	1.000*	0.999***
NFA loss X cover_sq	1	1.000***	1.000***	0.999
Observations	983	2392	1311	1039
Number of countries	23	29	18	15
R-squared	0.3058	0.0300	0.0414	0.0182

Notes: See notes for Table 6. Significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 8 reports estimated coefficients (in odds ratios) for the models applied to the weekly dataset. The Nurksean-rule models achieve a better fit on the weekly data, with a maximum 2.4% increase in explanatory power. For both rules, the models highlight the importance of interacting the cover ratio with the monetary regime. When this distinction

is made (column 5), the post-gold/open-fx group does not differ from the gold standard group in its adherence either to Nurksean rules or to Golden fettering.

Table 8: Nonlinear (logit) conditional fixed-effects estimates (weekly dataset)

(1)	(2)	(3)	(4)	(5)
Left-hand var.	Right-hand vars.	regimes	regimes + cover	regimes X cover
Nurksean rules	pre-gold (group a)	1.055	2.119***	4.354***
	post-gold, open KA (group c)	0.604***	0.633***	0.318
	post-gold, restrict. KA (group d)	0.802***	0.843**	0.258**
	cover		1.062***	1.054***
	a X cover			0.965
	c X cover			1.039
	d X cover			1.061*
	cover_sq		0.999***	1.000***
	a X cover_sq			1.000
	c X cover_sq			1.000
	d X cover_sq			0.999*
	Obs	5982	5982	5982
	Countries	12	12	12
	Pseudo-R2	.0036	.0199	.0238
Golden Fetters rules	pre-gold (a)	1.121	2.060***	3.038***
	post-gold, open (c)	1.643***	1.403***	2.588
	post-gold, restrict (d)	1.050	1.491***	0.164***
	cover		1.008	1.004
	a X cover			0.957
	c X cover			0.975
	d X cover			1.099***
	cover_sq		1.000**	1.000
	a X cover_sq			1.001
	c X cover_sq			1.000
	d X cover_sq			0.999***
	Obs	5982	5982	5982
	Countries	12	12	12
	Pseudo-R2	.0024	.0166	.0199

Notes: See notes for Table 6. Significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 9 is analogous to Table 7: it reports the models estimated individually for each regime type, using an interaction term for "NFA loss" (=1 if reserve depeletion; else zero), on the weekly dataset. The best fit is achieved by the model estimated on the gold standard (pseudo R2=0.0307). Here, higher cover ratios raise the odds of fettering given a reserve gain, and even more so given a reserve loss.

Table 9: Nonlinear (logit) fixed-effects estimates; Reserve-loss interaction (weekly dataset)

	pre-gold (A)	gold standard (B)	post-gold, open-fx (C)	post-gold, closed-fx (D)
cover	1.012	1.029***	1.04	1.150***
NFA loss X cover	0.993	1.018***	0.992	0.99
cover_sq	1.001	1	1	0.999***
NFA loss X cover_sq	1	1.000***	1	1
Observations	481	2,511	1,146	1,856
Number of countries	4	7	10	6
R-squared	0.0100	0.0307	0.0108	0.0140

7. Interpretation

Contemporary reviewers of *International Currency Experience* were unsurprised by Nurkse's failure to find rules compliance among interwar central banks.[157] The results here vindicate that judgement. They suggest that Nurkse would have done better to conceive of 'Rules' as 'best practice' in central banking, which is essentially what the Golden Fetters rule conveys. In the wake of postwar hyperinflations, best practice for interwar banks meant securing the money stock with international assets. Central banks losing these had every incentive to contract domestic liabilities; banks gaining international assets had no particular incentive commensurately to expand domestic liabilities. This ethos produced the self-imposed fettering so much in evidence when many countries' international payments balances turned adverse in the Great Depression. The 1980s literature clearly recognised these asymmetric rules.

The results reported in this paper take the matter forward one step: central banks did not enjoy an unfettering after suspension of the gold standard except by closing the capital account.[158]

How do these results fit with the resilience of the world economy to the 1937-38 US recession? One way to quantify that resilience is the impact on real imports. If countries in 1937-38 did not "fight fire with fire" (to paraphrase Eichengreen's description of policy responses to the 1929 US downturn), then imports should have held up better in 1937-38 than in 1929-1930. Figure 7 suggests just this. It reports the probability of a year-on-year decline in real imports of US trade partners for a 24-month period in each downturn centred on the peak of US industrial production. Only Switzerland and Chile had a higher incidence of falling real imports in the 1936-38 cycle compared to 1928-30.

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[157] Hawtrey, R., 'Reviewed Works: International Currency Experience', *Review of Economics and Statistics* 28:1 (February 1946), 41-42.

[158] Berg and Jonung argue that the Swedish authorities adopted a price-level targeting regime in the 1930s, after suspension of gold convertibility. This assertion is questioned by Straumann and Woitek, who attempt to show that the Swedish authorities adhered to a very firmly fixed exchange-rate peg to sterling in these years, and subordinated monetary policy to the goal of maintaining this peg. Berg, C. and Jonung, L., 'Pioneering price level targeting: The Swedish experience 1931-1937', *Journal of Monetary Economics* 43 (1999), 525-551. Straumann, T. and Woitek, U., 'A pioneer of a new monetary policy? Sweden's price-level targeting of the 1930s revisited', University of Zurich *working paper* 386 (August 2008).

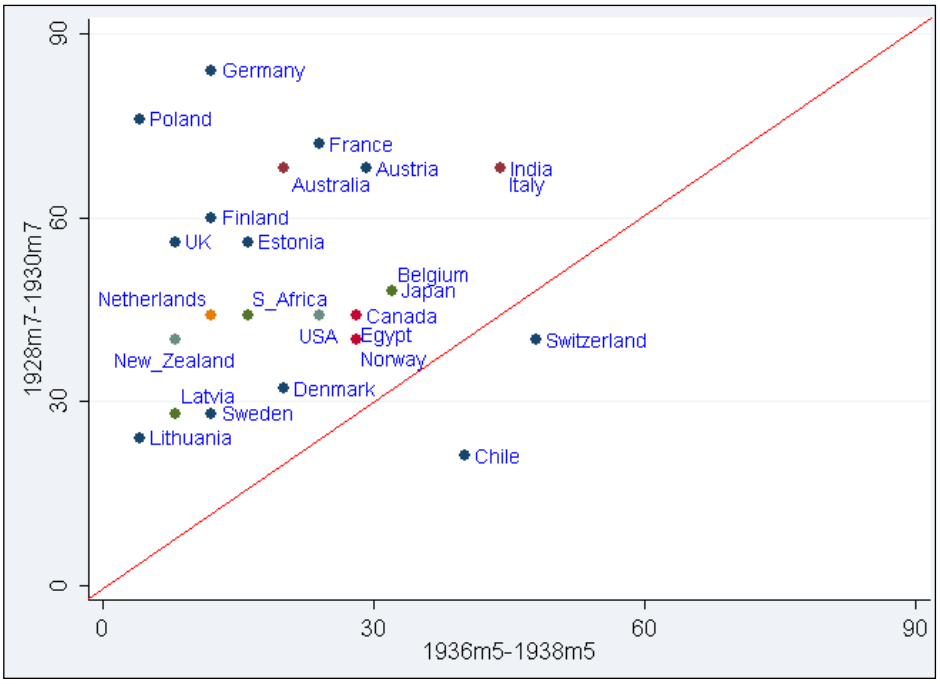

Figure 7: Probability of annual decline in real imports in two recessions

Source: Imports are from League of Nations, *Statistical Year-book* (various years) in local currency terms, deflated by national consumer price indices from Global Financial Data.
Note: Annual decline in imports in a 24-month period centred on peak US industrial production (s.a.), as % of all observations (usually 24). Example: 90% of monthly observations of imports for Germany in the first recession were declines, whereas fewer than 15% of in the second recession were declines.

For 40% of central banks, resilience to the 1937-38 shock is from restricted capital accounts. This segmented the domestic and foreign capital markets to insulate the former. For the rest, relief came from high reserves relative to liabilities. As reported in Table 7, an increase in the cover ratio for open-FX regimes is associated with a significant decrease in the odds of Fettering. This does not constitute an increase in flexibility vis-à-vis the gold standard, because the same effect is estimated during gold convertibility (the two coefficients are not strictly comparable since produced by separate estimations).

The difference is that reserves levels for open-FX countries were high in 1937 vis-à-vis 1929 (Figure 8 and Table 10 and Table 11). Postwar observers noted that stronger reserves in 1937 allowed countries to sustain real overvaluations until the US recovered*:*

> Thanks to the rise in the production and value of gold, many countries had large enough gold reserves to draw upon to fill the gap in their balance of payments…. The comparative mildness of the 1937/38 depression outside the United States may

> also be attributed in part to the fact that the recession in the United States, though extremely severe, was quickly arrested.[159]

The US Government's 1943 report on the interwar period acknowledged the contrast between a resilient global economy in 1937-38 and a universally depressed one in 1929-31.[160] That study cites policy flexibility, anticipating the Golden Fetters hypothesis:

> The major reason … that the recession produced only mild effects on other countries appears to be that they resorted little or not at all to deflation as a means of adjustment to the pressure on their balances of payments. On the contrary, the tendency was definitely in the opposite direction.[161]

It then queries the *source* of this flexibility:

> [T]he ability to follow policies of expansion in face of the contraction in the United States, whether specifically for anticyclical reasons or in preparation for war, was the result of [the fact that] the enhanced position of their reserves, reflecting the expansion in production and value of gold and their generally stronger balance-of-payments position in the middle thirties, enabled many countries to endure a prolonged drain before taking measures to counteract the loss…. [162]

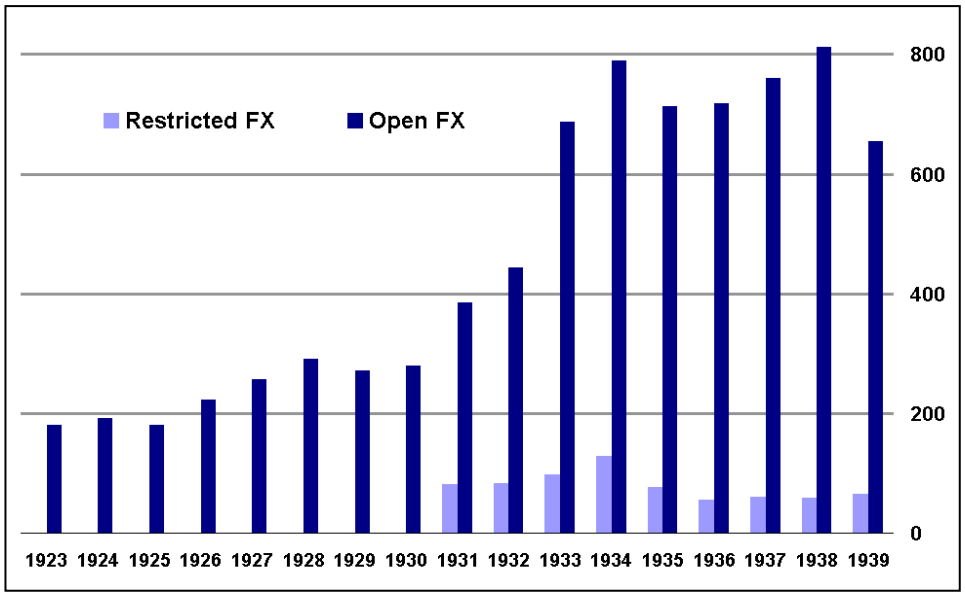

Figure 8: Mean reserves in millions of 1928 US dollars

Notes and sources: See text for sources. The y-axis is reserves of gold and foreign exchange in 1928 US dollar millions. Bars are mean value at end-year for panel countries, excluding USA; 1939 is August.

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[159] Nurkse, *International Currency Experience*, 109.
[160] Lary, H., *The United States in the World Economy: The International Transactions of the United States During the Interim Period* (Washington DC, 1943), vii.
[161] *Ibid*, 198.
[162] *Ibid*, 199.

Figure 9 reports the maximum monthly proportionate decline in international reserves in the 24-month period following each US business cycle peak, in nominal terms. For most countries, the decline in the second shock is only slightly less severe than in the first shock.

Table 10: International liquidity, current USD millions, 1923-1930 (excl USA)

	1923	1924	1925	1926	1927	1928	1929	1930
N	20	19	25	25	26	26	26	26
reserves	4,324	4,525	5,146	6,250	7,354	7,983	7,515	7,644
exports	14,284	17,312	20,014	18,675	20,570	20,713	18,992	14,217
res./exports (%)	30	26	26	33	36	39	40	54

Notes and sources: See text for sources. The table reports number of countries, cross-sectional sum of reserves of gold and foreign exchange at year-end, and cross-sectional sum of 12 times the monthly average exports per country. The sums include only countries for which both exports and reserves data are available.

Table 11: International liquidity, current USD millions, 1931-1939 (excl USA)

	1931	1932	1933	1934	1935	1936	1937	1938	1939
open-FX countries									
N	18	17	17	16	17	16	15	14	13
reserves	6,475	6,364	9,953	10,395	9,665	9,291	9,483	9,196	6,785
exports	6,958	5,395	8,409	8,334	8,963	9,991	9,950	8,649	7,543
res./exports (%)	93	118	118	125	108	93	95	106	90
restricted-FX countries									
N	9	10	10	13	11	11	11	10	8
reserves	673	675	807	1,297	725	534	602	510	443
exports	3,001	2,520	3,854	4,673	4,321	5,383	5,566	4,803	2,172
res./exports (%)	22	27	21	28	17	10	11	11	20

Notes and sources: See Table 10.

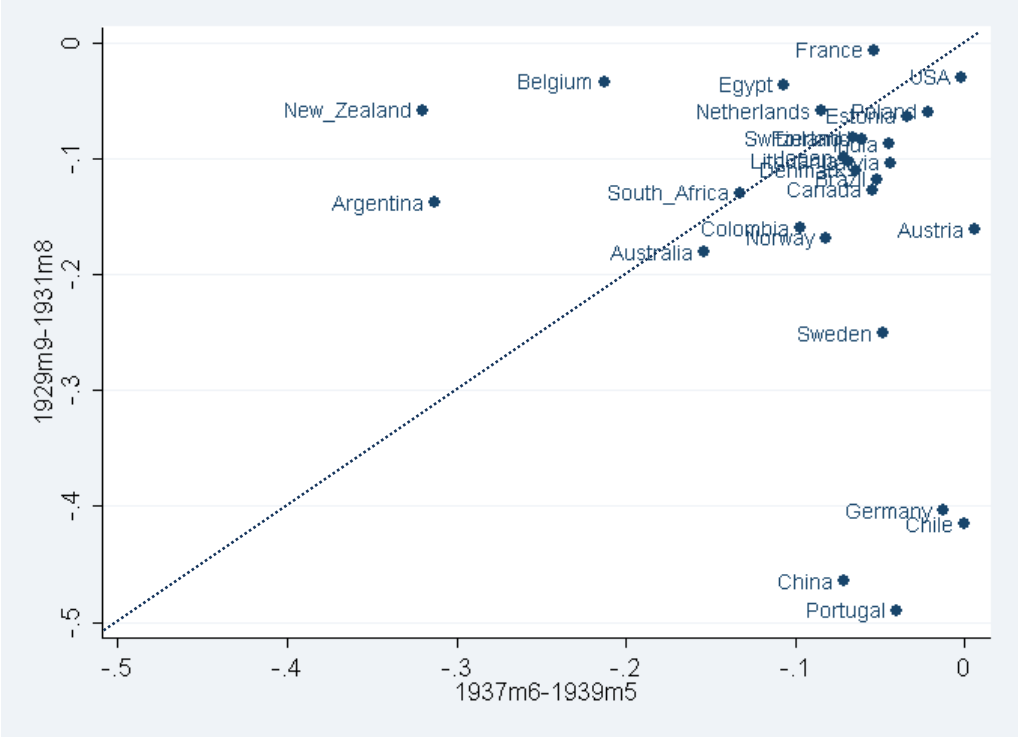

Figure 9: Largest monthly drop in international reserves over two cycles (log-difference)

Notes and sources: The data report the greatest monthly drop in international reserves over a 24-month period beginning with the US business cycle peak. The figures are log-changes and approximate the proportionate change in reserves. The percentage change is 100x the proportionate change. For Brazil, the figure reports the mean monthly change over a given period. See text for sources.

Limitations

The problem with estimations of the kind performed here – well-known in the modern literature on estimating central bank sterilisation reaction functions – is endogeneity.[163] Losses in central bank reserves could *follow* from increases in central bank domestic assets, whereas these estimations treat such increases in domestic assets as examples of a sterilised reserve loss, where the reserve loss is strictly considered exogenous. One remedial strategy, not performed here, would be to instrument reserve changes with an indicator of political events, since the latter are widely considered to have motivated reserve flows in the interwar period.

[163] See Edison, 'The effectiveness of central-bank intervention', *op cit.*

8. Conclusion

Monetary authorities' active management of the balance sheet in favour of systemwide adjustment to global payments imbalances has probably never been a feature of the international monetary system. Such a supra-sovereign bias was not in evidence in annual data compiled by Nurkse for interwar banks nor in pre-WW1 data compiled by Bloomfield. Neither is it apparent in monthly or weekly data reported here. In all these studies, adherence to a Nurksean-style rule, in which the monetary authority symmetrically accentuates a reserve loss or gain with a parallel domestic asset transaction, is apparent in less than half of all qualifying observations (i.e. those in which there is a change in foreign assets). The difficulty of nonlinear models to improve (conditional) maximum likelihood estimates of Nurksean rules compliance subject to various regime types and reserves/liabilities ratios lends weight to a suspicion that instances of Nurksean rules compliance were coincidental rather than intentional.

'Rules' are more appropriately conceived in terms of best practice. As the 1980s literature made clear, 'best practice' during the gold standard precluded pareto efficiency for the system as a whole, due to asymmetry of response to reserve gains and losses. Contrary to the 1980s literature, the results here reveal no watershed in policy rules in the 1930s. The prevailing best practice continued to emphasise the backing of domestic money with international reserves, and sterilization operations reflected this priority. Central banks which defied this convention were in the minority. Indeed, they were even rarer than suggested by the closed-fx coding of the League of Nations. Higher cover ratios among such regimes were associated with higher odds of fettered behaviour. In other words, the poorest central banks in terms of international reserves were the most likely to be free from Golden Fetters.

Appendix 1: Nonlinear probability

Estimating rules observance entails estimating the probability that the rules are observed conditional on the regressors. In a linear model, the predicted probabilities will not fall strictly between zero and one. To overcome this, probability can be expressed as an odds ratio: how often is the dependent variable true (y=1) compared to false (y=0)?

$$\Omega(\mathbf{x}) = \frac{\Pr(y = 1|\mathbf{x})}{\Pr(y = 0|\mathbf{x})} = \frac{\Pr(y = 1|\mathbf{x})}{1 - \Pr(y = 1|\mathbf{x})} \quad (1)$$

The log of these odds, i.e. ln $\Omega(\mathbf{x})$, is the logit, and can take values from negative to positive infinity. Thus, when regressed on the **x** vector, the model is linear in the logit:

$$\ln \Omega(\mathbf{x}) = \mathbf{x}\beta \quad (2)$$

Interpretation is less straightforward. Consider a logit model with two independent variables:

$$\ln \Omega(\mathbf{x}) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \quad (3)$$

For a unit change in x_k, the model estimates a change of β_k in the log of the odds (the logit). It is unclear what a change of β_k logits actually means. However, by taking the exponential of both sides of the equation, the model is returned – at that estimate – to an odds ratio. For a unit change in x_k, the odds of y being true (y=1) change by a factor of exp(β_k), holding all other variables constant. The exponential of the coefficient is the multiplicative effect on y of a change in x. For example, if the estimated coefficient is -0.05, the magnitude of the effect on the odds of y being true is exp(-0.05)=.9513. The odds have fallen by a factor of .95 or 5 percent.

Conditional logit "fixed effects"

The dataset contains 31 countries and a maximum of 201 observations per country. In order to control for unobserved heterogeneity (time-invariant characteristics unique to each country), time-invariant attributes are conditioned out of the estimation. Variation within members themselves is used to estimate the impact of the independent variables on the odds of rules observance. Nearly all of the panel members exhibit such variation: they practiced gold convertibility at some point in the data sample, and many restricted foreign-

exchange convertibility at some point. These provide the "within" variation needed for the estimations. The fixed-effects logit model is

$$\Pr(y_{it} = 1|\mathbf{x}_{it}) = F(\alpha_i + \mathbf{x}_{it}\beta) \quad (4)$$

As in (2), **x** is the vector of independent variables. Here, α_i is the country-specific effect, *F* is the cumulative logistic distribution, i denotes the individual members (countries) and t is the observation. The cumulative logistic distribution can be written as

$$F(z) = \frac{\exp(z)}{1 + \exp(z)} \quad (5)$$

To estimate (4) without the country-specific effect, α_i, the conditional fixed-effects logistic model estimates the probability of $y_i=(y_{i1},...,y_{iTi})$ conditional on $\sum_{t=1}^{T_i} y_{it}$.

Asymptotic properties of discrete-choice time series models

A special circumstance of the discrete-choice model used here is the time-series context. Some of the variables used in these estimations are known to be integrated of order 1 or higher. Park and Phillips develop an asymptotic limit theory for maximum-likelihood estimation of binary dependent variable models with nonstationary regressors. Their results suggest that "the limit distribution theory of the [maximum likelihood] estimator is mixed normal and that conventional methods of inference remain valid."[164] However, they also find that the sample proportion of binary choices follows an arc sine law and thus clusters around zero or unity, "just as a random walk spends most of its time on one side of the origin or the other".[165] An empirical implication for this paper is that the choice variable, Rules adherence, will be observed in large groups of no adherence or large groups of high adherence.

[164] Park, J. and Phillips, P., 'Nonstationary binary choice', *Econometrica* 68:5 (2000), 1249-1280 (1265).
[165] *Ibid*.

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Classifying 1930s Exchange-rate Regimes*

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April 2011

ABSTRACT

There is an implicit consensus that 1930s exchange-rate regimes can be characterised as some variant of 'floating'. This paper applies an adaptation of modern methodologies of exchange-rate regime classification to 47 countries in weekly observations between January 1919 and August 1939. On the basis of modern benchmarks, the 1930s world monetary system would not be considered "floating" or even "managed floating".

JEL codes N10, E51, E58

JEL keywords Monetary Policy, Monetary Standard, Economic History

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1. Introduction

Exchange-rate regime choice is the choice of running a fixed or floating currency, or some middle state between.[166] The notion of such a choice is a very modern invention. 'Best practice' for much of modern history was backing the currency with a metal; the choice facing the authorities was which metal or combination of metals to collateralise the currency (or, failing that, which metal-convertible foreign currency to serve as said collateral).[167] Exchange-rate regime choice as we know it today presupposes the issuance of un-backed money.[168]

Un-backed money is the norm today. Previously, it was associated with a few noteworthy incidences of seigniorage finance and inflation. The *assignat* of the French Revolution, which began as a money backed by church property, upon becoming un-backed provided modern Europe with its "first classic hyperinflation".[169] Un-backed money was largely limited to wartime necessity. Britain was on an un-backed money standard during the Napoleonic wars. The United States issued un-backed money during its civil war. Yet such cases were considered temporary departures from metal backing, sometimes not even considered to violate the spirit of the gold standard.[170] During World War One, almost all protagonists suspended gold convertibility. Yet there was scarcely any perceived post-war option but returning to gold. Doing so was arduous, but it was achieved on a scale the world had never before seen.[171]

This makes the 1930s a rupture in the history of modern money. With the end of gold convertibility in much of the world circa Britain's 1931 devaluation, there was an outbreak of an international monetary system characterised by the issuance of un-backed money – none of it excused by the contingency of war. Policymakers for the first time experienced exchange-rate regime choice as we know it today.

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[166] For a recent contribution to the literature, see Klein, M. and Shambaugh, J., *Exchange Rate Regimes in the Modern Era* (Cambridge MA, 2010).
[167] On the debates of bimetallism versus the gold standard, see Flandreau, M., *The Glitter of Gold: France, Bimetallism, and the Emergence of the International Gold Standard, 1848-1873* (Oxford, 2004).
[168] i.e. money that is inconvertible into base metal other than on the private market.
[169] Sargent, T. and Velde, F., 'Macroeconomic features of the French Revolution', *Journal of Political Economy* 103:3 (1995), 476.
[170] Bordo, M. and Kydland, F., 'The gold standard as a rule: An essay in exploration', *Explorations in Economic History* 32:4 (1995), 423.
[171] Nurkse, R., *International Currency Experience: Lessons from the Inter-war Period* (Princeton, 1944), 1.

This paper seeks to classify those choices. Section 2 sketches the background of the interwar international monetary system. Section 3 introduces the modern literature on exchange-rate regime classification and proposes a new classification methodology. Section 4 discusses data issues. Section 5 reports results of the classification methodology as applied to the interwar data. Section 6 discusses these results in the context of treatments in scholarship in the contemporary period. Section 7 concludes.

2. Exchange-rate regimes in the interwar period

The modern scholarship on the monetary affairs of the interwar period is dominated by a group of literature which might be called the 'Great Depression literature of the 1980s'. Most prominent among this group are the works of Eichengreen and Temin.[172] From this literature emerges a relatively clear picture of exchange-rate regime choice between the two world wars. Notwithstanding variation among countries, the period featured three regime stages.

At the beginning of the interwar period, in November 1918, was the "free-floating" period. Wartime inflation and the exhaustion of foreign currency reserves left many countries unable immediately to restore convertibility of the currency into gold at pre-existing gold weights and exchange rates to the dollar, whose value in gold had not changed. As a result, exchange rates in this period were determined in the foreign exchange market (Table).

This ended with nearly universal stabilisation of currencies on gold, notably of the German mark in 1924, the British pound in 1925 and the French franc in 1926 on a de facto basis.[173] This restoration of the international gold standard is sometimes called a gold-exchange standard in reference to frequent use of gold-convertible currencies instead of bullion as collateral for the currency. This practice was actually commonplace during the "classical" gold standard (before World War One).[174] Official endorsement of this gold economisation at Genoa in 1922 probably explains its identification with the interwar gold standard.[175]

Table 1: Interwar international currency regimes

Free floating	1918-1926
Gold standard	1927-1931
Managed floating	1932-1939

Source: Eichengreen, B., 'The comparative performance of fixed and floating exchange rate regimes: Interwar evidence', NBER *Working Paper* 3097 (September 1989), 1.

[172] Eichengreen, B., *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939* (Oxford, 1992) and Temin, P., *Lessons From the Great Depression* (Boston, 1989).
[173] "Stabilisation" was the contemporary term for convertibility of the note issue into metal at a fixed rate.
[174] Mundell, R. 'The global adjustment system' in M. Baldassarri, J. McCallum and R. Mundell, eds., *Global Disequilibrium in the World Economy* (London, 1992), 352.
[175] Fink, C., *The Genoa Conference: European Diplomacy, 1921-1922* (Chapel Hill NC, 1984).

The interwar phase of nearly worldwide gold convertibility ended on 21 September 1931 when the Bank of England ceased converting the pound into gold. Britain was not the first country to leave the gold standard, but its departure triggered an exodus. Figure reports the worldwide incidence of departure from the gold standard at this time.

The ensuing period, roughly from 1932-1939, is generally seen as a time of "managed floating":

> 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.[176]

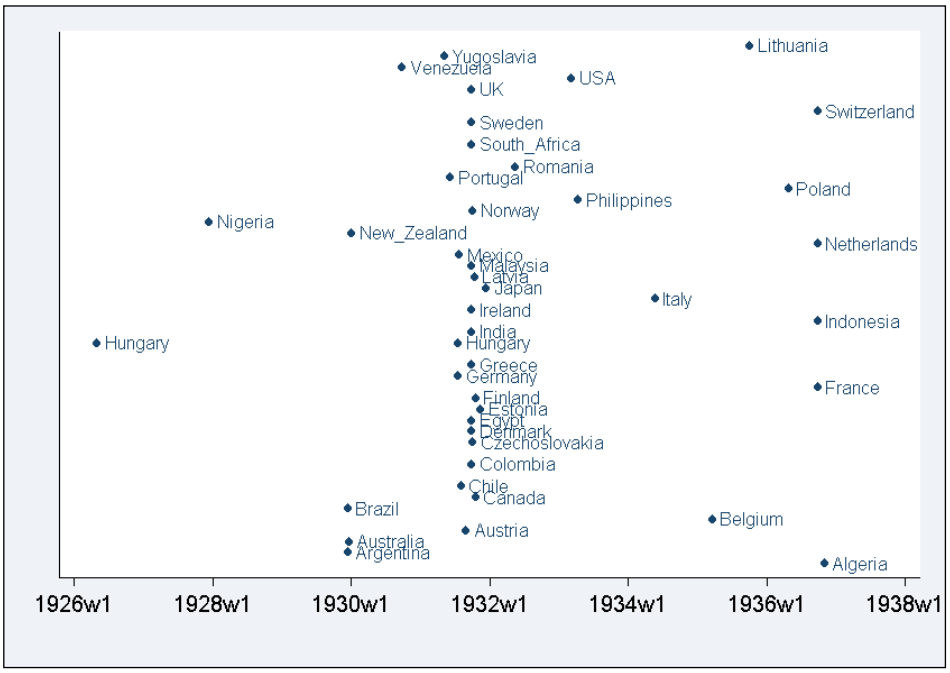

Figure 1: Point of departure from the interwar gold standard

Source: Author's dataset. See Part 4 for classification of gold standard departure.
Note: The y axis has no analytical significance.

The international monetary system of the 1930s resulted from the choices taken in the face of widespread gold departure. Some countries could not countenance devaluation. Among them were a group who chose exchange controls, ultimately viable only when made draconian, extending from the capital to the current account. These became the 'exchange

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[176] Bordo, M., 'The Bretton Woods International Monetary System: A historical overview', in M. Bordo, ed., *The Gold Standard and Related Regimes -- Collected Essays* (Cambridge, 1999), 395-500 (398).

clearing' countries, the most important being Germany.[177] Others foreswore devaluation and addressed their overvaluation by seeking domestic price deflation and erecting trade barriers -- all the while urging the world to return to gold. Large initial balances of foreign exchange and gold enabled this choice. This was the 'gold bloc', whose most important member was France.[178]

For most countries, the choice was immediate devaluation, often accompanied by trade barriers and sometimes capital controls, ranging from relatively strenuous (Denmark) to informal (Britain).[179] These were distinct from those applied in the exchange-clearing countries, insofar as they were not pursued to the point of payments-clearing for trade. An example is Denmark, whose exchange controls initially provided the space to combine an accommodative domestic monetary policy stance with a pegged currency. The latter was established on 1 January 1933, at 20% below the 1929 value against sterling (Figure 2). The authorities held to this value as a boom in non-tradables inflated.[180] By 1935, the limits of this policy had been reached. Rather than further tighten financial controls or give up the peg, the authorities abandoned independent policy and tightened severely.[181] Base money growth switched from more than 20% in 1934 to a 5% contraction in 1935, a reversal greater than any country had pursued even to defend gold convertibility.[182]

It is hard to see inflation as the authorities' main concern; it peaked at 4% in 1934. Moreover, Danish policymakers, like most of this era, were concerned with the level of prices rather than the rate of change.[183] By the end of 1934, prices had only just regained their 1929 position.

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[177] See Ellis, H., *Exchange Control in Central Europe* (Cambridge MA, 1941).
[178] See Mouré, K., *Managing the Franc Poincaré: Economic Understanding and Political Constraint in French Monetary Policy, 1928-1936* (Cambridge 1991).
[179] On the range of exchange controls practiced in this decade, see Gordon, M., *Barriers to World Trade: A Study of Recent Commercial Policy* (New York, 1941). Britain's exchange controls were little remarked by contemporaries, nor by the League of Nations in its ex-post recounting of exchange controls (League of Nations, *Statistical Year-book 1939/40* (Geneva, 1940), 193--195). Its controls were informal restrictions on debt placements. See Sayers, R., *The Bank of England 1891-1944, Vol. 2* (Cambridge, 1976), 492.
[180] "…in certain quarters it is now believed that building activity is near the point at which the market for new dwellings will be saturated." *The Economist*, "Economic Report (Denmark)", 21 September 1934, 586.
[181] Nurkse cites this as a the distinction between exchange-clearing countries and those which remained subject to the pressures of capital flows. Nurkse, *International Currency Experience*, 83.
[182] Based on the author's dataset of 31 interwar central bank balance sheets. See Section 4, 'Data'.
[183] Chadha, J., and Dimsdale, 'A long view of real rates', *Oxford Review of Economic Policy* 15:2 (1999), 17.

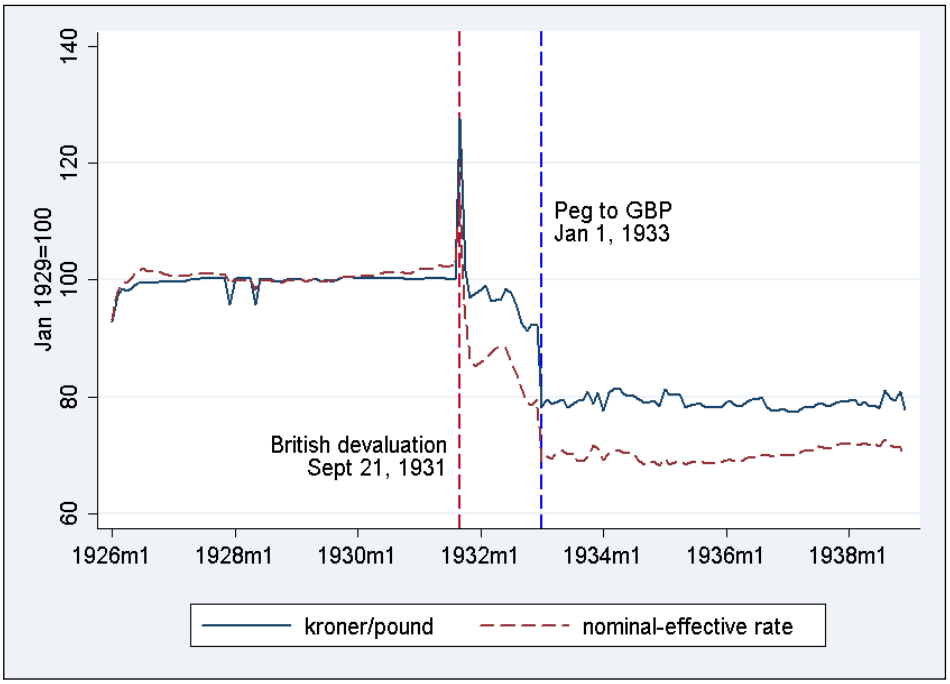

Figure 2: Danish exchange rate

Source: Author's dataset. See Part 4 for currency sources.

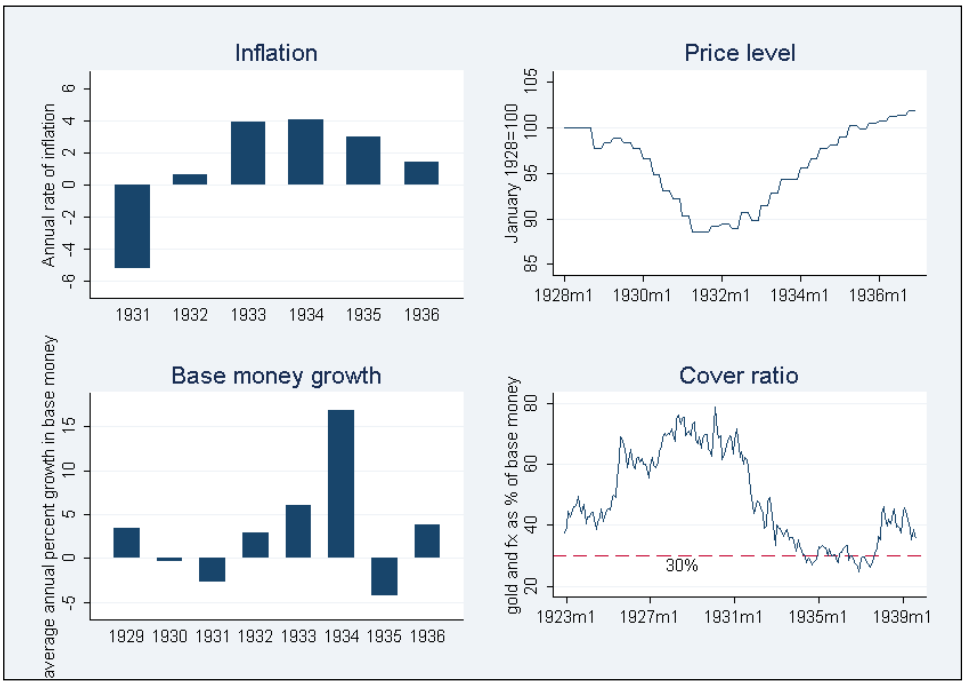

Figure 3: The Danish tightening

Source: Author's dataset. See Section 4 for data details.

Prices mattered to the extent that they affected the sustainability of the currency regime. As in most countries that chose devaluation and mixed-strength capital controls, foreign

reserves and gold were paramount. Their condition was reported in the financial press, soon after publication of regular central bank balance sheet data (central bank "returns" in the contemporary parlance). This explains the Danish determination to stop the credit boom. Foreign reserves and gold had fallen from 250 million kroner in 1931 to 150 million kroner in 1934. This was the amount of reserves which roughly covered a third of domestic sight liabilities, the minimum allowed by Danish statute (Figure 3).[184]

Denmark's monetary reversal was extreme because of the height of its early-1930s boom. But its concern with collateralising the note issue was common. The contemporary post-Second World War treatment of the interwar international monetary system addressed this in detail. *International Currency Experience* was published by the League of Nations in time for the Bretton Woods conference in New Hampshire in 1944. It is often portrayed as a polemic against floating exchange rates.[185] While Nurkse makes clear a distaste for market-set exchange rates, his treatise is primarily devoted to excoriating the practice of currency collateralisation in the 1930s. The book is a plea for un-backed money.[186]

As the Danish example suggests, choice over the exchange-rate regime in the interwar period had implications for domestic policy independence and for the degree of economic integration with the rest of the world. This tradeoff is known as the macroeconomic policy trilemma or 'impossible trinity'. It is the medium-term impossibility simultaneously to enjoy free capital flows, a fixed-exchange rate and monetary policy independence.[187] The trilemma provides a framework for characterising the international monetary system.[188] Table can be interpreted in these terms. Countries emerging from WWI relinquished exchange-rate fixity. After a period of floating, they stabilised on gold. To do so, they needed to foreswear independent policy. The 1931 rupture forced a new choice.

There is little in the literature to assess these choices on an empirical basis. More often, the period is used to associate outcomes with regime type, where regime type is taken *a*

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[184] Nurkse, *International Currency Experience*, 97.
[185] Bordo, M. and James, H., 'Haberler versus Nurkse: The case for floating exchange rates as an alternative to Bretton Woods?', NBER *Working Paper* 8545 (October 2001).
[186] See Urban, S., 'International Currency Experience and the Bretton Woods System: Ragnar Nurkse as Architect', in R. Kattel, J. Kregel and E. Reinert, eds., *Ragnar Nurkse (1907-2007): Classical Development Economics and its Relevance for Today* (London, 2008).
[187] Obstfeld, M., Shambaugh, J. and Taylor, A., 'Monetary sovereignty, exchange rates, and capital controls: The trilemma in the interwar period,' IMF *Staff Papers* 51 (2004).
[188] Harley, C., 'Twentieth century monetary regimes in Canadian perspective', working paper (2001).

priori.[189] This paper addresses that gap with a classification approach grounded in the methodology of the modern literature of *de facto* exchange rate regime classification.

[189] See, for example, Eichengreen, B., 'The comparative performance of fixed and floating exchange rate regimes: Interwar evidence', NBER *Working Paper* 3097 (Sept 1989) and Bordo, M., 'Exchange rate regime choice in historical perspective', NBER *Working Paper* 9654 (April 2003)

3. Exchange-rate regime classification

The Second Amendment to the IMF's Articles of Agreement, in effect from 1978, eliminated the provisions calling for maintenance of member currency parities into gold or the dollar, in a belated recognition of the collapse of the Bretton Woods system in 1971. The new articles merely enjoined countries to register regime type with the IMF and to "avoid manipulating exchange rates or the international monetary system in order to prevent effective balance of payments adjustment or to gain an unfair competitive advantage over other members….".[190]

These self-registrations constituted a *de jure* classification of exchange-rate regime.[191] A thread of economics literature has used these as a basis for ascertaining the importance of regime type for macroeconomic outcome (financial and real).[192] Initial work concluded that exchange-rate regime matters little.[193] Spurred in part by this surprising result, a *de facto* classification literature sprang up to infer from publicly available data whether *de jure* registrations were faithful to actual regime operation. This is the 'Fear of floating' literature, named for the eponymous 2000 paper by Calvo and Reinhart.[194]

At its core, exchange-rate-regime classification relies on measuring one or both of two observable statistics. The first is the exchange rate itself, which essentially measures the outcome of the exchange-rate regime. This approach is not derived from theory but from stylised notions of regime type and exchange-rate outcome.[195] A floating exchange-rate regime is presumed to be associated with a higher degree of exchange-rate variation vis-à-vis fixed regimes.[196]

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[190] International Monetary Fund, *Articles of Agreement* [revised] (Washington DC, 1977), Article IV, section 1, subsection (iii).
[191] IMF *de jure* classifications are reported in International Monetary Fund, *Annual Report on Exchange Arrangements and Exchange Restrictions* (Washington DC, annual issues), beginning from 1950.
[192] The important early entry is Stockman, A. and Baxter, M., 'Business cycles and the exchange-rate regime: Some international evidence', *Journal of Monetary Economics* 23:3 (May 1989), 377-400.
[193] The Stockman paper concludes, "We have been unable to find evidence that the cyclic behavior of real macroeconomic aggregates depends systematically on the exchange-rate regime." *Ibid*, 399.
[194] Calvo, D. and Reinhart, C., 'Fear of floating', *NBER Working Paper* 7993 (November 2000). Subsequent footnotes refer to the journal article, Calvo, D. and Reinhart, C., 'Fear of floating', *Quarterly Journal of Economics* 67:2 (May 2002), 379-408.
[195] Some of the main contributors to the literature acknowledge that most classification algorithms "do not correspond closely with theoretic concepts". Ghosh, A., Gulde, A. and Wolf, H., *Exchange Rate Regimes: Choices and Consequences* (Cambridge MA, 2002), 43, footnote 3.
[196] Methodologies based exclusively on the exchange rate include Reinhart, C. and Rogoff, K., 'The modern history of exchange-rate arrangements: A reinterpretation', NBER *Working Paper* 8963 (June 2002), 54-104

The second observable statistic for regime classification is international reserves -- a gauge of regime intention as opposed to outcome.[197] The basis is the balance-of-payments identity. Flows on capital and current account, minus changes to international reserves, must net to zero (identity a). Floating implies that current account imbalances are met on the capital account, with the exchange rate playing the equilibrating role (identity b). By definition, international reserve balances are unchanged (identity c).[198, 199]

BoP identity	$CA + KA - \Delta R \equiv 0$	(a)
BoP identity, floating	$CA \equiv KA$	(b)
Floating condition	$\Delta R = 0$	(c)

Appendix 1 on page 150 reports the results of an application of these methodologies to modern data. It finds that variation of the exchange rate is an inadequate guide to regime type. First, it overlooks the possibility that a credible floating regime can exhibit extremely low variability. As a consequence, floating regimes are sometimes identified as heavily managed or even pegged. Thus Reinhart and Rogoff classify the UK free float of September 1992 to December 2001 as "Managed floating" but Australia in December 1983 to December 2001 as "Freely floating". The Swiss franc and Canadian dollar are "De facto moving bands", while Japan is "Freely floating" (1/1977-12/2001).[200]

The second problem with variation in the exchange rate is misidentification of brittle pegs as floats. A pegged regime that periodically succumbs to devaluation pressure will exhibit a high variance statistic, leading to its mididentification as a "free float".

Appendix 1 reports that variance in international reserves also suffers from pitfalls. Reserve changes accruing from intervention must be "backed out" from valuation effects; and this requires knowledge of reserves portfolio currency composition. In addition,

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and Klein, M. and Shambaugh, J., 'Fixed exchange rates and trade,' *Journal of International Economics* 70:2 (December 2006), 359-383.

[197] An additional instrument is the policy interest rate. This is rarely used in the literature. An exception is the exchange rate flexibility index in Calvo and Reinhart, 'Fear of floating', 402.

[198] Methodologies using international reserves include Calvo and Reinhart, 'Fear of floating' and Poirson, H., 'How do countries choose their exchange rate regime?' IMF *Working Paper* 01/46 (April 2001).

[199] A third approach to classification is cluster analysis. This categorises regimes into five groups defined by least Euclidean distance from five cluster means of three variables: exchange-rate variation, reserves variation, and variation in the change of the exchange rate. See Levy-Yeyati, E. and Sturzenegger, F., 'Classifying exchange rate regimes: Deeds vs. words', *European Economic Review* 49:6 (August 2005), 1603-1635.

[200] Reinhart and Rogoff, 'The modern history of exchange rate arrangements', 56-102.

reserves data are subject to misreporting and obfuscation; and in many cases are not available in high quality or requisite granularity.

This paper applies two classification algorithms to interwar exchange-rate data. One is a binary peg/no-peg classification adapted by the author from Shambaugh 2004, the Lambda-Peg Indicator.[201] The other is an entirely new index of regime flexibility proposed by the author, the Lambda-Kurtosis Index.

Lambda-Peg Indicator

This indicator variable takes the value of 1 if the regime is pegged, otherwise zero. It is based on Shambaugh 2004, whose algorithm codes an exchange-rate regime 'pegged' if the observed month-end exchange-rate outcome falls within a ±2 percentage point band during the year. This is true if the difference between the maximum and minimum of the log of the month-end exchange rate does not exceed 0.04. The Shambaugh 2004 algorithm treats a one-time peg change as consistent with a pegged regime if the eleven other months of the year exhibit 0% change. The base currency is chosen after considering all relevant base currency candidates; the author's discretion is exercised where no clear base currency candidate is present. In addition to annual classifications, Shambaugh 2004 considers 'spells' of pegging, allowing for a monthly granularity of classification. A month is coded 'pegged' if the range of the log of month-end exchange rates does not exceed 0.04 over the trailing 12 months or if 11 of the past 12 months have 0% changes. To avoid spurious peg assignment, no month is coded 'pegged' unless it is part of at least a six-month continuous sequence of pegged months.

The Lambda-Peg Indicator proceeds from the latter approach, i.e. it is a rolling peg assignment. Five adaptations are made. First, Lambda-Peg uses weekly rather than monthly observations. Second, it picks the base currency for each 52-week period based on best fit, rather than relying on the researcher's discretion. Third, it includes among the base currency candidates a gold-numeraire candidate, as described below. Fourth, it reports the percentage of observations within a given year which qualified as 'pegged'. (By contrast, Shambaugh 2004 reports a given year as either pegged or not.) Fifth, it requires a band of ±1%.

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[201] Shambaugh, J., 'The effect of fixed exchange rates on monetary policy', *Quarterly Journal of Economics* 119:1 (Feb 2004), 301-352.

An observation is coded 'pegged' if the log-max and log-min of the bilateral exchange rate in a 52-week moving window ending in time *t* lie within a ±1 percentage point band, i.e. the log-difference must not exceed 0.02. As in Shambaugh 2004, the algorithm accommodates a one-time peg change as consistent with a pegged regime if 11/12 (92%) of the remaining observations in that 52-week period are unchanging (defined here as not exceeding the maximum weekly percentage change exhibited in the dollar-sterling rate during 1926-1930, which was 0.26%).

Step-by-step details of the coding algorithm are specified in Appendix 3 on page 166.

Gold numeraire index

Having considered a variety of numeraires (the US dollar, UK pound sterling and French franc), it is clear that, outside of the sterling bloc, many authorities are in fact pegging to gold. Thus a gold exchange rate index is derived for each country, which tracks movement of the local currency against the dollar in the period 1919 up to end-1932 inclusive, the French franc from 1933 to end-1935 inclusive, and the dollar from 1936 till August 15, 1939. The index of the bilateral exchange rate is set to the value of 100 at 1 January 1928. The index changes in proportion to the week/week change in the current designated gold numeraire exchange rate.

This approach is taken by a contemporary source:

> In the daily management of the exchange position practically all countries have adopted some definite principle of control, which makes it possible to distinguish between two main groups. In the first place there is a group of countries whose exchange rates are kept stable in relation to gold, either directly through the sale and purchase of gold by the central bank, or indirectly through exchange stability in relation to some gold currency. This group is much larger than the so-called gold bloc…. (T)he following list, which may not be exhaustive, gives countries in which the most representative exchange quotation is kept directly or indirectly in a stable relation to gold: besides France, where the free delivery of gold has been fully maintained, and the remaining members of the gold bloc -- Holland, Italy, Poland and Switzerland -- there are Albania, Belgium, Bulgaria, Cuba, Czechoslovakia, Danzig, Germany, Greece, Iran, Latvia, Lithuania, Mexico, Rumania, Spain, Turkey, USA, Uruguay and Yugoslavia.
>
> The other large group comprises Great Britain and the countries which in their exchange policy follow more or less the movements of sterling. To this group belong: Argentina, Australia, Bolivia, Brazil, Colombia, Denmark, Egypt, Estonia, Finland, Great Britain, India, the Irish Free State, Japan, Norway, New Zealand, Paraguay, Portugal, Siam, Straits Settlements, Sweden, Union of South Africa, and the British Crown Colonies. Apart from Britain herself, the only members of the

sterling group in Europe are Estonia, Finland, Portugal and the three Scandinavian countries.[202]

Lambda-Kurtosis Index

This paper proposes a new exchange-rate regime flexibility index based on the data-generating process underlying an exchange-rate time series. The hypothesis is that the degree of exchange-market intervention is revealed in a particular property of that series, namely the distribution of its changes. A summary statistic of the distribution is kurtosis, the ratio of the fourth moment around the mean to the standard deviation:

$$\text{Kurtosis:} \qquad \frac{1}{N}\sum_{i-N}^{i=1}\left(\frac{x_i - mean}{stdev}\right)^4 \qquad (1)$$

If the distribution of currency returns is subject to big outliers, its kurtosis is high and the distribution is peaked. The currency returns generated by a currency peg, perhaps succumbing to an occasional devaluation, should produce high kurtosis relative to a non-pegged currency. A high proportion of observations will lie on zero, and outliers will be more severe than in a floating regime. This makes sense: floating regimes might be subject to frequent exchange-rate changes, but the ability to change on a continuous basis should limit the pressure for one-time discrete changes. For a normal distribution, kurtosis is 3. At first glance, this begs the question: what type of distribution should be assumed of currency returns?[203]

The modern literature on asset pricing contains assumptions of normality in the distribution of returns.[204] Normality of currency returns in particular is assumed in some of the new literature on micro-structural foundations of exchange rates.[205] However, many financial theories of the exchange rate model currency returns non-normally. A well-known approach is the GARCH model, where time-varying conditional variances are mixed with normal distributions.[206] In the early years of post-Bretton Woods floating

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[202] Bank for International Settlements, *Fifth Annual Report: April 1, 1934 -- March 31, 1935* (Basle, 1935), 7.
[203] It is crucial to keep in mind that the data are currency *returns*, i.e. log changes or percentage changes.
[204] De Long, B., Shleifer, A., Summers, L., and Waldmann, R., 'Positive feedback investment strategies and destabilizing rational speculation', *The Journal of Finance* 45:2 (June, 1990), 379-395 (384)
[205] Carlson, J. and Osler, C., 'Rational speculators and exchange-rate volatility,' *European Economic Review* 44 (2000), 231-53 (240).
[206] Bollerslev, T., 'Generalized autoregressive conditional heteroskedasticity', *Journal of Econometrics* 31 (1986), 307-327.

experience, currency returns were thought to be non-normally distributed. More recently, analyses of returns from floating-regime pairs of currencies consistently report excess kurtosis approaching zero (i.e. kurtosis of 3, which comports with a normal distribution) as time horizons pass 24 hours.[207]

Fortunately, the Lambda-Kurtosis Index can be agnostic about exact normality of the underlying distribution of currency returns. The only requirement is that distributions without the central bank's presence in the foreign-exchange market are more normally distributed. The basis for such an assumption can be explained in the dynamic properties of the kurtosis statistic. Take the first derivative of equation (18) on page 46 with respect to a single observed exchange-rate return, x_i, with mean $\bar{x}$ and sample variance s^2:

$$\frac{\partial Kurtosis}{\partial x_i} = \frac{4(x_i - \bar{x})}{(s^2)^2}[(x_i - \bar{x})^2 - s^2 Kurtosis] \qquad (2)$$

Equation (2) reveals that when the additional observation's squared distance from the sample average exceeds the product of the sample variance and sample kurtosis, kurtosis increases as the new observation shifts further from the average. In all other cases, kurtosis rises when the new observation moves *toward* the average.[208] A pegged or heavily managed currency regime thus raises kurtosis in two ways. First, by generating large, discrete changes (upon periodic peg adjustment); second, by producing observations very close to the sample mean.

The intuition can be sketched with an historical example. The classical gold standard ended with World War One. Thereafter, the ability to subvert domestic conditions to the needs of external balance consistent with a fixed currency and open capital account was sharply reduced. This was partly the result of greater labour enfranchisement after the war. Eichengreen refers to this as the beginning of embedded liberalism, John Ruggie's term for the state-society compact embedding macro-stabilisation policies within a larger market-

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[207] The former literature begins as early as Westerfield, J., 'An examination of foreign-exchange risk under fixed and floating rate regimes'. *Journal of International Economics* 7 (1977), 181-200. The latter literature includes Dias, A. and Embrechts, P., 'Modeling exchange rate dependence dynamics at different time horizons'. *Journal of International Money and Finance* 28:8 (December 2010), 1687-1705. See in particular Table 2, page 1692. See also "Table 2: Exchange-Rate Kurtosis" in Savaser, Tanseli and Osler, 'Extreme returns without news: The case of currencies', *SSRN Working Paper* 1344854 (February 16, 2009), 32.

[208] Savaser and Osler, 'Extreme returns', 8.

based international system.[209] Monetary authorities nevertheless continued to seek a "stable" or fixed exchange rate. This posed a dilemma because they could not rely on internal price flexibility to deliver balance-of-payments equilibrium. Yet they would not condone the use of the exchange rate to do so. The only equilibrating mechanism would be reserves – which were, by definition, a diminishing option under conditions of currency overvaluation. Here again is the trilemma. Nurkse commented on its interwar presence, noting that if the monetary authority chooses to peg, there is

> no doubt [that] the maintenance of stable exchanges by [this] method presupposes an appropriate domestic credit policy.[210]

In the 20th century beyond World War One, policymakers were expected both to deliver a 'stable' currency and a stable or indeed rising domestic price level, in most cases without the benefit of truly binding exchange controls.

Such conflict between external and internal goals produces a characteristic pattern of exchange-rate time series. Periods of extremely low exchange-rate variability are punctuated by discrete, one-time changes. This happens because the peg cannot be held under a prolonged deficit in the external accounts. The resulting high variance statistic constitutes not floating but changes in *de facto* peg parities.[211] This behaviour in the time series produces a unique shape in the distribution of percentage changes in the exchange rate, which can be used to detect regime type.

Rigid exchange-rate regimes are susceptible to large, discrete changes. A peg is typically held until the monetary authority is forced to devalue, rendering a larger discrete devaluation than would be observed from a typical daily change in a floating currency. Figure 4 traces the Chilean peso / US dollar exchange rate in the interwar period. The floating period pre-1925 is immediately recognisable; the gold-exchange standard period (1925-1931) is clear from the steadiness of the quote. What happens next is clearly not a return to floating but a succession of peg adjustments (mostly devaluations).

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[209] Eichengreen, B., *Globalizing Capital: A History of the International Monetary System* (Princeton, 1996), 4. See Ruggie, J., 'International regimes, transactions, and change: Embedded liberalism in the postwar economic order', *International Organization* 36:2 (1982).
[210] Nurkse, *International Currency Experience*, 121.
[211] As we will see later, this is the meaning of "flexibility" used by Nurkse to describe 1930s regimes.

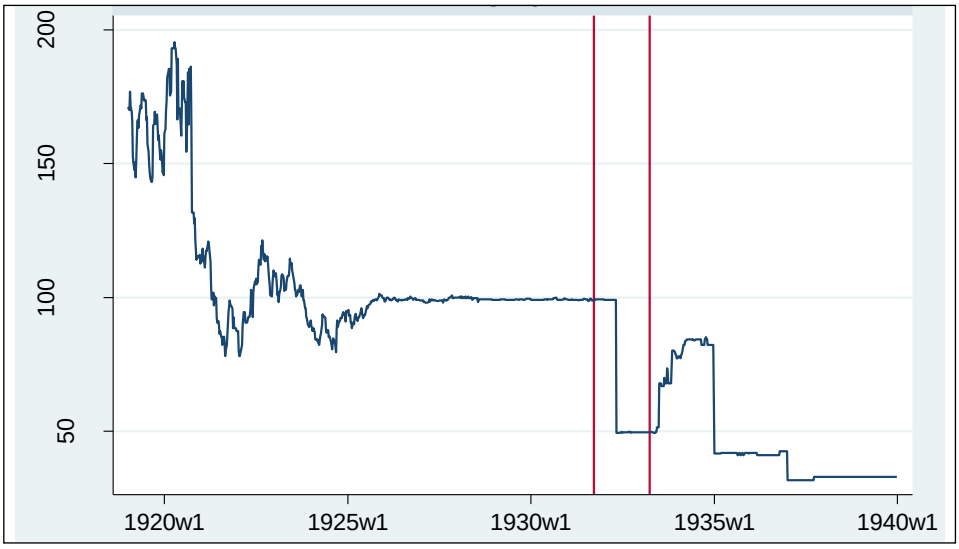

Figure 4: Chile peso / US dollar 1919-1940

Source: See 'Data' section in text.
Notes: Vertical lines correspond with sterling's Sept. 1931 devaluation and the US dollar's April 1933 devaluation.

A pegged regime like Chile's after 1925 features exchange-rate changes that are both rarer and larger than those of a floating regime, such as Chile's before 1925. This suggests that the distribution of changes will look very different for floats compared to fixes (Figure 5).

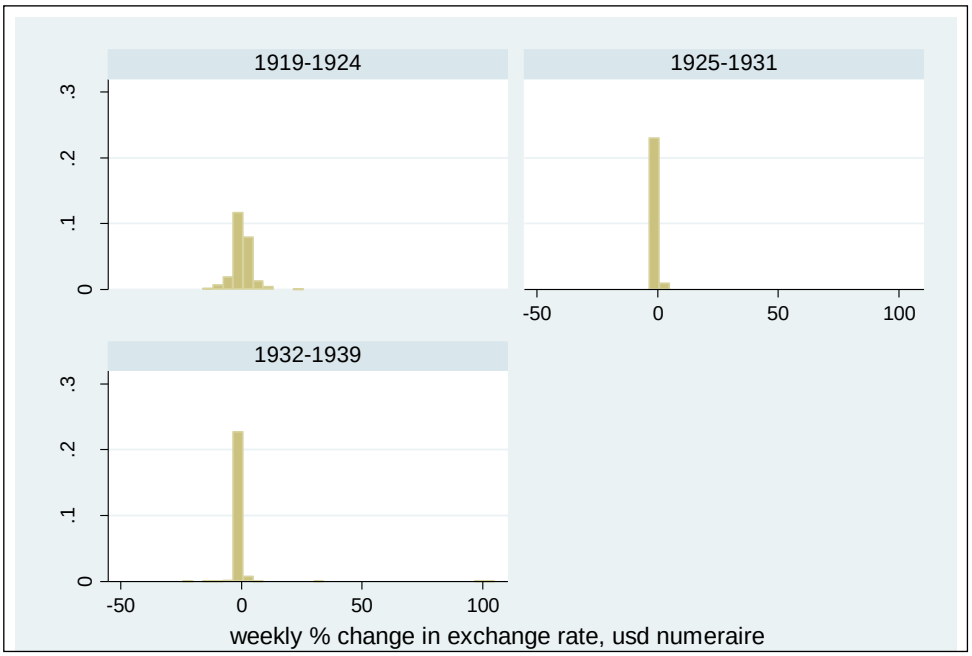

Figure 5: Distribution of weekly change in Chile peso/USD, 3 interwar periods

Note: Kurtosis for 1919-1924 is 9.5, for 1925-1931 14 and for 1932-1939 173.

The same principle holds for modern data. Figure 6 reports distributions of changes in the US dollar exchange rate for a modern float (Canada) versus a modern peg (Hong Kong).

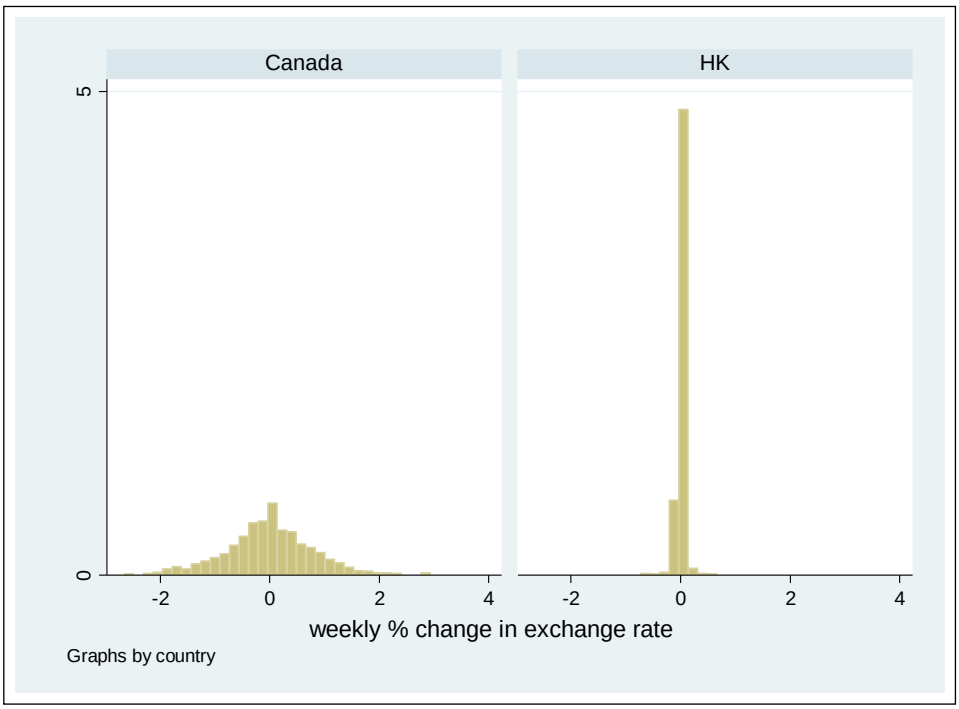

Figure 6: Distribution of first derivative of exchange rate, 1991-2006

Source: Author
Notes: Kurtosis for Canada is 3.65, for HK 34.78. Based on weekly observations.

Kurtosis does not feature in the modern literature of exchange-rate regime classification. For the interwar period, Eichengreen reports kurtosis of the exchange rate in levels (not in changes), but does not use it to assess regime type.[212]

Appendix 4 reviews the results of an application of kurtosis to the classification of exchange-rate regimes, with the same countries, samples and standards used to judge the performance of conventional methodologies. In this paper, a kurtosis-based index is used in which kurtosis of the first derivative of the exchange rate with respect to time is used to 'scale' the square root of the coefficient of variation of the exchange rate in levels:

$$\text{Lambda-Kurtosis Index: } \frac{\sqrt{c.v.(E)}}{kurt(f'E)} \qquad (3)$$

[212] Eichengreen, 'Comparative performance'.

Coefficient of variation in the numerator is necessary to identify credible pegs. A credibly pegged regime might enjoy a "target zone" distribution of exchange-rate changes, to the extent that markets anticipate the requisite actions by the authorities, and thus move the exchange rate into the target zone in a pro-stabilising way.[213] The resulting distribution of changes is distinctly bi-modal. The kurtosis of such a distribution is lower than that of a normal distribution, and hence kurtosis alone would misidentify such a credibly pegged regime as a float. By having volatility of the exchange rate in the numerator, such cases of low-kurtosis pegging are correctly identified as pegs.

Similarly, by taking the square root of the numerator, large variations in the exchange rate are less able to overwhelm a large kurtosis statistic and produce a misleading index score.

Numeraire issues

Flexibility indices incorporating a measure of the exchange rate (be it variation of the rate itself or kurtosis of its first derivative) will only be instructive if measuring the exchange rate vis-à-vis the proper reference currency, or 'numeraire'. In other words, if the monetary authority is targeting the value of the currency expressed in euros, it makes no sense to apply a classification system to the a time-series of the exchange rate expressed in dollars. In the modern period, this is relatively straightforward. To the extent that a currency is managed, it is usually managed against the US dollar. The exceptions in the present paper are the CFA franc, Danish krone and Swedish krona, which are pegged against the euro, having previously been pegged against the French franc and German mark, respectively.[214]

Designation of numeraire is more difficult in the interwar period, when no single currency was as dominant as the dollar is today. This becomes clear when looking at the time-series for three numeraires for the Spanish peseta, in Figure 7. Sterling or the dollar might be intuitive choices for a peseta reference currency. But the figure makes clear that, if the authorities had a target in mind during the 1930s, it was the franc.[215] (Part one of this dissertation suggests why this would be the case: monetary authorities targeted the gold value of their currency; in this period, the French franc was gold-convertible.)

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[213] With appreciation to Rui Pedro Esteves. Krugman, P., 'Target zones and exchange rate dynamics', *Quarterly Journal of Economics* 106:3 (Aug., 1991), 669-682.
[214] These reference currencies are used in the compilation of the preceding figures.
[215] The figure challenges the predominant view that Spain's peseta was a floating currency between the wars.

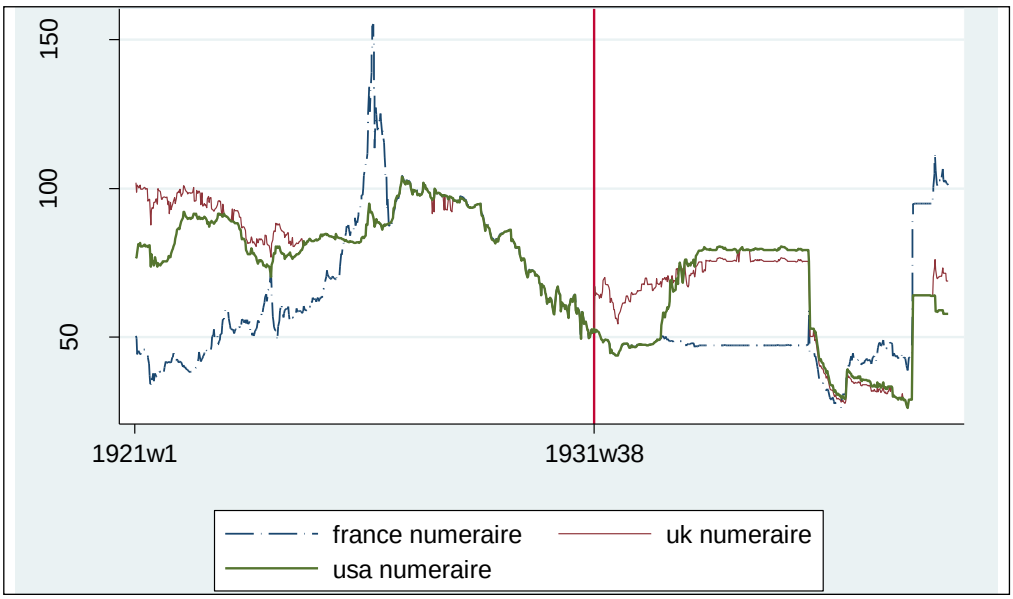

Figure 7: Spanish peseta, 1921-1939

Source: Author
Notes: The y-axis is the index value for each nominal bilateral exchange rate, rebased to 100 in the first week of 1928. The vertical line marks sterling's 21 September 1931 devaluation.

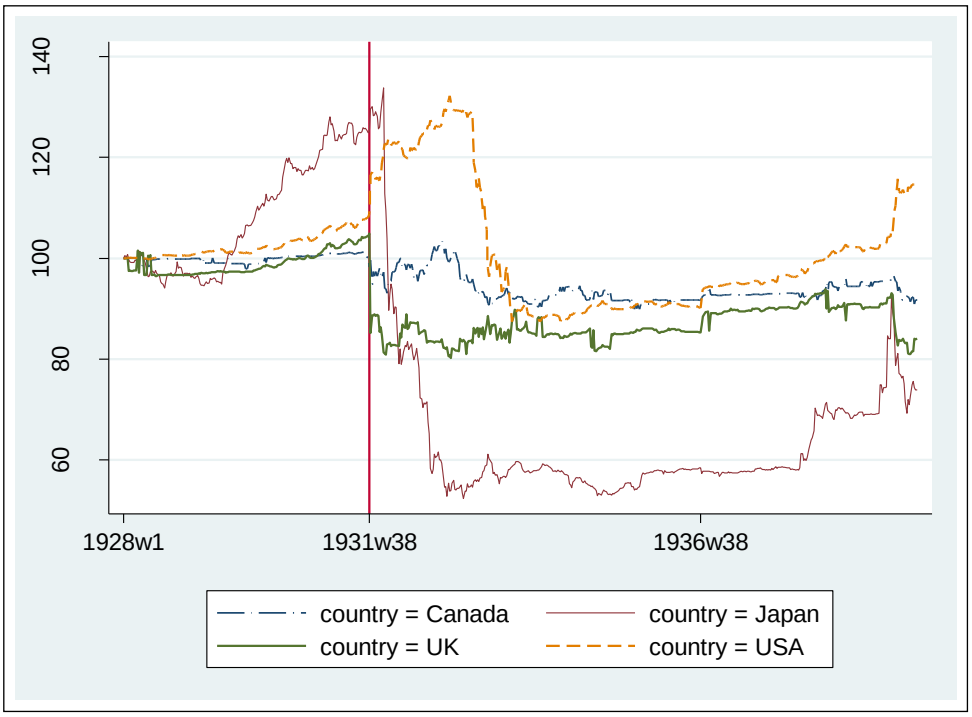

Figure 8: Trade-weighted exchange rates

Source: Author
Note: See 'Data' for construction of effective indices. The vertical line marks sterling's 1931 devaluation.

4. Data

Exchange rates

Exchange rates are sourced through Global Financial Data (GFD).[216] GFD's sources are detailed in Table 2. Data are weekly, end-of-period, in local currency units per US dollar, spanning 1920-1939. Non-standard market quotes, e.g. Australian pounds, are inverted to provide consistent expression. Cross rates are calculated as (local units / us dollar) / (target numeraire / us dollar).

Three bilateral exchange rate indices are compiled for each currency: US dollar numeraire, British pound sterling numeraire and French franc numeraire. The January 1928 index for country j against numeraire k in time t increases with j-currency appreciation:

$$\text{Index\_bilateral}_{jk,t} = 100*(e_{jk,1928w5} / e_{jk,t})$$

where *e* is local currency units per numeraire (*e* decreases with j-currency appreciation).

Table 2: Sources for US dollar exchange rates[217]

Currency	Source (code) see details below	Years
Algeria	LN	1920-1939
Argentina	LN	1920-1939
Australia	ER	1920-1930
	LN	1931-1939
Austria	LN	1920-1939
Belgium	LN	1920-1939
Brazil	LN	1920-1935
	AE	1936-1939
Canada	LN	1920-1939
Chile	LN	1920-1939
China	PC	1920-1939
Colombia	BR	1920-1939
	LN	1920-1939
Cuba	LN	1920-1939
Czechoslovakia	1/	
Denmark	2/	
Egypt	WW	1920-1939
	CF	1920-1939
	LN	1920-1939

[216] This source is widely used in the literature. The web address is www.globalfinancialdata.com
[217] As sourced through Global Financial Data, www.globalfinancialdata.com

Currency	Source (code) see details below	Years
Estonia	WW	1920-1939
	CF	1920-1939
	LN	1920-1939
Finland	FB	1920-1921
	LN	1920-1939
France	PB	1920-1927
	LN	1920-1939
Germany	LN	1920-1939
Greece	CF	1920-1939
	LN	1920-1939
HK	CF	1920-1939
	LN	1920-1939
Hungary	SJ	1920
	FR	1921-1939
	LN	1920-1939
	CF	1920-1939
India	BC	1920-1939
	LN	1920-1939
Indonesia	SS	1920-1922
	LN	1920-1939
	CF	1920-1939
Ireland	3/	
Italy	LN	1920-1939
Japan	LN	1920-1939
Latvia	LN	1920-1939
	CF	1920-1939
Malaysia	LN	1920-1939
	CF	1920-1939
Mexico	LN	1920-1939
	CF	1920-1939
Netherlands	LN	1920-1939
New_Zealand	LN	1920-1939
Nigeria	LN	1920-1939
	CF	1920-1939
Norway	LN	1920-1939
	CF	1920-1939
Philippines	LN	1920-1939
	CF	1920-1939
Poland	LN	1920-1939
	CF	1920-1939
Portugal	LN	1920-1939
Romania	LN	1920-1939
	CF	1920-1939
Russia	LN	1920-1939
	CF	1920-1939
South_Africa	LN	1920-1939
	CF	1920-1939

Currency	Source (code) see details below	Years
Spain	LN	1920-1939
	CF	1920-1939
Sweden	LN	1920-1939
	CF	1920-1939
Switzerland	SB	1920-1939
	LN	1920-1939
	CF	1920-1939
Turkey	RT	1920-1939
	LN	1920-1939
	CF	1920-1939
UK	4/	
USA	4/	
Venezuela	LN	1920-1939
	CF	1920-1939
Yugoslavia	LN	1920-1939
	CF	1920-1939

Code	Source
AE	Annuario Estistico do Brasil
BC	*Bombay Courier* (1822-1943)
BR	Banca de la Republica, *Memoria Annual* (Bogota, 1970)
CF	*Commercial and Financial Chronicle* (1920-1939)
ER	Wilson, R., 'Exchange rates on London,' *Economic Record* (1931): 125-130
FB	Finland's Bank, *Vuosikirja* (Year book) (Helsinki, 1914-1921)
FR	US Federal Reserve Bank (1921-1941)
LN	League of Nations, *Monthly Statistical Bulletin* (Geneva, 1920-1946)
PB	Paris Bourse, *La Cote Officiele* (1919-1927)
PC	Pick, F., *Pick's Currency Yearbook* (New York, 1920-1939)
RT	Republique Turque Office Central de Statistique, *Annuaire Statistique* (Ankara, 1920-1939)
SB	Societe de Banque Suisse, *Manuel des valeurs cotees a la Bourse de Geneve et des changes* (Geneve, 1920-1939)
SJ	Central Bank of Hungary, *Statistische Jahrbuch* (1900-1920)
SS	Schneider Statistisches Reichsamt (1920-1922)
WW	Schneider, J., Schwarzer, O., and Zellfelder, F., *Wahrungen der Welt*, Vol. 1-10 (Stuttgart, 1991)

Notes on ambiguous sources	
1/	Commercial and Financial Chronicle; Federal Reserve Board, Federal Reserve Bulletin, Washington D.C.: U.S. Government Printing Office; Ufficio Italiano dei Cambi; Bundesbank, Exchange Rate Statistics; Reuters, Schweizerisches Nationalbank, Monatsbericht, Zurich
2/	Commercial and Financial Chronicle; Federal Reserve Board, Federal Reserve Bulletin, Washington D.C.: U.S. Government Printing Office; Ufficio Italiano dei Cambi; Bundesbank, Exchange Rate Statistics; Reuters, Schweizerisches Nationalbank, Monatsbericht, Zurich; Denmarks Bank, (1913-)
3/	Not specified
4/	Commercial and Financial Chronicle; Federal Reserve Board, Federal Reserve Bulletin, Washington D.C.: U.S. Government Printing Office; Ufficio Italiano dei Cambi; Bundesbank, Exchange Rate Statistics; Reuters, Schweizerisches Nationalbank, Monatsbericht, Zurich; Bank of England

Source: Global Financial Data www.globalfinanicaldata.com

Trade-weighted exchange rates are compiled using direction of trade figures from League of Nations, *International Trade Statistics 1938* (Geneva, 1939). Data are reported for 1928, 1935 and 1938. The trade-weighted indices thus do not precede 1928. Trade weights are constant from each of these years until replaced by the succeeding years. For example, the weight of the UK in Argentine trade in December 1934 is the 1928 weight.

These weights are usefully located, respectively, inside of the interwar gold standard (1925-1931), and before and after the Tripartite Agreement (September 1936). The trade weight is the proportion of trading partner trade in total home country exports and imports in goods. Effective indices are geometric averages of individual weighted percent weekly changes in cross rates. For a given country, the index is:

$$\left(\prod_{i}^{n} e_i^{w_i}\right)^{1/\sum_i^n w^i} \tag{4}$$

where w_i is the proportion of total trade conducted with partner *i* and *e* is percent weekly change in the bilateral cross-rate with the currency of partner k, where the cross-rate is quoted in local currency units per partner currency.

Numeraire

For the Lambda-Kurtosis Index, numeraire currency is assigned according to Table 3.

Table 3: Interwar numeraire assignment

'On' the interwar gold standard (convertible into gold or a gold-convertible currency)	Year<1933: numeraire is US dollar Year≥1933: numeraire is French franc
Listed as "pegged de facto in relation to another currency" by League of Nations	Numeraire is peg target
Neither	Year<1930: numeraire is lowest coefficient of variation exchange rate for 1919-1924 Year≥1930: numeraire is lowest coefficient of variation exchange rate for 1934-1939

Notes and sources:
For starting year of interwar gold convertibility (de facto if different than de jure), the source is Officer, L., "The Gold Standard", in Whaples, R., ed., The EH.net Encyclopedia (26 March 2008).
The starting week of interwar gold convertibility is identified as the final observation of ≥1% exchange rate change against the dollar in the year of stabilisation. For ending date of interwar gold convertibility, the source is League of Nations, Statistical Year-book 1939/1940 (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, Legal value of currencies and the valuation of gold reserves." Departure from the gold standard is indicated in this source by devaluation or imposition of exchange controls. Instances and dates of de facto pegged relationships are itemised in the same source, namely: League of Nations, Statistical Year-book 1939/1940 (Geneva, 1940), page 196: "Currencies maintained de facto in fixed relation to another currency". Coefficient of variation is the standard deviation divided by the mean.

It is customary to see the dollar as the only reference currency for the immediate post-World War One period, since only it was stabilised on gold. This was certainly the opinion of some contemporary observers,[218] but it might not reflect those of policymakers. It may be that currencies, to the extent that they were guided, were done so with reference to the most important trade partner. As such, numeraire assignment follows lowest coefficient of variation of the exchange rate, assigned separately for the pre- and post-1931 period. In the first, it is based on 1919-1924; and the second is 1934-1939. However, numeraire assignment is automatic (a) where the currency is on the gold standard, in which case the numeraire is the US dollar pre 1933 and France thereafter, and (b) where the currency is listed by the League of Nations as "fixed in relation de facto to another currency."[219]

Figure 9 reports the overall composition of numeraire currency in the international monetary system in the 1930s, according to the algorithm in Table 3. The y axis reports total observations per year in which the named currency is the numeraire. The total possible in any year is 52 weeks * 48 countries = 2496 observations per year.

[218] "The United States dollar constituted the central point of reference in the whole post-war stabilization effort and was throughout the period of stabilization at par with gold" -- Brown, W., Jr., *The Gold Standard Reinterpreted* (1940), 394, cited in Officer, L., "The Gold Standard" in Whaples, R., ed., EH.Net Encyclopedia (March 26, 2008), http://eh.net/encyclopedia/article/officer.gold.standard
[219] League of Nations, *Statistical Year-Book 1939/40* (Geneva, 1940), page 196: "Currencies maintained *de facto* in fixed relation to another currency."

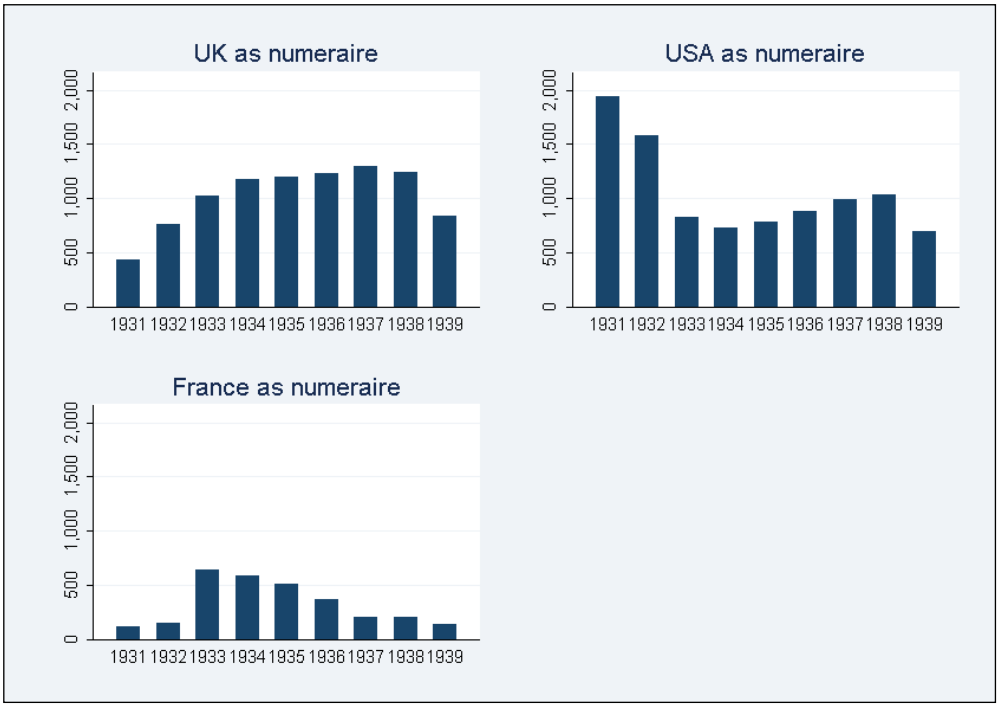

Figure 9: International numeraire assignment in the 1930s

Source: Author's dataset. See Table 3 for assignment algorithm.

Analytic weights

For summary statistics, analytic weights are share of panel GDP in constant dollars. The source is Maddison, A., "Historical Statistics for the World Economy: 1-2006 AD", Excel dataset, 2008. Gaps are imputed from time trends; missing observations are estimated from historic ratios to world GDP. For the modern (post-WW2) period, analytic weights are share of panel exports of goods, from IMF, *International Financial Statistics.*

Dynamic index for classification methodologies

For each country in the panel, a "dynamic numeraire" bilateral index is compiled in which the index value for time t is the index value in t-1 multiplied by the proportionate change in the numeraire exchange rate between time t-1 and time t. This allows changes of currency peg target to be made without disturbing the time series.

'Lunar' year

Insofar as the classification algorithms are reported on an annual basis (i.e. country X in year Y), there is a distinct possibility of missing important monetary changes introduced on the first day or week of the year. Thus the annual flexibility indices measure the current year plus the last observation of the previous year. For example, coefficient of variation of the exchange rate for 1933 is calculated over a period beginning in week 52 of 1932 and ending in week 52 of 1933; the coefficient of reserves is calculated similarly, over a 13-month year.

Reserves and sight liabilities

Foreign exchange and gold reserves data, as well as those for sight liabilities of the monetary authority, are from three sources. First is the US Federal Reserve, *Bulletin* (Washington DC, various issues), published monthly. Second is League of Nations, *Monthly Statistical Bulletin* (Geneva, various issues). Third is *The Economist* (London, various issues). All are transcribed by the author and checked for data entry errors. Figures are monthly, in millions of local currency units. Gold is valued at the latest legal parity and foreign exchange reserves are valued at market exchange rates.[220]

These are reserves of the central bank or monetary authority. However, in this period, several countries created currency-intervention funds with the proceeds from gold revaluation. The first intervention fund was Britain's Exchange Equalisation Account (EEA), set up in 1932.[221] This was joined by the United States (1934), Belgium (1935), and Switzerland, France and Holland (1936). Funds of less importance were set up in Canada and Argentina (1935); Spain, Latvia and Czechoslovakia (1936); Colombia and Japan (1937); and China (1939).[222]

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[220] The League of Nations *Bulletin* remarks in a footnote that "foreign reserves are believed to be valued at current exchange rates" and that gold is valued at the latest legal parity. Ideally, foreign-currency values of these reserves should be backed out of the local currency figures. This approach is not followed in the present draft. However, for the reader's benefit, international reserve series are reported in the appendix for four different numeraires: local currency, the French franc, the British pound, and the US dollar.

[221] Incomplete EEA data are reported by Howson for parts of 1932-1939. Howson, S., *Sterling's Managed Float: The Operations of the Exchange Equalisation Account, 1932-39* (Princeton, 1980).

[222] Bloomfield, A., *Capital Imports and the American Balance of Payments 1934-39: A Study in Abnormal International Capital Transfers* (Chicago, 1950), 148.

The author is aware of assets data only for the British EEA with monthly frequency. Unfortunately, even this source covers only discontinuous parts of the 1932-1939 period, making it of limited use in classification work.

For the modern period, reserves are reported in US dollars and re-denominated by the author where the country has an explicit or widely recognised non-US peg target. This means the Euro for EMR2 members and, for pre-1999, the Deutsche mark for ERM1/EMS members, and France for the CFA franc.

Panel and period

The broad panel contains 48 currencies, for which full exchange rate data are available and all cross rates are calculated, mostly in weekly observations from 1919 to 1939. These are Algeria, Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Cuba, Czechoslovakia, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, HK, Hungary, India, Indonesia, Ireland, Italy, Japan, Latvia, Lithuania, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Philippines, Poland, Portugal, Romania, Russia, South Africa, Spain, Sweden, Switzerland, Turkey, UK, USA, Venezuela and Yugoslavia.

Of these, 30, representing the preponderance of world trade, also have reserves data, for 1923-1939.

Observations for 1939 are truncated in order to exclude the outbreak of World War II: they run January-August inclusive (weeks 1 through 35). Statistics reported for 1939 are for this shortened time-span.

Gold convertibility, fx convertibility, and peg status

The interwar dataset is coded for observance of the gold standard. An observation is marked gold-convertible (i.e. on the gold standard) if it accords with Officer 2008. Officer reports only years of observance. [223] For weekly granularity, the gold standard is coded within the year reported by Officer, beginning with the final observation of 1% or greater change in the exchange rate against the dollar. The precise ending date of the gold standard is taken from League of Nations, *Statistical Year-book 1933/1934* (Geneva,

[223] Officer, L., "The Gold Standard", in Whaples, R., ed., *The EH.net Encyclopedia* (2008)

1934), page 206: "Dates of principal measures affecting exchange rates". For later in the decade, the source is League of Nations, Statistical Year-book 1939/1940 (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, legal value of currencies and the valuation of gold reserves." The Yearbook lists devaluations and capital controls separately from "Suspension" of the gold standard. In the author's dataset, convertibility is marked zero with the first of any violation of the gold-standard ethos (devaluation, fx controls or convertibility suspension).

Foreign exchange convertibility in the 1930s is coded 0/1 in accordance with League of Nations, *Statistical Year-Book 1939/40* (Geneva, 1940), pages 193-195: "Measures affecting exchange rates, Legal value of currencies and the valuation of gold reserves." Peg status (for the purpose of nomination of numeraire currency), is taken from League of Nations, *Statistical Year-Book 1939/40* (Geneva, 1940), page 196: "Currencies maintained de facto in fixed relation to another currency" and from Nurkse (1944), page 51: The Sterling Area.

High- and hyper-inflation

High inflation observations are coded for greater than 40% inflation. Qualifying observations are reported in Table 4. Inflation is calculated from the consumer price index, as sourced from Global Financial Data.

Table 4: High inflation observations, interwar period

	year	mean annual inflation
Austria	1919	89.8
Austria	1920	102.3
Austria	1921	205.7
Austria	1922	2992.0
Austria	1923	539.0
France	1920	42.6
Germany	1921	.
Germany	1922	.
Germany	1923	.
Hungary	1923	1663.7
Hungary	1924	1660.7
Italy	1920	56. 9
Philippines	1919	94.0
Poland	1922	228.5
Poland	1923	9220. 7

	year	mean annual inflation
Poland	1924	25460.6
Russia	1919	773.4
Russia	1920	1119. 4
Russia	1921	747.0
Russia	1922	7299.5
Russia	1923	5137.6
Russia	1924	43619.5
Russia	1932	84. 8
Russia	1933	49.7

Source: Author's dataset, calculated from CPI indices from Global Financial Data.

5. Results

Lambda-Peg Indicator

Figure 10 reports the percentage of observations coded as pegged per year, stacked by gold convertibility. "Pre-gold" are observations for regimes prior to taking up the gold standard and regimes, like Spain's and China's, which never took up the gold standard. "Post-gold" are regimes which have left the gold standard. The algorithm picks the appropriate peg for each 52-week period: an observation is coded "pegged" if the peg criteria are met using either the gold index or the exchange rate against sterling. This is an appropriate algorithmic choice: it allows the data to speak for itself. As Shambaugh notes, a float is unlikely to masquerade as a peg if it meets the 52-week ±2% corridor criterion.[224] This is even more applicable in the case here, where the corridor is ±1%.

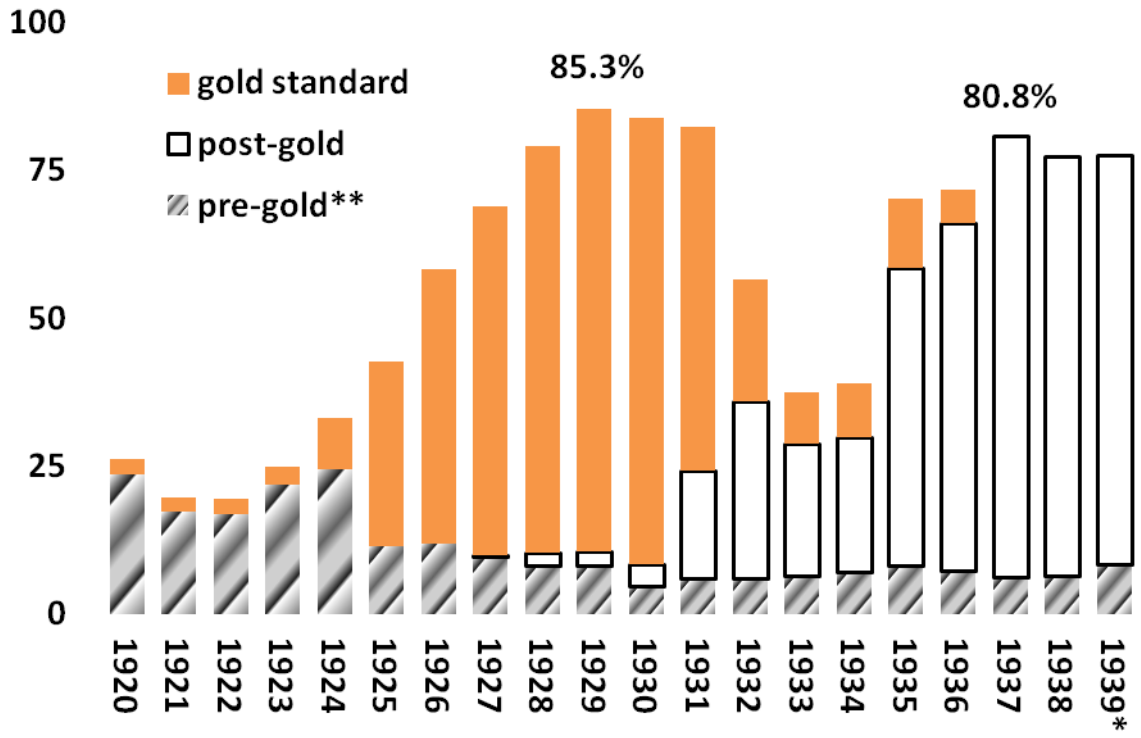

Figure 10: Pegged coding, % of annual observations, automatic numeraire

Source: See text.
Notes: *Truncated at 15/8/1939. **Or never gold.
The bars report the percentage of observations in 47 countries in 52 weeks per year which qualify as pegged on modified Shambaugh 2004 criteria. Shadings represent gold convertibility.

[224] Shambaugh, 'The effects of fixed exchange rates', 319.

Capital controls

Many countries kept fixed exchange rates with the help of capital controls. Figure 11 reports the percentage of open capital account observations coded as pegged. In 1930, 2347 observations (out of a total 2444) are open-KA regimes. The number falls to 1307 in 1938 (53% of total). Arguably, the League coding exaggerates the protection offered by most pegs. As noted earlier, Denmark is an example. Its controls were evaded on the current account, and by 1935 a fall in reserves forced the authorities to tighten policy.[225] Contemporary sources also note the relaxation of capital controls in many countries over the 1930s.[226]

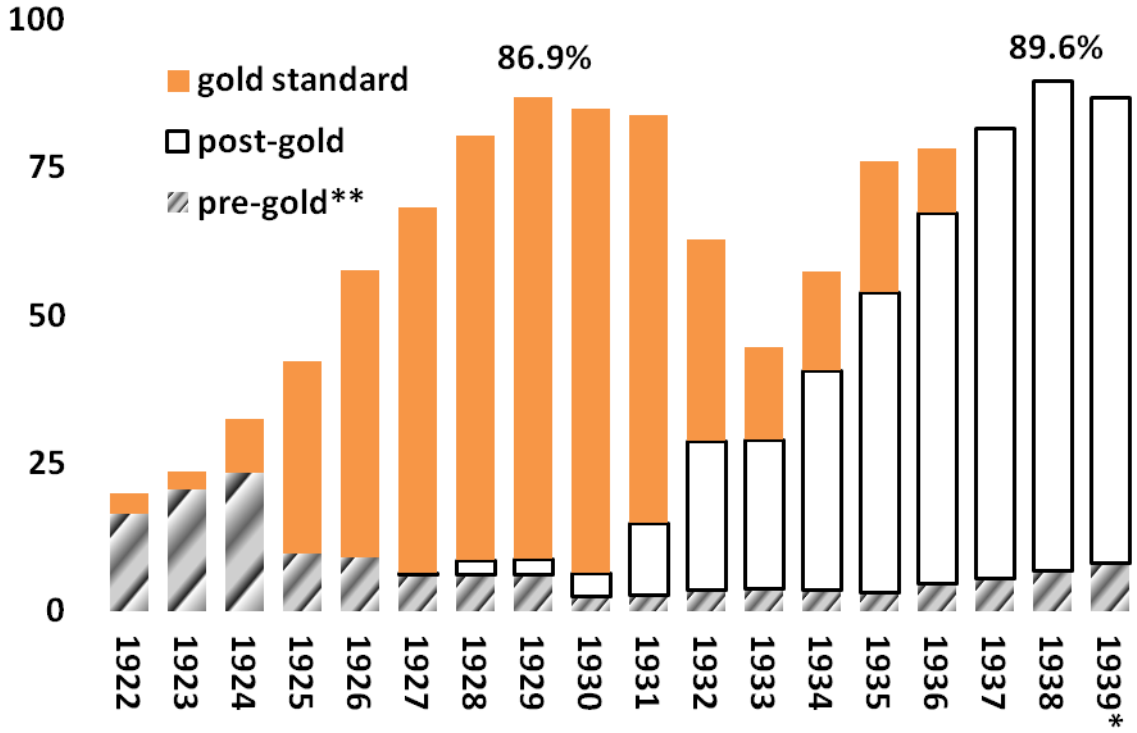

Figure 11: Pegs, % of observations for convertible currencies, automatic numeraire

Source and Notes: See Figure 10 and see text for details on numeraire assignment.

Pegging does not appear to be merely a reflection of the currency blocs which coalesced after the downfall of British gold convertibility in September 1931. The pegs reported here follow either sterling or gold, via a gold-convertible currency whose numeraire changed twice during the period (from US dollar to French franc and back to US dollar).

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[225] Nurkse, *International Currency Experience*, 82-83.
[226] Gordon, *Barriers to World Trade*, 87.

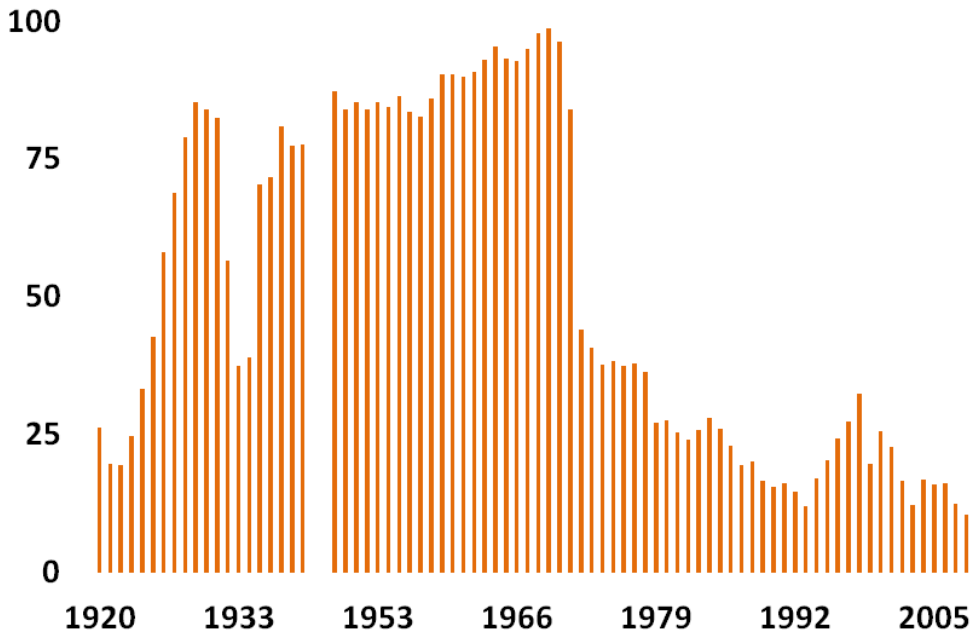

Figure 12: Pegged regimes 1920-2008, % of total annual observations

Source: See text.
Notes: Compiled from weekly observations of 47 countries with automatic numeraire; 1940-1945 excluded.

Lambda-Kurtosis Index

The modern period provides benchmarks for two poles of regime: free floating and hard pegging. Three kinds of stylised modern floating regime are noted in Table 5. To control for the possibility that the kurtosis-based flexibility index merely rewards market volume, Table 7 reports regime statistics segregated by trading in the Continuous Linked Settlement system.[227]

Table 5: Stylised floating regime constituents and dates

Group 1	since:	Group 2	since:	Group 3	since:
Germany	1973	Japan	1973	Chile	1998
Switzerland	1973	Australia	1984	Brazil	2000
Canada	1973	New Zealand	1984	Mexico	2000
UK	1993			Philippines	2000
Euro area	1999			South Africa	2000
				Israel	2003
				Colombia	2004

[227] CLS Bank is owned by the world's largest banks to manage settlement of foreign exchange between them (and for their customers and other third parties). CLS-traded currencies are listed in Table 6.

Table 6: Currencies traded through CLS

	since:		since:
Australia	2002m9	New Zealand	2004m12
Canada	2002m9	Norway	2003m9
Denmark	2003m9	Singapore	2003m9
Euro area	2002m9	South Africa	2004m12
Hong Kong	2004m12	South Korea	2004m12
Israel	2008m5	Sweden	2003m9
Japan	2002m9	Switzerland	2002m9
Mexico	2008m5	United Kingdom	2002m9

Source: CLS Bank.

Table 7: Stylised modern floats 2002-2008, summary statistics

group	CLS?		cv(E)	$[cv(E)]^{½}$	kurt(f'E)	cv(reserves)	λ reserves index	λ kurt index
0	0		10.95	1.71	8.37	7.98	0.32	0.32
		n	183	183	182	229	166	182
	1		1.6	1.12	5.84	5.32	0.31	0.29
		n	28	28	28	24	24	28
1	0		4.39	2.04	3.41	3.38	0.53	0.71
		n	4	4	4	11	4	4
	1		4.36	2.03	3.13	4.7	0.59	0.66
		n	24	24	24	24	24	24
2	0		4.8	2.18	4.26	10.35	0.22	0.58
		n	5	5	5	5	5	5
	1		5.2	2.16	4.31	9.84	0.8	0.55
		n	16	16	16	16	16	16
3	0		5.08	2.11	4.25	6.04	0.63	0.56
		n	42	42	42	42	42	42
	1		7.34	2.61	4.32	7.16	0.73	0.6
		n	4	4	4	4	4	4
groups 1-3	0		5.00	2.11	4.18	5.91	0.58	0.58
	1		4.94	2.13	3.67	6.79	0.68	0.62

Source: Author's dataset.
Notes: λ-reserves is the square root of the coefficient of variation of the exchange rate divided by the coefficient of variation of reserves. λ-kurtosis is the square root of the coefficient of variation of the exchange rate divided by the kurtosis of the % weekly change in exchange rate. Group means from weekly observations; group 0 is all other observations in the dataset (55-15=40 currencies during 2002-2008).

Table 8 and Table 9 are analogous to Table 6 and Table 7.

Table 8: Stylised pegs and dates

Group 4 Modern pegs	since:	Group 5 Bretton Woods 1948-1970	Group 6 East Asia pegs 1991-1996
Latvia	2005m5	Denmark	HK
Slovakia	2005m12	Belgium	Indonesia
Estonia	2004m7	Finland	Malaysia
Lithuania	2004m7	France	Korea
Slovenia	2004m6	Germany	Taiwan
HK	1983m10	Greece	Thailand
Denmark	1979m3	Japan	Singapore
		Netherlands	
		Spain	
		Switzerland	
		UK	

Table 9: Stylised pegs; groups defined in Table 8

group	CLS?		cv(E)	$[cv(E)]^{½}$	kurt(f'E)	cv(reserves)	λ reserves index	λ kurt index
0	0		8.92	1.74	12.09	12.42	0.24	0.34
		n	2694	2694	2187	1853	1752	2187
	0*		6.66	1.5	11.52	11.75	0.23	0.3
		n	2503	2503	2005	1721	1620	2005
	1		4.33	1.98	3.77	6.88	0.62	0.56
		n	59	59	59	55	55	59
4	0		0.66	0.69	6.71	9.63	0.13	0.16
		n	57	57	57	48	48	57
	1		0.5	0.62	7.86	3.72	0.24	0.15
		n	13	13	13	13	13	13
5	0		2.82	0.77	14.47	18.24	0.05	0.09
		n	264	264	197	147	147	197
6	0		1.23	1.03	7.15	7.68	0.17	0.23
		n	49	49	49	41	41	49
Groups 4-6	0		2.28	0.79	11.83	14.65	0.09	0.13
	1		0.50	0.62	7.86	3.72	0.24	0.15

Source: Author's dataset. See Table 6 for detailed notes. * excludes "freely falling" regimes, i.e. where inflation is greater than 40%.

Interwar period

Table 10: Interwar regime statistics, 1919-1939, by gold and fx convertibility

GS?	FX?	cv(E)	[cv(E)] ½	kurt(f'E)	cv (reserves)[a]	λ reserves index [a]	λ reserves index [b]	λ kurt index
0	0	7.49	1.96	13.88	11.04	0.80	0.13	0.24
	n	187	187	178	102	98	83	187
	1	6.63	1.97	9.48	10.98	2.16	0.10	0.39
	n	542	542	473	218	211	161	542
1	1	1.65	0.68	9.39	9.13	0.12	0.04	0.13
	n	267	267	227	172	169	139	266

Source: Author's dataset. "GS" indicates gold convertibility. "FX" indicates foreign-exchange convertibility. Sources for both are detailed in Part 4. (a) Reserves of gold and fx. (b) FX reserves only. "*n*" is country-year statistics making up the mean. Reserve statistics cover a subset of the dataset, as detailed in Part 4.

Table 10 reports the key interwar regime statistics for reserves- and kurtosis-based flexibility indices, grouped by gold-standard convertibility ("GS?") and foreign-exchange convertibility ("FX?"). In Table 11, the mean country-year statistic is grouped by phase of gold convertibility. Stage 1 is for all country-years prior to convertibility. For example, for Britain this is 1919-1924. Stage 2 is the beginning year of convertibility. Stage 3 is for country-years on convertibility. Stage 4 is the transition year when convertibility is lost. Stage 5 is for years off convertibility. Table 12 breaks out high-inflation observations during stage 1. Table 13 reports regime statistics for stage 5 by status of fx convertibility.

Table 11: International monetary system, 1919-39, by stage of gold convertibility

stage	cv(E)	[cv(E)] ½	kurt(f'E)	cv (reserves)[a]	λ reserves index [a]	λ reserves index [b]	λ kurt index
1	10.55	2.51	6.96	11.13	6.09	0.19	0.53
n	356	356	311	74	68	51	356
2	7.01	2	12.47	13.69	1.49	0.06	0.31
n	33	33	33	19	18	12	33
3	1.21	0.63	9.5	9.23	0.12	0.04	0.11
n	263	263	223	173	170	140	262
4	5.27	1.86	21.02	18.43	0.23	0.08	0.12
n	42	42	39	28	28	23	42
5	3	1.37	13.15	9.65	0.44	0.10	0.18
n	303	303	273	199	195	158	303

Sources and notes: Author's dataset. Stage 1 is for country-year statistics in years before convertibility. Stage 2 is in the year of transition to convertibility. Stage 3 is during convertibility. Stage 4 is in the transition year to post-convertibility. Stage 5 is post-convertibility. (a) Reserves of gold and foreign exchange. (b) Foreign-exchange reserves only. "*n*" is the number of individual country-year statistics making up the mean. Reserve statistics cover a subset of the panel, as detailed in Part 4.

Table 12: Interwar stage 1, by inflation category

40%+ inflation		cv(E)	[cv(E)] ½	kurt(f'E)	cv (reserves)[a]	λ reserves index [a]	λ reserves index [b]	λ kurt index
0		7.55	2.24	6.88	11.17	6.18	0.19	0.49
	n	334	334	291	73	67	50	334
1		56.07	6.6	8.05	7.93	0.27	0.27	1.24
	n	22	22	20	1	1	1	22

Source and notes: As in Table 10. The first row provides the regime statistics excluding observations with 40% or higher inflation, as reported in Table 4.

Table 13: Interwar stage 5, by fx convertibility

fx open		cv(E)	[cv(E)] ½	kurt(f'E)	cv (reserves)[a]	λ reserves index [a]	λ reserves index [b]	λ kurt index
0		4.07	1.63	14.31	9.41	0.64	0.09	0.18
	n	139	139	135	89	85	70	139
btwn[c]		5.79	2.03	11.69	22.25	0.43	0.15	0.28
	n	8	8	8	7	7	5	8
1		1.91	1.1	12.03	9	0.28	0.10	0.17
	n	156	156	130	103	103	83	156

Sources and notes: As in Table 10. Note (c): Statistic for year of switch between open and closed fx regime.

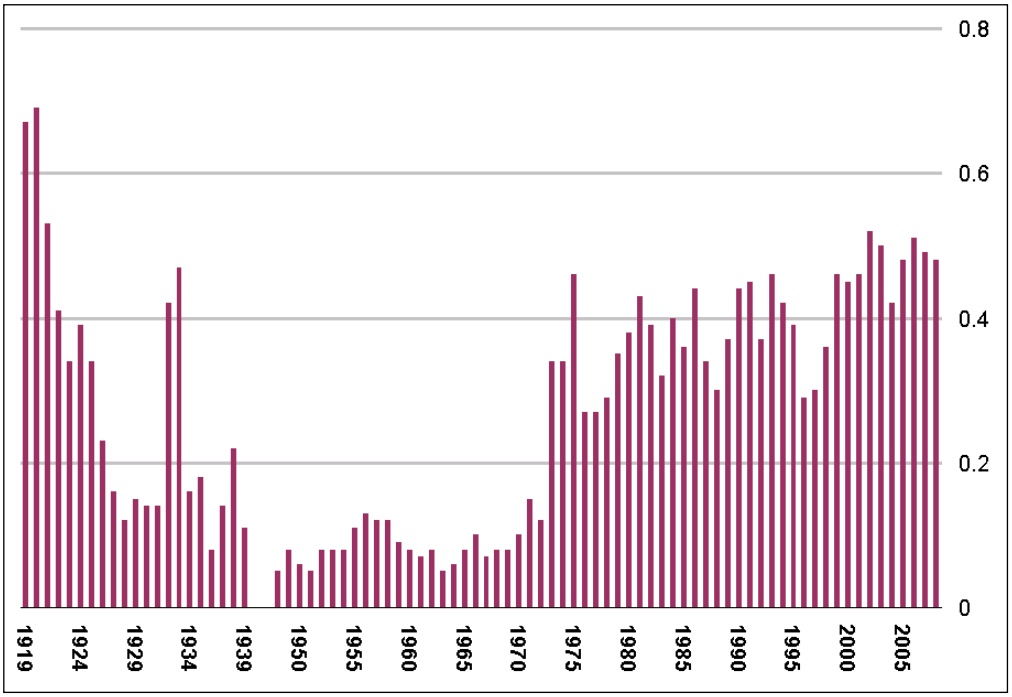

Figure 13: World monetary system flexibility, Lambda-kurtosis index

Source: Author's dataset.
Notes: Figures report weighted sums of country-year index scores. Excludes 40%+ inflation observations.

6. Interpretation

Floating seems to have existed only before adoption of the gold standard, mostly occurring immediately after the First World War. Afterwards there was essentially one exchange-rate regime: pegged. Gold convertibility is a separate matter. Countries which went off gold did not move to a float. The dollar's devaluation in 1933 caused much disruption but by 1935 pegging was as much in evidence as it had been at the peak of the gold standard.

Figure 10 on page 135 reported the percent of observations per year qualifying as pegged on the Lambda-Peg Indicator. Only in the immediate post-WWI years are a minority of regimes pegged. Thereafter, incidence of pegging approaches 100% at the peak of the gold-standard years and again after the nearly worldwide suspension of gold convertibility in 1931. Did the high incidence of pegging after 1931 merely reflect the choice by many countries to impose controls on foreign-exchange convertibility? Figure 11 on page 136 suggests not. It reports only observations for countries with fully convertible currencies; pegging incidence is high.

The Lambda-Kurtosis Index of flexibility accords with the Lambda-Peg Indicator. Benchmark index values for floating regimes during 2002-2008, reported in Table 7 on page 138, are between 0.58-0.62 for the lambda-kurtosis index.[228] The observations among floating groups 1-3 comprise a total of 15 currencies, listed in Table 5 on page 137. Similarly, index values for modern pegged regimes are 0.13 (kurtosis index) and 0.09 (reserves index). The CLS distinction suggests a key weakness of the reserves-based methodology: it gives fixed-regime observations under CLS a mean index score of 0.24.[229] This is because the CLS-listed currencies are likely to be higher-credibility regimes, in which case the need for intervention is smaller, since agents are more likely to speculate in pro-stabilising ways. Yet for the purposes of classification, it is important correctly to identify the flexibility of regimes; fixed regimes discourage adjustment via the exchange rate, whether credible or not. The modern period establishes poles of regime flexibility as summarised in Table 14 on page 143.

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[228] The mean values for country-years not among any of the three "floating" groups are between 0.31-0.32 for the lambda-reserves index and 0.29-0.32 for the lambda-kurtosis index. These 'code 0' observations comprise 40 currencies; by definition, they include a mixture of nonpure-floats, ranging from firm pegs to managed floats.

[229] CLS is the Continuous Linked Settlement platform for a select group of modern currencies.

Table 14: Summary values from modern benchmarks

	λ reserves index	λ kurt index
Freely floating	0.58-0.68	0.58-0.62
Hard pegs	0.09-0.24	0.13-0.15

Table 10 presented the broadest view of the interwar period, grouped according to gold convertibility, with the added distinction of inconvertible capital account under gold-non-convertibility. Reserves-based index values vary greatly depending upon the inclusion of gold within international reserves. Helpfully, the fx-based reserves index and kurtosis-based index judge regime flexibility in non-gold regimes to be 2.5 and 3 times higher, respectively, than in gold regimes. The kurtosis index reports a flexibility value for non-gold regimes of 0.39, close to the median between modern pegs and modern floats (0.37). To the extent that this is analogous to modern-day "managed" floats, this fits the judgement of non-gold interwar regimes as being some variant of floating.

Table 11 on page 140 reported observations by a finer distinction of inconvertibility. In particular, it distinguished between inconvertibility of the 1920s and that of the 1930s. The former preceded convertibility and is known as the post-World War One float. The latter is the subject of this paper, frequently known as the 1930s "managed float". The stages of main interest in Table 11 are 1, 3 and 5: pre-convertibility, convertibility, and post-convertibility. (Stages 2 and 4 isolate observations in the year of transition.) Stages 1, 3 and 5 are similarly sized, containing 356, 262 and 303 observations respectively for the kurtosis-based index; and 68, 170 and 195 for the reserves-based index. (The observations differ between the two indices because reserves data are from 1923-onwards.) The pre-convertibility score of 0.53 agrees with *a priori* understanding of interwar history; the score is only just below the range for modern freely floating currencies. Moreover, the 1920s float is only partly the result of high inflation regimes. Table 12 on page 141 reported a similar flexibility score when 40%+ inflation regimes are excluded.

The surprising result is lambda-kurtosis of 0.18 for post-convertibility. This is only just above the range for modern-day hard pegs. Table 13 on page 141 divided the post-convertibility observations by capital account regime. It reports a slightly lower score for open-KA regimes: 0.17. The reserves-based index scores again vary widely depending upon inclusion of gold. If gold is included, the reserves-based index suggests considerably higher flexibility in post-convertibility than under the gold standard. If gold is excluded,

flexibility in the post-convertible period is within the range of modern hard pegged regimes.[230]

Table 15: Summary values from interwar observations

	λ reserves index	λ kurt index
Pre-convertibility	0.19-6.18	0.49
Convertibility	0.04-0.12	0.11
Post-convertibility	0.10-0.28	0.17

Note: The reserves index show a range for gold-inclusive and –exclusive version of the lambda-reserves index. All values exclude high inflation observations and inconvertible fx regimes.

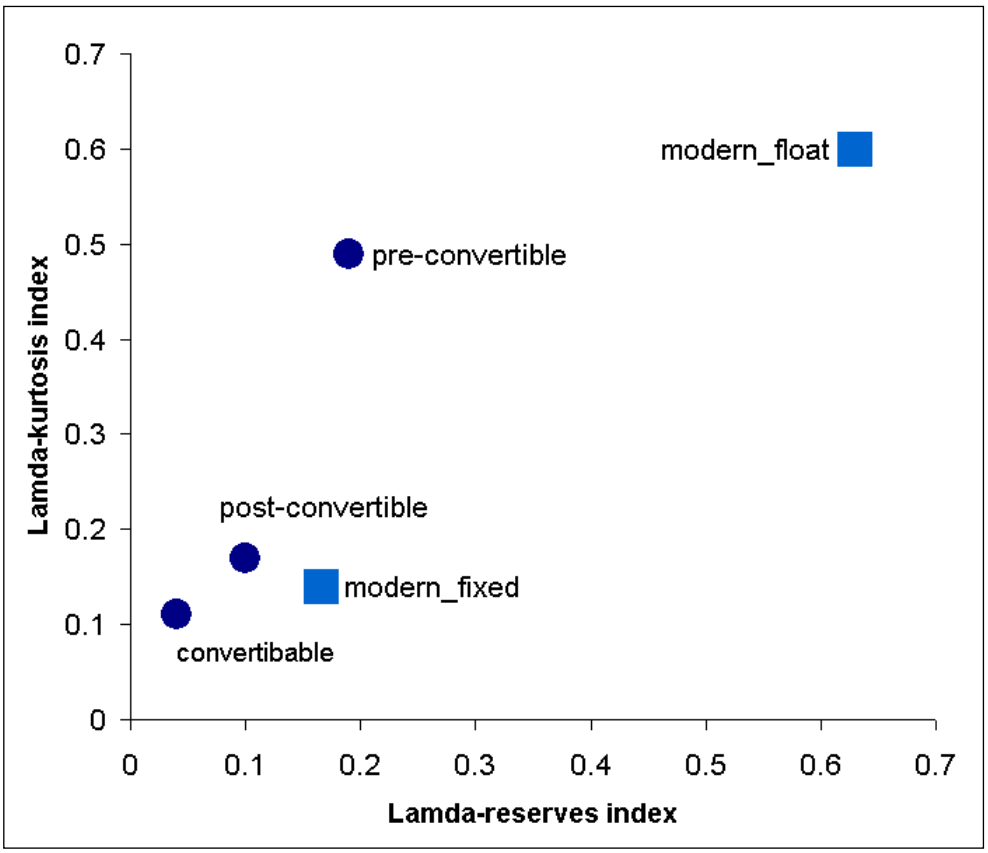

Figure 14: Flexibility scatterplot

Source: Author's dataset.
Notes: Lambda-reserves is foreign exchange only. The circles refer to interwar periods vis-à-vis gold convertibility. The squares refer to values for stylised groups of modern regimes.

[230] One reason to exclude gold is uncertainty over valuation in reported balance sheet data. However, fx-only data are problematic because, in many countries, gold-convertible fx are reported as gold itself, in keeping with the Genoa ethos of a "gold-exchange" standard.

Reserves might be a poor basis for measuring regime operation in the interwar period. As noted, reserve denomination is not widely known. In which case it is difficult to ascertain whether reserve values change because of exchange rates (price) or intervention (quantity).[231] Moreover, currency market intervention in the 30s was in many cases subsumed by ministries of finance under the aegis of 'exchange stabilisation' funds endowed from recognition of revalued gold reserves. Yet the published reserves data are generally those of the central bank.

Numeraire

Immediately upon devaluation of sterling in 1931 the dollar loses favour as numeraire, and its popularity gradually diminishes over the decade, until close to the outbreak of the Second World War (Figure 9, page 130). This is consistent with the findings of Eichengreen and Flandreau.[232] They note that both New York and London were important centres of liquidity, and that neither practiced very formidable capital controls.[233] Presumably also important was the international payments position run by the United Kingdom: its currency was readily available to exporters worldwide, as Britain ran an external deficit throughout this decade. Simple accounting dictated that no such balances of dollars could be accumulated.

Nurksean 'flexibility'

Nurkse is famous for documenting the "currency chaos of the great depression in the 'thirties".[234] Yet he carefully distinguishes between the "freely fluctuating exchanges" of the early 1920s and the "flexible" exchanges of the 1930s.[235] The confusion arises because, in today's parlance, "flexible" is akin to "floating". Nurkse has something different in mind: discretion. To Nurkse, a "flexible" currency is pegged, but its custodian retains discretion to alter that peg. We might today call this a *de facto* peg or adjustable peg.

> In the 'thirties, consequently, the situation was almost the reverse of what it had been in the 'twenties…. For considerable periods at a time, rates were 'pegged' or

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[231] An important contribution toward resolving this problem is underway. See Eichengreen, B., and Flandreau, M., 'The rise and fall of the dollar, or When did the dollar replace sterling as the leading reserve currency?', *CEPR Discussion Paper* 6869 (June 2008).
[232] *Ibid.*
[233] For details on informal British covenants restricting capital outflows, see Sayers, *The Bank of England, 1891-1944*, Volume 2, Appendix 30.
[234] Nurkse, *International Currency Experience*, 27.
[235] *Ibid*, 211.

> kept within certain limits of variation through sales and purchases of gold and foreign balances…. In this system of managed though flexible exchanges, gold … came to play a very important role.[236]

A currency becomes "flexible" when its peg is subject to discretion -- as happened when monetary authorities in most of the world suspended the obligation to convert the currency into a fixed amount of gold. Nurkse is clear that "freely fluctuating" currencies existed only for a short period after the First World War; they are what we would today call "floating". To Nurkse, a currency is "freely fluctuating" when the policymaker has no means to influence the exchange rate -- as happened when reserves had been exhausted, precisely the condition of the immediate post-WWI years. Nurkse liked neither of these:

> … the system of flexible exchanges in the 'thirties was associated with disturbances not very different from those associated with freely fluctuating exchanges [of the early 'twenties].[237]

Because he criticised both, his work is easily misinterpreted as a contemporary source for normative classification of 1930s floating. This can be cleared up by quoting him at length:

> The unprecedented wave of exchange depreciation in the early 'thirties affected all currencies in the world, except certain currencies in Central and Eastern Europe which were kept at the old parities by means of exchange control but not without resort to various forms of concealed depreciation. Wide and sudden changes took place in foreign exchange rates. Yet one of the facts that stands out from this experience is that monetary authorities in most countries had little or no desire for freely fluctuating exchanges.[238]

He continues:

> The pound sterling was a freely fluctuating currency only from September 1931 to the spring of 1932. Yet, though the pound itself was freely fluctuating in terms of the gold currencies during that period, a number of other currencies were pegged to it, thus giving up their own freedom to fluctuate. The United States dollar was a freely fluctuating currency from April 1933 to January 1934. France reverted to a "floating franc" from June 30, 1937 to May 4, 1938, though even in this period the exchange stabilization fund created after the devaluation of September 1936 occasionally intervened in the market.[239]

When Nurkse mentions the "devaluation cycle of the thirties", he states that "the term devaluation is here used in the sense of exchange depreciation followed by some form of

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[236] *Ibid*, 8-9.
[237] *Ibid*, 123.
[238] *Ibid*, 122.
[239] *Ibid*, 122.

stabilisation -- rigid or flexible -- at a lower level."[240] Nurkse is telling us that countries either pegged *de facto* (hence, a "flexible" stabilisation -- remember that "flexible", to Nurkse, equates with policy discretion) or maintained convertibility into gold. This is at odds with some of the late-1980s Great Depression literature, but is correct: Czechoslovakia and Belgium both resumed convertibility at depreciated rates.

> Some currencies (those of Czechoslovakia, Belgium, Italy, for example) underwent devaluation at one stroke, changing simply the level at which -- but not necessarily the method by which -- they were stabilised. Others settled down to a new level after a brief interval of uncontrolled fluctuation and were then more or less rigidly stabilized by being attached to gold or pegged to some other currency or subjected to intervention by exchange funds limiting the freedom and range of variation. [241]

Implications: 1930s

The exchange-rate-regime classifications presented here suggest the need to examine further the meaning of the worldwide loss of convertibility circa sterling's 1931 devaluation. Whereas the canonical literature portrays this as a regime change in the international monetary system, the findings of this paper might suggest the need for more emphasis on devaluation per se. The episode had reflationary effects, which explains why the first to leave the gold standard were the first to recover from the Depression.[242] The question is whether it presented policymakers with a novel solution to the 'trilemma'. These results suggest they did not. When pressures resurfaced, the response was defence of the exchanges, first with international reserves and then with domestic tightening, as seen in Denmark. When neither was possible, devaluation might ensue, but to a level defended by the monetary authority.

Such behaviour by the monetary authority is difficult to identify by variation in the exchange rate. Instead, it is revealed by the shape of the distribution of weekly changes in the exchange rate: those infrequent devaluations appear as large outliers around a preponderance of miniscule or no changes in the exchange rate. Kurtosis is this statistical property, and its use might have made sense to contemporary observers. They recognised that a floating currency, if suitably credible, could produce the stability sought by fixed regimes. This was anticipated in theory at least since the British 'bullionist debates' of the

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[240] *Ibid*, 122.
[241] *Ibid*.
[242] Eichengreen, B. and Sachs, J., "Exchange rates and economic recovery in the 1930s", *Journal of Economic History* 45:4 (Dec 1985), 925-946.

early 19th century.[243] Whale in 1936 emphasised the stabilising influence that short-term capital would have in a truly flexible regime.[244] Haberler noted the possibility in his 1937 League tract on growth theory, suggesting that short-term capital flows would fill-in any shortfall in currency demand that is deemed idiosyncratic.[245] Nurkse acknowledged that this was commonplace during the classical gold standard (1870-1914)[246], but dismissed its post-war potential.[247]

Bretton Woods and beyond

Was Bretton Woods a rejection of the 1930s? Certainly it was, insofar as it mustered an official consensus around international monetary rules that could not be achieved between the wars, perhaps most notably at the 1933 London Economic Conference. But it is hard to avoid seeing the imprint of the 1930s in the regime chosen at Bretton Woods. Outside of the exchange-clearing countries, the predominate choice seemed to centre on open current accounts, controls on short-term capital, and tight management or outright pegging of the exchange rate.[248] Little wonder that William Adams Brown, Jr., writing at the beginning of the 1940s, commented:

> It seems to me that the technical procedures of a [post-war gold standard] will be an elaboration and modification of those developed between 1934 and 1938.[249]

Finally, if 1930s exchange-rate regimes were not floating or "managed floating", it makes the international monetary system of that decade wholly different to the post-Bretton Woods system of today.[250]

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[243] Recounted in chapter four of Viner, J., *Studies in the Theory of International Trade* (New York, 1937).
[244] Whale, P.B., 'The theory of international trade in the absence of an international standard', *Economica* 3:9 (February 1936), 29.
[245] Haberler, *Prosperity and Depression* (London, 1964), 5th Edition, 441.
[246] Nurkse, *International Currency Experience*, 14.
[247] "After the experience of the inter-war period any attempt to reply once more on exchange speculation of the equilibrating sort would be doomed to instant failure." *Ibid*, 116.
[248] Eichengreen, among others, notes the parallels between the Tripartite Agreement and Bretton Woods. Eichengreen, B., 'International policy coordination in historical perspective: A view from the inter-war years', in W. Buiter and R. Marston, eds., *International Economic Policy Coordination* (Cambridge, 1985), 169-170.
[249] Adams Brown, W., Jr., 'Comments on gold and the monetary system', *American Economic Review* 30:5 (February 1941), 48.
[250] Eichengreen saw the 30s as precedent for the post-Bretton Woods floating. Eichengreen, *Golden Fetters*, 395.

7. Conclusion

This paper applied an adaptation of a modern currency regime classification algorithm to interwar exchange rate data. This "Lambda-Peg Indicator" identified the vast majority of interwar observations among 47 countries as "pegged", except for the early post-WWI period and the nearly universal suspension of gold convertibility in 1931. The 1930s pegs were not merely the result of capital controls; they were true of freely convertible currencies as well. The peg indicator is also applied to observations for most of the 20th century, showing the modern (post-Bretton Woods) years as comparable only to the early 1920s.

Using modern data, this paper also reported the utility of a classification index methodology. This "Lambda-Kurtosis Index" seems to overcome weaknesses in the conventional methodologies such as the proclivity of exchange-rate variation to misidentify brittle pegs as floats. Combining country-year Lambda-kurtosis values with country-year analytic weightings, an aggregate weighted index of world monetary system flexibility is presented in this paper.

Both methodologies portray a different picture than the one normally associated with the interwar period. The international monetary system returned to currency rigidity (or "stability") with the resuscitation of the gold standard, effectively from 1926 with French stabilisation. British devaluation in 1931 introduced three years of transition, where worldwide devaluations introduced temporary flexibility to the whole. Yet by 1934, the international monetary system returned to a degree of fixity which seemed to anticipate the post-WW2 Bretton Woods System.

Around 1931, the world did escape its golden fetters. But it did not float out of them; it devalued out of them. By implication, policymakers did not discover a novel solution to the trilemma in the 1930s. That development would have to wait another forty years, with the end of the Bretton Woods system.

Appendix 1: Exchange-rate regime classification empirics

The performance of various methodologies can be judged from their application to modern data. To do so, one must identify a standard against which to judge the results. This paper uses two standards. The first standard is IMF *de facto* classification. The Fund in 1999 developed a *de facto* classification methodology in recognition of the same problems with *de jure* classification pointed out by Calvo and Reinhart among others.[251] It subsequently applied this to members' exchange-rate regimes from 1990 onward.[252,253] The methodology is based partly on earlier Fund work by Ghosh, Gulde, Ostry and Wolf, who combined stated self-reporting of regimes with two additional distinctions: between frequent and infrequent peg changes; and between low and high foreign exchange market intervention (as reported by IMF desk officers).[254] The Ghosh et al database covers 1960-1990 over approximately 140 countries. The Fund's privileged access to national authorities might make its *de facto* classifications the best available standard against which to judge a *de facto* classification methodology. Yet the politicised nature of exchange-rate regimes might raise questions about the Fund's objectivity in making regime judgements.[255] Hence, a second standard employed in this paper is market consensus of regime type.[256]

Performance of classification methodologies

As noted, exchange-rate regime classification literature in general relies on two observable statistics: variance in the exchange rate and variance in reserves. This section of the paper uses these statistics to judge regime flexibility against two types of benchmarks. The first benchmark is the *de facto* classifications published by the IMF. A typology of these

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[251] International Monetary Fund, 'Exchange rate arrangements and currency convertibility: Developments and issues,' *World Economic and Financial Surveys* (Washington, 1999).
[252] Bubula, A. and Otker-Robe, I., 'The evolution of exchange rate regimes since 1990: Evidence from *de facto* policies,' IMF *Working Paper* 02/155 (Washington, 2002).
[253] IMF semi-annual *de facto* classifications from 2003-onward are reported at www.imf.org/external/np/mfd/er/index.asp. See author for printout.
[254] Ghosh, A., Gulde, A., Ostry, J., and Wolf, H., 'Does the nominal exchange rate regime matter?', *NBER Working Paper* 5874 (Cambridge MA, 1997).
[255] IMF oversight of semi-annual exchange-rate regime classification by the US Treasury, required by a 1988 US law, illustrates the political hazards of Fund classification. See Henning, C.R., 'Congress, Treasury, and the accountability of exchange rate policy: How the 1988 Trade Act should be reformed', Peterson Institute *Working Paper* 07-8 (September 2007).
[256] Based on stylised impressions of regime type. Ideally, one might want to base this on interview data of market participants' impressions of regime type.

classifications is presented in Table 16. The second benchmark is a stylised view of currency regime flexibility or "conventional wisdom" regarding regime type.

Approach 1: Exchange-rate variability

Figure 15 reports the means of annual currency variability in the years 2003, 2004, 2005 and 2006 for five categories of exchange-rate regime using IMF *de facto* exchange rate regime classifications. Regime categories are coded in increasing flexibility, where 1 is "currency board" and 5 is "independently floating".[257] In other words, Figure 15 compares the currency-variability method of *de facto* exchange rate regime classification to an explicit *de facto* classification of a third party, the IMF. The results suggest a good fit: exchange-rate variation rises with category of currency regime; fixed regimes have lower variability than floats.

Table 16: Key to IMF *de facto* exchange-rate regime categories

1	Currency Board Arrangements
2	Other Conventional Fixed Peg Arrangements
	Pegged Exchange Rates within Horizontal Bands
3	Crawling Pegs
	Exchange Rates within Crawling Bands
4	Managed Floating with No Predetermined Path for the Exchange Rate
5	Independently Floating

Source: International Monetary Fund. http://www.imf.org/external/np/mfd/er/index.asp
PDF printouts are available from the author.
Note: Ordinal ranks are assigned by the author. IMF categories are further detailed in Appendix 2.

The numeraire for Sweden, Denmark and the CFA franc is the euro. For all others it is the US dollar. The US dollar is not classified because its flexibility is determined by its trade partners – a consequences of being the centre currency.[258] How does the methodology compare to stylised impressions of currency regime? Figure 16 ranks 28 currencies in the 2001-2006 period by coefficient of variation in exchange rates (in percentage terms).[259] This compares the currency-variability measure to stylised consensus views. Here too the outcome is satisfactory: stylised free floaters have the highest exchange-rate variability.

[257] Table 16 provides a key to the IMF regime ranks; complete regime descriptions are in Appendix 2 on page 93.
[258] Nurkse commented on this peculiarity -- regarding sterling at the centre of the interwar sterling bloc. Nurkse, *International Currency Experience*, x.
[259] Coefficient of variation is the standard deviation divided by the mean.

One problem here could be the sample: 2001-2006 was a calm period in international finance, with falling sovereign spreads and improving external balances outside of the United States. To incorporate more tumultuous periods, Figure 17 reports coefficient of variation for the 1991-2006 period. The results suggest that currency variability is misleading over longer periods, e.g. of 10 years or more. The most stable currencies are those whose regimes are commonly accepted to be free floating. Currency variability here misidentifies floats as pegs or intermediates.

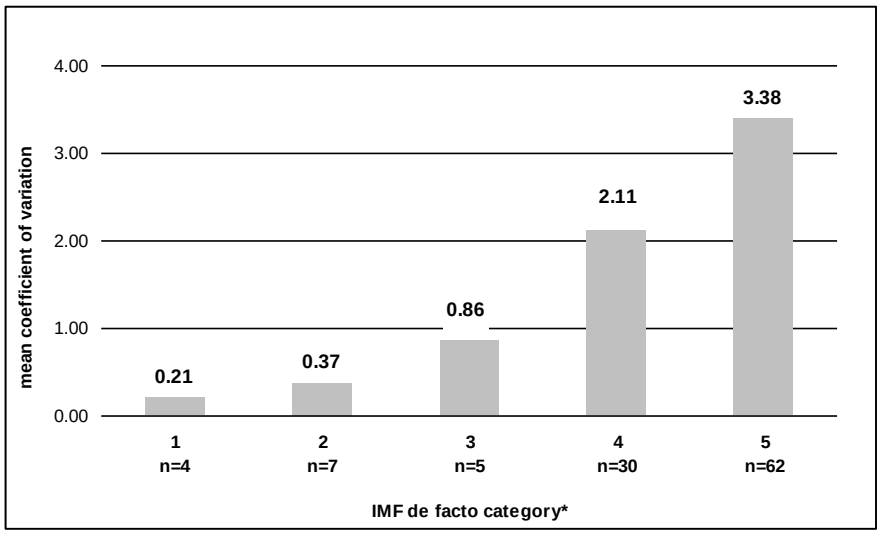

Figure 15: Mean currency variability by category of IMF regime classification

Source: Author
Notes: * Categories are arranged in increasing flexibility. See Table 16 for a key.
The coefficient of variation of exchange rate is calculated on an annual basis from weekly exchange rate observations for 27 currencies in 2003, 2004, 2005 and 2006. For each year, the currency is coded 1 to 5 based on IMF de-facto exchange-rate regime classification, as shown in Table 16. The figures in bars report the c.v. mean for each rank over the combined four years. Group populations are reported on the x axis.

Such a result is not surprising. In an actively traded foreign exchange market, agents have an incentive to take positions which stabilise the exchange rate. Those with confidence in the fundamentals of a currency might use a period of inordinate weakness to purchase the currency and inordinate strength to sell. The net effect is to stabilise the exchange rate.

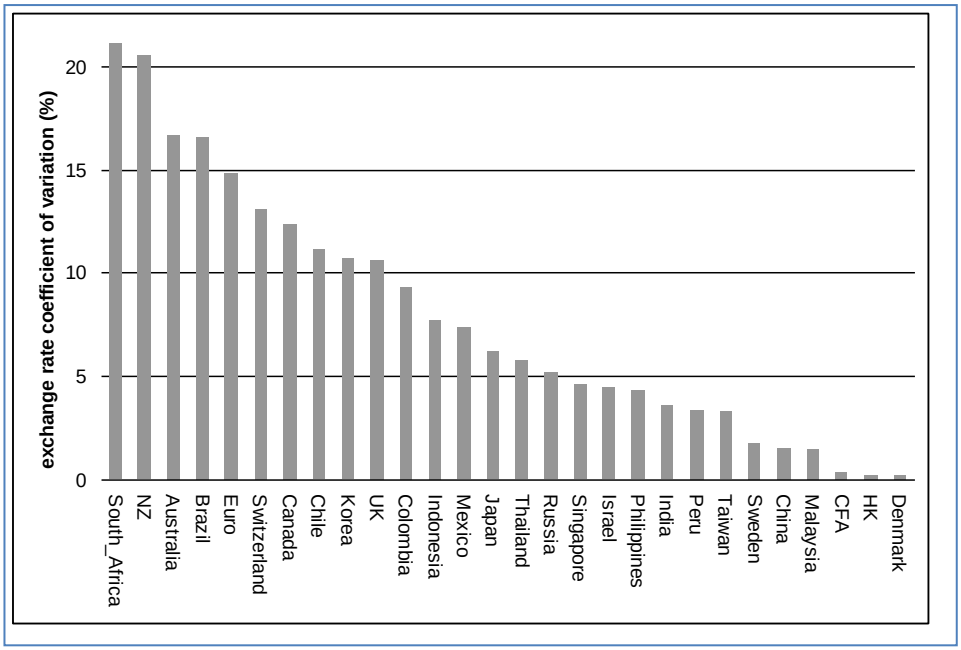

Figure 16: Exchange-rate variation in 2001-2006

Source: Author
Notes: The y-axis is coefficient of variation (%) of the exchange rate for 2001-2006, weekly observations.

Figure 17 shows that exchange-rate outcome is also susceptible to misidentifying pegs and intermediates as floats. Pegs periodically succumb to devaluation pressures except where the currency appears undervalued (China) or where domestic wages and prices are downwardly flexible (Hong Kong). The result is a high variance statistic despite an underlying pegged regime. The key examples in Figure 17 are Malaysia and the Franc CFA (*Communauté financière d'Afrique)*. Both exhibit higher variance statistics than do the stylised floaters (highlighted in a lighter tone) yet are pegged regimes. Until July 1997 Malaysia had a *de facto* ± 2% peg to the dollar, after which it transitioned to a tight dollar peg in October 1998. The Franc CFA was pegged throughout the 1991-2006 period; a one-time devaluation produces the high variance statistic.[260]

[260] Currency chronologies are catalogued in Reinhart and Rogoff, 'The modern history of exchange-rate arrangements', 54-104.

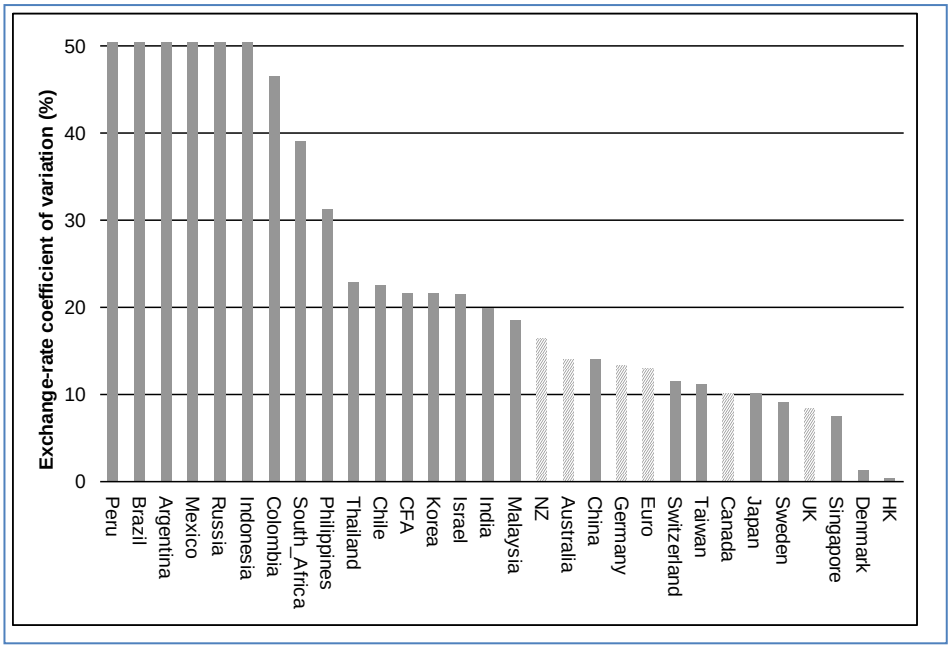

Figure 17: Exchange-rate variation, 1991-2006

Source: Author
Notes: The y-axis is coefficient of variation (%) of the exchange rate for the 1991-2006 period, based on weekly observations. Stylised free-floaters with medium or low variability are highlighted. Values are truncated at the 50% level.

An exchange-rate regime classification methodology relying exclusively on variation of the exchange rate will sometimes produce a 'false positive' for a pegged regime which is in fact floating, and will sometimes produce a 'false positive' for a floating regime which is in fact pegged or otherwise rigid. It overlooks the possibility that a free float breeds stability.

Approach 2: International reserves variability

A second approach to exchange-rate regime classification is measurement of policy tools -- a more direct gauge of regime intention. The most commonly used tool in the literature is international reserves variation.[261] The measure of variation employed throughout is coefficient of variation: standard deviation divided by the mean. This ensures that

[261] Reserves can change for reasons other than exchange-market intervention. Valuations can change, reporting can be poor, and reserves can change due to active portfolio management by the monetary authority. Additionally, a highly credible monetary authority backed by a highly flexible domestic economy can enjoy market support for the peg, necessitating minimal intervention. See Archer, D., 'Foreign exchange market intervention: Methods and tactics,' *BIS Papers* 24 (May 2005), 44.

comparisons between countries are on a like-for-like basis; i.e., the statistic is comparing equally scaled reserves changes.[262]

Figure 18 maps reserves variability to the IMF regime rankings. Rankings of international reserves variability over discrete periods are reported in Figure 19 and Figure 20.

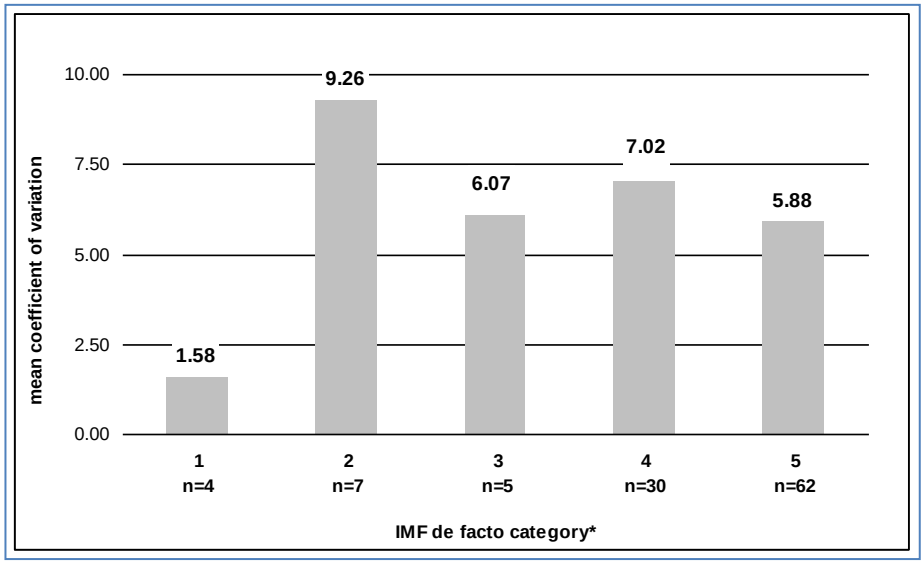

Figure 18: Mean reserves variability by category of IMF regime classification

Source: Reserves are from IMF International Financial Statistics, "total reserves excluding gold".
Notes: * Categories are arranged in increasing flexibility. See Table 16 for a key.
The coefficient of variation of reserves is calculated on an annual basis from monthly reserves observations for 27 currencies in 2003, 2004, 2005 and 2006. For each year, the currency is coded 1 to 5 based on IMF de-facto exchange-rate regime classification, as shown in Table 16. The figures in bars report the c.v. mean for each rank over the combined four years. Group populations are reported on the x axis.

[262] This problem is sometimes addressed in the literature by scaling reserves changes by the monetary base. Examples include Poirsson, 'How do countries choose?' and Levy-Yeyati and Sturzenegger, F., 'Deeds vs Words'.

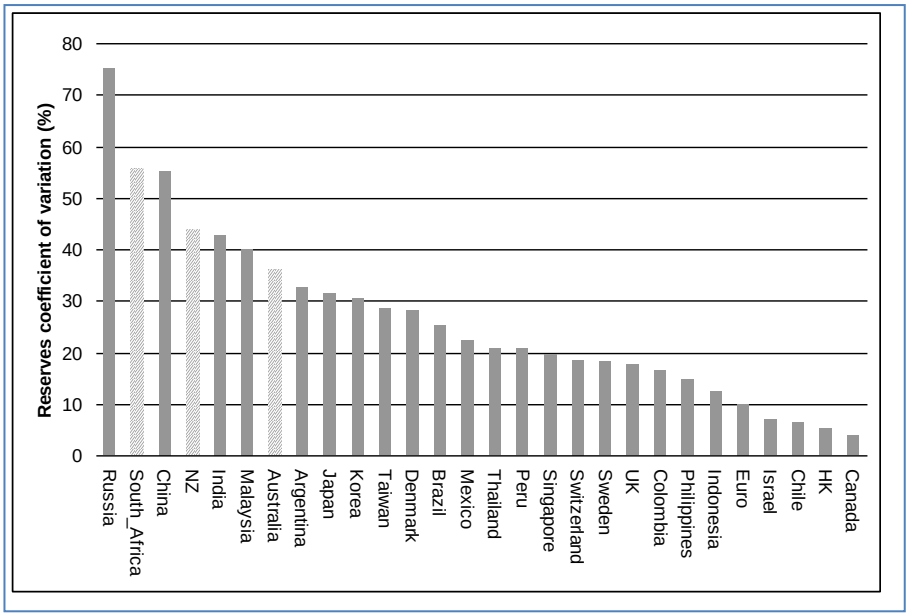

Figure 19: International reserves variation, 2001-2006

Source: Author
Notes: The y-axis is coefficient of variation (%) of international reserves, not seasonally adjusted, for the 2001-2006 period, based on monthly observations. Stylised free-floaters with high variability are highlighted.

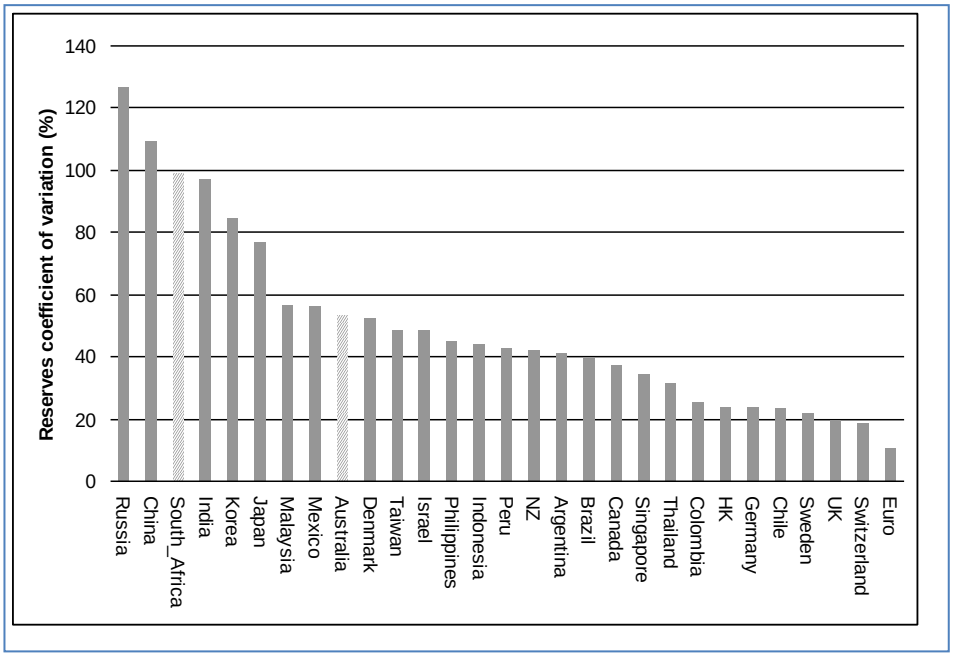

Figure 20: International reserves variation, 1991-2006

Source: Author
Notes: The y-axis is coefficient of variation of reserves (in percent terms), not seasonally adjusted, for the 1991-2006 period, based on monthly observations. Stylised free-floaters with high variability are highlighted.

Figure 18 suggests that reserve variation does not map well to IMF *de facto* regime coding. Figure 19 improves the validity of this measure vis-à-vis stylised consensus views on currency regimes. For example, Canada displays the lowest reserves variation in the group, and the UK and euro-area are among the lowest. Nevertheless, anomalous results include high variability for South Africa and Australia, which are both commonly understood to maintain floating exchange-rate regimes.

Reserves variation produces fewer 'false positives' for regime type than does currency variation. Yet a significant anomaly in the reported reserves results is Hong Kong. Its currency board regime, an extreme form of currency peg, would be incorrectly identified as a highly flexible regime due to the low variability in reserves.[263]

Flexibility indices

These methodologies are sometimes combined into a composite index measuring degree of currency regime flexibility.[264] For the index to be increasing in regime flexibility, outcome-based measures (e.g. exchange-rate variability) are in the numerator and policy-based measures (e.g. reserves variability) are in the denominator. Activist use of policy instruments suggests greater intervention in the foreign exchange market and hence a lower degree of floating.[265]

The performance of such indices can be judged from application to modern data. Figure 21 reports results from a generic index, to be called here "Lambda-standard". Its numerator is coefficient of variation of the exchange rate and denominator is coefficient of variation of reserves. Figure 22 and Figure 23 report individual currency results for the periods 2001-2006 and 1991-2006 respectively.

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[263] As highlighted in footnote xx.
[264] Calvo and Reinhart, 'Fear of floating', 400 and Poirson, 'How do countries choose?'.
[265] The short-term policy interest rate is another measurable instrument. See footnote xx.

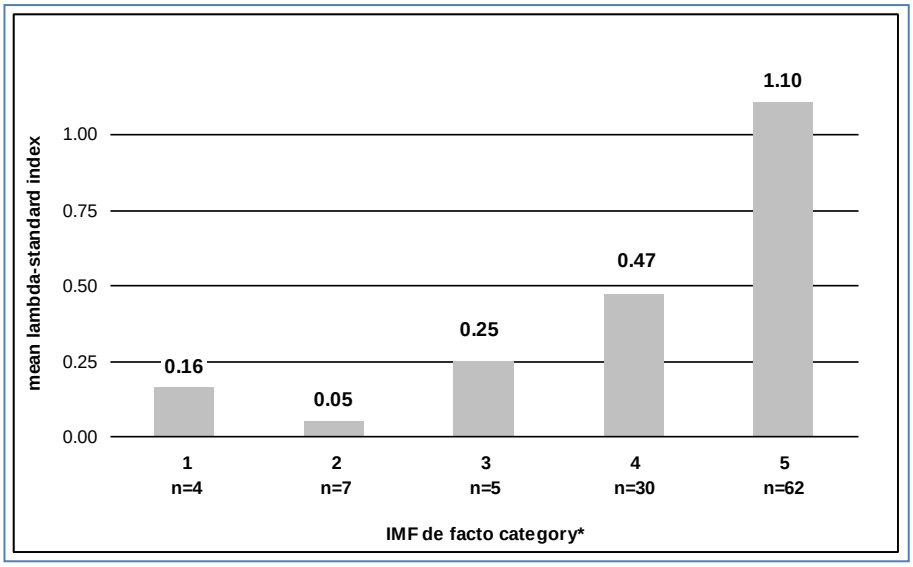

Figure 21: Mean Lambda-standard currency index by category of IMF classification

Source: Author

Notes: * Categories are arranged in increasing flexibility. See Table 16 for a key.
The Lambda-standard index is c.v. of exchange rate / c.v. of reserves less gold. The mean of the index is calculated on an annual basis for 27 currencies in 2003- 2006. For each year, currency is coded 1 to 5 based on IMF de-facto regime classification, as in Table 16. The figures in bars report the mean for each rank over the combined four years. Group populations are reported on the x axis.

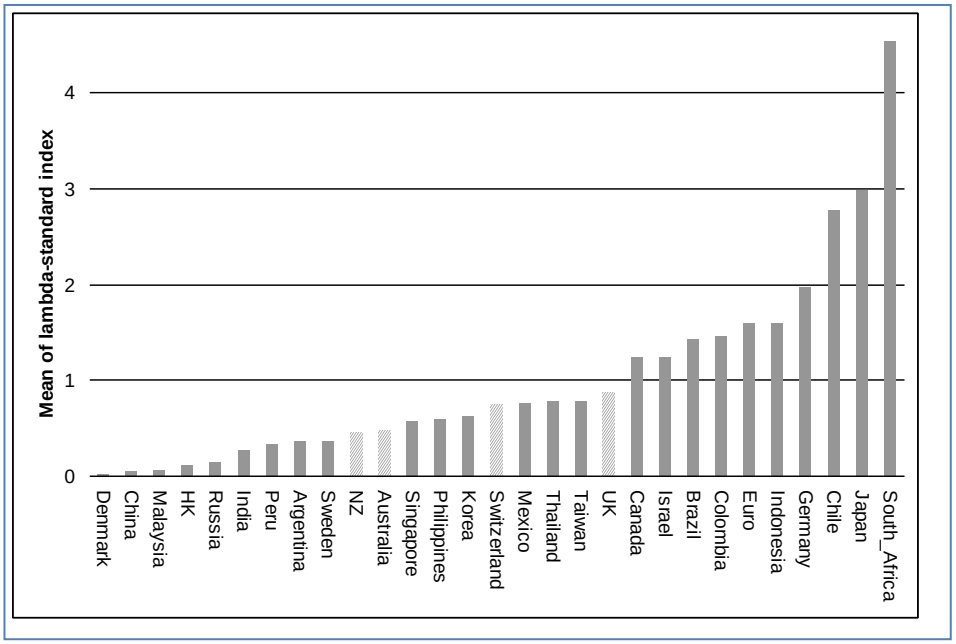

Figure 22: Lambda-standard index values, mean for 2001-2006

Source: Author

Notes: The y-axis is the mean of annual calculations of Lambda-standard for each currency. Lambda-standard is c.v. exchange rate / c.v. reserves. Stylised free floaters with low flexibility scores are highlighted.

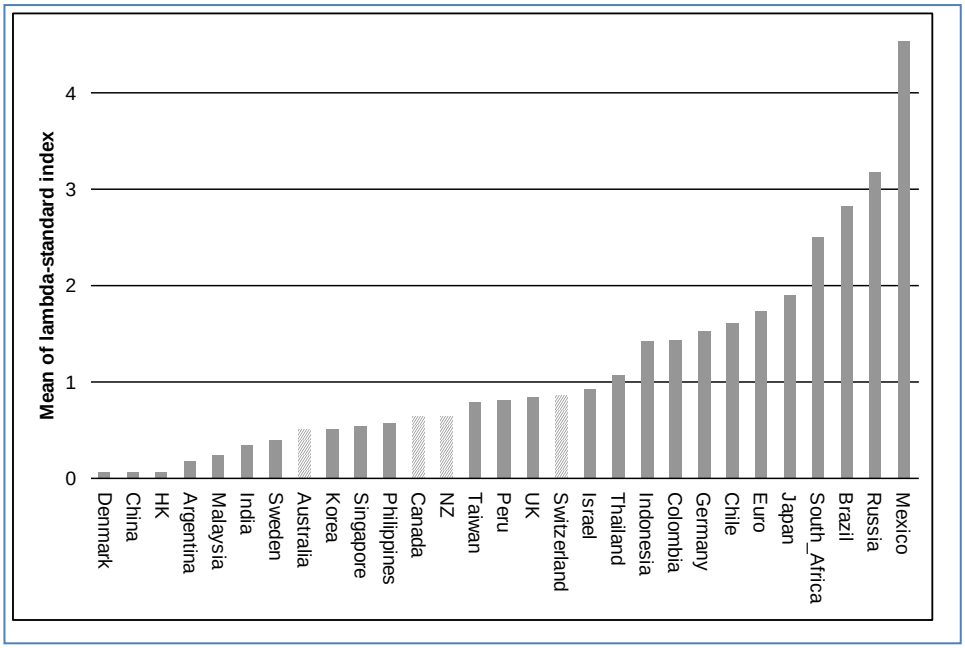

Figure 23: Lambda-standard index values, mean for 1991-2006

Source: Author
Notes: The y-axis is mean of annual calculations of Lambda-standard. Lambda-standard is c.v. exchange rate / c.v. reserves. Stylised free floaters with low scores are highlighted.

Figure 21 suggests a good mapping from IMF *de facto* regime category to currency regime classification methodology. However, category 2 -- "other conventional fixed peg arrangements" -- has a lower mean score than does category 1, "currency boards". Figure 22 and Figure 23 report several anomalous results vis-à-vis stylised floating regimes. In Figure 22, Australia, New Zealand, Switzerland and the UK, which are all considered to be floating regimes in the 2001-2006 period, exhibit very low currency flexibility index scores. In Figure 23, Canada, a long-time stylised floater, exhibits a low flexibility ranking in the 1991-2006 period.

These anomalies reflect weaknesses in the separate components of the index. In the case of Canada, the weakness is in the numerator: coefficient of variation of the exchange rate. Low variability in the Canadian dollar / US dollar exchange rate is pushing down the index value. In the case of Australia and New Zealand, the weakness is in the denominator: coefficient of variation of reserves. High reserves variation is pushing down the index.

The Lambda-standard index delivers plausible results in most cases, but anomalies make it a flawed measure of regime flexibility. The next section suggests alternatives, and submits them to the same tests: IMF *de facto* classifications and stylised views.

Lambda-adjusted index

Reserves variability has a stronger theoretical basis for use as an indicator of regime type than does exchange-rate variability. Yet its performance is only marginally better. One reason could be that the technique does not reflect realistic policymaking conditions. Recall from identity 1 the balance of payments floating condition:

$$\Delta \text{ international reserves} \equiv 0$$

This is too rigorous for most countries. In an insufficiently deep foreign exchange market, the monetary authority might meet temporary discrepancies in the balance of payments with funds from its reserves in the face of an exceptional deficit, or buy reserves in an exceptional surplus. The monetary authority of a small, open economy might use reserves to smooth seasonal distortions. A coffee exporter might buy reserves during the export season and sell them during seasonal weakness. Hence, the floating condition can be inter-temporal, in which case reserve changes net to zero over a discrete period (i), or when seasonally adjusted (ii).

Managed floating condition, option 1 $\quad \Sigma$ *(12 months)* Δ *international reserves = 0* (i)

Managed floating condition, option 2 $\quad \Delta$ *intl reserves, seasonally adjusted = 0* (ii)

Figure 24 - Figure 26 report seasonally adjusted equivalents of Figure 21 - Figure 23.

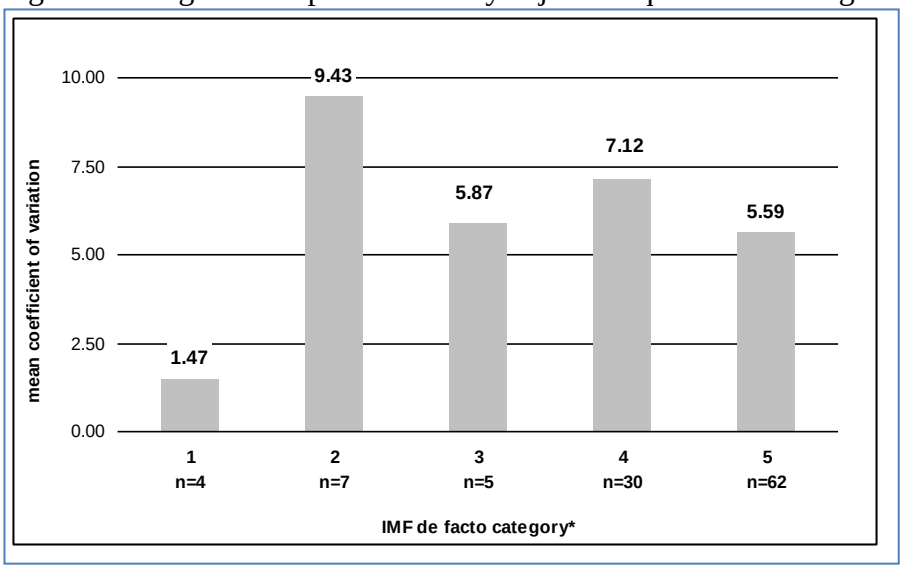

Figure 24: Seasonally adjusted reserves variation, by IMF category

Source: Original data are from IMF IFS "total reserves less gold".
Note: Seasonally adjusted using the US Census X-11 software.

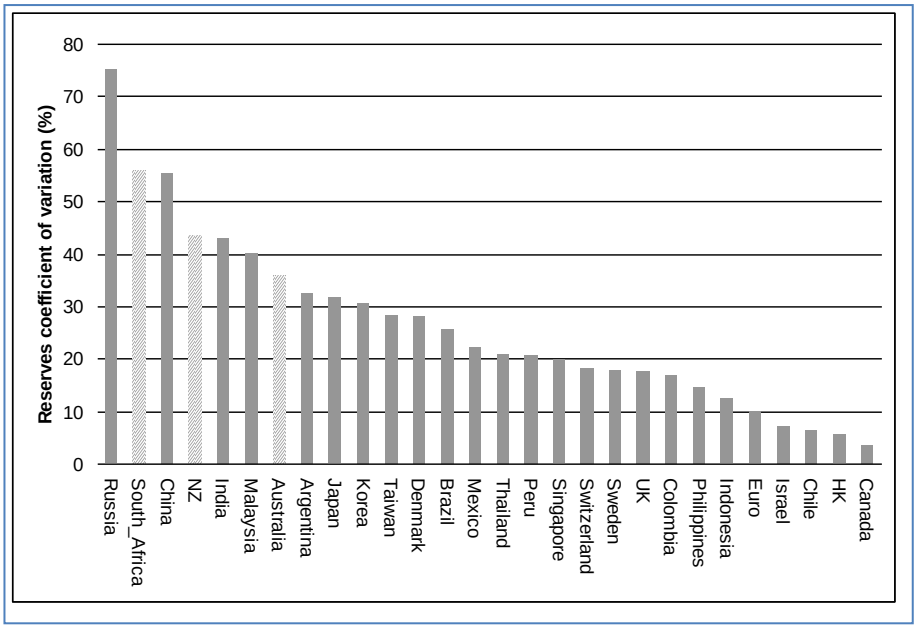

Figure 25: Seasonally adjusted reserves variation, 2001-2006

Source: Original data are from IMF IFS "total reserves less gold".
Note: Seasonally adjusted using the US Census X-11 software.

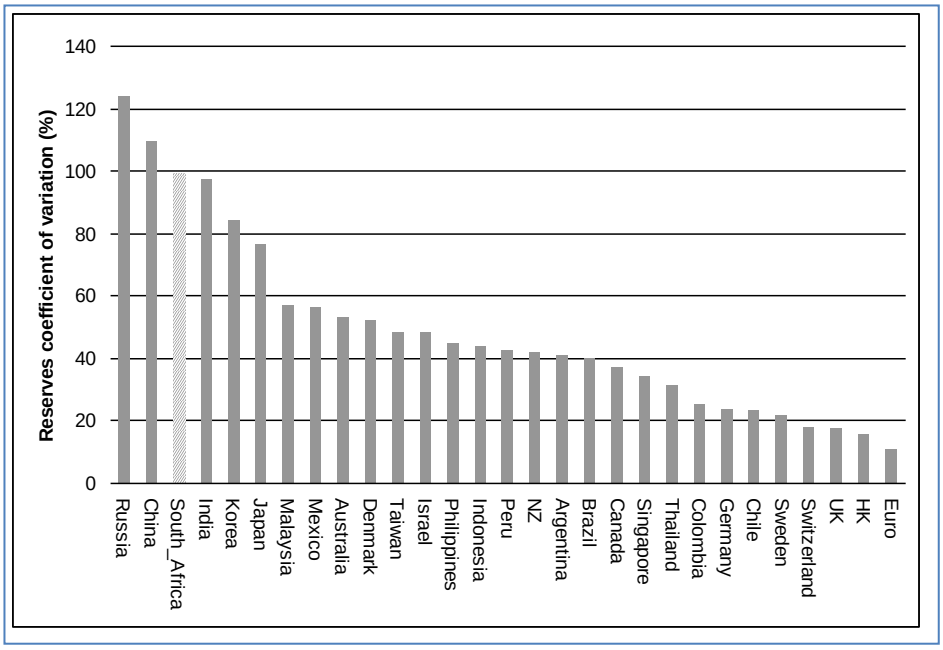

Figure 26: Seasonally adjusted reserves variation, 1991-2006

Source: Original data are from IMF IFS "total reserves less gold".
Note: Seasonally adjusted using the US Census X-11 software.

Reserves variation declines as regime-flexibility rankings increase, with two exceptions: Category 1 (currency board) and Category 3 (intermediate regimes). The reason for these

exceptions is credibility. Both categories are populated almost exclusively by high-credibility pegs: the Hong Kong dollar (Category 1) and the Danish krone (Category 3). One result of their credibility is a smaller recourse to intervention. In other words: the market believes the monetary authority will preserve the peg, so it anticipates that movement in a pro-stabilising way.

Figure 25 and Figure 26 suggest considerable improvement from seasonal adjustment. Stylised free floaters mostly populate the lowest ranks of reserves variability. However, an important exception is South Africa. Also anomalous is Hong Kong, with among the lowest reserves variability. This prevents the technique from correctly identifying the level of HK dollar regime fixity. Figure 27 through Figure 29 report a Lambda-adjusted index, where currency coefficient of variation is divided by coefficient of variation of seasonally adjusted reserves. The index is increasing in regime flexibility.

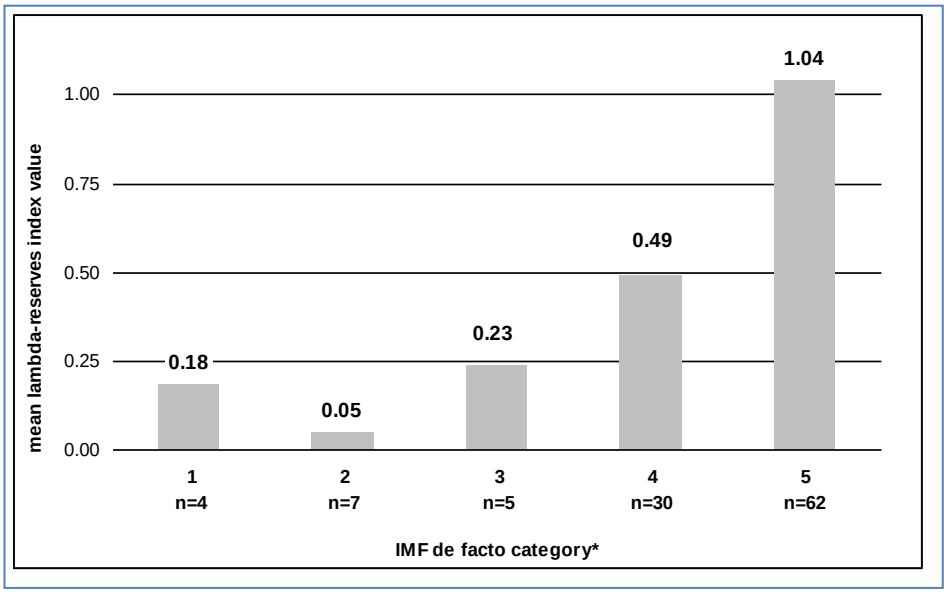

Figure 27: Lambda-adjusted index value, by IMF category

Source: Author
Notes: Lambda-adjusted is c.v. exchange rate / c.v. reserves, seasonally adjusted.

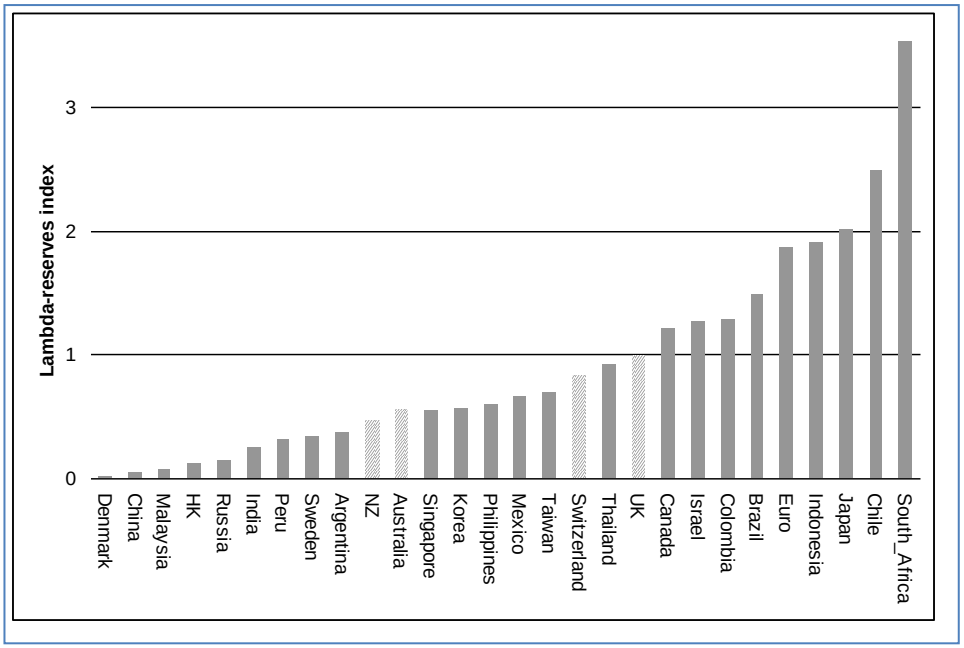

Figure 28: Lambda-adjusted index, 2001-2006

Source: Author
Notes: Lambda-adjusted is c.v. exchange rate / c.v. seasonally adjusted reserves.

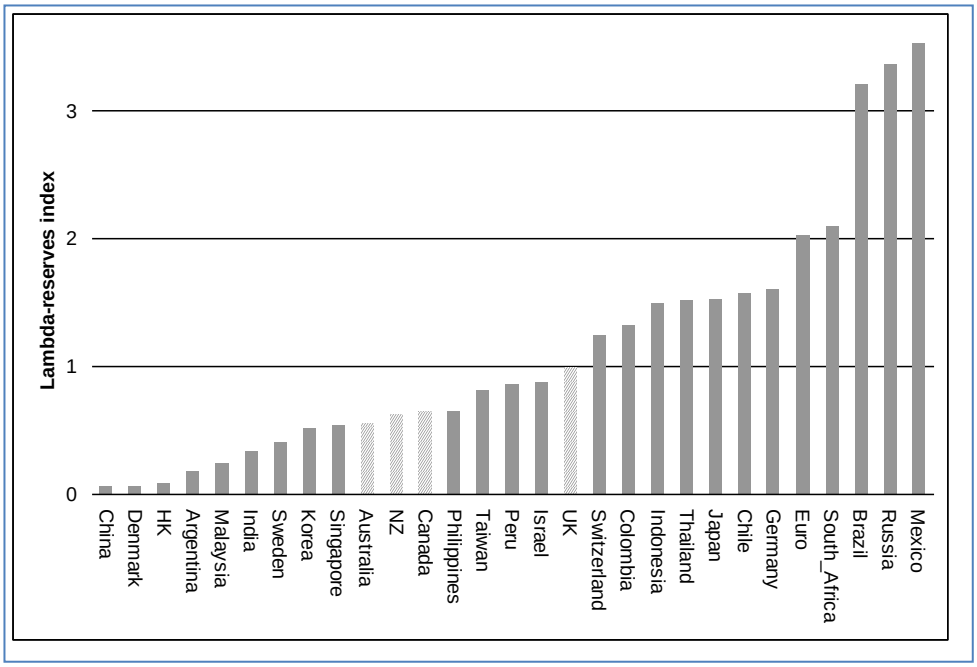

Figure 29: Lambda-adjusted index, 1991-2006

Source: Author
Notes: Lambda-adjusted is c.v. exchange rate / c.v. seasonally adjusted reserves.

This construction suffers from the flaws of currency variability as a gauge of regime flexibility. Misleading results are reported for stylised free-floaters including Australia, NZ and Canada, in both the short- and long-run.

Appendix 2: IMF *de facto* regime classification categories

0. Exchange arrangements with no separate legal tender

The currency of another country circulates as the sole legal tender (formal dollarization), or the member belongs to a monetary or currency union in which the same legal tender is shared by the members of the union. Adopting such regimes implies the complete surrender of the monetary authorities' control over domestic monetary policy.

1. Currency board arrangements

A monetary regime based on an explicit legislative commitment to exchange domestic currency for a specified foreign currency at a fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfillment of its legal obligation.

2. Conventional fixed peg arrangements

The country pegs its currency within margins of ±1 percent or less vis-à-vis another currency; a cooperative arrangement, such as the ERM II; or a basket of currencies, where the basket is formed from the currencies of major trading or financial partners and weights reflect the geographical distribution of trade, services, or capital flows.

3. Pegged exchange rates within horizontal bands

The value of the currency is maintained within certain margins of fluctuation of more than ±1 percent around a fixed central rate or the margin between the maximum and minimum value of the exchange rate exceeds 2 percent.

3. Crawling pegs

The currency is adjusted periodically in small amounts at a fixed rate or in response to changes in selective quantitative indicators, such as past inflation differentials vis-à-vis major trading partners, differentials between the inflation target and expected inflation in major trading partners.

3. Exchange rates within crawling bands

The currency is maintained within certain fluctuation margins of at least ±1 percent around a central rate—or the margin between the maximum and minimum value of the exchange rate exceeds 2 percent—and the central rate or margins are adjusted periodically at a fixed rate or in response to changes in selective quantitative indicators.

4. Managed floating with no predetermined path for the exchange rate

The monetary authority attempts to influence the exchange rate without having a specific exchange rate path or target. Indicators for managing the rate are broadly judgmental (e.g., balance of payments position, international reserves, parallel market developments), and adjustments may not be automatic. Intervention may be direct or indirect.

5. Independently floating

The exchange rate is market-determined, with any official foreign exchange market intervention aimed at moderating the rate of change and preventing undue fluctuations in the exchange rate, rather than at establishing a level for it.

Source: http://www.imf.org/external/np/mfd/er/2006/eng/0706.htm. Printout available from the author.
Notes: Numbers indicate ordinal assignment by the author.

Appendix 3: Algorithm for coding Lambda-Peg Indicator

The algorithm for coding the Lambda-Peg Indicator calculates the range of the log of the exchange rate over the prior 52 weeks (including the current week). A currency is coded as pegged (peg=1, else 0) if this range is strictly less than 0.02, or if 92% of the observations have less than 0.26% week/week changes, accommodating a one-time peg change. This is applied to the bilateral exchange rate with sterling and to an index tracking the current predominate gold-standard currency. A 'peg' is assigned if either of these base-currency alternatives achieves 'peg' classification. This is 'automatic' numeraire selection.

Step	Description
1.	Calculate the maximum and minimum values of the log of the bilateral exchange rate in the 52-week window ending in the present observation.
2.	Generate variable "band" equals maximum minus minimum log of exchange rate.
3.	Generate indicator variable “within02” equals 1 if absolute value of week/week log-difference in the bilateral exchange rate is less than 0.0026 (i.e. 0.26%).
4.	Generate variable “sum52”, a running 52-week sum of variable “within02”.
5.	Generate variable “PegSterling”=1 if the “band” variable for the bilateral exchange rate with sterling is less than 0.02 or the “sum52” OR if the “sum52” variable for the bilateral exchange rate with sterling is greater than or equal to 48.
6.	Repeat steps 2-5 for the exchange rate index based on the gold numeraire currency.
7.	Generate variable “Peg”=1 if either of the two bilateral peg indicators =1.

Appendix 4: Kurtosis application

Standard measures of exchange-rate regime were deficient in the cases of Canada and Hong Kong: Canada's regime was a false-positive for a fix due to low exchange-rate variation; Hong Kong was a false-positive for a float due to low reserves variation. Can the Lambda-kurtosis index do any better? Figure 30 reports the mean Lambda-kurtosis index value for each currency group identified by IMF *de facto* rankings. Figure 31 reports the Lambda-kurtosis index value for individual countries in the 2001-2006 period, and Figure 32 for the 1991-2006 period. The latter two can be judged against stylised notions of currency regime.

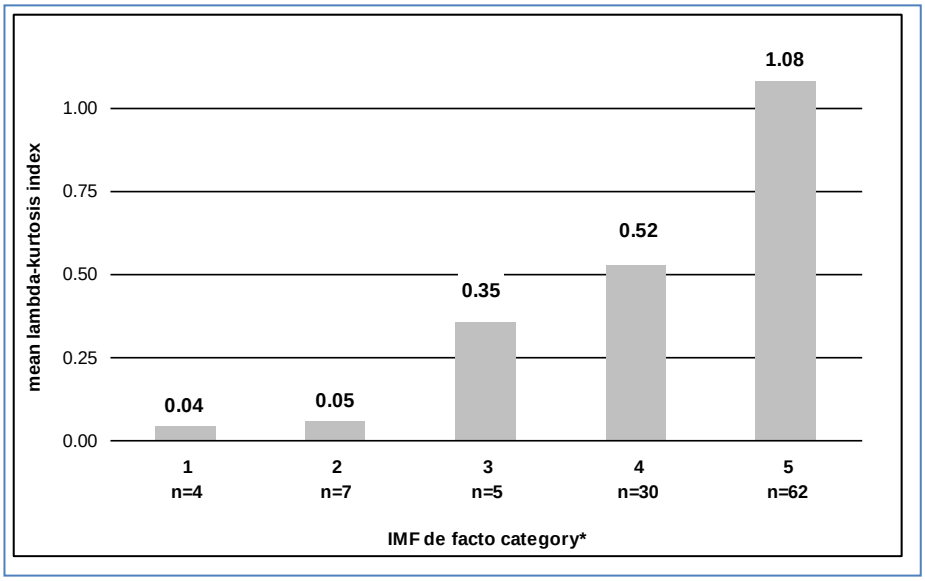

Figure 30: Lambda-kurtosis values by IMF *de facto* category

Source: Author
Notes: Lambda-kurtosis is c.v. exchange rate / kurtosis of % change in exchange rate. The y-axis measures the mean of the Lambda-kurtosis index for each group identified on the x-axis.

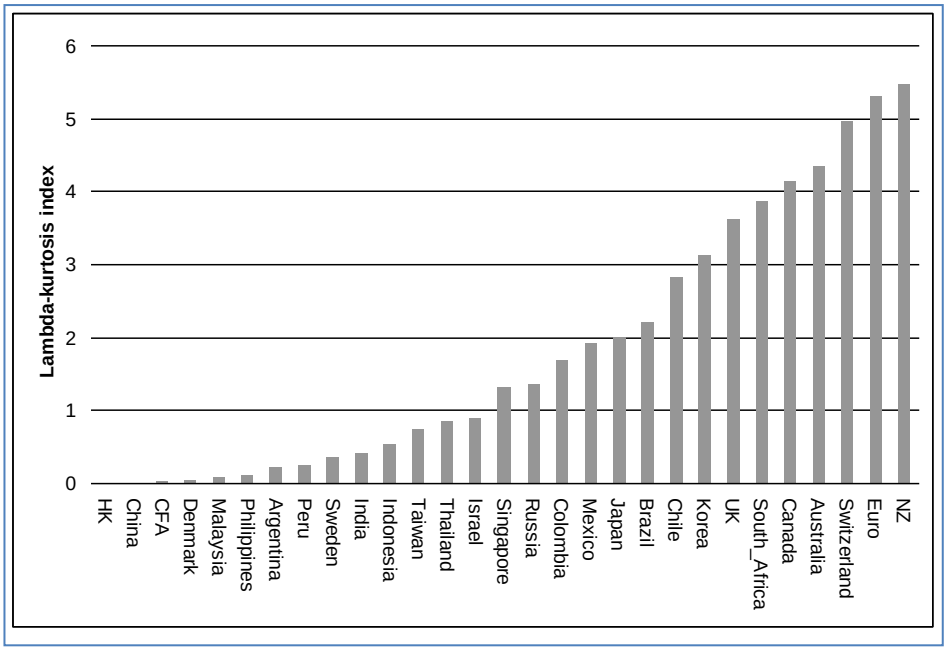

Figure 31: Lambda-kurtosis index, 2001-2006

Source: Author
Notes: Lambda-kurtosis is c.v. exchange rate / kurtosis of % change in exchange rate.

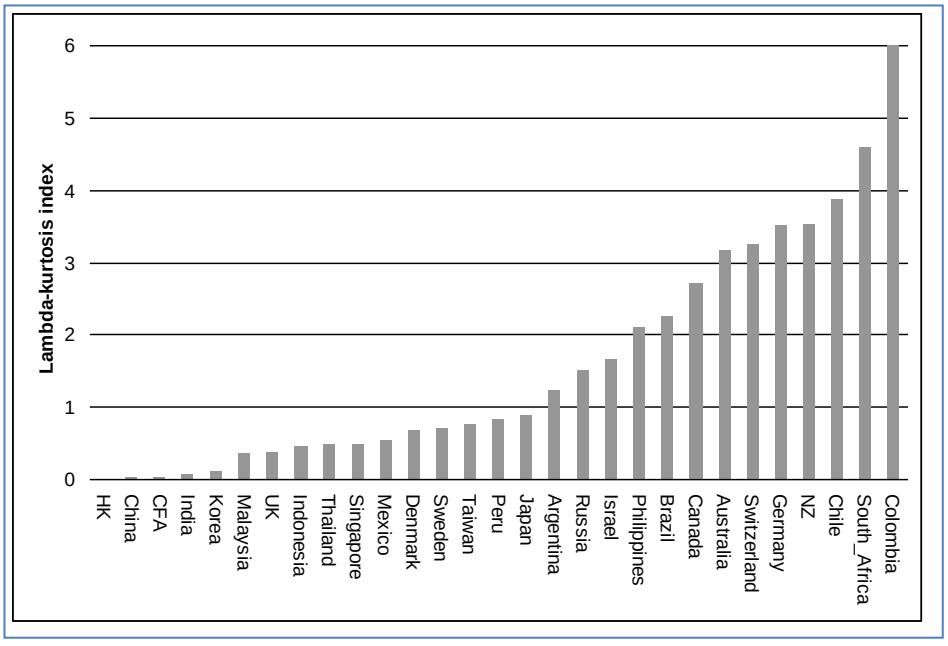

Figure 32: Lambda-kurtosis index, 1991-2006

Source: Author
Notes: Lambda-kurtosis is c.v. exchange rate / kurtosis of % change in exchange rate.
The value for UK is distorted by sterling's 1992 ejection from the ERM.

Judged against IMF *de facto* rankings, Lambda-kurtosis differentiates regimes, with successively flexible regimes achieving higher ranks. Lambda-kurtosis also solves the Hong Kong and Canadian anomalies present in the stylised figures. Figure 31 and Figure 32 rank Canada high, and Hong Kong low, in currency flexibility.

Kurtosis index: decomposition

Kurtosis by itself is not a valid measure of exchange-rate regime. The reason is that a truly market-credible peg, backed by a highly flexible domestic economy, can be sustained for long periods. It thus exhibits few or no large changes. The distribution of these changes -- though peaked in comparison to a floating currency -- is not as 'fat' as that of other pegs, and thus has lower kurtosis. The distinction here is between a market-credible, *de jure* peg such as Hong Kong's dollar currency board and a non-credible *de jure* peg such as the CFA franc or a *de facto* peg such as China's renminbi. All three have higher kurtosis than does a floating regime such as the Canada dollar, but the CFA franc and renminbi have higher kurtosis than does the HK dollar.

In the case of the CFA Franc, this is because of the susceptibility to one-off devaluations in an otherwise *de jure* fixed regime. In the case of the renminbi, this is because the authorities retain discretion to allow more changes in the regime than would be possible under a *de jure* fix such as a currency board.

To solve the high-kurtosis bias of *de facto* pegs and non-credible *de jure* pegs vis-à-vis credible *de jure* pegs, the Lambda-kurtosis index puts variation of the exchange rate in the numerator. This remedies the peg-distinction problem. The exchange-rate variance of a credible *de jure* peg is extremely low, offsetting the inadequately high kurtosis of the first derivative (inadequately high vis-à-vis kurtosis of pegs further up the spectrum of regime fixity.) Figure 33 decomposes the Lambda-kurtosis index to expose this effect.

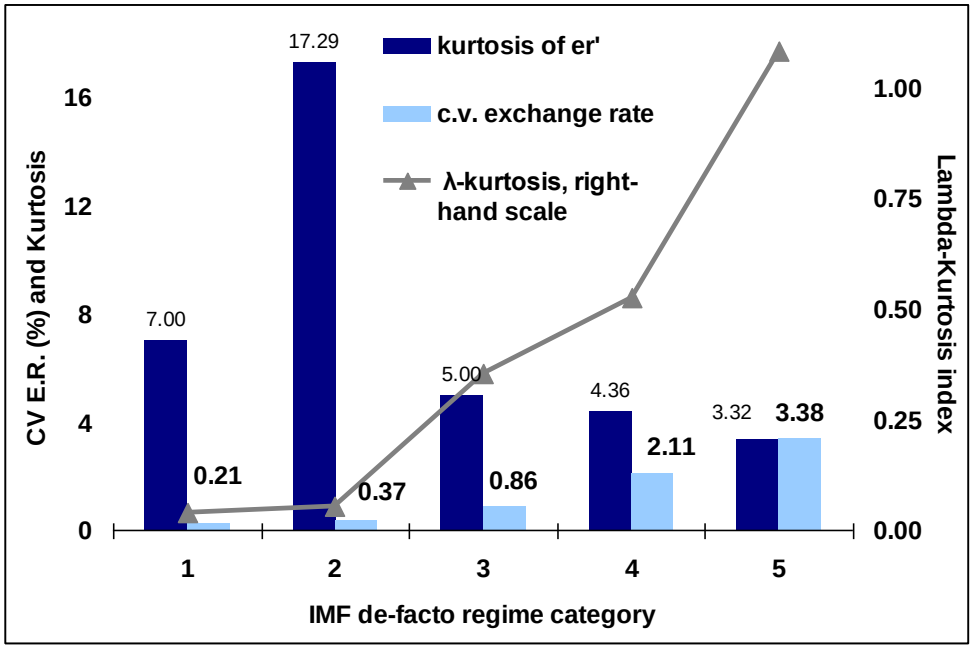

Figure 33: Components of Lambda-kurtosis, by IMF *de facto* category

Source: Author

Notes: The left y-axis measures coefficient of variation of the exchange rate (%) and kurtosis of the first derivative of the exchange rate. The right axis measures the Lambda-kurtosis flexibility index value. The index is coefficient of variation of the exchange rate divided by the kurtosis of the first derivative of the exchange rate. The x-axis is IMF de-facto exchange rate regime category, from least flexibility (1, currency board) to most (5, free floating). Bars above the x-axis report the means of each measure for each group, from a sample of 108 country-years. In other words, IMF de-facto rankings were made for 27 countries in four years (2003-2006), for a total of 108 data points.

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Conclusion

The world monetary system of the interwar period is known primarily for the ill-fated restoration of the international gold standard, dating roughly from Britain's return to gold in 1925 to its departure in 1931. Modern scholarship has illuminated the consequences of this restoration, in particular the role it played in fomenting and propagating the Great Depression, a business cycle episode of unusual depth and international scale.

This dissertation has tried to shed light on the monetary system in the aftermath of the gold standard and preceding the Second World War. The modern literature tends to emphasise a new-found policy freedom for monetary authorities in this decade, given that they were relieved of their 'golden fetters'. Without an obligation to convert central bank money into gold, monetary authorities had little ostensible need to uphold the exchange rate against the relevant numeraire currency. Free of the gold standard, these authorities also had little ostensible need to manage their liabilities (central bank money) in any particular relationship to gold.

Whether such freedoms actually were perceived by policymakers is questionable. To be sure, suspension of the gold standard was accompanied by helpful measures. In most cases, the exchange rate was allowed to depreciate. In others, capital controls were enacted to allow an expansionary domestic stance without such depreciation. Yet overwhelmingly, monetary authorities did target the exchange rate, and they did face at least a statutory obligation to manage the currency with regard to its relationship to gold.

According to the results of Paper One, the continued existence of statutory backing provisions for the currency -- known as 'cover limits' -- helps explain the apparent persistence of conservative central banking. As acknowledged by the modern literature, 1930s central bankers were slow in moving to expand the money supply even though they no longer had to worry about the gold-convertibility consequences of such expansion. There is a good reason for this: the statutory cover limit provisions. Moreover, it would make sense for central banks to embrace the maintenance of these provisions. They served as a bulwark of autonomy in the absence of the gold-convertibility obligation. According to the results of Paper Two, monetary authorities were no more willing to sterilize a reserve loss in the 1930s than they were during the gold standard -- except where they had enacted strict capital controls. According to the results of Paper Three, pegged exchange rates were ubiquitous in the 1930s.

Two relationships between central bank money and gold – convertibility (with freedom of gold import and export) and backing -- constitute two dimensions of the gold standard. The overwhelming focus of the modern literature regarding the interwar gold standard is the convertibility dimension. Yet many of the functions sought by the convertibility requirement, such as the ostensible maintenance of confidence in the currency, are also sought by the backing dimension. Because governments and central banks in the interwar period almost nowhere accepted the principle of un-backed money, the 1930s might be said to have featured an evolved form of gold standard. From early times, the conflict between globalisation and gold convertibility has driven efforts to economize on gold, resulting in evolution of the standard. In the interwar period, these efforts included the official endorsement of gold-exchange in place of gold bullion and, arguably, the reliance on a one-dimensional gold standard in place of the previously pursued two-dimensional standard.

There are a number of extensions suggested by this thesis, some of which reflect its shortcomings. Future research might take into account the supplies of gold held in the banking system. Also useful would be a treatment of the money supply multiplier, to the extent that central bankers in this period targeted higher aggregates of the money supply. The present thesis takes on faith that their operative focus is found on their balance sheet: the supply of their own monetary liabilities, i.e. the supply of central bank money.

This thesis concentrates on a finite period of monetary history: the 1930s. In provides a helpful linkage between the interwar gold standard and the Bretton Woods system constructed after the Second World War. Many of the tenets of Bretton Woods are lessons drawn from the difficulties of building and keeping alive the interwar international gold standard. Bretton Woods allowed countries to limit the convertibility of their currency into other currencies -- particularly in the event of scarcity in the numeraire currency (the so-called ‘scarce currency clause’). This, as well as the ‘adjustable peg’ of the Bretton Woods system, was a mainstay of 1930s exchange-rate regimes.