Finding equilibrium: on the relation between exchange rates and monetary policy

Sebastian Edwards[1]

Abstract

This paper deals with the relationship between exchange rates and monetary policy in small open economies. I also discuss the connection between policy rates in small countries and in major advanced economies. A main point is that central bankers need to know whether the currency is (approximately) close to its long-run equilibrium value. However, in the last 25 years there has been very little progress on finding the long-run exchange rate equilibrium. I argue that the economics profession needs to make a major effort to improve the relevant models. The historical situations discussed include the US abandonment of the gold standard in 1933, the East Asian crisis of 1997, and the recent fluctuations of the Mexican peso.

JEL classification: E52, E58, F30, F32.

[1] University of California, Los Angeles and National Bureau for Economic Research.

This is an expanded version of the keynote speech given at the BIS–Hong Kong Monetary Authority conference "The price, real and financial effects of exchange rates" held in Hong Kong on 28–29 August 2017. I thank conference participants for very helpful comments. As always, I have benefited from extensive discussions with Ed Leamer. The paper draws on some of my research in recent years. The title is taken from Till Düppe's and Roy Weintraub's wonderful book *Finding Equilibrium: Arrow, Debreu, McKenzie and the Problem of Scientific Credit*, where the authors discuss the process that led to the proof of the existence of a competitive equilibrium in a theoretical abstract economy.

1. Introduction

In this paper, I deal with exchange rates and monetary policy in small open economies. More specifically, I discuss the transmission mechanism under flexible exchange rates, and the relationship between the policy rate in small countries and in major advanced economies. A main point of the paper is that central bankers need to know whether the currency is (approximately) close to its long-run equilibrium value. This is a fundamental piece of information for making efficient monetary policy decisions. I review the methods currently used by central banks, the multilateral institutions and investment banks to assess the appropriateness of the real exchange rate – whether it is misaligned or close to equilibrium. I argue that these methods are rather crude, and that the profession should make a concerted effort to improve them. In that regard, this talk/paper is more a "call for action" than a catalogue of proposed solutions. Throughout the discussion, I discuss a number of historical situations, including the US abandonment of the gold standard in 1933, the East Asian crisis of 1997 and the recent fluctuations of the Mexican peso.

For a long time, it has been recognised that monetary policy affects exchange rates. Traditionally, different models have emphasised different mechanisms: the monetary approach to floating exchange rates, developed in the 1970s by Harry Johnson and Jacob Frankel, among others, emphasised the role of broadly defined money supplies – at home and abroad – as key determinants of bilateral nominal exchange rates. In these simple monetary models, it is assumed that a version of purchasing power parity (PPP) holds at all times. Monetary models in the rational expectations tradition, such as Edwards (1983), expanded this view, and tested whether money "surprises" drove most exchange rate changes. The portfolio approach, associated with authors such as William Branson and Penti Kouri, focused on portfolio equilibrium. In this setup, the exchange rate plays a fundamental role in allowing changes in the stocks of assets denominated in different currencies. In Dornbusch's celebrated model of exchange rate overshooting, monetary policy operates in a Keynesian way: an expansion of liquidity lowers short-term nominal and real interest rates, and through the uncovered interest parity condition (and under the assumption of sticky prices in the short run) generates a jump in the nominal exchange rate. Models that emphasise capital movements have focused on the "carry trade" as one of the main determinants of exchange rates in the short run. In these models, a lower policy rate generates net capital outflows, and consequently it will tend to depreciate the currency.[2] Recently, a number of authors have combined the most salient features of earlier models and have emphasised the fact that there are a number of exchange rate-related puzzles. Itskhoki and Mukhin (2017), for example, have proposed a "unified" theory of exchange rates that emphasises the role of financial shocks, including monetary policy changes, and considers new transmission mechanisms.

The works discussed above, and related literature, ask how changes in monetary policy affect exchange rates. In this paper I deal with this traditional causal relationship, as well as with causality in the opposite direction. That is, I inquire how changes in exchange rates impact, or provide a feedback, on central bankers' policy

[2] See, for example, Johnson and Frenkel (1978), Branson (1981), Kouri and Porter (1974), Dornbusch (1976), Frankel (1982), Rogoff (1996), Engel and West (2005). For early empirical tests of these models see, for example, Meese and Rogoff (1983). For recent attempts at synthesis see, for example, Itskhoki and Mukhin (2016).

decisions. I argue that in this "reverse causality" process it is fundamentally important to understand whether the (real) exchange rate is close to its long-run equilibrium value.

The rest of the paper is organised as follows. In Section 2, I provide a brief discussion of the transmission mechanism of monetary policy in small open economies. In Section 3, I deal with the feedback from the policy rate in a foreign country into domestic policy decisions. I argue that there is recent evidence of "policy spillover" from advanced to emerging countries. In Section 4, I discuss the devaluation of the dollar in 1933, one of the most important and well known devaluations in the history of monetary economics. I ask whether at the time the dollar was overvalued, or if, on the contrary, its devaluation may be seen as some sort of "currency manipulation". In Section 5, I discuss and review the alternative methods used by the economics profession to assess whether the (real) exchange rate is close to its long-run equilibrium. I argue that these methods have changed very little in the last 25 years or so, and that they provide only imprecise measures of possible real exchange rate misalignment. I point out that it is important that the profession develops better models to deal with this particular problem. In this section, I also discuss recent (2015–17) developments in Mexico, including the way in which the rapid depreciation of the peso affected the central bank's policy decisions. Finally, Section 6 concludes.

2. The transmission mechanism and exchange rates

The traditional transmission mechanism of monetary policy under flexible exchange rates and inflation targeting is the yield curve – see any model in the Mundell-Fleming tradition. The central bank changes the policy rate – usually a very short-term interbank rate – with the expectation that this change will be transmitted along the yield curve, and will affect longer-term interest rates, which, in turn, will impact consumption decisions by households and investment decisions by firms. In the case of the United States, the expectation is that changes in the federal funds rate will be reflected in the 10-year Treasury note yield. It is this longer-term benchmark rate that affects economic agents' expenditure decisions, including households' expenditure on big ticket items. In discussing the transmission mechanisms of monetary policy, Leamer (2007) has recently argued that the most important effect of changes in the long interest rate is on the housing sector.

For some time now – approximately since the first decade of the 21st century – there has been concern among experts that monetary policy in the United States – and in other advanced countries or monetary unions, for that matter – has lost effectiveness and power. Long-term interest rates seem to be much less responsive to changes in the policy rate. Perhaps the clearest manifestation of this phenomenon happened after July 2004 in the United States. Starting in that month, the Federal Reserve hiked its policy rate by 425 basis points. However, the longer-term rate (10-year Treasuries) did not change, or changed very little. This is what the then Fed Chairman Alan Greenspan referred to as the "conundrum". The most common explanation for this phenomenon is that in a globalised economy with interconnected financial markets, longer-term interest rates are determined by the global interaction between savings and investment, and are not susceptible to being influenced by local monetary policy, not even by large countries' central banks. This view came to be known as the "saving glut" perspective, as proposed and defended strongly by Ben Bernanke.

This point has been acknowledged by a number of central bankers. For example, in a 2016 presentation made at a conference in Singapore, the Governor of the Central Bank of Iceland Már Gudmundsson argued, persuasively, that the traditional interest rate transmission mechanism is weakened (or broken) in open economies in the 21st century. This is particularly so if the country in question is very small, as in the case of Iceland, New Zealand, Thailand, Chile and similar nations. Governor Gudmundsson argues that, under these open economy circumstances, the main mechanism of transmission ceases to be the yield curve, and is replaced by the nominal exchange rate.

This "exchange rate" transmission mechanism works as follows: a hike in the central bank policy rate will generate, through the "carry trade", an exchange rate appreciation. The stronger currency, in turn, will generate downward pressure on prices – through some version of the law of one price for tradable goods – and in this way will reduce the inflationary pressure in the domestic economy. Likewise, a reduction in the policy rate will prompt currency depreciation, and through this mechanism, will generate upward pressure on prices. In addition, currency depreciation will result in export expansion and an increase in domestic activity. Changes in foreign central bank policy rates will also have an impact on the value of the domestic currency: a hike in international interest rates generated by a federal funds rate increase will tend to depreciate the currency of small countries, and through this channel affect domestic prices.

In order to understand fully the transmission mechanism through exchange rate channels, it is important that models can answer two questions: (i) what is the impact of changes in domestic (and foreign) policy interest rates on the exchange rate (both bilateral and multilateral), and (ii) what is the "pass-through" coefficient that translates changes in the exchange rate into changes in domestic inflation. I address these two issues from Iceland's perspective in the second part of this report.

To the extent that monetary policy is, indeed, transmitted through exchange rate changes, it is natural that the central bank in a small open economy will take the exchange rate into account – either directly or indirectly – when formulating policy. In particular, central bankers should be concerned whether the real exchange rate is close to equilibrium, or if it is misaligned. If a country is facing misalignment, monetary policy actions triggered by inflation considerations may exacerbate this disequilibrium. This means, that there are reasons other than "fear of floating" for central bankers to worry about exchange rates – see Calvo and Reinhart (2000) on fear to float. I address some of these issues in the second part of this report, as well as in the annex devoted to real exchange rate overvaluation.

3. Monetary "policy "spillovers"

An important policy issue for small open economies with inflation targeting and flexible exchange rates is how their central banks should react when advanced countries' central banks (and, in particular, the Federal Reserve and/or the European Central Bank) change their monetary policy stance. According to traditional models of international macroeconomics (ie the Mundell-Fleming model, in many of its versions), under flexible exchange rates countries are able to undertake independent monetary policies, and don't face the "trilemma".

That is, according to these traditional models, central banks in small open economies do not have to follow (or even take into account) the policy position of

the advanced nations, such as the United States and the euro area. More recently, however, some authors, including, in particular, Taylor (2007, 2013, 2015), and Edwards (2012, 2015a, b) have argued that, even under flexible exchange rates, there is significant policy interconnectedness across countries. In a highly globalised setting, even when there are no obvious traditional reasons for raising interest rates, some central banks will follow the Fed. This phenomenon may be called "policy spillover", and could be the result of a number of factors, including the desire by central banks to protect domestic currencies from "excessive" volatility. If this is indeed the case, then even under flexible exchange rates there is no such a thing as true "monetary independence".

The late Ron McKinnon from Stanford University captured this idea, when in May 2014 he stated at a conference held at the Hoover Institution that "there's only one country that's truly independent and can set its monetary policy. That's the United States."

Of course, not every co-movement of policy rates should be labelled as a "spillover". It is possible that two countries (the United States and, say, Colombia) are reacting to a common shock – a large change in the international oil price, for example. A "spillover" would happen if, after controlling by those variables that usually enter into a central bank policy reaction function – the traditional Taylor rule variables, say – there is still evidence that the smaller central bank has followed the Fed.

As Clarida (2014), Edwards (2017a), Taylor (2015) and others have recently argued, there are at least two reasons why it may be optimal for central banks in small economies to include the interest rate of advanced countries central banks in their policy reaction function.[3] The first has to do with what Calvo and Reinhart (2000) called "fear to float". This phenomenon is usually present in countries where there is significant currency mismatch in the banking sector. There is plenty of evidence from Latin America – Chile in 1982, Mexico in 1994, Argentina in the 2000s, for example – that indicates that, due to currency mismatch, large devaluations create havoc in the financial sector. If interest rate hikes by foreign central banks result in a (large) depreciation of the domestic currency, it may be optimal for the domestic central bank to react by hiking its own policy rate, as a way of avoiding the balance sheet effects of the depreciation in the context of significant currency mismatches.

The second reason for "policy spillover" has to do with potential real exchange rate misalignment. If currency "overvaluation" is costly – and there are many reasons why this is, indeed, the case – then it may be optimal for the central bank to take misalignment into consideration when undertaking monetary policy. For instance, it is possible that an increased degree of overvaluation will undercut exports, resulting in a large future output gap. This was the case of Mexico during 2015–17.

3.1 A simple framework

In a world with two countries, this situation is captured by the following two policy equations, where r_p is the policy rate in the domestic country, r_p^* is the policy rate in the foreign country, and x and x^* are vectors with the traditional determinants of policy rates (the elements in standard Taylor rules, for example), such as deviations of

[3] It should be noted that I am referring here to the direct inclusion of the foreign policy rate in the reaction function. From early on it was understood that the exchange rate was part of any country's Taylor rule, as long as there is not a zero "passed through" coefficient.

inflation from their targets and the deviation of the rate of unemployment from the "natural" rate:

$$r_p = \alpha + \beta r_p^* + \gamma x \quad (1)$$

$$r_p^* = \alpha^* + \beta^* r_p + \gamma^* x^*. \quad (2)$$

In equilibrium, the monetary policy rate in each country will depend on the other country's rate.[4] For the domestic country the equilibrium policy rate is (there is an equivalent expression for the foreign country):

$$r_p = \frac{\alpha + \beta\alpha^*}{1 - \beta\beta^*} + \left(\frac{\gamma}{1 - \beta\beta^*}\right)x + \left(\frac{\beta\gamma^*}{1 - \beta\beta^*}\right)x^*. \quad (3)$$

Changes in the drivers of the foreign country's policy interest rate, such as α^*, β^*, γ^*, or x^*, will have an effect on the domestic policy rate. This interdependence is illustrated in Graph 2, which includes both reaction functions (1) and (2). PP is the policy function for the domestic country, and P*P* for the foreign nation. The initial equilibrium is at point A. As may be seen, a higher x^* (say the gap between the actual and target inflation rate in the foreign country), will result in a shift to the right of P*P* and in higher equilibrium policy rates in both countries; the new equilibrium is given by B.[5] Notice that in this case the final increase in the foreign policy rate gets amplified: it is larger than what was originally planned by the foreign central bank. The extent of the effect of the foreign country's policy move on the domestic country policy rate will depend on the slopes of the two curves; these, in turn, depend on the parameters of equations (1) and (2).

Given the concerns that have emerged in central banks from around the world in the last few years, it is possible to think that in some countries the actual policy rate would include other global variables, including the long rate in the world economy (r^{*L}) and the extent of uncertainty in global financial markets (μ). In this case, equation (2) would become:

$$r_p = \alpha + \beta r_p^* + \gamma x + \delta r^{*L} + \theta\mu \quad (4)$$

In a number of papers, Edwards (2012, 2015a, 2016) estimated this type of equation for a group of small open economies in Latin America and Asia. His findings suggest that, indeed, there have been "policy spillovers" in most of these countries. However, it is in the Latin American nations – Chile, Colombia, and Mexico – where this phenomenon has been stronger during the period under study, 2000–09. Similar results were obtained by Han and Wei (2018).

For a small nation's central bank, a key question is whether it should take into account explicitly policy decisions by large banks, such as the Federal Reserve or the European Central Bank. Interestingly, when asked about this issue, most central bankers state that their institution has a well defined process, or monetary rule, which takes into account the development of domestic and international variables, but that they do not follow the lead of other central banks. If pressed on the subject, many

[4] The stability condition is $\beta\beta^* < 1$. This means that in Graph 2 the P*P* schedule has to be steeper than the PP schedule.

[5] The new equilibrium will be achieved through successive approximations, as in any model with reaction functions of this type, where the stability condition is met.

central bankers become agitated and offended. For them, following a major central bank is a mistake, something that "serious" central bankers do not do.

3.2 Empirical assessment

In a series of papers, I estimated a number of error correction models of the following type for a group of East Asian and Latin American countries.

$$\Delta r_t^p = \alpha_0 + \alpha_1 FF_t + \alpha_2 \Delta r_{t-1}^p + \alpha_3 r_{t-1}^p + \Sigma \rho_j x_{jt} + \varepsilon_t . \quad (5)$$

r_t^p is the policy rate in each of the three countries in period t, FF_t is the federal funds (target) interest rate, the x_{jt} are other variables that affect the central bank policy actions, including, in particular, the long rate in the foreign country (the United States), inflationary pressures, global perceptions of country risk, and expectations of global inflation: that is, these variables capture what we would normally expect to be included in an expanded Taylor rule type of equation. If there is policy "spillover" the estimated α_1 would be significantly positive, even after controlling for other variables that affect central bankers' decisions. The extent of long-term policy spillover is given by $-\left(\frac{\alpha_1}{\alpha_3}\right)$. If, for example, $-\left(\frac{\alpha_1}{\alpha_3}\right) = 1$, then, there will be full importation of Fed policies into domestic policy rates. Parameter γ allows for the adjustment to a new equilibrium policy rate to be cyclical; this, however, is unlikely. In equation (6), the timing of the variables is contemporaneous. The purpose of these analyses is to determine whether historically central banks have taken into account the evolution of the Federal Reserve policy rate when changing their own policy rates (the period of analysis was restricted to 2000–08, in order to avoid the "zero pound" problem, and to exclude the QE period).

From a methodological perspective, the plan is to start with a bivariate specification that regresses the domestic policy rate on the foreign policy rate, and then to add additional covariates suggested by the theory, in an attempt to "knock down" the coefficient for the federal funds rate. The question is whether co-movement between the two policy rates disappears once the "true" determinants of policy decisions in the small country are included in the regression. If, after including a series of "monetary policy rule" covariates, the coefficient of the foreign policy rate continues to be significantly positive, we can state that there is some evidence suggesting the existence of "policy spillovers". In order to simplify the discussion, in this paper I only present the multivariate results.

In Table 1, I present the results from the estimation of equations of the form of (5), using instrumental variables, for a group of three East Asian countries for the period 2000–08 (I use weekly data): Korea, Malaysia and the Philippines. These three nations provide an interesting and varied sample: Korea and the Philippines had (some degree of) currency flexibility during 2000–08, while during most of the period under study Malaysia had fixed exchange rates (relative to the USD). Moreover, these three East Asia nations' central banks were de facto (but not necessarily de jure) quite independent from political pressure; and Korea and the Philippines followed inflation targeting.[6] In Table 2, I present the results for a sample of three Latin American countries (Chile, Colombia, and Mexico). All three of these countries had flexible exchange rates, followed an inflation targeting policy, and had independent central

[6] For indices of central bank transparency and independence, see Dincer and Eichengreen (2013).

banks during the period under analysis. The definition of the covariates is clear from the two tables.[7]

The most important findings may be summarised as follows. (1) For East Asia, the coefficients of the traditional Taylor rule components (inflationary pressures and domestic growth) are not significant, suggesting that during this period these countries implemented monetary policy following a criterion that differed from traditional Taylor rules. (2) There is, however, evidence that changes in the policy stance in the United States were transmitted, to some extent, to these East Asian nations. (3) The magnitude of the monetary policy "spillover" coefficients is much smaller in East Asia than in Latin America (compare tables 1 and 2). As may be seen, the coefficients for the impact effect are smaller in the East Asian case. But, more importantly, the long-term pass-through coefficient is significantly smaller in East Asia than in Latin America. Compare, for instance, equations (1.1) and (2.1), which have the same specification. According to (2.1) the long-run pass-through in the Latin American nations is a relatively high 0.68, while it is only 0.29 in the East Asian nations. Interestingly, this historical difference in response is consistent with central banks behaviour in the period December 2015 through November 2017 (the time of writing): the Latin American countries tended to follow the Fed – and in some cases, they even tried to pre-empt the Fed – and raised their policy rates, while the East Asian nations stayed "on hold".

All in all, then, the evidence summarised in these two tables provides some support to the view that under floating exchange rates there is a "policy spillover" from the large countries to the small ones. Taylor (2013) has argued that this calls for enhanced policy coordination across central banks.

4. Some history: the devaluation of the dollar in 1933 and monetary policy

In this section, I discuss one of the most important historical episodes where exchange rate and monetary policy interacted with each other. In late January 1934, President Franklin Delano Roosevelt devalued the dollar with respect to gold. The century-old parity of $20.87 per ounce of fine gold was altered, and a new price, which lasted until August 1971, was established at $35 per ounce of gold. The accepted view among economic historians – from Friedman and Schwartz to Bernanke – is that the abandonment of the gold standard and the devaluation of the dollar were at the heart of the US economic recovery from the Great Depression.[8]

4.1 The abandonment of the gold standard and the devaluation of the dollar

From today's perspective, it is difficult to imagine the depth of the Great Depression. Between 1929 and 1932, gross domestic product (GDP) measured in current dollars almost halved, production of durable goods, including automobiles, dropped by 81%, and the value of agricultural production fell by an astonishing 63%. During the same period, employment declined by almost 50%, and the number of unemployed

[7] For details and sources, see Edwards (2016).

[8] Parts of this section draw on Edwards (2017b) and Edwards (2018). For a complete and detailed analysis of the process that led to the devaluation of the dollar and its repercussion on monetary policy, see Edwards (2018).

surpassed 15 million. Those that still had jobs were earning much less than during 1929: according to the Federal Reserve, average wages declined by 67%, and cash income in the rural sector fell by more than 70%.

One of the most destructive aspects of the crisis was the generalised decline in prices. Between mid-1929 and mid-1932, the index of wholesale prices went down by approximately 70%, while the cost of living declined by 40%. Things were particularly bad in the agricultural sector, where the prices of some crops were so low that it was not worth harvesting them. Between 1919 and 1932, the average value of an acre of land for farming declined by almost 60%; the average price of cattle dropped by 63%, and that of hogs by almost 80%. The price of a dozen eggs went from 41.3 cents in 1919 to only 14.2 cents in 1933 – a decline of 66%. A bushel of wheat that in 1919 had commanded $1.53 was sold at 13.5 cents in 1932. And the price of cotton, the commodity that Roosevelt would monitor throughout his first presidency, experienced a decline from 35.34 cents per pound in 1919, to 6.52 cents in 1932 – a reduction of 82%.

As soon as he was sworn in as President, Roosevelt said that he wanted to see a price of cotton above 10 cents a pound by the end of 1933. In May, however, his goal became more ambitious, and he announced that the objective of his economic policy was to return agricultural prices to their 1926 level.

The dollar was devalued in stages: on 19 April 1933 the President announced that the country had abandoned the gold standard. Gold exports were forbidden. Not only that, individuals and institutions had to sell all of their gold holdings to the Federal Reserve at the old parity of $20.87 per ounce. On 5 June, Congress passed a Joint Resolution abrogating the gold clause in contracts. In mid-October a "gold buying program" was implemented in an effort to generate an increase in agricultural prices. On 15 January 1934, the president announced that he was asking Congress to pass a new Gold Act. On 30 January, the new legislation was passed. The next day, the president devalued the dollar officially to $35 per ounce of gold. At this point, the United States committed itself to buying and selling gold in the international market at that particular price.

Graph 2 contains monthly data from 1915 through 1940 for the quantity of money (M2), the monetary base (or high powered money), the stock of monetary gold, and the multiplier. The April 1933–January 1934 period, which corresponds to the months that elapsed between the abandonment of the gold standard and the official devaluation of the dollar, is shaded. The story that emerges from these graphs is well known and forms part of the "received wisdom" on the Great Depression mentioned above. Although the monetary base increased by 18.3% between September 1929 and April 1933, the stock of M2 money declined by 34.7% during the same period. The reason for this drop was the collapse of the multiplier. Although the stock of monetary gold remained flat, at approximately $4.1 billion, it experienced significant month-to-month variations in 1931, 1932 and early 1933. Graph 2 also shows the relaxation in monetary conditions after the January 1934 (official) devaluation of the dollar. As may be seen, this was the result of the increase in base money, which, in turn, was the consequence of large gold inflows: the multiplier remained essentially flat (more on this below). Finally, this graph also captures the change in monetary policy stance in 1937, when the Federal Reserve began to sterilise monetary inflows.

In Graph 3, I present weekly data on the USD/sterling and USD/French franc spot exchange rates between 1921 and 1936. Both rates are in the form of "dollars per unit

of foreign currency". As before, the transition period between April 1933 and January 1934 is shaded. This graph captures much of the history of global currencies during these years, including: (a) the return of Britain to gold in May 1925; (b) the re-pegging of the franc to gold (at a much depreciated level) in late 1926; (c) the devaluation of the USD in April 1933; (d) the period of a "managed" currency between April 1933 and January 1934; (e) the adoption of the new dollar gold parity in January 1934; and (f) devaluation of the French franc in October 1936.

4.2 1934: Gold and monetary policy

The first full year of recovery, with a new (more depreciated) currency, was 1934. Output was up in almost every sector, unemployment declined, and prices began to recuperate. Of course, the Depression was not completely over, but the freefall had been arrested and there was hope.

As Milton Friedman, Ben Bernanke and Allan Meltzer, among others, have emphasised, the most important factor behind these developments was a profound change in monetary policy. For the first time since 1927, the broadly defined quantity of money increased throughout the year (see Graph 2). At the heart of this policy change was the decision by the Federal Reserve to allow large inflows of gold triggered by the devaluation of the dollar to be translated into higher liquidity and credit. That is, the central bank made no attempt to "sterilise" gold inflows by selling securities to the public, and in that way mopping up liquidity from the system. With an expansion in money and credit came a jump in confidence, higher investment, enhanced sales and a reduction in unemployment. The New Deal policies, including the more controversial ones such as the National Recovery Administration (NRA) and the Agricultural Adjustment Act (AAA), also contributed to the change in mood and renewed optimism, by making clear that the government was willing to try anything in order to bring the Depression to an end.[9]

Between January and December 1934, the stock of monetary gold more than doubled in the United States, going from $3.9 billion to $8.1 billion. Part of this increase – a little over $2.5 billion – was the result of the devaluation of the dollar, which allowed the Treasury to reprice its stock of bullion (received from the Federal Reserve) at $35 an ounce. But more important than repricing were the large amounts of gold that came into the country immediately after the Gold Reserve Act was passed in late January 1934. More than $750 million flew in during February alone – $239 million from London, $124 million from Paris – another $262 million in March, and $155 million in April.[10]

Several factors were behind these very large shipments. First, as required by the newly passed Gold Reserve Act, after the devaluation the Treasury was willing to buy unlimited amounts of gold in foreign markets at $35 an ounce. This was a significant difference with respect to the second half of 1933. Second, although the devaluation was smaller than what was permitted under the Thomas amendment, it was large enough to give investors' confidence that there would be no additional adjustments in the medium term. Third, most people believed that the United States was on the

[9] Most economic historians, however, have concluded that neither the AA nor the NRA contributed to the recovery itself. In fact, a number of analysts have argued that both these programmes introduced significant distortions into the economy, and resulted in lower investment. See, for example, the essays collected in Bordo, Goldin and White (1998).

[10] Crabbe (1989).

recovery path. There was, also, an increasing feeling in financial centres that the gold bloc countries were in an untenable position and that sooner rather than later they were going to abandon the gold standard and devalue their currencies.

The decision to allow gold inflows to be reflected in higher liquidity was momentous. This change in policy, however, was not due fully to the Federal Reserve. After the Gold Reserve Act of 1934, it was the Treasury and not the central bank that controlled the policy towards gold and exchange rates. The Treasury paid for bullion by issuing gold certificates, which were deposited at the Fed. After receiving the certificates, the central bank "printed money" – fresh dollars – which were then used by the Treasury to pay foreigners for their gold.[11] It was this "printing of money" that resulted in higher liquidity. As Allan Meltzer has noted, Fed officials – including Marriner S Eccles, the new Chairman who took over from Eugene Black in late 1934 – continued to be concerned about possible bouts of inflation, and were leery about the rapid increases in liquidity. When it came to monetary policy, between 1934 and 1941 the Federal Reserve was in the back seat: its leaders "opposed devaluation, silver purchases or increases in money unless they increased consumers' purchasing power".[12]

4.3 Was the US dollar overvalued in 1933?

When analysing this historical episode in US monetary history, it is unavoidable to ask whether in 1933 the dollar was overvalued, or if, on the contrary its value was consistent with "economic fundamentals". Interestingly, in the late 1920s and early 1930s, technical analyses on these issues were mostly confined to purchasing power parity calculations. Indeed, this method had been used by Cassel and Keynes when looking at the interwar situation in Europe.[13] There are no discussions in contemporary – and by this I mean 1932 and 1933 – diaries, correspondence or memoirs on whether in the dollar was out of equilibrium (for more detail, see, for example, Edwards (2018)).

Analysing in detail whether the dollar was misaligned in the early 1930s is beyond the scope of this paper. However, and in order to have some notion about orders of magnitude, Graph 4 displays the evolution of two monthly trade-weighted real exchange rate indexes for the USD for this period – RER4 and RER5. The RER4 index includes the currencies of Canada, France and the United Kingdom: the RER5 adds Italy and Switzerland. These indexes have a base of 1913=100. The graph captures, clearly, the effects of a number of shocks and policy decisions on the US real exchange rate. In particular, it is possible to see the consequences of the suspension of the gold standard during the Great War, the return to the gold standard by the sterling area countries (Canada and the United Kingdom) and Switzerland in 1925, the return to gold by Germany in 1924, and by France and Italy in 1926. The devaluation of sterling in September 1931 is captured by the positive spike in the RER during that month; and the devaluation of the dollar in 1933–34 by a spike in the opposite direction in both indices. The devaluation of the French and Swiss francs is also clearly captured by the data.

[11] As noted by Friedman and Schwartz (1963, p 473), since the Treasury used newly created money to pay for gold, these operations did not put any pressure on the budget.

[12] Meltzer (2003, p 465).

[13] Cassel (1922), Keynes (1924).

Graph 5 presents data on the evolution of the current account balance over GDP for 1919–37. As may be seen, in every year between 1919 and 1933 the United States ran a current account surplus. These were very large in the years immediately following the Great War, reflecting the very high prices of agricultural commodities. After 1923 the surpluses hover at around 0.5% of GDP.

Graphs 4 and 5 show that (i) in late 1932 the RER indexes for the USD were between 12% and 16% higher – that is, more appreciated – than in 1913. That is, the dollar was approximately 14% stronger than it had been just before the war; and (ii) in 1931, 1932 and 1933, the United States was still experiencing a current account surplus. This was true in spite of the fact that, as pointed out by Wigmore (1987) and Temin and Wigmore (1990), foreign central banks and foreign investors withdrew significant amounts of gold during that period. However, it is important to stress that, although there were significant week-to-week fluctuations in gold flows, the overall contribution of the current account to the stock of bullion was positive in 1931 and 1932.

Taken together, these two facts suggest that the US dollar may have been slightly overvalued at the time. This would have called for a small correction in the exchanges relative to the pre-war levels. However, neither the RER data nor the current account information indicate that a massive correction of the exchanges was needed from a purely "fundamentals" point of view. It was only in the years that followed that economists embarked on detailed investigations of whether different currencies were close to their long-run "equilibrium". In early 1935, Harry Dexter White wrote a memorandum at the Treasury where he argued that at that time the dollar was 3% undervalued: according to his calculations, the pound was undervalued by 19%, while the German mark was overvalued by 27%.[14] In 1936, and after a long and detailed study, Harris (1936, p 20) concluded that "[i]t is clear from the large inflow of gold into the United States in the years 1934–1935 that the dollar is undervalued."

5. Finding equilibrium

The discussion in the previous section, on the abandonment of the gold standard and the devaluation of the dollar in 1934, brings to the fore an obvious issue: what type of method should economists use in trying to determine whether a particular currency is close to its long-run equilibrium? This is an old question in international economics.[15]

It is possible to classify the different methods used to evaluate the appropriateness of the (real) exchange rate into four groups: (1) models based on the purchasing power parity approach; (2) models based on the country's external sustainability; (3) regression-based models based on real exchange rate "fundamentals"; and (4) an approach based on DSGE models.[16] In this section, I review

[14] White (1935).

[15] There is an extensive literature on trying to determine the equilibrium value of the real exchange rate. A few examples going back to the 1980s include Edwards (1989), Williamson (1994), Wren-Lewis and Diver (1998), Montiel (1999), Edwards and Savastano (2001), Cline and Kim (2010).

[16] For a detailed discussion of this topic, see, for example, Edwards and Savastano (2001). In a comprehensive review article, Isard (2016) points out that there are six methods for assessing equilibrium real exchange rates. However, two of the methods that he describes are variants or submethods of the ones discussed here.

them briefly, and I point out that none of them provides a satisfactory way of looking at the problem. I, consequently, argue that the profession should make greater efforts to improve on these methods. I point out that this is important not only for investors or other market participants, but also for central bankers.

5.1 PPP and the equilibrium real exchange rate

As late as the 1930s there were very few economists who had thought thoroughly about the subject. The two most important were Cassel (1918, 1922) and Keynes (1924). Another active participant in this discussion was the Italian economist Bresciani-Turroni (1937), who analysed inflation and the equilibrium value of the German mark after the First World War, and who emphasised the fact that the law of one price did not hold on the aggregate if countries had different production baskets. These three authors based their analyses on variations of the purchasing power parity (PPP) doctrine. While Cassel and Keynes focused on price *levels*, Bresciani-Turroni (1937, p 139) emphasised rates of change, or the so-called "relative" version of PPP.

The PPP approach is based on the notion that, at some point in the past, the real exchange rate was in equilibrium and that the value it had during that "base year" is representative of equilibrium at the current moment. The application of the methodology implies undertaking at least two steps: first, some kind of real exchange rate index is calculated for the base and subsequent years. Second a comparison is made between the value of the index in the current moment and during the "base or equilibrium" year. If, at the present time (or at the time we are evaluating), the real exchange rate index departs significantly from its value during the "base year", it is said that the currency is misaligned. In these analyses, "significantly" is not clearly defined a priori.

Possibly one of the most lucid applications of this methodology was undertaken by Lloyd Metzler (1947), who estimated whether the currency values that the members of the International Monetary Fund had declared as initial equilibrium, in December 1946, were in line with the economically defined equilibrium. In this analysis, Metzler used the average real exchange rate between October 1936 and June 1937 as the "base year" for every country in his sample. Metzler justified the use of this benchmark year as follows (p 117):

"This period was selected because it was relatively close to the war years but at the same time reasonably free of war influences. If an earlier period had been used, difficulties would have arisen from the wave of currency devaluations which occurred in the early thirties and mid-thirties. If later period had been used, on the other hand, complication would have been introduced both by the American depression of 1937–38 and by the effects which the eminence of war had upon foreign exchange markets."

In explaining why the use of PPP was appropriate and reasonable, Metzler (p 129) said: "The virtue of the parity rate is that it preserves the earlier real exchange ratio between the goods and services of one country in the goods and services of another."

Of course, Metzler understood that there were a number of limitations associated with this approach. A particularly serious problem was that individual prices moved in different ways within each country and that these relative price movements were not captured appropriately by price composites or indexes. In his words (p 132):

"When some prices or costs rise more rapidly than others within the same country, no simple comparison between price movements in different countries can

be made. The best that can be done is to use an average or index number of price changes, and if the discrepancies in price movement between different commodities in the same countries are large, such an index number at best is only a rough indication of the changes in the value of the monetary unit. Moreover, since several types of price index number are usually available, the calculation of parity rate is not a simple procedure, but involves a considerable element of judgment as to what prices and costs are important for a country's balance of payments."

This difficulty in deciding which price level to use has led a number of analysts to suggest that it is most appropriate to focus on "unit labour costs" instead of price indices.[17] The attraction of this alternative is that, by emphasising costs in different countries, it provides an intuitive measurement of countries' degree of *international competitiveness*. However, this methodology is subject to many of the same limitations as more straightforward PPP based analyses, which are discussed below.

As noted, the main goal of Metzler's study was to undertake a comparison between the initial "equilibrium" parities actually announced by the International Monetary Fund, and the rates calculated by him using different versions of purchasing power parity. Metzler concluded that a number of nations had announced "overvalued" exchange rates to the IMF. This was not an auspicious way of launching the institution, since its mandate was to provide financial assistance to countries that run into financial difficulties because of an inadequate exchange rate level.

The PPP method for assaying the appropriateness of the real exchange has been criticised by trade theorists for a number of reasons. A central limitation is that a mechanical application of the method may lead to very misleading conclusions. This is because there is no reason for the "base period" to capture the equilibrium conditions at the present time or at the time of interest. It is possible that the terms of trade, the degree of openness and other variables – including geopolitical ones – have changed through time, rendering the old equilibrium an irrelevant historical relic. In an important paper, Rogoff (1996) showed that there are large and persistent deviations of purchasing power parity, which are corrected only very slowly over time. Indeed, this finding is considered in the literature to be one of the exchange rate-related puzzles.

Another serious limitation of simple PPP calculations is that they do not take into account the fact that productivity gains differ across countries. According to the Samuelson-Balassa effect, the equilibrium real exchange rate will appreciate – the currency will strengthen in real terms – in countries that experience faster productivity growth than their trading partners and competitors do. For details, including a survey of empirical studies, see for example Edwards and Savastano (2001). This fact has led some analysts such as Isard (2007) to argue that it is important to distinguish between the simple application of the PPP method, and a "productivity differentials-adjusted" PPP approach, where an effort is made to explicitly correct the simple PPP calculations by productivity differentials.

In spite of its problems, this methodology continues to be used around the world by central banks, investment banks, large conglomerates, consultants, journalists and even some academics. Isard (2007) reports that the simple application of the PPP methodology suggested that, in 2006, the USD was roughly in line with its long-term equilibrium. At the same time, the "productivity-adjusted" PPP approach indicated

[17] Indeed, the CBI calculates several ER indices, including one based on unit labour costs.

that that same year the dollar was 11.5% overvalued. Interestingly, Isard (2007) shows that, when alternative methods are used, including the external balance approach discussed below, extremely different results are found for the USD in 2006: according to some of these methods the dollar was overvalued by as much as 25%, while other methodologies suggested equilibrium.

5.2 Current account balance, NIIP, and the equilibrium real exchange rate

A second popular methodology for assessing if a country's RER is close to equilibrium is to analyse whether the current value of the RER is consistent with the country achieving external balance. In the simplest version of this approach, the analyst asks what is the level of the RER consistent with the country's current account balance being equal to zero. Naturally, in order to answer this question, it is necessary to have an opinion about variables that, jointly with the exchange rate, determine the current account balance. These are the so-called "real exchange rate fundamentals" and include the terms of trade, country risk premium, global interest rates, degree of openness of the economy, demand for non-tradables, and others.

A more advanced version of this method recognises that a country may have, for prolonged periods of time, current account balances that are different from zero. This approach, thus, concentrates on the "sustainable current account balance." See, for example, Milessi-Ferretti and Razin (1998) for a discussion, including for some rules of thumb on levels beyond which a current account deficit becomes dangerous. Once the *sustainable* level of the current account balance is determined – say, a deficit of 2.5 % of GDP – the analyst calculates the level of the RER that is consistent with that particular current account balance.

The simplest way to derive the "sustainable" current account balance is to undertake an analysis of the net international investment position (NIIP) of the country in question. Roughly speaking, this methodology consists of the following steps. First, and through a global portfolio analysis, the researcher determines the "equilibrium" net international demand for the country's assets. Once an equilibrium or stable ratio of the NIIP to GDP is established – this may be either a positive or negative number – it is straightforward to estimate the sustainable current account to GDP ratio. At this point, the analyst can extract, after assuming specific values of the "fundamentals", the equilibrium real exchange rate consistent with this specific sustainable NIIP to GDP ratio, and with the associated current account balance. It is important to note that this method requires – as any sophisticated version of PPP does – having a judgment about the long-term equilibrium value of these "fundamentals".

This type of analysis has been used quite extensively in effort to determine whether the USD is out of line with long-run equilibrium. For example, in an extensive paper based on this methodology, Edwards (2005) estimated that in 2004 the dollar was overvalued by around 11%. Using a similar analysis, where the NIIP analysis is based on considerations related to savings and investment, Isard (2007) estimated that in 2006 the USD was overvalued by more than 20%. Obstfeld and Rogoff (2005) use a slightly different model that emphasised the role of tradable and non-tradable goods to analyse the extent of misalignment of the dollar in 2004, and concluded that at the time it was overvalued by approximately 25%.

It is interesting to notice that, if one takes into account both the PPP and the NIIP methods, there is a wide range of estimates on the appropriateness of the value of the dollar in 2004–05. These go from equilibrium to overvaluation of the order of

25%. Having very wide range of estimated values is not particularly useful for policymakers seeking to determine how to incorporate the exchange rate into monetary policy decisions.

5.3 Regression analyses of real exchange rate "fundamentals"

A number of authors – including economists at major investment banks – have used small econometric models to assess whether a country's real exchange rate is compatible with long-run equilibrium. As a background for estimating such systems, many authors derive theoretical models of open economies that include the usual building blocks – representative consumer, optimising firms and others – and consider the existence of a number of external shocks, including terms of trade and productivity shocks.

A simplified rendition of this methodology is as follows. From the theoretical model, and as noted, a reduced form for the real exchange rate is derived and estimated. The covariates consist of the "fundamentals". Depending on the model's degree of sophistication, some monetary variables may be allowed to have a short-run effect on the real exchange rate (but not in long-run equilibrium). For mid-size countries, concerns over endogeneity emerge. In small open economies, however, assumptions of exogeneity of most (but not all) fundamentals are acceptable. Roughly speaking the RER is said to be "misaligned" if its actual value at any given moment in time deviates "significantly" from the regression fitted value. Many of the authors who have used this approach, including officials and researchers at investment banks such as Goldman Sachs and JP Morgan, use single-equation regression models.

A number of authors have argued that, to perform this type of analysis correctly, it is necessary to use "long-term equilibrium" values of the fundamentals. That is, the analyst needs to make a judgment call with respect to, say, the long-run equilibrium value of the country's terms of trade. The simplest way of doing this is by decomposing the "fundamentals" into a permanent and a transitory component. The estimated "equilibrium" real exchange rate is obtained by using the permanent components of the fundamentals in the estimated regression. Examples of work along these lines include Baffes, Elbadawi and O'Connell (1997), Ades (1996), Razin and Collins (1997), Halpern and Wyplosz (1997) and Iossifov and Loukoianova (2007).

In his 2007 paper on Iceland – the smallest of all "small open economies" with a currency of its own – Tchaidze used this regression-based methodology. He included the following fundamentals in the (logarithm of the) RER regression: net foreign assets as a fraction of import/export, a productivity differential that captures the Balassa-Samuelson effect, the logarithm of the terms of trade, and the ratio of government expenditure over GDP. When this equation was used by the CBI to assess the appropriateness of the RER in 2012, it was concluded that the króna had to depreciate by 8–10% relative to its 2006 average in order to achieve long-term equilibrium.

In spite of its popularity, this type of model has a number of shortcomings. First, by construction, these models assume that the real exchange rate has been, on average, in equilibrium during the period under study (this is the case if an intercept is included in the regression). However, from an economic point of view, there is no reason for this to be the case in every country. A second problem is that these models will tend to give very different results, depending on the sample used and on the specification considered. For example, Montiel (1997) estimated that the Thai baht

was significantly overvalued from 1981 to 1987, as well as from 1992 to 1994. On the other hand, the model of Ades (1996) indicates that the Thai currency was persistently undervalued between 1985 in 1993. Other examples include the Mexican peso: according to Broner et al (1997) the Mexican currency was already overvalued in 1990: others suggest that overvaluation started in 1987; while Warner (1997) argues that the peso was slightly undervalued until mid-1993.

5.4 Macro and DSGE models

In the last 20 years, a number of authors have developed dynamic simulation models of open economies and have used them to assess how the equilibrium exchange rate responds to different shocks, both policy-induced as well as exogenous. Some of these models have asked whether central banks should respond to changes in global interest rates that stem from policy action in large nations. See, for example, Lubik and Schorfheide (2007).

Many of these models followed the framework developed by Obstfeld and Rogoff (2005). As has become customary, these models assumed utility-maximising consumers and profit-maximising firms. They differ, however, on the assumptions with regard to the relationship between domestic and international prices. While some models consider a version of the "law of one price", others assume that there is "pricing to market." One of the challenges of this type of model is incorporating a well specified financial and banking sector. See, for example, Edwards and Vegh (1997) for an attempt along these lines.

From a practical perspective, many of these DSGE models generate results that are in line with those obtained when using the external sustainability approach discussed above. For example, Isard (2007) reports that, when these types of model were used to assess the value of the dollar in 2006, they found that the USD was overvalued in the order of 20%, a number similar to that obtained from his "external sustainability" model.

In addition to these DSGE models, a number of central banks have used mid-sized macroeconomic models with estimated equations to analyse external equilibrium conditions, and the appropriateness of the RER at given moment in time. For instance, for a number of years the Central Bank of Iceland has used a model (QMM) which is described as follows:

"QMM is used in the Central Bank of Iceland to assist in analysing the current economic situation, making economic projections, assessing the effect of policies and shocks, evaluating risks, handling uncertainty and with communication both within and outside the bank… QMM is a one-sector representation of the Icelandic economy, containing 28 empirically estimated behavioural relations and 119 other equations, such as accounting identities and definitions."

5.5 A recent episode: Mexico

In this final subsection, I discuss briefly one episode which illustrates the points made in this part of the talk/paper. Graph 6 depicts the evolution of the Mexican real effective exchange rate index between January 2010 and July 2017. As may be seen, this index was relatively stable until January 2015. At that time, and due to a number of reasons, including, in particular, presidential candidate Donald Trump's rhetoric with respect to Mexico, the peso began to rapidly lose value. During these few months, Mexico's REER lost 31%. This deep weakening of the real exchange rate was 100% due to movements in the nominal exchange rate with respect to the USD. As

the peso depreciated, inflationary pressures increased, and the Bank of Mexico was forced to react, in order to maintain macroeconomic and price stability.

Graph 7 includes data on Mexico's policy rate during this period. As may be seen, at a time when most major central banks continued to have an almost zero interest rate, Mexico hiked its policy rate by 400 basis points, to 7%. This episode illustrates two important points that have been emphasised in this paper. The first is that the exchange rate clearly affects central bankers' decisions with respect to policy. The second, which is subtler, is that in order to undertake monetary policy, it is important for the central bank to know whether the currency was initially close to its long-term equilibrium, or if it was somewhat misaligned. However, given the limitations of the current models for dealing with this question, the Bank of Mexico had to operate without having all the required information. It is important to emphasise that this is, in no way, a criticism of the Bank; on the contrary, in my opinion the Bank acted correctly. This is rather a call for the profession to improve on current methods.

6. Concluding remarks

In this paper, I have addressed a number of issues related to exchange rates and monetary policy. I have focused on several aspects of this problem, and emphasised four points. I have also discussed an important historical episode – the US abandonment of the gold standard in 1933 – where the relation between exchange rates and monetary policy was particularly salient. The most important points made in this talk/paper may be summarised as follows:

- In the last few years, there is evidence that the transmission mechanisms through the yield curve have weakened in most countries. In many nations, and in particular in small ones, the exchange rate appears to provide the most important transmission channel of monetary policy. This means that central bankers have to be particularly conscious of exchange rate movements, and of the way their policies affect the exchange rate.
- There is evidence of "policy spillover". Empirical analyses suggest that, in the last few years, many countries have taken into account policy decisions by the major central banks – principally the Federal Reserve and the European Central Bank – when deciding on policy actions. This type of spillover calls for increased monetary policy coordination across countries.
- The analysis of the 1934 USD devaluation provides a clear case of connection between exchange rates and monetary policy. In this paper, I have gone beyond most studies on the subject, and I have asked whether there was evidence that in 1933–34 the dollar was overvalued. Although I do not provide conclusive evidence – that is beyond the scope of this paper – the data that I analyse, including two newly constructed real exchange rate indexes, suggest that the dollar was not significantly out of line at that time. This indicates that the devaluation of the USD did not play a role in moving the currency back to equilibrium; it was mostly a monetary policy decision.
- A review of the methods used by economists to assess whether the exchange rate is consistent with its "fundamentals" suggests that there has been very little progress in this area in the last three decades or so. I argue that the estimates obtained from using these methods are too broad, and in most cases provide insufficient guidance to policymakers. In that regard, it is important that the

economics profession devote some additional time and effort to improving on these methods in the future.

References

Ades, A (1996): "GSDEEMER and STMPI's, new tools for forecasting exchange rates in emerging markets", Goldman Sachs Economic Research.

Baffes, J, I Elbadawi and S O'Connell (1997): "Single-equation estimation of the equilibrium real exchange rate", *World Bank Policy Research Working Paper,* no 1800.

Bordo, M, C Goldin and E White (2007): *The Defining Moment: The Great Depression and the American Economy in the Twentieth Century*, University of Chicago Press.

Branson, W (1981): "Macroeconomic determinants of real exchange rates", *NBER Working Paper*, no 801.

Bresciani-Turroni, C (1937): *The economics of inflation: a study of currency depreciation in post-war Germany 1914–1923*, Allen & Unwin.

Broner, F, N Loayza, and H Lopez (1997): "Misalignment and fundamental variables: equilibrium exchange rates in seven Latin American countries", *Coyuntura Economica*, vol 27, no 4, pp 101–24.

Calvo, G and C Reinhart (2000): "Fear of floating", *NBER Working Papers*, no 7993.

Cassel, G (1918): "Abnormal deviations in international exchanges", *Economic Journal*, vol 28, no 112, pp 413–15.

——— (1922): *Money and foreign exchange after 1914*, Macmillan.

Clarida, R (2014): "Monetary policy in open economies: Practical perspectives for pragmatic central bankers", *Journal of Economic Dynamics & Control*, December, pp 21–9.

Cline, W and J Kim (2010): "Renminbi undervaluation, China's surplus, and the US trade deficit", Peterson Institute for International Economics.

Crabbe, L (1989): "The international gold standard and US monetary policy from World War I to the New Deal", *Federal Reserve Bulletin*, no 75, p 423.

Dincer, N, and B Eichengreen (2013): "Central bank transparency and independence: updates and new measures", *International Journal of Central Banking*, vol 10, no 1, March.

Dornbusch, R (1976): "Expectations and exchange rate dynamics", *The Journal of Political Economy*, vol 84, no 6, pp 1161–76.

Edwards, S (1983): "Floating exchange rates, expectations and new information", *Journal of Monetary Economics*, vol 11, no 3, pp 321–36.

——— (1989): *Real exchange rates, devaluation, and adjustment: exchange rate policy in developing countries*, MIT Press.

——— (2006): "The relationship between exchange rates and inflation targeting revisited", *NBER Working Papers*, no 12163.

——— (2012): "The Federal Reserve, the emerging markets, and capital controls: a high-frequency empirical investigation", *Journal of Money, Credit and Banking*, vol 44, no 2, pp 151–84.

——— (2015a): "Monetary policy independence under flexible exchange rates: an illusion?", *NBER Working Papers*, no 20893.

——— (2015b): "Sovereign Default, Debt Restructuring, and Recovery Rates: Was the Argentinean "Haircut" Excessive?", *Open Economies Review*, vol 26, no 5, pp 839-867.

——— (2017a): "Monetary Policy Independence under Flexible Exchange Rates: The Federal Reserve and Monetary Policy in Latin America -- Is There Policy ``Spillover"? pp 1-54, in Bordo, M and J Taylor (Eds) (2017): Rules for International Monetary Stability: Past, Present, and Future, Hoover Press.

——— (2017b): "The London Monetary and Economic Conference of 1933 and the end of the Great Depression", *Open Economies Review*, pp 1–29.

——— (2018): *American default: The untold story of FDR, the Supreme Court, and the battle over gold*, Princeton University Press.

Edwards, S and R Rigobon (2009): "Capital controls on inflows, exchange rate volatility and external vulnerability", *Journal of International Economics*, vol 78, no 2, pp 256–67.

Edwards, S and M Savastano (2001): "Exchange rates in emerging economies: what do we know? What do we need to know?", *NBER Working Papers*, no 7228.

Edwards, S and C Vegh (1997): "Banks and macroeconomic disturbances under predetermined exchange rates", *Journal of Monetary Economics*, vol 40, no 2, pp 239–78.

Frankel, J (1982): "The mystery of the multiplying marks: A modification of the monetary model", *The Review of Economics and Statistics*, vol 64, no 3, pp 515–9.

Friedman, M and A Schwartz (1963): "A monetary history of the United States", Princeton University Press.

Gudmundsson, M (2017): "Global financial integration and central bank policies in small, open economies", *The Singapore Economic Review*, vol 62, no 1, pp 135–46.

Halpern, L and C Wyplosz (1997): "Equilibrium exchange rates in transition economies", *Staff Papers*, vol 44, no 4, pp 430-461.

Han, X and S-J Wei (2018): "International transmissions of monetary shocks: Between a trilemma and a dilemma", *Journal of International Economics*, vol 110, pp 205-219.

Harris, S (1936): *Exchange Depreciation: Its Theory and Its History, 1931-35, with Some Consideration of Related Domestic Policies*, Harvard University Press.

Iossifov, P and E Loukoianova (2007): Estimation of a behavioral equilibrium exchange rate model for Ghana, *International Monetary Fund Working Paper*, no 07/155.

Isard, P (2007): "Equilibrium exchange rates: assessment methodologies", *IMF Working Paper*, no 07/296.

Itskhoki, O and D Mukhin (2016): "Exchange rate disconnect", in *2016 Meeting Papers*, no 1589, Society for Economic Dynamics.

Johnson, H and J Frenkel (1978): *The Economics of Exchange Rates: Selected Studies*, Addison-Wesley Publishing Company.

Keynes, J (1924): *Monetary reform*, Harcourt, Brace and Company.

Kouri, P and M Porter (1974): "International capital flows and portfolio equilibrium", *Journal of Political Economy*, vol 82, no 3, pp 443–67.

Leamer, E (2007): "Housing is the business cycle", *NBER Working Paper*, no 13428.

Lubik, T and F Schorfheide (2007): "Do central banks respond to exchange rate movements? A structural investigation", *Journal of Monetary Economics*, vol 54, no 4, pp 1069–87.

Meese, R and K Rogoff (1983): "Empirical exchange rate models of the seventies: Do they fit out of sample?", *Journal of International Economics*, vol 14, no 1-2, pp 3–24.

Meltzer, A (2003): *A History of the Federal Reserve, Volume 1*, University of Chicago Press.

Metzler, L (1947): "Exchange rates and the International Monetary Fund", *International Monetary Policies,* Board of Governors of the Federal Reserve System, Washington DC, pp 30–42.

Milesi-Ferretti, G and A Razin (1998): "Current Account Reversals and Currency Crises: Empirical Regularities", vol 98, no 89, pp 1-44.

Montiel, P (1997): "Exchange Rate Policy and Macroeconomic Management in ASEAN Countries", in J Hicklin, D Robinson and A Singh (eds), Macroeconomic Issues Facing ASEAN Countries, Washington, DC: IMF.

——— (1999) Determinants of the long-run equilibrium exchange rate: an analytical model. In: Hinkle L, Montiel P (eds) Exchange rate misalignment: concepts and measurement for developing countries. Oxford University Press, Oxford, pp 264–292.

Obstfeld, M, and K Rogoff (2005): "Global current account imbalances and exchange rate adjustments", *Brookings Papers on Economic Activity*, no 2005(1), pp 67–146.

Razin, O and S Collins (1997): "Real exchange rate misalignments and growth", *NBER Working Papers*, no 6174.

Rogoff, K (1996): "The purchasing power parity puzzle", *Journal of Economic Literature*, vol 34, no 2, pp 647–68.

Taylor, J (2007): "Globalization and monetary policy: Missions impossible", in J Gali and M Gertler (eds), *International Dimensions of Monetary Policy*, pp 609–24, University of Chicago Press.

——— (2013): "International monetary coordination and the great deviation", *Journal of Policy Modeling*, vol 35, no 3, pp 463–72.

——— (2015): "Rethinking the international monetary system", remarks at the CATO Conference on Rethinking Monetary Policy.

Temin, P, and B Wigmore (1990): "The end of one big deflation", *Explorations in Economic history*, vol 27, no 4, pp 483–502.

Warner, A (1997): "Mexico's 1994 exchange rate crisis interpreted in light of the nontraded model", *NBER Working Paper*, no 6165.

White, H (1935): "Recovery program: the international monetary aspect", The Harry Dexter White papers, Princeton University, Box 3, folder 13.

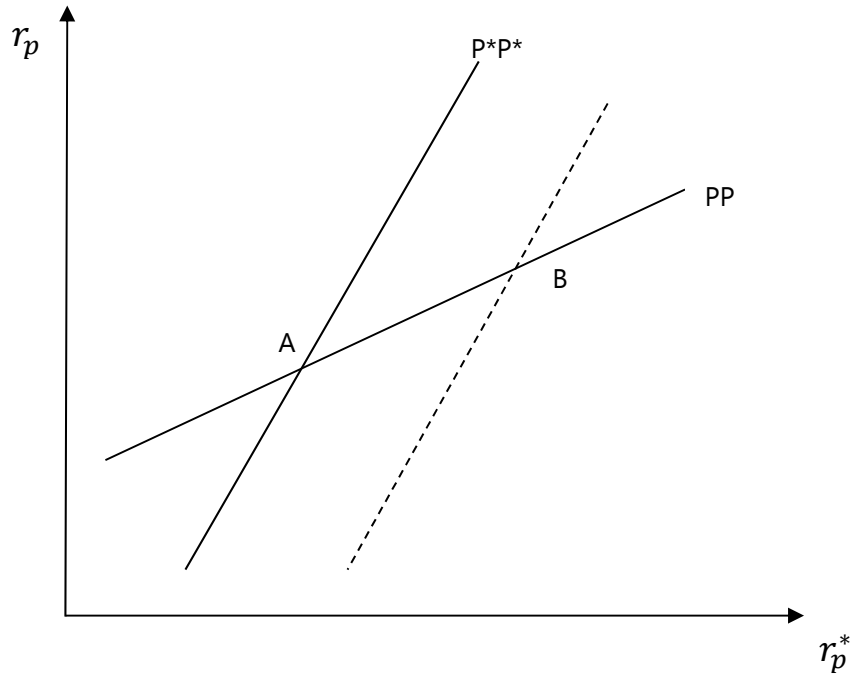
Wigmore, B (1987): "Was the Bank Holiday of 1933 Caused by a Run on the Dollar?", *The Journal of Economic History*, vol 47, no 3, pp 739–755.

Williamson, J (1994): "Estimating equilibrium exchange rates", Peterson Institute.

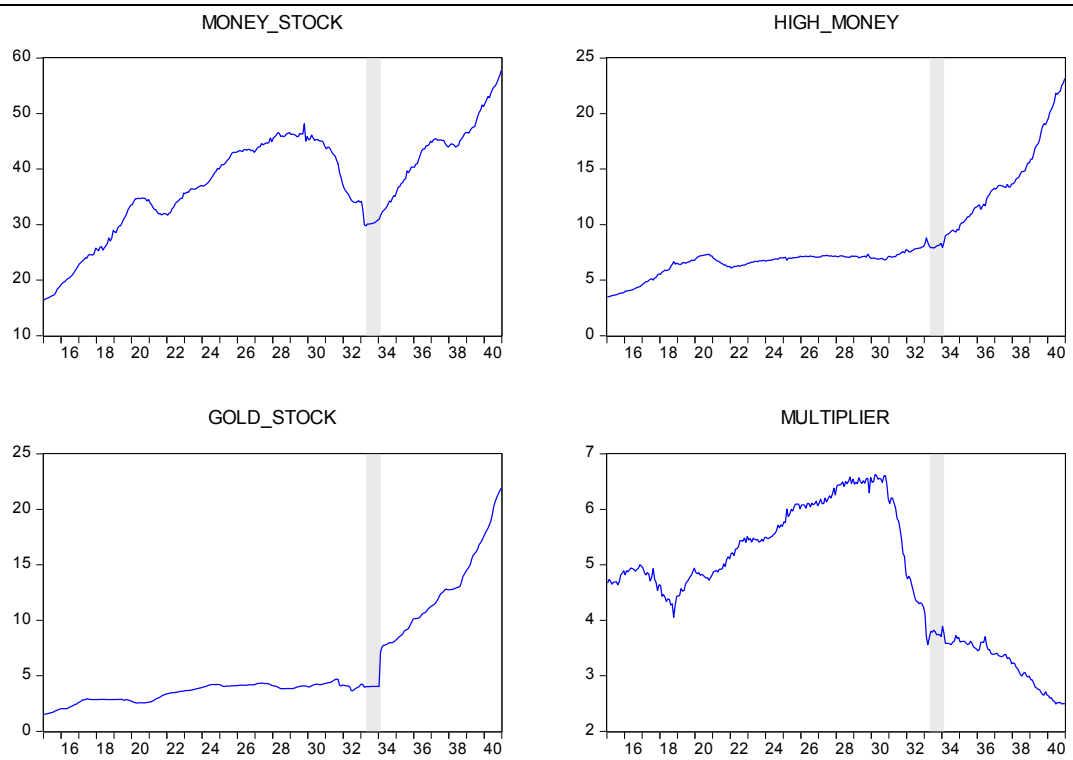
Wren-Lewis, S and R Driver (1998): "Real exchange rates for the year 2000", Peterson Institute Press: Policy Analyses in International Economics.

Graphs

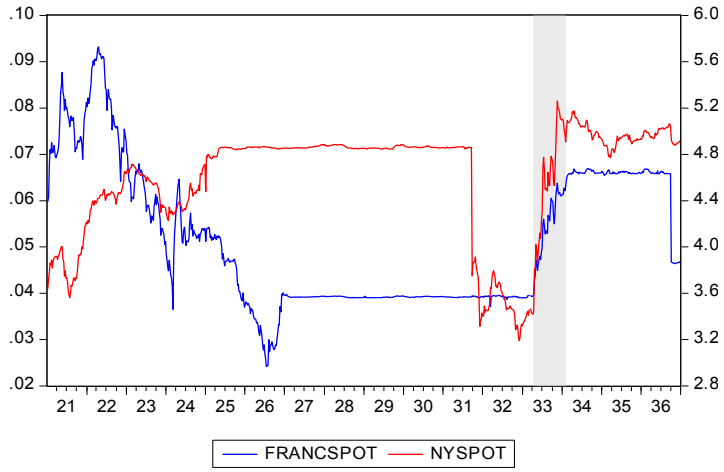
Policy rates equilibrium under "policy spillover" and large countries — Graph 1



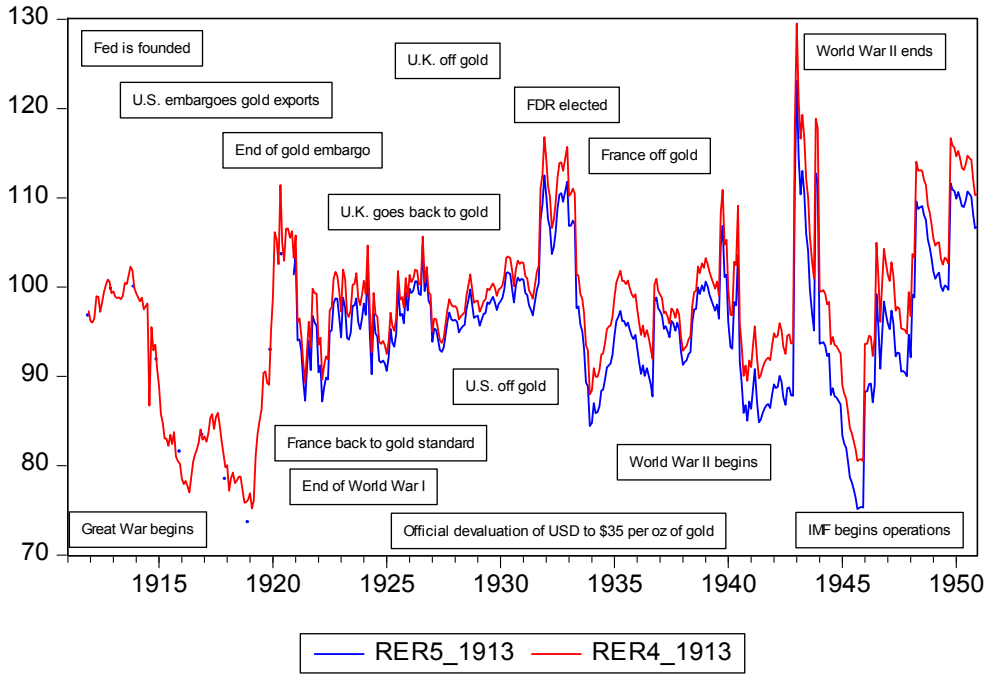
Monetary conditions, 1910–40 — Graph 2



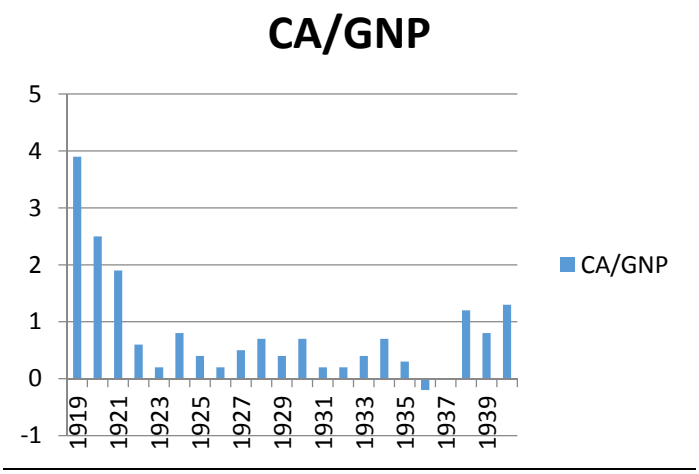
Dollar-sterling and dollar-French franc exchange rates, weekly, 1921–36 Graph 3



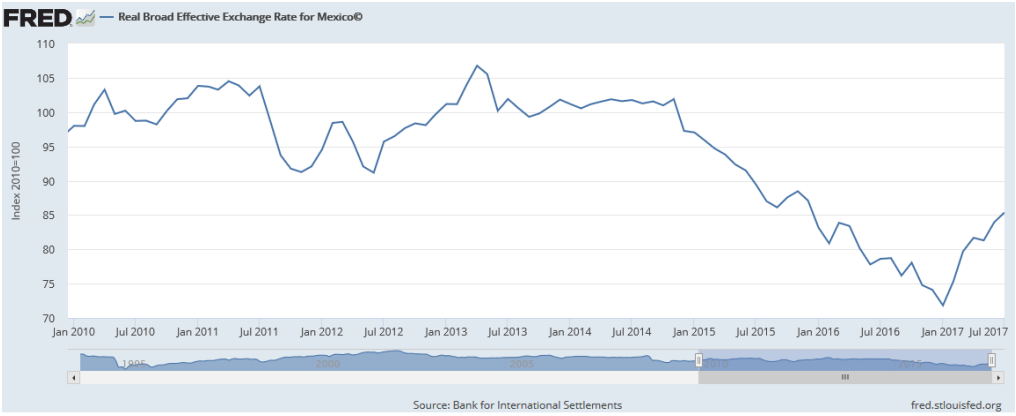
Trade-weighted real exchange rate for the US dollar, 1910–50: 1913=100 Graph 4



Current account balance as percentage of GDP, 1919–40 Graph 5



The Mexican peso RER index, January 2010–July 2017 Graph 6



Mexico's policy rate, January 2010–July 2017 Graph 7

Tables

Monetary policy rates in East Asia, dynamic panel, 2000–08

(Instrumental variables) Table 1

Eq Name:	(1.1)	(1.2)	(1.3)	(1.4)
FF_POLICY	0.0116	0.0149	0.0115	0.0114
	[4.0109]***	[2.0996]**	[3.0940]***	[3.8950]***
C	0.2523	0.2483	0.2524	0.2494
	[3.2841]***	[3.2271]***	[3.2776]***	[3.2262]***
POL_RATE(-1)	-0.0399	-0.0407	-0.0400	-0.0417
	[-4.6058]***	[-4.6363]***	[-4.5188]***	[-4.4447]***
TIPS_ INF_USA(-1)	-0.0199	-0.0175	-0.0200	-0.0212
	[-1.2329]	[-1.0432]	[-1.2150]	[-1.2906]
EMBI_ASIA	0.0003	0.0006	0.0003	-0.0002
	[0.0371]	[0.0747]	[0.0340]	[-0.0220]
D(POL_RATE(-1))	-0.0020	-0.0031	-0.0019	0.0006
	[-0.0521]	[-0.0802]	[-0.0484]	[0.0163]
INF_YOY(-4)	0.0004	0.0008	0.0004	0.0004
	[0.1587]	[0.2890]	[0.1548]	[0.1549]
GROWTH(-6)	-0.0064	-0.0045	-0.0065	-0.0079
	[-1.6088]*	[-0.8470]	[-1.3051]	[-1.5894]
UST_2YR	–	-0.0053	–	–
		[-0.5097]		
UST_5YR	–	–	0.0003	–
			[0.0305]	
UST_10YR	–	–	–	0.0054
				[0.5058]
Observations:	676	676	676	676
R-squared:	0.0244	0.0321	0.0240	0.0180
F-statistic:	3.8769	3.4716	3.4411	3.4715

*, **, and *** refer to significance at 10%, 5% and 1%, respectively.

Monetary policy rates in Latin America and the yield curve, dynamic panel (Chile, Colombia), 2000–08

(Instrumental variables) Table 2

Eq Name:	(2.1)	(2.2)	(2.3)	(2.4)
FF_POLICY	0.0141	0.0846	0.0421	0.0253
	[2.1931]**	[3.3751]***	[2.8125]***	[2.4035]**
C	-0.2987	-0.0639	-0.0976	-0.1300
	[-2.2316]**	[-0.4022]	[-0.5878]	[-0.7080]
POL_RATE(-1)	-0.0206	-0.0246	-0.0205	-0.0201
	[-2.4229]**	[-2.7927]***	[-2.3970]**	[-2.3629]**
TIPS_ INF_USA(-1)	0.0688	0.1009	0.0903	0.0811
	[1.9609]*	[2.6842]***	[2.4531]**	[2.2328]**
EMBI_LATAM	0.0083	0.0022	0.0077	0.0092
	[1.6130]*	[0.3919]	[1.4865]	[1.7716]
D(POL_RATE(-1))	-0.0338	-0.0306	-0.0306	-0.0325
	[-0.8611]	[-0.7602]	[-0.7737]	[-0.8263]
INF_YOY(-4)	0.0204	0.0101	0.0136	0.0169
	[2.6494]***	[1. 6910]*	[1.6212]*	[2.0742]**
GROWTH(-6)	0.0171	-0.0044	0.0020	0.0086
	[1.6648]*	[-0.3255]	[0.1528]	[0.6823]
UST_2YR	–	-0.0935	–	–
		[-2.9143]***		
UST_5YR(-1)	–	–	-0.0573	–
			[-2.0730]**	
UST_10YR(-1)	–	–	–	-0.0402
				[-1.3436]
Observations:	709	709	709	709
R-squared:	0.0529	0.0082	0.0424	0.0520
F-statistic:	4.1658	4.7380	4.2026	3.9069

*, **, and *** refer to significance at 10%, 5% and 1%, respectively.