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Working Paper 23134
<http://www.nber.org/papers/w23134>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 2017

We wish to thank Duygu Guven and seminar participants at the Bank of International Settlements and the AEA meetings for helpful comments and suggestions and Lukas Althoff, Patricio Merlani, Paul Schmelzing, and Jordan Ward, for outstanding research assistance. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 23134
February 2017
JEL No. E50,F3,F4,N2

ABSTRACT

This paper provides a comprehensive history of anchor or reference currencies, exchange rate arrangements, and a new measure of foreign exchange restrictions for 194 countries and territories over 1946-2016. We find that the often-cited post-Bretton Woods transition from fixed to flexible arrangements is overstated; regimes with limited flexibility remain in the majority. Our central finding is that the US dollar scores (by a wide margin) as the world's dominant anchor currency and, by some metrics, its use is far wider today than 70 years ago. In contrast, the global role of the euro appears to have stalled in recent years. While the incidence of capital account restrictions has been trending lower for decades, an important wave toward capital market integration dates as recently as the mid-1990s. We suggest that record accumulation of reserves post 2002 has much to do with many countries' desire to stabilize exchange rates in an environment of markedly greater capital mobility. Indeed, the continuing desire to manage exchange rates despite increased capital mobility post-2003 may be a key factor underpinning the modern-day Triffin dilemma that some have recently pointed to.

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Introduction

The impossible trinity, sometimes referred to as the macroeconomic trilemma, holds that a country with an open capital account that opts to fix its exchange rate must subordinate its monetary policy to that of the anchor currency country. If it wishes to maintain capital mobility and an independent monetary policy, then the country must give up on the idea of stabilizing its exchange rate. If intent on achieving both independent monetary policy and stabilizing its exchange rate, then it must resort to foreign exchange controls. Only two of the three options are possible at any point in time. The theory does not specify clearly what independent monetary policy might entail. For example, over much of the 1980s, targeting monetary or credit aggregates was popular; the Federal Reserve has had a long history of maintaining targets for its policy interest rate; and inflation targeting was formalized by New Zealand in 1989 and has since been adopted by almost thirty countries.

Focusing primarily on interest rates, Obstfeld, Shambaugh, and Taylor (2005) conclude that the evidence supports the implications of the Trilemma for more than a century. For instance, during the gold standard era (fixed exchange rates), which Eichengreen (1996) and others have characterized as a period of high capital mobility, the three authors suggest that monetary policy independence appears to have been quite limited. Frankel (2008), however, emphatically argues that the pairings (whether by design or circumstance) among the components of the trinity are time-varying within country as well as across countries. In principle, the optimal or desired combination is not etched in stone. Indeed, Frankel's observation about time and cross-country variation is soundly supported by the country chronologies that are a companion to this paper.¹

In this paper we compile a new and comprehensive dataset on exchange arrangements and capital mobility (two sides of the Trinity) for 194 countries and territories over seven decades (1946-2016). The third side of the trinity (monetary independence) plays a smaller role in our analysis, but we nevertheless

¹ See the companion chronologies to this paper, Ilzetki, Reinhart and Rogoff (2016).

devote considerable attention in our analysis to the comparatively novel phenomenon of inflation targeting frameworks. For example, as a building block to classifying the exchange rate regime of Eurozone (EZ) countries, we examine the interest rate policies of the European Central Bank.

It has been well documented for some time that de jure descriptions of exchange rate regimes, monetary policy, and capital account restrictions routinely depart from actual practices and can be downright misleading. Calvo and Reinhart (2001) pointed out that the behavior of the exchange rate and foreign exchange reserves for many countries that were self-declared floaters was virtually indistinguishable from that of countries with limited flexibility arrangements. Reinhart and Rogoff (2004) emphasized in their classification of exchange rate arrangements that gauging the true extent of exchange rate flexibility requires incorporating the parallel market exchange rate has in the analysis, especially for developing countries but also for advanced economies during the Bretton Woods era.² Indeed, in periods where parallel premiums are high, the parallel market exchange rate is often a better gauge of the underlying monetary policy stance than the official (usually pegged) rate. Venezuela's ongoing hyperinflation is a recent illustration of that point. A conclusion from that study was that the de facto exchange rate regimes were not always as "fixed" as advertised and often involved "back-door" floating. As Levy Yeyati and Sturzenegger (2005) put it, the objective should be to quantify "deeds not words".

There has been a proliferation of de facto exchange arrangement classifications in recent years. Reinhart and Rogoff (2004) categorize countries based on the degree of exchange rate variability, while taking into account parallel markets.^{3 4} Levy Yeyati and Sturzenegger (2005) incorporate the behavior of reserves. Shambaugh (2004) also studies exchange rate variability, but allows for regime changes in

² The Reinhart and Rogoff (2004) study spanned 1946-2001 and covered 153 countries.

³ Klein and Shambaugh (2010) contains an excellent overview.

⁴ The Reinhart and Rogoff (2004) classification has been extremely widely used in empirical macroeconomics across a wide variety of topics, for example Aghion et al (2009) and Rajan and Subramanian (2005) on growth, Aizenman and Lee (2007) and Jeanne and Ranciere (2006) on reserve accumulation, Chinn and Wei (2013) and Ghosh et al (2013) on current account adjustment, Hau and Rey (2006) on capital flows and equity prices, Mendoza and Terrones (2008) and Jorda, Schulariak and Taylor (2015), Ball, Lopez and Reyes (2013) on the effect of remittances on the macroeconomy; Habib et al (2016) on the effect of oil shocks.

higher frequency. The IMF's annual report on exchange arrangements and exchange restrictions has moved from a de-jure classification of exchange arrangements to a de facto one as well.

Exchange arrangements in our new data and the analysis of this paper are based on a new updated version of the classification scheme advanced by Reinhart and Rogoff (2004). However, we advance previous analyses in that we tackle the critical question of anchor currencies directly. The algorithm we propose allows much more fully for the possibility of multiple currency poles. In the process of classifying anchor currencies, we also update and refine the classification of Reinhart and Rogoff (2004). The new classification series runs through 2015, whereas the widely-used existing series ends in 2001.

On capital controls, the work of Chinn and Ito (2006 and updates) covering 1970-2014 and Fernandez et. al. (2015) covering 1995-2013 has exploited a broad range of the information provided by IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AEAER) to construct a variety of measures of capital mobility. But the policies described in the AEAER are strictly de jure, which do not necessarily capture de facto capital mobility⁵ Mathieson and Rojas-Suarez (1992), among others, emphasize the erosion of the effectiveness of capital controls over the course of the developing country debt crisis of the 1980s. Indeed, in a broad array of countries, tax and capital control evasion appears almost at the level of a national sport. Our exercise is a contribution to these efforts in a narrow but important dimension. We focus on unitary/dual/multiple exchange rate practices that the AEAER compiles; regular publications by Franz Pick (various issues and Pick and Sedillot, 1971) also contribute importantly to the chronology on dual markets. This record is supplemented by information on parallel market exchange rates: apart from de jure chronologies, there is a de facto component to the index.

Some of our main findings can be summarized as follows:

Based on our new classification of anchor currencies, the dollar is as dominant today as the world's reserve currency as it was at the time of the early Bretton Woods era. Indeed, by other metrics, its

⁵ Kose Prasad, Wei and Rogoff (2003) emphasize the important distinction between de facto and de jure classifications in their analysis of the effects of financial globalization on developing economies.

global role has expanded even further following the collapse of the ruble zone. The euro is a distant second. From the early 1980s until the introduction of the euro, the German Deutschemark's (DM) sphere expanded first in Western Europe and later in the East. The euro consolidated the French franc and German DM zones but appears to have stalled in the 21st century. By some metrics (given the shrinking share of Europe in world output) its global importance has declined. No other major established international currencies compete at present with the dollar and the euro. The much-debated international role of the renminbi is a live future possibility but, at this stage, is difficult to quantitatively separate its role given its history of strong linkage to the US dollar.

There are, of course, many corroborating pieces of evidence on dollar dominance besides the de facto exchange rate regime, including the importance of dollar funding for global banks and non-financial firms (e.g. Bruno and Shin, 2015), the outsize influence of US Federal Reserve policy in global capital markets (e.g., Rey, 2013), and the widespread prevalence of dollar pricing in trade in global markets (e.g., Gopinath, 2015). But these corroborating pieces of evidence are all partial and indirect. We argue that the revealed preference of monetary authorities' choice of anchor currency provides an important summary statistic of the overall degree of dollar dominance. That so much of the world chooses the dollar as its anchor/reference currency underscores the broad importance of the dollar across global markets.

To some, the dominance of the dollar may seem natural and obvious, but in fact this is hardly the central view in the literature. Indeed, many researchers continue to argue that since the share of the United States in the global economy is declining, the US dollar's role as the de facto world currency is likely declining as well. Eichengreen (2011), for example, argues that the world is headed towards a multi-polar system where the euro dominates in Europe, the US dollar is the anchor in the Americas while Chinese Renmenbi becomes the main currency in Asia.

In fact, to the extent there has been debate, it has been more about whether fading dollar dominance can be considered a good thing. Frankel (2008) argues that it is ultimately inefficient to have multiple

world currencies, for much the same reason that barter is inefficient; see also Mundell (1969) and McKinnon and Schnabl (2004). Rogoff (2001), however, argues that despite the transactions benefits of having a single world anchor currency, an equilibrium with two or three major currencies might still be preferable because it provides a critical check on the center country's incentives to misbehave, for example to inflate away debt. (This theme is echoed in Farhi and Maggiori, 2016.)

On the basis of classifying exchange rate arrangements for 194 countries over 1946-2016, we also conclude that the frequently cited global transition from fixed to floating exchange rates considerably overstates the reality. The fact that since 2007 the IMF has classified all Eurozone member countries as having independently floating exchange rates contributes to this misperception. As we revisit the classification criteria, we conclude that an approach that places Malta's exchange rate arrangements in the same bucket as Australia's is questionable on many grounds. By our metric, less flexible exchange rate arrangements currently account for about 80 percent of all countries or about one-half of world GDP, the latter being lower because some of the wealthiest economies float freely and some of the largest emerging markets have recently adopted managed floating regimes.

An increasing number of countries have adopted (de jure) inflation targeting regimes and the question arises as to whether this classification makes a country's exchange rate classification irrelevant. We argue that this is not the case after examining the monetary policy and exchange rate practices of countries that have adopted de jure an inflation targeting framework. Closer inspection reveals that the inflation targeting banner encompasses a very broad spectrum of exchange rate arrangements. Almost 40 percent of these regimes involve limited flexibility arrangements, such as crawling pegs (Guatemala and Serbia, for example). The majority of the regimes are managed or freely floating exchange rates. While we duly indicate in the individual country chronologies whether inflation targets are a part of the monetary framework, we do not treat these cases as a separate category.

What emerges clearly from our analysis is the markedly lower incidence of bi-polar or corner solutions, in the words of Stanley Fischer (2001). Instead, we find a marked increase in the adoption of intermediate regimes. De jure pegs and pre-announced narrow bands are less common today. Also less common in the 21st century are the chronically collapsing currencies that accompany very high inflation. We classify these cases as freely falling, but in other classifications these “anchorless” currencies were usually included in the floating category. While the managed floating category has expanded somewhat, the same cannot be said of freely floating, which has remained confined to a few countries.

As to our index of exchange restrictions, which also spans seven decades, there is little that surprises. The global march to higher capital mobility has a well-defined trend. In 1946 about 70 percent of the independent countries had either a dual exchange rate, multiple exchange rate practices, or active parallel markets with substantial premiums. By 2016, the share was hovering around 20 percent, despite a noticeable pick-up since 2014. The path to greater capital market integration evolved in steps and had stalled from the late 1960s to the mid-1990 (at around 50 percent). The lower incidence of controls globally and higher degree of capital mobility is of a fairly modern vintage for emerging and developing countries.

The mercantilist and self-insurance motive explanations of the unprecedented surge in official reserve holdings during 2003-2013 (often referred to as the demand for safe assets) are well known. We suggest here that the combination of arrangements with limited exchange rate flexibility and markedly greater (and increasing) capital market integration (as documented here) also helped to fuel the demand for reserves. To some extent, reserves have replaced capital controls.

Finally, we integrate our data and findings to the discussion of a modern-day Triffin dilemma in Farhi, Gourinchas and Rey (2011), Obstfeld (2013) and Farhi and Maggiori (2016). We document some of the features of the comparatively shrinking advanced economies that are supplying the reserve assets. But our primary contribution comes from connecting the demand for reserves by the expanding emerging market group to their exchange rate arrangements and choice of anchor or reserve currency. As already

noted, reserve assets are provided primarily (by a wide margin) by the United States. We conclude and concur with the aforementioned studies that the stage is set for a Triffin-type dilemma. This time it is not driven by the demand for reserves by other advanced economies, as was the case in the 1970s, but by the demand from emerging markets. Although the literature has extensively discussed global demand for safe advanced-country assets, we argue that countries' desire to stabilize exchange rates (for example because of financial dollarization) also plays a key role in this phenomenon. Unlike the 1970s, the numeraire for reserves is not connected to a sluggishly expanding supply of gold; in the modern context, the numeraire is connected to the sluggishly expanding supply of US goods and services.

Section II defines our methodology to determine anchor currencies and exchange rate arrangements. This section also addresses the criteria applied to the classification of currency union countries in general, and Eurozone in particular. The treatment of countries that have adopted an inflation target and its rationale are outlined in our classification strategy. The following section presents a global profile over 1946-2016 on the major currencies that serve as *anchors* for the rest of the world and the evolution of exchange rate arrangements, with an emphasis on their degree of flexibility and their incidence of inflationary crises. A new measure of capital or foreign exchange restrictions that spans the post-World War II era is introduced. Section IV uses our findings to revisit some of the recent themes in the international financial system including the surge in reserve accumulation and the modern-day Triffin dilemma. Concluding remarks focus on research and policy implications.

II. Anchor Currencies and Exchange Rate Regimes: Methodology

This section describes the classification framework that we apply to each of the 195 countries (or territories) that comprise our sample of 2016. The core exchange rate and inflation data is monthly and spans January 1946 through October 2016, approximately seven decades. The classification algorithms perform two intertwined tasks. First, they identify the relevant anchor currency for each country over the course of the sample, and second, they define the exchange rate arrangement by metrics that primarily (but not exclusively) measure the degree of flexibility. The approach follows builds on that introduced by

Reinhart and Rogoff (2004). Important extensions to the Reinhart-Rogoff framework address: (i) explicit classification of anchor or reference currency (ii) the classification of inflation targeting cases; (iii) the treatment of Eurozone countries. The exercise yields a monthly classification. The criteria for evaluating the regime, however, almost always involve a multi-year window.

1. Anchor or Reference Currency

Choosing the anchor currency and determining the exchange rate classification is an interactive simultaneous process. The selection of candidate anchor currencies is informed by several features of country practices. A country whose external trade is concentrated in the Eurozone and primarily invoices its trade in euro is more likely to favor the euro as an anchor currency. If a nation's external debts are largely denominated in US dollars, that country may be more inclined to stabilize its currency versus the dollar, so as to avoid potentially destabilizing fluctuations in its debt servicing burden. The currency composition of a country's official reserves is also informative. Reserve holdings that are skewed to the US dollar may be a sign that the central bank of that country is more prone to intervene to stabilize its bilateral exchange rate viz the US dollar than other currencies. Historical boundaries also figure prominently in the choice of anchor currency, especially in the earlier part of our sample. Colonies and former colonies use (almost without exception) the currency of the colonial power. A country with a high and unstable inflation rate chooses as an anchor the currency of a country whose inflation performance they want to mimic. For instance, despite the fact that Brazil has been Argentina's most important trading partner by a wide margin for decades, Brazil's comparatively high and chronic inflation through the 1990s limited the usefulness of its currency as a potential anchor in the fight against inflation—Argentina preferred the US dollar. Some de jure exchange rate practices, such as Australia's arrangements with several nearby islands or South Africa's with Botswana and Lesotho also inform the possible short-list of currency anchors.

Since world trade and finance are dominated by a handful of currencies, the process of elimination to select the anchor for each country and period is tedious but not intractable. It is also the

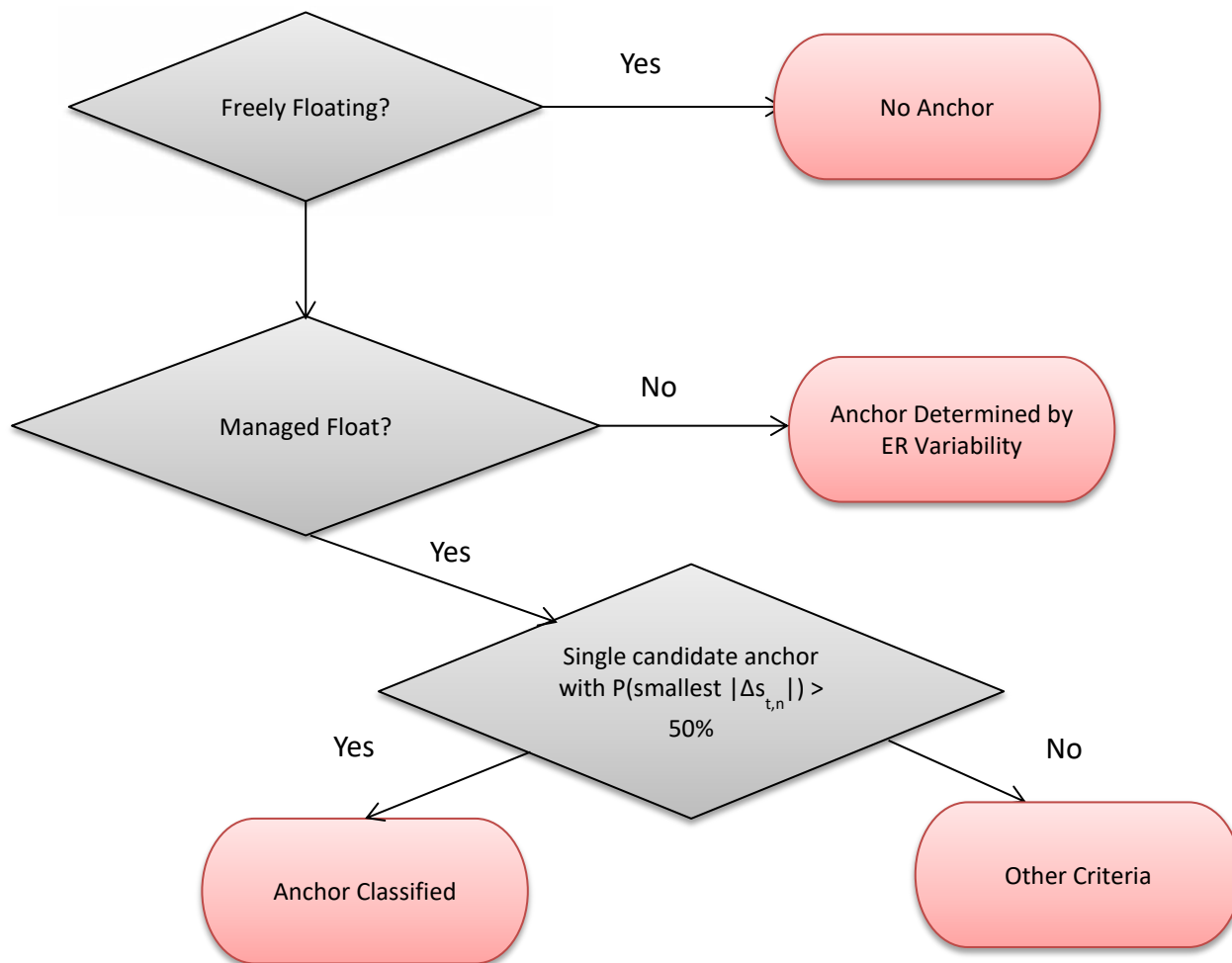
case that there is considerable inertia and path dependence in the choice of anchor currency. Switches of anchor currencies are far more infrequent than changes and revisions to the degree of exchange rate flexibility. Intuitively, in most cases the anchor currency will display a much tighter link and less variation to the country under scrutiny than the other potential anchors. The most transparent cases are the variants of pegs or crawling pegs (de facto or de jure)—also to be defined. As highlighted by Calvo and Reinhart (2002) and Reinhart and Rogoff (2004), these comparatively rigid arrangements dominated much of the global landscape through the 1990s.

Figure 1 sketches the process of anchor currency selection. The distinction between freely and managed floating will be defined below. If a currency is identified as “freely floating” it is classified as having no anchor or reference currency. At the other end of the spectrum, countries with arrangements that are less flexible than managed floating have a low degree of exchange rate variability viz a specific anchor. In these cases, we use this lack of flexibility as a summary measure and classify the anchor currency accordingly.

More recently, managed floating has emerged as a regime of choice among the larger emerging markets. Managed floating is a relatively more flexible exchange arrangement and the classification of a currency as managed floating doesn’t assign a clear anchor currency. Therefore, for these exchange rates, we calculate the monthly, one-year moving average of the absolute value of the change in its bilateral exchange rate relative to all candidate anchor currencies. If the currency shows smaller movements relative to any single anchor in more than 50 percent of the observations, we link the currency to this anchor.⁶

⁶ Candidate anchor currencies are the US dollar, the euro, the Japanese yen, the British pound, the Australian dollar and, more recently, the Chinese yuan. Some past arrangements focused (at least on a de jure basis) on the IMF’s Special Drawing Rights (SDR). With these candidate anchors, moving more closely against a single currency 50% of the time is a relatively high bar. Classifications are not sensitive to altering this to 40% or 60%.

Figure 1: Anchor Currency Selection Process



Even with this refinement, there remain 11 episodes whose anchor remains unclassified based on exchange rate behavior alone. Table 1 lists these cases and how, using supplementary information we were able to allocate these to a currency bloc. We use four separate criteria to assign a reference currency to these countries. First, in which currency is the majority of foreign trade is invoiced? Second, in which currency is the largest share of external (public and publically guaranteed) debt denominated? Third, which currency comprises the largest share of central bank foreign reserves? And finally, which was the most recent anchor currency? Conveniently, all four indicators point to the same reference currency in all countries in the table. As Table 1 highlights, nearly all these cases are a recent phenomenon, beginning in the early 2000s and accelerating during the global financial crisis. The last column summarizes the

supplementary information we used to arrive at our reference currency decision. These are admittedly cases where the notion of an anchor currency is less relevant and we therefore refer to “reference currency” in these cases.

Table 1: Classifying the Unclassified Anchors with Supplementary Indicators

Country (anchor)	Years	Fine ERA Classification	Indicators
Brazil (USD)	2001-	12	94% of exports and 84% of imports in USD. 90% of PPG debt in USD. Anchored to USD before the 2000s.
Canada (USD)	2001-	12	70% of exports and 75% of imports in USD. Debt in domestic currency. Most recently anchored to USD.
Chile (USD)	2008-	12	No data available on invoicing, but given the large share of copper in exports and the denomination of international copper prices in USD, the lion share of exports are likely denominated in USD. Algorithm anchors the CLP to the USD as recently as 2008.
Colombia (USD)	2008-	12	Close to 100% of invoicing in USD and close to 100% of public debt in USD. Algorithm classifies a dollar anchor as recently as 2008.
Iceland (USD)	2001-	10	Very diversified invoicing between USD, GBP and EUR, but with USD the largest share. Central bank FX reserves diversified with USD the largest close to 50%.
India (USD)	2012-	10	86% of exports and 80% of imports in USD. 80% PPG debt in USD.
Israel (USD)	2005-	10	Approximately 70% of exports and imports denominated in USD. Over 60% of Bank of Israel reserves in USD. Most recently anchored to the USD.
Korea (USD)	1999-	12	Anchored to the USD in the 1990s. Other data unavailable.
Latvia (EUR)	1998-2001	10	Diversified invoicing, with EUR the majority at approximately 50% of imports and exports. The country was in transition to joining the Eurozone.
Turkey (USD)	1998-	10 (until 2000) and 12 (from 2003)	Diversified invoicing with the majority in USD. Foreign currency public debt is 60% in USD and 40% in EUR.
Uruguay (USD)	2009-	10	Anchored to the USD until the late 2000s. Other data unavailable.

For completeness, we assess the robustness of our anchor choice by studying two recent natural experiments. There have been two large recent swings in the bilateral USD-EUR exchange rate (see Appendix 1). Both movements can be traced back to monetary policy shocks in Europe and the US. First, on July 22, 2012, Mario Draghi, the President of the European Central Bank, made his now famous speech, in which he stated that the ECB stood ready to do “whatever it takes” to preserve the euro.

Following his pronouncements, spreads on sovereign bonds of peripheral EZ governments declined and the euro appreciated by about 10 percent relative to the dollar through the end of the year. Second, the minutes of FOMC meeting of June 17-18, 2014 increased market perceptions that the Federal Reserve would initiate its tightening cycle, a perception that gathered momentum throughout the rest of the year. As a result, the dollar appreciated by a cumulative 30 percent relative to the Euro through March of 2015.⁷ While Appendix 3 provides the details for the full exercise, we highlight here that all in all, these two event studies strongly corroborate our anchor classification for the borderline cases.

Unlike other prominent exchange rate classification strategies (for example, Levi-Yeyati and Sturzenegger (2005), and Shambaugh (2004), which focus almost exclusively on the degree of exchange rate stability, our approach places considerable emphasis on getting the currency anchor right. In that regard, our aim is closer in spirit to Frankel and Wei (1994), Frankel (2008), and Frankel and Xie (2010). A common thread in the papers by Frankel and co-authors is the attempt to estimate the weights in currency baskets.

2. Measuring Exchange Rate Flexibility

We now outline our approach to classify exchange regimes. Figure 2 (top and bottom panels) describe the algorithm and statistical tests involved. Starting from the top of Figure 2, the first issue to resolve is whether, due to exchange rate controls, there exists a dual exchange rate arrangement, multiple exchange rate practices, or an important parallel market. This issue has been extremely important at different points on time. For example, in post-war Europe, in Africa, parts of Asia, and in Latin America during the debt crisis of the 1980s, and immediately following the dissolution of the Soviet Union in the newly-formed republics parallel markets accounted for an important part of exchange rate developments. Parallel market practices have become significantly less prevalent in the twenty-first century, but their

⁷ This differs from the proverbial “taper tantrum” of the previous year, when the Federal Reserve indicated plans to slow down and eventually reverse asset purchases as part of its quantitative easing policies. While this announcement did create some volatility in emerging market currencies, it had a relatively muted effect on the bilateral Euro-Dollar exchange rate.

resurgence in many lower income countries since 2014 suggest such arrangements still need to be addressed (see Reinhart, 2016).

Assuming a unified rate (no parallel market), the algorithm goes on to examine whether the official announcement (the de jure regime) matches up with actual exchange rate management (the de facto regime). Importantly, there is a separate category, called *freely falling*, for regimes with very high inflation (over 40 percent per annum), which is treated separately, irrespective of whether the exchange rate is unitary or not. In most classifications, these dysfunctional episodes are lumped together with ordinary flexible exchange rate regimes.

Figure 2 (bottom panel) describes our statistical method, which begins by tabulating (the absolute value of) percentage changes in the currency against the anchor currency. If a country has (virtually) no change in the exchange rate for four months or longer, it is classified as a de facto peg (unless it is a de jure arrangement, such as Hong Kong's). An example of a much looser category is a "narrow band" which requires that 80 percent of monthly exchange rate changes be less than 2 percent over a two-year or five-year rolling window.

Freely and managed floating exchange rate categories are the residual cases that do not fall into any of the less flexible arrangements. We then form an index whose numerator captures the mean absolute exchange rate change over a five year rolling window, while the denominator is the probability of exchange rate changes less than one percent. To qualify as "managed float," (in lieu of a freely floating exchange rate), the index must take on an extremely low value relative the volatility of the world's major floating exchange rates.⁸ Supplementary documentation that the country in question intervenes on a regular basis in the foreign exchange market also places the country in the managed floating bucket rather than the freely (or independently in the IMF's lexicon). As we shall discuss in detail, our algorithm is the same for de jure inflation targeting countries.

⁸ See Reinhart and Rogoff (2004) for further details.

Table 2 provides the full range of regimes and their numeric classification for both the detailed fine grid as well as the condensed (simplified) version that comprises the coarse grid. In both classification grids lower numbers indicate less exchange rate flexibility.

3. Classifying Eurozone and Other Currency Unions

A major development in exchange rate practices in the past two decades has been the introduction of the Euro. Since the Eurozone (EZ) comprises more than 15 percent of world GDP, any conclusion about the evolution of global exchange rate arrangements and their degree of flexibility in recent decades depends importantly on how the exchange rate practices of EZ members are treated.

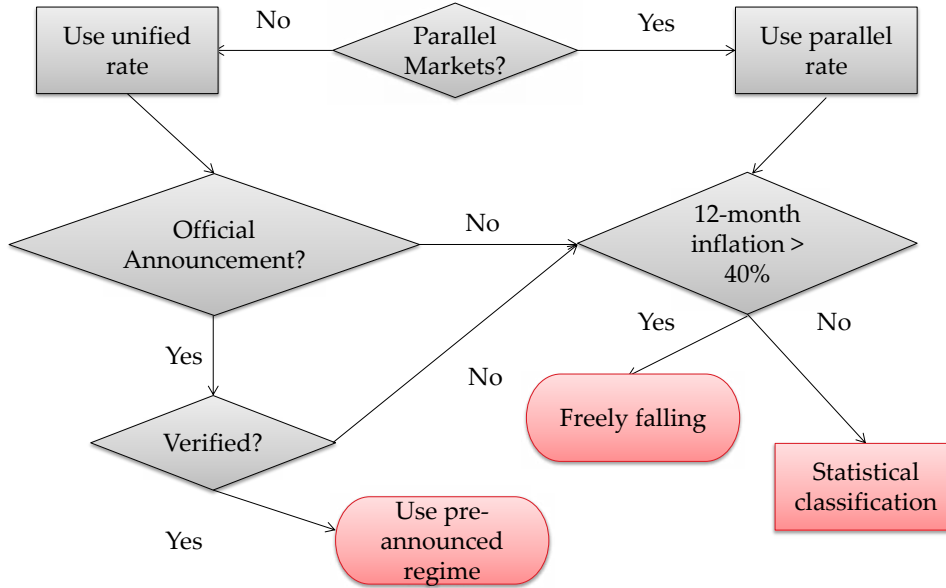
As noted, the IMF, in its *Annual Report on Exchange Arrangements and Exchange Restrictions* (AEAER), currently treats the Eurozone as though it were a single sovereign nation with a freely floating exchange rate. As a consequence, every member country of the Euro area from Malta to Italy and Germany is accordingly placed in the independently floating exchange rate category. An approach that places Malta's and Italy's exchange rate arrangements in the same bucket as Australia's and the United States is questionable on many grounds.

To be sure, according to our classification algorithm, the euro floats freely against other major currencies. But, to state the obvious, Eurozone is far from a cohesive sovereign entity. Individual EZ members do not have their own currency. Faced with a country-specific shock to inflation, output or unemployment, there is no exchange rate that can immediately adjust in response.⁹ Thus, in our classification, individual member countries of EZ are placed at the bottom end of the flexibility spectrum. The currency union label is tantamount, in the flexibility scale, to an exchange rate arrangement with no separate legal tender or a de jure peg (Coarse-grid 1). To reflect (for information purposes only) that the

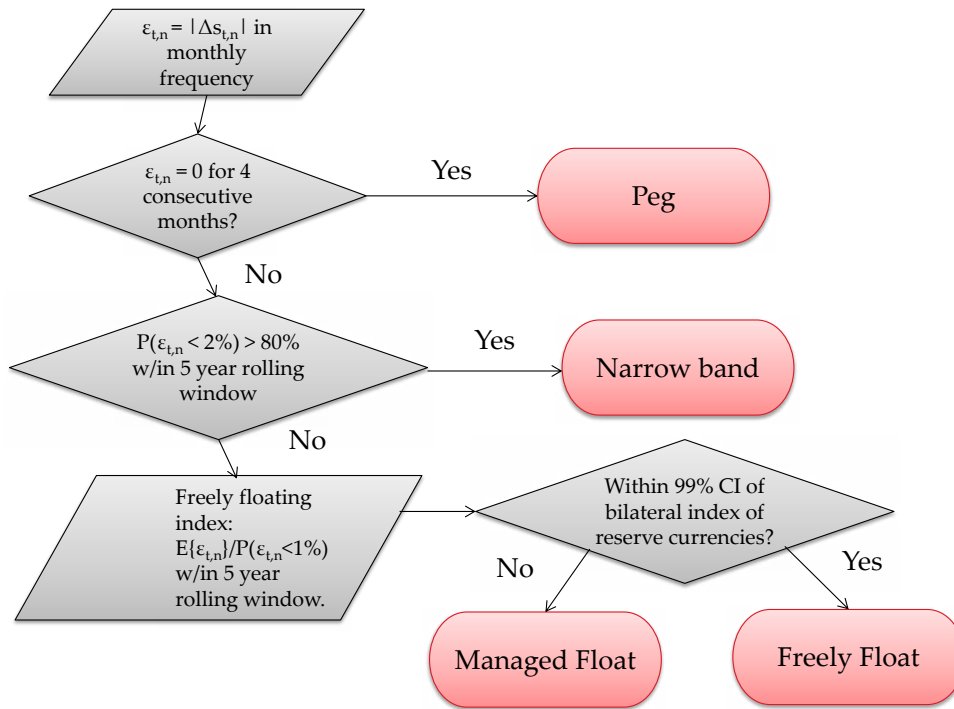
⁹ Of course, as prices adjust over time, real exchange rates will also change in response to country-specific (idiosyncratic) shocks, much the same way as these would for other "hard pegs."

Figure 2. Exchange Rate Arrangement Classification Algorithm

Sequence and general scheme



Statistical tests



Source: The authors.

Table 2: Fine and Coarse De Facto Exchange Rate Arrangement Classification

The fine classification codes are:

- 1 • No separate legal tender or currency union
- 2 • Pre announced peg or currency board arrangement
- 3 • Pre announced horizontal band that is narrower than or equal to $\pm 2\%$
- 4 • De facto peg
- 5 • Pre announced crawling peg; de facto moving band narrower than or equal to $\pm 1\%$
- 6 • Pre announced crawling band that is narrower than or equal to $\pm 2\%$ or de facto horizontal band that is narrower than or equal to $\pm 2\%$
- 7 • De facto crawling peg
- 8 • De facto crawling band that is narrower than or equal to $\pm 2\%$
- 9 • Pre announced crawling band that is wider than or equal to $\pm 2\%$
- 10 • De facto crawling band that is narrower than or equal to $\pm 5\%$
- 11 • Moving band that is narrower than or equal to $\pm 2\%$ (i.e., allows for both appreciation and depreciation over time)
- 12 • De facto moving band $\pm 5\%$ / Managed floating
- 13 • Freely floating
- 14 • Freely falling
- 15 • Dual market in which parallel market data is missing.

The coarse classification codes are:

- 1 • No separate legal tender
- 1 • Pre announced peg or currency board arrangement
- 1 • Pre announced horizontal band that is narrower than or equal to $\pm 2\%$
- 1 • De facto peg
- 2 • Pre announced crawling peg
- 2 • Pre announced crawling band that is narrower than or equal to $\pm 2\%$
- 2 • De facto crawling peg
- 2 • De facto crawling band that is narrower than or equal to $\pm 2\%$
- 3 • Pre announced crawling band that is wider than or equal to $\pm 2\%$
- 3 • De facto crawling band that is narrower than or equal to $\pm 5\%$
- 3 • Moving band that is narrower than or equal to $\pm 2\%$ (i.e., allows for both appreciation and depreciation over time)
- 3 • Managed floating
- 4 • Freely floating
- 5 • Freely falling
- 6 • Dual market in which parallel market data is missing.

currency (euro) for the union as a whole floats freely, the label attached to each member of the EZ is currency union/freely floating.¹⁰

The main considerations behind our classification of the EZ countries are as follows:

First, our approach consistently defines exchange rate arrangements at the country level and not at the currency level; our units of observation are countries rather than currencies. Under its current approach the IMF lists Portugal (like all EZ members) as having a floating exchange rate while at the same time Panama (which adopted the US dollar as its sole legal tender in the early 20th century) is placed in the category of an arrangement with no separate legal tender. If the currency criterion was applied to Panama, it should be considered a floater, since the US dollar floats. Because from the vantage point of Portugal or Panama, neither country has its own currency; in our classification both are in the same bucket as regards exchange rate flexibility. Empirical studies that use our or other de facto exchange rate classifications often ask questions about the relative economic performance of countries under different exchange rate regimes. There too, the unit of observation tends to be sovereign countries, rather than currencies.¹¹

Second, even the largest Eurozone members (Germany, France, Italy, Spain, and the Netherlands) have the equivalent of less than a 4 percent share each of voting rights on the board of the European Central Bank (ECB). These countries rotate such that four of the five is represented in each ECB board meeting. In meetings when they are represented, they have one of 21 votes. Other countries are represented less frequently—in only 11 out of every 19 board meetings. But even the largest members have only a small de-jure influence on the conduct of ECB monetary policy. This arrangement tends to limit the likelihood that ECB policy at any given meeting is set in response to a particular country-specific shock. By contrast, the monetary policies of the central banks of Australia and the United

¹⁰ See the companion chronologies in Ilzetki (2016) for individual countries over 1946-2016.

¹¹ See Levi Yeyati and Sturzenegger (2005), for example.

Kingdom (among other floaters) are routinely and importantly determined by the very nature of their country-specific idiosyncratic shocks.

Third, our classification is continuous in the time series sense—the IMF’s is not (for the EZ group at least). As noted, in *Annual Report on Exchange Arrangements and Exchange Restrictions*, the IMF described the exchange rate policy of future EZ members in the latter part of the 1990s exclusively by their de jure arrangement, which involved at that time +/- 15 percent floatation bands. In reality, even the most committed floaters seldom make use of +/-15 percent bands. From 1999 until 2006, Eurozone countries (then 12 in total) were listed in the IMF’s AEAER under the category of exchange rate arrangement with no separate legal tender. By the time the 2007 AEAER was published, however, EZ members (then 13, with the addition of Slovenia) had been transferred from the most rigid exchange rate regime category to the most flexible (independently floating). This shift The AEAER classification therefore implies that the introduction of euro brought a marked *increase* in exchange rate flexibility in Europe over the past decade.

By contrast, we characterize most members of the European Exchange Rate Mechanism (ERM) as having a de facto peg to the Deutschmark well prior to the introduction of the Euro.¹² Germany, in the freely floating category, was the exception. In our classification, it follows from these observations that for most EZ members, the adoption of the Euro did not represent a drastic change, with a slight (yet important) reduction in the exchange rate exchange rate flexibility of its members.^{13 14}

Finally, the de facto interest rate policy of the European Central Bank appears to support classifying individual members of Eurozone as an exchange rate arrangement with no separate legal tender. At a very basic level, theory suggests that a country with a pegged exchange rate and an open capital account has little or no scope for adjusting the policy interest rate in response to changes in

¹² Some future EZ members had narrow +/-2 percent bands.

¹³ As shown in Table 2, in the fine grid, a de facto peg is a 4 and no separate legal tender or currency union is a 1, so the introduction of the euro reduces flexibility. In the coarse grid classification, categories 1 through 4 of the fine grid are subsumed in category 1, the least flexible category.

¹⁴ To reiterate, the observation on limited change refers narrowly to exchange rate flexibility. In countless other dimensions the introduction of the euro represented major changes for EZ countries, not the least of these was the creation of Target2.

domestic inflation or fluctuations in the output gap. By contrast, a country with a floating exchange rate can respond to inflationary pressures and an overheated economy (shrinking output gap) by raising interest rates, for example. This type of policy response is at the core of a Taylor rule.¹⁵ Simply put, evidence in favor of a Taylor rule is consistent with a flexible exchange rate regime and at odds with a peg.¹⁶

To be clear, the ECB has not (at least in the public domain) considered itself to be guided by a Taylor rule when setting the course of its policies. In that context, the estimation of the Taylor rule for an individual member of the Eurozone should be interpreted primarily as a checkpoint to confirm that, indeed, the ECB's de facto monetary policy is *not* set on the basis of the idiosyncratic economic conditions of any of its members (consistent with a peg).

The only case where a Taylor rule accords with the data reasonably well is pre-2008 Germany. It is as if the ECB policy rate extended Germany's policy rule almost exactly until the onset of the global financial crisis. This evidence is in line with the earlier findings of Smant (2002), who concludes that, after an initial period of lower than expected interest rates, the ECB since mid-2000 set the interest rate consistent with the Bundesbank's old policy rule. Indeed, we find no sign of a structural break in the fit of the Taylor rule to the actual policy once the euro was adopted in January 1999. The sharp contrast of the German case with all other EZ members is discussed in Appendix 1, where additional details are provided.

Classifying other currency unions (specifically, the East Caribbean Dollar bloc and the Central African Franc (CFA) zone, which is itself comprised of Communauté Économique et Monétaire de l'Afrique Centrale, CEMAC and West African Monetary Union, WAEMU) is comparatively straightforward. The reason is that these are clear-cut cases of pegged or rigid arrangements whether the focus is on the currency unit or the country unit. As we have argued for the EZ membership, from the

¹⁵ See Taylor (1993).

¹⁶ Unless, of course, the country doing the pegging has virtually no idiosyncratic shocks of its own and its cycle is perfectly correlated with the anchor country's cycle. This match made in heaven scenario rarely accords with reality.

vantage point of any member country of these currency unions, they do not have their own currency. At the same time, the Central African Franc or the East Caribbean Dollar are pegged to the euro and US dollar, respectively. Recalling that currency unions, a de jure peg, and exchange rate arrangement with no separate legal tender are all in the same least flexible (see Table 2) category, the classification outcome is narrowly circumscribed. In their respective chronologies, members of these currency unions appear under the label currency union/peg. Their flexibility score is the same as for the EZ countries.

4. Inflation Targeting and the Exchange Rate Regime

To integrate inflation targeting (IT) frameworks into our classification scheme, we begin by taking stock of the global emergence of IT and the countries that adopted these policies. IT cases are far from homogenous, spanning across regions, income levels, and exchange rate policies, among other considerations. As shown in Table 3, which lists the countries that have adopted this policy framework, the dates of its inception, and the de facto exchange rate regime classification on the basis of exchange rate behavior, the proliferation of inflation targeting as a de-jure monetary regime has been a development of that past two-three decades, with a more recent history in emerging markets. Since New Zealand adopted an inflation target in 1989, close to 30 countries have followed suit. Nevertheless, with respect to the exchange rate, the impact of inflation targeting has been far less widespread than a simple roll call of IT countries might suggest.

As Table 3 highlights, there is considerable variation in de facto exchange rate practices among countries with a de jure IT policy framework. Among this group (as with non-IT cases), exchange rate practices range from the freely floating currencies of Australia and the United Kingdom to Romania's de facto peg to the euro since 2012. The more flexible arrangements (Categories 3 and 4 in the coarse-grid classification) include: the freely floating case, managed floating, and *moving* bands that are narrower than or equal to +/-2 percent.¹⁷ Slightly less than 2/3rds of the IT group (17 of 27) falls into this basket. De facto pegs, crawling pegs and narrow crawling bands (categories 1 and 2 in the coarse-grid

¹⁷ A moving band refers to the cases where periods of sustained appreciations are also evident; with crawling bands, changes are always in the direction of depreciation.

classification) make up the remaining ten IT countries. More than half of the Fix-IT group is from of Emerging Europe.

Table 3 suggests that the de-jure IT category masks significant differences in monetary practices and that our classification provides information beyond the headline label of inflation targeting. In effect, there is a subset of cases where the mantra of inflation targeting has hidden a continued “fear of floating” by many central banks (Calvo and Reinhart, 2002).

Beyond the analysis of the exchange rate through our various filters, we adopt two different but complementary empirical strategies to assess whether the behavior of IT countries and their non-IT counterparts are similar or distinct. First, we follow an event study approach. Specifically, we focus on the collapse of Lehman Brothers in September 2008--a major global shock exogenous to the monetary conduct of smaller economies. We also revisit the minutes of the FOMC meeting of June 17-18, 2014 (about a year following the Taper-Tantrum of May 2013) which produced a marked appreciation in the US dollar that was particularly acute viz emerging market currencies. The response of IT and non IT countries during these episodes are compared. Second, to assess if IT countries are less distinctive as a group than advertised, we estimate an augmented Taylor rule (that includes a role for the exchange rate) for the sample of IT cases.¹⁸

evident for both de jure IT cases and the control group, which is comprised of countries without an official inflation target. Faced with major external shocks, the exchange rates of inflation targeters with a de facto crawling peg react almost identically on average to countries with a de facto peg and no inflation target.

The main take-away of the Taylor rule estimates is that countries with a de jure inflation target are heterogeneous in their exchange rate practices. In countries we classify as having a crawling peg, the policy interest rate responds less aggressively to inflation and more aggressively to exchange rate

¹⁸ See Taylor (2001).

movements than in countries with flexible exchange arrangements, supporting the conclusions of the event studies. These insights suggest that inflation targeting by itself is too vague and encompassing to constitute a separate category as its own exchange rate arrangement. The de facto exchange rate classification appears to do a far better job in predicting exchange rate variability in IT countries than the de jure classification of inflation targeting.

III: The “Big Picture”

This section quantifies to what extent a handful of major currencies serve as *anchors* for the rest of the world. Apart from documenting the exit of old anchors, the emergence of new ones, and the resilience of some, our study attempts to shed light on the factors that determine which currencies prevail or fail as anchors. We then shift emphasis from the anchor currency question to focus on the evolution of exchange rate arrangements in the seven decades since World War II ended. Of particular interest is the emergence of new types of de jure monetary and exchange rate arrangements and their degree of exchange rate flexibility. We ask whether these arrangements are characterized by trends, say toward greater exchange rate flexibility, or by long cycles with no clear-cut tendency. A new measure of capital or foreign exchange restrictions is introduced.

1. Anchor Currency

Figure 3 presents two snapshots of the world with the information on anchor currencies displayed in maps. This spatial view is shown for the years 1950 and 2015. Of course, comparable figures are possible for all the intervening years, as all the information about currency anchors on a continuous basis is contained in Ilzetzki, Reinhart and Rogoff (2016). The maps show that the dollar zone has expanded considerably since 1950.

Table 3: Countries with Inflation Targets and Their De Facto Exchange Rate Arrangements

Country	Start date	Exchange rate arrangement
Armenia, Republic of	January 2006	+/-2% crawling band. US dollar.
Australia	June 1993	Freely floating
Brazil	June 1999	Managed floating
Canada	February 1991	Managed floating
Chile	September 1999	Managed floating
Colombia	October 1999	Managed floating
Czech Republic	December 1997	+/-2% band. Euro
Ghana	May 2007	De facto crawling peg and later +/-2% band. Large devaluations and nearly freely falling. Managed floating since December 2010.
Guatemala	December 2005	Crawling peg
Hungary	June 2001	De facto crawling band +/- 2% since 2009. Euro. Broader band prior.
Iceland	March 2003	Managed floating.
Indonesia	July 2005	De facto crawling band +/-2 to 5% range, depending on the sub-period considered. US dollar.
Israel	June 1997	Managed floating
Korea, Republic of	April 1998	De facto moving band +/-2 to 5% range, depending on the sub-period considered.
Mexico	December 2001	Managed floating
New Zealand	December 1989	Managed floating
Norway	March 2001	De facto moving band +/-2%. Euro.
Peru	January 2002	De facto crawling band +/-2%. US dollar.
Philippines	January 2002	De facto crawling band +/-2%. US dollar.
Poland	December 1998	De facto crawling band +/-2 to 5% range, depending on the sub-period considered. Euro.
Romania	August 2005	De facto peg since 2012. Euro. De facto crawling band, 2-5%, depending on sub-period.
Serbia	January 2009	De facto crawling peg. Euro.
South Africa	February 2000	Managed floating
Sweden	December 1995	De facto moving band +/-2% since 2008. Euro.
Thailand	May 2000	De facto Moving band +/-2%. US dollar.
Turkey	January 2006	Managed floating
United Kingdom	October 1992	Freely floating since January 2009. Moving band, +/-2%. Euro earlier subsample.
<i>Memorandum items:</i>		
Number (share) of IT cases with more flexible arrangements (Coarse grid 3-4)	17 (63%)	Australia, Brazil, Canada, Chile, Colombia, Iceland, Israel, Korea, Mexico, New Zealand, Norway, South Africa, Sweden, Thailand, Turkey, United Kingdom, and Ghana more recently.
Number (share of IT cases with least flexible arrangements (Coarse grid 1-2)	10 (37%)	Armenia, Czech Republic, Guatemala, Hungary, Indonesia, Peru, Philippines, Poland, Romania, and Serbia

This growth has been due to two world developments. Chronologically, the first spurt to the dollar zone in the years since 1950 comes from the dismantling of the sterling zone, as former British colonies switched from British pounds to American dollars in the decades following the war. This process was already underway by 1950, but gathered momentum with the UK's sterling crisis of 1967 and the country's mounting economic difficulties. By the 1970s the transition out of pound sterling was essentially complete, an issue we revisit in the next section.

Second, the collapse of the former Soviet Union dismantled the sizable ruble block. Russia and most of the former Soviet republics have since anchored to the dollar. Most of the Eastern European nations that were either a part of the USSR (the Baltics) or satellites in the Soviet sphere left the ruble to embrace first the German DM and later the euro. Estonia, Latvia, Lithuania, the Slovak Republic and Slovenia are now a part of the 19-country EZ. As the chronologies document, a number of the others in the region have fairly tight links to the euro via de facto pegs or crawling pegs or narrow corridors.

Shifting from a spatial view of selected years to the time-series dimension, Figure 4 presents the evolution of four major anchor currencies from 1946 through 2015. The top panel shows the (unweighted) share of countries anchored to each anchor currency. The bottom panel of Figure 4 presents the same information but weighs the observations by each country's share in world GDP. Two old anchor currencies disappeared (the British pound and the French franc); one emerged in the 1970s only to disappear (the German DM); a new currency emerges (the euro); and one prevails throughout (the US dollar). In Figure 4, the French franc and German DM, both which transitioned to the euro in January 1999, are combined into a single zone for the 1946-1998 period.

The Bretton Woods system institutionalized the role of the US dollar as the main anchor currency, and until the 1970s, about 70 percent of global GDP was anchored to the dollar. The remainder was split roughly evenly between the UK pound and the Soviet ruble. The end of the Bretton Woods era

in the 1970s witnessed the Deutschmark emerge as the dominant currency of Europe as many European countries began to shadow the actions of the Bundesbank, explicitly or otherwise.

Despite the fact that during this period the US dollar was the currency of choice among the former British colonies that were exiting from the Sterling zone, the loss of comparatively high-income Europe to the DM led to a shrinking of the dollar zone by 1980. This dent to the US dollar zone is apparent in both top and bottom panels of Figure 4. At this time, another rising trend was reducing the share of countries with a tight exchange rate link to the US dollar.

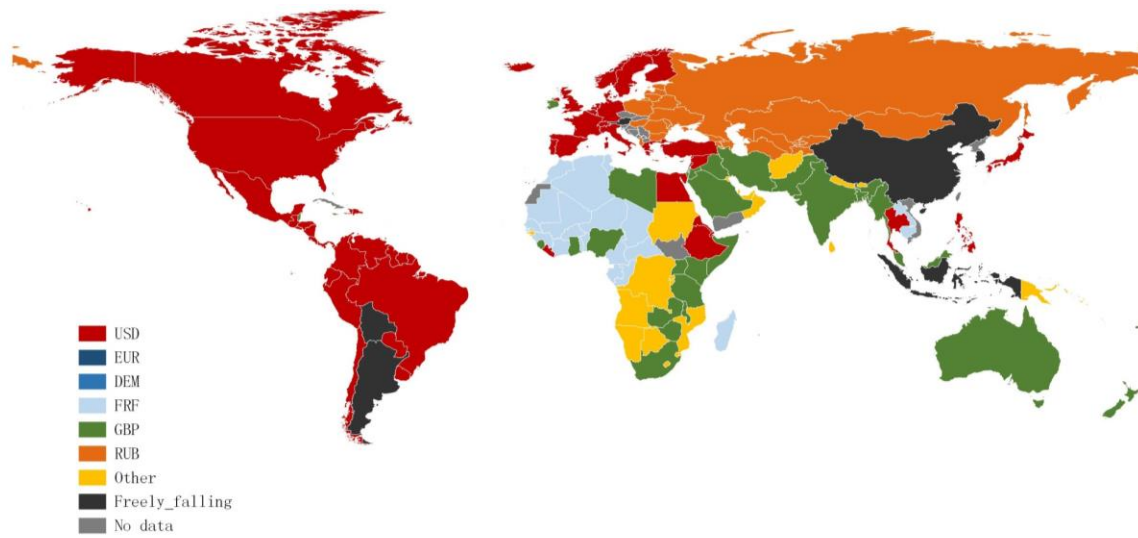
By the late 1970s and into the 1990s, a significant proportion of countries in Latin America and Africa (and some, like Vietnam, in Asia or Turkey in Europe) had freely falling currencies.¹⁹ Chronic and high inflation, and in numerous cases hyperinflation, meant that these countries were “anchorless” with regards to their exchange rate, which steadily plummeted in value versus nearly all other currencies. As inflationary crises became much less common in the 21st century (to date), nearly all the countries with freely falling currencies in the late 1970s-1990s have re-anchored to the dollar. Arguably, one can plausibly reinterpret the history of the freely falling cases and conclude that these countries maintained a US dollar anchor even during the years of very high inflation, as their trade, debts, and hard-currency reserves continued to be dominated by the US currency. In effect, during these long and chronic high inflation bouts many of these countries became significantly dollarized domestically as well.²⁰ The one place that the dollar link was not apparent was in their sinking currencies (which had decoupled from the US dollar or any other currency).

¹⁹ As noted in Figure 2 and Table 2, freely falling captures all the cases where the 12-month inflation rate exceeds 40 percent. The incidence of freely falling over 1946-2016 will be discussed later in this section.

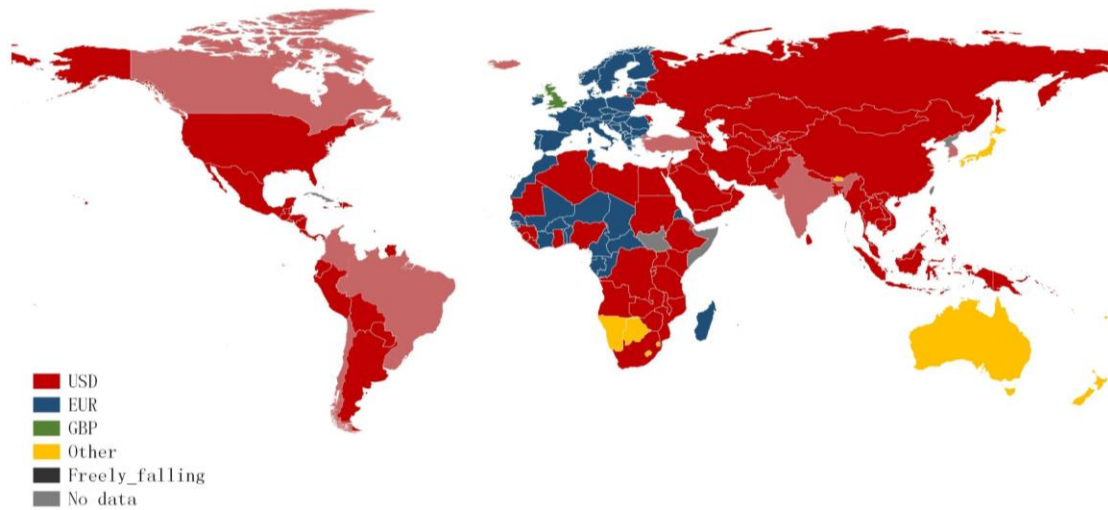
²⁰On de facto dollarization see, for instance, Calvo and Vegh (1999); Reinhart, Rogoff, and Savastano (2014) and Ize and Levy Yeyati (2003)

Figure 3. The Geography of Anchor Currencies, 1950 and 2015

1950



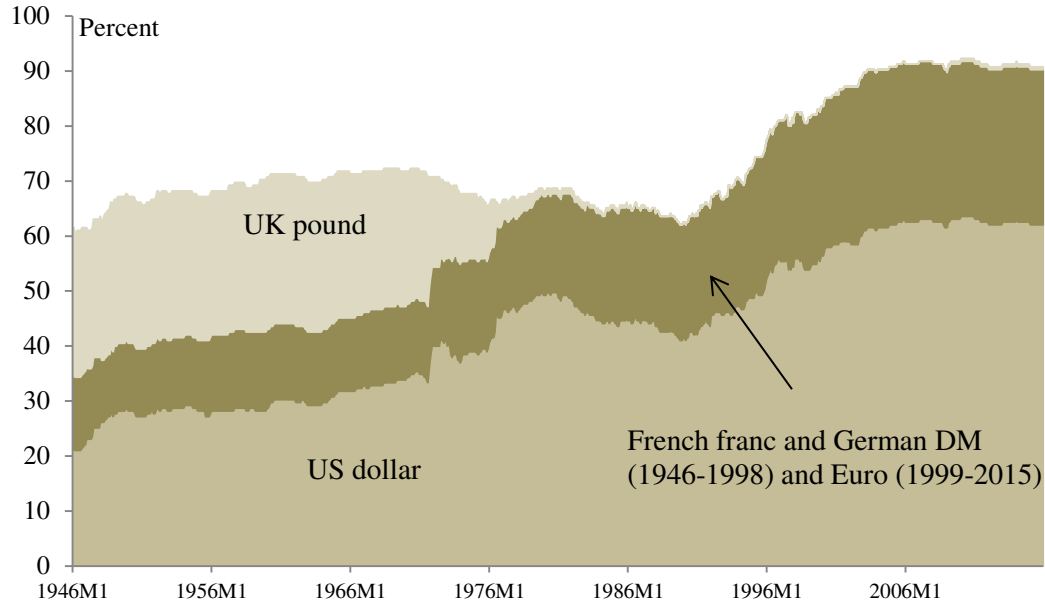
2015



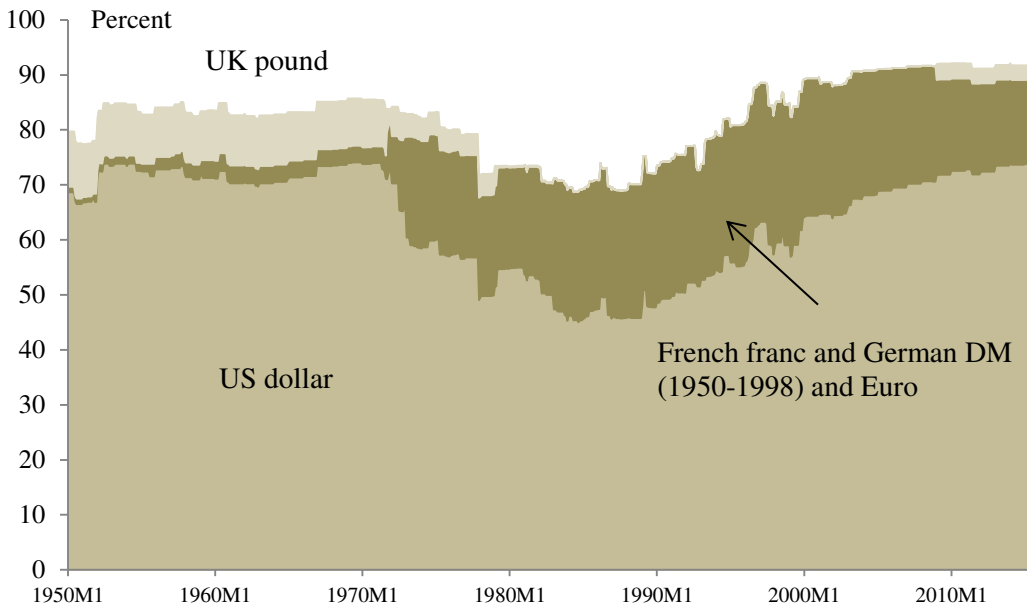
Sources: *Currency Yearbook*, various issues, International Monetary Fund, *International Financial Statistics*, Pick and Sedillot (1971), Reinhart and Rogoff (2004) and sources cited therein.

Figure 4 Post-World War II Major Anchor Currencies

Share of countries, 1946-2015, excludes freely falling cases



Number of countries weighted by their share in world GDP, 1950-2015, excludes freely falling cases



Sources: The Conference Board Total Economy Database, International Monetary Fund International Financial Statistics, Reinhart and Rogoff (2004) sources cited therein, and authors' calculations

Note: The Country Chronologies that supplement this paper show the evolution of the anchor currency on a country-by-country basis.

The dollar dip was eventually largely reversed by the collapse of the Soviet Union and the global disinflation trend from the mid-1990s. The latter translated to a sharp reduction in the share freely falling currencies, which are recorded in our methodology as having no particular currency anchor. The French franc zone, which had its largest roots in French Africa and most explicit connection to the CFA currency arrangement, held a steady share throughout this period until it was replaced by the euro in early 1999.

The DM zone, which in 1999 was consolidated with the French franc area under the aegis of the euro, expanded to encompass approximately 20 percent of global GDP by the start of the 21st century. Since then, the proportion of world GDP that is anchored to the Euro has declined. The UK pound has delinked from its former euro anchor and importantly the Eurozone's share of global GDP has declined. The shrinking euro area (as a share of world GDP) has both external causes, the growth of China and other emerging market economies (an issue we take up in the next section) and the severe nature of the crisis of 2008-2009, which affected so many EZ members.²¹

2. Drivers of Anchor Currencies

Although Japan eventually emerged from the devastation of World War II as one of the world's most dynamic economies with a share of world GDP that peaks close to 10 percent in the early 1990s, the Japanese yen has not figured in our discussion of post-war anchor or reserve currencies. Indeed, given Japan's wide global trade network, it is somewhat of a puzzle that the yen never takes its place among the world's major anchor currencies. In this section, we discuss some of the factors that help determine whether a particular currency gains ground in the global theater or not.

We now explore a number of factors that may potentially determine the choice of anchor currency. Each of these factors has been used elsewhere as an indicator of the dollar's global reach. So this exercise can also be seen as a cross-check that our anchor classifications are a useful summary measure of these factors. Table 4 studies four reserve currencies (dollar, euro, pound, and yen) and reports the share of countries that are anchored to each as well as a number of factors that may explain their roles

²¹ See Reinhart and Rogoff (2014).

as global currencies. These factors include the share of world reserves held in this currency, the share of developing country debt that is denominated in the anchor currency, and an index that summarizes the extent to which world trade is denominated in the anchor currency. The trade invoicing index is based on trade

Table 4: Markers of a Reserve Currency
(figures for 2015, unless otherwise noted)

Anchor measure or criteria: US dollar	Percent
Share of countries with a US dollar anchor in their exchange rate arrangements	62
Share of world's reserves (excluding gold) in US dollars	65
Share of developing country external debt denominated in US dollars. (This does not include debt owed to China that are denominated in US dollars)	64
Trade invoicing "index"	69
Memorandum item:	
Share of the US in world GDP	18
Anchor measure or criteria: Euro	Percent
Share of countries with a euro anchor in their exchange rate arrangements	28
Share of world's reserves (excluding gold) in euro	20
Share of developing country external debt denominated in euro	13
Trade invoicing "index"	55.5
Memorandum item:	
Share of the Eurozone in world GDP	11.8
Share of France and Germany in World GDP	5.6
Anchor measure or criteria: UK pound	Percent
Share of countries with a pound anchor in their exchange rate arrangements	Nil
Share of world's reserves (excluding gold) in pounds	4
Share of developing country external debt is denominated in pounds	Less than 1
Trade invoicing "index"	8.5
Memorandum item:	
Share of UK in World GDP	2.7
Anchor measure or criteria: Japanese yen	Percent
Share of countries with a yen anchor in their exchange rate arrangements	nil
Share of world's reserves (excluding gold) in euro	4
Share of developing country external debt is denominated in euro	6
Trade invoicing "index"	9.6
Memorandum item:	
Share of Japan in World GDP	5

Sources: The Conference Board *Total Economy Database*, Gopinanth (2015), International Monetary Fund *International Financial Statistics*, Reinhart and Rogoff (2004) sources cited therein, World Bank, and authors' calculations.

Note: The Country Chronologies that supplement this paper show the evolution of the anchor currency on a country-by-country basis. GDP in millions of 1990 US\$ (converted at Geary Khamis PPPs)

invoicing data from Gopinath (2015) and is detailed in Appendix 4. It averages the percent of countries with *any* trade invoiced in a given anchor currency with the *share* of all trade invoiced in that currency.

The picture emerging from Table 5 is fairly consistent across indicators and confirms our assessment that the US dollar stands out as the dominant anchor. Based on the classification approach outlined in Section II, as of 2016 the dollar serves as the anchor or reference currency for 62 percent of the 195 countries that are a part of our study. About two-thirds of the worlds' foreign exchange reserves are held in US dollars and a comparable share of developing and emerging market economies' external debt is denominated in greenbacks.²² Both in magnitude and relative importance, these numbers align with our own estimates on exchange rate arrangements. Finally, the US scores 69 percent on the trade invoicing index, a score that exceeds that of any other anchor currency.

The only other major anchor currency, by our classification, is the euro, to which 28% of countries have an anchor. This figure somewhat overstates the euro's global reach as the euro's sphere of influence appears to be confined to Europe (including emerging Europe). The factors show a similarly consistent picture on the role of the euro as a far second. While the trade invoicing indicator has a fairly high reading (intra-Europe trade is significant), the other indicators on reserves and external debt are considerably lower than their readings for the US dollar. Asia, Latin America, the Middle East and much of Africa (CFA Zone notwithstanding) is dominated by the use of the dollar as a reserve currency.

We are not aware of any country that either pegs to or shadows the yen or UK pound at present. Indeed, apart from its colonies prior to World War II or its occupied territories during that war, Japan's currency served as an anchor only for the domestic economy and even then one which had competition from the dollar. The trade invoicing indicator gives some insight why the UK pound and Japanese yen have very limited status as world anchor currencies during this period. For each of the factors, the score is less than 1/7th of the dollar's combined score. The late Ronald McKinnon, in several of his papers on what

²²See also Faudot and Ponsot (2016).

he called East Asia's dollar standard, emphasized this point.²³ Only the euro comes close to the use of the dollar in trade invoicing. In fact, as Gopinanth's (2015) data highlights, about 50 percent of Japan's exports and over 70 percent of its imports are denominated in US dollars. Furthermore, Japan's link to the US dollar lasted longer than Europe's and well past the breakdown of the Bretton Woods arrangements, as Japan maintained a narrow de facto band until 1977 (see the companion chronologies to this paper.)

3. Exchange Rate Arrangements

Having described the trends in anchor currencies, we now turn to the global evolution of exchange arrangements. Figure 5 provides a spatial view of exchange rate arrangements in 1950, the early Bretton Woods era and recent experience (2015), comparable to what Figure 3 showed for anchor currencies. In each map, countries are shaded based on their coarse exchange rate classification, with lighter shades indicating greater exchange rate flexibility.

In the early years, the majority of countries participated in the Bretton Woods system, pegging their currencies to the US dollar, which itself was convertible to gold at a fixed rate. Why then do large tracts of Europe show up as more flexible managed arrangements in Figure 5? The answer lies directly with the first question we pose in our classification algorithm, as illustrated by Figure 2: Is the exchange rate unitary? In nearly all of post-war Europe through the mid-1950s, the answer to that question was a resounding no. While there was an official parity registered with the IMF and its gold equivalent, in practice this was an era of comprehensive and widespread foreign exchange and capital account restrictions of multiple exchange rate practices, as discussed at length in DeVries (1969) and (1987). A widespread dollar shortage at the time (see a summary in Reinhart, 2016) drove parallel market premia sky high (often into three digits). The gyration in the parallel market provided what Reinhart and Rogoff (2004) called back-door floating.

²³ See, for example, McKinnon and Schnabl (2004).

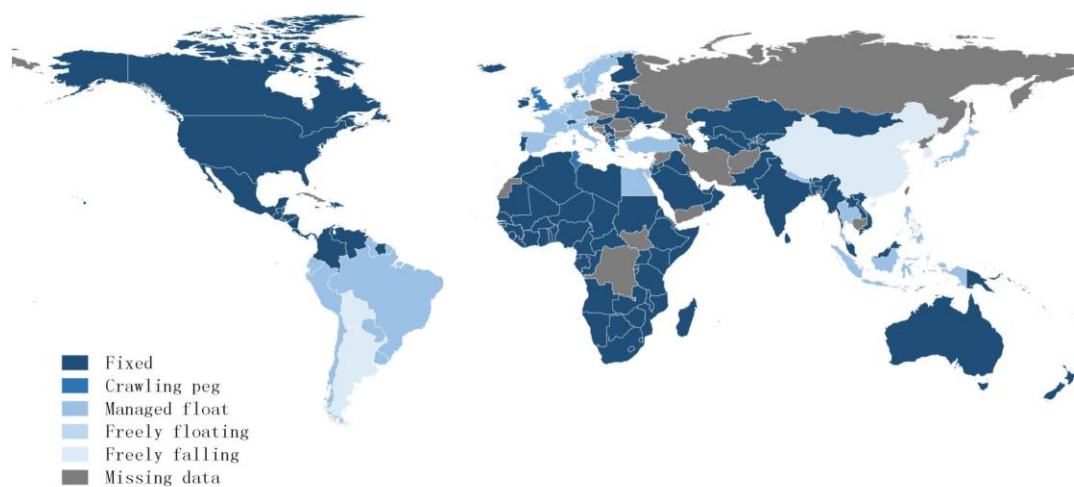
On the other side of the iron curtain, many of the remaining countries were in the Soviet block and had pegs to the ruble. If Western Europe's exchange arrangements at that time were decidedly opaque, the arrangements of the Eastern bloc were outright inscrutable. Multiple exchange rate practices were the norm and the Soviet Union and Yugoslavia could, at any point in time, list administered exchange rates by the dozen. Continued scarcity meant that black currency markets were active despite repression. Unlike the Western European countries, for which we have the parallel market exchange rate data, we do not have their counterpart. Hence, we leave these cases under the label Parallel markets-no data.

The geographical snapshot of Bretton Woods in 1950 and 2015 is supplemented by the time series profile over 1946-2016 shown in Figure 6 in three panels. The first of these panels traces the evolution of the least flexible arrangements (Coarse classifications 1 and 2, as defined in Table 2) while the second presents the more flexible arrangements (Coarse classifications 3 and 4). The third panel traces out the incidence of the dysfunctional freely falling category as well as those cases where there are dual or multiple exchange rate practices or an active parallel market and we do not have time series data on the parallel market exchange rate that allows us to classify the arrangement by its degree of flexibility. Figure 6 only includes independent (sovereign) states, which means that the total number of entities more than doubles over the course of the sample, from 79 in 1946 to 188 in 2016.²⁴ To offer a clearer picture of the incidence of regimes across countries and avoid presenting a global picture that is dominated by a handful of very large economies, we first report the unweighted tally for each regime.

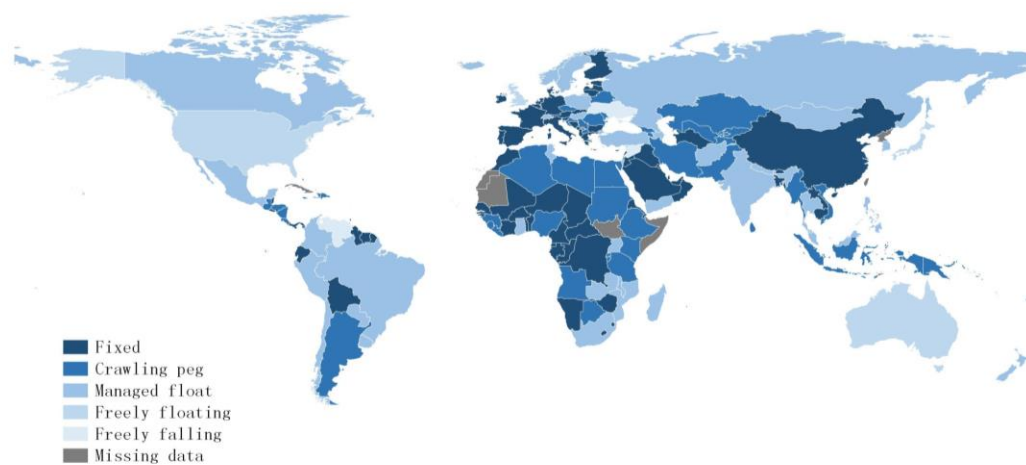
²⁴ There are six territories for which we have a full classification, bringing the total to 194. As we also have the pre-independence de facto exchange rate arrangements, Figure 6 can be also reproduced for all countries and territories, which would mean 194 entries for each year.

Figure 5. The Geography of Exchange Rate Arrangements, 1950 and 2015

1950



2015



Sources: *Currency Yearbook*, various issues, International Monetary Fund, *International Financial Statistics*, Pick and Sedillot (1971), Reinhart and Rogoff (2004) and sources cited therein.

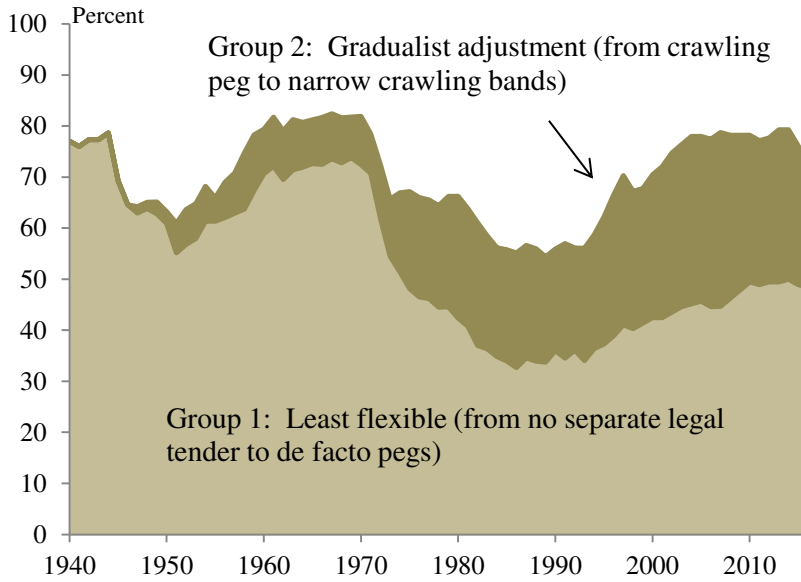
The most striking feature of Figure 6 (top panel) is that if the two least flexible arrangements (Coarse 1 and 2) are combined, the share of countries living with limited exchange rate flexibility is about the same today as at the outset of the sample under Bretton Woods.²⁵ This aggregate masks the fact that within these two groups there was a significant migration from the explicit de jure pegs that we tend to associate with the post-war Bretton Woods era to the still limited flexibility arrangements (Coarse Grid 2) that have more “escape valves” either because they allow for a drift in the exchange rate over time (crawling pegs), because they are de facto and not de jure arrangements—so there is no explicit commitment to “maintain the peg” and therefore adjustments to the pegs are often discretionary--or a combination of the two. It is evident in Figure 6 that Coarse grid 2 arrangements were virtually nonexistent until well into the 1950s only to gain in popularity post-1980s.

The incidence of managed and free floats (second panel) re-enforces the finding that flexible arrangements are not as commonplace since the breakdown of Bretton Woods as one might have thought or as the IMF’s classifications suggest. Freely floating exchange rates after all these years are still largely confined to a few wealthy economies. If instead of focusing on the share of countries in each category, we were to weigh the aggregation by the country shares in world GDP, as is done in Figure 7 (second panel for the floaters), then the share of floaters about doubles from less than 20 percent in Figure 6 to somewhere between 30 and 40 percent, as shown in Figure 7. Since the United States and Japan float freely, this already accounts for 23 percent of world GDP, as Table 4 makes plain. Thus, to develop a sense of country practices around the world, Figure 6 is far more suited to the task.

²⁵ The classification regime studied by Klein and Shambaugh (2010) is broadly similar in spirit to ours and (we believe) would also show that the rise in reserves coincided with a rise in the weight of less flexible exchange rate regimes. Another widely used system, Levy-Yeyati and Sturzegger (2005) gives this result to some extent by construction, since it includes reserve accumulation (where available) in its algorithm for detecting exchange rate inflexibility.

Figure 6. De Facto Exchange Rate Arrangements, Coarse Classification, 1946-2016:
Share of (independent) countries in each group

Groups 1 and 2: Less flexibility, primarily nominal exchange rate anchors



Groups 3 and 4: Flexibility, primarily interest rate, money and most inflation target arrangements

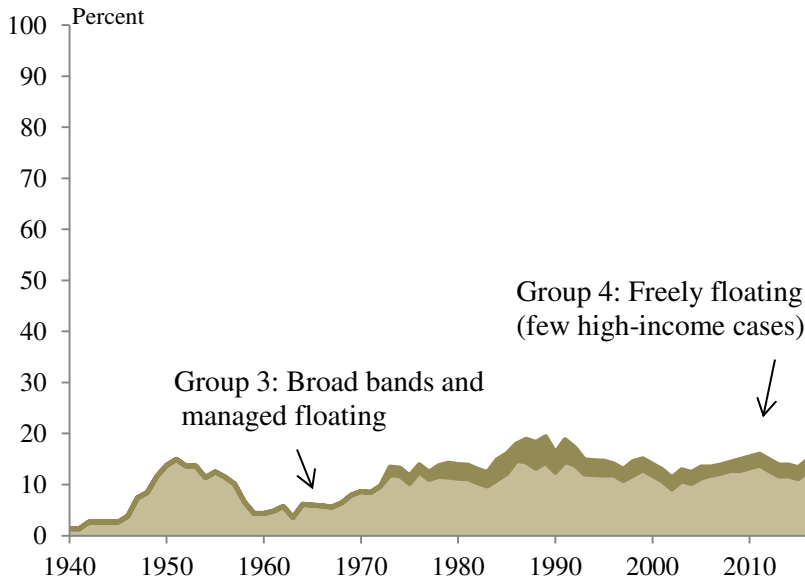
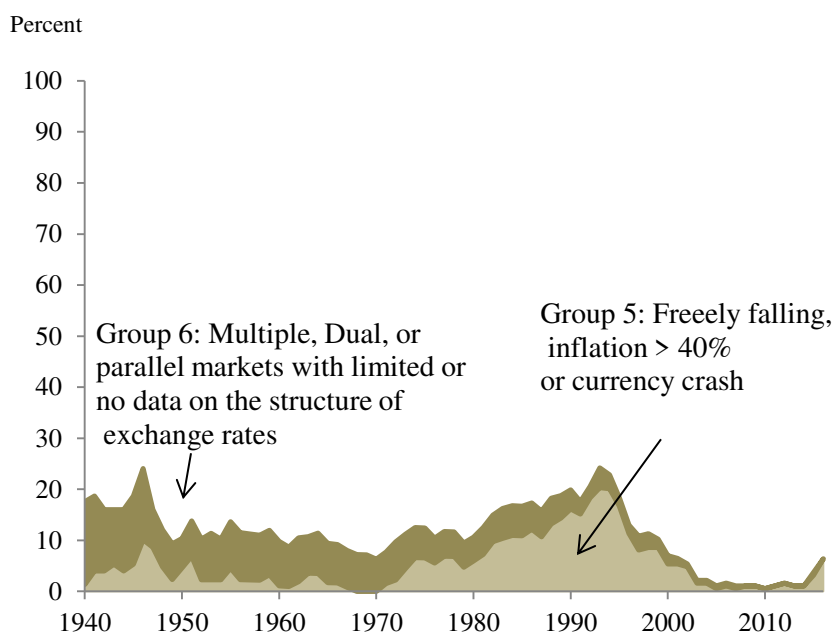


Figure 6 (concluded) De Facto Exchange Rate Arrangements, Coarse Classification, 1946-2016:
Share of (independent) countries in each group

Groups 5 and 6: Flexibly unstable: Anchorless



Sources: International Monetary Fund *International Financial Statistics* and *Exchange Arrangements and Exchange Restrictions*, Reinhart and Rogoff (2004) sources cited therein, numerous detailed country sources listed in the Data Appendix, and authors' calculations.

The third panel of Figures 6 and 7 highlights that freely falling went into a hiatus early in the 21st century. The wave of hyperinflations that spread across former Soviet Republics came to an end. Also the resolution of the debt crisis of the 1980s in the mid-1990s re-opened international capital markets for many large emerging markets (Brazil, Mexico, Poland, among others), which meant that these countries that had relied heavily on inflationary finance had other options available to them. The spread of inflation targeting to emerging markets that began in the late 1990s (Table 3) has also contributed to the lower global incidence of inflationary crises. Some resurgence of high inflation should not be ruled out; now in the third year of a sharp decline in oil and commodity prices losses in revenues, depleted foreign exchange reserves and markedly slowing economic activity may drive some countries back to inflationary finance. The most extreme case is Venezuela (estimated inflation is well over 800 percent in 2016) but other countries in Africa are reporting inflation rates that are climbing back into double digits.

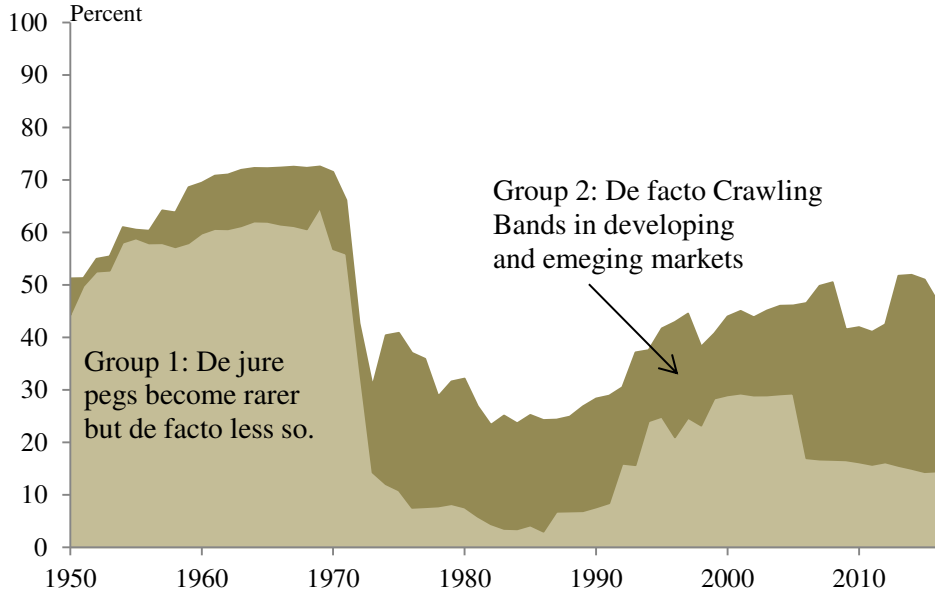
These figures also include the share of cases where we can document that there were de jure parallel markets or multiple exchange rates but we simply do not have the parallel market data to classify these cases according to their flexibility. Most of the cases in that group come from either the soviet ruble bloc or low income countries where data collection on parallel rates is patchy or nonexistent. Our documentation of the post-2014 re appearance of parallel markets (more of this to follow) relies heavily on the financial press and web-based sources rather than on a single publication or official sources.

Finally, Figure 8 shows how our classification contrasts with that of the IMF in 2014: the last year for which the IMF classification was available. It compares the percentage of world GDP classified in each (coarse) exchange rate regime according to our and the IMF's classifications. In addition to classifying all Eurozone as freely floating, the IMF classified a larger number of inflation targeting countries as having flexible arrangements. These differences lead to very different conclusions of the international monetary system. The IMF classifies 70 percent of world GDP as either freely floating, managed floating or floating (an intermediate category that we do not use). Nearly all other countries are classified as having a crawling peg, leaving a negligible fraction of the world economy in a fixed exchange arrangement.

Based on this classification one might conclude (incorrectly in our view) that the world has made enormous strides towards exchange rate flexibility and that fixed exchange rates are essentially a thing of the past. In contrast, we find that the world is roughly evenly divided between more flexible exchange arrangements (freely or managed floats) and crawling or hard pegs. In the latter category, most pegs are hard (in fact, mostly countries with no separate legal tender). Our conclusions point to far greater constancy in the international monetary system than the seismic shift suggested by the IMF's classification.

Figure 7. De Facto Exchange Rate Arrangements, Coarse Classification, 1946-2016: Arrangement Categories as Shares of World GDP

Groups 1 and 2: Less flexibility, primarily nominal exchange rate anchors



Groups 3 and 4: Flexibility, primarily interest rate, money and most (not all) inflation targeters

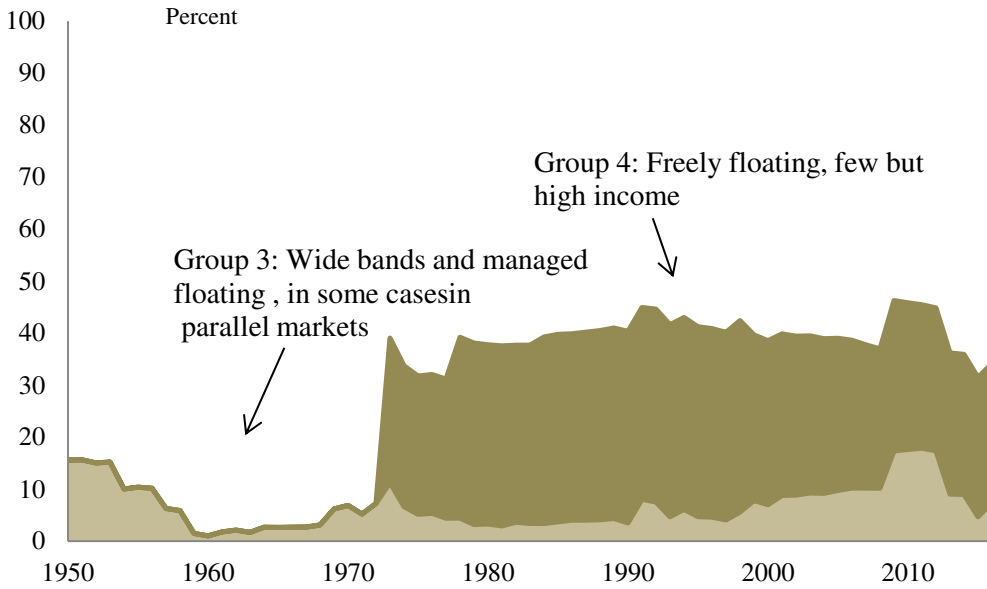
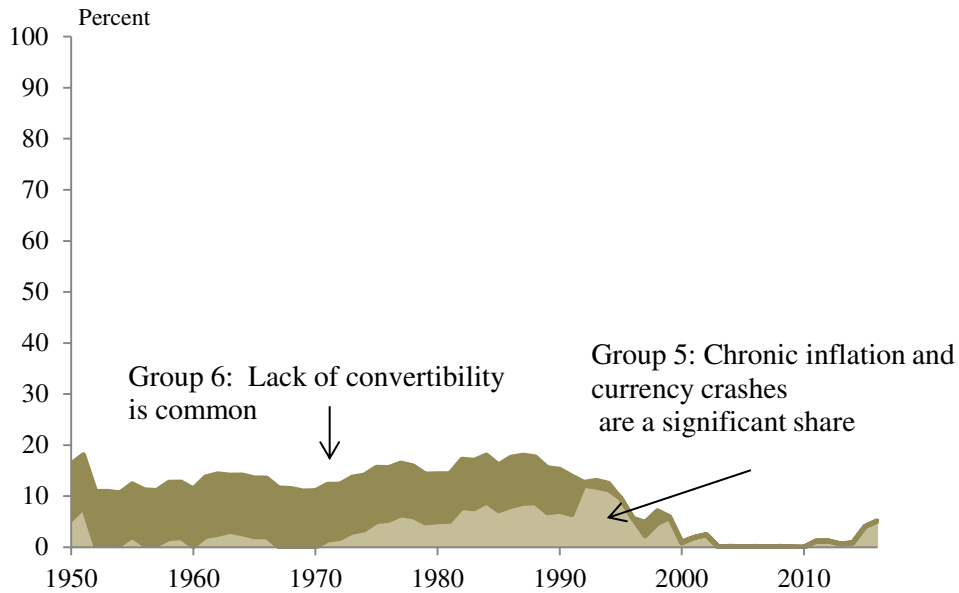


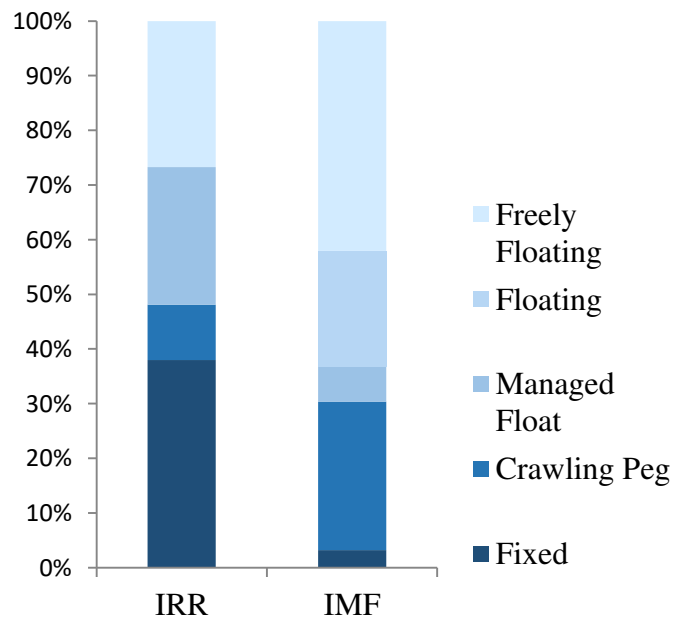
Figure 7 (concluded) De Facto Exchange Rate Arrangements, Coarse Classification, 1946-2016: Arrangement Categories as Shares of World GDP

Groups 5 and 6: Flexibly unstable: Anchorless



Sources: International Monetary Fund *International Financial Statistics* and *Exchange Arrangements and Exchange Restrictions*, Reinhart and Rogoff (2004) sources cited therein, numerous detailed country sources listed in the Data Appendix, and authors' calculations.

Figure 8: Share of World GDP by Exchange Arrangement: Ilzetzi, Reinhart and Rogoff (2016) and IMF (2014)



4. Capital Mobility, Multiple Exchange Rates, and Parallel Markets

In much of the literature on exchange rate arrangement classification, the closely related issue of capital mobility has often been ignored altogether. This omission is at odds with the discussions in the closely related literature on the Impossible Trinity (Frankel 1999) and the Policy Trilemma or Dilemma (Obstfeld and Taylor 2003, Obstfeld et al 2005, Gourinchas and Obstfeld 2012, Rey 2013). These papers pointedly connect the choice of exchange rate regime not only to the ability to conduct independent monetary policy (an issue we have discussed in the previous section in connection with the classification of Eurozone regimes and inflation targeting) but also to the prevalence of capital mobility. We concur that a profile of the global financial system that includes a discussion of reserve currencies, exchange rate arrangements, and monetary policy would be incomplete without an assessment of developments in capital market integration.

To this end, we compile here a (0,1) index of capital mobility that offers insights into the big question of the extent of integration of capital markets over the course of 1946-2016. The index we choose is a narrow measure of capital restrictions and we discuss the limitations of our chosen index in detail below. As described in Section II, the first step of our classification is to determine whether the exchange rate is unitary or not. The IMF's AEAER provides an annual update on whether a country has an official dual market or multiple exchange rate practices. Indeed, this report offers detailed information on the extent of many other capital account restrictions.

The work of Chinn and Ito (2006 and updates) covering 1970-2014 and Fernandez et. al. (2015) covering 1995-2013 exploited a broad range of the information provided by AEAER to construct a variety of measures of capital mobility.²⁶ Our exercise is a contribution to these efforts in a narrow but important dimension. Our interest is confined to the record on unitary/dual/multiple exchange rate practices that the AEAER compiles; regular publications by Franz Pick (various issues and Pick and Sedillot, 1971) contribute importantly to the chronology on dual markets. This record is supplemented by

²⁶ See Quinn, Schindler and Toyoda (2011) for an assessment of this literature and Quinn (2003) for an insightful long view spanning 1890-1999.

information on parallel market exchange rates. Depending on the era and the region, parallel markets have accounted for a significant share of the activity in foreign exchange markets. Tighter capital account restrictions are often accompanied by higher parallel market premia.²⁷ The monthly index we provide for 194 countries or territories from 1946 through 2016 is based on the answers to three questions: (i) is there a de jure dual market? (ii) is there a de jure system of multiple exchange rates? (iii) is there a parallel market (official, tolerated or outright illegal) and if there is, is the parallel market premium above 10 percent over the majority of a moving 12-month period? If the answer is yes to any of the three questions above, the index takes on the value of one. It is zero otherwise.

As noted, this measure of capital mobility is not as comprehensive as others which incorporate specific measures that are designed to limit or ban capital outflows or inflows, regulate the repatriation of profits abroad, cap foreign ownership, require the surrender of foreign exchange receipts, etc. We suggest, however, that this index is informative as a “minimum measure” of restrictions nonetheless. While a country can have many of the capital account restrictions listed above (or others) and still have a de facto as well as a de jure unified exchange rate, the converse is not true. First, if the answer is yes to questions (i) and (ii), these are de jure controls. Second, if the answer to question (iii) is yes, it is difficult to see how a significant and sustained gap between the official exchange rate and the parallel market exchange rate can persist in a country where there is a high degree of capital mobility. De facto (if not de jure) capital mobility would tend to equalize those rates.²⁸ Therefore there must be other restrictions or market imperfections that prevent this from happening.

With the caveats in mind that this measure may be overstating the degree of capital mobility and that in reality capital controls are seldom a (0,1) process, the top panel of Figure 9 plots the index (as a share of all independent countries) with and without weights that reflect country shares in world GDP. While the index is available since 1946, GDP weights are only available for these many countries since

²⁷ The premium is defined as $(s_t^p - s_t)/s_t$, the percentage difference between the parallel market and the official exchange rate.

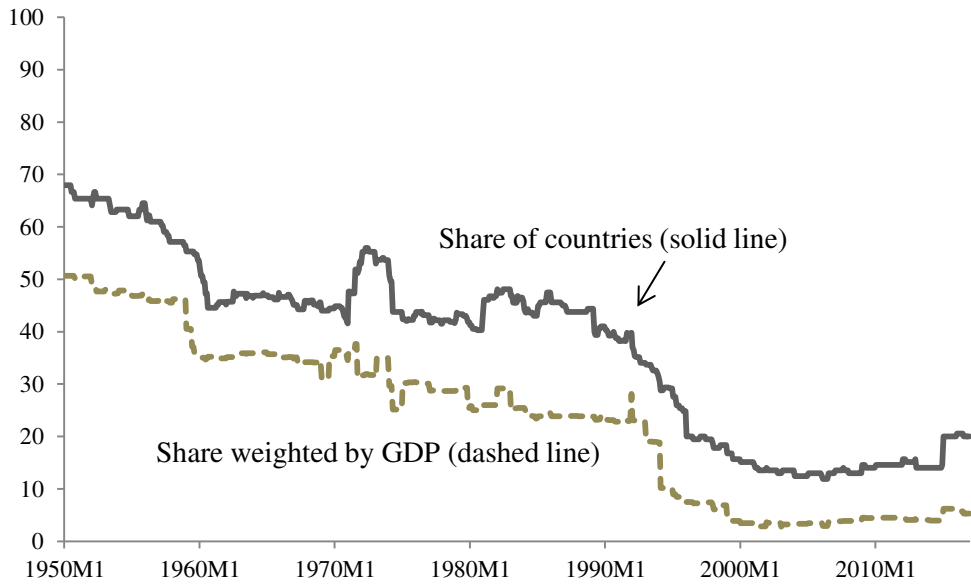
²⁸ De facto capital mobility refers here to cases where the existing de jure controls are not binding, either because these are being circumvented or because they have become outmoded or obsolete.

1950. About 70 percent of all countries did not meet the criteria of a unified exchange market in 1950. In the 1960s that share drops to around 50 percent, as many advanced economies move to eliminate multiple exchange rate practices (an important goal of the IMF at the time, as discussed by De Vries (1969) and shown in the bottom panel of Figure 9) and the post-war dollar shortage is less acute. The next round of capital market integration occurs in the 1990s as the former Soviet bloc joins global capital markets alongside the emerging markets that regain capital market access after a long debt crisis.

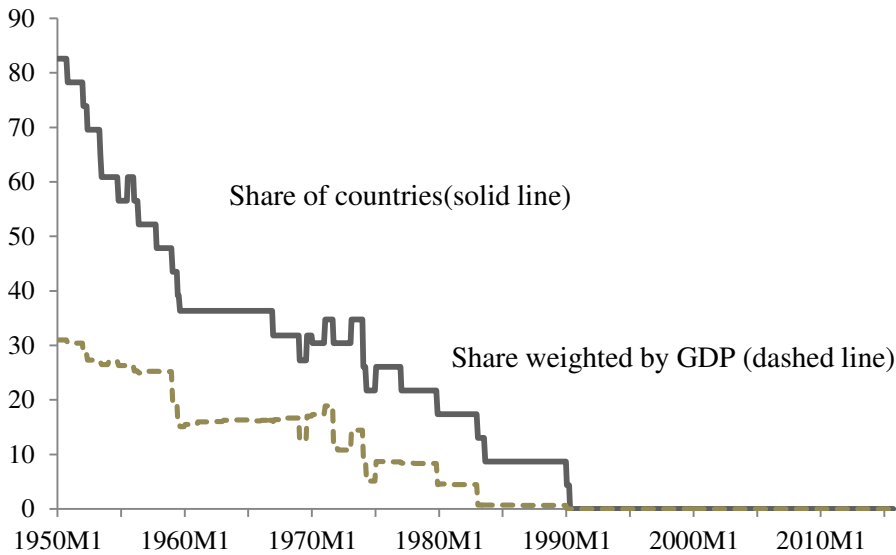
Since mid-2014, many developing and emerging markets, particularly (but not exclusively) those that rely on primary commodity exports, have seen foreign exchange reserves dry up and governments have turned once again to capital controls. Under these conditions, parallel markets have re-emerged, particularly in Africa, the Middle East and Central Asia. Parallel market premia have risen, in several cases into the three and even four digit range. Despite this recent revival of foreign exchange controls, which has been mostly confined to lower income countries, global capital mobility (by this measure) is higher since the mid-1990s. Perhaps the combination of increasingly mobile capital across borders and the stubbornly high share of countries that continue with exchange rate arrangements that have limited flexibility (Figure 6) can help explain the sustained and unprecedented rise in the emerging world's demand for reserves. The next section takes up this and related issues.

Figure 9. Share of Independent Countries with Dual, Multiple, or Parallel Exchange Rates, January 1950-September 2016

All independent countries



Advanced economies



Sources: International Monetary Fund *International Financial Statistics* and *Exchange Arrangements and Exchange Restrictions*, Reinhart and Rogoff (2004) sources cited therein, and authors' calculations.

Note: The Country Chronologies that supplement this paper show the evolution of the anchor currency on a country-by-country basis and whether a system of dual, multiple, or parallel exchange rates was in place. The number of countries increases from 72 in 1946 to 184 in 2016.

IV. Trilemmas and Dilemmas; Triffin and the Impossible Trinity

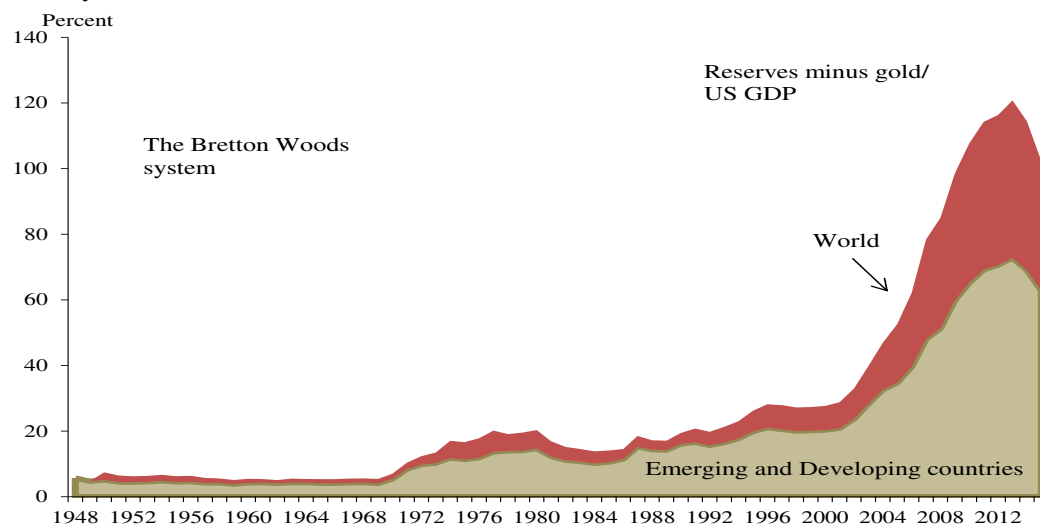
Having developed a quantitative assessment of the global evolution of the world's reserve currencies, exchange rate arrangements, and international capital mobility over seven decades, we turn our attention to a broad set of questions regarding the implications of the established trends and some potential risks in the current global financial system. We begin by revisiting a topic that has attracted the attention of academics and policy makers alike for more than a decade now: the surge in reserve accumulation since the early 2000s by emerging markets in general and China in particular. The possibility of a modern version of the Triffin dilemma has been recently addressed in Farhi, Gourinchas and Rey (2011), Obstfeld (2013), and Farhi and Maggiori (2016)—we connect that discussion to our data, including the rise in managed exchange rates despite increasing capital mobility

1. The Impossible Trinity and the 2003-2013 Reserve Surge

Since the International Monetary Fund was established at the end of World War II, no period has witnessed a comparable surge in the stock of reserves held by central banks across the world. As is well known, this war chest of reserves was built primarily by emerging markets, notably Asia, and most famously China. A fast-growing literature has examined the causes of that growth. Some papers have stressed the precautionary, self-insurance motive (see, Gourinchas and Obstfeld, 2012, for instance) while others have highlighted the mercantilist motive and the desire to avoid or limit exchange rate appreciation (Aizenman and Lee, 2007, Dooley et al, 2003). Figure 10 plots world reserves—and their emerging market and developing country component—scaled by US GDP. US GDP was the scale variable of choice, as the US dollar remains the dominant reserve currency by what appears to be a widening margin.²⁹

²⁹ A variant of this Figure could pair reserves held in US dollars to US GDP and another variant could pair world reserves to world GDP. This latter version would be far less informative since what we want to ultimately focus on are the North-South trends (more of this to follow).

Figure 10: World Reserves minus Gold (US dollars) as a percent of US GDP (Principal anchor currency country), 1948-2015



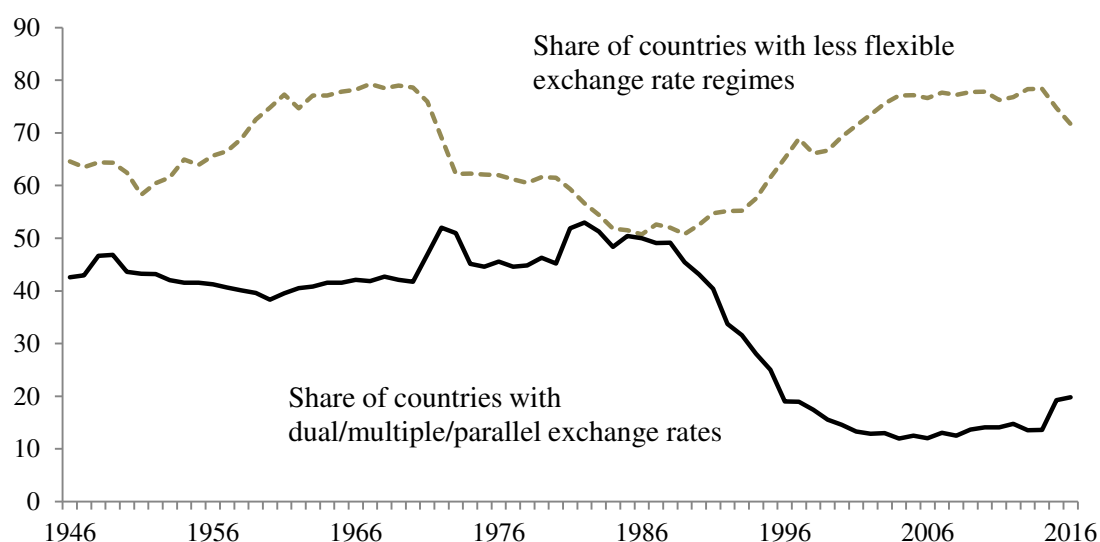
Sources: International Monetary Fund *International Financial Statistics*, Bureau of Economic Analysis, and authors' calculations.

Apart from the aforementioned self-insurance or mercantilist motivation, we would add that the Impossible Trinity offers insights why reserve accumulation accelerated so markedly in the past decade. This motivation for reserve accumulation has been suggested by Korinek (2013), Bussiere et al (2015), and Heathcoate and Perri (2016) among others. Countries that want to simultaneously limit exchange rate fluctuations and reduce their reliance on capital controls or other administrative measures will rely more heavily on the use of foreign exchange reserves and interest rate policy to achieve their goals. Other things equal, a country that is fully committed to a floating exchange rate will require lower levels of reserves, even with a fully open capital account.

In connecting this discussion to the data, we recall that in the previous section it was shown (Figure 6, top panel) that limited flexibility arrangements still dominate the landscape. At the same time, we estimated that about 80 percent of all countries had abandoned the kinds of exchange controls that led to a fragmented foreign exchange market (Figure 9 top panel). These two trends in exchange rate arrangements and capital market integration are connected in Figure 11. Because we are focusing on the unweighted measures, the series start in 1946. Figure 12, top and bottom panels connect reserve

accumulation to the rising share of countries with limited exchange rate flexibility (top panel) and the decline in exchange controls, or rising capital mobility (bottom panel).

Figure 11: Exchange Rate Arrangements and Capital Mobility, 1946-2016



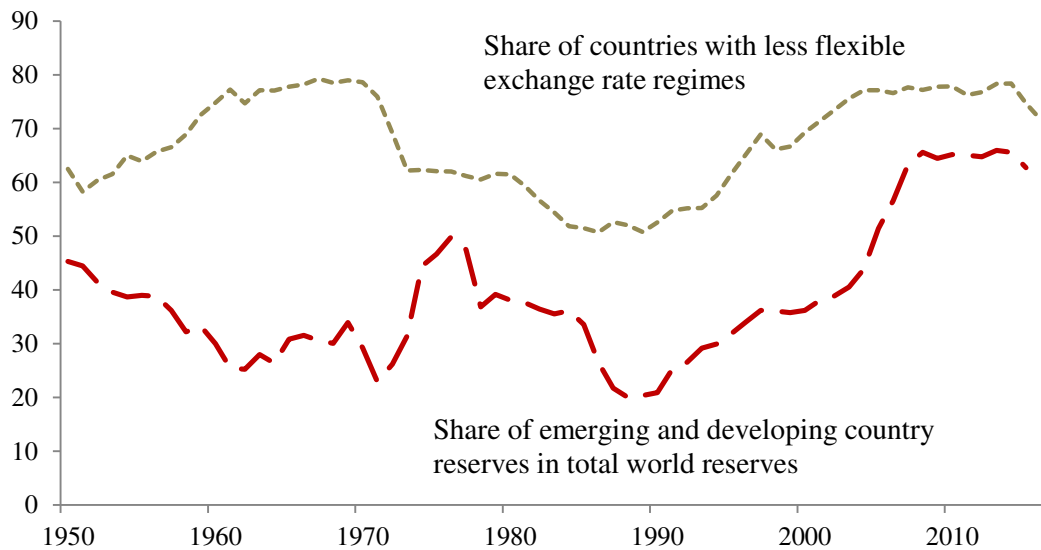
Source: The authors, based on Figures 6 and 8.

As documented by Reinhart, Reinhart and Trebesch (2016), since the early 2000s, emerging markets faced a “double bonanza” of booming commodity prices and surging capital inflows. Apart from an acute but brief interruption during the Global Financial Crisis 2008-2009, this process resumed in full force up to the time of the Taper Tantrum in May 2013, following the Federal Reserve’s announcement to scale back from their accommodative policy stance. Also at this time, China began to slow and commodity prices started to slide. As Figure 10 highlights, that also marks the peak in reserves for both the world and the emerging markets. Leaning against the wind of an appreciation and a “double bonanza” with mobile capital may have required the significant reserve build up. While on the surface, this sounds like a mercantilist explanation, it also encompasses the precautionary motive, as bonanzas often end in large current account deficits and often financial crisis. The arguments advanced in Levy Yeyati, Sturzenegger and Guzman’s (2013) “Fear of Appreciation” may also help motivate the reserve accumulation in some countries during the double bonanza decade.

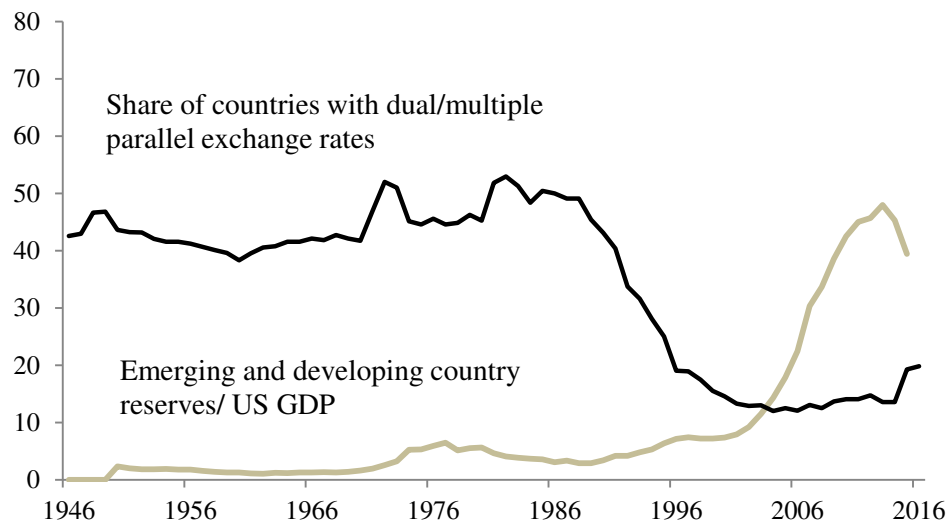
The trends in reserves, exchange rate flexibility, and capital mobility shown here are not a substitute for popular explanations that stress self-insurance and mercantilist motives behind the 2003-2013 historic episode of reserve accumulation. Yet these components of the impossible trinity perhaps merit a larger role than they were assigned in the large pool of studies on the topic. The role of growth differentials in the advanced and emerging economies, which we turn to next, is another trend influencing the demand and supply of international reserves.

Figure 12: Reserves and Two Sides of the Impossible Trinity, 1950-2015

The incidence of limited exchange rate flexibility



Are reserves a substitute for capital controls?

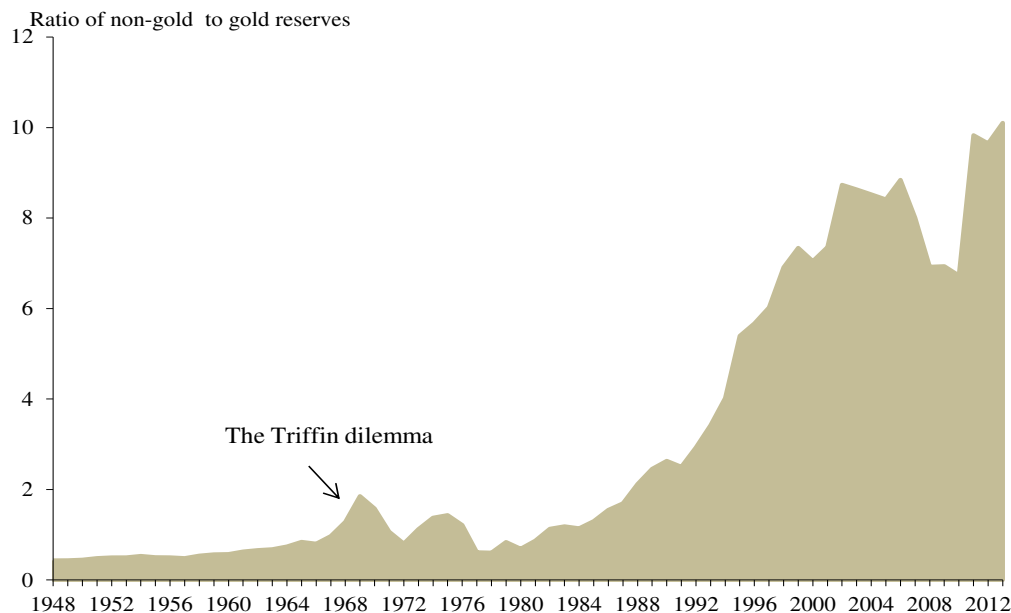


Sources: International Monetary Fund *International Financial Statistics*, Bureau of Economic Analysis, and authors' calculations.

2. The Triffin Dilemma

With recovery from the war underway in Europe and a sustained expansion in global trade, the global demand for reserves grew rapidly in the 1950s and 1960s. Reserves, at that time, usually took two forms: gold and dollar assets (US government debt or greenbacks) which were also linked to gold, in that the gold content of the major (and numerous minor) currencies had been registered at the IMF. Given that the world's gold supplies were not increasing as fast as the demand for reserves, an expanding share of the world's reserve assets came to be paper denominated in US dollars. The rest of the world's appetite for dollars could be met by the US issuing more dollar debt and selling it to the rest of the world. In the balance of payments, this would require the US to run sustained current account deficits, but importantly, a fiscal deficit, as Obstfeld (2013) observes. However, fulfilling the demand for reserves also meant that over time the ratio of "paper dollar" reserves to gold reserves was steadily rising (as shown in Figure 13). Until 1969, the "paper-to-gold ratio had been hovering around 0.5, but in a couple of years in the very early 1970s it quadrupled to almost two.

Figure 13: Ratio of Total Reserves minus Gold (US dollars) to Gold Reserves (US dollars): World, 1948-2015

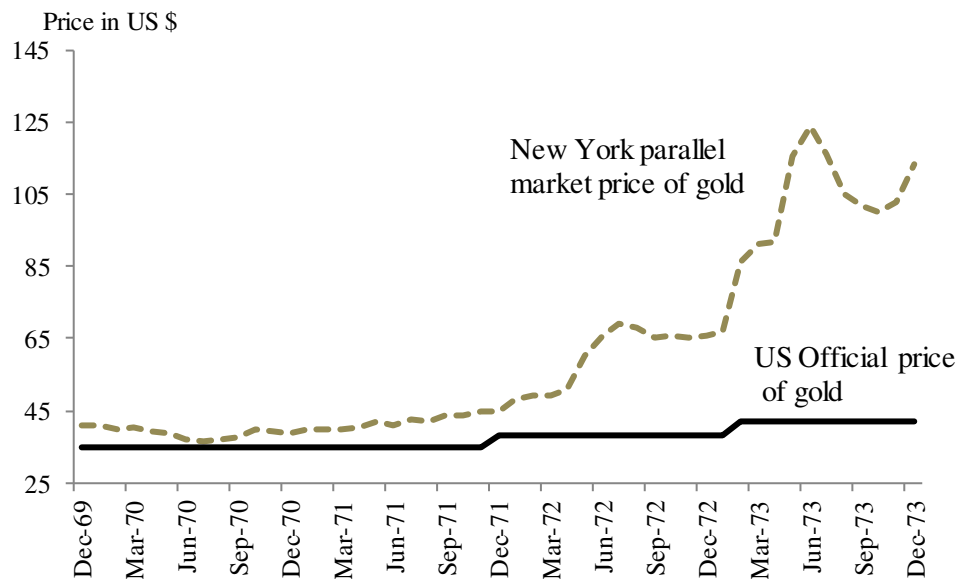


Sources: International Monetary Fund *International Financial Statistics* and authors' calculations.

To maintain the official dollar/gold parity, the US would have had to restrict its supply of dollars and cease to borrow from the rest of the world, that is run a current account surplus, which in the context of the time meant running a fiscal surplus. The incompatibility of the national goals to maintain the parity and the international role to serve as sole provider of the reserve currency is the essence of the dilemma that Robert Triffin (1960) foresaw as a risk to the Bretton Woods system.

As the supply of dollars rose (relative to gold reserves) the gap between the parallel market price of gold and the official US price of gold (then set at \$35 per ounce) widened (Figure 13). Two increases in the official price of gold (tantamount to a devaluation of the dollar) in December 1971 and February 1973 were not sufficient to correct the “overvaluation” of the dollar. The Bretton Woods system came to an end in March 1973, when the dollar and other major currencies were allowed to float.

Figure 14: Official and Parallel Market Price of Gold, United States December 1969-December 1973



Sources: *World Currency Reports* (various issues) and *World Currency Yearbooks* (various issues).

3. *Triffin II?*

The underpinnings of a modern version of the Triffin dilemma has been recently addressed in Farhi, Gourinchas and Rey (2011) and Obstfeld (2013), who also revisits the 1970s episode. Farhi and Maggiori (2016) add to the discussion, by primarily focusing on the *supply* of the reserve asset, which includes the possibility of a small group of suppliers, as well as the hegemon case. They note that fiscal capacity, reputation, and pricing currency in the goods market are the key factors that importantly determine the emergence of a hegemon. The demand for reserves is not their focal point. We connect some of the issues raised in these studies to our data. In particular, the data on exchange rate arrangements, currency preferences, and capital mobility help to shape and quantify the potential *demand* for reserves. Of particular interest is the connection between exchange rate arrangements and the demand for reserves, as the surge in the reserves during 2003-2013 came from the official sector (the central banks) in emerging markets (see, for instance, Alfaro, Kalemli-Ozcan, Volosovych, 2014).³⁰

³⁰ For instance, it would be quite interesting to consider in a Farhi and Maggiori (2016) setting the demand implications of a hegemon (People's Bank) or small but influential group (ASEAN).

Our point of departure is in line with Obstfeld (2013), who observes that the first asymmetry driving the modern-day Triffin dilemma is that “the emerging and developing world is growing more quickly than the more creditworthy industrial world. While “the second asymmetry is that the main advanced countries remain more creditworthy on average than the poorer countries.” We would re-write the first statement to read that the emerging and developing world is growing more quickly than industrial world. It is certainly true that advanced economies are more creditworthy than the poor ones. Yet, the severe and lasting impacts of the global financial crisis, the continued debt build-up in Japan and other countries have had an effect on the reputational standing, of several advanced economies, as measured by their credit ratings. With regard to the Triffin dilemma this is not a trivial point, as it distinctly shrinks the pool of assets that qualify as reserves. Furthermore, because of deflation and the precarious state of the banking sector, in many cases large scale purchases by the domestic central banks are further impacting the supply of reserve assets.³¹

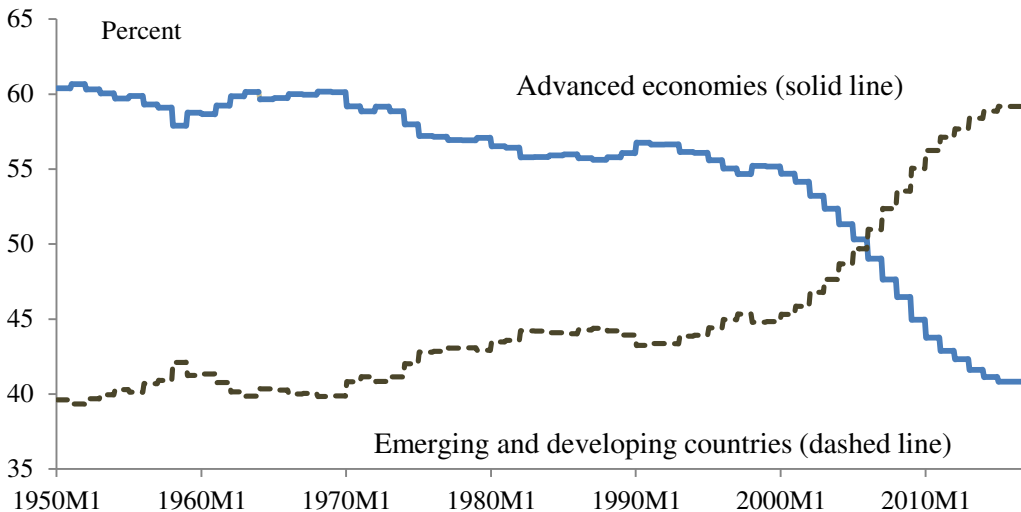
When examining measures of economic activity that separate the world into advanced economies and emerging or developing countries it becomes evident that over the past 15 years or so, there are signs of some degree of convergence. As in the original Triffin episode, the increase in the demand for reserves that have accompanied this rebalancing has been unprecedented, as already discussed. The cumulative effect of the persistent growth gap between emerging and advanced economies is evident in Figure 15, which shows the shares of world GDP for advanced and emerging economies from 1950 through 2015. Emerging and developing countries now account for about 60 percent of world GDP, far higher than at any time in the past. Given that advanced economy growth prospects remain subdued, these trends are likely to continue (even with the evident slowing in China and other emerging markets.)

To reiterate, the connection of these trends to the Triffin dilemma has to do with the fact that it is the shrinking advanced economies that are supplying the reserve assets (more on this) while the demand for safe assets (or reserves) is primarily coming from the emerging (and expanding) group. Complicating

³¹ This statement goes beyond the Federal Reserve, Bank of Japan and ECB.

matters is the fact that it is primarily (by a large margin) the United States, among the advanced economies, that is providing the reserve assets.

Figure 15: The Shifting Distribution of World GDP, 1950-2015



Source: The Conference Board, *Total Economy Database*.

As noted earlier, exchange rate arrangements usually play a key role in driving the demand for international reserves. The next four figures (Figures 16-19) juxtapose our measures of potential sources of “world demand” for four major currencies with the potential suppliers’ share of world GDP. For each figure the top panel plots the share of countries where the US dollar, euro, UK pound and Japanese yen is the main anchor currency in the context of their prevailing exchange rate arrangements. The dashed line represents the US, Germany and France, UK, and Japan’s share in world GDP. The bottom panel only differs in that the share of countries anchored to the reference currency is weighted by their share in world income.

The US dollar retains its dominant position as the world’s reserve currency (Figure 16); 60 to 70 percent of all countries have the dollar as the anchor or reference currency (top panel). As Figure 15 highlights, by some metrics it is as dominant as it was at the time of the early Bretton Woods era. By other metrics, its global role has expanded even beyond that following the collapse of the ruble zone. In Section III we already discussed the main factors behind the “dip” of the late 1970s and 1980s. What is

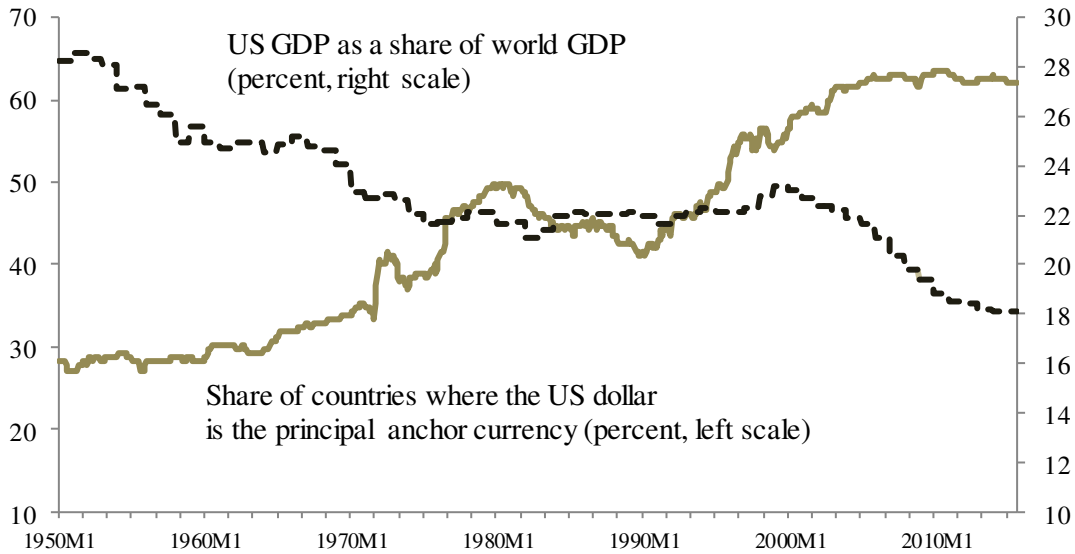
most suggestive of Figure 16 is the trends since the start of the 21st century, which show a more rapidly shrinking US share of that world economy coupled with a rise in the share of the world anchored to the dollar. Presumably the latter is a representation of the demand for US dollar assets (reserves). These widening and divergent trends are the essence of the modern-day Triffin dilemma for the United States. Particularly because, as Figures 16-19 show there is limited competition from other major economies in the provision of reserve assets.

The euro (Figure 17) is a distant second to the US dollar. From the early 1980s until the introduction of the euro, the German Deutschemark's (DM) sphere expanded first in Western Europe and later in the East. The euro consolidated the French franc and German DM zones but appears to have stalled in the 21st century. By some metrics (given the shrinking share of Europe in world output) its global importance has declined. No other major established international currencies compete at present with the dollar and the euro.

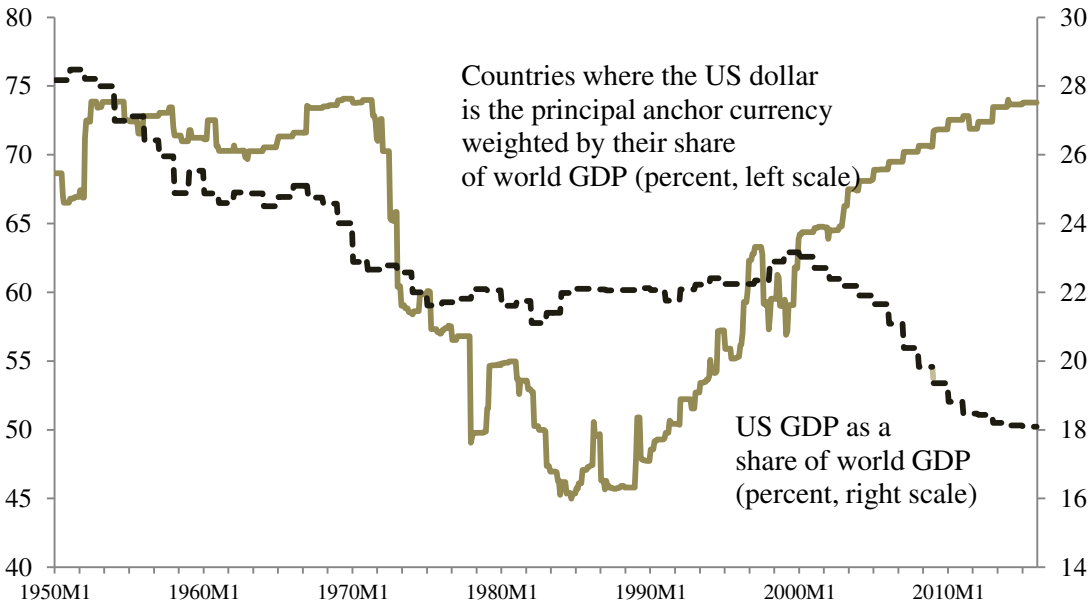
For the United Kingdom (Figure 18), the loss of its colonies following World War II eventually translated to a shift away from the pound into the US dollar. The sterling crisis of 1967 was followed by a lingering economic crisis. In June 1972 the UK introduced a series of capital control measures that effectively put an end to the sterling area, although the official dismantling of the Sterling Area was in 1979. The Farhi and Maggiori (2016) criteria all seem to apply to the demise of sterling, as the UK had 11 IMF programs during the 1950s-1970s (with significant consequences to its global image), a precarious fiscal situation, and a shrinking piece of the trade and invoicing pie. To interpret the bottom panel, we note that since the Global Financial Crisis, the pound has become the anchor currency for the UK. While the UK has a history back to the early 1970s (see chronology) of managed floating, during the late 1970s until 2008, it was included (on the basis of the exchange rate behavior, see Figure 1) in the DM/euro group, with practically all the rest of Europe.

In the case of Japan (Figure 19), which has a freely floating exchange rate since the late 1970s, the two series overlap in the bottom panel because Japan is the only country that has a yen anchor. Between 1950 and 1978, Japan's anchor currency had been the US dollar. Farhi and Maggiori (2016) highlight that fiscal capacity, reputation, and pricing currency in the goods market are the key factors that importantly determine the emergence of a hegemon. Applying their criteria to Japan, it is very clear that the world does not invoice in yen. As Table 2, which is based on Gopinanth (2016), highlights, only 18 percent of the countries in that sample have any trade invoiced in yen and the shares invoiced in yen are a trivial share of the total. Furthermore, not even Japan invoices the majority of own trade in yen. But invoicing notwithstanding, its lack of international resonance remains puzzling. In its heyday, prior the the banking crisis of the early 1990s, Japan accounted for nearly 10 percent of world GDP; it had low levels of public debt; according to Institutional Investors, it had higher ratings than the United States and in the 1980s, it was the *it* country to emulate. Perhaps regulatory measures or the structure of domestic banking, postal saving, and pension funds never gave the rest of the world an opportunity to hold yen assets (specifically yen government bonds). It remains a case for further study.

Figure 16: Measures of the Role of the Dollar and US Economy in a Global Context, 1950-2015
Share of countries measure



Share of countries measure weighted by share of world income

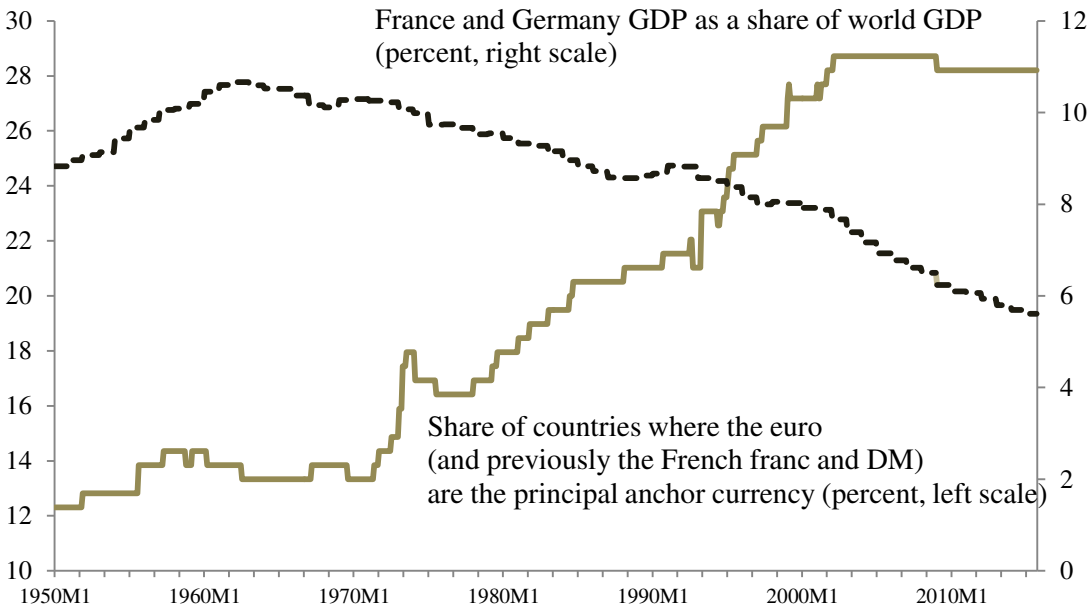


Sources: The Conference Board *Total Economy Database*, International Monetary Fund *International Financial Statistics*, Reinhart and Rogoff (2004) sources cited therein, and authors' calculations.

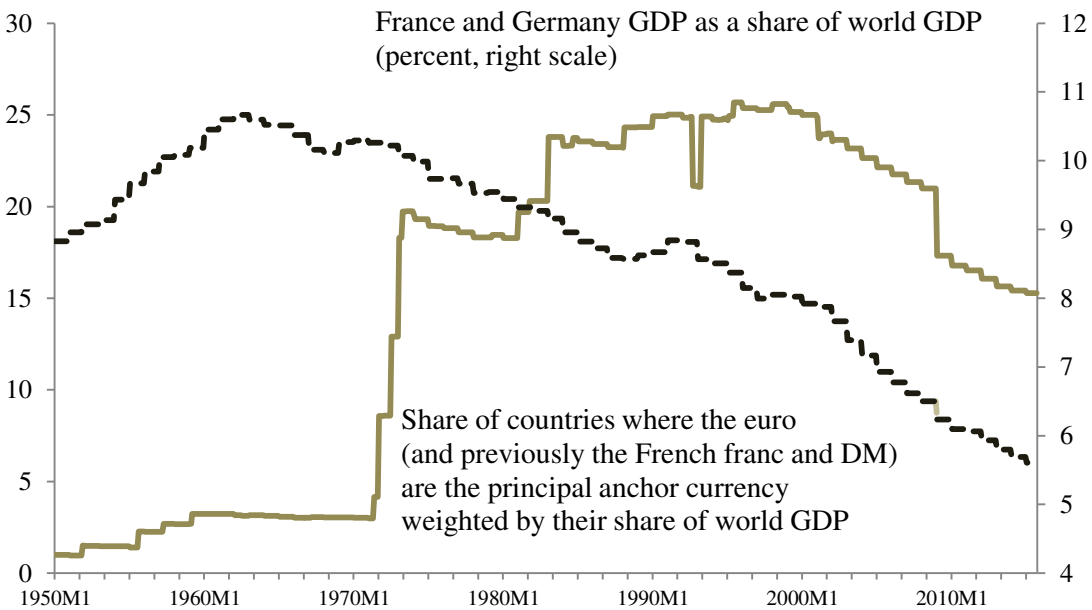
Note: The Country Chronologies that supplement this paper show the evolution of the anchor currency on a country-by-country basis.

Figure 17: Measures of the Role of the French Franc, Deutschmark (1950-1998), and Euro (1999-2015) and French and German Economies in a Global Context

Share of countries measure



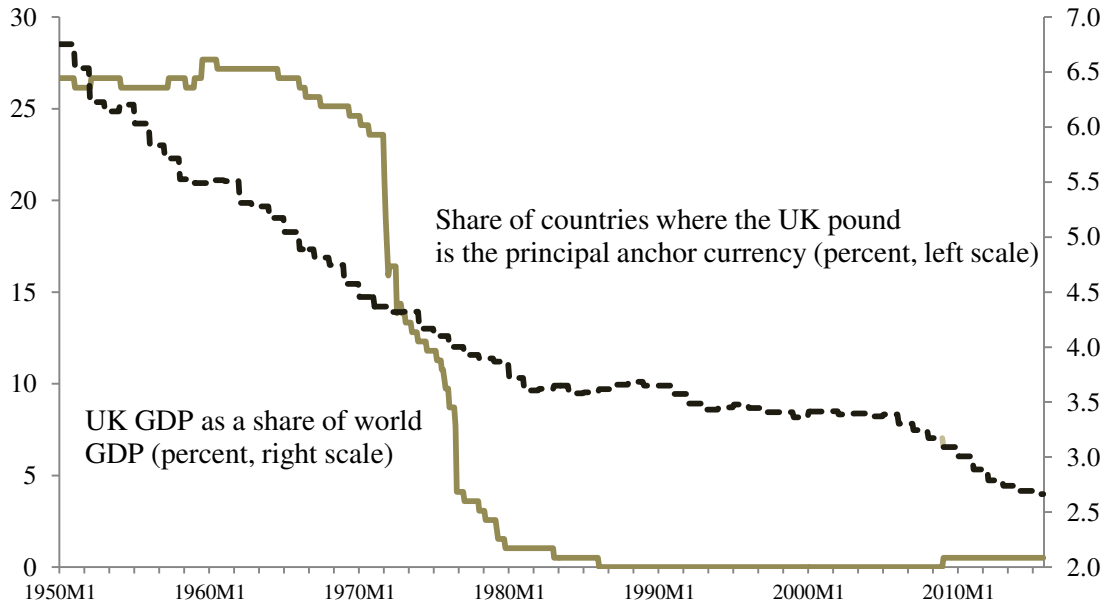
Share of countries measure weighted by share of world income



Sources: The Conference Board *Total Economy Database*, International Monetary Fund *International Financial Statistics*, Reinhart and Rogoff (2004) sources cited therein, and authors' calculations.

Figure 18: Measures of the Role of the UK Pound and the UK Economy in a Global Context, 1950-2015

Share of countries measure



Share of countries measure weighted by share of world income

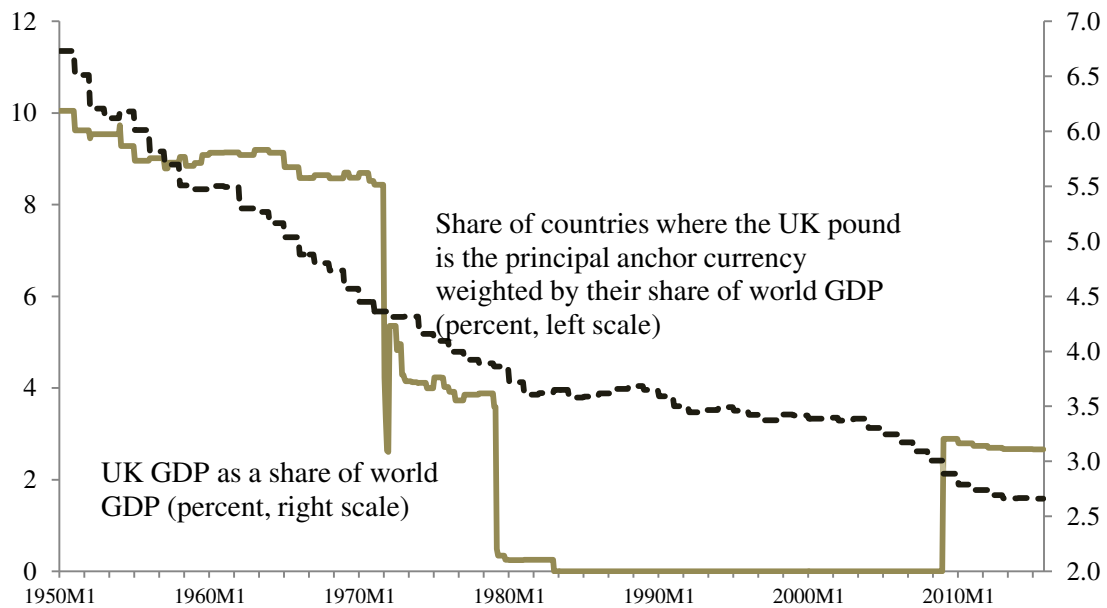
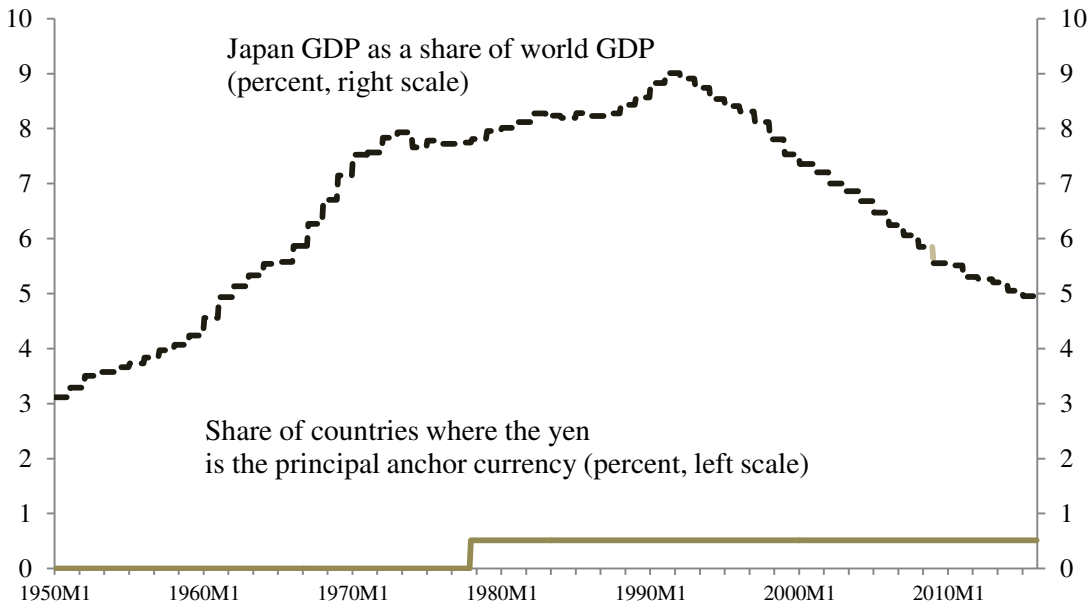
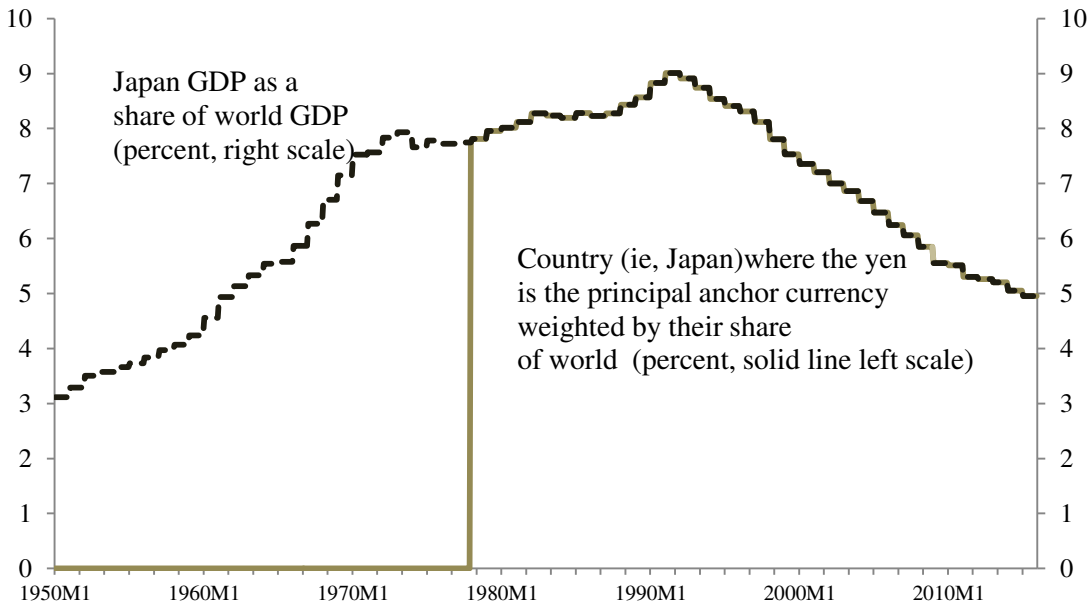


Figure 19: Measures of the Role of the Yen and the Japanese Economy in a Global Context, 1950-2015
Share of countries measure



Share of countries measure weighted by share of world income



V. Concluding remarks: Which anchor will hold?

What topics and areas would enhance our understanding of the international financial system in general and the anchor currency question in particular? While that list is long, perhaps an obvious key starting point involves China and its rapidly expanding global role. While a great deal is written on the subject, it is a much smaller literature that quantifies that role. More is known about China's connections through trade of goods and services with the rest of the world than its growing financial linkages. Chinese lending to a broad range of emerging and developing countries is not captured in the extensive databases of the World Bank, International Monetary Fund, or Bank of International Settlements. Much of this lending is done through its development banks, but credit lines and swap arrangements between the People's Bank of China and other central banks are also rapidly expanding. Given the opaqueness of these cross-border financial transactions, it is not clear whether the US dollar or the renminbi is the dominant currency in this new source of lending. As the Gopinanth (2016) study reflects, information on China's trade invoicing by currency is also scant.

It should be noted that our categorization of anchors is fundamentally retrospective. Over time, one might expect the Chinese yuan with its far reaching trade and finance network to serve as an anchor for some countries. Indeed, it is possible that the Chinese yuan has already become (or made significant inroads as) an anchor currency. In the summer of 2015, the modest devaluation of the renminbi triggered marked depreciations of several Asian currencies (as well as others outside Asia). By our exchange rate metric, however, China remains part of the dollar bloc, and it is unclear how many countries might move along with the yuan if it were ever to separate from the US dollar. This will certainly be a significant development when it happens. During the latter stage of Bretton Woods, a cursory inspection of exchange rate practices in Europe would have led one to conclude that the US dollar was the across-the-board anchor. It was only when Germany's DM separated from the dollar that it became evident that the European economies had already transitioned from a dollar to a DM anchor.

The role of China also figures prominently in questions we raise about the global demand for reserves and the implications of the modern-day Triffin dilemma. These implications include: the possibility of sustained dollar depreciation (as in the 1970s), imparting a capital loss on China and other major holders of US Treasuries; some significant reduction in the global demand for reserves (China floating); a new supplier of reserve assets that is re-oriented and connected to some degree to the fast-growth regions of the world. This connection could be more direct (renminbi acquires reserve currency status) or less direct, as in an expanded role for the SDR (renminbi is now a part of the SDR). The common thread in this discussion is the pressing need to better quantify the finance networks of the world's second largest economy.

Lastly, we reiterate our main conclusions. Our new algorithm for jointly determining a country's anchor currency and its degree of exchange rate flexibility shows a world where relatively inflexible exchange rate regimes remain extremely important, and where the dollar's dominance as an anchor/reference currency appears to be at least as great as it was under Bretton Woods. Moreover, many countries' continuing desire to stabilize exchange rates despite generally increasing capital mobility (as our new measure of capital ability based on exchange rate restrictions underscores) is potentially a key element of the modern-day Triffin dilemma that needs to be added to the widely-discussed scarcity of safe advanced-country assets.

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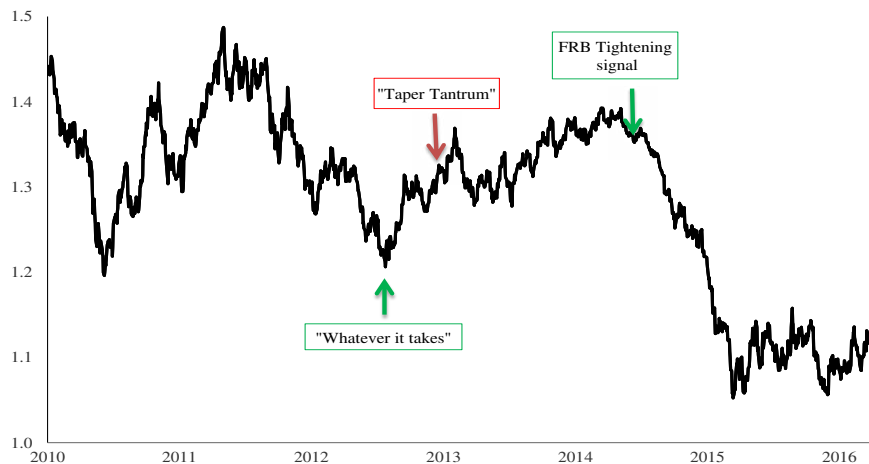
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Appendix I. Stress Testing Anchors

We assess the robustness of our anchor choice (see Table 1) by studying two recent natural experiments. There have been two large recent swings in the bilateral USD-EUR exchange rate. Both movements can be traced back to monetary policy shocks in Europe and the US. First, on July 22, 2012, Mario Draghi, the President of the European Central Bank, made his now famous speech, in which he stated that the ECB stood ready to do “whatever it takes” to preserve the euro. Second, the minutes of FOMC meeting of June 17-18, 2014 increased market perceptions that the Federal Reserve would initiate its tightening cycle, a perception that gathered momentum throughout the rest of the year. As a result, the dollar appreciated by a cumulative 30 percent relative to the Euro through March of 2015.³² Figure A1.1 highlights these events.

Figure A1.1 US dollar-Euro Exchange Rate, 2010-2016



Source: Bloomberg.

The large movements of the USD-EUR bilateral exchange rate allow “stress-testing” of our anchor currency classification, at least between the critical choice of the dollar or the euro. Specifically,

³² This differs from the proverbial “taper tantrum” of the previous year, when the Federal Reserve indicated plans to slow down and eventually reverse asset purchases as part of its quantitative easing policies. While this announcement did create some volatility in emerging market currencies, it had a relatively muted effect on the bilateral Euro-Dollar exchange rate.

we would expect currencies anchored to the dollar to move more closely with the dollar during these episodes, while currencies with other anchors (most commonly the euro) might move more freely relative to the dollar. These two episodes have the advantage that they are primarily due to the monetary policies of the ECB and the Federal Reserve, not idiosyncratic shocks facing other economies. In one case the dollar depreciated while it appreciated in the other.

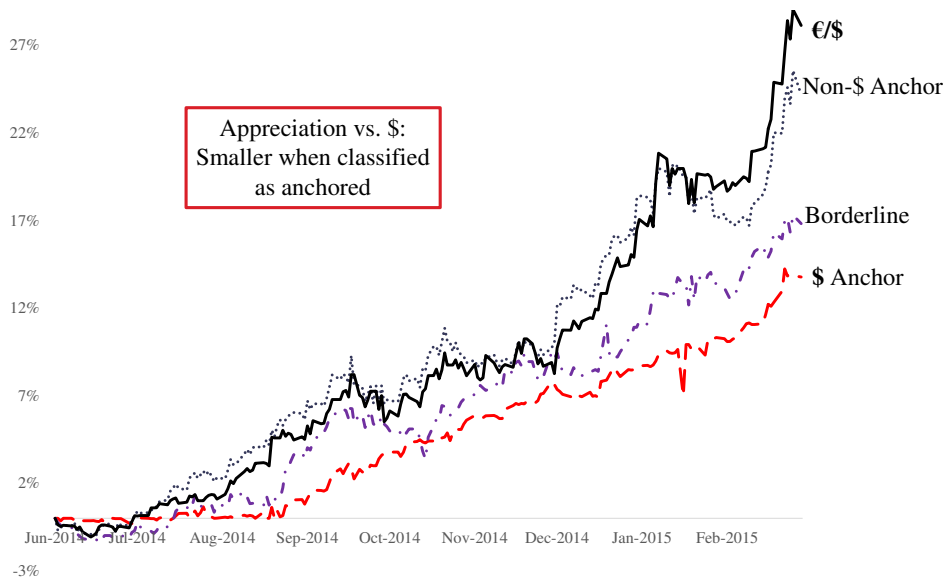
Figure A1.2 shows the median percent depreciation of countries with +/-5 percent exchange rate bands and countries classified as managed floats; the results would naturally be far sharper if we included all countries. We divide these economies into three groups, based on the algorithm we used to classify these countries' anchors. The first two groups include currencies that could be classified at the first stage based on the magnitudes of exchange rate movements relative to anchor currencies. The red (dashed) line shows countries classified as anchored to the US dollar and the blue (dotted) line shows countries classified with other anchors (three countries anchored to the Euro and one to the Australian dollar).

In both episodes, currencies not anchored to the US dollar moved in tandem with the Euro. These currencies appreciated 5 percent on average relative to the dollar in 2012 and depreciated 20 percent in 2014-5. In contrast, currencies classified as having a dollar anchor moved far less relative to the dollar. Following Draghi's speech, their bilateral US dollar exchange rate appreciated by less than 2%. These currencies depreciated only 10 percent following 2014-15 as the Fed began signaling a tightening cycle. The difference in cumulative exchange rate movement relative to the US dollar between these two groups of countries is statistically significant at the 90 percent confidence level in the first episode and at the 99 percent confidence level in the second.

Figure A1.2, Two Monetary Policy Events, 2014 and 2014
Draghi's Whatever it Takes



Fed Tightening, 2014



Source: Bloomberg and authors' calculations.

Finally, the purple (dash-dotted) line shows the average exchange rate change of countries with unclassified anchors in 2015, listed in Table 1. All were classified as having the US dollar as their reference currency, based on supplementary data, as described in Table 1. As might be expected from

intermediate cases, their movements relative to the dollar were larger than currencies more clearly anchored to the dollar, but less so than the freely-floating Euro or currencies that were not anchored to the dollar. (In both episodes, we cannot reject the hypothesis that exchange rate movement relative to the dollar in these intermediate cases was the same as either of the other two groups of countries, on average.)

Appendix 2: Classifying the Eurozone

In what follows, we describe the approach adopted and results obtained from estimating an individual Taylor rule for the countries that make up the Eurozone. We regress the ECB's policy interest rate on inflation, unemployment, and on a constant term. Specifically, we estimate A2.1 below for each country:

$$i_{t,n} = \alpha + \beta_1 \pi_{t,n} + \beta_2 y_{t,n} + \varepsilon_{t,n} \tag{A2.1}$$

Where $\pi_{t,n}$ is year-on-year inflation for country n ; the output gap, $y_{t,n}$ proxy is the difference between average unemployment in country n over 1992-2007 and unemployment in month t .

The Taylor principle is satisfied when $\alpha + \beta_1 > 1$. Given the definition of the output gap, countercyclical policy implies, $\beta_2 > 0$.

Figure A2.1 shows, the coefficients on inflation (top panel) and the output/unemployment gap (bottom panel) for all original Eurozone members, plus Greece. The whiskers depict the 95 percent confidence intervals of the estimates. The data is monthly and spans from January 1999, when the Euro was adopted, to September 2014 when the ECB set interest rates at zero and the connection to a simple Taylor rule loses meaning (variants that incorporate quantitative easing are not explored here.)

The contrast between the coefficient estimates for Germany and other Eurozone members is of note. The coefficient on the inflation rate for Germany is estimated at slightly below one, but the standard error is large enough to encompass the possibility that the coefficient is greater than one, the necessary

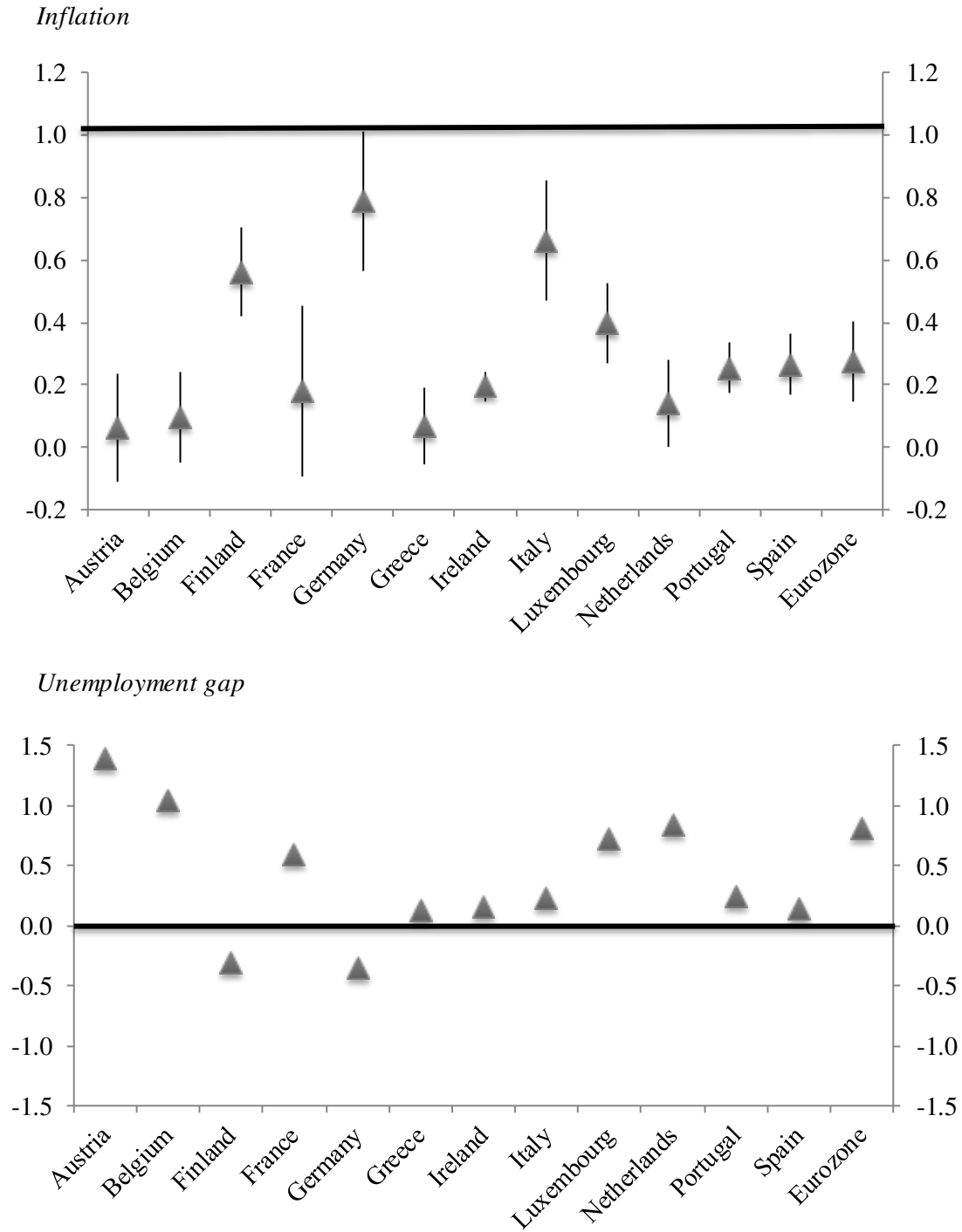
response for monetary policy to be stabilizing. This result becomes even stronger when the post-2008 crisis years are excluded. Therefore, we cannot reject the hypothesis that the ECB follows the Taylor principle—that the real interest rate should rise in response to an increase in inflation—for Germany. This result is anticipated in Smant (2002), who concludes that, after an initial period of lower than expected interest rates, the ECB since mid-2000 set the policy interest rate consistent with the Bundesbank's old policy rule.

In contrast, for all other Eurozone members, we can reject at the standard levels of significance that the coefficient is greater than one.³³ The Taylor principle is also violated for the Eurozone as a whole. In other words, we cannot reject the hypothesis that the ECB's practice has been to stabilize inflation in Germany, but not for the currency area as a whole. On the surface, at least, these estimates indicate that in the decade and a half of its existence, the ECB may have de facto placed a greater emphasis on stabilizing inflation in Germany than elsewhere. Beyond the Taylor rule, there is broad agreement and clear theoretical foundations for the notion that a central banks' interest rate policy ought to respond actively to inflation. Based on this notion, it is hard to argue that countries other than Germany have had the type of monetary autonomy that would justify classifying them as having a freely floating currency.

The coefficient on the output gap, shown in the bottom panel of Figure A2.1, paints a somewhat different picture, as it is positive for all Eurozone members other than Finland and Germany with the interpretation that the ECB does conduct countercyclical monetary policy for most EZ members. There is less agreement as to the necessity that the central bank responds to unemployment, nor on the value that the coefficient on unemployment should take. Given that the ECB's dominant mandate is achieving and maintaining price stability, one cannot rule out that the countercyclical nature of its policy is indeed secondary.

³³ Or that it is significantly different from zero, for that matter.

Figure A2.1. Taylor Rule Coefficients and Confidence Bands: January 1999 – September 2014



Sources: Eurostat, OECD, International Monetary Fund, and the authors.

A different way to pose the same question is to re-construct what interest rate policy would have looked like using a Taylor rule for the Eurozone and for individual Eurozone members, and ask whether actual policy followed that path. Taylor's (1993) original rule, given by:

$$i_t = \pi_t + .5y_t + .5(\pi_t - 2) + 2 \quad \text{A. 2.2}$$

where i_t is the recommended policy rate, y_t is the output gap, and π_t is inflation over the 12 previous months. The output gap is measured as the difference between average unemployment in the country in question and unemployment in month t .

Figures A2.2 and A2.3, present the evolution of the hypothetical policy rate associated with a Taylor rule as a dashed line for two Eurozone countries Portugal, and France; and for Germany and the Eurozone as a whole.³⁴ Policy rates were far lower than the Taylor rule would have advocated for countries like France and Portugal and indeed for the currency union as a whole until 2008. By contrast, from 1999 to the onset of the global financial crisis, the ECB followed Germany's "Taylor rule" with a remarkable degree of precision.

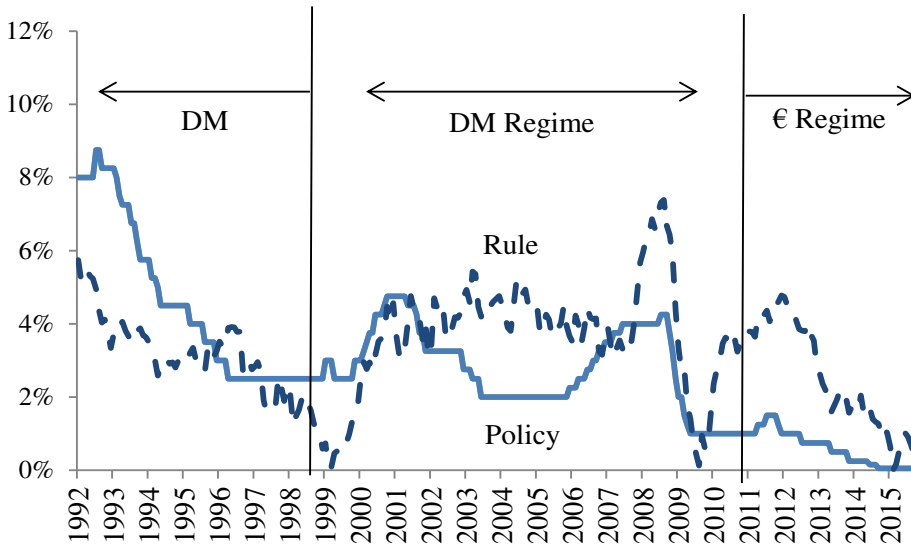
As the crisis hit, the ECB became more willing to loosen policy due to conditions in the crisis countries, which in varying degrees included France, Greece, Germany, Ireland, Italy, the Netherlands, Portugal, and Spain, as documented in Reinhart and Rogoff (2014). As a result, the policy rate has followed the Eurozone Taylor rule more closely (Figure A2.3, bottom panel). In recent years it would appear that no single Eurozone member country, including Germany, has had any great degree of monetary autonomy and the independently floating label that the IMF assigns to all EZ countries.

³⁴ We report the results for France and Portugal, as these are representative of the remaining Eurozone countries (with the exception of Germany, as discussed). The Taylor rule for all the remaining Eurozone countries are not reported to economize on space but are available from the authors.

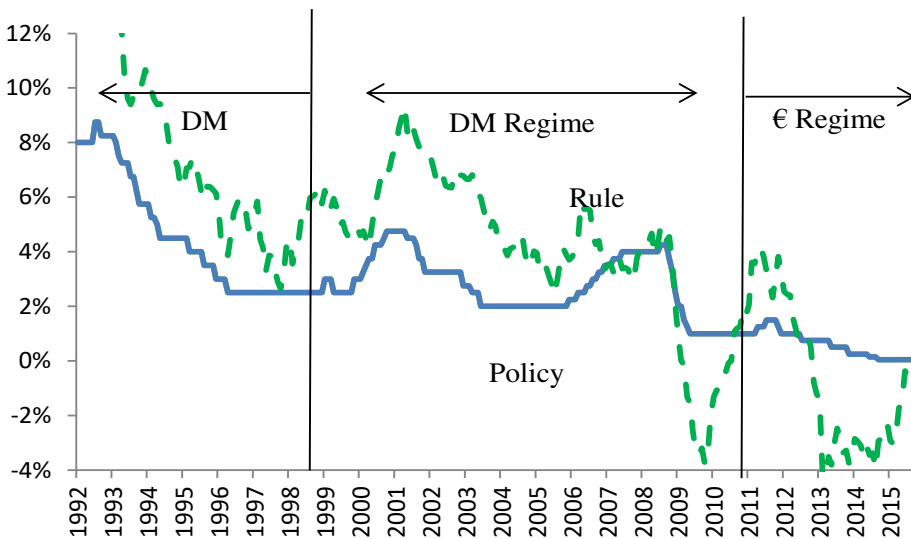
In sum, apart from Germany's case during 1999-2007, we conclude that the de facto practice of the ECB (alongside the other criteria discussed in Section III) justifies classifying Eurozone members as tantamount to having an exchange rate arrangement with no separate legal tender.

Figure A2.2. Taylor Rule versus Actual Policy Rate: France and Portugal, 1992 to 2015

France



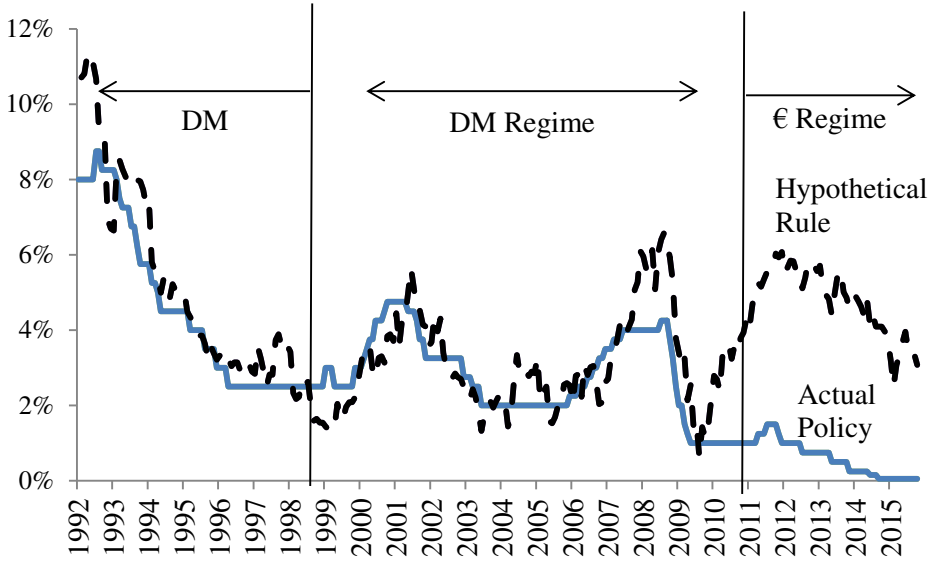
Portugal



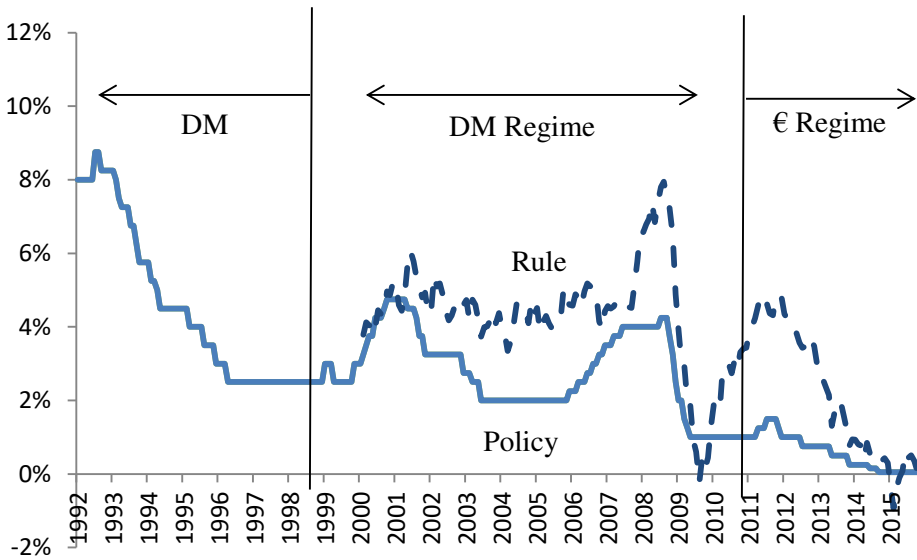
Sources: Eurostat, International Monetary Fund, and OECD.

Figure A2.3. Taylor Rule versus Actual Policy Rate: Germany and Eurozone, 1992 to 2015

Germany



Eurozone



Sources: Eurostat, International Monetary Fund, and OECD.

Appendix 3. IT Countries: A Breed Apart?

This appendix delves into the details of the two exercises summarized in Section II of the paper. The first of these focuses on a pair of event studies over 2008-2014 while the second involves estimating an augmented Taylor rule for the IT group over the period 1990-2015. The aim of these exercises is to ascertain whether IT countries behave distinctly as a single group or whether that overarching de jure label needs to be qualified with additional considerations.

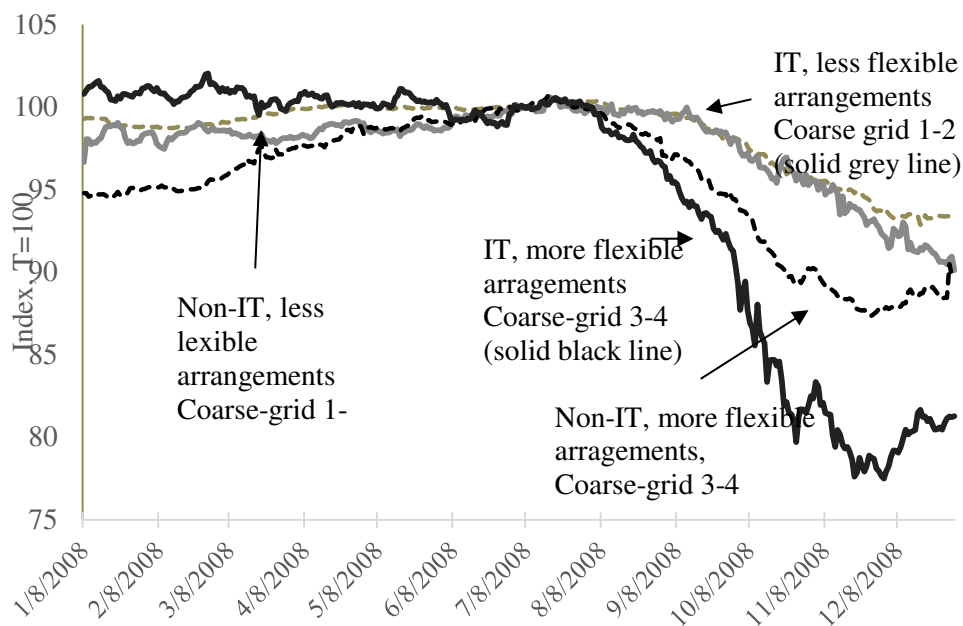
Lehman, September 2008 and FOMC Minutes, June 2014

The average response of (nearly) all currencies during two episodes is plotted in Figures A3.1 and A3.2. The period surrounding the collapse of Lehman in the fall of 2008 is shown in Figure A3.1 while the following figure presents the comparable data around the June 2014 meeting of the Federal Open Market Committee (FOMC). The grey solid and dashed lines trace the responses of currencies within the less flexible arrangements, which include de jure and de facto pegs, crawling pegs, or narrow (less than +/-2%) bands or crawling bands (Coarse-grid 1 and 2). The black solid and dashed lines chart the responses of currencies with managed or freely floating regimes (Coarse-grid 3 and 4). Solid lines give the average exchange rate index of IT countries vis a vis their anchor currency and dashed lines present the comparable index for the control group of non-IT countries.

As shown in Figure A3.1, the depreciation cycle around the Lehman shock in fact began in July of 2008, when commodity prices peaked and the ECB increased its policy rate. Depreciations accelerated following the collapse of Lehman Brothers. For the IT cases (solid lines), it is evident that our classification picks up large differences in exchange rate practices. Currencies that we classify as floating depreciated sharply: peaking at more than 20%. In contrast, exchange rate movements were more muted among IT countries we classify as having a variant of a peg, with a median depreciation of merely 10%. The difference between the average depreciation in these two groups of countries is statistically significant at the 95% confidence interval. The response of the IT group with a de-facto crawling

crawling peg was almost identical to their 1-2 counterparts without an inflation target. In assessing exchange rate movements, our classification adds important information to the de-jure label of IT.

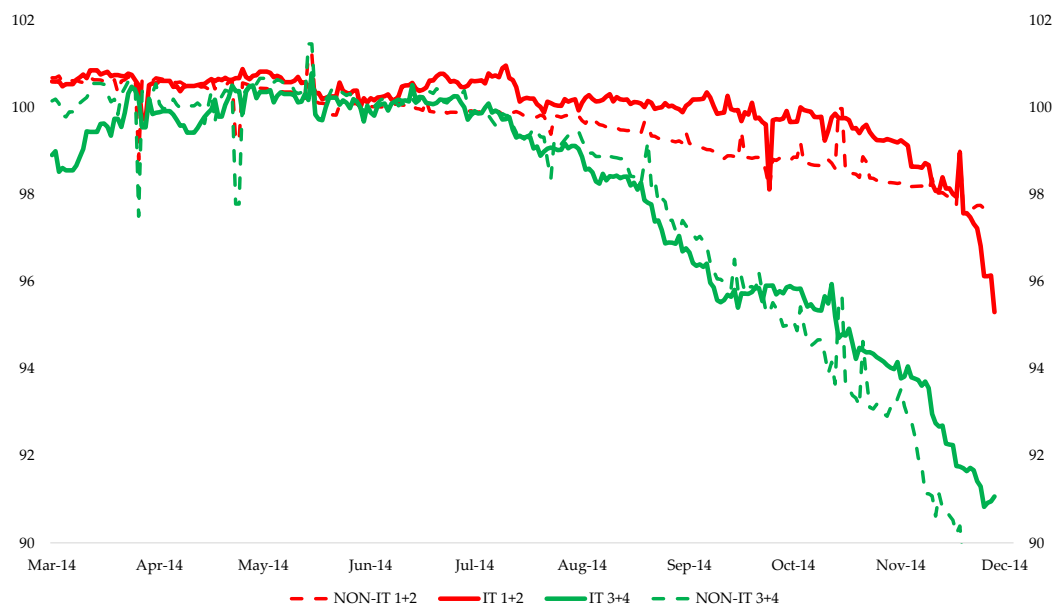
Figure A3.1. Inflation Targeters and Control Group: Lehman, September 2008



Sources: Bloomberg and authors' calculations.

A similar pattern is evident as the Fed tightened policy in 2014. IT countries with flexible exchange arrangements posted a depreciation of 10% from the FOMC meeting in June to the end of the year. This contrasts with a 2% cumulative depreciation among IT cases with comparatively fixed exchange arrangements. The difference between the two groups is again statistically significant at the 95% confidence interval. As before, exchange rate movements among inflation targeters that we classify as having a fixed exchange arrangement is strikingly similar to the non-IT control group. The temporary bout of exchange rate flexibility in mid-December among IT countries with fixed or semi fixed exchange arrangements reinforces rather than contradicts our argument. This spike is driven by a single currency—the Armenian dram, with a de-facto inflation target, but which we classify as having a narrow crawling band.

Figure A3.2. Inflation Targeters and Control Group: FOMC Minutes June 17-18, 2014

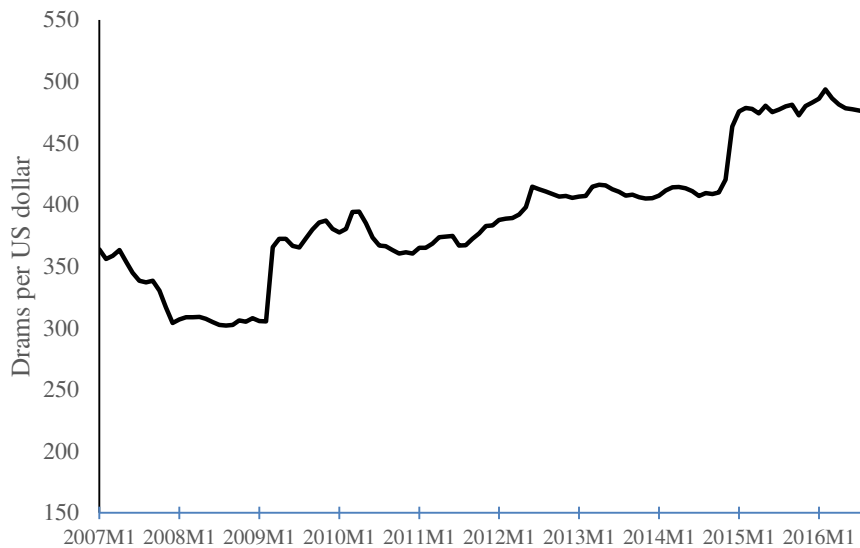


Sources: Bloomberg and authors' calculations.

Following a 30% depreciation in a single week, the dram recovered by 28% in two trading days (December 17-18).³⁵ Tracing the dram's monthly movements over a number of years (Figure A2.3) it is evident that the currency's trajectory is strikingly similar to currencies under a traditional crawling peg (or crawling narrow band), and illustrates the value of lower frequency measures of exchange flexibility. The dram shows remarkable stability vis a vis the US dollar for long stretches, punctuated with the occasional devaluation.

³⁵ The Central Bank of Armenia auctioned \$4 million in reserves on the 17th, although it claimed that it attracted no purchase bids. The ruble recovered 9% on the 17th and it is impossible to reject the possibility that the dram's movements were merely a reaction to the recovering ruble.

Figure A3.3. The Armenian Dram-US Dollar Exchange Rate, 2007:1 to 2016:8



Source: International Monetary Fund, *International Financial Statistics*.

Augmented Taylor Rule

To demonstrate our contention that IT cases are far less distinctive as a group than advertised, we estimate an augmented Taylor rule for the sample of countries with an inflation targeting framework in place. Specifically,

$$i_t = \bar{r} + \pi_t + a(\pi_t - \bar{\pi}) + by_t + cs_t \tag{A3.1}$$

where $\pi_{t,n}$ is year on year inflation in country n in month t , $y_{t,n}$ is the output gap, measured by the difference between a country's average unemployment rate and that in month t . The usual specification is augmented by the inclusion of the exchange rate, s . Of course, Taylor rules are the only way to characterize monetary policy, but they do contain the key variables of interest to most central banks. As we shall see, the exercise is quite revealing.

The version of equation A3.1 we estimate for a panel of IT countries is given by equation A2.2. The regressions include country fixed effects, so that they exploit the time variation within countries,

giving the average Taylor rule coefficient for countries in the panel. We then augment our Taylor rule with a reaction to exchange rates. Formally, we estimate the following regression:

$$i_{t,n} = \beta_1 \pi_{t,n} + \beta_2 y_{t,n} + \beta_3 FIX_{t,n} \pi_{t,n} + \beta_4 FIX_{t,n} y_{t,n} + \alpha_n + \varepsilon_{t,n} \quad A3.2$$

where $FIX_{t,n}$ is a dummy variable that obtains a value of 1 if we classify country n as following a variant of a peg or crawling peg in month t , and α_n is a vector of country fixed effects.

Results are summarized in Table A3.1. In the first three columns, we treat central banks as having a strict inflation target. Regressing the policy rate on inflation alone gives a coefficient of 0.68. This is consistent with a response to inflation, albeit not sufficient to increase the (ex-post) real interest rate in response to inflation. In the second column, we include the natural logarithm of the bilateral exchange rate with respect to each country's anchor currency. We find that the policy rate responds to the exchange rate, with a sign that is consistent with exchange rate stabilization. IT central banks increase the policy rate by an average of 20 basis points in response to a 10 percent exchange rate depreciation.

Column 3 provides interaction terms that allow a separate Taylor rule estimates for countries with "fixed" exchange rates and those with more flexible arrangements. We classify countries with a coarse classification of 2 as "fixed" and those with coarse classifications of 3 or 4 as "flexible". We see that inflation targeting central banks with more flexible exchange arrangements stabilize inflation more aggressively, with a coefficient of 0.74 on inflation. They nevertheless do appear to respond to the exchange rate. However, countries with more rigid de-facto exchange rate arrangements target inflation less aggressively, with a coefficient of 0.55. Instead, they respond more aggressively to exchange rate movements, with a coefficient that is 17% larger than in countries with more flexible arrangements. This may in fact understate the full difference between countries with different exchange arrangements as much currency intervention is conducted with non-interest-rate tools.

Column 4 includes unemployment in the Taylor rule. The coefficient is of the “wrong” sign, with central banks increasing interest rates when unemployment is high. This is plausible if a country follows a strict inflation target.

Table A3.1: Estimated Taylor Rules for Inflation Targeting Countries
Unbalanced Panel 1990-2015

Regression Results w. Country Fixed Effects					
Dependent Variable = Nominal Interest Rate					
	1	2	3	4	5
Inflation	.68*** (.014)	.67*** (.015)	.74*** (.017)	.74*** (.017)	.73*** (.017)
Log(Exchange Rate)		2.24*** (.144)	2.03*** (.147)	1.99*** (.150)	1.60*** (.150)
Unemployment				.10*** (.017)	.07*** (.017)
Commodity Price Inflation					1.00 (.628)
Inflation*”Fixed”			-.19*** (.026)	-.19*** (.026)	-.18*** (.026)
Log(Exchange Rate)*”Fixed”			.34*** (.053)	.36*** (.053)	.34*** (.054)
Commodity Price Inflation*”Fixed”					.22 (.168)
R ²	0.32	0.35	0.36	0.36	0.36
N	4717	4666	4665	4574	4529

It is possible that the exchange rate may embed information about future inflation and the central bank is responding to this information in its interest rate policy. While we cannot fully reject this possibility, we include a forward looking variable in the regression reported in column 5. Commodity prices have been suggested as an important forward looking variable, whose exclusion may bias estimates of central banks’ policy rules (see Sims 1992). Central banks do respond to commodity price inflation, with a coefficient of 1, although the coefficient is not precisely estimated. We use an index of the prices of global commodities (from the IMF’s International Finance Statistics). Once accounting for the response to commodity prices, the average response to the exchange rate is smaller. The difference across exchange arrangements, however, remains almost identical, with countries classified as having fixed

exchange arrangement responding less aggressively to inflation and more to the exchange rate. Similar results follow when controlling for oil prices or food prices.

Appendix 4: Trade Invoicing Index

Using data from Gopinanth (2016), who studies trade invoicing patterns and exchange rate pass-through, we create an index of trade invoicing by anchor currency. Based on her data for 49 countries over the period 1999-2014, we construct a composite measure of invoicing importance for the four major currencies: the US dollar, the euro, the UK pound, and the Japanese yen. This measure combines information on the incidence of use of the four currencies for invoicing (i.e., the share of countries who quote some of their trade in these currencies) and the quantitative importance, as measured by the share of total imports and exports in each currency. The two components are complementary since it is possible that many countries invoice some of their trade in, say, the UK pound. However, it may be the case, that the fraction of total trade that is invoiced in pounds is so small that its overall quantitative importance is quite limited. Table A4.1 summarizes the components and the summary measure of the trade invoicing index for the four anchor currencies.

Table A4.1 Trade Invoicing Patterns in 49 Countries, 1999:Q1-2014:Q4

	Share of countries (excluding home country) where invoicing in the anchor currency > 0			Average share (excluding home country): imports, exports, trade in the anchor currency			Summary of incidence and volume
	Imports	Exports	Trade	Imports	Exports	Trade	
US dollar	93.8	95.8	94.8	43.0	44.1	43.6	69.2
Euro	93.3	83.9	88.6	25.0	19.7	22.3	55.5
UK pound	18.8	14.6	16.7	0.3	0.4	0.4	8.5
Japanese yen	22.9	14.6	18.8	0.7	0.3	0.5	9.6

Source: Gopinanth (2015) and authors' calculations.

Table AI.1. Country Coverage

Country	Official exchange rate	Parallel market exchange rate
Albania	1954:12-2001:12	1954:12-1998:12
Algeria	1946:1-2001:12	1955:1-1998:12
Argentina	1946:1-2001:12	1946:1-1998:12
Armenia	1992:4-2001:12	n.a.
Australia	1946:1-2001:12	1946:1-1998:12
Austria	1946:1-2001:12	1946:1-1998:12
Azerbaijan	1992:12-2001:12	n.a.
Belarus	1992:1-2001:12	1991:8-1998:12
Belgium	1946:1-2001:12	1946:1-1998:12
Benin	1946:1-2001:12	1970:7-1998:12
Bolivia	1946:1-2001:12	1948:1-1998:12
Bosnia-Herzegovina	1997:1-2001:12	n.a.
Botswana	1946:1-2001:12	1989:1-1998:12
Brazil	1946:1-2001:12	1946:1-1998:12
Bulgaria	1946:7-2001:12	1946:7-1998:12
Burkina Faso	1946:1-2001:12	1970:7-1998:12
Burundi	1946:1-2001:12	1983:1-1998:12
Cameroon	1946:1-2001:12	1970:7-1998:12
Canada	1946:1-2001:12	1947:1-1998:12
Central African Republic	1946:1-2001:12	1970:7-1998:12
Chad	1946:1-2001:12	1970:7-1998:12
Chile	1946:1-2001:12	1948:1-1998:12
China	1951:1-2001:12	1949:9-1998:12
Colombia	1946:1-2001:12	1952:1-1998:12
Congo, Democratic Republic of	1946:1-2001:12	1962:1-1996:12
Congo, Republic of	1946:1-2001:12	1970:7-1998:12
Costa Rica	1946:1-2001:12	1948:1-1998:12
Cote D'Ivoire	1946:1-2001:12	1970:7-1998:12
Croatia	1992:12-2001:12	1991:12-1998:12
Cyprus	1955:1-2001:12	1970:7-1998:12
Czech Republic	1946:1-2001:12	1946:1-1998:12
Denmark	1946:1-2001:12	1946:1-1998:12
Dominican Republic	1946:1-2001:12	1960:3-1998:12
Ecuador	1946:1-2001:12	1947:1-1998:12
Egypt	1946:1-2001:12	1946:1-1998:12
El Salvador	1946:1-2001:12	1961:1-1998:12
Equatorial Guinea	1946:1-2001:12	1970:7-1998:12
Estonia	1992:62001:12	1991:8-1998:12
Finland	1946:1-2001:12	1946:1-1998:12
France	1946:1-2001:12	1946:1-1998:12
Gabon	1946:1-2001:12	1970:7-1998:12
Gambia	1946:1- 2001:12	1985:1-1998:12
Georgia	1995:10-2001:12	n.a.
Germany	1946:1-2001:12	1946:1-1998:12
Ghana	1946:1- 2001:12	1962:3-1998:12
Greece	1946:1-2001:12	1946:1-1998:12

Table AI.1. Country Coverage (continued)

Country	Official exchange rate	Parallel market exchange rate
Guatemala	1946:1-2001:12	1985:1-1998:12
Guinea	1949:1-2001:12	1970:7-1998:12
Guinea-Bissau	1946:1-2001:12	1970:7-1998:12
Guyana	1946:1-2001:12	1985:1-1998:12
Haiti	1946:1-2001:12	1985:1-1998:12
Honduras	1946:1-2001:12	1985:1-1998:12
Hong Kong	1946:1-2001:12	1946:1-1998:12
Hungary	1946:8-2001:12	1946:8-1998:12
Iceland	1946:1-2001:12	1949:1-1998:12
India	1946:1-2001:12	1946:1-1998:12
Indonesia	1946:1-2001:12	1947:1-1998:12
Iran	1946:1-2001:12	1947:1-1998:12
Iraq	1946:1-2001:12	1947:2-1998:12
Ireland	1946:1-2001:12	1946:1-1998:12
Israel	1948:5-2001:12	1946:1-1998:12
Italy	1946:3-2001:12	1946:1-1998:12
Jamaica	1946:1-2001:12	1974:1-1998:12
Japan	1946:3-2001:12	1946:3-1998:12
Jordan	1950:7-2001:12	1955:1-1998:12
Kazakhstan	1993:11-2001:12	n.a.
Kenya	1946:12-2001:12	1966:12-1998:12
Kuwait	1949:9-2001:12	1970:7-1998:12
Kyrgyz Republic	1993:5-2001:12	n.a.
Laos	1946:1-2001:12	1959:1-1998:12
Latvia	1992:2-2001:12	1991:8-1998:12
Lebanon	1946:1-2001:12	1946:1-1998:12
Lesotho	1946:1-2001:12	1985:1-1998:12
Liberia	1946:1-2001:12	1989:1-1998:12
Libyan Arab Republic	1952:1-2001:12	1955:1-1998:12
Lithuania	1992:1-2001:12	1991:9-1998:12
Luxembourg	1946:1-2001:12	1946:1-1998:12
Macedonia	1993:12-2001:12	1997:6-1998:12
Madagascar	1946:1-2001:12	1985:1-1998:12
Malawi	1946:1-2001:12	1970:7-1998:12
Malaysia	1946:1-2001:12	1946:1-1998:12
Mali	1946:1-2001:12	1970:7-1998:12
Malta	1946:1-2001:12	1985:1-1998:12
Mauritania	1946:1-2001:12	1974:1-1998:12
Mauritius	1946:1-2001:12	1985:1-1998:12
Mexico	1946:1-2001:12	1947:1-1998:12
Moldova	1991:12-2001:12	n.a.
Mongolia	1970:3-2001:12	1970:3-1998:12
Morocco	1956:10-2001:12	1959:1-1998:12
Myanmar	1946:1-2001:12	1955:1-1998:12
Nepal	1955:12-2001:12	1970:7-1998:12
Netherlands	1946:1-2001:12	1946:1-1998:12
New Zealand	1946:1-2001:12	1948:1-1998:12
Nicaragua	1946:1-2001:12	1947:1-1998:12
Niger	1946:1-2001:12	1970:7-1998:12
Nigeria	1946:1-2001:12	1970:7-1998:12

Table AI.1. Country Coverage (concluded)

Country	Official exchange rate	Parallel market exchange rate
Norway	1946:1-2001:12	1946:1-1998:12
Pakistan	1946:1-2001:12	1948:4-1998:12
Panama	1946:1-2001:12	n.a.
Paraguay	1946:1-2001:12	1951:3-1998:12
Peru	1946:1-2001:12	1946:1-1998:12
Philippines	1946:1-2001:12	1949:8-1998:12
Poland	1946:1-2001:12	1946:1-1998:12
Portugal	1946:1-2001:12	1946:1-1998:12
Romania	1957:1-2001:12	1946:7-1998:12
Russian Federation	1992:6-2001:12	1946:1-1998:12
Saudi Arabia	1952:10-2001:12	1959:12-1998:12
Senegal	1946:1-2001:12	1970:7-1998:12
Singapore	1946:4-2001:12	1973:5-1998:12
Slovak Republic	1993:1-2001:12	1993:1-1998:12
Slovenia	1991:12-2001:12	n.a.
South Africa	1946:1-2001:12	1946:1-1998:12
South Korea	1946:1-2001:12	1946:1-1998:12
Spain	1946:1- 2001:12	1946:1-1998:12
Sri Lanka	1946:1-2001:12	1956:1-1998:12
Suriname	1949:9-2001:12	1970:7-1998:12
Swaziland	1946:1-2001:12	1985:1-1998:12
Sweden	1946:1-2001:12	1946:6-1998:12
Switzerland	1946:1-2001:12	1946:1-1998:12
Syrian Arab Republic	1947:7-2001:12	1970:7-1998:12
Tajikistan	1992:1-2001:12	n.a.
Tanzania	1946:12- 2001:12	1970:7-1998:12
Thailand	1946:5-2001:12	1948:1-1998:12
Togo	1946:1-2001:12	1970:7-1998:12
Tunisia	1956:3-2001:12	1960:1-1998:12
Turkey	1946:1- 2001:12	1946:1-1998:12
Turkmenistan	1993:11-2001:12	n.a.
Uganda	1946:12- 2001:12	1970:7-1998:12
Ukraine	1992:12-2001:12	1991:8-1998:12
United Kingdom	1946:1-2001:12	1946:1-1998:12
United States	1946:1-2001:12	n.a.
Uruguay	1946:12- 2001:12	1946:1-1998:12
Venezuela	1946:1-2001:12	1960:11-1998:12
Zambia	1946:12- 2001:12	1970:7-1998:12
Zimbabwe	1946:12- 2001:12	1970:7-1998:12

Table AI.2. Data Sources

Variable	Source
Official exchange rate, 1946-1956	Pick's Currency Yearbook and Pick's World Currency Report, various issues.
Official exchange rate, 1957-2001	IMF, International Financial Statistics
Parallel Market exchange rate 1946-1980	Pick's Currency Yearbook, Pick's Black Market Yearbooks, and Pick's World Currency Report, various issues.
Parallel Market exchange rate 1980-1998	World Currency Yearbook, various issues.
Consumer price index, 1957-2001	IMF, International Financial Statistics