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The Open-Economy Trilemma in the Long Run

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This paper extends the literature on the open-economy trilemma by developing a consistent set of indicators of exchange rate stability, monetary autonomy and capital-account openness for a large sample of countries, starting in 1890 and extending into the second decade of the 21st century. Analysis of these indicators confirms stylized facts in the literature on international monetary and financial history and is consistent with the trilemma paradigm.

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I. Introduction

The open-economy trilemma, also known as the "impossible trinity" – that countries can pursue at most two of three things: exchange rate stability, free capital mobility and monetary autonomy – is one of the central postulates of international macroeconomics. The trilemma features prominently in all modern textbooks on international finance. It is a corollary of the Mundell-Fleming model (Mundell 1963, Fleming 1962). Its precursors extend back to 1930, when Keynes published his *Treatise on Money* (Keynes 1930), and arguably further.

This framework has given rise to a substantial body of scholarship in which investigators classify countries according to their policy choices with regard to the trilemma. One set of studies categorizes countries by the openness of the capital account of the balance of payments (see for example Chinn and Ito 2008, Schindler 2009 and Fernandez, Klein, Rebucci, Schindler and Uribe 2015). Generally these studies start by attempting to distill and render consistent qualitative information from the International Monetary Fund's *Exchange Arrangements and Exchange*

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Restrictions annual, which tabulates a range of measures intended to limit inflows and outflows of financial capital. They then go on in some cases to relate the resulting measures to country characteristics, both economic and political characteristics (see for example the early study of Quinn 1997 or more recently Karchur and Steinberg 2013). But temporal coverage is limited. When authors do extend their time series back before 1970, those extensions are rarely accompanied by attempts to analyze the determinants, or correlates, of capital account regimes.[1]

A second set of studies undertakes the analogous exercise for exchange rate regimes. For many years the IMF published a de jure classification of such regimes, again in its *Exchange Arrangements and Exchange Restrictions* annual. But observers have long recognized that actual exchange rate arrangements may differ from policy commitments as reported to the Fund. Calvo and Reinhart (2002), in coining the term "fear of floating," drew attention to these discrepancies, noting that countries officially declaring a flexible or floating exchange rate were often reluctant to allow that rate to move significantly in practice. Subsequent investigators therefore used information on actual exchange rate variability, supplemented by information on foreign-exchange-market intervention as captured by changes in official reserves, to construct indices of de facto exchange rate arrangements (see Reinhart and Rogoff 2004, Levy-Yeyati and Sturzenegger 2005 and Eichengreen and Razo-Garcia 2013). Like studies of capital-account regulation, these investigators then sometimes went on to relate these policy choices to the observed characteristics of countries (see e.g. Alesina and Wagner 2006, Steinberg and Malhotra 2014). The limitation of this work, like that on capital-account regulation, is that the de facto indices in question vary across studies, and temporal coverage is spotty (in this case, coverage is generally limited, at a maximum, to the period since World War II).

Finally, a third set of studies seeks to measure the extent of monetary policy autonomy in countries with different exchange-rate and capital-control regimes. Early work by Flood and Rose (1995) and Rose (1996) found little evidence that countries with more flexible exchange rates enjoyed more monetary autonomy, as measured by interest differentials vis-à-vis their base country, the United States, or conversely that countries prepared to forego monetary autonomy, as measured by the same interest-rate differential, had greater success at pegging their exchange rates.

More recent work on these questions, in contrast, is more supportive of the trilemma. Shambaugh (2004) again used observed interest rate differentials between the subject and base countries as a measure of monetary autonomy but allowed base countries to differ, taking Germany as the base for most European countries but the

[1] Exceptions that consider select subsets of (mainly European) countries for portions of the 1950s and 1960s are Voth (2004) and Wyplosz (2001). Quinn has also extended his data set backward in time for a subset of countries.

U.S. for Asia and Latin America, and showed that the relevant interest differentials were larger in countries with flexible exchange rates, indicative of greater monetary autonomy. Miniane and Rogers (2007) confirmed Shambaugh's result for exchange rate regimes, finding that interest rates in countries that peg their currencies followed interest rates in the base country more closely than interest rates in countries that float. They did not find, however, significant differences in interest-rate behavior between countries with more and less stringent capital-account regimes. Bluedorn and Bowdler (2010) similarly documented that monetary policy shocks in the base country were more readily transmitted to subject countries with pegged exchange rates. Limitations of these studies are, again, that they cover only the recent period and that they do not always agree among themselves, much less with studies of the other two legs of the trilemma.

This paper extends the empirical literature on the open-economy trilemma in two directions. First, it covers a longer period of time. I extend existing indices of de facto exchange rate stability, capital account openness and monetary autonomy back to 1890, taking advantage of the additional variation along all three dimensions of the trilemma offered by a long-term perspective. Second, I provide an integrated analysis of the economic and political determinants of policy choices, analyzing the determinants of exchange rate stability, capital account openness and monetary autonomy together rather than separately.

Three basic conclusions follow from the analysis. First, the global regime matters for the trilemma choices of individual countries, over and above the impact of country-specific characteristics and institutions. Countries are even more likely to choose pegged exchange rates than their observable characteristics and institutions would lead one to predict in periods like the gold standard era before 1914, the 1920s and the Bretton Woods era after World War II, when other countries were similarly maintaining pegged rates. Countries are significantly more likely to opt for capital account restrictions than their observable characteristics would lead one to expect in periods like the 1930s and the third quarter of the 20th century when other countries were making analogous choices. Whether this reflects the spillover effects of polices in other countries or common omitted variables affecting many countries similarly is difficult to say. But whatever the interpretation, the same conclusion follows, namely that the international policy regime matters.

Second, larger economies tend to opt for more flexible rates and less open capital accounts. The greater flexibility of their exchange rates is consistent with the theory of optimum currency areas, which suggests that small countries facing relatively high transactions costs with foreign counterparties will prefer to peg (Gagnon and Hinterschweiger 2011). The greater openness of the financial account of the balance of payments in small countries is similarly a corollary of the theory of optimum currency areas, which emphasizes that the currencies of small countries will not be widely accepted internationally. In addition, larger economies may prefer capital

controls on optimum-tariff-like grounds – in other words, on the grounds that they can turn the financial terms of trade in their favor (as argued by Alesina, Grilli and Milesi-Ferretti 1993).

Third, countries with higher per capita GDP prefer more open capital accounts and greater exchange rate flexibility. That countries gravitate toward greater capital account openness as their incomes rise and regulatory and other policy institutions mature conforms to the predictions of the literature on capital account regimes and with the casual observation that high-income countries tend to have more open capital accounts. And that they have more flexible exchange rates is consistent with the view that fear of floating is primarily a developing-country phenomenon. It does not appear, however, that high-income countries exercise the greater monetary autonomy made possible by that exchange rate flexibility according to the trilemma.

The remainder of the paper is organized as follows. Section 2 starts with a broad-brush overview of trilemma configurations in history, characterizing exchange rate arrangements, capital-mobility regimes and monetary-policy independence since 1890, and describing how these configurations and their institutional context have changed. Section 3 introduces the data employed in this study and explains how they are used to construct measures of exchange rate stability, capital mobility and monetary autonomy. Section 4 reports the resulting indices. Section 5 discusses some estimation issues, while Section 6 reports the econometric results. Section 7 is a summing up.

II. Historical Background

The trilemma provides a lens through which to view the development of the global monetary and financial system, starting with the classical gold standard that was the monetary framework for 19th century globalization. This period is conventionally portrayed as one in which countries opted for stable exchange rates and full capital mobility, sacrificing monetary autonomy.

But this conventional characterization immediately raises two questions. Is it accurate? And to the extent that it is, what made this policy configuration economically and politically feasible?

About the extent of financial openness there is little question: there were few legal restrictions on capital flows, although governments sometimes used moral suasion to influence the direction of foreign investment (Feis 1930, Fishlow 1985). Exchange rates were more stable at the center of the system than at its periphery – in particular, they were less stable outside Europe, where some countries were late to adopt the gold standard and others periodically suspended their participation.[2]

[2] That said, there is some disagreement about where to place specific countries like the United

Some scholars also point to differences across countries in the degree of monetary autonomy. Great Britain, they argue, enjoyed a relatively high degree of monetary autonomy by being the center country to which other countries pegged, by virtue of its well-developed money market, and because the Bank of England was able to "attract gold from the moon" (in the words of Bagehot 1873). France possessed monetary autonomy as a result of its exceptionally large foreign reserves (White 1933). In contrast, other countries, with neither equally ample reserves nor such well-developed money markets, enjoyed less monetary autonomy and were thus forced to follow the policies of these countries.

A set of distinctive economic and political conditions was required to make this trilemma configuration feasible and sustainable. Cairncross (1953) and Kindleberger (1973) point to complementarities between the global trade and financial systems: to the expanding network of world trade, the openness of the core countries to exports from the periphery, and the countercyclicality of foreign lending by the center (of British foreign lending in particular). Bayoumi and Eichengreen (1996) provide evidence that price and wage flexibility was greater than subsequently, allowing internal adjustment to substitute more easily for exchange-rate and monetary-policy adjustment.

Eichengreen (1992) emphasizes in addition political factors that made feasible the sacrifice of monetary autonomy. The extent of the electoral franchise was limited, so political pressure to subordinate the pursuit of exchange rate stability to other economic policy goals was rarely intense.[3] Organized labor was not yet influential. Awareness of unemployment as a macroeconomic problem, much less as a problem that central banks should do something about, had not developed.

These circumstances were then altered by World War I. With the outbreak of war, European countries were forced to suspend gold convertibility, embargo gold exports and impose capital controls. As a result of the differing degrees of money creation relied on to finance the war, their exchange rates began to move. Those exchange rate fluctuations then increased further starting in 1919, as controls were relaxed and wartime cooperation to peg exchange rates, like that between the U.S. and UK, was terminated.

By the mid-1920s a growing number of countries returned to the gold standard, stabilizing their exchange rates and removing many of their wartime controls. The historical literature suggests that monetary autonomy was more limited than under the classical gold standard. Because political circumstances had changed (the electoral franchise had been extended, trade unions had gained strength, and

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States in this core-periphery taxonomy. Thus, Eichengreen (1992) characterizes the U.S. as a member of the gold standard periphery, while Officer (n.d.) treats it as part of the core.

[3] A prominent exception to this rule was the United States, where populist pressure to abandon the gold standard in order to counter deflation was intense in the 1890s – this being one reason why there is disagreement about whether to classify the U.S. as a member of the gold standard core or periphery.

awareness of unemployment had heightened), the ability to subordinate other policy objectives to the pursuit of exchange rate stability was less. More limited monetary credibility meant less scope for deviating from the policies of the center country if the official commitment to stable exchange rates and full capital mobility was to be maintained (Obstfeld, Shambaugh and Taylor 2004, Bordo and MacDonald 2012).

This reconstructed gold standard broke down in the 1930s in the face of the Great Depression. As unemployment rose, countries abandoned their currency pegs and imposed capital controls, resorting to monetary autonomy to meet the crisis. The perspective of the trilemma raises the question of why it was also necessary for countries to impose controls if they were prepared to give up exchange rate flexibility, or conversely why they were forced to devalue if they were prepared to apply controls. One answer (as in Urban 2009) is that countries were not in fact prepared to let their exchange rates move substantially. There was "fear of floating" in this earlier period, like more recently. How inflexible exchange rates were in practice is of course an empirical question, to which we return below.

The quarter century following World War II is sometimes portrayed as a unified Bretton Woods period. Recent analyses emphasize the break in 1958-9, when a majority of advanced-industrial countries restored current account convertibility. After this, exchange rate parities were adjusted less frequently than before. But full convertibility did not extend to the capital account of the balance of payments. Restraints on capital flows remained, allowing countries to hold their exchange rates stable and at the same time exercise a modicum of monetary independence. But with controls growing more porous, either that exchange rate stability or that monetary independence eventually had to give. In the end, it was exchange rate stability that was sacrificed.

Previous scholarship has shed limited light on policy choices in emerging markets and developing countries. Edwards and Santaella (1993) suggest that developing countries had a similar tendency to declare pegged exchange rates but a greater propensity to adjust those pegs, often through major devaluations. Such studies shed little light, however, on whether the exchange rates of developing countries became more or less stable, and whether capital controls became more or less pervasive, as the period progressed.

The balance of the 20th century, following the breakdown of Bretton Woods, is then seen as a period of declining exchange rate stability, increasing monetary autonomy and rising capital mobility. The extent of these changes, and the change in exchange rate management in particular, have been questioned for emerging markets by Calvo and Reinhart (2002), as noted, and for advanced countries by scholars of the European Monetary System (e.g. Giavazzi and Giovannini 1989). Consistent with this view that there was relatively little change in de facto exchange rate regimes after 1973, there was surprisingly little decline in the demand for

foreign exchange reserves across this regime threshold. Observers had anticipated a sharp fall in central bank holdings of foreign exchange, since there would be less need to use them in intervention operations with the shift to a freer float. To their considerable surprise, the demand for reserves remained essentially unaffected, as if central banks still valued the option to intervene (see e.g. Frenkel 1978, Heller and Kahn 1978)..

The post-Bretton Woods period also saw gradual relaxation of capital-account restrictions, although the operative word here is "gradual." Advanced countries generally moved further in this direction than their emerging and developing-country counterparts, although even in the advanced countries there were reversals, as in Europe in 1992-3, when controls were tightened on an emergency basis, and again after 2008, when the same occurred in Iceland and Cyprus. Emerging markets retained more capital-account restrictions, although they too moved in the direction of greater financial openness. But here too, exceptions and reversals were evident, for example Malaysia in the midst of the Asian financial crisis (Kaplan and Rodrik 2003), and China when it experienced capital outflows and reserve losses in 2015-6 (Peltier 2017).

Recently, a growing number of central banks, first in advanced countries and then in emerging markets, have adopted inflation targeting. They declared an inflation target, adjusted policy to hit it, and used publications (inflation and monetary policy reports), press conferences and speeches to communicate to the public the relationship between their targets and policy instruments. In its textbook formulation, inflation targeting requires a flexible exchange rate (and an open capital account), consistent with the trilemma constraint. But a growing number of central banks formally engaged in inflation targeting, in small open economies in particular, appear to worry independently about the exchange rate (independently in the sense that the exchange rate matters to policy makers separate from its implications for inflation).[4] The trilemma would suggest that a central bank can target both inflation and the exchange rate only if it maintains restrictions on transactions on capital account.

In the end, how central banks are trading off the three dimensions of the trilemma is an empirical question. This is an empirical question on which a long-term perspective can presumably shed light.

[4] Or, in the case of flexible inflation targeting, they worry about the exchange rate independent of its implications for inflation and the output gap. This point is documented in Ostry, Ghosh and Chamon (2012). See Eichengreen (2002) for further discussion of the phenomenon.

III. Data and Measures

This section describes the data used to measure exchange rates, interest rates and financial openness and explains how they are transformed into indicators of currency stability, monetary autonomy and financial openness.

Monthly data on exchange rates were used to construct the exchange rate stability (ERS) index. Exchange rates, in national currency per US dollar, were taken from *Global Financial Data* for the period 1890-1955, while from 1955 to 2015 end-of-month data were taken from the IMF's *International Financial Statistics*.

To construct the index of monetary independence, I used monthly interest rates. For the period 1890-1915, data made available by Neal and Weidenmier (2003) in their gold standard data base were used, while for the years 1915 to 1955 data from *Global Financial Data* were employed.[5] For 1955-2014, interest rates were drawn from the IMF's I*nternational Financial Statistics*. Money market interest rates were used wherever possible, supplemented as necessary by deposit and discount rates.

When computing exchange rates and comparing interest rates, a base country must be selected. The procedure here follows Shambaugh (2004), taking as the base that country which the home country's monetary policy follows most closely. In practice, Great Britain was used as the base country from 1890 to 1914, following the convention of Obstfeld, Shambaugh and Taylor (2005). For the interwar period (1919 to 1945), the base country alternated between the US and France, as in Obstfeld, Shambaugh and Taylor (2004). The US was taken as the base country between 1919 and 1924, while from 1927 to 1937 that country was France, and from 1938 through 1955, the US was utilized again. After 1955, I adopted the list of base countries in Shambaugh (2004). For countries not in Shambaugh's list, I assigned base countries based on information reported the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions*.

Dennis Quinn has constructed an index of capital controls from 1890 to 2004 (see Quinn, Schindler and Toyoda 2011 for discussion). The index takes on values from 0 to 100, with 0 indicating complete lack of mobility of capital and 100 indicating full capital mobility. The Chinn-Ito index for financial openness (FI) is available for 1970 to 2014, and this index is on a scale from 0 to 1, with 0 indicating a complete lack of capital mobility and 1 indicating complete financial openness. From 1880 to 1969, only Quinn's values for capital controls were used, and from 1970-2004, the Chinn-Ito values were used to supplement Quinn's values for the cases where Quinn's values were missing. From 2005-2014, the values for financial openness given by the Chinn-Ito index were used. Since the Chinn-Ito index varies from 0 to 1, in order for the financial openness measure given by both data sets to be

[5] These data were supplemented in a few cases with information drawn from League of Nations *Statistical Yearbooks* and the Federal Reserve's *Banking and Monetary Statistics* (1943).

on the same scale, Quinn's index was rescaled to take on values between 0 and 1. Where Quinn's data did not cover a country, information for the earlier period was filled in using contemporary sources like League of Nations (1930, 1938a,b) and historians' accounts like Capie (2002). These sources provide information on the portion of the year over which controls were applied and the types of transactions that were restricted. These were mapped into the subcategories distinguished in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions,* which were then aggregated as unweighted averages, in the same manner as Quinn.

To calculate the exchange rate stability (ERS) and monetary independence (MI) indices, the procedures of Chinn and Ito were used. Monthly exchange rates with respect to the base country were first calculated. Then the monthly change in the exchange rate for each country was used to calculate the annual standard deviation. If the monthly fluctuation in the exchange rate was within a+/-0.33 percentage range, a value of 1 was assigned. In addition, any exchange rate that had a change of 0 in 11 of 12 months was treated as fixed. If there were two exchange rate fluctuations in 3 months, and the remaining 11 months experienced no change, then ERS was assigned a value of 1. For all the remaining observations, the following formula was to calculate ERS:

$$ERS = \frac{0.01}{0.01 + stdev(\Delta \log(\text{exch}_{\text{rate}}))}$$

To calculate Monetary Independence (MI), the annual correlation between the monthly interest rate of the home country and the base country was transformed as follows:

$$MI = 1 - \frac{corr(i_i, i_{j,}) + 1}{2}$$

This index takes on values between 0 and 1, with 0 indicating no monetary autonomy and 1 indicating complete monetary autonomy. If the correlation between two countries was undefined, a value of 0.5 was assigned, following the convention used by Chinn and Ito. The index was smoothed by calculating three year moving averages.

Ancillary variables used in the analysis include GDP and GDP per capita at constant international prices, both from the Maddison data base (Maddison 2017). Political arrangements are from the Polity IV data base (Marshall, Gurr and Jaggers 2016). We consider both their index of democracy and the raw Polity score. For each year and country, the Polity score ranges from -10 to +10, with -10 to -6 corresponding to autocracies, -5 to 5 corresponding to anocracies, and 6 to 10

corresponding to democracies. These rankings are based in turn on the competitiveness and openness of elections, the extent and nature of political participation generally, and checks on executive authority. As an alternative, I focus directly on democracy, extracting from the Polity data set a scaler measure of democracy, running from zero to 10, constructed from information on the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive, but not including information autocratic tendencies.[6]

IV. Indices

The results, disaggregated by period and level of economic development, are shown in Figures 1-4. These figures are simplified variants of those in Aizenman, Chinn and Ito (2008, 2012). Here each vertex denotes, respectively, full exchange rate stability ($ERS = 1$), full financial openness ($FI = 1$), and monetary independence ($MI = 1$).

The periods, following Eichengreen (2008), are the classical gold standard (1890-1913), the post-World War I float (1919-1924), the interwar gold standard years (1925-31), the 1930s managed float (1932-39), the post-World War II pre-convertibility period (1950-58), the Bretton Woods years (1959-69), the post-Bretton Woods managed float (1970-99), and the 21st century "nonsystem" (2000-2014). I also categorize countries as advanced or emerging/developing, including among the advanced countries all OECD members other than Chile, Israel, Mexico, South Korea and recent Eastern European members. Figures 1 and 2, for advanced and emerging markets respectively, show the full set of indices. Figures 3 and 4 are then the corresponding figures for the reduced set of country/year observations for which there is information on all three dimensions. The reduced data set is considerably smaller than the first. For example, for the 1919-24 period there were no emerging markets for which it was possible to construct values for all three indices.

Figure 1 for the advanced countries shows that exchange rate stability was greatest under the classical gold standard (1890-1913) and Bretton Woods (1959-69). It was least in the turbulent post-World War I period (1919-24) and following the breakdown of the interwar gold standard (1932-39). The other periods fall in between.[7]

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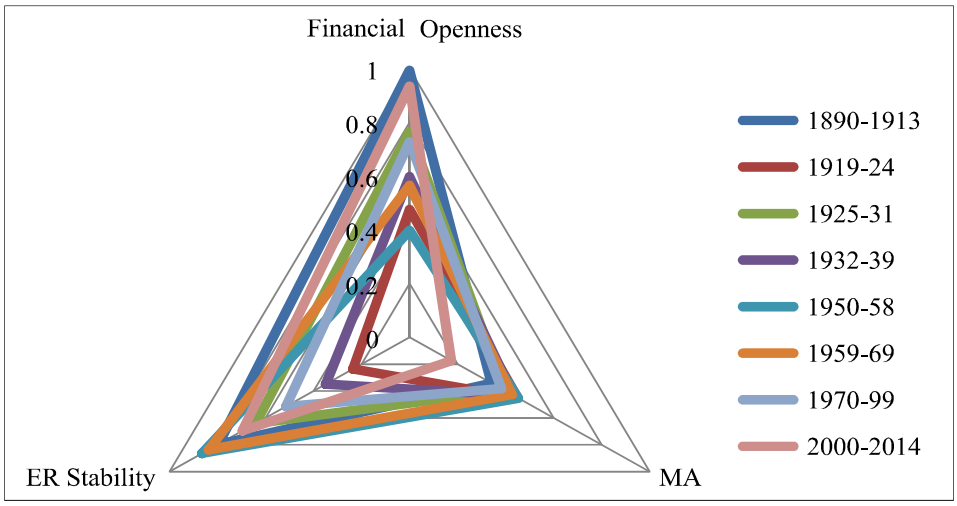
[6] The Polity score is constructed by subtracting a separate score for the extent of autocracy from the democracy score.

[7] These results for the 1930s thus contrast with those of Urban (2009).

[Figure 1] Advanced Economies



Capital mobility was also relatively free under the gold standard, relatively limited under Bretton Woods. There is strong support, in addition, for the presumption that capital controls grew increasingly porous (that financial mobility increased) following the return to current-account convertibility in 1958-9, and that this was accompanied by greater exchange rate variability.

Monetary autonomy, meanwhile, was greatest in the aftermath of World War I (1919-24), in the aftermath of World War II (1950-58) and in the 1930s, three periods when capital controls were widespread. It was least under the classical gold standard and, interestingly, since the turn of the 21st century, consistent perhaps with the Calvo-Reinhart view that countries are increasingly reluctant to make use of their monetary autonomy in practice.[8] There is noticeable decline in both monetary autonomy and exchange rate stability between the two Bretton Woods subperiods (1950-58 and 1959-69), which is accompanied by (and may be explained by) increased financial openness, consistent with the trilemma.

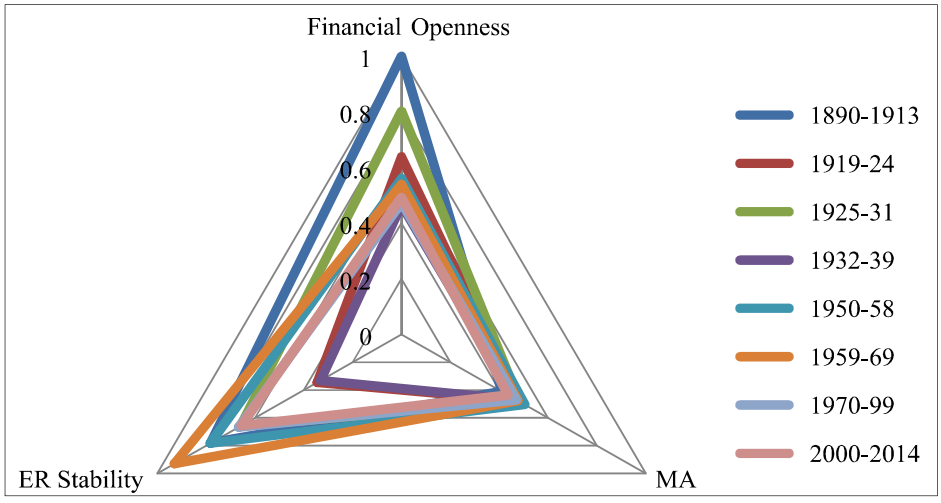
The trilemma framework suggests that, in periods of relatively high exchange rate flexibility, countries should have enjoy greater monetary autonomy and freer capital mobility. The results for the 1919-24 period in Figure 1 suggest that these goals were not universally achieved; in this turbulent period, advanced countries with flexible exchange rates pursued different monetary policies than their respective base countries, as the trilemma framework suggests was possible, but those different monetary policies were not always disciplined, forcing them to respond to consequent financial and balance-of-payments problems with the

[8] That exchange rate flexibility as measured here in fact declined between the 1970-99 and 2000-14 periods is consistent with this view.

maintenance of controls. The same was true of the 1932-39 period, although both exchange rate stability and financial openness were greater than immediately after World War I.

Figure 2 for emerging markets shows somewhat different patterns. Exchange rate stability was again greatest under the classical gold standard and Bretton Woods and least immediately after World War I and in the 1930s. But the measured degree of exchange rate flexibility was considerably less in the post-Bretton Woods (1970-99) period compared to that in the advanced economies, consistent with the presumption that fear of floating was especially prevalent in emerging markets in these years. Financial openness was greatest under the classical and interwar gold standards. It remains significantly less in the 21st century, despite trending upward in recent years.

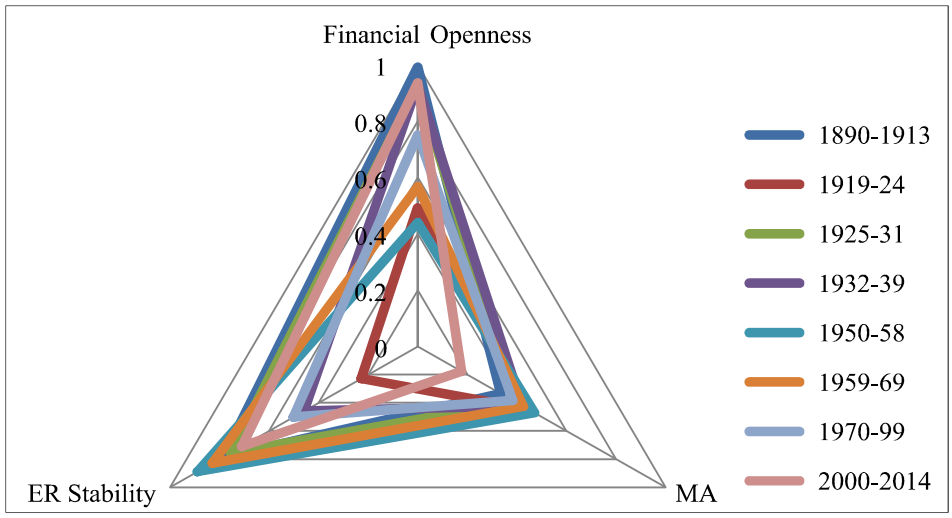
[Figure 2] Emerging Economies



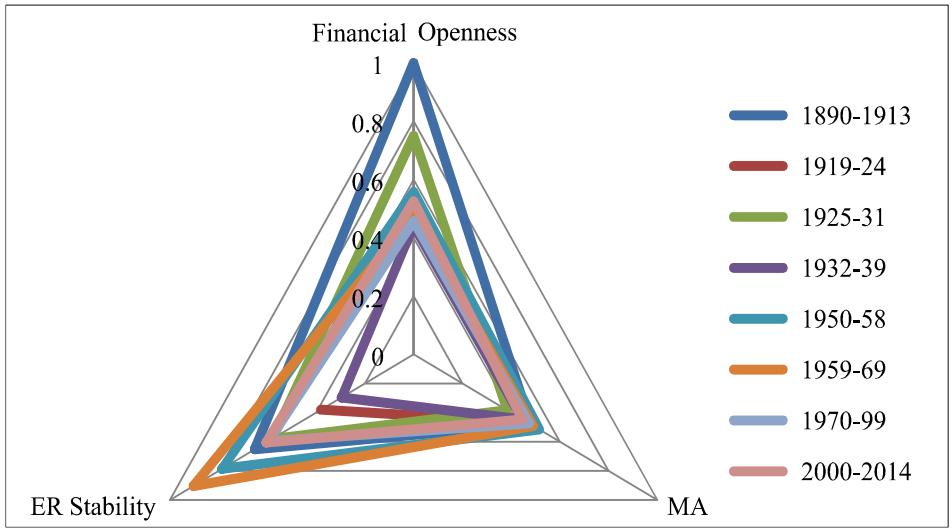
In addition, there is no indication of increasing financial openness between the two Bretton Woods subperiods before and after 1958-9, analogous to what is evident for the advanced countries in Figure 1. If anything, controls became tighter and more pervasive as the period progressed. Exchange rate stability increased between the two periods, presumably reflecting the insulation provided by those additional controls, in conjunction with little change in the degree of monetary independence.

A few differences are evident when comparing Figures 1 and 2 with Figures 3 and 4. For instance, the differences in the degree of exchange rate stability between 1919-24 and 1932-39 for the advanced countries are more pronounced in Figure 3 than Figure 1, while the corresponding differences between the 1930s and 1970s are less. Broadly speaking, however, the previously described regularities carry over.

[Figure 3] Advanced Economies—Edited List



[Figure 4] Emerging Economies—Edited List



V. Estimation Issues

The trilemma framework implies that choices regarding its three dimensions – exchange rate stability, monetary autonomy and capital-account openness – are not independent. If a variable x increases the likelihood of both exchange rate stability and financial openness in a given country and year, then it must reduce the extent of observed monetary autonomy. The sign of the coefficient on x in the third

equation can, in this case, be inferred from the signs of the coefficients on x in the other two equations. When the variables are appropriately scaled, the magnitude of the coefficient can be derived as well. This is equivalent to the observation famously made for the determinants of financial portfolio shares by Brainard and Tobin (1968).

Inferring the coefficient on x in the third equation can be problematic, however, if the other dependent variables are measured with nonrandom error. In this case it may be preferable to estimate the coefficient on x in the third equation directly without assuming the adding-up constraint.[9] I follow this second procedure in what follows. Readers who prefer the first procedure are free to disregard one of the three estimates.[10]

There is also the possibility that certain country characteristics may enable countries to shift the trilemma tradeoff in their favor. For example, countries with stronger institutions and greater policy credibility may be able to achieve a higher level of monetary autonomy for any given level of exchange rate stability and capital-account openness. When credibility is greater, market participants will not infer from an observed monetary policy divergence that policies will continue to diverge further in the same direction, which will make possible larger short-term divergences and greater monetary autonomy. This is an implication of the literature on exchange rate target zones (Krugman 1991) and of studies of monetary autonomy under the gold standard (Bordo and MacDonald 2012). In this case the coefficients on variables like per capita incomes (as a proxy for economic development and for the strength of institutions and policy credibility) need not sum to zero across the three equations, creating a rationale for reporting estimates of all three.[11]

Then there is the question of the appropriate estimator. Ordinary least squares offers ease of interpretation. Given that the dependent variables are bounded by zero and one, an alternative is pseudo logit, where the dependent variable is expressed as $\log [x/(1-x)]$ and therefore has full support. This is equivalent to interpreting the trilemma indices as probabilities, i.e. the probability of full

[9] This is equivalent to the argument against estimating a system of equations by Seemingly Unrelated Regressions when one or more variables is measured with error. Note that this argument militates against using SUR as well.

[10] This begs the question of which one to disregard. One argument is that it makes most sense to disregard the equation for monetary autonomy. Differences in financial markets across countries and over time imply, unavoidably, that different interest rates must be compared (see Section 3 above). This in turn introduces the possibility of measurement error in the monetary autonomy index. This is equally true of course of studies limited to recent decades due to differences in financial market structure and development across countries.

[11] Similarly, the coefficients on a variable like total financial wealth need not sum to zero across equations in the Brainard-Tobin model. We can thus think of variables like per capita income as increasing "trilemma wealth."

exchange rate stability or full financial openness. Results using both estimators are reported below, but I take the pseudo logit estimates as definitive.

In addition to the explanatory variables described above, I include a vector of period fixed effects corresponding to the global monetary regimes described in Section 2: 1880-1913 (the classical gold standard), 1919-24 (the post-World War I float), 1925-31 (the interwar gold standard), 1932-39 (the interwar dirty float), 1950-58 (Bretton Woods pre-convertibility), 1959-69 (Bretton Woods convertibility), 1970-99 (post-Bretton Woods float). The 21st century (2000-14) is the omitted alternative. I omit data for the two 20th century world wars throughout.

VI. Econometric Results

Table 1 reports full-sample results. The period fixed effects are jointly significant, suggesting that the global monetary regime affects individual countries' trilemma choices even after controlling for other observable country characteristics, such as economic size, the level of economic development and the political system. The fixed effects enter with their expected signs. Exchange rate stability is even greater than expected under the classical gold standard and in the Bretton Woods years, even less than otherwise expected immediately after World War I, in the 1930s and following the breakdown of Bretton Woods. Financial openness is greater than expected under the two gold standards and less than expected in the remaining periods, where, recall, the 21st century is the omitted alternative and therefore the standard of comparison.

Monetary autonomy was less under the two gold standards than today, controlling for other observable country characteristics, consistent with the literature on that regime, although only in the case of the classical gold standard is that difference significant at conventional confidence levels. It was greater in the second half of the 20th century than it is in the 21st century, presumably reflecting on relaxation of capital controls over time.

Larger economies as measured by aggregate GDP have more flexible rates and less open capital accounts. (The sign of the coefficient on aggregate GDP in the second column of Table 1 suggests, counterintuitively, that they have less monetary autonomy, but it is not significantly different from zero at standard confidence levels.) The greater flexibility of their exchange rates is consistent with the theory of optimum currency areas (small countries facing relatively high transactions costs with foreign counterparties will prefer to peg, while larger economies have greater ability to float). So too is the lesser openness of their capital accounts (small countries, which lose most in terms of "moneyness" from closing the capital account, will hesitate to do so). There is also the argument that large economies find capital controls appealing because restrictions on foreign lending and borrowing can turn

the financial terms of trade in their favor, in the monetary equivalent of the argument for tariffs on terms-of-trade grounds in countries with market power.

[Table 1] Pooled Data: Regressions with Period Fixed Effects and Democracy as Political Indicator

	(1)	(2)	(3)
	ers	mi	ka_open
democ	-0.00793***	0.00298***	0.00318**
	(-6.90)	(3.47)	(2.65)
GDP	-0.0728***	-0.0127	-0.0645***
	(-4.77)	(-1.50)	(-9.23)
GDPCapita	0.00195*	-0.0113***	0.0219***
	(2.03)	(-15.26)	(26.98)
d1	0.0577**	-0.104***	0.294***
	(3.19)	(-7.73)	(20.75)
d2	-0.357***	0.0100	-0.160***
	(-13.75)	(0.46)	(-7.31)
d3	-0.0655*	-0.0297	0.0370
	(-2.30)	(-1.27)	(1.21)
d4	-0.333***	0.0141	-0.213***
	(-14.17)	(0.80)	(-6.55)
d5	0.107***	0.0422**	-0.183***
	(5.02)	(3.16)	(-8.81)
d6	0.220***	0.0350**	-0.169***
	(15.15)	(2.98)	(-10.10)
d7	-0.0598***	0.0410***	-0.216***
	(-4.28)	(4.42)	(-15.55)
_cons	0.716***	0.461***	0.633***
	(52.15)	(49.22)	(41.65)
N	5952	3113	4668

Note: t statistics in parentheses, computed on the basis of robust standard errors. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. d1: 1880-1913, d2: 1919-1924, d3: 1925-1931, d4: 1932-1939, d5: 1950-1958, d6: 1959-1969, d7: 1970-1999.

The estimates in Table 1 suggest that more democratic governments have more open capital accounts, consistent with the idea that such countries see electoral pressure for capital account deregulation (voters resisting restrictions on their permissible financial transactions, as argued by Quinn 2000). Democracies also find it more difficult to credibly peg their currencies (the coefficient on exchange rate stability is significantly negative).[12] Greater exchange rate flexibility buys them greater monetary autonomy, consistent with the trilemma framework. Eichengreen (1992, 2008) argues that democracies find it difficult to prioritize exchange rate

[12] We will revisit this particular result shortly.

stability above all other objectives of economic policy, so that democratization should be associated with more flexible exchange rates and more exercise of monetary autonomy, especially when the capital account is open. The results in Table 1 are consistent with this view.

Richer, more developed countries (those with higher per capita GDPs) appear to prefer more open capital accounts, consistent with modern conventional wisdom. They also have more stable exchange rates, consistent with observations about the superior performance of the gold standard and Bretton Woods systems at the high-income core and about the superior ability of developed countries with relatively strong institutions to hold their exchange rates stable. Interestingly, they appear to exercise less monetary autonomy, which is consistent with the trilemma framework but surprising in light of the qualitative literature. We will however want to revisit this provisional finding below.

[Table 2] Pooled Data: Regressions with Period Fixed Effects and Polity as Political Indicator

	(1)	(2)	(3)
	ers	mi	ka_open
polity	-0.00465***	0.00172***	0.00305***
	(-7.55)	(3.71)	(4.67)
GDP	-0.0723***	-0.0128	-0.0639***
	(-4.77)	(-1.53)	(-8.97)
GDPCapita	0.00167	-0.0112***	0.0210***
	(1.81)	(-15.84)	(27.34)
d1	0.0557**	-0.103***	0.295***
	(3.09)	(-7.67)	(20.84)
d2	-0.359***	0.0108	-0.162***
	(-13.86)	(0.50)	(-7.41)
d3	-0.0676*	-0.0291	0.0349
	(-2.38)	(-1.25)	(1.16)
d4	-0.337***	0.0156	-0.210***
	(-14.34)	(0.89)	(-6.48)
d5	0.104***	0.0439***	-0.182***
	(4.88)	(3.30)	(-8.78)
d6	0.217***	0.0364**	-0.166***
	(14.86)	(3.08)	(-9.95)
d7	-0.0622***	0.0417***	-0.212***
	(-4.46)	(4.49)	(-15.32)
_cons	0.736***	0.453***	0.614***
	(51.14)	(45.48)	(38.39)
N	5952	3113	4668

Note: t statistics in parentheses, computed on the basis of robust standard errors. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. d1: 1880-1913, d2: 1919-1924, d3: 1925-1931, d4: 1932-1939, d5: 1950-1958, d6: 1959-1969, d7: 1970-1999.

[Table 3] Pseudo-logit Models

	(1) z_ers	(2) z_ers	(3) z_mi	(4) z_mi	(5) z_ka_open	(6) z_ka_open
Democ	-0.136***		0.011***		-0.086***	
	(-8.154)		(2.808)		(-5.735)	
Polity		-0.078***		0.007***		-0.026***
		(-8.780)		(2.996)		(-3.308)
GDP	-0.978***	-0.971***	-0.057	-0.057	-0.741***	-0.735***
	(-4.794)	(-4.783)	(1.239)	(-1.267)	(-7.194)	(-7.067)
GDPCapita	-0.021	-0.027**	-0.046***	-0.046***	0.277***	0.255***
	(-1.515)	(-1.982)	(-12.078)	(-12.393)		(19.576)
d1	-1.023***	-1.060***	-0.462***	-0.459***	5.139***	5.116***
	(-3.689)	(-3.833)	(-6.871)	(-6.816)	(19.810)	(19.828)
d2	-4.783***	-4.818***	-0.008	-0.006	-2.672***	-2.758***
	(-15.205)	(-15.361)	(-0.086)	(-0.066)	(-7.314)	(-7.571)
d3	-2.628***	-2.666***	-0.139	-0.137	2.243***	2.121***
	(-7.023)	(-7.123)	(-1.289)	(-1.279)	(4.878)	(4.662)
d4	-4.961***	-5.020***	0.078	0.083	3.265***	3.182***
	(-17.462)	(-17.687)	(1.096)	(1.171)	(7.945)	(7.771)
d5	1.070***	1.018***	0.102	0.108	-2.234***	-2.262***
	(3.466)	(3.300)	(1.546)	(1.644)	(-6.953)	(-7.031)
d6	2.578***	2.513***	0.111*	0.117**	-2.937***	-2.935***
	(11.748)	(11.420)	(1.896)	(1.976)	(-10.403)	(-10.424)
d7	-1.178***	-1.216***	0.088*	0.092*	-3.689***	-3.645***
	(-5.888)	(-6.077)	(1.869)	(1.930)	(-14.698)	(-14.592)
Constant	5.204***	5.532***	-0.111**	-0.141***	3.703***	3.687***
	(26.536)	(26.787)	(-2.308)	(-2.739)	(13.800)	(13.564)
Observations	5,952	5,952	3,017	3,017	4,501	4,501
R-squared	0.159	0.161	0.096	0.097	0.428	0.424
r2	0.159	0.161	0.0965	0.0969	0.428	0.424

Note: t statistics in parentheses, computed on the basis of robust standard errors. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. d1: 1880-1913, d2: 1919-1924, d3: 1925-1931, d4: 1932-1939, d5: 1950-1958, d6: 1959-1969, d7: 1970-1999.

Table 2 shows that these results carry over, virtually without exception, when we substitute the Polity score for the index of democracy.

Table 3 reports logit estimates of the same relationships. The results for the period dummies and country size are the same as before, but those for political regime and per capita GDP now differ. Democracies continue to display more flexible exchange rates and exercise more monetary autonomy, as in Tables 1 and 2. But democracy is now negatively rather than positively associated with capital account openness. An interpretation is that exchange rate flexibility alone buys them the level of monetary autonomy that popular pressures require.

Now, in addition, countries with higher per capita incomes appear to prefer more flexible exchange rates. This is consistent with casual observation and with the fear-

of-floating view (insofar as fear of floating is seem as primarily a developing-country phenomenon). But it is inconsistent with the implications of the trilemma, insofar as high-income countries also exercise less monetary autonomy. The underlying explanation for these patterns deserves further study. One hypothesis is that the correlation of interest rates between subject and base countries is an imperfect measure of monetary autonomy, insofar as monetary policy operates not only through interest rates but also other channels.[13]

VII. Conclusion

This paper has extended the literature on the open-economy trilemma, developing a consistent set of indicators of exchange rate stability, monetary autonomy and capital-account openness for a large sample of countries starting in 1890 and extending into the second decade of the 21st century. Analysis of these new data confirms stylized facts in the literature on international monetary and financial history and is consistent with the trilemma paradigm. In addition, three specific findings emerge from the analysis.

First, the long sweep of history confirms many of the predictions of the theory of optimum currency areas, for example those concerning the different trilemma policy choices of large and small economies.

Second, the analysis here supports popular hypotheses about how trilemma choices evolve with economic and institutional development. It supports the notion that, as per capita incomes rise, countries move in the direction of capital account openness and monetary autonomy, but that they are forced to sacrifice exchange rate stability in return. There are some exceptions, however, such as the exercise of monetary autonomy, which is not obviously higher in high-income countries.

Third, the global monetary regime (gold standard, Bretton Woods, managed float etc.) matters for country choices over and above the influence of observable country characteristics. In some cases the direction of these regime effects is intuitive: for example, in the turbulent years following World War I economies display more exchange rate volatility and more severe restrictions on international capital flows than their other observable characteristics would lead one to predict. In other cases, explanations for the results are less obvious. While countries enjoyed even less monetary autonomy than their observable characteristics would lead on to predict under the classical and interwar gold standards, and more autonomy than expected under Bretton Woods and the post-Bretton Woods float, monetary autonomy appears to have declined, controlling for country characteristics, since the turn of the century. This is contrary to the predictions of the literature on inflation targeting,

[13] See footnote 11 above.

which suggests that an increasingly firm commitment to this operating strategy should have given central banks greater room for maneuver. If this is not in fact the case, as suggested by the results here, this paradox is an important topic for future research.

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