DO THE RULES OF THE GAME MATTER? EXCHANGE RATE REGIMES AND THE FINANCIAL CYCLE (1922-2015)

German Forero-Laverde[φ]

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Abstract

We draw evidence on a possible link between exchange rate regimes and the behavior of the stock market and credit aggregate's boom-bust cycle. We run panel regressions and variance ratio tests on innovative Boom Bust Indicators (BBIs) for the stock market, real credit and credit to GDP of six Western European countries. We find that once we control form general economic conditions, foreign exchange, monetary policy, and capital flows, the exchange rate regime does not seem to matter for credit to GDP while evidence for its effect on the other variables is elusive. However, we identify a distinct behavior of the Boom Bust Indicators both in mean and volatility under each exchange rate regime and exploit these differences to rank regimes according to the (in)stability of assets and credit. Results indicate that some currency peg coincides with heightened volatility and above average growth of credit and stocks. The rigor of the peg seems to affect stock markets and credit aggregates differently as stricter pegs coincide with lower stock market volatility and higher dispersion in credit. Additionally, even though the gold exchange standard and the European Monetary Union bear similarities regarding a commitment to an exchange rate and free capital flows, the former coincides with more volatile stock and credit variables than the latter. Finally, while credit seems to remain stable during under a floating exchange rate, the stock market becomes as volatile, if not more, than under any other regime.

Keywords: Exchange rate regimes, financial cycle, stock market, credit growth, international financial institutions.

JEL codes: C14, C23, E02, E32, E42, E44, F33, G01, N2

[φ] PhDc in Economic History at Universitat de Barcelona. Email: german.forero@gmail.com. Scholarship holder from Universidad Externado de Colombia.

"The occurrence of manias, panics, and crashes, and their ultimate scope, also depended very much on the monetary and capital-market institutions of the time."
(Kindleberger & Aliber, 2005, pg. vii)

Introduction

The macroeconomic trilemma first put forward by Fleming (1962), and Mundell (1963) has commanded the attention of macroeconomists and economic historians for more than half a century. The idea is that of an impossible trinity that forces authorities to choose two out of three desirable goals: stable exchange rates, free and autonomous monetary policy and free capital flows (Obstfeld, Shambaugh, & Taylor, 2005). Findings of more than five decades of research in this prolific topic are diverse. Aizenman et al. (2013) measure and identify the validity of the trilemma expressed as a trade-off between the three desirable policy objectives. Baxter & Stockman (1989) identify the irrelevance of exchange rate regimes on macroeconomic aggregates. Obstfeld (2015) and Klein & Shambaugh (2015) identify the existence of an autonomous monetary policy under scenarios of financial integration and flexible or floating exchange rates; while Rey (2015) contests these results and finds that the US monetary policy drives individual monetary policies in periphery countries. Eichengreen & Rose (2004) find that capital control regimes are more persistent than exchange rate regimes.

Economic historians, since the early work of Kindleberger, have found the idea of the policy trilemma and financial stability to be natural correlates. Bordo et al. (2001) adopt the periodization of the macroeconomic trilemma since the late 19th century to explain the increasing frequency, albeit not the severity of financial crises. Obstfeld & Taylor (2004) have found in the framework of the impossible trinity a fertile ground to construct a narrative for the evolution of capital markets, financial integration, and crises throughout the long twentieth century and beyond. On this issue, Bordo & James (2015) identify a second policy trilemma linking financial stability to capital flows and exchange rates. On the other hand, Obstfeld & Taylor (2010) and recent and unpublished work by Aizenman (2017) link the original trilemma to financial stability directly.

In a parallel literature, Borio & White (2004) along with the researchers at the Bank for International Settlements (BIS), indicate one can characterize policy regimes by their elasticity. They describe it as the "inherent potential to allow financial imbalances to build up over time, with endogenous forces failing to rein them in, until the imbalances eventually unwind, possibly resulting in financial instability" (pg. 1).

Following these two approaches, this paper is the first step in a broader research endeavor to link how authorities resolve the policy trilemma during the last century with volatility in asset prices and credit. In theory, surges in asset prices, to be sustainable, should happen through an increase in expected income from investments or through a reduction of their risk profile (Fama, 1970). Whenever asset prices increase disconnected from fundamentals —building financial imbalances— they are likely to correct this increase when the unsustainable trend is evidenced (Kindleberger & Aliber, 2005). This boom-bust process has become relevant for policymakers because it affects consumption and real economic activity (Bernanke & Gertler, 1999). Credit aggregates evolve in a similar cyclical fashion, mainly guided by regulation, the level of prices and interest rates and agents' expectations. When compounded, asset booms fueled by excessive credit growth have long-run consequences as imbalances unwind and crises appear (Borio, 2014). It has been shown that economic recessions are deeper and more pervasive when they are accompanied joint crises in asset and credit markets (Jordà *et al.*, 2015).

We employ a new measure of booms and busts to characterize the ebb and flow process of stock market prices and credit aggregates —the financial cycle— and answer the question of whether exchange rate regimes play a role in its evolution. This is relevant, as further understanding of the time-changing amplitude and frequency of the financial cycle becomes critical for designing policies that may put a lid on harmful booms and mitigate the prevalence of busts.

Two starting caveats are relevant. First, we do not aim, at this point, to make any claims on the possible link between the other corners of the trilemma, namely monetary policy and capital flows and financial stability. A proposal for further research on these issues will be presented in the final section. Second, this research is not aimed at analyzing the full breadth of implications that a given exchange rate regime may have on the broad economy and in that sense we refrain from touching on the broad literature that covers the possible feedbacks (either positive or negative) present between a given regime and the business cycle.

Out database includes six Western European countries: France, Germany, Italy, the Netherlands, Sweden and the United Kingdom, from 1922 until 2015. All these countries participated in the interwar gold standard and Bretton Woods, they experienced a combination of hard pegs, soft pegs, and floating exchange rates during the period of study, and both their stock and credit markets were developed at the beginning of the twentieth century. A discussion of the choice of countries and the merits of this database vis-à-vis a large panel of countries is presented in Annex 1.

We follow the usual periodization in the literature on the trilemma: the interwar gold standard as period of stable exchange rates and open capital accounts; the Bretton woods agreement characterized by closed capital accounts and a more open use of monetary policy to attend the rising demands of the domestic population (Eichengreen, 2008); and the post Bretton woods period which combined soft pegs, freely floating exchange rates and a currency union between some of the countries in this study. The period covered in this paper is also appealing since it has seen both long and ample booms and busts in stock markets and credit.

From a methodological perspective, we construct three new dependent variables, each with a different time horizon, which serve as measures of the cycles in the credit and the stock market: the Boom Bust Indicators (BBIs). These time series are preferred above traditional dummy sequences[1] for several reasons: they contain more variability; their informational content is closer to the original data; they indicate whether there is a boom or bust and provide a measure of intensity to establish qualitative differences between diverse types of expansions and contractions, they focus on the empirical distribution of the data rather than performing statistical assumptions about the

[1] The traditional dummy sequence in the financial crises literature is a binary time series that takes a value of 0 in calm periods and a value of 1 during crises periods. The definition of a threshold to distinguish between crises and non-crises periods is one of the critical decisions a researcher must make during its construction.

data generating process (DGP), and they do not require a particular framework of time series decomposition.

We use these dependent variables in yearly pooled OLS and panel regressions with country fixed effects on macroeconomic variables as controls and independent variables associated with the different trilemma decisions. We then include exchange rate regime dummies and test their joint significance to assess whether the exchange rate regime plays a role on the booms and busts of assets and credit. Then, we run panel regressions with country fixed of monthly exchange rate regime dummies on the BBIs to identify whether these indicators behave differently, in mean, under certain regimes. Finally, we perform difference of variance tests to determine whether the BBIs are more volatile under a given exchange rate regimes. We consolidate results in mean-variance scatter plots to proxy for each regime's elasticity.

This is a pioneer study in presenting a ranking of regimes by their underlying elasticity to the accumulation of financial imbalances. A caveat has to be made as, up to now, the resulting ranking provides indications of a correlation between dependent and independent variable, but this does not imply a causal link. Although further research is needed to address this topic, this study provides results pointing in the expected direction: the indicators behave differently both in mean and variance under the exchange rate regimes covered in this study.

We find that once we control for general economic conditions, foreign exchange, monetary policy, and capital flows, the exchange rate regime does not seem to matter for credit to GDP while evidence for its effect on the other variables is elusive. However, we identify a distinct behavior of the Boom Bust Indicators both in mean and volatility under each exchange rate regime and exploit these differences to rank regimes according to the (in)stability of assets and credit. Results indicate that some currency peg coincides with heightened volatility and above average growth of credit and stocks. The rigor of the peg seems to affect stock markets and credit aggregates differently as stricter pegs coincide with lower stock market volatility and higher dispersion in credit. Additionally, even though the gold exchange standard and the European Monetary Union bear similarities regarding a commitment to an exchange rate and free capital flows, the former coincides with more volatile stock and credit variables than the latter. Finally, while credit seems to remain stable during under a floating exchange rate, the stock market becomes as volatile, if not more, than under any other regime.

The rest of the paper is structured as follows: Part 2 presents a theoretical framework based on the trilemma as well as a literature review on the interaction between monetary regimes and financial crises. Part 3 presents the database for the stock market, real credit, credit to GDP, exchange rate regime dummies, and additional control variables. Part 4 describes the methodology for constructing the Boom-Bust Indicators (BBIs). Part 5 presents the empirical results. Part 6 offers a discussion of contributions and caveats to the analysis. Part 7 presents future lines of research.

Part 2. Trilemma and financial stability: Implications for policy-making

This section of the paper covers the whole trilemma and not only exchange rate regimes because it is designed for the final version of the paper and not only for this preliminary version.

Trilemma regimes, characterized by the different policy choices that authorities make at a point in time to resolve the impossible trinity, are institutional arrangements and thus determinant to the economic system's vulnerability to shocks caused by macroeconomic instability (Eichengreen & Portes, 1987). A trilemma regime has three salient features which, following Bordo & Schwartz (1997), are the following[2]:

- **Nominal anchor:** Regimes may be based on convertible currencies where the nominal anchor is the price of the specie, or fiat currencies where the nominal anchor is some macroeconomic variable such as the price level.
- **Exchange rates:** Convertible regimes imply a fixed exchange rate between currencies of participants while fiat currency regimes allow for exchange rates to be fixed, floating or somewhere in between.
- **Capital flows:** Monetary regimes may have different degrees of openness of the current and capital accounts and thus may allow or restrict imports and foreign flows to and from the country to protect their exchange rates or manage the volatility of foreign investment.

A (naïve) summary of the interplay of these different choices as solutions to the trilemma during the period of study is presented in Table 1.

Table 1: Solutions to the macroeconomic trilemma during the twentieth century

Regime	*Free monetary policy*	*Stable exchange rates*	*Free capital flows*
Interwar gold exchange standard (1922 - 1936)	NO	**YES**	**YES**
Bretton Woods (1946 - 1971)	**YES**	**YES**	NO
Managed float (1971 - 2015)	**YES**	NO	**YES**
European Monetary Union (1999-2015)	NO	**YES**	**YES**

Sources: Bordo & Schwartz (1997), Obstfeld, Shambaugh & Taylor (2005), Bordo & James (2015). Author's design

Of course, this categorization is not clean cut, particularly around the dates of regime changes. For example during the eight years before the start of the Second World War, starting with the failure of the Austrian Credit-Anstalt in 1931, several countries that partook in the gold exchange standard started imposing capital controls (Eichengreen & Portes, 1987). Similarly, one of the causes for the demise of Bretton Woods was increased capital mobility (Bordo & Schwartz, 1997). During the managed float regime, several European countries took until 1988 to remove capital controls completely (OECD, 1993). Additionally, since 1999 several European countries have adopted the Euro and formed the EMU which, because of its characteristics is closer to the interwar gold exchange standard than to a managed float regime (Bordo & James, 2015). A final criticism to this characterization is brought forward by Rey (2015) who states that there is a transmission of monetary policy from core countries towards the periphery via cross-border flows and the leverage of financial institutions. For the said author, this renders the possibility of independent monetary policies moot, even in the presence of floating exchange rates.

Theorized mechanisms and expected findings by trilemma regime

Regime-specific characteristics give rise to diverse channels of transmission from the trilemma regime in place onto the financial cycle: discretionary monetary policy can be lax or tight; while the

[2] In the original Bordo & Schwartz (1997) paper they refer to these as monetary policy regimes but we believe the term Trilemma regimes is more indicative of the phenomenon we wish to characterize as these choices are not restricted to monetary authorities.

rules of the game may demand a commitment to a fixed exchange rate or not; and international capital mobility can be free or restricted. This yields some expected mechanisms at work under each regime with testable implications under certain assumptions.

Interwar gold standard

Under the gold exchange standard during the interwar years, there was a commitment to a fixed parity to gold where countries would only issue national currency if they had gold bullion or assets convertible to gold in their reserves (hence the name gold exchange standard) (Neal,2015). This arrangement worked under free capital flows across borders so, to maintain the parity between gold and the national currency, the interest rate behaved as a function of incoming or outgoing flows. Under the price-specie mechanism, when too much money flows into a country, due to capital or current account transactions, it causes an increase in the monetary base which leads to inflation, a decrease in the interest rate and, we expect, increases in asset prices and credit aggregates. When, on the other hand, capital flows outward, prices decrease, the interest rate increases due to the scarcity of national currency, the debt burden increases due to deflation, and asset prices fall. Consequently, two testable implications arise. First, there should be a strong correlation between changes in capital flows and changes in interest rates. Second, once we control for capital flows and other macroeconomic variables, the explanatory power of interest on the boom-bust cycle of assets and credit should be minimal.

Of course, these testable implications only function under certain assumptions; namely, that the parity to gold is fixed except for (rare) one time appreciations or devaluations and, that no forces interrupt the functioning of the price specie mechanism. This, of course, is not historically accurate, as countries like France, when confronted with capital inflows, kept the interest rate relatively high by not increasing the amount of French francs available and increasing their reserves of monetary gold. This, in turned caused an inherently unbalanced system which, in the end, led to the demise of the interwar gold standard (Neal, 2015)

Bretton Woods

During the Bretton Woods agreement (1944-71) there was a commitment from all participating countries to keep a fixed exchange rate which could only be altered when persistent imbalances were present. The first period of the Bretton Woods regime (1944-58) was characterized by a systematic shortage of dollars in the worldwide market which fostered the creation of the European Payment Union (1950) to allow for bilateral trade agreements between European countries while keeping a stable exchange rate vis-à-vis the US dollar. Convertibility was fully achieved in 1958, after the implementation of the Marshall Plan (1953), the devaluation of the British pound and many other European currencies (1949-51) and the constant running of trade deficits by the US to reverse the flow of dollars. The second period of the Bretton Woods agreement (1958-71) is characterized by stable exchange rates and a dollar excess, caused by the financing of budget deficits during the Korean and Vietnam wars, via monetary emission.

Under this system, the idea was that to keep a stable exchange rate authorities had to resort to monetary policy and international reserves while catering to the needs of the domestic population. The IMF was to serve to resolve temporary current account imbalances via short-term loans, and that external shocks to the exchange rate would be minimized through the establishment of capital controls. Thus, a testable implication of how this particular trilemma regime affected asset markets and credit aggregates runs through monetary policy as, theoretically, both capital flows and exchange rates were constant.

However, the mechanism mentioned above works only under three relevant assumptions. First, exchange rates did remain constant or face occasional one-time discrete devaluations (jumps). Secondly, we define capital controls as a total shut-down of the capital account both for inflows and outflows. This did not happen in reality since agents throughout the period devised ways to, for example, invest capital in other countries while registering the operations as trade-related. This made the capital controls porous throughout the whole period and is one of the reasons for the system's demise in 1971. A final assumption has to do with the independence of monetary policy conducted in each country. We may give credence to this assumption in the presence of full capital controls, but in a scenario of increasing capital mobility the idea of a contagious monetary policy from core to periphery countries cannot be disregarded (Rey, 2015).

Post Bretton Woods

The end of the Bretton Woods agreement (1971) and of the further attempts to return to a fixed exchange rate system, like the Smithsonian agreement (1973), the solution to the trilemma veered towards a world of free monetary policy and free capital flows where the exchange rate would be the residual of the interplay of these two forces. In this theoretical framework, once controlling for monetary policy and capital flows, the explanatory power of exchange rates on asset prices and credit aggregates should be minimal. When thinking about the mechanisms, capital flows can be thought of as a form of foreign credit that increases economy-wide leverage and that, when targeted to portfolio investment, may cause an increase in asset prices. Reversals in capital flows may cause sudden stops in the economy which can cause credit crises and asset prices busts, although this particular issue is more common in developing countries than in developed ones. The mechanism for monetary policy has to do with the effect that reductions in the interest rate increase the value of assets (both stock market and collateral), relaxes credit conditions and strengthens the balance sheet of creditors (Bernanke & Gertler (1999, 2001) balance sheet channel).

Two critical assumptions underpin the above-mentioned mechanism. The first one has to do with the independence of monetary policy in its response to shocks and the fulfillment of whatever mandate is given to the central bank. The discussion brought forth by Rey (2015) is particularly relevant for this period. The second assumption that the exchange rate is a residual does not coincide with the historical account. Table 9 in Appendix 1 shows that after 1971 all of the countries in the database have had at some point in time some form of commitment to an exchange rate either via a hard or a soft peg.[3] The commitment to stable exchange rates reduces the flexibility of monetary policy in the face of open capital accounts.

[3] Although defined later in detail, a hard peg allows for a maximum 2% monthly change in an exchange rate with respect to a base currency. The soft peg allows for a maximum 5% yearly change in the exchange rate.

The link between trilemma regimes and financial stability: What we know

Recent literature on the link between trilemma arrangements and financial and economic crises is abundant. According to Dell'Ariccia, *et al.*, (2013), the regime in place impinges on the cost of money and credit markets which, with their booms and busts, augment asset volatility and increase the probability of shocks that may affect long-term stability and growth. Concurrently, regimes affect policy space for the resolution of crises. On the one hand, countries with flexible exchange rates can respond aggressively to shocks since their monetary policy options are unfettered by exchange rate obligations (Almunia, *et al.*, 2010). On the other hand, economies with fixed exchange rates are unable to respond adequately to the build-up of imbalances (Dell'Ariccia, *et al.*, 2013). Additionally, under fixed exchange rates it becomes easier for an economy to accumulate and service debts denominated in foreign currency (Bordo, Meissner & Stuckler, 2009).

According to Kindleberger & Aliber (2005), capital inflows are relevant variables since they increase the amplitude of the credit cycle —by augmenting the availability of funds for banks and possibly reducing credit constraints—, and of the asset cycle —as they increase both the demand for securities and the volatility of their prices in the recipient country (Claessens & Kose 2013). Additionally, capital flows may increase a country's vulnerability to external shocks from shifts in interest rates, growth rates or perceived risk (Taylor, 2013). Finally, open capital accounts expose countries to the risk of a sudden stop, defined as a large decline or a sharp reversal in aggregate capital flows to a country which can lead to deflation since it contracts credit, prices and the value of collateral assets (Claessens & Kose, 2013).

The role of stock prices, which in this paper proxy for general asset prices, deserves special mention since they are more volatile than housing prices and thus present many more booms and busts (International Monetary Fund, 2003). For example, most countries had mayor booms and busts in the interwar period. Booms after the Second World War were related to recovery in Europe (France and Italy among others). The next series of booms and busts came in the 1980s and 1990s in the United Kingdom, Germany, Italy, and Sweden among others (Bordo & Landon-Lane, 2013). Barro & Ursúa (2009) find that, during the twentieth century, stock market crashes go along with minor depressions on 10% of occasions and large depressions are usually accompanied by market crashes.

Critiques to the use of stock market data arise on the grounds of relevance and causality. On the one hand, boom and bust cycles in the equity market seem to represent a lower risk for the economy than those in the housing market (Claessens & Kose, 2013). This is nuanced by Jordà *et al.*, (2015) who indicate that equity busts do not affect the length of economic recessions **if** they are not coupled with credit busts. However, when both events occur concurrently, their effect on a recession's duration can be identified clearly. On the other hand, Mishkin & White (2002) highlight that establishing causality going from stock market crashes towards financial stability is a challenge and hint that increased risk-taking by investors may be a possible channel. These two criticisms, compounded with the excessive attention the 2008 crises has brought to other asset classes such as housing and derivatives, have made the focus of research shift away from stock markets. This change in direction may be equivalent to shutting one eye to possible sources of instability since stock markets are known to react faster than other economic variables, to information innovations than other economic variables. In that sense tapping again on the study of stock market crises may yield interesting results that may not be obtained from less volatile and less reactive markets.

Recently, researchers from the BIS and many others have highlighted that the fact that financial imbalances may accumulate under scenarios of stable inflation challenges the conventional wisdom that price stability, as guaranteed by inflation targeting regimes, is tantamount to financial stability (Borio, 2014). If a given resolution to the trilemma affects the accumulation and unwinding of imbalances then, necessarily it has implications for policymaking, crises prevention, and crises resolution. The contribution of this paper to the literature is precisely to shed light on this relationship to include it in a broader debate on the role that the monetary policy reaction functions should give to asset prices, credit aggregates and their cycle.

Currently, one side of the debate, the "Jackson Hole Consensus" (Jones, 2015, p. 8) proposes a view of benign neglect arguing that increases in asset prices should be taken into account if and only if they affect expected inflation; that it is impossible to determine whether a boom is tied or not to fundamentals making equivocal reactions in monetary policy costly in terms of output and inflation; and that there is no theoretical justification for singling out the stock market as an additional variable for monetary policy (Bernanke & Gertler, 1999, 2001). Additionally, Dell'Ariccia, *et al.* (2013) indicate that tightening monetary policy will lower unobservable risk but will increase observable unemployment, the present debt burden and reduce asset prices, making policy decisions harder to take.

At the other side of the debate, the "Basel consensus" (Jones, 2015, p. 8) led by the BIS, proposes policymakers should follow a leaning against the wind policy —monetary tightening in the face of imbalances—, as a sort of insurance against crises in order to prevent busts that may be followed by a credit crunch and a fall in output (Bordo & Jeanne, 2002). Borio & Lowe (2002) find that under a fiat currency the only constraint for the expansion of credit is the policy rule of monetary authorities. Thus, there cannot be a real anchor to the value of a currency unless the monetary rule responds to the buildup of financial imbalances. Additionally, Jordà *et al.* (2010) do not find that inflation trends serve to detect growing financial vulnerability, a sharp criticism to the inflation targeting regime. They state that it is possible central banks misread the absence of inflation and kept interest rates too low for too long before the recent financial crises. Concurrently, Bordo & Landon-Lane (2013) find loose monetary policy is a good indicator of booms in asset prices.

In our case, results in the direction that the accumulation and unwinding of imbalances is not contingent on the different monetary regimes may be seen as an argument in favor of a benign neglect policy and the irrelevance of foreign sector controls. However, if the boom-bust cycles in asset prices and credit are contingent on the trilemma regime, then under regimes that are more prone to the accumulation and unwinding of imbalances there should be both a leaning against the wind policy and regulation of the foreign sector. This argument would alter the benign neglect claim and suggest that an optimal monetary order is not only one where prices are stable but where other conditions are present to avoid imbalances from accumulating. Additionally, it would imply that not only monetary authorities but regulators are responsible for financial stability in an environment of international cooperation, a relevant argument in favor of macroprudential regulation (Freixas, et al., 2015).

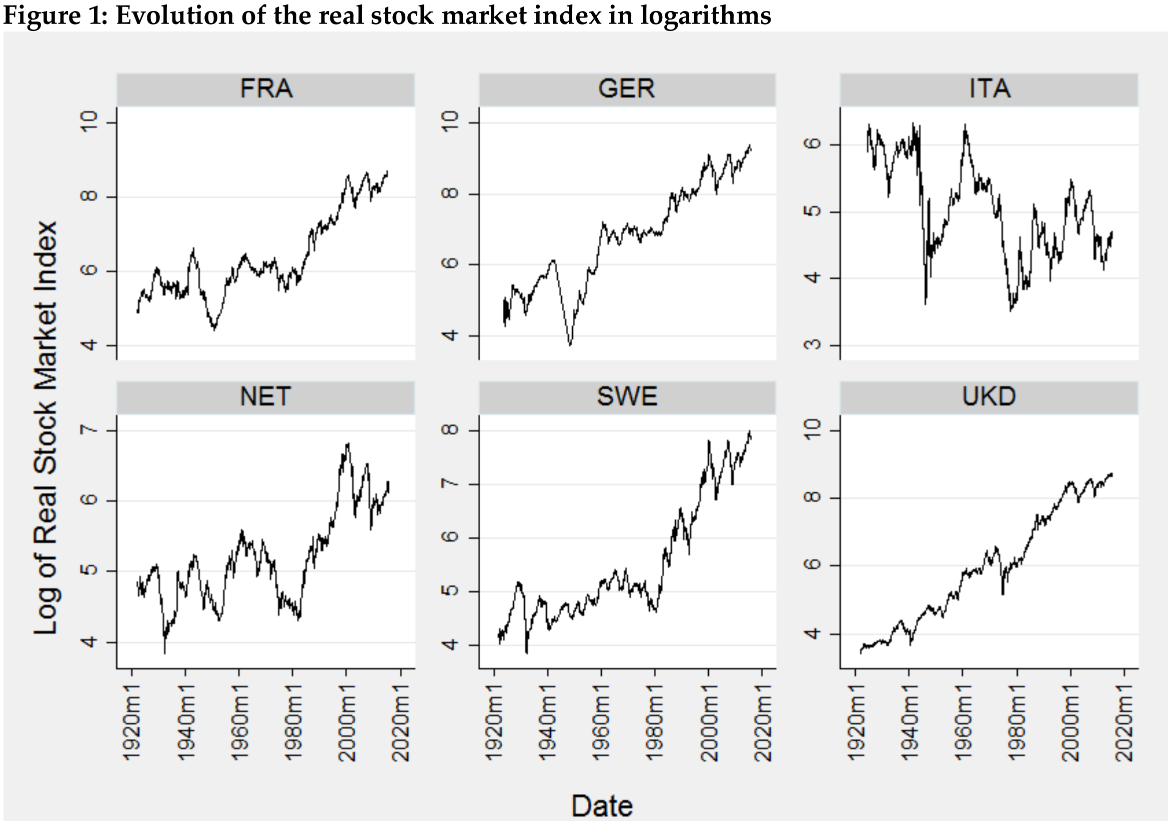
Part 3. Database and descriptive statistics

In this section, we will discuss the construction of the database and the exchange rate regime dummies.

Stock market information

We will use monthly market-wide value-weighted stock indices expressed in real terms for the six countries starting in January 1922 and ending in September 2015. All time series were downloaded from the Global Financial Database[4] and were normalized to a value of 100 in January 1950. When data had a daily frequency, we chose as the monthly datum the one for last trading day of each month. Missing data were filled by using the last known value of the index. Specifics for each time series are presented in Annex 2. Figure 1 presents the logarithmic transformation of the stock market indices.

Figure 1: Evolution of the real stock market index in logarithms



The logarithmic transformation of the series reduces issues with scale and allows us to inspect peaks, troughs and changes in volatility with a simple inspection. For example, all stock markets present a crash during the 1940s, possibly due to the Second World War, however, this way of presenting the data does not allow us to compare the different series as the scales differ. To compare summary statistics, we calculated a linear growth rate (simple return) of the form $r_{it} =$

[4] A particular issue with the use of stock market indices for such long periods of time since their composition is not constant. This issue is partially solved by using broad market indices so that the particular weight of any single stock decreases.

$(P_{it}/P_{it-1}) - 1$ for each series, where P_{it} corresponds to the closing price for country i at time t. We present the summary statistics in Table 2.

Table 2: Descriptive statistics for the simple one month return on the stock market indices

Descriptive statistics on stock market index simple returns							
		France	*Germany*	*Italy*	*Netherlands*	*Sweden*	*United Kingdom*
Observations		1118	1102	1124	1124	1124	1124
Mean	*Monthly*	0.53%	0.71%	0.20%	0.23%	0.45%	0.57%
	Yearly	6.49%	8.92%	2.39%	2.84%	5.51%	7.03%
Standard deviation	*Monthly*	6.22%	6.01%	7.78%	4.89%	5.00%	4.66%
	Yearly	21.55%	20.83%	26.96%	16.95%	17.31%	16.15%
Min	*Monthly*	-22.01%	-91.10%	-60.05%	-36.06%	-32.12%	-26.87%
	Yearly	-94.93%	-100.00%	-100.00%	-99.53%	-99.04%	-97.66%
Max	*Monthly*	86.76%	47.82%	59.70%	23.92%	27.95%	50.05%
	Yearly	179963.87%	10784.07%	27413.53%	1211.75%	1824.86%	12922.34%

Monthly descriptive statistics were transformed into yearly values to make them comparable to credit data presented in the following subsection. The means minima and maxima were converted into compounded annual growth rates (CAGRs) and standard deviations were annualized by multiplying them by the square root of twelve as is standard in the financial literature.

This summary statistics allow for comparisons across countries. For example, although the average monthly return is positive for all countries, Germany's average monthly growth is more than three times that of the Italian stock market. The riskiest stock market is the Italian one since it has the most significant sample standard deviation while the United Kingdom seems to have the safest stock market in the sample. The worst month on the whole sample saw investors lose 91.1% of their wealth (in Germany) while the worst month in France signified a loss of "only" 22.01%. Further analysis of time series characteristics for the indices can be found in Annex 2.

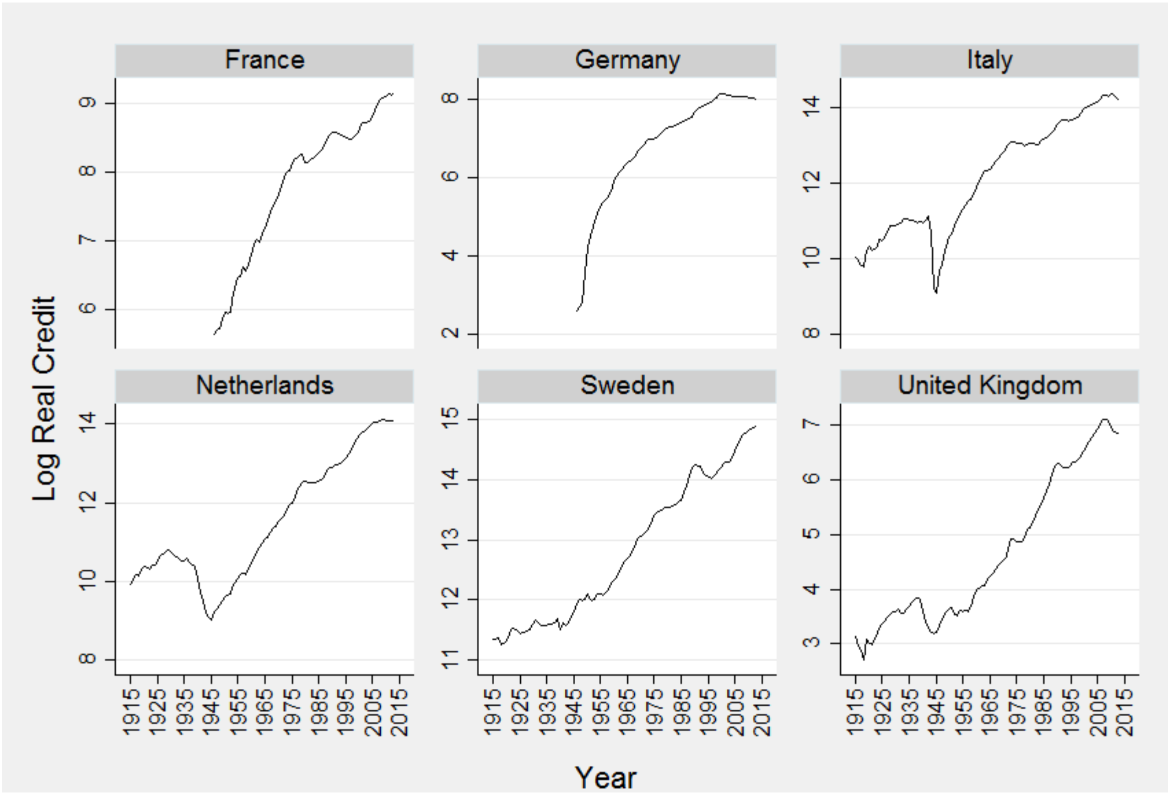
Credit variables

For credit, we use two different variables: total loans to the non-financial private sector in real terms and local currency and total loans to the non-financial private sector to GDP. These yearly time series, which start in 1915 and run until 2013, were obtained from Jordà, Schularick & Taylor (2017).

Real credit to the non-financial sector

The first issue with this series is that missing data were filled by using the last known value of the index. Figure 2 presents the logarithmic transformation of the real credit series.

Figure 2: Evolution of real net loans in logarithms



The time series for France and Germany start in 1946 because the data of the interwar years presents anomalies.[5] The remaining series show reductions in the total value of credit during the Second World War which begs a necessary clarification. This data includes only domestic private credit and at no point reflects the behavior of either public debt or debt to foreign creditors. To allow for comparability across series, we present the descriptive statistics for the yearly growth rates in Table 3.

Table 3: Descriptive statistics for the simple returns of real net loans to the non-financial sector

Descriptive statistics on real net loans to the non financial sector (simple returns)						
	France	*Germany*	*Italy*	*Netherlands*	*Sweden*	*United Kingdom*
Observations	67	67	98	98	98	98
Mean	5.53%	9.39%	5.81%	4.75%	3.88%	4.22%
Standard deviation	6.16%	17.98%	15.42%	9.61%	5.93%	9.18%
Min	-11.36%	-4.88%	-76.09%	-30.08%	-17.43%	-20.63%
Max	20.94%	117.99%	80.50%	21.72%	17.28%	45.69%

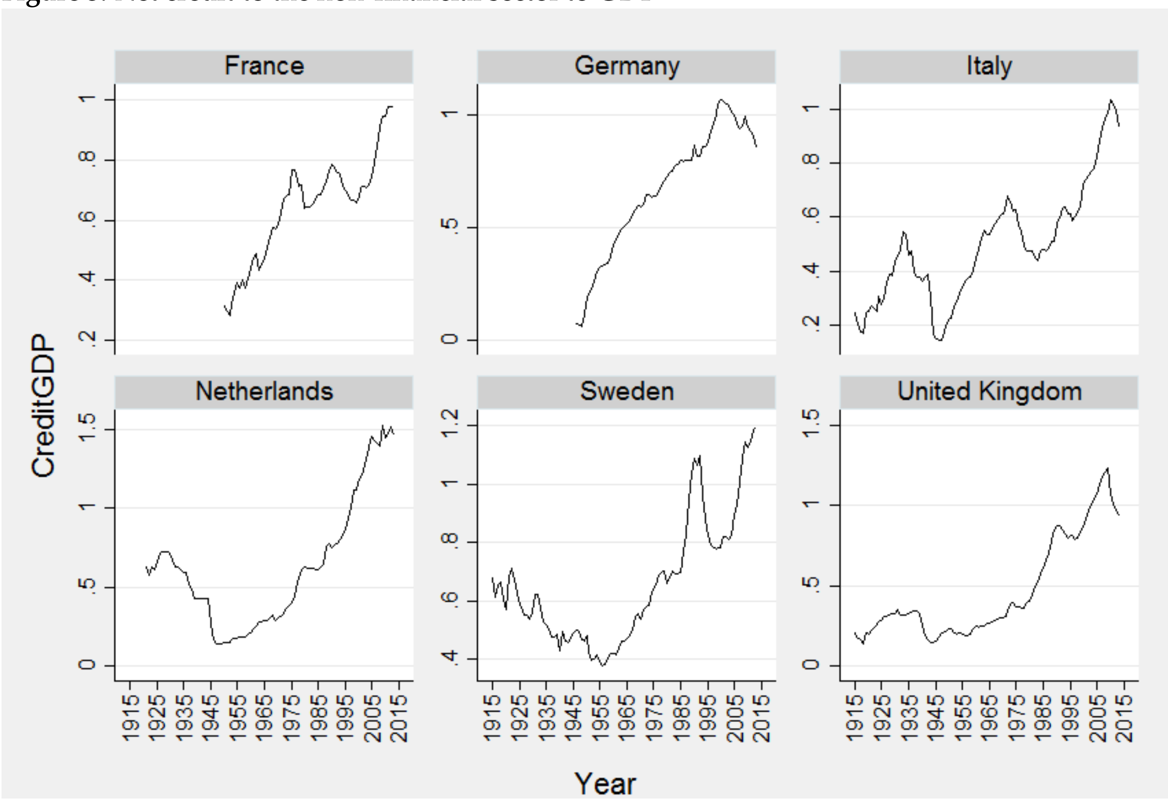
[5] The growth rate for 1945-46 for France is extremely high (1,114.02%) and for Germany is extremely low (-93.21%). This probably happens due to issues that arise from linking different data series. When confronting the online statistical annex of Jordà *et.al.*, (2017) we find that the gaps between 1940-46 for France and Germany were constructed using statistical artifacts.

When comparing the results from Table 2 and Table 3, we find that although by country on average the stock market grows less than credit aggregates, the standard deviation is higher for the former than for the latter. From the table, we can see credit growth is least volatile in France and Sweden, while it is three times more volatile in Germany and Italy. Interestingly the sample yearly volatility for the German stock market and real credit growth are quite similar.

Credit to the non-financial sector as a proportion of GDP

Figure 3 presents the series of net credit to the non-financial sector as a proportion of GDP.

Figure 3: Net credit to the non-financial sector to GDP



In general, the series for which we have available observations present a constant decrease in the participation of private debt to GDP from the end of the First World War and into the mid-1940s. Then the series present pronounced growth until the 1970s, where France and Italy crash while the other series stagnate until the deregulation wave of the 1980s. The Swedish series crashes with the mortgage crisis of the 1990s, which shows up as a short period of stagnation for the UK and Italy. Then all series, notably Germany and the UK, show a correction after the Great Financial Crisis (GFC) and Italy after the European debt crisis of 2010-12. Table 4 presents descriptive statistics for the time series.

Table 4: Descriptive statistics on net loans to the non-financial sector to GDP

Descriptive statistics on net loans to the non financial sector to GDP						
	France	*Germany*	*Italy*	*Netherlands*	*Sweden*	*United Kingdom*
Observations	64	68	99	93	99	99
Mean	64.22%	66.80%	49.15%	62.79%	65.62%	46.52%
Standard deviation	17.61%	28.12%	21.56%	39.57%	21.36%	31.25%
Min	28.51%	6.54%	14.15%	13.60%	37.62%	13.68%
Max	97.92%	106.80%	103.31%	152.21%	119.57%	123.89%

The Dutch series is the one with the broadest range and highest standard deviation of all series. The least volatile series is the one for France, followed closely by the Swedish and Italian data. Importantly, all series peak around the time of the GFC and face their lowest point during or shortly after the Second World War.

Dummy sequences for the monetary regimes

For the construction of exchange regime dummies, we obtained different exchange rate series from the Global Financial Database. These dummies look at de facto exchange rate regimes by country as we are more interested in what countries do rather than what they say they do. We build two different sets of exchange regime dummies. The first one excludes the European Monetary Union and looks at the exchange rate regime of euro countries against the US dollar. For countries participating in the euro, all dummies behave the same from 1999 until 2015. The second series contains a fifth dummy that proxies for the countries' participation in the Euro. When the euro dummy takes the value of one, all other dummies are set to 0.

We follow Bernanke & James (1991) for the dating of the de facto interwar gold exchange standard. Additionally, we follow the methodology by Klein & Shambaugh (2015) to distinguish between hard pegs, soft pegs, and floating exchange rates. In their paper, they calculate monthly devaluations and revaluations of the exchange rate with respect to a base currency from 1973 until 2011. The base currency is that to which the country has historically pegged its currency or the currency to which it is most likely to peg.

The base currency before 1944 changes by country depending on foreign trade information and data availability. When comparing the importance of the US and the UK as a destination of exports for the countries in the database, we identify that the base currency for France, Germany, the Netherlands, and Sweden should be the British pound while for Italy and the UK it should be the US dollar.[6] However, due to data availability, for Germany, we use as a base currency the US dollar from 1921 until 1944 as the exchange rate of the German Mark against the British Pound, has long periods of missing data. Where both US dollar and British pound exchange rates are available

[6] We check the validity of these choices by comparing the base currency to the main destination of each country's exports in 1928. To do so we use the UN International Trade Statistics 1900-1960 published in 1962 and available in https://unstats.un.org/unsd/trade/imts/Historical%20data%201900-1960.pdf. We find for France the main destination of exports is the United Kingdom with 15.1% of the total; for Germany the United Kingdom with 11.95% of the total; for Italy the United States with 10.53% of the total; for Netherlands the United Kingdom with 21.88% of the total, and for Sweden the UK, with 25.12%.

results, do not vary with the change of base currency except for 1935-36 where the exchange rate against the UK follows a hard peg, and the exchange rate against the US Dollar shows a soft-peg.

During the Bretton Woods agreement (1944-71) the base currency for all countries during was the US dollar. Subsequently, for the period 1972-99 the base currency for Germany is the US dollar while for the other five countries it is the German Mark. During the Economic and Monetary Union (1999-2015), the base currency for the euro countries is the US dollar from while it is the Euro for Sweden and the United Kingdom.

To determine whether a currency is in a hard peg, we follow Obstfeld, Shambaugh & Taylor (2010). A country will be classified as a hard peg if its monthly official exchange rate to the base currency remains in a 2% band over the course of a year or if it does not change more than 1%[7] during 11 out of 12 months and then has, at most, a discrete jump. To avoid mistaking periods of low volatility for hard pegs, we require that a hard peg is sustained for at least two years.

For the classification as a soft peg, we also follow Obstfeld, Shambaugh & Taylor (2010). A country is classified as a soft peg if the YOY change in the official foreign exchange is smaller than 5% or lower than 2% on a monthly basis. To avoid mistaking periods of low volatility for hard pegs, we require that a hard peg is sustained for at least two years. A country is classified in the floating regime if it is neither in the gold exchange standard (GES), the hard peg (HPEG), the soft peg (SPEG) or the euro (EMU).

We summarize the classification of each regime in each country in Table 5.

Table 5: Yearly exchange rate regime dummies

Country	GES	Hard peg	Soft peg		Float		EMU	Total years /country
			W.O. EMU	*In EMU*	*W.O. EMU*	*In EMU*		
France	9	45	4	2	34	21	15	**92**
Germany	8	31	9	7	44	31	15	**92**
Italy	7	41	8	6	36	23	15	**92**
Netherlands	12	58	7	5	15	2	15	**92**
Sweden	8	44	16		24		0	**92**
United Kingdom	7	35	10		40		0	**92**
Total years /regime	51	254	54	46	193	141	60	

The second column in the soft peg and float panels refers to the case where we include the European monetary union. We also extend this exercise to monthly frequency for the final part of this paper. We present results in Table 6.

[7] The original classification is more strenuous and demands that the exchange rate does not vary at all during 11 out of 12 months.

Table 6: Monthly exchange rate regime dummies

Country	GES	Hard peg	Soft peg		Float		EMU	Total months /country
			W.O. EMU	*In EMU*	*W.O. EMU*	*In EMU*		
France	101	556	38	15	430	252	201	**1125**
Germany	83	410	82	59	550	372	201	**1125**
Italy	78	525	84	61	438	260	201	**1125**
Netherlands	139	700	84	61	202	24	201	**1125**
Sweden	90	533	216		286		0	**1125**
United Kingdom	77	425	111		512		0	**1125**
Total months /regime	568	3149	314	222	1684	972	804	

We observe in both tables that most of the data is concentrated in the hard peg due to the duration of the Bretton Woods period. Next in relevance, come the floating regime, the European monetary union, the gold exchange standard and finally the soft peg. In the monthly case, sample sizes seem to be large enough to perform robust inference. The sample size in the annual case, we will argue further, may be causing a loss of significance in the results.

Control and trilemma variables

Additionally, we include in our database variables for the different choices of the trilemma, as well as macroeconomic controls. These variables will be used as controls when we test for the role of the exchange rate regimes on assets and credit. Their characteristics and sources are presented in Table 7:

Table 7: Control and trilemma variables

Variable Name	Content	Source
	Macroeconomic controls	
Dividend yield	Dividend yield (percentage)	GFD
GDP Nominal	GDP (nominal, local currency)	
Government revenue	Government revenues (nominal, local currency)	
Real GDP per capita	Real GDP per capita (PPP) original Madison data	Jordà-Schularick-Taylor Macrohistory Database (2017)
Population	Population	
Real consumption per capita	Real consumption per capita (index, 2006=100)	
Real GDP per capita	Real GDP per capita (index, 2005=100)	
	Monetary policy	
Narrow money	Narrow money (nominal, local currency)	
Broad money	Broad money (nominal, local currency)	Jordà-Schularick-Taylor Macrohistory Database (2017)
Short-term interest rate	Short-term interest rate (nominal, percent per year)	
Long-term interest rate	Long-term interest rate (nominal, percent per year)	
	Capital flows	
Exports	Exports (nominal, local currency)	Jordà-Schularick-Taylor Macrohistory Database (2017)
Overall current Balance	Overall current Balance nominal local currency	BR Mitchell - International historical statistics, 1750-2010
Capital Account	Capital account inferred from Mitchell nominal local currency	
	Exchange rates	
Change in FX Base currency	Percentage change in exchange rate of local currency	GFD, Author calculations based on
USD exchange rate	USD exchange rate (local currency/USD)	Jordà-Schularick-Taylor Macrohistory
Terms of trade	Terms of Trade	World Bank

We were careful not to include explanatory variables that were strongly correlated with each other. For that reason, we excluded imports (strongly correlated to exports) and government expenditure (strongly correlated to government revenue).

Part 4. The Boom-Bust Indicator (BBI)

For the last two decades, a rich set of literature has evolved with the aim of understanding the determinants of the behavior of the financial cycle. To do so, researchers use diverse definitions of what constitutes "excessive growth" for asset prices and credit which can be broadly categorized into two distinct groups. One group of researchers borrows from business cycle theory like the works of Bry & Boschan (1971) and Pagan & Sossounov (2003) and uses a non-parametric algorithm, the turning point analysis, to find peaks and troughs in asset prices and growth time series. They then identify the phase that runs from a peak (trough) to a trough (peak) as a recession (expansion).

Other researchers use series decomposition techniques in the time domain such as the Hodrick & Prescott (1997) filter or on the frequency domain such as the Band-Pass filter as in Christiano & Fitzgerald (2003) to extract trend and cycle components from time series. They then compare the original data to the extracted components to declare periods of above or below trend growth. These techniques require an *a priori* definition of what constitutes a boom or a bust. Most of these analyses produce a dummy sequence that takes a value of one for crises or busts and a value of zero for calm periods or booms depending on the research question.

These dummy sequences are subject to several criticisms. First, results vary from study to study as there is a lack of consensus on the way of constructing the indicators and on the thresholds for determining whether there is a boom or a bust (Schüler *et al.*, 2015). Second, these sequences are distilled from data with high variability and other statistical properties that are not reflected in a 0/1 sequence (Pagan & Sossounov, 2003). Finally, Romer & Romer (2015) highlight that a dummy sequence does not allow drawing distinctions between different kinds of booms and busts.

To tend to these issues and to improve our understanding of the behavior of time series, we construct three distinct Boom–Bust Indicators (short-run, medium-run, and long-run) based on the structure of the empirical distribution of the underlying data. The intuition behind the measure is that if aggregate returns for several time horizons move farther to the right (left) of the distribution the indicator, measured in standard deviations, takes larger positive (negative) values. This technique differs from spectral analysis or time series decomposition techniques in that it does not treat the underlying time series as a combination of unobserved components. Contrarily, what the BBI methodology does is express the original data in such a way that the researcher can distinguish between explosive (short-run), expansive (medium-run) and pervasive (long-run) booms and busts without an *a priori* definition of what constitutes a boom or a bust, and low data smoothing.

As a thought experiment one can think of the data generating process behind the evolution of a time series as throwing a stone in the center of a pond, producing waves that move outward towards the shore. The turning point algorithm identifies the peaks and troughs of the waves. The HP filter compares the observed wave to a recursive prediction of how it should behave and highlights only significant deviations. The band pass filter decomposes the ripples and observes only those that conform to certain preset frequencies. It presumes that the various components of the wave are driven by different phenomena (orthogonality assumption) omitting the fact that only one stone caused the ripples. The BBIs look at the waves differently, separating those that disappear closer to the center from those that move farther away and from those that reach the shore. Thus the BBIs distinguish between booms or busts that only affect short-run returns from those that affect the medium or long-run.

To construct BBIs, we first build an n-period linear return matrix $\mathbf{R}$ in which rows will represent time and column vectors $\mathbf{r_n}$ will hold the return from period t-n until t. Thus, the position $r_{t,n}$ in the matrix can be obtained from $r_{t,n} = (P_t/P_{t-n}) - 1$, where P_t corresponds to the value of the stock or credit variable at time t. The index n will only take integer values from 1 to 12 months and then values of 18, 24, 30, 36, 42, 48, 54 and 60, such that vector $\mathbf{r_{24}}$ contains the two year returns and vector $\mathbf{r_{60}}$ contains the five year returns. We distinguish between short-run returns (up to 12 months), medium-run returns (up to 36 months) and long-run returns (up to 60 months) following the standard investment literature.[8]

By construction, vectors $\mathbf{r_n}$ and $\mathbf{r_m}$ have different measures since they express n and m period returns respectively. A solution to keep comparability and thus desirable properties such as additivity across vectors with different values of n, we can standardize matrix $\mathbf{R}$. By doing so we generate a new matrix $\mathbf{Z}$ such that:

$$z_{t,n} = \frac{\left(r_{t,n} - \mu_n\right)}{\sigma_n} \quad (2)$$

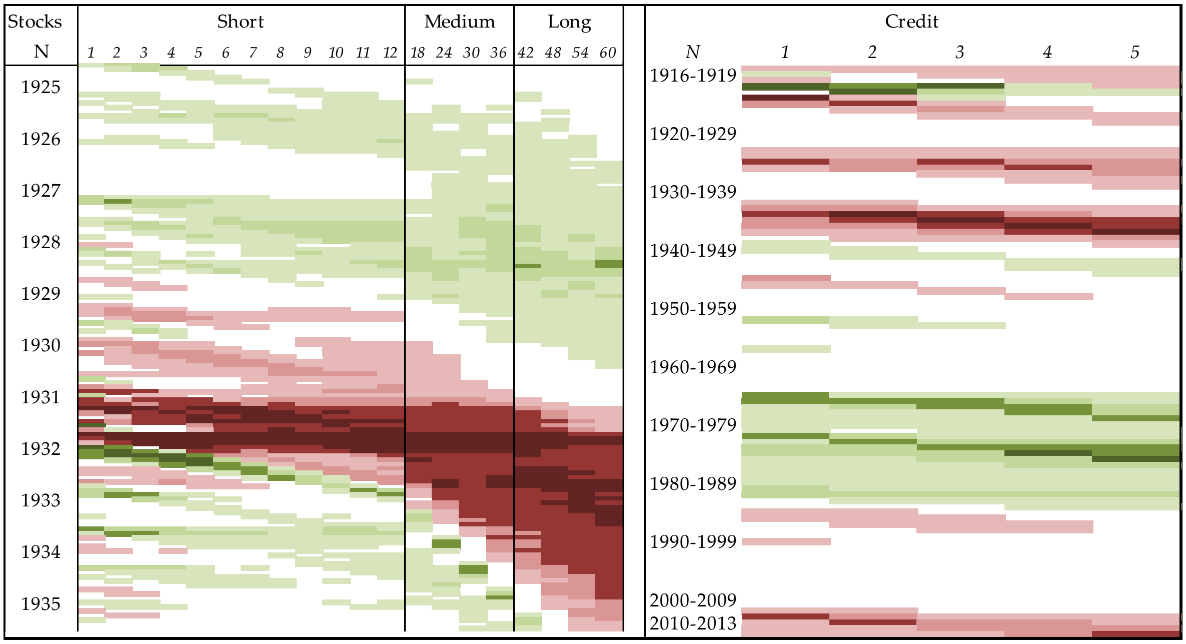
The values obtained from (2) refer to the number of sample standard deviations σ_n that a given observation $r_{t,n}$ is away from the sample mean μ_n of vector $\mathbf{r_n}$. Since the unit of measurement of all observations $z_{t,n}$ is the same, vectors $\mathbf{z_n}$ and $\mathbf{z_m}$ are comparable within $\mathbf{Z}$. In unreported results, all vectors in $\mathbf{R}$ and $\mathbf{Z}$ are stationary and have no linear trend.

We use matrix $\mathbf{Z}$ as input to build a heat map following a simple coloring rule on a vector-by-vector basis. The rule is such that observations farther away in the tails are colored darker, while those closer to the center of the distribution are shaded in lighter colors. Any return falling in the interquartile range will not be colored. Left tail (first quartile) events are colored in shades of red and right tail (fourth quartile) events will be colored in shades of green. The different shades of red (green), from darkest to lightest correspond to percentiles 1 (99), 5 (95), 10 (90) and 25 (75). We offer results for the Swedish stock market and real credit in Figure 4. Since there are more than 1000 observations for the stock market, we only present a select period (1925-35). However, bear in mind that the coloring ruled is followed using the full sample, so the dark red in 1931-32 corresponds to

[8] Since the credit variables discussed in part 3 are of annual frequency we chose to disaggregate them into monthly time series following the generalized least squares approach in Stram & Wei (1986). This univariate method to disaggregate series does not require any indicators. The real credit variable is disaggregated as is, while the nominal credit to the non-financial sector and nominal GDP series that originate the credit to GDP series are disaggregated separately. They are al treated as stocks such that the value of GDP for any given month, for example October 1979, corresponds to the accumulated flow variable from November 1978 until October 1979. When we calculate the BBIs using the annual series or the disaggregated series results (available upon request) the annual series perfectly overlaps the monthly series. This has an underlying economic logic given the short-run stability of both real credit and credit to GDP. Changing the total amount of credit in an economy, or its participation with respect to GDP is a process that takes time and that is not prone to jumps.

the lowest returns in the full series. For credit we use the annual data as, by construction, monthly results would bear a similar pattern (See footnote 8).

Figure 4: Heat map for Z matrices: Sweden



It is interesting to see the clustering of both positive and negative returns Since we construct the heat map based on the empirical distribution of the whole sample, darker shades of red (green) show the worst (best) returns in the full series which allows for comparisons between different booms and busts. To highlight the idea of persistence, the heat map for the stock market contains three distinct sections for the short, medium and long-run returns; more persistent booms and busts move from left to right in the figure to indicate events that transition from explosive (short-run) to expansive (medium-run) and pervasive (long-run). A benefit of performing this experiment is that we have no need of defining what a boom or a bust is, but instead let the data speak and reveal the underlying processes.[9]

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[9] The heat map for the stock market can be read in the following historical context: During the 1920s Edvinsson (2005) evidences a depression (1920-21) and two expansions 1921-24 and 1925-30, interrupted by a short and shallow recession (1924-25, -0.6% CAGR). The first recession is a deflation crisis, while the second one recession is due to a harvest failure in the first three quarters of 1924 (Edvinsson & Hegelund, 2016). During these two recessions there is an abandonment of the gold standard (1920-24), but convertibility is restored by April. Sweden would remain in the gold standard until September 28, 1931 (Ilzetzki, Reinhart, & Rogoff, 2017). According to Bordo & Landon-Lane (2013) there was an important stock market boom that lasted from 1923-28. This boom, which started in Wall Street, was also evidenced in many other countries including Sweden and Finland. According to Waldenström, (2015a, 2015b) the 1920s were also important because they evidenced the final stages of Swedish industrialization, and with it, the change from a capital importing country (from France and Germany) to a net creditor to other countries. Edvinsson & Hegelund (2016), show that what was thought to be a recession from 1930-1932 (Edvinsson, 2005), was really a double-dip recession 1930-31 and 1931-32, with an expansion during 1931Q1-Q2. Interestingly there was an economic expansion that started in 1932 and lasted until when the Second World War was well under way in 1939. In terms of the stock market, there were two relevant busts 1928-32 and 1936-41. Importantly there was a recovery from 1932-36 in which the compounded annual growth rate (CAGR) in the stock market averaged 25% (Bordo & Landon-Lane, 2013).

We also observe that the clustering happens in a wave-like fashion in which a boom period (in green) is followed by a bust period (in red). However, the matrix consists of 20 different vectors making it a natural next step to aggregate the information available in these matrices into single indicators that can serve to analyze the boom-bust cycle for the stock market and credit aggregates. These new variables, which we will refer to as a Boom-Bust Indicators (BBIs) are obtained directly from matrices **Z**.

$$\mathrm{BBI} = \omega'\mathbf{Z} \tag{3}$$

Where ω is a vector of weights that add to 1.

Let us recall that the different vectors are expressed as z-scores, with the same unit of measurement, and thus linear combinations of them are interpretable. However, combining short-run and long-run returns may smooth-out relevant information. To avoid this issue, we construct a short-run BBI with the returns from one month up to one year, a medium-run BBI with returns from 18 months up to three years, and a long-run BBI with returns from 42 months up to five years. To do so, we need to divide **Z** into three corresponding matrices: $\mathbf{Z_{short}}$ contains vectors from $\mathbf{z_1}$ to $\mathbf{z_{12}}$, $\mathbf{Z_{medium}}$ contains vectors from $\mathbf{z_{18}}$ to $\mathbf{z_{36}}$, and $\mathbf{Z_{long}}$ contains vectors from $\mathbf{z_{42}}$ to $\mathbf{z_{60}}$

The corresponding vectors of weights ω for each **Z** are obtained through factor analysis, one of the techniques designed to reduce the dimension of a dataset which includes a large number of variables n into a smaller number m of unobserved factors. A regular factor analysis takes the following form (Tsay, 2002):

$$\mathbf{Z} - \boldsymbol{\mu} = \mathbf{F}\boldsymbol{\Lambda}' + \epsilon \tag{4}$$

Since the n vectors in **Z,** of dimensions t*x*n, are standardized, we know that $\boldsymbol{\mu}$ is a matrix of dimensions txn populated with zeros. **F** is a matrix of orthogonal unobserved factors of dimension txm and $\boldsymbol{\Lambda}$ is a matrix of factor loadings of dimensions nxm. Moreover, ϵ is a txn matrix of error terms. Since we wish to obtain a single BBI for each specification of **Z**, in this particular case m=1, $\boldsymbol{\Lambda}$ is a column vector $\boldsymbol{\lambda}$ of length n and **F** a column vector **f** of length t. We can rewrite (4) as:

$$\mathbf{Z} = \mathbf{f}\,\boldsymbol{\lambda}' + \epsilon \tag{5}$$

Each scalar λ_n is the optimal value used to multiply the factor **f** in order to obtain the corresponding vector $\mathbf{z_n}$. Written in a linear form:

$$\mathrm{z_{t,n}} = \lambda_\mathrm{n}\mathrm{f_t} + \epsilon_{t,n}; n = 1, \dots, N \tag{6}$$

Thus, to estimate the optimal weight assigned to each vector z to obtain BBIs, we can solve for f_t in (6):

$$\frac{\mathrm{z_{t,n}}}{\lambda_\mathrm{n}} - \frac{\epsilon_\mathrm{t,n}}{\lambda_\mathrm{n}} = \mathrm{f_t}; n = 1,2, \dots, N \tag{7}$$

In this formulation, the error term contains the variance in **Z** that cannot be explained by the single vector **f** and is directly related to its explanatory power. We tend to this issue in depth in other unpublished work. From here onward, we will deal with the estimators of the factor loadings ($\widehat{\lambda_\mathrm{n}}$) and of the factor ($\hat{\mathbf{f}}$) allowing us to rewrite (7) as:

$$\frac{z_{t,n}}{\widehat{\lambda_n}} = \widehat{f_t}; n = 1,2, \dots, N \tag{8}$$

The factor loadings do not need to add up to 1, so to transform them into weights we perform the following calculation:

This recovery, however, is not sufficient to affect long-run returns as evidenced in the long-run section of the heat map, where the bust that starts in 1931 lasts well into 1935.

$$\omega_n = \frac{1/\widehat{\lambda_n}}{\sum_{i=1}^{n}(1/\widehat{\lambda_n})} \tag{9}$$

The construction of ω in (8) guarantees that BBIs mimic the factor with the largest explanatory power over the original matrix **Z** while still being interpretable as standard deviations.

We can rewrite (3) using (8) and (9) as follows:

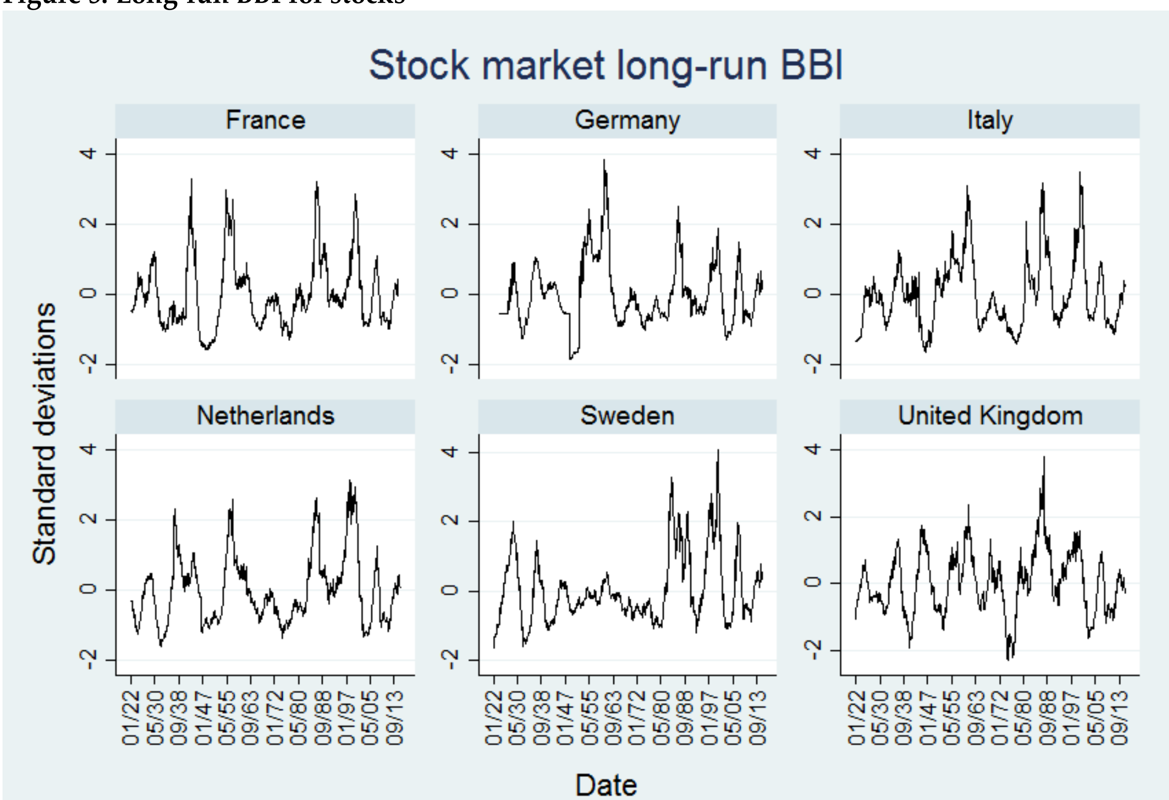
$$BBI_t = \frac{z_{t,n}/\widehat{\lambda_n}}{\sum_{i=1}^{n}(1/\widehat{\lambda_n})} = \frac{\widehat{f_t}}{\sum_{i=1}^{n}(1/\widehat{\lambda_n})}; n = \begin{Bmatrix} 1,2,\ldots,12 \text{ if BBI short} \\ 18,24,30,36 \text{ if BBI medium} \\ 42,48,54,60 \text{ if BBI long} \end{Bmatrix} \tag{10}$$

From (10) we can see that the short, medium and long-run BBIs correspond to a rescaled version of the factor that bears the highest explanatory power over matrices $\mathbf{Z}_{\mathbf{short}}$, $\mathbf{Z}_{\mathbf{medium}}$, or $\mathbf{Z}_{\mathbf{long}}$. Results are presented in the following subsections.

BBIs for the stock markets

Figure 5 presents the results for the long-run BBI for the stock market. All other specifications can be found in Annex 3.

Figure 5: Long-run BBI for stocks



A first element that is critical to interpreting these results is that they are comparable within time series allowing us to compare, for example, two booms for the same country. The long-run indicator has an important level of variability that we will exploit in the following section. This indicator measures the persistence of any given boom or bust. Intuitively, it shows whether a boom or a bust affects very long-run returns in the **Z** matrix (when *n*>30 months).

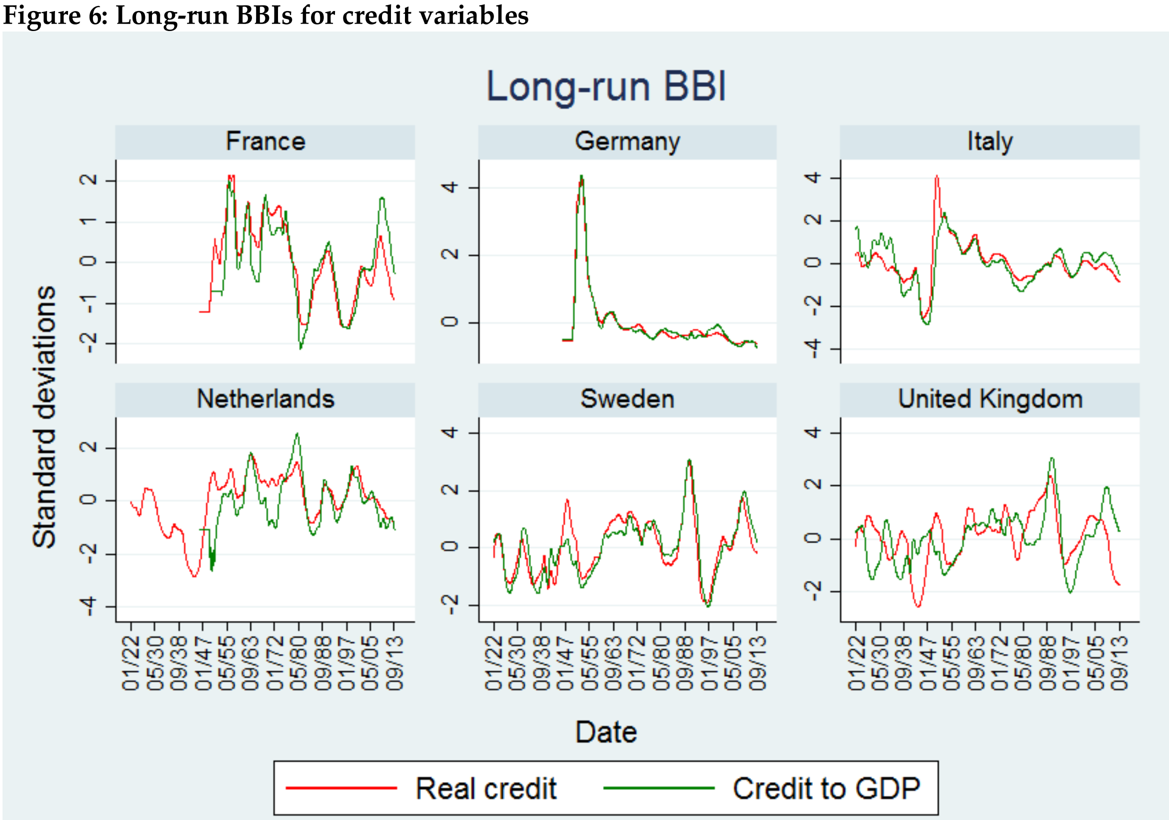
A first glance shows that booms (positive values of the indicator) are more pervasive than busts (negative values of the indicator) for all countries. This is true since booms in every country reach higher absolute values of the indicator than busts. A possible reason for the long-run pervasiveness of booms has to do with the fact that no policymaker wants to be responsible for "turning off the music while the party is going" and causing a reduction in asset prices. Since the distance between the fundamental price of an asset and its market value cannot be adequately measured, very long lasting booms can be seen as positive events and not necessarily excessive accumulation of financial imbalances thus delaying or even deterring policy action. Busts, on the other hand, are harmful events and policymakers, regulators and agents tend to act to avoid their adverse effects. Effective action should consequently reduce their pervasiveness.

We can see busts that are common to all countries, such as the 1940s, the 1970s, and the recent 2008 crisis. Shared booms can be found in the late 1950s and early 1960s (except for Sweden) and the early 2000s. This is interesting as it hints at the possibility of contagion, which we further discuss as proposed further research. Additionally, in most series, except for France and Germany, recent booms are more intense than earlier booms. Contrarily, for all series, the more extreme busts tend to maintain their level of pervasiveness. In unreported results, we find the stock market BBIs to all time horizons to be positively skewed, leptokurtic, and both time series and panel stationary.

BBIs for credit variables

We applied the BBI methodology to the monthly data for real credit and credit to GDP. Figure 6 presents the results for the long-run indicator of both series by country. All other specifications can be found in Annex 3.

Figure 6: Long-run BBIs for credit variables



A first result that is worth highlighting is the behavior of the German series. Their correlation coefficient is very close to one, and the series presents two booms during the late 1940s and early 1950s and then remains below 0 until present. This result is driven by the observations for

1948-50. Real credit growth for 1948-49 is almost 118%, while for 1949-50 it is 84%. The percentage change in Credit to GDP for the same periods is 82% and 59% respectively. These two observations increase the mean of the annual real credit growth in one half, and more than double the standard deviation in the series. In the annual change of credit to GDP a similar phenomenon occurs, where the mean almost doubles and the standard deviation almost triples because of these two observations. This highlights the sensitivity of the BBI methodology to the quality of the data and invites further research to confirm that these values are historically accurate.

In general, we find that both series are strongly correlated, except the ones for the United Kingdom where the correlation coefficient is 0.37. The deviations in these series may be due to periods of significant changes in GDP which may be relevant drivers in the credit to GDP series. In general, we see boom periods in credit after the Second World War, during the 1960s, coinciding with the deregulation process of the second half of the 1980s and during the years before the GFC. We find a coincidence in credit busts during the interwar years, the Second World War, the late 1970s, the 1990s and after the GFC. In unreported results, we find BBIs for credit variables to all time horizons to be both time series and panel stationary.

Part 5. Do exchange rate regimes matter in the evolution of the financial cycle?

In this section, we first attempt to identify a link between exchange rate regimes and stock market and credit aggregates. To do so, first, we run regressions of BBIs on exchange rate regime dummies in the presence of several controls associated with general economic conditions and the different solutions to the trilemma across time. Then we test whether BBIs behave differently in mean and variance under different exchange rate regimes as possible indications of the way in which booms and busts occur under each configuration.

Do regimes matter?

Using the variables presented in Part 3, we will run panel regressions with country fixed effects of the following form:

$$\begin{aligned}\mathrm{BBIPY}_{i,t} = \alpha_i + \tau \mathrm{Trend}_{i,t} + \boldsymbol{\beta X}_{\mathrm{macro},\, i,t} + \boldsymbol{\gamma X}_{FX,i,t} + \boldsymbol{\delta X}_{KF,i,t} + \boldsymbol{\theta X}_{MP,i,t} \\ + \boldsymbol{\varphi D}_{FX,i,t} + u_{i,t}\end{aligned} \tag{11}$$

where matrices are in bold, BBIPY_i corresponds to the boom bust indicator for time horizon P (short, medium or long-run) and underlying variable Y (stocks, real credit or credit to GDP), for country *i*. $\boldsymbol{X}_{\mathrm{macro}}$ corresponds to a matrix of macroeconomic controls, $\boldsymbol{X}_{FX}$ corresponds to some variable or variables related to the exchange rate, $\boldsymbol{X}_{KF}$correspond to some variable or variables related to capital flows, $\boldsymbol{X}_{MP}$ refers to some variable or variables related to monetary policy and, $\boldsymbol{D}_{FX,i}$ corresponds to a matrix with the different exchange rate regime dummies. The testable implication is for the joint significance of the coefficients in vector $\boldsymbol{\varphi}$.

We ran nine different specifications of the model in (11), using variables in levels (4 specifications), in changes (3 specifications) and mixed models that combined both types of variables (2 specifications). It is important to note that both dependent and independent variables are panel stationary under a battery of unreported tests. An in-depth description of the variables used in each of the specifications can be found in Annex 4. The regressions on stock market BBIs also included the annual percentage dividend yield as a control variable.

Additionally, we expect there to be collinearity between the exchange rate variables and the corresponding regime dummies as they are strongly related. To control for this we ran the same regression in (11) excluding the exchange rate variables through the following regression equation:

$$\text{BBIPY}_{i,t} = \alpha_i + \tau\text{Trend}_{i,t} + \boldsymbol{\beta X}_{\text{macro},\,i,t} + \boldsymbol{\delta X}_{KF,i,t} + \boldsymbol{\theta X}_{MP,i,t} + \boldsymbol{\varphi D}_{FX,i,t} + u_{i,t} \qquad (12)$$

And performed the same F test for the joint significance of the coefficients in vector $\boldsymbol{\varphi}$**.** Recall that we have defined two different sets of exchange regime dummies where one includes the EMU and the other does not. Table 8 presents the percentage of models where we cannot accept the null hypothesis that the coefficients associated with the different sets of exchange rate regime dummies are equal to zero with 90% confidence.

Table 8: Percentage of models where exchange regime dummies are jointly significant with 90% confidence

Percentage of specifications where dummies are jointly significant with 90% confidence							
Including independent variables associated to exchange rate (Equation 11)				*Excluding independent variables associated to exchange rate (Equation 12)*			
		Panel Fixed Effects				Panel Fixed Effects	
Dependent variable		Dummies excluding EMU	Dummies including EMU	Dependent variable		Dummies excluding EMU	Dummies including EMU
Real Credit BBI	Short run	11.1%	11.1%	Real Credit BBI	Short run	22.2%	11.1%
	Medium run	11.1%	22.2%		Medium run	22.2%	0.0%
	Long run	33.3%	44.4%		Long run	33.3%	33.3%
Credit to GDP BBI	Short run	0.0%	0.0%	Credit to GDP BBI	Short run	0.0%	0.0%
	Medium run	0.0%	0.0%		Medium run	0.0%	0.0%
	Long run	0.0%	0.0%		Long run	0.0%	0.0%
Stocks BBI	Short run	0.0%	0.0%	Stocks BBI	Short run	0.0%	0.0%
	Medium run	0.0%	33.3%		Medium run	0.0%	11.1%
	Long run	0.0%	11.1%		Long run	0.0%	0.0%

Indicates the percentage of the nine specifications presented in Annex 4 where the test for joint significance of the dummies cannot accept the null that the dummies are jointly equal to 0 with 90% confidence

The panel related to equation 11, which includes correlates for the exchange rates, shows that once we control for variables associated with the trilemma and other controls associated with general economic conditions, the different exchange rate regime dummies bear no explanatory power on the evolution on credit to GDP. This result is consistent with the findings by Baxter & Stockman (1989), who indicate that the exchange rate regime does not affect the evolution of macroeconomic aggregates. Additionally, this result is robust to whether we include the European Monetary Union in the exchange rate regimes or not.

The case for real credit is somewhat different in that the exchange rate regime dummies bear significance in at least some of the nine models. This significance is increasing in the horizon, meaning that the effect becomes more evident as we shift the horizon from the short-run (up to one year) to the medium-run (up to three years) and the long-run (up to five years). This effect becomes stronger for the medium and long-run indicators if we include a dummy variable for the EMU. For the stock market, we find no significance of the exchange rate regime to any time horizon when excluding the EMU. An effect does show up when we include the EMU dummy and is more clearly identifiable in the medium-run than in the long-run or short-run indicators.

Results presented in the right panel associated with (12) are similar to those in the left panel when we exclude the EMU from the set of dummies. However, when we include the EMU dummy under this new specification, statistical significance is lower than in the case associated to (11).

As a robustness check, we shifted from panel regressions with fixed effects to pooled OLS regressions to test whether the country fixed effects were capturing part of the explanatory power of the exchange rate regime dummies. Results for this new test are presented in Annex 5 and do not change significantly with respect the results presented above.

As we will argue in the section on further research, we believe that the lack of significance of the dummies is associated with the fact that we are only testing for one-third of the decisions related to the trilemma. As we broaden this study to include capital controls and monetary policy regimes and include the interactions between the three components of the trilemma, we expect to be able to identify stronger relationships between these correlates and the variables that compose the financial cycle.

Do stock markets and credit behave differently under different exchange rate regimes?

To determine whether BBIs for stocks, real credit or credit to GDP behave differently under each exchange rate regime, we will perform tests on their two first statistical moments. Verifying if they behave differently in mean will indicate whether there is a more significant presence of booms under a given regime. Testing for differences in the second moment, through variance ratio tests, will help us indicate whether a given regime coincides with more volatile indicators, namely whether any of the variables present more booms and busts under a given exchange rate regime. Regimes which coincide with more presence of booms and with higher volatility in the different BBIs may be characterized as more elastic in the sense that they coincide with both the accumulation of above-mean growth periods and with deeper troughs once these imbalances unwind. However, the results of the panel regressions presented above prevent us from establishing any credible causal implications. We expect to tend to this issue in future versions of this paper.

Booming regimes: Differences in the BBIs' mean across exchange rate regimes

To identify whether, in mean, the Boom Bust Indicator for stocks, real credit or credit to GDP behave differently contingent in a regime we have the following identification strategy:

$$\text{BBIPY}_{,i,t} = f\left(DGES_{i,t}, DHPEG_{i,t}, DSPEG_{i,t}, DFLOAT_{i,t}, DEMU_{i,t}\right) \qquad (13)$$

where BBIPY_i corresponds to the boom bust indicator for time horizon P (short, medium or long-run) and underlying variable Y (stocks, real credit or credit to GDP), for country i. The dummy variables at the right side of the equation are the ones defined in Part 3. Since we are not using any other control variables of annual frequency we can use monthly date for both BBIs and the exchange rate regime dummies.

To avoid the dummy variable trap, and since the constant in this regression cannot be interpreted[10], we will build a regime switching matrix with the results of running different

[10] In a traditional dummy regression, for example when the dummy represents gender (male=1 and female=0) the effect of being female is captured by the intercept in the regression and the effect of being male is the sum of the intercept and the coefficient for the dummy variable. However, when using more than one dummy

regressions. We present the equations for the case in which we include the EMU, while the alternative case is defined similarly:

$$\text{BBIPY}_{,i,t} = \beta_0 + \beta_1\text{DHPEG}_{i,t} + \beta_2\text{DSPEG}_{i,t} + \beta_3\text{DFLOAT}_{i,t} + \beta_4\text{DEMU}_{i,t} + \alpha_i + u_{i,t} \quad (14)$$

$$\text{BBIPY}_{,i,t} = \beta_0 + \beta_1\text{DGES}_{i,t} + \beta_2\text{DSPEG}_{i,t} + \beta_3\text{DFLOAT}_{i,t} + \beta_4\text{DEMU}_{i,t} + \alpha_i + u_{i,t} \quad (15)$$

$$\text{BBIPY}_{,i,t} = \beta_0 + \beta_1\text{DGES}_{i,t} + \beta_2\text{DHPEG}_{i,t} + \beta_3\text{DFLOAT}_{i,t} + \beta_4\text{DEMU}_{i,t} + \alpha_i + u_{i,t} \quad (16)$$

$$\text{BBIPY}_{,i,t} = \beta_0 + \beta_1\text{DGES}_{i,t} + \beta_2\text{DHPEG}_{i,t} + \beta_3\text{DSPEG}_{i,t} + \beta_4\text{DEMU}_{i,t} + \alpha_i + u_{i,t} \quad (17)$$

$$\text{BBIPY}_{,i,t} = \beta_0 + \beta_1\text{DGES}_{i,t} + \beta_2\text{DHPEG}_{i,t} + \beta_3\text{DSPEG}_{i,t} + \beta_4\text{DFLOAT}_{i,t} + \alpha_i + u_{i,t} \quad (18)$$

where α_i refers to the country fixed effects. Note that the omitted dummy in each of the regression establishes the base case and the coefficients can be interpreted as the change in the dependent variable given a change from the base case regime to the regime represented by the dummy of interest[11].

For the sake of brevity, we present the different regime switching matrices in Annex 6. After running the panel regressions, we estimated Green's (2000) modified Wald test for groupwise heteroscedasticity in the residuals and found that in most cases we cannot reject the null hypothesis of homoscedasticity. The only cases where we cannot accept the hypothesis occur when we regress the real credit short-run BBI on either set of dummies. When we run those regressions with robust standard errors, the joint significance of the dummies disappears. In all other cases, the exchange rate regime dummies are jointly significant with a 99.9% confidence. This confirms that in mean, the Boom Bust Indicators do behave differently depending on the regime in place. We only take into account results where means are different across different regimes with a 95% confidence. The rest of the results will be presented jointly with those for the variance ratio tests at the end of this section.

Risky regimes: Differences in the BBIs' variance across monetary arrangements

In standard financial analysis the dispersion of a series, its variance or standard deviation, is understood as a measure of risk. As we can see from the different figures depicting the time series evolution of BBIs, variability is not constant across time. There is volatility clustering where periods of high variability in the indicator are followed by periods of low dispersion. Thus a next step is to confirm whether these changes in volatility are contingent on the monetary regime in place. To do so, we perform a standard variance ratio test where the null hypothesis is that the variances of two variables are the same and the alternative is that they are not. We interact each BBI with the different exchange rate regime dummies and contrast the pairwise variances for the same BBI across regimes. We use the results to establish rankings between the different the regimes regarding the volatility of the BBIs. We only take into account results where volatility is different across regimes with a 95% confidence.

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variable for the same phenomenon, the exchange rate regime, the value of the intercept cannot be interpreted as the coefficient for the base case (the omitted dummy) (Wooldridge, 2002).

[11] A clarification on interpretation is useful. In equation 15, for example, β_2 can be interpreted as the change in the BBI when there is a regime switch form the hard peg regime to the soft peg regime. In equation 14, β_4 can be interpreted as the change in the BBI when there is a regime switch form the gold exchange standard to the European Monetary Union. Even if this case does not make historical sense, the coefficient identifies whether the means for the BBIs are statistically different under both regimes. It is in this sense that we provide the interpretation of results.

How does it all come together? Mean-variance analysis of exchange rate regimes

We will draw from the usual mean-variance analysis in finance (Markowitz, 1952, 1959) to derive stylized facts about the behavior of BBIs under different exchange rate regimes. To do so, we build ordered pairs (x,y) for stocks and credit under each regime and BBI. The x coordinate corresponds to the ranking in volatility while the y coordinate corresponds to the ranking in the mean. The regimes with the lowest mean or variance will be given a ranking of 1 and the ones with the most significant mean, or variance will be given a ranking of 5.[12] If there is no possible distinction between two regimes either in terms of mean or variance they will share the same value. We present the results in scatter plots, where the X-axis represents the variance, and the Y-axis represents the mean. Regimes to the right of the graph are riskier than regimes to the left. Regimes on the upper part of the graph are more prone to booms, while regimes at the bottom are prone to lower growth rates.

During what is left of this analysis it is important to highlight that our qualifications of regimes as riskier or safer is only done about financial stability as reflected by the behavior of stock market prices and credit growth. This qualification of regimes is restricted to this arena and, as it was indicated earlier, does not contemplate the positive or negative effects that exchange rate regimes, as broad institutional arrangements, may have on the overall economy, on the evolution of the business cycle or social welfare conditions.

If we try to determine whether a regime is "better" than others we need to determine the criteria under which this qualification can be done. From the definition of BBIs and the characterization of regimes according to their propensity to booms and volatility, it is to expect that more stable (less volatile regimes) are preferable. Also, regimes that do not allow the accumulation of financial imbalances (booms) [13] are preferable to those that allow prices grow explosively. In that sense, in the definition provided earlier in this paper, the less elastic regimes would be concentrated closer to the origin, and the more elastic regimes would appear in the north-east corner of the graphs. The idea that the joint appearance of high volatility and unchecked booms in asset prices and credit aggregates are counter to financial stability arises from the works of Borio (2006, 2014), Borio & Lowe (2002, 2004), Borio & White (2004) and Drehmann *et.al.*, (2012) among others.

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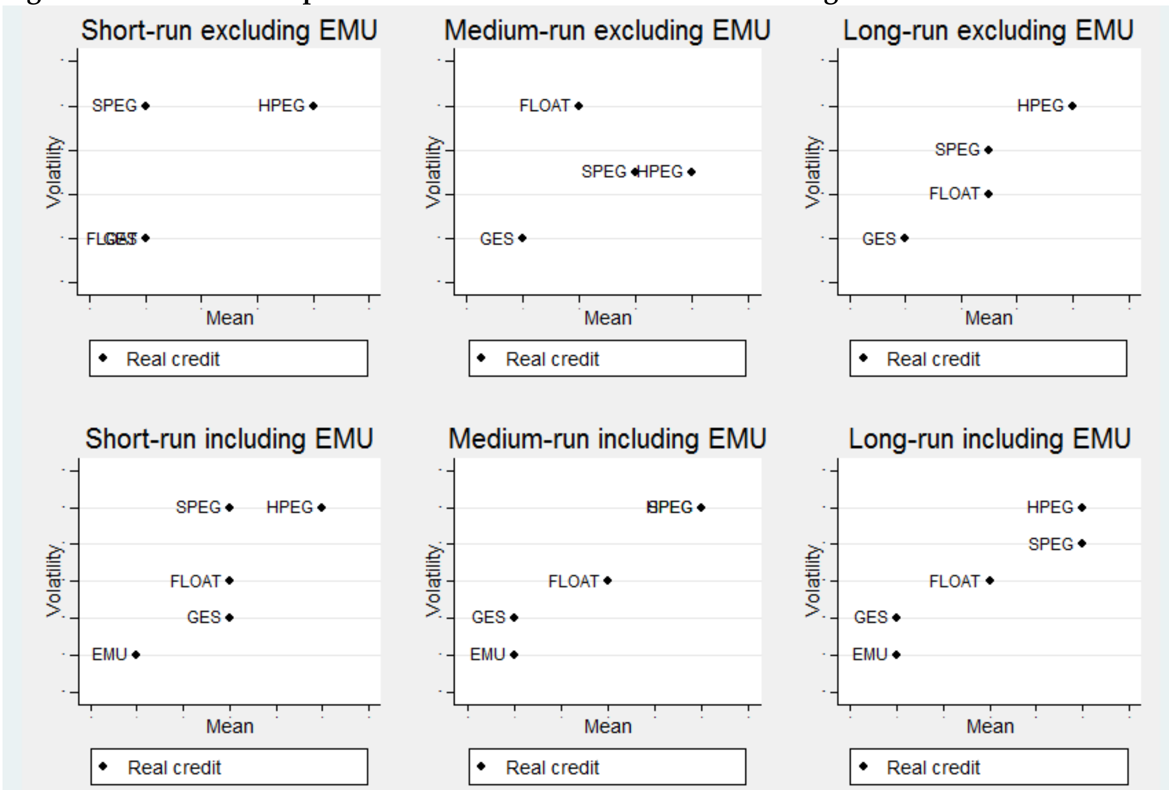
[12] This in the case we are distinguishing between five regimes. For the set of dummies that excludes the EMU these variables will take integer values between 1 and 4.

[13] We refrain from using the term bubble throughout this whole document as it presumes that there is a fundamental (fair) value which is known to at least a subset of investors and that, anyways, they allow market prices to increase beyond it. On the other hand, booms are readily observable contemporaneously to all investors. The term "bubble" only indicates that the boom is theoretically unjustified and has more of a political/philosophical tinge to it.

Real credit

Figure 7: Mean-variance plots for real credit BBIs under different regimes



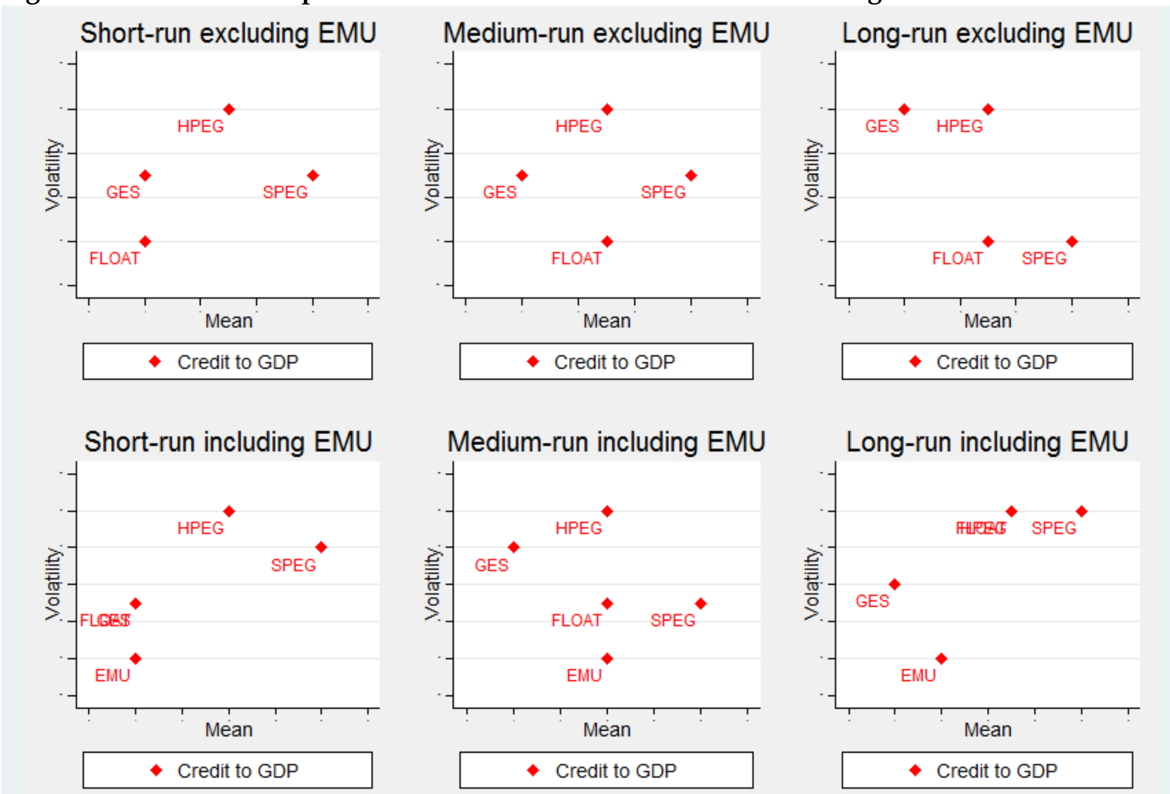
The top three graphs in Figure 7 correspond to the mean-variance ranking of the exchange rate regimes excluding the EMU. The three graphs at the bottom include the EMU regime. The left-most column includes graphs for the ranking of regimes according to changes in mean and volatility in the short-run BBI, the two graphs in the center correspond to the medium-run BBI, and the right-most graphs correspond to the long-run BBI.

A first observation is that in the six graphs the hard peg and the soft peg are farther away from the origin than any other regime. This indicates that the BBIs for real credit appears to have both a higher mean and volatility during these two regimes. At this point, it serves to recall that the hard peg has a strong correspondence with the Bretton Woods agreement while the soft peg, although occurring throughout the whole sample, concentrates most observations after 1999 (See Annex 1, Table 9).

Contrarily, in the top row, the gold exchange standard is closest to the origin as coinciding with both lower volatility and a lower average value of the indicator. This changes with the inclusion of the EMU dummy, which replaces the GES as the regime under which the indicator presents the most stability. The top left graph is the least illuminating of all, showing that in the short-run there is no statistical difference either in mean or volatility between the floating regime and the gold exchange standard. They both have lower mean and volatility than the pegged regimes. In general, when we include the EMU, the floating regime appears between the peg regimes and the nominal anchor regimes (gold exchange standard and EMU).

Credit to GDP

Figure 8: Mean-variance plots for credit to GDP BBIs under different regimes

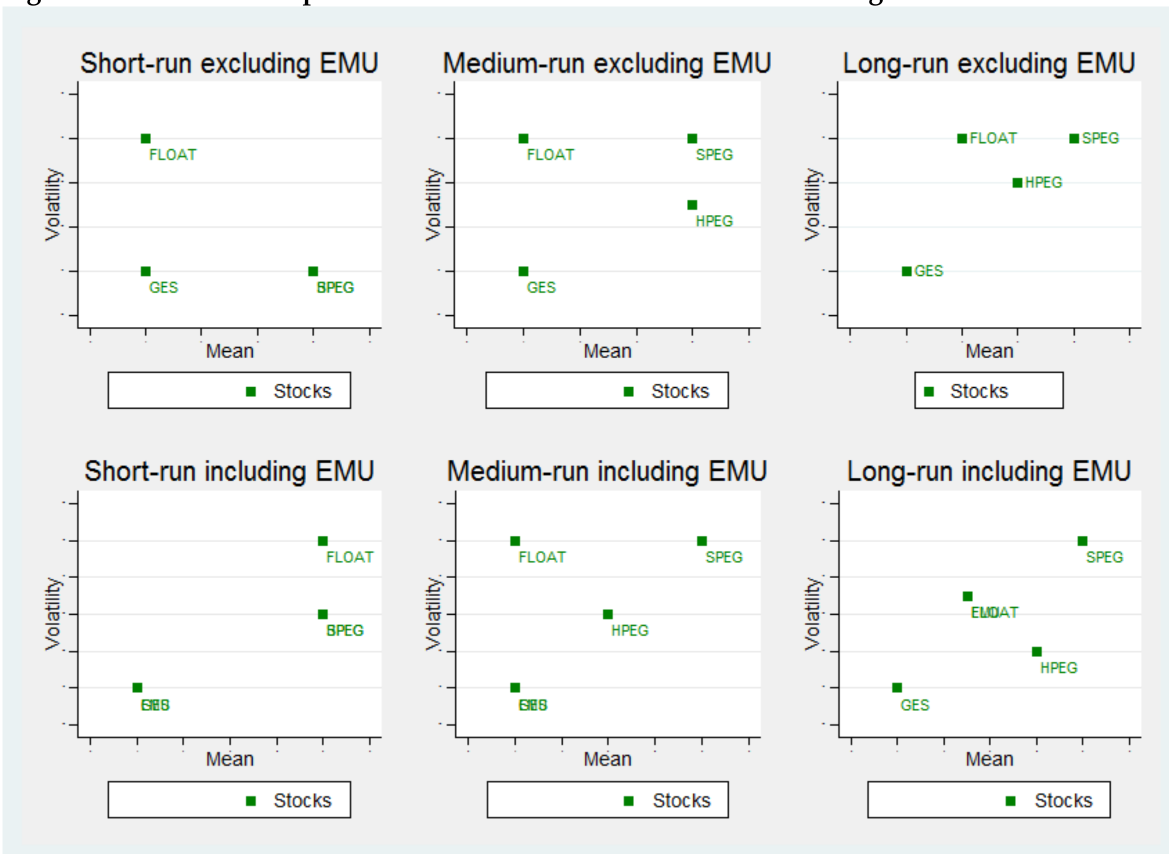


As with real credit BBIs, in all six panels, the pegged regimes are farthest from the origin than any of the other regimes. It is interesting that under the soft peg credit to GDP presents the highest mean (more presence of booms on average) than any other regime, while its volatility decreases as the time horizon increases. Note that the soft peg regime usually coincides with inflation targeting regimes and no capital controls.

Opposite to what happens with real credit, when using the credit to GDP BBI we find that the gold exchange standard is consistently more volatile than the floating regime (when excluding the EMU) and more volatile than the EMU in all cases. However, this volatility is not accompanied by high means, as the regime usually appears next to the Y axis and is usually one of the left-most regimes in these diagrams. Additionally, the volatility ranking of the gold standard regime is increasing in the time horizon, so this regime coincides with long-run volatility in the credit to GDP variable.

Stocks

Figure 9: Mean-variance plots for credit to GDP BBIs under different regimes



The case for stocks coincides with the previous two in that gold exchange standard is mapped close to the origin while the pegged regimes are farthest. However, volatility of the BBI for stocks under the pegged regime increases with the time horizon while they consistently rank high in the mean behavior of the indicator. This may indicate the presence of more pervasive stock market busts, particularly under the soft peg. A similar phenomenon occurs with the EMU regime, that is indistinguishable from the gold standard in mean and volatility both for the short and medium-run, but that shows significantly higher mean and volatility for the long run indicator. This is consistent with the recent long-run booms and busts in the stock market. The float regime behaves in the opposite direction, with high mean and volatility in the short-run, only high volatility in the medium run and appears in the center of the graph in the long-run.

Part 6. Discussion: Contributions and caveats

The contributions of this paper can be analyzed from two different perspectives: on the one hand, the addition of new time series to the literature and, on the other hand, the mean-variance analysis of BBIs contingent in the exchange rate regimes.

Contributions: A new time series and an elasticity-based ranking for regimes

The literature on financial crises has broadened our understanding of these phenomena for over thirty years, and it has done so using mostly dummy sequences as dependent variables. These series are not free from criticism, as they reflect rather poorly on the statistical characteristics of underlying data, depend strongly on choices performed by the researcher, and contain minimal variability thus affecting the interpretability of results, increasing regression standard errors and thus affecting statistical significance of coefficients.

These criticisms, which we have made relevant in part 4, are partially resolved by the use of the Boom-Bust Indicator which has more desirable characteristics than binary sequences. First, it provides not only a measure of direction but also of the intensity of the asset price and credit cycles. Secondly, it reflects on different time horizons thus allowing for analysis of booms and busts as persistent processes that may be explosive, expansive and pervasive and it allows differencing these three characteristics. This goes in sharp contrast with time series decomposition techniques such as filtering or spectral analysis in the frequency domain, where different signals are extracted from the data implying that what is contained in one of the extracted signals may not be contained in any other, thus making it impossible to characterize a same event (boom or bust) as both explosive and pervasive (which may happen in reality). Third, by construction BBIs contain more variability and thus will allow for the testing of new hypothesis. As an example, the tests ran in this paper would have been impossible using a *probit* model since it would be a dummy on dummy regression. Finally, these time series resolve the identification problem that many researchers face when defining what a boom or a bust is. Instead, the researcher can observe both booms and busts arise in the time series.

This is a pioneer study in presenting a ranking of regimes by their underlying elasticity to the accumulation of financial imbalances. The most relevant result coincides with Baxter & Stockman (1989) in that the regime seems to have no bearing on economic aggregates once we control for a series of variables. Even if this is true for the series of credit to GDP, under some specifications, regimes do seem to matter for other measures such as real credit to the non-financial sector and stock markets.

A second finding is that the boom and bust cycle of stocks and credit do behave differently by regime and even if the regime is not the proximate cause this poses an interesting research avenue to follow. Surprisingly, the hard peg regime, which usually coincides with a period of capital controls and financial repression, ranks highest among all other regimes for the presence of booms and the volatility of the indicator. The behavior of the indicators associated with credit is more volatile for the hard peg than for the soft peg, but the opposite occurs, consistently, for the stock market indicator. This probably has to do with the natural relaxation of capital controls that occurs when shifting from a more restrictive peg and that may foster investment from abroad in national assets.

A third contribution has to do with the EMU as an exchange rate regime. The EMU dummy proxies for the commitment to stable exchange rate and free capital flows that euro countries undertook since 1999, sacrificing their monetary policies. Results show that the behavior of the different BBIs under this regime is less volatile and less prone to booms than the interwar gold standard with which it shares several characteristics. This may be a result of institutional characteristics and learning or the heightened role given to macroprudential policy since the GFC.

A final contribution has to do with the behavior of the indicators under the floating regime. Credit to GDP appears to have low volatility under the floating regime, although it increases in the long-run when including the EMU. Conversely, stocks under the floating regime are characterized by being at least as volatile, or more so, than under any other regime. This may be related to the fact that while the floating regime allows for a free monetary policy and free capital flows it also coincide with inflation targeting regimes which do not include stock market prices into their policy optimizing function. In that sense, the authorities seem to be turning a blind eye towards the stock market which may foster larger swings.

Caveats to this analysis

Of course, this analysis is not exempt from criticisms and issues to be resolved in the future. A first element to take into account is that issues can arise from the use of stock market variables rather than series for some other asset class. Even though stock market wealth is very important today, both as a percentage of GDP and as a percentage of wealth for agents in the economy, [14] this might not be true for the first half of the twentieth century. In that sense, a robustness check for these results begs for the use of housing prices or some other variables. The tradeoff, of course, is the loss of observations due to a lower frequency in the data and the increased measurement error in new asset price series.

A second issue has to do with the use of a restrictive definition of credit such as the one in this paper. Domestic credit to the non-financial sector is only a part of the full story. Future research can be aimed at identifying the cycle in credit when private debt to foreign creditors is included; this will require a change in the database towards a more comprehensive definition of credit. The inclusion of this variable may serve to nuance the results presented in this paper regarding the benefits of EMU and the gold exchange standard as free capital flows not only take the form of foreign direct investment or portfolio investment but also of credit from abroad.

A third issue relates to omitted variables. Since the introduction, we stated that this paper is the first step in a broader research endeavor aimed at linking the different solutions policymakers implement to the macroeconomic trilemma and financial stability during the twentieth century. In that sense, this paper has only started to tackle the issue by studying exchange rate regimes. However, we have omitted the study of capital controls and monetary policy regimes and the interactions of the three. We understand that we have left out an essential part of the story and that is the direction of the next section, in future research.

A final, closely related issue has to do with causality. Even though we found that there is a relation between changes in the exchange rate regimes and differences in the behavior of the credit aggregates and the stock market, this relationship need not be causal. Even after including the other corners of the trilemma into the analysis, the different regimes continue to be endogenous. In that sense a whole different paper will be devoted to placing our findings in a historical context and,

[14] Recall that every employee who has a pension plan, state managed or privately held, is, at least in some portion, invested in the stock market. A stock market crash, causing a loss in aggregate wealth will necessarily affect investment-consumption decisions for the future, altering both aggregate demand and economic growth.

through a compelling narrative, provide indications as to the causal mechanisms that drive this interesting, albeit sometimes obscure, relationships.

Part 7. Future research: Advancing propositions

The first avenue for future extensions to this paper has to do with the synchronization of booms and busts across countries and the active participation of the different countries in a global financial market that ebbs and wanes during the twentieth century. It is possible that the changing decisions on capital controls as well as the stability or instability of the exchange rate play a role in the cross-border alignment of stock markets and credit aggregates. Analyzing this phenomenon will inscribe this research in the broader literature about contagion and may reveal new possible mechanisms through which the trilemma decisions affect financial stability.

However, the most relevant future research, aimed at answering the central larger question, has to do with including the remaining components of the trilemma and testing their significance jointly. To do so, currently, we are building series for capital controls and monetary policy regimes. Once they are available we believe the optimal testing strategy to be the following:

$$\begin{aligned}\text{BBIPY}_i = \alpha_i + \beta X_{\text{macro}} + \gamma(D_{FX}X_{FX}) + \delta(D_{KF}X_{KF}) + \theta(D_{MP}X_{MP}) + \varphi(D_{FX}D_{KF}X_{FX}X_{KF}) \\ + \omega(D_{FX}D_{MP}X_{FX}X_{MP}) + \vartheta(D_{MP}D_{KF}X_{MP}X_{KF}) + \tau(D_{FX}D_{MP}D_{KF}X_{FX}X_{MP}X_{KF}) \\ + u_{i,t}\end{aligned}$$

Where D refers to a dummy variable and X to a covariate. FX refers to exchange rate regimes and covariates, KF refers to capital flows, and MP refers to monetary policy regimes and variables. The idea is to test the statistical significance of the coefficients of interest in the following way:

1. Test individually γ, δ, θ.
2. Test γ, δ, θ jointly to get a first insight on the different components of the trilemma.
3. Test γ, δ, and φ, to see the role that exchange rates, capital controls and their interactions play.
4. Test γ, θ, and ω, to see the role that exchange rates, monetary policy and their interactions play.
5. Test δ, θ, and ϑ, to see the role that monetary policy, capital controls and their interactions play.

The last term, the triple interaction highlighted in yellow, may be complicated as having so many dummies may lead to too few observations per coefficient of interest, causing this test to consistently fail the significance test. After performing these tests, the sign of the coefficients of the capital flow, foreign exchange and monetary policy, as well as of their interactions, will give us clues as to the mechanisms to investigate through the narrative approach.

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This research has also benefited from comments received at several venues such as the "*Seminario Semanal de Economía del Banco de la República*" (Bogotá, Colombia, May 18, 2016), the session on "The interaction of State and Finance in History" at the *Congreso Latinoamericano de Historia Económica* – CLADHE V (Sao Paulo, Brazil, July 19-21, 2016), the session on "Institutions: Booms and Busts" at the Third Conference of the World Interdisciplinary Network for Institutional Research – WINIR III (Boston, United States, September 2-5, 2016), the 11th Sound Economic History Workshop (Helsinki, Finland, November 3-4, 2016), the XREPP Doctoral Day (Barcelona, Spain, November 23, 2016), the *Seminario de la Facultad de Economía de la Universidad de Valencia* (Valencia, Spain, December 21, 2016), the fourth version of the workshop "New Economic Historians of Latin America" (Madrid, Spain, January 20, 2017), the poster session at the Economic History Association Annual Conference (San Jose, California, September 15-17, 2017) and the Macroeconomics Seminar at UC Davis (Davis, California, October 16, 2017).

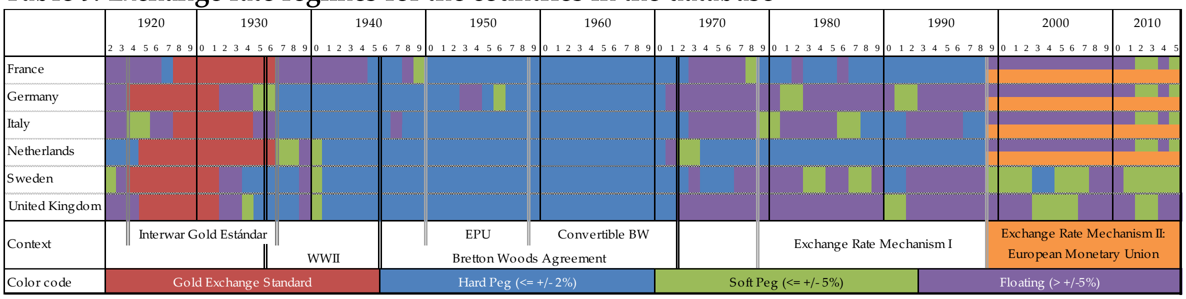
Annex 1. Choice of countries

This study will be limited to Western European countries —France, Germany, Italy, the Netherlands, Sweden and the United Kingdom— instead of continuing the tradition of long-run panel data with all available countries as in the works of Jordà, *et.al.*, (2010, 2011, 2013, 2014), Schularick & Taylor (2012), or Reinhart & Rogoff (2009a, 2009b, 2010, 2013). The main reason to avoid a large set of countries is that it complicates disentangling specific events in each of them, and it increases the margin of error in complicated issues such as arriving at policy recommendations. Large panels of data presume comparability between countries, assuming that whatever country-specific characteristics remain within the estimators for country fixed effects. A usual caveat to reducing the width of the panel has to do with the fact that since booms and busts are rare events, the variability of the independent variables may be nuanced (Jordà, *et al.*, 2013). We aim at resolving this issue by substituting the traditional dummy sequence for booms and busts with a more sophisticated the Boom Bust indicator presented in Part 4.

The choice of countries is related to the fact that they all participated in the exchange rate regimes discussed. First, they actively partook in the interwar gold exchange standard. Second, following Eichengreen (2008) we know that all six countries in the database were founding members of the European Payments Union (1950), and the European Monetary Agreement which came into force in 1958. These institutions were all aimed at attaining currency convertibility for Europe at fixed rates of exchange complying with the Bretton Woods agreement signed in 1944. By

1973 all countries except Sweden were members of the European Economic Community, and all participated in the "snake" (1972), an agreement where signatories would not let their pairwise currencies fluctuate more than 4.5%. In 1979 the European Monetary System and the Exchange Rate Mechanism were put in place, and all countries in the database except the United Kingdom participated either explicitly or *de facto*. After 1999 all countries in the database except for Sweden and the United Kingdom adopted the Euro and lost control of their independent monetary policies. This brief recount of the exchange rate history, summarized in the following Table, serves to prove that the choice of countries will allow us to have representatives of all monetary regimes.

Table 9: Exchange rate regimes for the countries in the database



Annex 2. Details on the database

In this statistical annex, we present additional information about the time series used for stocks and credit as well as a more granular statistical analysis of each. We also present different definitions of the dummy sequences employed for the different monetary regimes. This additional definition of the dummy sequences will be used for the robustness checks presented in Annex 4

Stocks

The different time series used for the stock market were obtained from the Global Financial Database. Specifics about each are the following:

- *France*: The leading time series is *France CAC All-Tradable Total Return Index* which has a monthly frequency from January 1885 until January 1991 and daily frequency from January 1991 until March 2015. The data was obtained in real terms with CPI index = 100 for December 1998. There was no missing data, but this series ends six months before all others.
- *Germany*: The leading time series is the *CDAX Total Return Index* which has a monthly frequency from December 1869 until December 1969 and daily frequency from January 1970 until September 2015. There is an issue with hyperinflation (1922-1923) which makes including stock prices prior to 1924 for Germany nonsensical due to an increase in measurement error. Thus we decide to cut the series and only use values starting in November 1923, the month in which Germany returned to the Gold Exchange Standard and where it remained until 1931. The data was obtained in real terms with CPI index = 100 for April 2010. There were 66 missing observations.
- *Italy*: The leading time series is the *Banca Commerciale Italiana (BCI) Index* which has a monthly frequency from September 1905 until December 1956 and daily frequency from

December 1956 until September 2015. The data was obtained in real terms with CPI index = 100 for the year 2010. There were 29 missing observations.

- *Netherlands*: The leading time series is the *All-Share Price Index* which has a monthly frequency from January 1919 until December 1979 and daily frequency from January 1980 until September 2015. The data was obtained in real terms with CPI index = 100 for the year 2010. There were 31 missing observations.
- *Sweden*: The leading time series for Sweden is the *OMX Affärsvärldens General Index* which has a monthly frequency from January 1906 until December 1979 and daily frequency from January 1980 until September 2015. The data was obtained in real terms with CPI index = 100 for the year 1980. There was no missing data.
- *United Kingdom*: The leading time series is the *UK FTSE All-Share Return Index* which has a monthly frequency from August 1694 until December 1964 and daily frequency from December 1964 until September 2015. The data was obtained in real terms with CPI index = 100 for January 1987. There was no missing data.

Annex 3. The Boom Bust Indicator

In the following figures we present the short-run and medium-run specification of the Boom Bust Indicators for stock markets and credit variables presented in Part 4.

Figure 10: Short-run BBI for stocks

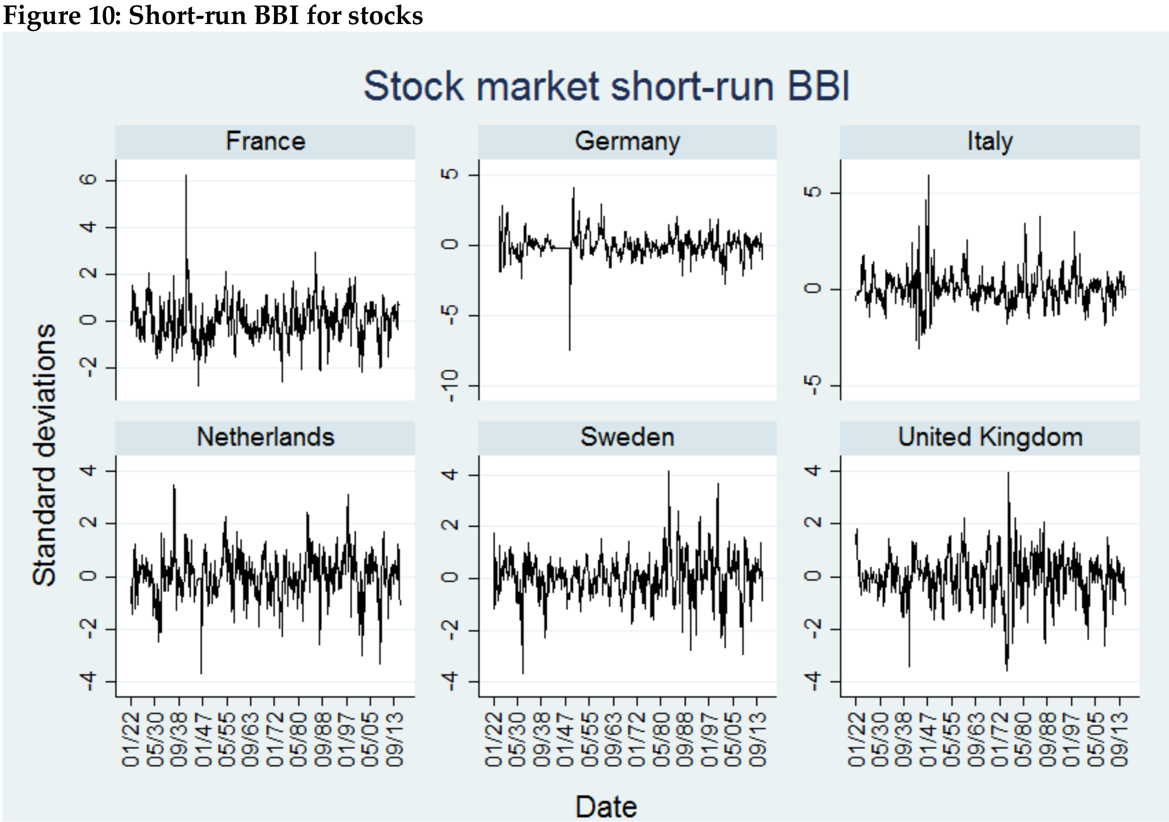


Figure 11: Short-run BBIs for credit

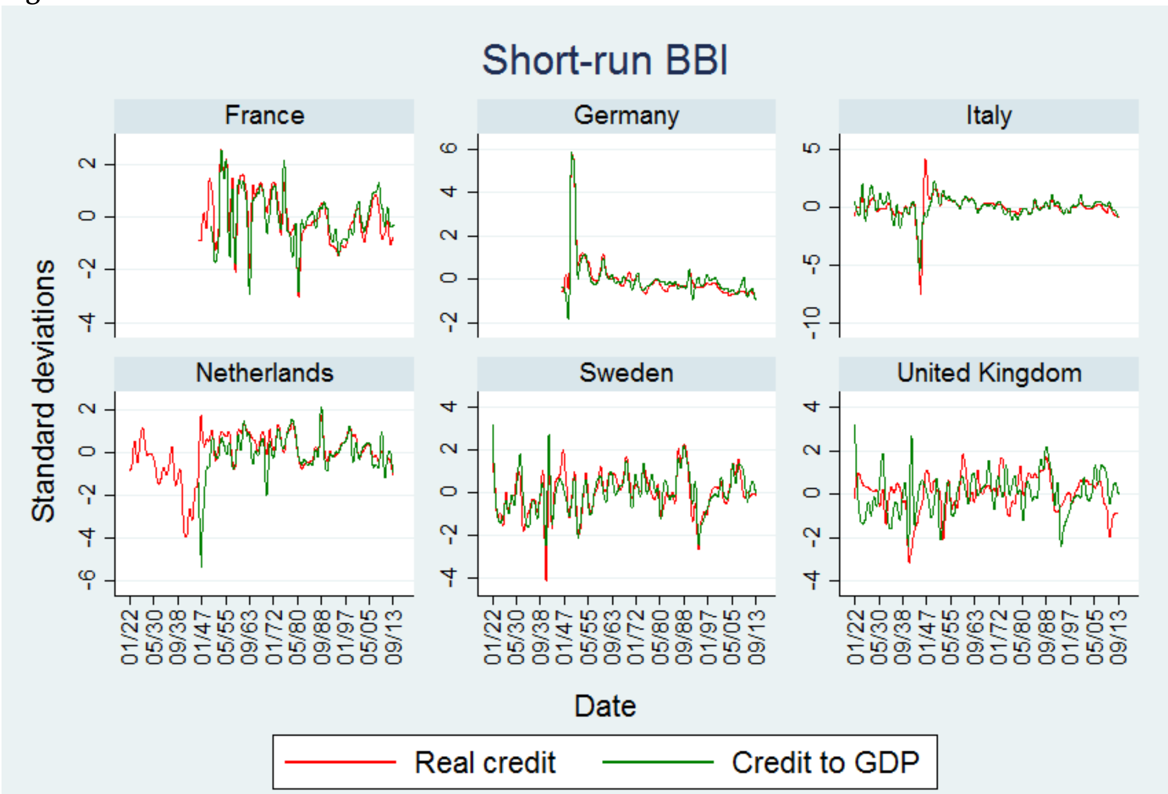


Figure 12: Medium-run BBI for stocks

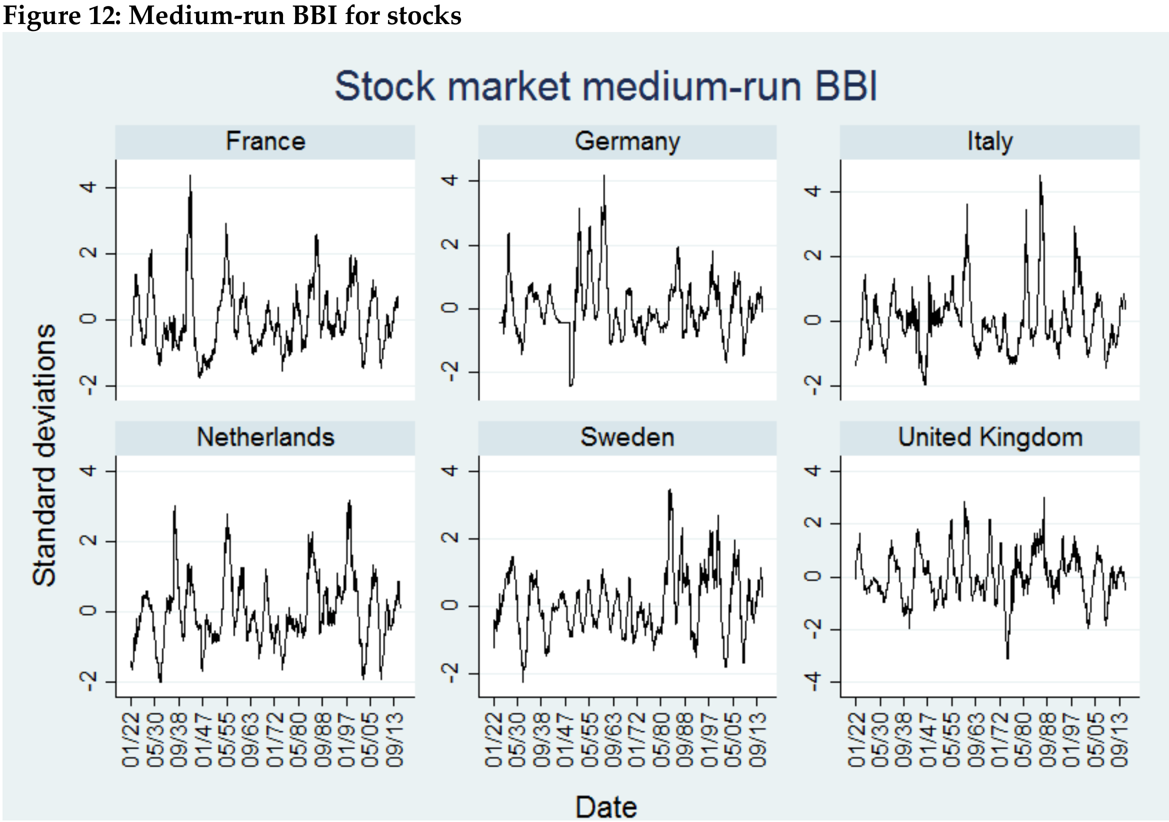
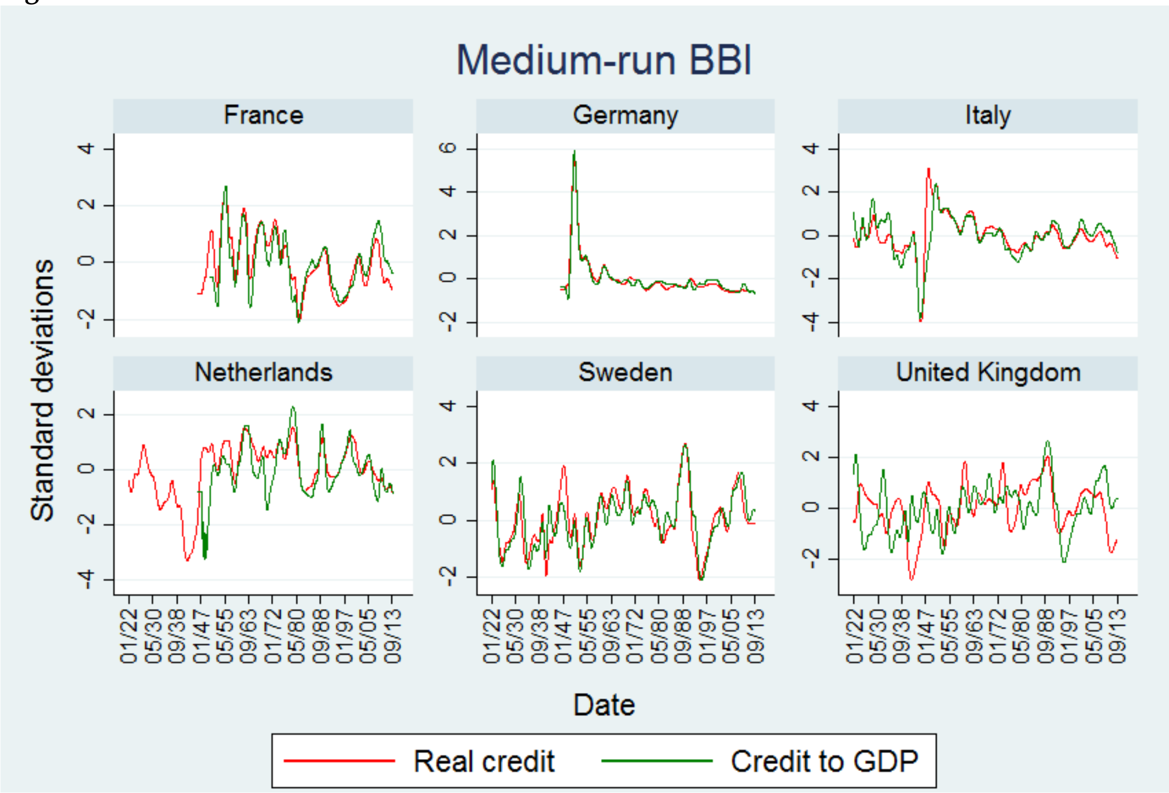


Figure 13: Medium-run BBI for credit



Annex 4. Panel regression with country fixed effects: different specifications

Table 10 presents the different independent variables employed in the panel regression of credit BBIs as presented in equation 11 of part 5. All dependent and independent variables are panel stationary. A linear time trend was included for each country in every model. Additionally, when the dependent variable was any of the BBIs for the stock market, we included the annual percentage dividend yield as a macro control variable.

Table 10: Different specifications for the panel regressions

Models in Levels

Model 1		Model 2		Model 3		Model 4	
Group	*Variable*	*Group*	*Variable*	*Group*	*Variable*	*Group*	*Variable*
Macro	Real consumption p.c.	Macro	Real GDP p.c.	Macro	Real consumption p.c.	Macro	Real GDP p.c.
Macro	Government Revenue to GDP	Macro	Government Revenue to GDP	FX	FX against USD	FX	Terms of Trade
FX	FX against USD	FX	Terms of Trade	KF	Capital flows to GDP	KF	Capital flows to GDP
KF	Capital flows to GDP	KF	Capital flows to GDP	KF	Overall current balance to GDP	KF	Overall current balance to GDP
KF	Overall current balance to GDP	KF	Overall current balance to GDP	MP	Slope of the term structure	MP	Slope of the term structure
MP	Slope of the term structure	MP	Slope of the term structure				

Models in Changes

Model 5		Model 6		Model 7	
Group	*Variable*	*Group*	*Variable*	*Group*	*Variable*
Macro	Change in population (%)	Macro	Change in population (%)	Macro	Change in population (%)
Macro	Change in Real GDP p.c. (%)	Macro	Change in real GDP (%)	Macro	Change in real consumption p.c. (%)
FX	Change in FX to base currency (%)	FX	Change in FX to base currency (%)	FX	Change in FX to base currency (%)
KF	Change in exports (%)	KF	Change in exports (%)	KF	Change in exports (%)
MP	Change narrow money (%)	MP	Change in long term interest rate (%)	MP	Change in the slope of the term structure
MP	Change short term interest rate (%)	MP	Change in broad money (%)		

Mixed Models

Model 8		Model 9	
Group	*Variable*	*Group*	*Variable*
Macro	Change in real GDP p.c. (%)	Macro	Change in real consumption p.c. (%)
Macro	Real consumption p.c.	Macro	Real GDP p.c.
FX	Change in FX to base currency (%)	FX	Change in FX to base currency (%)
FX	FX against USD	FX	Terms of Trade
KF	Change in exports (%)	KF	Capital flows to GDP
KF	Capital flows to GDP	KF	Overall current balance to GDP
KF	Overall current balance to GDP	MP	Change in long term interest rate (%)
MP	Change narrow money (%)	MP	Change in broad money (%)
MP	Change short term interest rate (%)	MP	Slope of the term structure
MP	Slope of the term structure		

Annex 5. Pooled OLS regression

Table presents the percentage of specifications, run as pooled OLS regressions, where the exchange rate regime dummies are jointly significant with 90% confidence.

Percentage of specifications where dummies are jointly significant with 90% confidence

Including independent variables associated to exchange rate (Equation 11)

Dependent variable		Pooled OLS: Dummies excluding EMU	Pooled OLS: Dummies including EMU
Real Credit	Short run	22.2%	22.2%
	Medium run	44.4%	44.4%
	Long run	33.3%	44.4%
Credit to GDP	Short run	11.1%	0.0%
	Medium run	0.0%	0.0%
	Long run	0.0%	0.0%
Stocks	Short run	0.0%	11.1%
	Medium run	11.1%	33.3%
	Long run	11.1%	33.3%

Excluding independent variables associated to exchange rate (Equation 12)

Dependent variable		Pooled OLS: Dummies excluding EMU	Pooled OLS: Dummies including EMU
Real Credit	Short run	22.2%	22.2%
	Medium run	33.3%	22.2%
	Long run	33.3%	33.3%
Credit to GDP	Short run	22.2%	0.0%
	Medium run	0.0%	0.0%
	Long run	0.0%	0.0%
Stocks	Short run	0.0%	11.1%
	Medium run	11.1%	55.6%
	Long run	11.1%	33.3%

Indicates the percentage of the nine specifications presented in Annex 4 where the test for joint significance of the dummies cannot accept the null that the dummies are jointly equal to 0 with 90% confidence

We find results to be consistent with those presented in Table 8.

Annex 6. Regime switching matrices for real credit, credit to GDP, and stocks

The following tables present the regime switching matrices described in part 5. They are the outcome of running regressions of the different BBIs on the exchange rate regime dummies. The first set of tables presents the results for the set of dummies excluding the EMU, while the second set of tables includes the EMU dummy. Highlighted in yellow are the results that loose significance when using robust standard errors. The results in bold are those that ar statistically significant with a 95% confidence. The coefficients are to be interpreted as the change in mean in the corresponding BBI in a shift from the regime in the columns to the regime in the rows or vice versa.

Table 11: Regime switching matrix for real credit excluding EMU

From \ To		Real credit								
		Short-run BBI			Medium-run BBI			Long-run BBI		
		GES	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*
HPEG	Coefficient	**0.300**			**0.380**			**0.374**		
	S.E.	**0.052**			**0.052**			**0.053**		
	P value	**0.000**			**0.000**			**0.000**		
SPEG	Coefficient	0.007	**-0.293**		**0.228**	**-0.151**		**0.206**	**-0.169**	
	S.E.	0.064	**0.045**		**0.064**	**0.045**		**0.066**	**0.046**	
	P value	0.907	**0.000**		**0.000**	**0.001**		**0.002**	**0.000**	
FLOAT	Coefficient	0.017	**-0.283**	0.010	**0.110**	**-0.270**	**-0.119**	**0.126**	**-0.249**	-0.080
	S.E.	0.054	**0.028**	0.046	**0.054**	**0.028**	**0.047**	**0.055**	**0.029**	0.048
	P value	0.752	**0.000**	0.837	**0.043**	**0.000**	**0.011**	**0.023**	**0.000**	0.094
Intercept	Coefficient	**-0.141**	**0.159**	**-0.133**	**-0.225**	**0.155**	0.004	**-0.211**	**0.163**	-0.005
	S.E.	**0.049**	**0.018**	**0.041**	**0.049**	**0.018**	0.041	**0.050**	**0.018**	0.042
	P value	**0.004**	**0.000**	**0.001**	**0.000**	**0.000**	0.932	**0.000**	**0.000**	0.901
Observations			6046			6046			6046	
F-test	Statistic		**44.45**			**41.30**			**35.35**	
	P value		**0.000**			**0.000**			**0.000**	

Table 12: Regime switching matrix for credit to GDP excluding EMU

From \ To		Credit to GDP								
		Short-run BBI			Medium-run BBI			Long-run BBI		
		GES	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*
HPEG	Coefficient	0.055			**0.274**			**0.312**		
	S.E.	0.062			**0.064**			**0.067**		
	P value	0.376			**0.000**			**0.000**		
SPEG	Coefficient	**0.179**	**0.124**		**0.461**	**0.187**		**0.446**	**0.134**	
	S.E.	**0.072**	**0.045**		**0.074**	**0.046**		**0.077**	**0.048**	
	P value	**0.012**	**0.006**		**0.000**	**0.000**		**0.000**	**0.005**	
FLOAT	Coefficient	-0.032	**-0.087**	**-0.212**	**0.253**	-0.022	**-0.208**	**0.319**	0.007	**-0.127**
	S.E.	0.063	**0.027**	**0.046**	**0.065**	0.028	**0.047**	**0.068**	0.029	**0.049**
	P value	0.609	**0.001**	**0.000**	**0.000**	0.438	**0.000**	**0.000**	0.807	**0.010**
Intercept	Coefficient	-0.016	**0.039**	**0.164**	**-0.255**	0.019	**0.206**	**-0.295**	0.017	**0.151**
	S.E.	0.059	**0.018**	**0.041**	**0.061**	0.018	**0.042**	**0.064**	0.019	**0.044**
	P value	0.789	**0.025**	**0.000**	**0.000**	0.294	**0.000**	**0.000**	0.375	**0.001**
Observations			5710			5710			5710	
F-test	Statistic		**8.20**			**13.79**			**11.24**	
	P value		**0.000**			**0.000**			**0.000**	

Table 13: Regime switching matrix for stocks excluding EMU

From \ To		Stock market								
		Short-run BBI			**Medium-run BBI**			**Long-run BBI**		
		GES	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*	*GES*	*HPEG*	*SPEG*
HPEG	Coefficient	**0.122**			**0.167**			**0.245**		
	S.E.	**0.037**			**0.042**			**0.044**		
	P value	**0.001**			**0.000**			**0.000**		
SPEG	Coefficient	**0.144**	0.022		**0.321**	**0.154**		**0.338**	**0.093**	
	S.E.	**0.048**	0.037		**0.054**	**0.041**		**0.056**	**0.043**	
	P value	**0.003**	0.542		**0.000**	**0.000**		**0.000**	**0.030**	
FLOAT	Coefficient	0.062	**-0.060**	**-0.082**	0.055	**-0.112**	**-0.266**	**0.135**	**-0.111**	**-0.203**
	S.E.	0.039	**0.023**	**0.038**	0.043	**0.026**	**0.042**	**0.045**	**0.027**	**0.044**
	P value	0.108	**0.008**	**0.029**	0.203	**0.000**	**0.000**	**0.003**	**0.000**	**0.000**
Intercept	Coefficient	**-0.072**	**0.051**	**0.073**	**-0.099**	**0.068**	**0.222**	**-0.174**	**0.071**	**0.164**
	S.E.	**0.034**	**0.015**	**0.034**	**0.039**	**0.017**	**0.038**	**0.040**	**0.017**	**0.039**
	P value	**0.038**	**0.001**	**0.030**	**0.011**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Observations		6721			6721			6721		
F-test	Statistic	**5.59**			**18.93**			**18.21**		
	P value	**0.001**			**0.000**			**0.000**		

Table 14: Regime switching matrix for real credit including EMU

From \ To		Real credit											
		Short-run BBI				**Medium-run BBI**				**Long-run BBI**			
		GES	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*
HPEG	Coefficient	**0.295**				**0.375**				**0.369**			
	S.E.	**0.052**				**0.052**				**0.053**			
	P value	**0.000**				**0.000**				**0.000**			
SPEG	Coefficient	0.098	**-0.198**			**0.329**	-0.045			**0.304**	-0.064		
	S.E.	0.065	**0.047**			**0.066**	0.048			**0.067**	0.049		
	P value	0.135	**0.000**			**0.000**	0.345			**0.000**	0.188		
FLOAT	Coefficient	0.037	**-0.259**	-0.061		**0.129**	**-0.246**	**-0.201**		**0.157**	**-0.212**	**-0.148**	
	S.E.	0.056	**0.032**	0.050		**0.056**	**0.032**	**0.051**		**0.057**	**0.033**	**0.052**	
	P value	0.511	**0.000**	0.226		**0.022**	**0.000**	**0.000**		**0.006**	**0.000**	**0.004**	
EMU	Coefficient	-0.090	**-0.386**	**-0.188**	**-0.127**	0.006	**-0.369**	**-0.323**	**-0.123**	-0.003	**-0.371**	**-0.307**	**-0.159**
	S.E.	0.062	**0.040**	**0.058**	**0.045**	0.062	**0.041**	**0.059**	**0.046**	0.064	**0.042**	**0.060**	**0.047**
	P value	0.143	**0.000**	**0.001**	**0.005**	0.923	**0.000**	**0.000**	**0.007**	0.964	**0.000**	**0.000**	**0.001**
Intercept	Coefficient	**-0.138**	**0.158**	-0.040	**-0.101**	**-0.221**	**0.153**	**0.108**	**-0.093**	**-0.207**	**0.161**	**0.097**	-0.051
	S.E.	**0.049**	**0.018**	0.044	**0.026**	**0.049**	**0.018**	**0.044**	**0.026**	**0.050**	**0.018**	**0.045**	0.026
	P value	**0.005**	**0.000**	0.360	**0.000**	**0.000**	**0.000**	**0.014**	**0.000**	**0.000**	**0.000**	**0.032**	0.053
Observations		6046				6046				6046			
F-test	Statistic	**36.35**				**37.11**				**32.56**			
	P value	**0.000**				**0.000**				**0.000**			

Table 15: Regime switching matrix for credit to GDP including EMU

From \ To		Credit to GDP											
		Short-run BBI				**Medium-run BBI**				**Long-run BBI**			
		GES	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*
HPEG	Coefficient	0.051				**0.264**				**0.299**			
	S.E.	0.062				**0.064**				**0.067**			
	P value	0.416				**0.000**				**0.000**			
SPEG	Coefficient	**0.280**	**0.229**			**0.556**	**0.292**			**0.528**	**0.229**		
	S.E.	**0.073**	**0.048**			**0.075**	**0.049**			**0.078**	**0.051**		
	P value	**0.000**	**0.000**			**0.000**	**0.000**			**0.000**	**0.000**		
FLOAT	Coefficient	-0.056	**-0.107**	**-0.336**		**0.247**	-0.017	**-0.309**		**0.326**	0.027	**-0.202**	
	S.E.	0.064	**0.031**	**0.050**		**0.066**	0.032	**0.052**		**0.069**	0.034	**0.054**	
	P value	0.378	**0.001**	**0.000**		**0.000**	0.596	**0.000**		**0.000**	0.424	**0.000**	
EMU	Coefficient	-0.045	**-0.096**	**-0.325**	0.011	**0.193**	-0.071	**-0.363**	-0.054	**0.230**	-0.068	**-0.298**	**-0.095**
	S.E.	0.071	**0.039**	**0.058**	0.045	**0.073**	0.040	**0.060**	0.046	**0.076**	0.042	**0.062**	**0.048**
	P value	0.522	**0.015**	**0.000**	0.807	**0.008**	0.080	**0.000**	0.245	**0.003**	0.106	**0.000**	**0.048**
Intercept	Coefficient	-0.012	**0.039**	**0.268**	**-0.068**	**-0.247**	0.017	**0.309**	0.000	**-0.284**	0.014	**0.244**	0.041
	S.E.	0.059	**0.017**	**0.044**	**0.025**	**0.061**	0.018	**0.045**	0.026	**0.064**	0.019	**0.047**	0.027
	P value	0.846	**0.026**	**0.000**	**0.007**	**0.000**	0.334	**0.000**	0.994	**0.000**	0.444	**0.000**	0.125
Observations		5710				5710				5710			
F-test	Statistic	**12.69**				**16.45**				**12.64**			
	P value	**0.000**				**0.000**				**0.000**			

Table 16: Regime switching matrix for stocks including EMU

From \ To		Stock market											
		Short-run BBI				**Medium-run BBI**				**Long-run BBI**			
		GES	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*	*GES*	*HPEG*	*SPEG*	*FLOAT*
HPEG	Coefficient	**0.122**				**0.167**				**0.245**			
	S.E.	**0.037**				**0.042**				**0.044**			
	P value	**0.001**				**0.000**				**0.000**			
SPEG	Coefficient	**0.107**	-0.016			**0.347**	**0.180**			**0.376**	**0.130**		
	S.E.	**0.050**	0.040			**0.057**	**0.044**			**0.059**	**0.046**		
	P value	**0.035**	0.689			**0.000**	**0.000**			**0.000**	**0.005**		
FLOAT	Coefficient	**0.101**	-0.021	-0.005		0.070	**-0.097**	**-0.276**		**0.111**	**-0.134**	**-0.264**	
	S.E.	**0.041**	0.026	0.042		0.045	**0.029**	**0.047**		**0.047**	**0.030**	**0.049**	
	P value	**0.012**	0.417	0.903		0.122	**0.001**	**0.000**		**0.018**	**0.000**	**0.000**	
EMU	Coefficient	0.023	**-0.099**	-0.083	**-0.078**	0.043	**-0.124**	**-0.304**	-0.027	**0.178**	-0.067	**-0.197**	0.067
	S.E.	0.046	**0.033**	0.048	**0.037**	0.051	**0.037**	**0.054**	0.042	**0.053**	0.039	**0.056**	0.043
	P value	0.609	**0.003**	0.086	**0.036**	0.400	**0.001**	**0.000**	0.511	**0.001**	0.083	**0.000**	0.122
Intercept	Coefficient	**-0.073**	**0.050**	0.034	0.029	**-0.100**	**0.068**	**0.247**	-0.029	**-0.173**	**0.072**	**0.202**	**-0.062**
	S.E.	**0.035**	**0.015**	0.037	0.021	**0.039**	**0.017**	**0.041**	0.023	**0.040**	**0.017**	**0.043**	**0.024**
	P value	**0.035**	**0.001**	0.358	0.167	**0.010**	**0.000**	**0.000**	0.210	**0.000**	**0.000**	**0.000**	**0.010**
Observations		6721				6721				6721			
F-test	Statistic	**4.23**				**14.24**				**15.70**			
	P value	**0.002**				**0.000**				**0.000**			

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