FINANCIAL STABILITY AND THE DESIGN OF MONETARY POLICY[1]

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Abstract

This paper builds upon the existing empirical literature on the factors behind financial stability, focusing on the role of monetary policy design. In particular, it analyzes a sample of 79 countries in the period 1970 to 1999 to evaluate the effect of the choice of the central bank objectives and the monetary policy strategy on financial stability. We find that focusing the central bank objectives on price stability reduces the likelihood of a banking crisis. This result is robust, in general, to several model specifications and groups of countries. The results are less clear-cut for the monetary policy strategy although for some model specifications, in particular for the group of countries in transition, the choice of an exchange rate-based strategy appears to reduce the likelihood of a banking crisis. Finally, locating regulatory and supervisory responsibilities at the central bank seems to reduce the likelihood of a banking crisis when controlling for this variable.

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1 INTRODUCCION

The relation between monetary policy and financial stability has been long debated but there is still no clear consensus on how one affects the other and, in particular, whether there are trade-offs or synergies between them. This issue clearly deserves further attention, since it could help devise arrangements and policy responses to promote both monetary and financial stability.

We look into the role of the monetary policy design, in particular the choice of the central bank objectives and the monetary policy strategy, in fostering financial stability. More specifically, we assess empirically whether countries whose central banks focus narrowly on price stability are less prone to financial instability. In the same vein, we test which monetary policy strategy (exchange rate based, money or inflation targeting), if any, best contributes to financial stability.

The motivation for focusing on the monetary policy design as a potential factor contributing to financial stability stems from the encouragingly growing literature on the role of institutions and policy design. In the case of financial stability, the rationale behind is that an appropriate policy design should foster a better credit culture and an effective market functioning. The design of monetary policy should be particularly important since the central bank has a natural role in ensuring financial stability, as argued by Padoa-Schioppa (2002)[3] or Schinasi (2003), and has virtually always been involved in financial stability, directly or indirectly.[4]

2 EXISTING LITERATURE

What do we mean by financial stability?

Financial stability is an elusive concept to define, as proven by the fact that practically no explicit definition exists and most often the opposite concept, financial instability, is generally used.[5] The

3 In his words, "the issue of financial stability was part of the central banks' genetic code".

4 At the beginning, the stability issue arose because the issuers of banknotes were profit-maximizing commercial banks, who had incentives to print more notes than they could back with holdings of gold and silver, or with deposits of government bonds. This led to "wildcat banks that heavily engaged in over-issuance (Gorton, 1999). For a description of the role of central banks in financial stability across regimes see Borio and Lowe (2002).

5 Recently, Padoa-Schioppa (2002) has offered a working definition of financial stability, namely "a condition where the financial system is able to withstand shocks without giving way to cumulative processes which impairs the allocation of

main reason for this difficulty is that "stability" could, at first sight, be associated with lack of volatility while volatility is not necessarily bad for financial markets.[6]

The literature has mainly focused on the extreme realization of financial instability, the occurrence of a financial crisis, in particular a banking crisis. According to Mishkin (1996) a financial crisis is a disruption to financial markets in which adverse selection and moral hazard become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities. A very different definition of a financial crisis is given by Bordo et al. (1995) where a real ─ as opposed to pseudo ─ financial crisis is a flight to cash because of the perception that no institution will supply the necessary liquidity. These different definitions reflect the opposing theories concerning the causes of financial crises: asymmetric information in the former and monetary developments in the latter. In any case, both definitions include the danger of a failure of financial and/or non-financial firms.

Apart from the realization of banking crises, there are a number of broader ─ but also less precise ─ definitions of financial instability. Bernanke and Gertler (1990) concentrate on financial fragility, as a situation in which potential borrowers have low wealth relative to the size of their projects. Such a low insider's stake increases the agency problems and exacerbates frictions in the credit market (balance sheet channel). Finally, financial instability is sometimes used synonymously to asset price volatility, which takes prices far away from their fundamental level, finally reversing suddenly and producing a "crash" (Bernanke and Gertler (2000), Crockett (2000)). The difficulty with these broader definitions is how to determine when financial fragility or asset price volatility is so large that it creates system-wide instability.

In this work, we are interested in the more specific definition of financial instability (banking crisis) since the role of central banks is more widely accepted than for asset price volatility or financial

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savings to investment opportunities and the processing of payments in the economy". However, as in the other cases, financial stability is defined in terms of financial instability rather than explicitly.

6 As Schinasi (2003) explains, even stable markets can have high volatility in asset prices. Issing (2003) goes even further arguing that large swings in asset prices leading to some failures of financial institutions could even be a sign of stability or of self-purifying powers of the system. The question is, thus, when is volatility so large that it creates systemic damage to the system and the real economy.

fragility in general.[7] The IMF (1998) has coined a definition that focuses on this: namely, banking crises are situations in which actual or potential bank runs or failures induce banks to suspend the internal convertibility of their liabilities or which compel the government to extend assistance to banks on a large scale. Another more general definition of banking crisis, by Gupta (1996), is a situation in which a significant group of financial institutions have liabilities exceeding the market value of their assets, leading to portfolio shifts or to deposit runs and/or the collapse of financial institutions and/or government intervention. Under such circumstances, an increase in the share of non-performing loans, an increase in financial losses, and a decrease in the value of the bank's investments cause solvency problems and may lead to liquidations, mergers and restructuring of the banking system. Both definitions, and others which focus on the banking system, boil down to the description of a banking crisis. However, the complexity of these definitions indicates that no single quantitative indicator can proxy a banking crisis accurately enough. An additional problem is the lack of comparable cross-country data to construct such indicator (i.e., the share of non-performing loans or risk-weighted capital to asset ratios). This is why the empirical literature has opted for identifying banking crises as events, expressed through a binary variable, constructed with the help of cross-country surveys (Lindgreen et al. (1996), Caprio and Klingebiel (2003)). This will be our approach as well.

Determinants of financial stability

The economic literature has mostly concentrated on the macroeconomic determinants of financial stability and, to a lesser extent, on the financial sector determinants. Among the former, the main ones are: low growth or recessions (Frankel and Rose (1998)); too high real interest rates (Demirgüç-Kunt and Detragiache (1998)), large capital inflows or outflows in the case of emerging countries (Calvo (1997)), and shocks to inflation or to the price level (Bordo and Murshid (2000), English (1996), Hardy and Pazarbasioglu (1999)). The last one is in part related to the way monetary policy is conducted, in so far as monetary policy aims at price stability, and thus it is related to our research objective. Among the latter, excessive credit growth[8] (Gavin and Hausmann (1996), Sachs

7 See Borio and Lowe (2002) for a review of the trade-offs of monetary authorities reacting to asset price movements and, more generally, to financial imbalances.

8 Lending booms are often seen as the domestic image of large capital inflows (Gourinchas et al. (2001)).

et al. (1996)), low levels of liquidity in the banking system (Calvo (1997)), and currency mismatches in emerging countries' banking systems (Chang *et al.* (2000)).

Less attention has been paid to the impact of institutional and policy design, with some exceptions; in particular the relevance of a well-functioning legal system (La Porta *et al*. (1998)), an explicit and limited deposit insurance scheme (Demirgüç-Kunt and Detragiache (2000)), and the risks of financial liberalisation if good quality regulation and supervision are not in place (Demirgüç-Kunt and Detragiache (1998)).

In this paper, we focus on the design of monetary policy and in particular, the central bank objectives and strategy. The existing literature on monetary policy design has concentrated on issues different than financial stability (mainly price stability but also output stabilization) There is some empirical analysis, albeit still scarce, on the reverse issue, namely the impact of financial instability, and in particular of banking crises, on a country's monetary policy. In particular, García Herrero (1997) and Martinez Peria (2000) find empirical evidence that money demand is stable in the long run in countries having experienced systemic banking crises. García Herrero (1997) also reviews seven case studies of the impact of banking crises on monetary policy, including the strategy and instruments. To the best of our knowledge, no study is available on the reserve causality.

The impact of the monetary policy design on financial stability is related to the very much debated question of the relation between price stability and financial stability. The economic literature is divided as to whether there are synergies or a trade-off between them. Among the arguments for a trade-off, Mishkin (1996) argues that high level of interest rates, necessary to control inflation, negatively affect banks' balance sheets and firms' net financial worth, especially if they attract capital inflows, contributing to over-borrowing and increasing credit risk, as well as to currency mismatches if foreign capital flows are converted into domestic-currency denominated loans. Cukierman (1992) states that inflation control may require fast and substantial increases in interest rates, which banks cannot pass as quickly to their assets as to their liabilities, increasing the interest rate mismatch and, thus, market risk. Among the arguments for synergies between price and financial stability, Schwartz (1995), states that credibly maintained prices provide the economy with an environment of predictable interest rates, contributing to a lower risk of interest rate mismatches, minimizing the inflation risk premium in long-term interest rates and, thus, contributing to financial soundness. From this view of price stability almost being a sufficient condition for financial

stability, some more cautious supporters of the "synergies" view argue that price stability is a necessary condition for price stability but not a sufficient one (Padoa-Schioppa (2002) and Issing (2003)).

It is important to note that the focus of this paper is not so much the relation between the inflation outcome and the occurrence of banking crises but, rather the importance that the central bank gives to price stability in its objectives and strategy and banking crises. This will obviously depend on how central banks understand the relation between financial and price stability.

3 PURPOSE OF THE STUDY

This paper builds upon the existing literature on how to foster financial stability, focusing on the role of monetary policy design. In particular, it assesses empirically whether the choice of the central bank objectives and the monetary policy strategy affects financial stability.

Monetary policy design can have important implications for financial stability. Central banks are providers of immediate liquidity and responsible for the smooth functioning of the payment system and that of the transmission mechanism. The central bank is also in charge of price stability and, sometimes, output stabilization, both relevant for financial stability, as we shall see later. The monetary policy objectives and strategies are the main tools the central bank has to perform its functions, so they will necessarily influence financial stability, directly or indirectly.[9] In fact, if they lead to a too lax monetary policy, inflation will tend to be more volatile. Positive inflation surprises redistribute real wealth from lenders to borrowers and negative inflation surprises have the opposite effect. Redistribution in either direction – although even more so in the latter case – may provoke bankruptcy, with serious implications for the quality of banks' loans. In addition, a very tight monetary policy leading to very low inflation levels and, thereby, very low interest rates, makes cash holdings more attractive than interest-bearing bank deposits. This may induce disintermediation and, thereby, financial instability. On the other hand, if tight monetary policy does not manage to bring down inflation and real interest rates remain high, financial stability might be at risk. Sharp increases in real interest rates may also have adverse effects on the balance sheets of banks and even bring about a credit crunch. While the potential implications of monetary policy

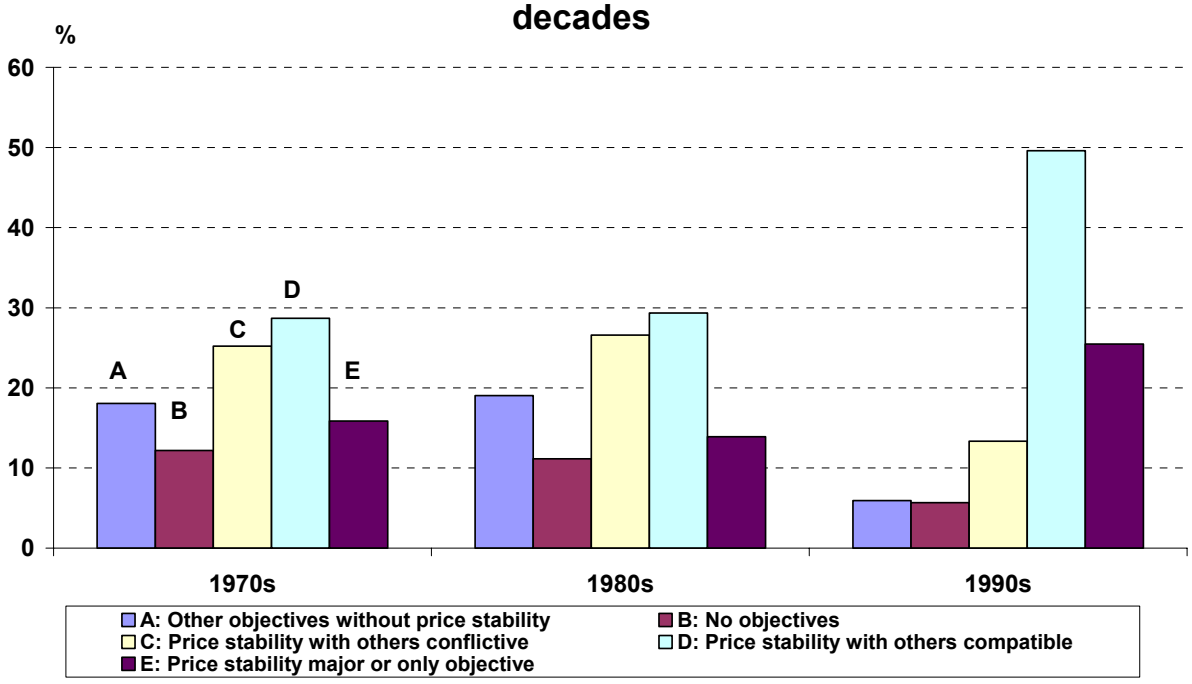
9 Padoa-Schioppa (2002) argues that financial stability considerations are taken into account when designing the central bank objectives and strategy.

design on financial stability are clear from these arguments, the above arguments offer no *a priori* on which monetary policy design is best.

The central bank objectives and the way to achieve them – the monetary policy strategy – are crucial elements of the monetary policy design, determining the focus of the central bank and the stance of its monetary policy. We shall, thus, concentrate on these two aspects in our empirical study.

Since their creation, central banks have moved back and forth in the objectives they have targeted. In the last decade, the trend has been towards narrowing down the central bank objectives to a single one, price stability, or at least to a set of objectives considered to be compatible with price stability (see Figure 1). However, many other situations still exist: some central banks aim at price stability together with other – in principle non-compatible – objectives; others do not include price stability in their list of objectives or do not have such thing as declared objectives.

Figure 1: Distribution of central bank objectives by decades



The trend towards objectives with a greater focus on price stability is explained by the conviction – based on theoretical and empirical literature – that it contributes to price stability while not much is known about its effect on financial stability. This is partly due to the lack of consensus whether synergies – or a trade-off – exist between price and financial stability. If synergies exist, a central bank focusing on price stability should be able to promote financial stability as well as price

stability. However, if there is a trade-off, a central bank with multiple objectives should be able to take this trade-off better into account.

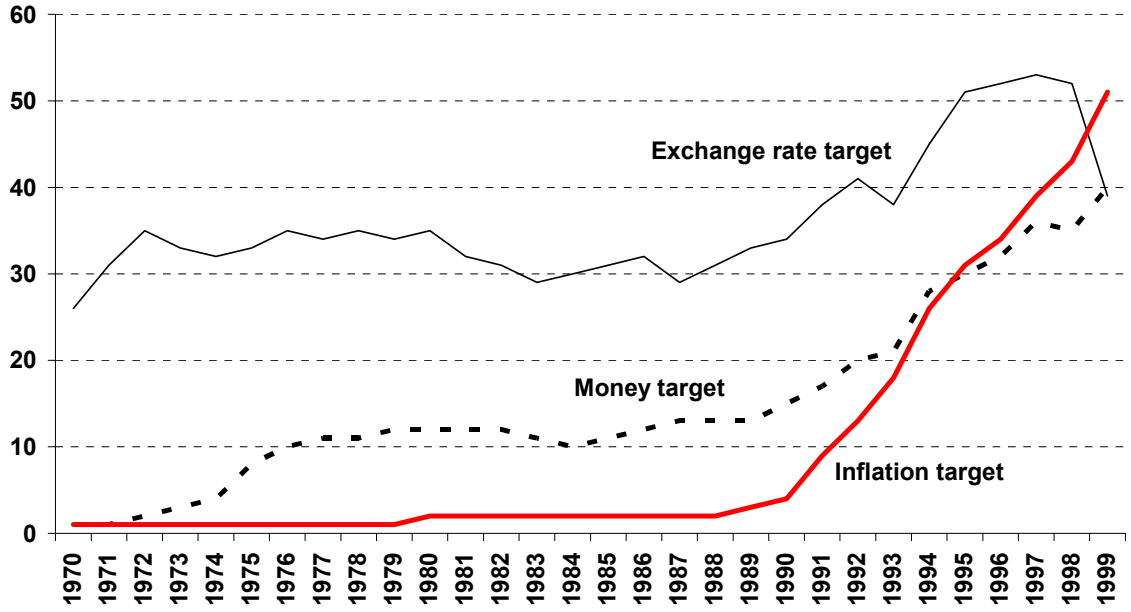
As regards the choice of the monetary policy strategy, there is a wealth of literature on the advantages and disadvantages of each strategy for achieving price stability but hardly any evidence exists on how it affects other potential objectives, such as financial stability. While this might be the right way to choose the strategy – it avoids using one single instrument for too many objectives – it is still interesting to know whether there are spill-overs from the choice of the strategy towards financial stability.

When compared with the central bank objectives, the reasons why the choice of the monetary policy strategy can affect financial stability are less clear-cut. Perhaps the most debated case is the exchange-rate based strategy, but even in this case there is no consensus in the empirical literature (Domaç and Martinez Peria, 2000). There is, thus, hardly any *a priori* on which strategy can better contribute to financial stability.

A historical overview of the monetary policy strategies (based on our data sample) adopted over time shows that the number of central banks with direct inflation targeting strategies has surged from close to zero at the end of the 1980s to over 50 today (see Figure 2). The number of central banks targeting a monetary aggregate has also grown albeit less rapidly; they are nearly 40 today. On the contrary, central banks with an exchange rate anchor are less than 40 today from over 50 in the mid 1990s. This corresponds with a certain degree of disenchantment with fixed exchange rates, after the Mexican and Asian crises. The information available also shows that there is a growing number of central banks with more than one target in its monetary policy strategy. This could be understood as a growing preference for a certain degree of flexibility.

Finally, we want to control for the location of regulation and supervision responsibilities. Being a central bank task in several countries, it could influence central bank behaviour, and even the choice of objectives and strategy. As for the objective variables, there is no consensus view on which location (central bank or separate agency) is better to avoid banking crises although many more efforts have been devoted to this question than to the monetary policy design.

Figure 2: Evolution of monetary policy strategies
(number of countries)



4 VARIABLE DEFINITIONS AND DATA

We now describe the definitions chosen for our dependent variable, financial instability, and the objective variables (mainly, the central bank objectives and the monetary policy strategy) as well as the source of the data. Finally, the choice of the control variables is also briefly described. A detailed account of the sources and construction of all variables can be found in the Appendix.

Among the different definitions given to financial instability, we concentrate on its extreme realization, namely a crisis event. We choose banking crises, and not currency or twin crises, as banks are the major player in most countries' financial system and are most directly influenced by the central bank.

To account for banking crises, we use existing different surveys of crisis events and identify periods of systemic and non-systemic crises according to the information and chronology of episodes provided by Caprio and Klingebiel (2003) and Domaç and Martinez Peria (2000). We choose these surveys because they are the most comprehensive and updated ones. We check for potential inconsistencies between the two, and when they exist, we support our choice with other sources (such as IMF staff reports, and financial news). We also follow the authors' definition of a systemic banking crisis as the situation when a large part of the banking system is affected by the crisis, in

terms of the number of banks, the share of assets or the amount of bank capital lost. Table A2 of the Appendix offers a list of crisis events, its classification into systemic and non-systemic episodes and their duration.

We now move to the objective variables, describing the monetary policy design. The first summarizes the type of central bank objectives into an index, which follows the approach of Cukierman *et al*. (1992) although with some transformations following Mahadeva and Sterne (2000). The index takes a larger value the more narrowly the central bank statutory objectives focus on price stability. More specifically, it takes the value of 1 when price (or currency) stability is the only, or the main, goal. It takes the value of 0.75 when the price stability objective is accompanied by ─ in principle non-conflicting ─ objectives, such as financial stability. It takes the value of 0.50 when price stability goes together with others ─ in principle conflicting ─ objectives, such as economic growth and/or employment creation. In particular, this is the case when objectives such as employment or growth are stated separately without being qualified by statements such as "without prejudice to monetary or price stability". Finally, the index takes the value of 0.25 when there are no statutory objectives and 0 when there are statutory objectives but none of the existing goals is price stability[10]. This index is constructed with the information provided by Cukierman, Webb and Neyapti (1992), Mahadeva and Sterne (2000) and finally Cukierman, Miller and Neyapti (2002) in the case of accession countries. The list of objectives for each country is available roughly by decades, so we need to assume the index to be constant during a decade with some exceptions for which more information could be found on changes in central bank objectives, particularly in more recent periods.

The second objective variable is the monetary policy strategy, which mainly consists of the choice of the intermediate variable to achieve the central bank objectives. Strategies are, thus, classified into exchange rate targeting, monetary and direct inflation targeting. Three dummy variables are created, one for each strategy, which take the value of one when the central bank uses that specific strategy and zero otherwise. It should be noted that these dummies are not mutually excludable since there are countries whose central banks use two different monetary strategies in parallel. One example is that of Spain during the last years of participation in the ERM when it had both an

10 We could have used a dummy for each objective or a non-linear index instead of a linear index. However, our goal here is to examine the importance of narrow objectives, which is a proxy of how much central banks focus on price stability, rather than on the choice among the many different options .

exchange rate and a direct inflation targeting. Also the euro-zone is classified as having two strategies (monetary and inflation ones).

To construct these dummies, we use information on the monetary policy strategies used by 94 central banks from a survey carried out by the Bank of England in 1999 (Mahadeva and Sterne (2000)). The survey provides a chronology of the adoption and removal of explicit targets and monitoring ranges for the exchange rate, monetary aggregates and inflation in the 1990s, including strategies adopted before the 1990s and remaining until this decade, but periods with different strategies which ended before the 1990s are missing. Since our empirical exercise covers the period 1970 to 1999, we had to complement the data with information from other sources. Regarding the exchange rate strategy, we use existing classifications of exchange rate regimes, namely, Reinhart and Rogoff (2002), Berg *et al.* (2002) and Kuttner and Posen (2001), to extract those countries which had exchange rate anchors during the 30 year period of interest for us. Data for monetary and direct inflation targeting are complemented with information in Kuttner and Posen (2001) and Carare and Stone (2003).

Finally, to control for the location of regulation and supervision, we include a dummy which takes the value of one when the central bank is in charge and zero otherwise. This variable is taken from a survey conducted by the IMF in 1993, found in Tuya and Zamalloa (1994), where all member countries where asked to inform of which institution was responsible for banking regulation and supervision in their respective countries. Unfortunately, no panel information is available on this issue.

Based on the previously reviewed literature, we include two types of control variables in our estimations, macroeconomic and financial. Among the macroeconomic variables, we take inflation, the real interest rate, the ratio of net capital flows to GDP, the growth of real GDP and the level of real GDP per capita, the last as a proxy of a country's institutional framework. The rationale behind the latter is that poorer countries tend to have more inefficient legal systems, as well as a weaker enforcement of loan contracts and deficient prudential regulations.[11]

11 While there may be more accurate information on the quality of institutions that the GDP per capita, available surveys do not have a time dimension. The lack of different observations over time makes these – in principle better – institutional indicators inadequate for our empirical analysis. The same is true for other relevant institutional variables, such as the existence of a deposit insurance scheme.

While the *a priori* sign of inflation on the likelihood of banking crisis events is positive, it should be noted that a protracted period of price stability has been argued to be problematic if it leads to an inappropriate discounting of economic risks due to myopic growth expectations in countries which are not used to price stability.[12] As for real interest rates, high levels should hamper financial stability, but too low levels (namely negative) are also problematic since they reduce banks' margins and discourage savings. Large capital inflows may be detrimental in as far as they are intermediated by the banking system and converted into rapid loan growth. Outflows, on the other hand, can bring about crises by depriving banks of foreign financing and also by heightening the expectation of a meltdown, leading to bank runs. The remaining macroeconomic variables (real economic growth and per capita GDP) have a clearer expected sign. First, higher growth should reduce the likelihood of a banking crisis through lower non-performing loans and higher savings and, thereby, bank deposits. In the same vein, a higher per capita GDP, reflecting better institutions, should reduce banks' uncertainty regarding the operating environment, particularly their right to recover their assets.

A number of financial variables are also included as control variables. In particular, the growth of domestic credit to the private sector, the banks' currency mismatch, measured by the ratio of their foreign liabilities to foreign assets, and the liquidity of the banking system, measured by the ratio of cash to banks assets, to capture the banks' ability to deal with potential deposit runs. From the literature review, the first, two variables have a positive *a priori* sign and the third a negative one.

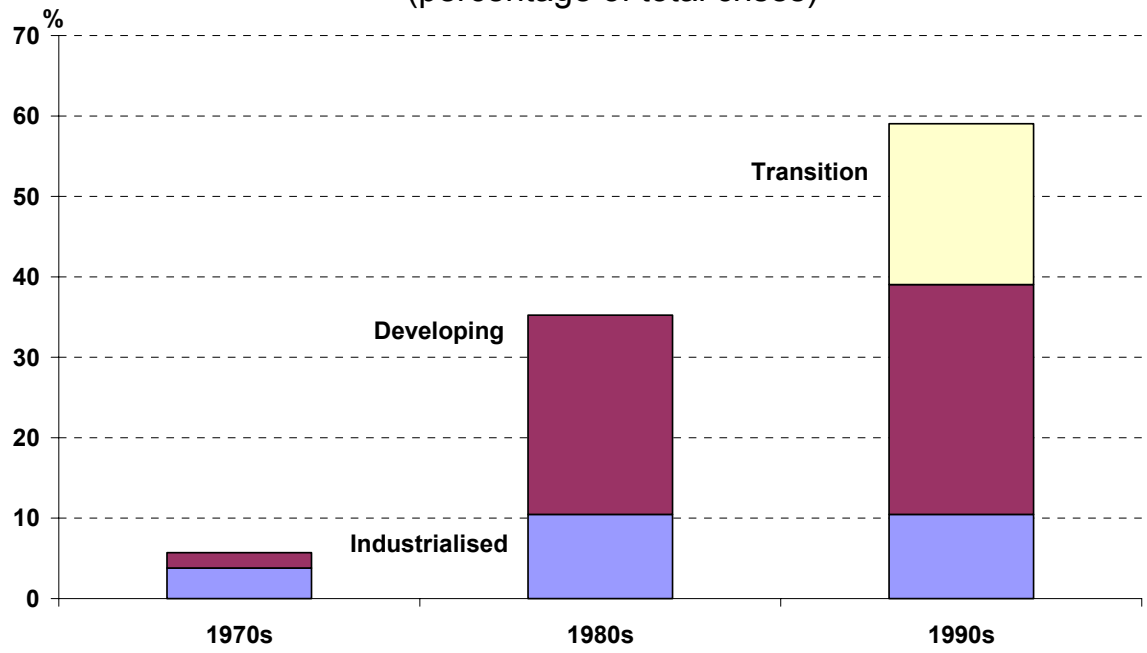
5 SOME STYLISED FACTS

Before embarking in the regression analysis we look at the data properties (see the descriptive statistics and the correlation matrix in Tables 3 and 4 of the Appendix) and show some stylized facts.

Measured by the number of crisis events worldwide, there appears to be a substantial increase in financial instability in the 1980s, with respect to the 1970s levels, particularly in emerging countries, a trend which has continued in the 1990s (see Figure 3). The latter is mainly due to the larger

12 Blinder (1999), Crockett (2000), Viñals (2001) and Borio and Lowe (2002).

Figure 3: Distribution of crises by decades and countries
(percentage of total crises)

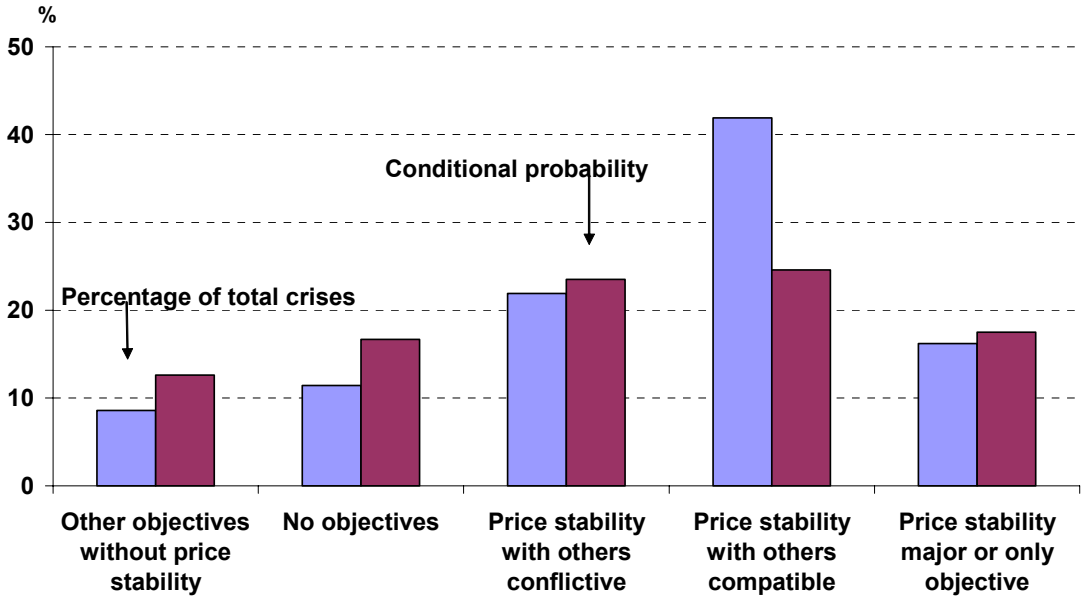


number of crises that occurred in transition countries in this decade and to the additional, albeit marginal, increase in the number of crises in emerging countries.

In order to assess whether the design of monetary policy can affect the likelihood of banking crisis events we conduct a few preliminary exercises before embarking in the econometric analysis. We first look at the number of crises which have occurred in the period of study (1970-1999) for different country groups, on the basis of their central bank objectives. Figure 4 (light-coloured column) shows that those countries whose central bank objectives do not include price stability experienced the lowest number of crises, followed by those with no statutory objectives and those whose central banks narrowly focus on price stability as the single (or main) objective. On the other hand, those countries with objectives compatible *a priori* with price stability suffered the largest number of crises.

Since these stylised facts may be biased by the number of observations in each group we use conditional probabilities to assess under which type of central bank objectives the probability of a banking crisis is higher (Figure 4, dark column). As before, those countries whose central bank objectives do not include price stability have the lowest probability that a banking crisis may occur, followed closely by those with no statutory objectives and those who narrowly focus on price stability. The highest probability of crisis is still again for those countries whose central banks aim at

Figure 4: Distribution of crises by central bank objectives
(percentage of total crises and conditional probability of crisis)

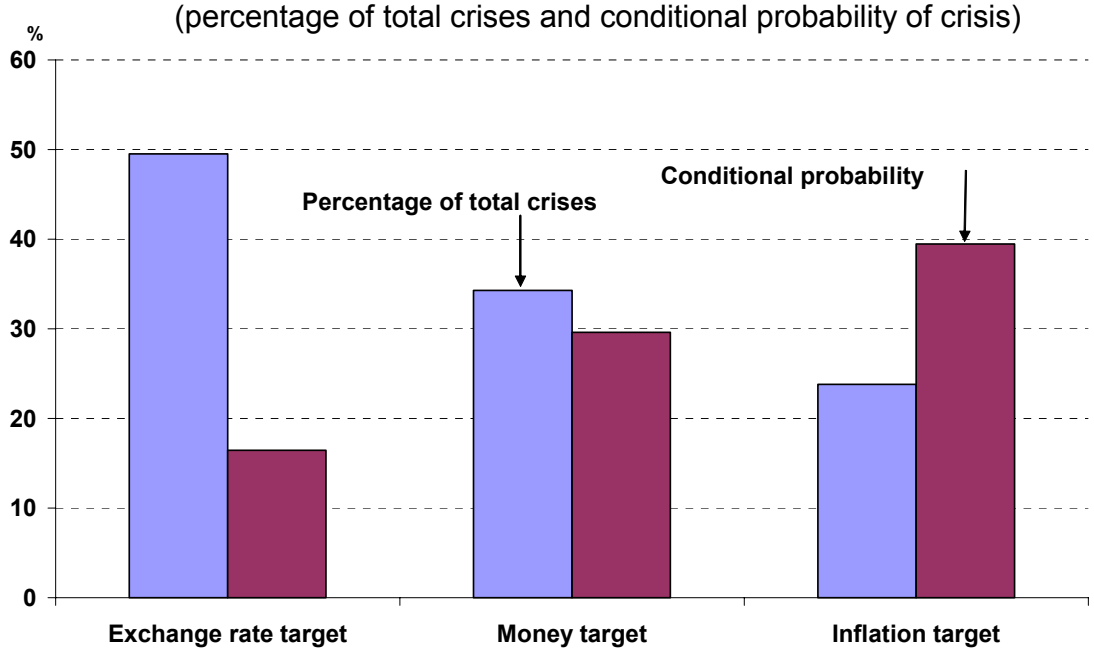


price stability with other *a priori* compatible objectives, but followed closely by those with *a priori* conflictive objectives.

We now look at the distribution of countries on the basis of their monetary policy strategies and crisis events during the same period. Figure 5 (light column) shows that countries whose central banks target the exchange rate are the ones with the highest percentage of crisis events, followed by those under monetary targeting. However, these stylised facts are clearly biased by the larger number of observations of exchange rate targeting and, to a lower extent, monetary targeting. The conditional probabilities (dark column in the same Figure) actually show that the probability of a banking crisis event is clearly lower for countries whose central banks target the exchange rate, followed by monetary targeting. The highest probability is for those countries with inflation targeting.

Obviously enough, these stylised facts do not allow us to extract any definitive conclusions, since we do not take into account important factors already identified in the empirical literature as affecting the probability of a banking crisis. This will be the objective of the next section.

Figure 5: Distribution of crises by monetary policy strategies
(percentage of total crises and conditional probability of crisis)



6 EMPIRICAL METHODOLOGY

We apply a binary (logit) model to a panel of yearly data for 79 countries (27 industrial, 32 emerging and 20 transition) over the years 1970-1999. We have an unbalanced panel because of the lack of data for some countries, particularly in the first years included in the sample (see table A1 in the Appendix). All in all, we have 1492 observations.

We estimate the relationship between monetary policy design and financial instability, controlling for other relevant variables. The former is defined in terms of the central bank objectives, and index variable, and the monetary policy strategy (exchange rate, monetary or inflation targeting), which is reflected in three dummies. The latter reflects the occurrence, or not, of a banking crisis, through a dummy, which takes the value of one if a crisis occurs and zero otherwise. The binary nature of the dependent variable explains the choice of a logit model for the estimation.[13]

We use a logistic distribution function to estimate whether, and to what extent, our regressors affect the probability of a banking crisis. The dependent variable equals zero in years and countries where

13 A logit model is preferred to a probit to avoid assuming normality.

there are no crises and it equals one in the country and year where there is a crisis. Given the logistic distribution, the probability of a banking crisis in period t can be expressed as follows:

$$\Pr ob(Crisis = 1 \mid X_{t-1}) = \frac{e^{(\beta' X_{t-1})}}{1 + e^{(\beta' X_{t-1})}} \quad (1)$$

Similarly, the probability of no crisis in period t is:

$$\Pr ob(Crisis = 0 \mid X_{t-1}) = \frac{1}{1 + e^{(\beta' X_{t-1})}} \quad (2)$$

The ratio of (1) over (2) is the odds ratio in favour of a crisis. Taking natural logs of this ratio, it should be clear that it is not only linear in X_{t-1}, but also linear in the parameters ß. Given (3), ß measures the change in the log-odds ratio for a unit change in X_{t-1} [14].

$$\ln \frac{\Pr ob(Crisis = 1 \mid X_{t-1})}{\Pr ob(Crisis = 0 \mid X_{t-1})} = \beta' X_{t-1} \quad (3)$$

One of the main challenges we face is the heterogeneity inherent in a study with 79 countries. We exclude the use of a conditional logit (fixed effects) because it would reduced the number of observations to a very low number and, even more importantly, it would have eliminated the information content of some countries that have not experienced any crisis as well as the few countries, especially transition countries, which have being in crisis during their whole sample period. Another problem is the low degree of time variation of the objective variables. In particular, the index of central bank objectives mostly draws from surveys conducted for decades (only for the last decade we have more frequent data for some countries). We, thus, need to use random effects, even if it does not take into account the possibility of unobservable individual fixed effects being correlated with the regressors. We also use robust standard errors for our estimation and. Finally, in view of the large standard deviation of some control variables, particularly inflation, real interest

14 However, the marginal effect of a regressor on the dependent variable, which is the usual interpretation for coefficients in the ordinary least squares setup, is different from ß (although it still depends on it), namely:

$$\frac{\partial \Pr ob(Crisis = 1 \mid X_{t-1})}{\partial X_{t-1}} = \beta * \frac{\exp(\beta' X_{t-1})}{1 + \exp(\beta' X_{t-1})} * \frac{1}{1 + \exp(\beta' X_{t-1})}$$

Note that this expression will vary with X_{t-1}. In practice, the marginal effects are calculated at the means of the regressors.

rates and credit growth (Table 3 in the Appendix), we substitute the 5% extreme values in the sample for a maximum value close to the 95th percentile (see the definition of variables in the Appendix). This should avoid outliers determining the results.

Another issue is endogeneity. Once a crisis starts it is likely to affect the evolution of the macro and financial variables and even our objective variable, the monetary policy regime. This might be true notwithstanding the findings of the empirical literature previously reviewed that money demand continues to be stable in the long run even after a systemic banking crisis. This should reduce central bankers' interest in changing the design of monetary policy but they could still decide to do so. To reduce the potential endogeneity problem, the empirical literature of banking crises generally eliminates the crisis observations beyond the first year (i.e., only gives the value of one to the starting year of the crisis and loses the rest of the crisis years). We follow the same approach and also lag all regressors by one period.

These adjustments reduce the number of observations to 1181 from 1492, and the number of countries to 71 (27 industrial, 31 emerging and 13 transition) instead of the original 79.[15]

7 RESULTS

With the methodology described above, we conduct one set of regressions, which can be considered the baseline, and five more sets of regressions, as robustness tests. Each set is composed of three specifications. The first includes the index of central bank objectives as the single objective variable and all macroeconomic and financial variables previously described as control variables. The second takes the three dummies for the monetary policy strategy and all control variables, but excludes the index of objectives to avoid interference between the two objective variables.[16] The third takes both the index of central bank objectives and the three strategy dummies, as well as all control variables.

The first set – the baseline – takes all countries in the sample and a narrow definition of banking crisis – which only includes systemic events – as dependent variable. This should eliminate those

15 The eight countries lost are transition ones which had experienced crises throughout the period. Given that we take lags we need at least two observations to keep a country in the sample.

16 Note, however, that we do not expect much interference since the correlations are low. In the most obvious case, between the dummy for the inflation targeting strategy and the index showing how important the price stability objective is, the correlation is only 0.19, and in any case the highest between the two objective variables (Table 4 in Appendix).

crises stemming from one or a few banks' mismanagement and not necessarily from macroeconomic, institutional or policy rated issues.

The results show the important role that central bank objectives play in determining the likelihood of a banking crisis in all specifications where it is included. The results for the monetary policy strategy are less clear-cut. As for the control variables, results were as expected: A higher economic growth and higher real GDP per capita – a proxy for the quality of institutions – significantly reduce the probability of a banking crisis in all specifications. Finally, more liquidity in the banks' balance sheets, measured by the share of cash held by banks to bank assets, is found beneficial in all specifications.

Table 1: Logit estimations for systemic banking crises in all countries

Variable	(1)	(2)	(3)
Control variables			
Inflation	-0.0049	-0.0059	-0.0061
	-(0.73)	-(0.90)	-(0.89)
Real interest rate	0.0118	0.0164 *	0.0141
	(1.35)	(1.79)	(1.55)
GDP per capita	-0.0003 ***	-0.0003 ***	-0.0003 ***
	-(7.61)	-(7.57)	-(6.78)
Real GDP growth	-0.0616 **	-0.0685 ***	-0.0599 **
	-(2.27)	-(2.57)	-(2.19)
Domestic credit growth	0.0065	0.0055	0.0069
	(1.02)	(0.90)	(1.09)
Cash held by banks / Bank assets	-2.5173 **	-3.5448 ***	-2.3851 **
	-(2.07)	-(2.97)	-(1.97)
Foreign liabilities / Foreign assets	-0.0109	-0.0083	-0.0089
	-(0.37)	-(0.30)	-(0.32)
Net capital flows / GDP	-0.1370	-0.1272	-0.1333
	-(0.58)	-(0.63)	-(0.61)
Objective variables			
Central bank focus on price stability	-1.4063 ***		-1.0740 **
	-(3.36)		-(2.27)
Exchange rate target strategy		-0.5361 *	-0.3695
		-(1.73)	-(1.14)
Money target strategy		-0.4490	-0.0915
		-(1.15)	-(0.22)
Inflation target strategy		-0.6480	-0.4493
		-(1.33)	-(0.90)
Number of observations	1181	1181	1181
Wald Test (p-value)	(0.00)	(0.00)	(0.00)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: *z-statistics* (in parentheses) robust to heteroskedasticity; *Wald test* measures the joint significance of all coefficients and it is distributed as a *Chi squared* with degrees of freedom equal to the number of coefficients.

We move to describing the three baseline specifications in more detail. The first one – with the central bank objectives as single objective variable – yields a highly significant negative impact (at 1% level) of narrow objectives (focused on price stability) on the probability of a banking crisis (see column 1 of Table 1). This result is independent on whether a low inflation environment is actually achieved since there is a control variable accounting for this and, incidentally, is not found significant. A way to see that the index of central bank objectives is not picking up the effect of the inflation variable is the very low, and even negative, correlation between the objective index and inflation (Table 4 in the Appendix).

In the second specification, with the monetary policy strategy as single objective variable, the results yield a negative coefficient for the exchange rate based strategy at a10% significance level (column 2 of Table 1). In other words, among the three monetary policy strategies included (exchange rate, monetary based and inflation targeting), the former is found superior – albeit marginally significant – as far as financial stability is concerned. It should be recalled that our definition of financial stability focuses on banking crisis events and not on asset prices or currency crises. Finally, in this specification, higher real interest rates appear to contribute to a higher probability of banking crisis at a 10% significance level.

The third and final specification – with all objective variables – confirms the negative coefficient of narrow central bank objectives but not that of the exchange rate based strategy (see column 3 of Table 1).

Given that the distinction between systemic and non systemic crises is not very clear-cut in the available surveys, we carry out the same regressions on a broader crisis definition as a robustness test (see table 2). This includes both systemic and non-systemic crises as events in our binary model. The results hardly change for the central bank objectives and the control variables in the three model specifications. The main difference is that with this broader definition of crises, the choice of the monetary policy strategy offers clearer results. In fact, an exchange rate based strategy reduces the likelihood of a crisis at a 1% significance level in all specifications where included. In addition, in the second and third specifications higher real interest rates increase the probability of a crisis as well as higher inflation albeit at a lower confidence. This latter result could offer some preliminary empirical ground to the recent literature strand which considers very low levels of inflation as the

Table 2: Logit estimations for systemic and non-systemic banking crises in all countries

Variable	(1)	(2)	(3)
Control variables			
Inflation	-0.0076	-0.0106 *	-0.0104 *
	-(1.22)	-(1.71)	-(1.66)
Real interest rate	0.0129	0.0167 **	0.0143 *
	(1.59)	(1.99)	(1.74)
GDP per capita	-0.0002 ***	-0.0002 ***	-0.0002 ***
	-(7.21)	-(7.31)	-(6.30)
Real GDP growth	-0.0791 ***	-0.0763 ***	-0.0691 ***
	-(3.22)	-(3.17)	-(2.86)
Domestic credit growth	0.0051	0.0057	0.0066
	(0.90)	(1.02)	(1.16)
Cash held by banks / Bank assets	-2.2088 **	-2.6255 ***	-1.6861 *
	-(2.18)	-(2.64)	-(1.72)
Foreign liabilities / Foreign assets	-0.0137	-0.0120	-0.0123
	-(0.49)	-(0.45)	-(0.47)
Net capital flows / GDP	-0.0241	-0.0706	-0.0546
	-(0.11)	-(0.42)	-(0.30)
Objective variables			
Central bank focus on price stability	-1.1859 ***		-0.8918 ***
	-(3.56)		-(2.51)
Exchange rate target strategy		-0.8266 ***	-0.6951 ***
		-(3.37)	-(2.79)
Money target strategy		-0.1065	0.0949
		-(0.36)	(0.31)
Inflation target strategy		-0.4666	-0.2106
		-(1.18)	-(0.52)
Number of observations	1115	1115	1115
Wald Test (p-value)	(0.00)	(0.00)	(0.00)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: z-statistics (in parentheses) robust to heteroskedasticity; Wald test measures the joint significance of all coefficients and it is distributed as a Chi squared with degrees of freedom equal to the number of coefficients.

origin of euphoria and potential crises in countries not used to price stability, but it should be recalled that the result is only found for all crises, including non-systemic ones, and is not very robust.

Another important issue which might have a bearing with our empirical analysis is the location of the responsibility for banking regulation and supervision. One could think that central banks in charge of regulation and supervision might have a special interest in reducing the likelihood of a banking crisis, being an additional aim in their portfolio, other than monetary policy. We control for the location of regulation and supervision responsibilities with a dummy variable, which takes the value of one when the central bank is in charge and zero otherwise. The central bank objectives

Table 3: Logit estimations for banking crises in all countries controlling for central bank supervision of financial system.

	Systemic Banking Crises			Systemic and Non-systemic Banking Crises		
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Control variables						
Inflation	-0.0001	-0.0009	-0.0013	-0.0051	-0.0075	-0.0078
	(-0.02)	(-0.14)	(-0.21)	(-0.85)	(-1.22)	(-1.27)
Real interest rate	0.0135 *	0.0155 *	0.0144 *	0.0136 *	0.0155 *	0.0139 *
	(1.69)	(1.88)	(1.74)	(1.74)	(1.94)	(1.75)
GDP per capita	-0.0003 ***	-0.0003 ***	-0.0003 ***	-0.0002 ***	-0.0002 ***	-0.0002 ***
	(-8.12)	(-7.97)	(-7.34)	(-7.45)	(-7.42)	(-6.63)
Real GDP growth	-0.0521 **	-0.0527 **	-0.0506 *	-0.0702 ***	-0.0634 ***	-0.0604 **
	(-2.02)	(-2.01)	(-1.91)	(-2.88)	(-2.63)	(-2.49)
Domestic credit growth	0.0061	0.0064	0.0068	0.0059	0.0069	0.0072
	(1.03)	(1.07)	(1.12)	(1.07)	(1.26)	(1.31)
Cash held by banks / Bank assets	-2.7822 ***	-3.0175 ***	-2.6352 **	-2.0940 **	-2.1189 **	-1.6237 *
	(-2.52)	(-2.85)	(-2.33)	(-2.16)	(-2.28)	(-1.72)
Foreign liabilities / Foreign assets	-0.0164	-0.0108	-0.0127	-0.0101	-0.0076	-0.0094
	(-0.57)	(-0.40)	(-0.47)	(-0.39)	(-0.31)	(-0.38)
Net capital flows / GDP	-0.1418	-0.1370	-0.1381	-0.0106	-0.0579	-0.0463
	(-0.58)	(-0.62)	(-0.60)	(-0.05)	(-0.32)	(-0.24)
Objective variables						
Central bank focus on price stability	-0.4517		-0.3440	-0.6606 *		-0.5392
	(-1.18)		(-0.82)	(-1.88)		(-1.52)
Exchange rate target strategy		-0.2475	-0.2301		-0.6468 ***	-0.6008 **
		(-0.84)	(-0.78)		(-2.64)	(-2.44)
Money target strategy		-0.1586	-0.0629		0.0895	0.1803
		(-0.44)	(-0.17)		(0.30)	(0.60)
Inflation target strategy		-0.2848	-0.2111		-0.2313	-0.0983
		(-0.63)	(-0.46)		(-0.60)	(-0.25)
Central bank supervision of financial system	-1.1626 ***	-1.1669 ***	-1.0980 ***	-0.7986 ***	-0.8233 ***	-0.6960 ***
	(-4.37)	(-4.46)	(-3.98)	(-3.11)	(-3.39)	(-2.78)
Number of observations	1181	1181	1181	1115	1115	1115
Wald Test (p-value)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: z-statistics (in parentheses) robust to heteroskedasticity; Wald test measures the joint significance of all coefficients and it is distributed as a Chi squared with degrees of freedom equal to the number of coefficients.

continue to be significant in the first specification – albeit mildly – when all systemic and non-systemic banking crises are included (column 4 of Table 3).

As in the previous robustness test, having an exchange rate-based monetary policy strategy significantly reduces the likelihood of suffering from all banking crises, systemic and non-systemic (column 5 of Table 3). This is also true when including the central bank objectives as an additional variable (column 6 or Table 3). These results, however, do not hold any longer for a stricter definition of banking crises, with systemic events only (column 1, 2 and 3 of Table 3).

Finally, an interesting result drawn from this set of regressions is that locating bank regulation and supervision at the central bank significantly reduces the likelihood of a banking crisis in all model specifications. This finding is robust to the dependent variable chosen (only systemic or all crises). It should be noted, however, that the relevance of this finding is limited by potentially large endogeneity problems. These cannot be minimized as for the other regressors because the dummy variable representing the location of regulation and supervision is time-invariant. In fact, available

information does not allow including changes in the location of responsibilities for regulation and supervision over time, even if they have taken place, and perhaps even as a consequence of a crisis.

We now split the sample in three groups of countries, industrial, emerging and transition to check whether the results are robust to the different country groups. As before, in the case of industrial countries, central bank objectives focused on price stability significantly reduce the likelihood of crisis events, in the first specification (column 1 of Table 4). However, no monetary policy strategy appears superior to the others as regards the occurrence of a banking crisis (column 2 of Table 4). When including all objective variables in the regression, in the third specification, having narrow central bank objectives is still beneficial but at the 10% significance level. As for the control

Table 4: Logit estimations for systemic banking crises in industrial countries

Variable	(1)	(2)	(3)
Control variables			
Inflation	-0.0512	-0.0382	-0.0482 *
	-(0.71)	-(0.57)	-(0.67)
Real interest rate	0.0855	0.0763	0.0937
	(1.05)	(0.95)	(1.21)
GDP per capita	-0.0002 ***	-0.0002 ***	-0.0002 ***
	-(3.32)	-(3.63)	-(3.12)
Real GDP growth	-0.1495	-0.1730	-0.1574
	-(1.07)	-(1.37)	-(1.15)
Domestic credit growth	0.0008	-0.0007	-0.0013
	(0.03)	-(0.03)	-(0.05)
Cash held by banks / Bank assets	-4.5091	-6.3432	-3.9695
	-(0.70)	-(0.90)	-(0.61)
Foreign liabilities / Foreign assets	-0.1149	-0.0859	-0.0438
	-(0.34)	-(0.25)	-(0.13)
Net capital flows / GDP	-0.3516	-2.8797	-0.4678
	-(0.05)	-(0.38)	-(0.06)
Objective variables			
Central bank focus on price stability	-1.8625 **		-1.7007 *
	-(1.95)		-(1.73)
Exchange rate target strategy		-0.4692	-0.2088
		-(0.67)	-(0.28)
Money target strategy		-0.3932	0.0084
		-(0.54)	(0.01)
Inflation target strategy		-35.0796	-34.6788
		(0.00)	(0.00)
Number of observations	613	613	613
Wald Test (p-value)	(0.00)	(0.00)	(0.00)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: z-statistics (in parentheses) robust to heteroskedasticity; Wald test measures the joint significance of all coefficients and it is distributed as a Chi squared with degrees of freedom equal to the number of coefficients.

variables, only the real GDP per capita is found significant, with the correct sign, and, in the third specification, high inflation appears to reduce the likelihood of a crisis at a 10% confidence level, as was found for all crises in the full sample.

In the emerging country group the results are also similar to the baseline one (Table 5). In the first specification, countries which narrowly focus on price stability tend to suffer from fewer banking crises, other things given. In the second one, no monetary policy strategy seems superior to the others in terms of financial stability. As in the baseline, real GDP per capita and the liquidity held by banks substantially lower the likelihood of a banking crisis and the opposite is true for high real interest rates.

Table 5: Logit estimations for systemic banking crises in emerging countries

Variable	(1)	(2)	(3)
Control variables			
Inflation	-0.0008	-0.0014	-0.0025
	-(0.08)	-(0.16)	-(0.27)
Real interest rate	0.0197 *	0.0238 **	0.0203 *
	(1.72)	(2.05)	(1.74)
GDP per capita	-0.0004 ***	-0.0005 ***	-0.0004 ***
	-(3.79)	-(3.93)	-(3.12)
Real GDP growth	-0.0557	-0.0581 *	-0.0514
	-(1.52)	-(1.65)	-(1.43)
Domestic credit growth	0.0020	0.0013	0.0023
	(0.22)	(0.15)	(0.26)
Cash held by banks / Bank assets	-2.9177 **	-3.8944 ***	-2.8319 **
	-(1.96)	-(2.77)	-(1.92)
Foreign liabilities / Foreign assets	-0.0036	-0.0012	-0.0030
	-(0.14)	-(0.05)	-(0.12)
Net capital flows / GDP	-0.1083	-0.0916	-0.1053
	-(0.45)	-(0.44)	-(0.46)
Objective variables			
Central bank focus on price stability	-1.1741 **		-0.9689
	-(2.10)		-(1.57)
Exchange rate target strategy		-0.3206	-0.2801
		-(0.75)	-(0.63)
Money target strategy		-0.5513	-0.1377
		-(0.95)	-(0.22)
Inflation target strategy		-0.6522	-0.4939
		-(1.12)	-(0.82)
Number of observations	518	518	518
Wald Test (p-value)	(0.00)	(0.00)	(0.00)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: z-statistics (in parentheses) robust to heteroskedasticity; Wald test measures the joint significance of all coefficients and it is distributed as a Chi squared with degrees of freedom equal to the number of coefficients.

Finally, the same exercise is conducted for transition countries. This is the only case in which having central bank objectives which narrowly focus on price stability does not reduce the probability of banking crises in a significant way. On the other hand, the choice of an exchange rate based strategy is clearly superior to the other two since it significantly reduces the likelihood of a crisis both in all specifications where included (column 2 and 3 of Table 6). It is interesting to note the marked differences in results for transition economies and the rest of the sample: choosing an exchange rate strategy appears to be more important for them, in terms of financial stability, than focusing on price stability, while the opposite is true for the full sample. Nevertheless, the results for the transition country group should be taken with care, due to the small number of observations

Table 6: Logit estimations for systemic banking crises in transition countries

Variable	(1)	(2)	(3)
Control variables			
Inflation	0.0013	0.0052	-0.0056
	(0.12)	(0.41)	-(0.34)
Real interest rate	-0.0019	0.0243	0.0367
	-(0.10)	(1.01)	(1.23)
GDP per capita	-0.0001	0.0000	-0.0001
	-(0.64)	(0.09)	-(0.63)
Real GDP growth	0.1456	0.2231	0.2609 *
	(1.65)	(1.62)	(1.63)
Domestic credit growth	0.0226 *	0.0300 **	0.0219 *
	(1.75)	(2.30)	(1.66)
Cash held by banks / Bank assets	1.6448	0.4500	0.7752
	(0.59)	(0.14)	(0.22)
Foreign liabilities / Foreign assets	-0.4312	0.3085	0.2477
	-(0.68)	(0.44)	(0.31)
Net capital flows / GDP	-6.9050	-12.0739	-21.7375 **
	-(0.86)	-(1.39)	-(1.93)
Objective variables			
Central bank focus on price stability	-1.7827		5.4542
	-(1.07)		(1.54)
Exchange rate target strategy		-3.2477 **	-6.7013 **
		-(1.92)	-(2.15)
Money target strategy		-0.5359	-1.5787
		-(0.50)	-(1.22)
Inflation target strategy		-0.7958	-0.2033
		-(0.72)	-(0.17)
Number of observations	50	50	50
Wald Test (p-value)	(0.07)	(0.07)	(0.07)

Note: Logit estimates with random effects. All variables in first lags. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Tests: z-statistics (in parentheses) robust to heteroskedasticity; Wald test measures the joint significance of all coefficients and it is distributed as a Chi squared with degrees of freedom equal to the number of coefficients.

available. The structural break in the early 1990s meant that we could only take them from the early 1990s, rather than from the1970s as for the rest of the sample.

8 CONCLUSIONS

Building upon the existing empirical literature on the factors behind financial stability, we assess what is the role of monetary policy design in determining the likelihood of a banking crisis.

With a sample of yearly data for 79 countries for the period 1970 to 1999, we find evidence that the choice of the central bank objectives significantly influences the probability that a banking crisis may occur. In particular, having narrow central bank objectives, focused on price stability, reduces the likelihood of a banking crisis, other things given. This result is robust, in general, to broad and narrow definitions of banking crises (systemic and non-systemic or only systemic) and to different country groups, except for transition countries. The results for this latter group, however, should be taken with care due to the relatively small number of observations on which they are drawn.

As for the monetary policy strategy, exchange rate targeting is found beneficial in terms of financial stability when a broad definition of banking crises is chosen and for the group of transition countries, but not for industrial and emerging countries. This finding would support the choice of relatively fixed exchange rate regimes in countries in transition in terms of avoiding banking crises, but the result could change if the definition of financial instability were expanded to currency crises or other asset prices.

We also control for the location of regulatory and supervisory responsibilities and the results do not change for the broad definition of banking crises: focusing the central bank objectives on price stability is still superior. The same is true for an exchange rate based monetary policy strategy. But the results do not hold for a narrow definition of banking crises. Another interesting result when introducing the location of regulation and supervision is that having the central bank in charge of it reduces the likelihood of a banking crisis in all model specifications. This is a strong result for an issue which has been long debated in the literature and for which no consensus exists, but it should be taken with caution because of obvious endogeneity problems stemming from the time invariability of this variable.

On the basis of these preliminary, but encouraging results, we intend to improve and extend our analysis in several directions. First, the relation between the central bank monetary policy intentions

(in terms of objectives and strategy) and its achievements (the inflation outcome) is worth exploring. This could be achieved by introducing other important aspects of central bank design as the degree of independence but also the rule of law, as recently shown by Eijffinger and Stadhousers (2003). Second, a potentially important determinant of banking crises, financial liberalization, is now absent because of lack of information for such a large sample of countries. This is particularly unfortunate if we consider that the central bank generally plays an important role in financial liberalization and warrants additional data compilation for an extension of the paper. Finally, different angles of financial stability, other than the occurrence of banking crises, would warrant attention. This would imply using broader definitions of financial stability as dependent variable, measuring the fragility of financial institutions and "excessive" asset price movements.

APPENDIX

Data sources and definitions of variables

Below we list the variables and sources used for this study, as well as the explanation of any change we have introduced. The data is annual and it covers the period 1970-99.

Dependent variable

- *Systemic and non-systemic banking crises dummy*: equals one during episodes identified as in Caprio and Klingebiel (2003). They present information on 117 systemic banking crises (defined as much or all of bank capital being exhausted) that have occurred since the late 1970s in 93 countries and 51 smaller non-systemic banking crises in 45 countries during that period. The information on crises is cross-checked with that of Domaç and Martinez-Peria (2000) and with IMF staff reports and financial news.

  Source: Caprio and Klingebiel (2003) and Domaç and Martinez Peria (2000).

Objective variables:

- ***Central Bank focus on price stability***: measures to what extent statutory objectives do provide the central bank with a clear focus on price stability following the approach of Cukierman *et al.* (1992). Statutory monetary objectives may be potentially conflicting with price stability when objectives such as employment or growth are stated separately without being qualified by statements such as "without prejudice to monetary or price stability". Financial stability objectives are not interpreted as potentially conflicting with monetary stability. The classification of objectives differs somewhat from Cukierman's and it is more similar to that of Mahadeva and Sterne (2000). The variable takes the following values: 0 (only goals other than price stability); 0.25 (no statutory objectives); 0.5 (price stability with other conflicting objectives); 0.75 (price stability + financial stability and non-conflicting monetary stability objectives); and 1 (only goal is price, monetary or currency stability).[17] The list of objectives and countries is available by decades, so we have assumed it constant through every year of each

17 Cukierman's classification distinguishes between "price stability is the only objective", rated 0.8, and "price stability is the major or only objective in the charter, and the central bank has the final word in case of conflict with other government objectives", rated 1.

decade except for the most recent years where the information on some countries has been updated with other sources, mainly Mahadeva and Sterne (2000).

Source: For the 1970s and the 1980s, Cukierman, Webb and Neyapti (1992) and Cukierman, Miller and Neyapti (2002). For the 1990s, Mahadeva and Sterne (2000).

- ***Monetary policy strategies***: these three variables (*Exchange rate target, Money target and Inflation target*) are dummies that equal one during periods in which targets for these variables were used according to the chronology of the Bank of England survey of monetary frameworks, in Mahadeva and Sterne (2000). Since it provides a chronology for the 1990s, we have complemented it with information from other sources for the previous years. Regarding exchange rate arrangements, we use classifications of exchange rate strategies in Reinhart and Rogoff (2002), Kuttner and Posen (2001), and Berg, Borensztein and Mauro (2002) for Latin America countries. Data for monetary and inflation targets were complemented with the information taken from Kuttner and Posen (2001) and Carare and Stone (2003). It should be noted that some judgement has gone into the classification of regimes.

  Source: Mahadeva and Sterne (2000), Reinhart and Rogoff (2002), Kuttner and Posen (2001), Berg, Borensztein and Mauro (2002) and Carare and Stone (2003).

Control Variables

- ***Macroeconomic variables***
  - ***Inflation***: percentage change in the GDP deflator. (Since the value for the 95% percentile is 106.3%, but the variance is extremely high due to several cases of hyperinflations, we have substituted all values above 150% for 150%).

    Source: International Monetary Fund, International Financial Statistics, line 99bir.
  - ***Real Interest Rate***: Nominal interest rate minus inflation in the same period, calculated as the percentage change in the GDP deflator. (Since the value for the 5% percentile is –30% and for the 95% percentile is 21.2%, but the variance is extremely high, we have substituted all values above 50% for 50% and those below –50% for 50%).

    Source: International Monetary Fund, International Financial Statistics. Where available, money market rate (line 60B); otherwise, the commercial bank deposit interest rate (line 60l);

otherwise, a rate charged by the Central Bank to domestic banks such as the discount rate (line 60).

- ***Net Capital Flows to GDP***: Capital Account plus Financial Account + Net Errors and Omissions.

  Source: International Monetary Fund, International Financial Statistics, lines (78bcd + 78bjd +78cad).

- ***Real GDP per capita in 1995 US dollars***: this variable is expressed in US dollars instead of PPP for reasons of data availability. GDP per capita in PPP was available only for two points in time.

  Source: The World Bank, World Tables; and EBRD, Transition Report, for some transition countries.

- ***Real GDP growth***: percentage change in GDP Volume (1995=100).

  Source: International Monetary Fund, International Financial Statistics (line 99bvp) where available; otherwise, The World Bank, World Tables; and EBRD, Transition Report, for some transition countries.

Financial variables:

- ***Domestic Credit growth:*** percentage change in domestic credit, claims on private sector. (Since the value for the 95% percentile is 112.2%, but the variance is extremely high, we have substituted all values above 150% for 150%).

  Source: International Monetary Fund, International Financial Statistics, line 32d.

- ***Bank Cash to total assets***: Reserves of Deposit Money Banks divided by total assets of Deposit Money Banks.

  Source: International Monetary Fund, International Financial Statistics, line 20 divided by lines (22a + 22b + 22c +22d +22f).

- ***Bank Foreign Liabilities to Foreign Assets***: deposit money banks foreign liabilities to foreign assets.

  Source: International Monetary Fund, International Financial Statistics, lines (26c+26cl) divided by line 21

- ***Central Bank Supervision of Financial System***: this variable is a dummy which takes the value 1 for countries where the Central Bank is responsible for the supervision of the financial system and takes 0 otherwise. This variable is not time-varying; it stems from a survey conducted by the IMF in 1993 where all member countries where asked to inform of which institution was responsible for banking regulation and supervision in their respective countries. The results of the survey are shown in Tuya and Zamalloa (1994).

  Source: Tuya and Zamalloa (1994).

Table A1: Countries and years included

Country name	Years	Country name	Years
Industrialised			
Australia	1971-1999	Honduras	1978-1997
Austria	1970-1996	Indonesia	1981-1999
Belgium	1975-1997	Kenya	1975-1999
Canada	1970-1999	Malaysia	1974-1999
Cyprus	1976-1999	Malta	1971-1998
Denmark	1975-1999	Mexico	1982-1999
Finland	1975-1998	Mongolia	1993-1999
France	1975-1997	Nicaragua	1988-1996
Germany	1970-1998	Nigeria	1977-1999
Greece	1975-1999	Paraguay	1988-1999
Hong Kong, China	1991-1999	Peru	1977-1999
Iceland	1976-1999	South Africa	1970-1999
Ireland	1974-1998	Tanzania	1976-1999
Israel	1979-1999	Thailand	1976-1997
Italy	1970-1998	Turkey	1974-1997
Japan	1977-1999	Uganda	1981-1999
Korea, Rep.	1976-1999	Uruguay	1978-1999
Netherlands	1970-1997	Venezuela, RB	1970-1999
New Zealand	1972-1999	Zambia	1985-1999
Norway	1975-1999	**Transition**	
Portugal	1975-1999	Albania	1995-1998
Singapore	1972-1999	Armenia	1993-1999
Spain	1975-1997	Bulgaria	1992-1997
Sweden	1970-1999	Kazakhstan	1995-1999
Switzerland	1977-1999	Croatia	1994-1998
United Kingdom	1970-1999	Czech Republic	1994-1997
United States	1970-1999	Estonia	1993-1999
Developing		Georgia	1996-1997
Argentina	1981-1999	Hungary	1983-1997
Bahamas	1985-1995	Kyrgyz Rep.	1996-1998
Barbados	1970-1995	Latvia	1994-1999
Bolivia	1976-1999	Lithuania	1994-1999
Botswana	1976-1999	Macedonia	1996-1999
Brazil	1981-1999	Moldova	1994-1999
Chile	1977-1999	Poland	1990-1999
China	1985-1999	Romania	1993-1999
Colombia	1970-1999	Russian Federation	1994-1999
Costa Rica	1970-1999	Slovak Republic	1994-1997
Ecuador	1975-1999	Slovenia	1993-1999
Egypt, Arab Rep.	1976-1999	Ukraine	1994-1998
Ghana	1971-1999		

Table A2: Countries and crises included. 1970-1999.

Country name	Systemic	Non-systemic	Country name	Systemic	Non-systemic
Industrialised					
Australia		1989-92	Honduras	no crises	no crises
Austria	no crises	no crises	Indonesia	1992-97,1997-	
Belgium	no crises	no crises	Kenya	1985-89,1992,1993-95	1996-
Canada		1983-85	Malaysia	1997-	1985-88
Cyprus	not in sample	not in sample	Malta	not in sample	not in sample
Denmark		1987-92	Mexico	1981-82,1994-97	
Finland	1991-94		Mongolia	not in sample	not in sample
France		1994-95	Nicaragua	1988-96	
Germany		1978-79	Nigeria	1990s	1997
Greece		1991-95	Paraguay	1995-99	
Hong Kong, China		1982-83, 1983-86,1998	Peru	1983-90	
Iceland		1985-86,1993	South Africa		1977,1989
Ireland	no crises	no crises	Tanzania	1988-	
Israel	1977-83		Thailand	1983-87,1997-	
Italy		1990-95	Turkey	1982-85	1994
Japan	1992-		Uganda	1994-	
Korea, Rep.	1997-		Uruguay	1981-85	
Netherlands	no crises	no crises	Venezuela, RB	1994-99	1978,1981,1982,1985,1986
New Zealand		1987-90	Zambia	1995	
Norway	1987-93		**Transition**		
Portugal	no crises	no crises	Albania	1992-	
Singapore		1982	Armenia	1994-96	
Spain	1977-85		Bulgaria	1991-97	
Sweden	1990-94		Croatia	1996	
Switzerland	no crises	no crises	Czech Republic	1997-	
United Kingdom		1974-76,1984,1991,1995	Estonia	1992-95	1998
United States	1980-83	1980-91	Georgia	1991-	
Developing			Hungary	1991-95	
Argentina	1980-82,1989-90,1995		Kazakhstan	not in sample	not in sample
Bahamas	not in sample	not in sample	Kyrgyz Rep.	1990s	
Barbados	not in sample	not in sample	Latvia	1995-96,1998-99	
Bolivia	1986-87,1994-		Lithuania	1995-96	
Botswana		1994-95	Macedonia	1993-94	
Brazil	1990,1994-99		Moldova	not in sample	not in sample
Chile	1976,1981-87		Poland	1990s	
China	1990s		Romania	1990-	
Colombia	1982-87		Russian Federation	1995,1998-99	
Costa Rica	1987	1994-	Slovak Republic	1991-	
Ecuador	1980-82,1996-		Slovenia	1992-94	
Egypt, Arab Rep.	1980-85	1991-95	Ukraine	1997-98	
Ghana	1982-89	1997-			

This table presents the periods of systemic and non-systemic banking crisis based on the information provided by Caprio and Klingebiel (2003) and Domaç and Martinez Peria (2000).

Table A3: Descriptive statistics of the regression variables

Variable	No. Obs.	Mean	Std. Deviation	Minimum	Maximum
Crisis dummy	1492	0.23	0.42	0.00	1.00
Inflation	1492	72.64	562.01	-4.00	11750.00
Real interest rate	1492	8.62	626.98	-11680.85	14155.99
Real GDP per capita	1492	6925.07	4976.04	125.20	21487.30
Real GDP growth	1492	3.46	4.67	-38.29	52.55
Domestic credit growth	1492	87.91	800.47	-55.71	18939.19
Cash held by banks / Bank assets	1492	0.14	0.17	0.00	1.78
Foreign liabilities / Foreign assets	1492	1.88	4.26	0.00	85.25
Net capital flows / GDP	1492	0.00	0.71	-12.99	8.07
Central bank focus on price stability	1492	0.61	0.31	0.00	1.00
Exchange rate target strategy	1492	0.60	0.49	0.00	1.00
Money target strategy	1492	0.27	0.44	0.00	1.00
Inflation target strategy	1492	0.17	0.38	0.00	1.00
Central bank supervision	1492	0.69	0.46	0.00	1.00

Note: For an explanation on the construction and modification of the variables see main text and the description in this Appendix.

Table A4 : Correlation matrix of the regression variables

	Crisis	Inflation	Real int.	GDP pc	Real GDP	Dom. credit	Cash/ assets	Foreign Liab.	Capital flows	Price stab.	Exch. Target	Money Target	Inflation target
Crisis dummy	1												
Inflation	0.11	1											
Real interest rate	0.05	-0.19	1										
Real GDP per capita	-0.16	-0.11	0.02	1									
Real GDP growth	-0.11	-0.15	0.00	-0.07	1.0								
Domestic credit growth	0.08	0.92	-0.20	-0.09	-0.12	1							
Cash held by banks / Bank assets	0.08	0.10	-0.06	-0.44	0.03	0.07	1						
Foreign liabilities / Foreign assets	-0.05	-0.01	-0.01	-0.04	-0.02	0.00	0.03	1					
Net capital flows / GDP	-0.12	-0.01	0.00	0.03	-0.01	-0.01	-0.06	-0.08	1				
Central bank focus on price stability	0.05	-0.05	-0.06	-0.07	-0.01	-0.03	0.01	-0.09	0.00	1			
Exchange rate target strategy	-0.11	-0.08	-0.02	-0.04	0.13	-0.06	-0.04	-0.02	0.05	0.03	1		
Money target strategy	0.09	-0.06	-0.01	0.07	-0.10	-0.04	-0.13	-0.07	0.03	0.10	-0.11	1	
Inflation target strategy	0.19	-0.05	0.00	-0.08	0.01	-0.04	-0.10	-0.01	-0.01	0.19	0.02	0.18	1

Note: For an explanation on the construction and modification of the variables see main text and the description in this Appendix.

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