# FINANCIAL STABILITY AND THE DESIGN OF MONETARY POLICY[1]

**Alicia García Herrero and Pedro del Río**[2]

## 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 the occurrence of banking crises. 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. As for the monetary policy strategy, the results are less clear. For a few model specifications, particularly 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, a large degree of independence of the central bank and locating regulatory and supervisory responsibilities at the central bank seem to reduce the likelihood of a banking crisis.

JEL Classification: E52, E44, G21

Key words: Monetary policy design, monetary policy objectives, monetary policy strategy, financial stability, banking crisis

---

1 This is a revised version of a paper which received the Marjolin Prize at the 24th SUERF Colloquium in Tallin, June 2003, and the first "3rd Journées" prize of the Fondation Banque de France, in November 2003. The paper has benefited from comments from Roberto Chang, Martti Randveer and José Viñals. Holger Wolf also offered substantial comments to a very preliminary version of the paper. Remaining errors are the authors' responsibility.

2 Both authors are affiliated with Banco de España. However, the opinions expressed are those of the authors and not of the institution they represent. Corresponding author: aligarcia-herrero@bde.es (+0034913387032)

## 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. Among the different aspects of financial instability, we choose banking crisis events, following the existing literature. More specifically, we assess empirically whether countries whose central banks focus narrowly on price stability are less prone to banking crises, other things given. In the same vein, we test which monetary policy strategy (exchange rate based, money or inflation targeting), if any, reduces the likelihood of banking crises.

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] and Schinasi (2003), and has virtually always been involved in financial stability, directly or indirectly.[4]

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).

## 2 THE CONCEPT AND MEASUREMENT OF FINANCIAL STABILITY

### *The concept of 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 used.[5] The main reason for this difficulty is that, at first sight, "stability" is associated with no volatility while volatility is not necessarily bad for financial markets.[6]

Haldane, Hoggarth and Saporta (2001) offer a very general definition of financial stability, related to the economy's saving-investment nexus. Deviations from the optimal saving-investment plan may arise because of inefficiencies in the functioning of the financial system or from instabilities in the system in the face of shocks. Financial instability is often 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)). 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). In the same line, Crockett (1997) defines financial stability as the absence of stresses that have the potential to cause measurable economic harm beyond a strictly limited group of customers and counterparties. All these conceptual definitions lack a clear benchmark to separate situations of stability from those of instability. The usual way to do it is based on deviations from the mean (Kaminsky and Reinhart, 1999) or from a trend (Borio and Lowe, 2002).

Another strand of the literature focuses on extreme realizations of financial instability. 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

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 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.

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.

The empirical literature concentrates on this second type of definitions (i.e., referring to financial crises) since extreme realizations are easier to identify than more general measures. The disadvantage, though, is that situations of moderate financial instability are not included in these empirical studies.

***How to measure financial instability? : The role of banking crises***

Among the different aspects of financial crises, banking crises have received special attention given the crucial role that banks play in most financial systems, particularly in emerging countries. Other types of financial crises analyzed are currency crises and asset price crashes. We are particularly interested in banking crises, as a financial stability outcome, because the design of the central bank is more directly related to the functioning of the banking system than to the rest of the financial system. This does not mean that currency crises or asset price crashes are totally excluded from the analysis. Financial institutions are particularly sensitive to abrupt asset price declines because of their negative net worth effects on banks' borrowers or, directly, on banks' balance sheets (Greenwald and Stiglitz (1988)). Currency crises also affect them indirectly (through the impact on banks' borrowers) and directly depending on the bank's currency position (Kaminsky and Reinhart (1999)). In any event, given the importance of the topic, it seems worth extending this research to other aspects of financial instability in the future. Obvious candidates are currency crises, excessive volatility in asset prices and general financial fragility. While the former is an extreme realization and, thus, easier to measure, the others need a subjective definition of what is considered excessive volatility[7] and what is meant by fragility.

The literature offers several definitions of banking crises. From the early definitions of Friedman and Schwartz (1963) and Bordo (1986), who concentrate on bank panics, more general definitions have followed (see Table A for a summary of many definitions). Lindgren *et al*. (1996) focus on

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.

unsoundness, shown in high inefficiency, low earnings and capitalization, and leading to banking crises. Caprio and Klingebiel (1997) define a banking crisis as a situation where actual or incipient bank runs or failures lead to suspend the internal convertibility of their liabilities or force the government to intervene to avert this by replacing a significant share of the banks' capital. Gupta (1996) describes a banking crisis as 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. More recently, the IMF (1998) has coined a broad definition of banking crisis, 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. Such definitions, except for Lindgren *et al*. (1996), are basically description of a banking crisis. A more complex matter is how to summarize such description in one single quantitative, or a set of them. Existing indicators, such as those mentioned by Lindgren *et al*. (1996) are not readably available for a large number of countries, or else there is the lack of comparable cross-country data to construct such indicator. 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 (Lindgren *et al*. (1996), Caprio and Klingebiel (2003)). This will be our approach as well.

**Table A: Measures of financial instability based on banking crises**

| | |
|---|---|
| Friedman and Schwartz (1963) | Deposit runs |
| Lindgren *et al*. (1996) | High inefficiency, low earnings and capitalization leading to financial unsoundness |
| Caprio and Klingebiel (1997) | Actual or incipient bank runs or failures leading to suspend the internal convertibility of their liabilities or forcing the government to intervene replacing a significant share of the banks' capital |
| Gupta (1996) | 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 |
| IMF (1998) | Actual or potential bank runs or failures inducing banks to suspend the internal convertibility of |

| | |
|---|---|
| | their liabilities or compelling the government to extend assistance to banks on a large scale |

## 3 THE DETERMINANTS OF BANKING CRISES

The economic literature has mostly concentrated on the macroeconomic determinants of financial stability and, to a lesser extent, on the financial sector determinants (see Table B for a summary of the literature). Among the macroeconomic factors, low growth or recessions have been found to increase the likelihood of a banking crisis. In turn, too high real interest rates (either external or domestic), large capital inflows but also capital flight, particularly in the case of emerging countries, and shocks to inflation or to the price level also appear to increase the probability of a banking crisis. It should be noted that the last factor, inflation, is related to the way monetary policy is conducted, in so far as monetary policy aims at price stability. Another macroeconomic variable frequently analyzed, but for which there is no consensus, is the exchange rate regime. This is also an important variable in our analysis in as far as the monetary policy strategy is based on an exchange rate anchor.

Among the financial sector determinants, excessive credit growth[8] and low levels of liquidity in the banking system have been found to increase the likelihood of banking crises. As for currency mismatches, there is growing theoretical support but no clear evidence in the empirical literature.

Less – albeit growing – attention has been paid to the impact of institutional variables and policy design. The exceptions are the legal system, the deposit insurance scheme and financial liberalization. A well-functioning legal system reduces the probability of banking crises while a deposit insurance scheme, especially if unlimited and/or implicit increases that probability. This is also the case for financial liberalization, particularly when good quality regulation and supervision are not in place.

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

**Table B: Determinants of banking crises**

| **Macroeconomic** | **Impact** | **Literature** |
|---|---|---|
| Real GDP growth | - | Kaminsky (1999) |
| | - | Frankel and Rose (1998) |
| External real interest rates | + | Goldfajn and Valdes (1995) |
| | + | Eichengreen and Rose (1998) |
| | + | Kaminsky (1999) |
| Domestic real interest rates | + | Mishkin (1998) |
| | + | Demirgüç-Kunt and Detragiache (1998) |
| Large capital inflows | + | McKinnon and Pill (1994) |
| Capital outflows or capital flight | + | Calvo (1997) |
| | + | Demirgüç-Kunt and Detragiache (1998) |
| | + | Kaminsky (1999) |
| Inflation | + | Bordo and Murshid (2000) |
| | + | English (1996) |
| | + | Hardy and Pazarbasioglu (1999) |
| | + | Demirgüç-Kunt and Detragiache (1998) |
| Fixed exchange rate regime | +/- | Eichengreen (1998): + if outside shock, - if threat to stability from inside |
| | - | Domaç and Martínez Peria (2000): but with higher cots when crisis occurs |
| | +/- | Eichengreen and Arteta (2000) |
| **Financial** | | |
| Growth of bank credit to the private sector | + | Gavin and Hausmann (1996) |
| | + | Sachs *et al*. (1996) |
| | + | Kaminsky (1999) |
| | + | Eichengreen and Arteta (2000) |
| Liquidity in the banking system | - | Calvo (1997) |
| | - | Bordo *et al* (2001) |
| | - | Eichengreen and Arteta (2000) |
| Currency mismatches | + | Céspedes *et al*. (2000) |

| | | |
|---|---|---|
| | +/- | Arteta (2003) |
| **Institutional** | | |
| Rule of law | - | La Porta *et al*. (1998) |
| Deposit insurance scheme | + | Demirgüç-Kunt and Detragiache (2000) |
| Financial liberalization | +<br>+ | Demirgüç-Kunt and Detragiache (1998)<br>Eichengreen and Arteta (2000) |

In this paper, we focus on the design of monetary policy. The existing literature on monetary policy design has concentrated on issues different than financial stability (mainly price stability but also output stabilization). In particular, it is well documented that a high degree of central bank independence and an explicit mandate to restrain inflation are important institutional devices to ensure price stability (Berger, Haan and Eijffinger (2001)). The role of the monetary policy strategy chosen is less clear even for price stability and output stabilization although inflation targeting has received more support in the recent literature.[9]

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 regarding the impact of banking crises on monetary policy, which includes the strategy and instruments, and reports that banking crises do not necessarily lead to substantial changes in the monetary policy design. These results are important because they weaken somewhat the endogeneity problem we face in this study. To the best of our knowledge, no study is available on the reverse 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. If synergies existed between the two objectives it seems safe to argue that the same monetary policy design which helps achieve price stability (namely, narrow central bank objectives and central bank independence) also fosters financial stability. However, if there were a trade-off, it would be much harder to establish an *a-priori* on the impact of price stability on financial stability.

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. This is because capital inflows contribute to over-borrowing and increase credit risk, and may lead to currency mismatches if foreign capital flows are converted into domestic-currency denominated loans. Cukierman (1992) states that the inflation control may require fast and substantial increases in interest rates, which banks cannot pass as quickly to their assets as to their liabilities. This increases interest rate mismatches and, thus, market risk. Another type of trade-off stems from too low inflation or deflation, which reduces banks' profit margins and, by damaging borrowers (and not lenders as inflation) increases the amount of non performing loans in banks' balance sheets (Fisher (1933)).

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

In this discussion of synergies versus trade-offs, it is important to note that the focus is on outcomes (i.e., on the achievement of price and financial stability) while this paper focuses on a different – albeit related – issue: the institutional design of monetary policy. In fact, the design might focus on price stability but inflation may remain high. We shall control for developments in inflation – and growth, a relevant objective for some central banks – but such outcome variables do not constitute the objective of this study.

## 4 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.

---

9 In terms of macroeconomic performance, however, it is hard to argue that inflation targeting is clearly superior (Ball and Sheridan 2003).

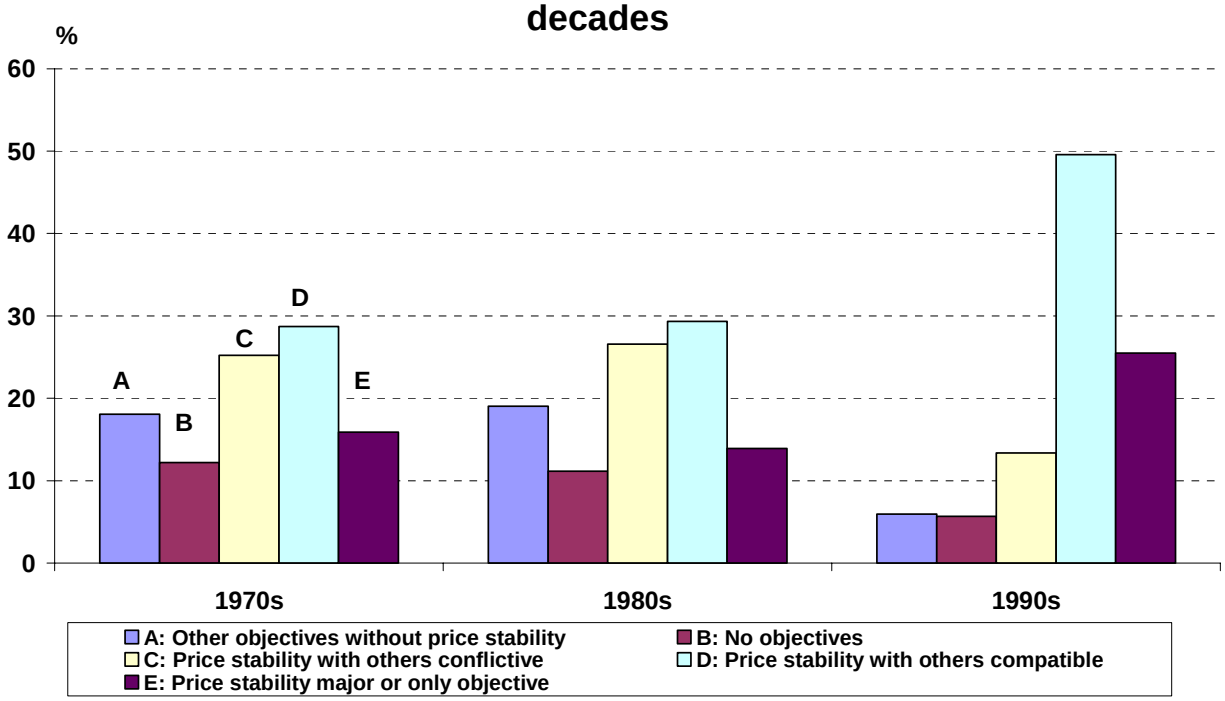
Monetary policy design can have important implications for financial stability. Central banks are providers of immediate liquidity and responsible for the smooth functioning of the payment system and that of the transmission mechanism. The central bank is also in charge of price stability and, sometimes, output stabilization, both relevant for financial stability. 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.[10] In fact, if the central bank design leads 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 a 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. From these arguments, it seems hard to establish an *a priori* on the implications of monetary policy design for financial stability. To make matters even more complicated, there could be instances in which the direction of causality is the opposite. That is, where financial instability - or banking crises in particular – lead to changes in the design of monetary policy either because the problem is very large or because the monetary policy authorities want to adapt to avoid future crises. More generally, while fragile banking systems may be a consequence of wrong central bank policies in the past, that fragility may oblige central banks to adjust their design to those circumstances. Admittedly, such endogeneity problem is inherent to our analysis. Section 7 explains how we attempt to account for it.

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. Another important aspect is the degree of central bank independence, which clearly influences how much room central banks have to stick to their objectives.

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

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 at all in their list of objectives or do not have clearly specified objectives.

**Figure 1: Distribution of central bank objectives by decades**




The trend towards a greater focus on price stability in the central bank objectives is explained by the conviction – based on the theoretical and empirical literature – that it contributes to price stability. However, not much is known about its effect on financial stability. This is partly due to the previously reviewed 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 no clear consensus on which one is preferred, at least in a long enough time span. Furthermore, no evidence exists on

how it may affect financial stability. While the choice of the monetary strategy will mainly depend on its relation with the central bank's main objective (the inflation outcome or sometimes the macroeconomic performance) – on the basis that one instrument should serve one objective – 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. Domaç and Martinez Peria (2000) find that fixed exchange rate regimes, and implicitly an exchange rate-based monetary strategy, are preferred to reduce the likelihood of banking crises among developing countries. However, Eichengreen (1998) argues that whether fixed or floating exchange rate regimes reduce the probability of banking crises depends on the source of disturbances. If the threat to the stability of the banking system comes from outside, there is a case for exchange rate flexibility (which may translate into a monetary or inflation targeting in terms of the monetary policy strategy). Instead, if the threat comes from inside (i.e., erratic monetary policies at home), an exchange rate anchor is a better strategy. Finally, Eichengreen and Arteta (2000) also find mixed results. In sum, there is hardly any *a priori* on which strategy can better contribute to financial stability.

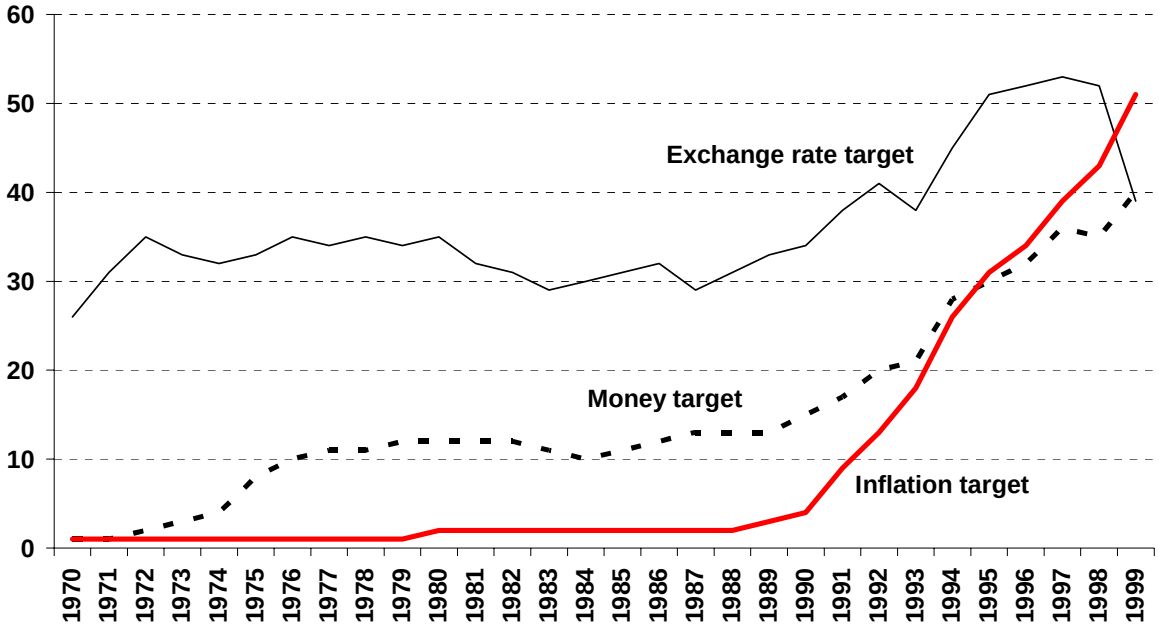
A historical overview of the monetary policy strategies adopted over time in our sample shows that the number of central banks with direct inflation targeting strategies has surged from close to zero at the end of the 1980s to over 50 today (see Figure 2). The number of central banks targeting a monetary aggregate has also grown albeit less rapidly; they are nearly 40 today. It is important to note that many of the central banks targeting money have an additional target in their monetary policy strategy, usually inflation targeting. The most obvious cases are the twelve euro countries, included separately in our exercise. 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.

As an additional aspect of the monetary policy design, we introduce central bank independence. The rationale behind is that the government may interfere in the central bank's pursuing its objectives if

the central bank is not independent. The *a priori* for the impact of central bank independence on financial stability should, therefore, follow the same reasoning as for the central bank objectives. If synergies exist, a high degree of central bank independence, which has been proved to foster price stability, should also contribute to financial stability.

Finally, we will control for the location of regulation and supervision responsibilities, being closely related to the institutional design and in many cases, to the central bank functions. Again, 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 role of the monetary policy design.

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




## 5 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 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 the list of crisis events considered, 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[11]. 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 transition 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

11 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.

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 targeting 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.

To construct these dummies, we use information on the monetary policy strategies of 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. It includes 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).

In order to take into account the degree of independence of the central bank, we include an index which measures to what extent the central banks are legally independent according to their charters, following the approach of Cukierman *et al.* (1992). This variable goes from 0 (least independent) to 1 (most independent) and is taken from Cukierman *et al.* (1992), for the 1970s and 1980s, and from Mahadeva and Sterne (2000) and Cukierman *et al.*[12] (2002) for the 1990s. Although many other indexes exist, these have been chosen because they cover the largest number of countries for the largest time frame and also because they are very similar in their construction[13]. In fact, both

12 This is only available for transition countries.

13 The construction of central bank independence indices differs widely. Mangano (1998) compares the Cukierman index and the Grilli-Masciandaro-Tabellini index and concludes that 45% of the criteria are not regarded as relevant in the second.

Cukierman *et al*. (1992 and 2002) and Mahadeva and Sterne (2000) clusters include the appointment, dismissal and term of office of Governor, the independence in policy formulation, the limitations in lending to the government, and the central bank objectives, as components of their central bank independence index. Given that the central bank objectives are a component of the independence index, we should expect some degree of collinearity between the two variables. As in the case of the variable of central bank objectives, the index of independence is assumed to be constant through every year of each decade.

We also want to control for an important institutional variable, the location of bank regulation and supervision. This information 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 for a long enough period of time.

Finally, we also control for three types of factors, based on the previous review of the literature, macroeconomic, financial and institutional ones. 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.[14]

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.[15] As for real interest rates, high levels should hamper financial stability, but too low levels (namely negative) may also be detrimental since they reduce banks' margins and discourage savings. Large capital inflows may be harmful 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

14 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.

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

economic growth and real GDP per capita) 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 real GDP per capita, 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, which should 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.

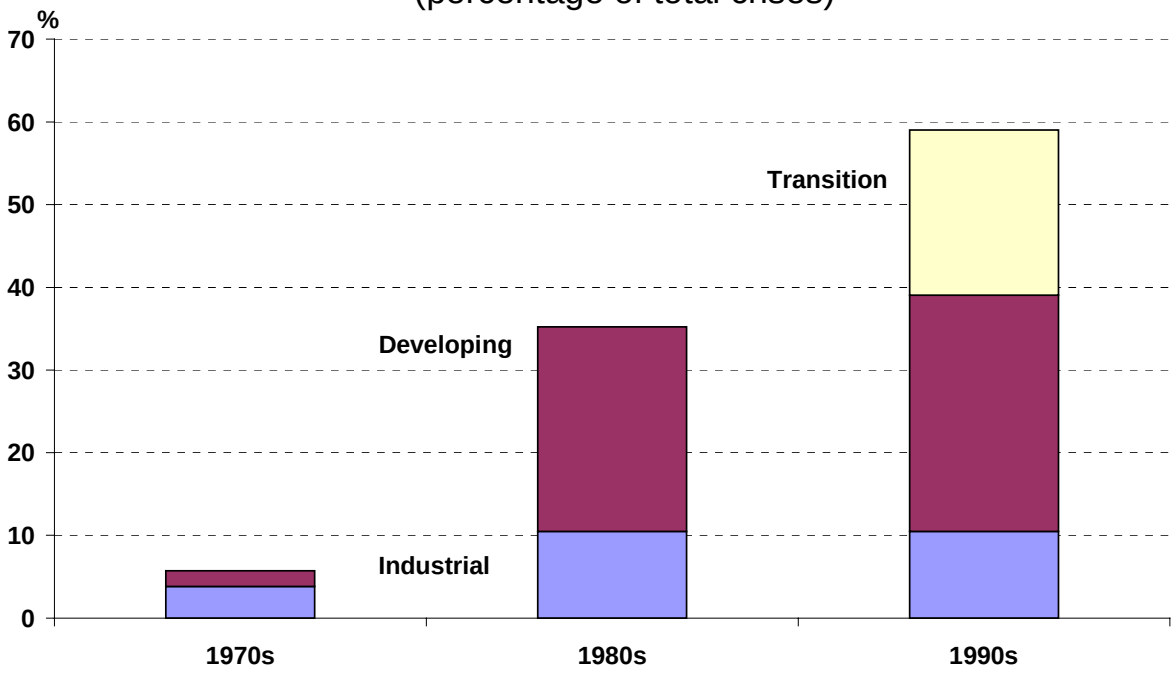
The third set of control variables are institutional ones: the existence of a deposit insurance scheme and financial liberalization. Both variables are dummies stemming from different surveys and empirical studies (see the appendix for details and sources). Given the risks of unlimited deposit insurance systems and disorderly financial liberalizations highlighted in the literature, both variables have a positive a priori sign in our analysis.

## 6 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 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.

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

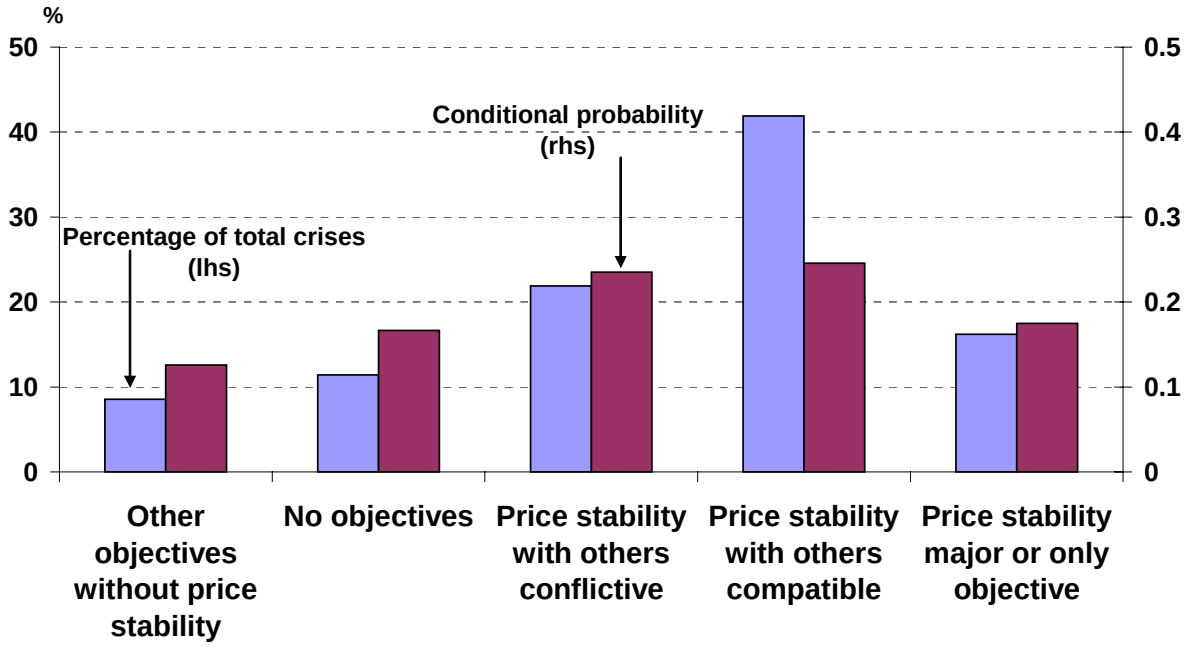



In order to assess whether the design of monetary policy can affect the likelihood of banking crisis events, we conduct a few preliminary exercises before embarking in the econometric analysis. We first look at the number of crises which have occurred in the period of study (1970-1999) for different 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

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

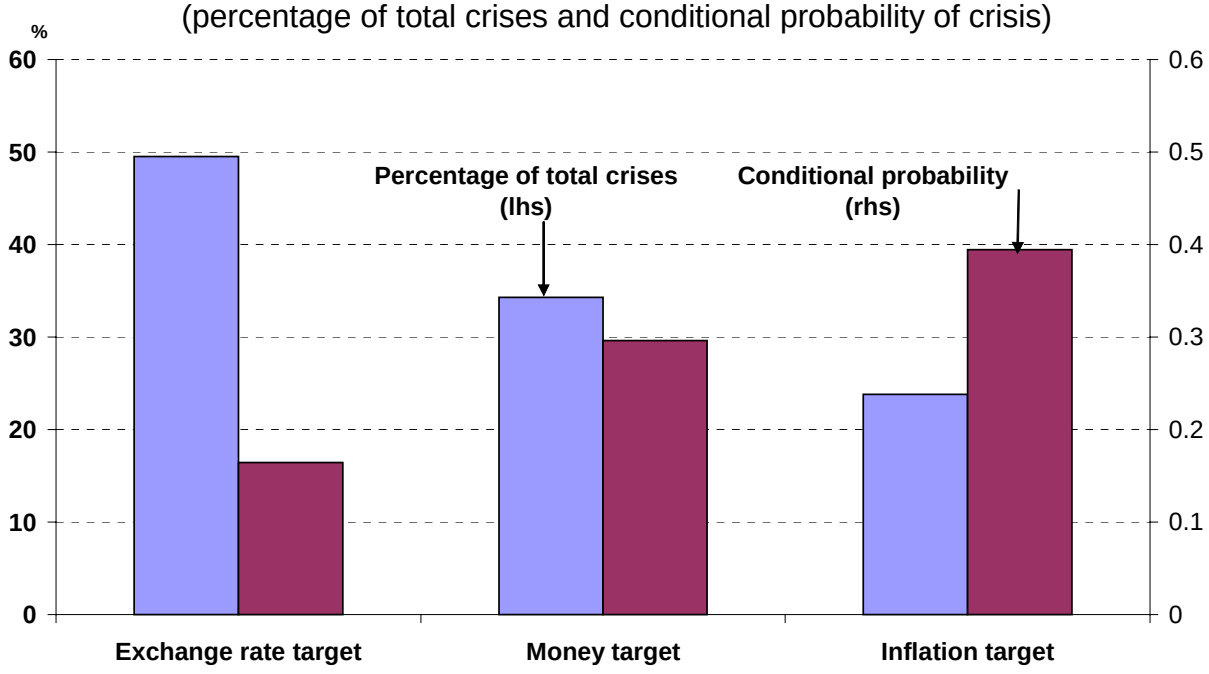
**Figure 4: Distribution of crises by Central Bank Objectives**
(percentage of total crises and conditional probability of crisis)




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 substantially 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 and previously revised in section 3 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)




## 7 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 focuses on 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.

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 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:

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

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

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

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 $X_{t-1}$[16].

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

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 crucial reason why we cannot use fixed effects is the small 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. Finally, in view of the large standard deviation of some control variables, particularly inflation, real interest rates and credit growth (Table 3 in the Appendix), we

16 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:

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

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

substitute the 5% extreme values in the sample for a maximum value close to the 95$^{th}$ 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, financial and institutional variables and even our objective variable, the monetary policy design. 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. While this should reduce central bankers' interest in changing the design of monetary policy, 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.[17]

## 8 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, financial and institutional 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.[18] The third takes both the index of central bank objectives and the three strategy dummies, as well as all control variables. It should be noted that, throughout the results, we show the coefficients of the regressions, not the marginal effect of each regressor on the probability of a banking crisis. This should be sufficient as we are mainly interested in the sign and significance of the coefficient.

17 Seven of 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.

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 crises stemming from one or a few banks' mismanagement and not necessarily from macroeconomic, financial or institutional reasons.

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. Targeting the exchange rate is mildly significant in reducing the likelihood of a banking crisis in one specification. As for the control variables, the results were as expected: A higher economic growth and higher real GDP per capita 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.

18 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).

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

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| **Control variables** | | | |
| *Inflation* | -0.0059 | -0.0069 | -0.0072 |
| | -(0.87) | -(1.04) | -(1.05) |
| *Real interest rate* | 0.0084 | 0.0138 | 0.0105 |
| | (0.90) | (1.45) | (1.11) |
| *GDP per capita* | -0.0003 *** | -0.0004 *** | -0.0003 *** |
| | -(6.98) | -(7.18) | -(6.43) |
| *Real GDP growth* | -0.0614 ** | -0.0720 *** | -0.0624 ** |
| | -(2.22) | -(2.66) | -(2.23) |
| *Domestic credit growth* | 0.0058 | 0.0049 | 0.0059 |
| | (0.91) | (0.79) | (0.93) |
| *Cash held by banks / Bank assets* | -2.3800 * | -3.6000 *** | -2.3140 * |
| | -(1.91) | -(2.98) | -(1.87) |
| *Foreign liabilities / Foreign assets* | -0.0070 | -0.0059 | -0.0044 |
| | -(0.24) | -(0.21) | -(0.16) |
| *Net capital flows / GDP* | -0.1501 | -0.1298 | -0.1430 |
| | -(0.61) | -(0.63) | -(0.62) |
| *Financial liberalization* | 0.4501 | 0.3914 | 0.5680 |
| | (1.23) | (1.10) | (1.51) |
| *Deposit insurance* | -0.0017 | 0.2248 | 0.0730 |
| | (0.00) | (0.51) | (0.16) |
| **Objective variables** | | | |
| *Central bank focus on price stability* | -1.6112 *** | | -1.2144 ** |
| | -(3.46) | | -(2.38) |
| *Exchange rate target strategy* | | -0.5283 * | -0.3427 |
| | | -(1.69) | -(1.03) |
| *Money target strategy* | | -0.6486 | -0.2482 |
| | | -(1.54) | -(0.55) |
| *Inflation target strategy* | | -0.7650 | -0.6300 |
| | | -(1.54) | -(1.21) |
| *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 – as concerns the probability of suffering from a banking crisis. This is in line with the result found by Domaç and Martinez-Peria (2000).

The third and final specification – with all objective variables – confirms the negative coefficient of narrow central bank objectives (at 5% level) 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 significantly reduces the likelihood of a crisis in all specifications where it was included. Additionally, as one would expect, financial liberalization significantly increases the likelihood of a banking crisis in two of the three specifications. Finally, in the second and third specifications, inflation reduces the probability of a crisis at a 10% confidence level. Although the result is weak and should be taken with care, it could offer some preliminary empirical support to the recent literature strand which considers very low levels of inflation, in countries not used to price stability, as a source of euphoria and, thereby, financial instability.

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

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| **Control variables** | | | |
| *Inflation* | -0.0091 | -0.0120 * | -0.0117 * |
| | -(1.44) | -(1.90) | -(1.84) |
| *Real interest rate* | 0.0086 | 0.0138 | 0.0108 |
| | (1.01) | (1.57) | (1.24) |
| *GDP per capita* | -0.0002 *** | -0.0002 *** | -0.0002 *** |
| | -(6.27) | -(6.45) | -(5.64) |
| *Real GDP growth* | -0.0786 *** | -0.0783 *** | -0.0706 *** |
| | -(3.13) | -(3.17) | -(2.83) |
| *Domestic credit growth* | 0.0043 | 0.0050 | 0.0058 |
| | (0.76) | (0.90) | (1.02) |
| *Cash held by banks / Bank assets* | -2.0780 ** | -2.6834 *** | -1.6418 |
| | -(2.00) | -(2.61) | -(1.62) |
| *Foreign liabilities / Foreign assets* | -0.0101 | -0.0094 | -0.0082 |
| | -(0.36) | -(0.36) | -(0.32) |
| *Net capital flows / GDP* | -0.0429 | -0.0826 | -0.0686 |
| | -(0.20) | -(0.48) | -(0.36) |
| *Financial liberalization* | 0.6229 ** | 0.4991 | 0.6249 ** |
| | (2.07) | (1.64) | (2.01) |
| *Deposit insurance* | -0.2972 | -0.2026 | -0.2621 |
| | -(0.85) | -(0.58) | -(0.75) |
| **Objective variables** | | | |
| *Central bank focus on price stability* | -1.4255 *** | | -1.0599 *** |
| | -(3.85) | | -(2.73) |
| *Exchange rate target strategy* | | -0.8249 *** | -0.6600 ** |
| | | -(3.26) | -(2.53) |
| *Money target strategy* | | -0.1902 | 0.0322 |
| | | -(0.60) | (0.10) |
| *Inflation target strategy* | | -0.6446 | -0.4084 |
| | | -(1.54) | -(0.96) |
| *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.

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. We use only systemic crises as dependent variable.

As before, in the case of industrial countries, central bank objectives focused on price stability significantly reduce the likelihood of crisis events, but only in the first specification (column 1 of Table 3), and at a lower confidence level. In addition, no monetary policy strategy appears superior

to the others as regards the occurrence of a banking crisis (column 2 of Table 3). As for the control variables, only the real GDP per capita is found significant, with the correct sign.

**Table 3: Logit estimations for systemic banking crises in industrial countries**

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| **Control variables** | | | |
| *Inflation* | -0.0595 | -0.0486 | -0.0536 |
| | -(0.76) | -(0.66) | -(0.70) |
| *Real interest rate* | 0.0942 | 0.0923 | 0.1007 |
| | (1.10) | (1.08) | (1.24) |
| *GDP per capita* | -0.0002 ** | -0.0002 ** | -0.0002 ** |
| | -(2.18) | -(2.38) | -(2.18) |
| *Real GDP growth* | -0.1672 | -0.1895 | -0.1710 |
| | -(1.15) | -(1.43) | -(1.20) |
| *Domestic credit growth* | 0.0021 | 0.0010 | -0.0001 |
| | (0.08) | (0.04) | (0.00) |
| *Cash held by banks / Bank assets* | -4.1366 | -5.6206 | -3.6587 |
| | -(0.64) | -(0.81) | -(0.56) |
| *Foreign liabilities / Foreign assets* | -0.1187 | -0.1004 | -0.0524 |
| | -(0.33) | -(0.27) | -(0.15) |
| *Net capital flows / GDP* | -0.2406 | -2.4806 | -0.3011 |
| | -(0.03) | -(0.33) | -(0.04) |
| *Financial liberalization* | -0.4822 | -0.6295 | -0.3686 |
| | -(0.56) | -(0.74) | -(0.43) |
| *Deposit insurance* | 0.2062 | 0.2197 | 0.1943 |
| | (0.24) | (0.26) | (0.22) |
| **Objective variables** | | | |
| *Central bank focus on price stability* | -1.7389 * | | -1.6127 |
| | -(1.81) | | -(1.63) |
| *Exchange rate target strategy* | | -0.5012 | -0.2209 |
| | | -(0.71) | -(0.30) |
| *Money target strategy* | | -0.3345 | 0.0222 |
| | | -(0.44) | (0.03) |
| *Inflation target strategy* | | -33.8510 | -37.5597 |
| | | (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.

In the emerging country group the results are similar to the baseline one (Table 4). 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, money target seems slightly superior to the other monetary policy strategies. As in the baseline, real GDP per capita and the liquidity held by banks substantially lower the likelihood of a banking crisis. Finally, higher real interest rates appear to increase the probability of banking crises at a 10% significance level in two of the three specifications.

**Table 4: Logit estimations for systemic banking crises in emerging countries**

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| **Control variables** | | | |
| *Inflation* | -0.0006 | -0.0010 | -0.0020 |
| | -(0.07) | -(0.11) | -(0.23) |
| *Real interest rate* | 0.0188 | 0.0224 * | 0.0193 * |
| | (1.60) | (1.95) | (1.65) |
| *GDP per capita* | -0.0004 *** | -0.0005 *** | -0.0004 *** |
| | -(3.75) | -(3.96) | -(3.14) |
| *Real GDP growth* | -0.0561 | -0.0570 * | -0.0522 |
| | -(1.53) | -(1.66) | -(1.46) |
| *Domestic credit growth* | 0.0017 | 0.0005 | 0.0014 |
| | (0.19) | (0.06) | (0.15) |
| *Cash held by banks / Bank assets* | -2.9402 ** | -3.8913 *** | -2.9789 ** |
| | -(1.95) | -(2.87) | -(2.00) |
| *Foreign liabilities / Foreign assets* | -0.0026 | -0.0006 | -0.0015 |
| | -(0.10) | -(0.02) | -(0.06) |
| *Net capital flows / GDP* | -0.1057 | -0.0606 | -0.0815 |
| | -(0.43) | -(0.27) | -(0.34) |
| *Financial liberalization* | 0.0440 | 0.1393 | 0.1670 |
| | (0.10) | (0.32) | (0.36) |
| *Deposit insurance* | 0.3255 | 0.7812 | 0.5663 |
| | (0.60) | (1.48) | (0.96) |
| **Objective variables** | | | |
| *Central bank focus on price stability* | -1.1821 ** | | -0.8043 |
| | -(2.08) | | -(1.31) |
| *Exchange rate target strategy* | | -0.3556 | -0.2991 |
| | | -(0.91) | -(0.67) |
| *Money target strategy* | | -1.0383 * | -0.5586 |
| | | -(1.73) | -(0.76) |
| *Inflation target strategy* | | -0.7162 | -0.5783 |
| | | -(1.26) | -(0.96) |
| *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 (Table 5). Nevertheless, the results for the transition country group should be taken with care, due to the small number of observations 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. Since the tests of joint significance are very poor, we exclude a few control variables to increase the degrees of freedom. In particular, we exclude the two dummies representing institutional variables (columns 4-6 of Table 5). In this case, the choice of an exchange rate based strategy is clearly superior, in terms of the likelihood of a crisis both in all specifications where included. 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. In addition, the growth of domestic credit increases the probability of a crisis and net capital flows reduce it.

**Table 5: Logit estimations for systemic banking crises in transition countries**

| Variable | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Control variables** | | | | | | |
| *Inflation* | -0.0159 | -0.0692 | -0.0780 | 0.0013 | 0.0052 | -0.0056 |
| | -(0.68) | -(0.93) | -(0.92) | (0.12) | (0.41) | -(0.34) |
| *Real interest rate* | -0.0140 | 0.0297 | 0.0886 | -0.0019 | 0.0243 | 0.0367 |
| | -(0.51) | (0.45) | (0.94) | -(0.10) | (1.01) | (1.23) |
| *GDP per capita* | -0.0001 | -0.0002 | 0.0000 | -0.0001 | 0.0000 | -0.0001 |
| | -(0.31) | -(0.73) | -(0.02) | -(0.64) | (0.09) | -(0.63) |
| *Real GDP growth* | 0.1542 | 0.2834 | 0.3247 | 0.1456 | 0.2231 | 0.2609 * |
| | (1.17) | (1.29) | (1.34) | (1.65) | (1.62) | (1.63) |
| *Domestic credit growth* | 0.0259 | 0.0211 | 0.0486 | 0.0226 * | 0.0300 ** | 0.0219 * |
| | (1.45) | (1.47) | (1.53) | (1.75) | (2.30) | (1.66) |
| *Cash held by banks / Bank assets* | 7.7069 | 14.3156 | 23.6004 | 1.6448 | 0.4500 | 0.7752 |
| | (1.30) | (1.20) | (1.34) | (0.59) | (0.14) | (0.22) |
| *Foreign liabilities / Foreign assets* | -0.4810 | 0.0370 | 0.9332 | -0.4312 | 0.3085 | 0.2477 |
| | -(0.60) | (0.03) | (0.62) | -(0.68) | (0.44) | (0.31) |
| *Net capital flows / GDP* | -4.6147 | -30.3405 * | -34.0572 | -6.9050 | -12.0739 | -21.7375 ** |
| | -(0.40) | -(1.73) | -(1.53) | -(0.86) | -(1.39) | -(1.93) |
| *Financial liberalization* | 5.6562 | 11.4704 | 21.9029 | | | |
| | (1.08) | (1.29) | (1.40) | | | |
| *Deposit insurance* | -1.5454 | -1.4148 | -0.8872 | | | |
| | -(0.81) | -(0.86) | -(0.57) | | | |
| **Objective variables** | | | | | | |
| *Central bank focus on price stability* | -8.2991 | | -11.7726 | -1.7827 | | 5.4542 |
| | -(1.29) | | -(1.27) | -(1.07) | | (1.54) |
| *Exchange rate target strategy* | | -12.1139 | -15.2821 | | -3.2477 ** | -6.7013 ** |
| | | -(1.51) | -(1.31) | | -(1.92) | -(2.15) |
| *Money target strategy* | | -1.3984 | -1.5860 | | -0.5359 | -1.5787 |
| | | -(0.86) | -(0.78) | | -(0.50) | -(1.22) |
| *Inflation target strategy* | | -1.4525 | -4.4284 | | -0.7958 | -0.2033 |
| | | -(0.94) | -(1.26) | | -(0.72) | -(0.17) |
| *Number of observations* | 50 | 50 | 50 | 50 | 50 | 50 |
| *Wald Test (p-value)* | (0.75) | (0.76) | (0.92) | (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.

We now introduce two important institutional variables, which are directly related to the objective of our study: the degree of central bank independence and the location of the responsibility for bank regulation and supervision. When controlling for these two variables (Table 6), central bank independence significantly reduces the likelihood of a banking crises. The central bank objectives are not significant any longer, which is not strange if we consider the high collinearity between the two variables (0.47). This is because having narrower objectives increases the degree of central bank independence in the index used in this study.

The exchange rate-based monetary policy strategy is no longer even mildly significant as in the baseline exercise. The results for the control variables are practically the same as in the baseline, namely the GDP per capita, real GDP growth and banks' liquidity reduce the likelihood of a crisis and financial liberalization increases it.

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. It should be noted 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.

**Table 6: Logit estimations for systemic banking crises in all countries controlling for central bank independence and central bank supervision of financial system**

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| **Control variables** | | | |
| *Inflation* | -0.0007 | -0.0017 | -0.0015 |
| | -(0.12) | -(0.27) | -(0.23) |
| *Real interest rate* | 0.0119 | 0.0116 | 0.0121 |
| | (1.39) | (1.35) | (1.39) |
| *GDP per capita* | -0.0003 *** | -0.0003 *** | -0.0003 *** |
| | -(6.63) | -(6.14) | -(6.09) |
| *Real GDP growth* | -0.0468 * | -0.0478 * | -0.0481 * |
| | -(1.76) | -(1.75) | -(1.76) |
| *Domestic credit growth* | 0.0051 | 0.0055 | 0.0054 |
| | (0.85) | (0.92) | (0.89) |
| *Cash held by banks / Bank assets* | -2.2684 ** | -2.2127 ** | -2.2913 ** |
| | -(2.09) | -(2.04) | -(2.05) |
| *Foreign liabilities / Foreign assets* | -0.0099 | -0.0086 | -0.0077 |
| | -(0.37) | -(0.33) | -(0.30) |
| *Net capital flows / GDP* | -0.1495 | -0.1428 | -0.1405 |
| | -(0.60) | -(0.58) | -(0.58) |
| *Financial liberalization* | 0.5774 * | 0.6143 * | 0.6137 * |
| | (1.72) | (1.80) | (1.79) |
| *Deposit insurance* | 0.0026 | 0.0264 | 0.0583 |
| | (0.01) | (0.06) | (0.14) |
| **Objective variables** | | | |
| *Central bank focus on price stability* | 0.0965 | | 0.1756 |
| | (0.19) | | (0.34) |
| *Exchange rate target strategy* | | -0.1526 | -0.1537 |
| | | -(0.51) | -(0.51) |
| *Money target strategy* | | -0.1817 | -0.2141 |
| | | -(0.47) | -(0.54) |
| *Inflation target strategy* | | -0.1085 | -0.1106 |
| | | -(0.22) | -(0.23) |
| *Central bank independence* | -1.6935 ** | -1.4338 ** | -1.5910 * |
| | -(2.11) | -(2.11) | -(1.93) |
| *Central bank supervision of financial system* | -1.0826 *** | -1.0241 *** | -1.0359 *** |
| | -(3.74) | -(3.50) | -(3.52) |
| *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.

## 9 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. 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. Finally, when including the degree of central bank independence, this becomes highly significant in reducing the likelihood of a banking crisis while the central bank objectives lose their significance. This is probably due to the high collinearity between the two variables, being the central bank objectives part of the independence index.

As for the monetary policy strategy, exchange rate targeting is found beneficial 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 to avoid banking crises, but the result could change if the definition of financial instability were expanded to currency crises or other asset prices.

Finally, locating bank regulatory and supervisory responsibilities at the central bank significantly reduces the probability of banking crises. This is an interesting 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 the variable representing the location of supervision.

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 which affects the central bank design and the degree of independence, for instance the rule of law, as recently shown by Eijffinger and Stadhousers (2003). Second, 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).[19] The list of objectives and countries is available by decades, so we have assumed it constant through every year of each decade except for the most recent years where the information on some countries has been

19 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.

updated with other sources, mainly Mahadeva and Sterne (2000) but also Cukierman *et al*. (2002) for transition countries

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

- ***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).*

- ***Central Bank Independence***: measures to what extent the central banks are legally independent according to their charters, following the approach of Cukierman *et al.* (1992). This variable goes from 0 (least independent) to 1 (most independent) and is taken from Cukierman *et al.* (1992), for the 1970s and 1980s, and from Mahadeva and Sterne (2000) and Cukierman *et al*. (2002) for the 1990s. Without getting into too much detail (see the references in case of interest), and disregarding some minor differences of construction, both indexes are more or less coherent and comparable as both try to cluster the same important issues for central bank independence (e.g., the appointment, dismissal and term of office of Governor; policy formulation; objectives; and limitations on lending to the government). As in the case of the variable of focus on price stability, the index of independence is assumed to be constant through every year of each decade.

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

- ***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).*

**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*

***Institutional variables***

- ***Financial Liberalization****:* this variable is a dummy which takes the value 1 for countries and years where the domestic financial sector (mainly, the interest rates) have been liberalized and 0 otherwise. This variable stems from several chronologies of financial liberalization: Mehrez and Kaufmann (2000) for 59 countries over the period 1973-1998, Demirgüç-Kunt and Detragiache (1998) for a panel of 53 countries for the period 1980-1995, Kaminsky and Schmukler (2002) for 28 countries since 1973 (we have take the year for the liberalization of the domestic financial sector) and Williamson and Mahar (1998) for 34 countries over the period 1973-1996.

*Source: Mehrez and Kaufmann (2000), Demirgüç-Kunt and Detragiache (1998), Kaminsky and Schmukler (2002) and Williamson and Mahar (1998).*

- ***Deposit Insurance***: this variable is a dummy which takes the value 1 for countries where there is an explicit deposit insurance system, since the year of its enactment, and 0 otherwise. This variable stems from a World Bank database compiled by Demirgürç-Kunt and Sabaci (2002). *Source: Demirgürç-Kunt and Sabaci (2002).*

**Table A1: Countries and years included**

| Country name | Years | Country name | Years |
|---|---|---|---|
| **Industrial** | | | |
| 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 |
|---|---|---|---|---|---|---|
| **Industrial** | | | | | | |
| 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 |
| Financial liberalization | 1492 | 0.49 | 0.50 | 0.00 | 1.00 |
| Deposit insurance | 1492 | 0.27 | 0.44 | 0.00 | 1.00 |
| 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 independence | 1492 | 0.48 | 0.23 | 0.00 | 0.97 |
| 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 | CB Superv. | Finan. Liberal. | Depos. Insur. | CB Indep. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | | | | | | |
| 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 | | | | |
| Central bank supervision | 0.03 | 0.10 | 0.03 | -0.28 | 0.06 | 0.10 | 0.04 | 0.03 | 0.02 | 0.11 | 0.01 | 0.08 | 0.11 | 1 | | | |
| Financial liberalization | 0.07 | 0.00 | 0.31 | 0.27 | -0.10 | 0.04 | -0.21 | -0.07 | 0.00 | 0.09 | -0.14 | 0.23 | 0.26 | -0.10 | 1 | | |
| Deposit insurance | 0.00 | -0.15 | 0.13 | 0.47 | -0.09 | -0.14 | -0.28 | -0.06 | -0.05 | -0.03 | -0.07 | 0.23 | 0.05 | -0.33 | 0.41 | 1 | |
| Central bank independence | 0.01 | -0.19 | 0.16 | 0.23 | 0.01 | -0.19 | -0.12 | -0.06 | 0.01 | 0.47 | -0.04 | 0.14 | 0.33 | -0.06 | 0.41 | 0.27 | 1 |

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

**REFERENCES**


Arteta, C. (2003) "Are Financially Dollarized Countries More Prone to Costly Crises?", in *International Finance Discussion Papers*, No. 763, Board of Governors of the Federal System.

Ball, L. and Sheridan, N. (2003) "Does inflation targeting matter?", NBER Working Paper 9577. National Bureau of Economic Research, Cambridge, Mass.

Barry, E. (1998) "Exchange rate stability and financial stability", Open Economies Review 9:S1 pp. 569-607.

Berg, A., Borensztein, E. and Mauro, P. (2002) "An evaluation of monetary regime options for Latin America", IMF Working Paper WP/02/211.

Berger, H., Haan, J., and Eijffinger, S. (2001) "Central bank independence: an update of theory and evidence". Journal of Economic Surveys, Vol. 15. Nº.1

Bernanke, B. and Gertler, M. (1990) "Financial fragility and economic performance", *Quarterly Journal of Economics*, Vol. 105, No. 1, pp. 87-114

Bernanke, B. and Gertler, M. (2000) "Monetary policy and asset price volatility", NBER Working Paper 7559. National Bureau of Economic Research, Cambridge, Mass.

Blinder, A. (1999) "General discussion: monetary policy and asset price volatility", *Fed of Kansas City Economic Review*, 4th quarter, pp. 139-140.

Bordo, M. (1986) "Financial crises, banking crises, stock market crashes, and the money supply: some international evidence, 1980-1933", in Capie, F. and Wood, G. eds., *Financial crises and the world banking system*, New York: St. Martin's.

Bordo, M., Eichengreen, B., Klingebiel, D. and Martinez Peria, M. S. (2001) "Is the crisis problem growing more severe?", Economic Policy, Volume 16, Issue 32, pp. 51-82.

Bordo, M. and Murshid, A. (2000) "Are financial crises becoming increasingly more contagious? What is the historical evidence on contagion?", NBER Working Paper 7900. National Bureau of Economic Research, Cambridge, Mass.

Bordo, M.., Mizrach, B. and Schwartz, A. (1995) "Real versus pseudo-international systemic risk: some lessons from History", NBER Working Paper 5371. National Bureau of Economic Research, Cambridge, Mass.

Borio, C. and Lowe, P. (2002) “Asset prices, financial and monetary stability: exploring the nexus”, BIS Working Papers No 114.

Calvo, G. (1997) “Capital flows and macroeconomic management: Tequila lessons” *International Journal of Finance and Economics*, vol. 1, no. 3, pp. 207-23.

Caprio, G. and Klingebiel, D. (1997) “Bank Insolvencies: Cross-Country Experience”, Policy Research Working Paper, No. 1620, Washington D.C., The World Bank.

Caprio, G. and Klingebiel, D. (2003) “Episodes of systemic and borderline financial crises”, Dataset mimeo, The World Bank.

Carare, A. and Stone, M. (2003) “Inflation targeting regimes”, IMF, WP/03/9.

Céspedes L., Chang, R and Velasco, A. (2000) "Balance sheets and exchange rate policy," NBER Working Papers 7840. National Bureau of Economic Research, Cambridge, Mass.

Crockett, A. (1997) “Why is Financial Stability a Goal of Public Policy” in *Maintaining Financial Stability in a Global Economy*, pp. 7-36, Federal Reserve Bank of Kansas City.

Crockett, A. (2000) “In search of anchors for financial and monetary stability”, SUERF Colloquium, Vienna, April 2000.

Cukierman, A. (1992) *Central bank strategy, credibility and independence: theory and evidence*, MIT Press.

Cukierman, A., Miller, G.P. and Neyapti, B. (2002) “Central bank reform, liberalization and inflation in transition economies – an international perspective”, *Journal of Monetary Economics*, 49 (2002), pp. 237-264.

Cukierman, A., Webb, S.B. and Neyapti, B. (1992) “Measuring the independence of central banks and its effect on policy outcomes”, *The World Bank Economic Review* 6, pp. 353-398.

Demirgürç-Kunt, A. and Detragiache, E. (1998) “Financial liberalization and financial fragility”, Annual World Bank Conference on Development Economics.

Demirgürç-Kunt, A. and Detragiache, E. (2000) “Does deposit insurance increase banking system stability?”, IMF WP/00/3.

Demirgürç-Kunt, A. and Sabaci, T. (2002) “Deposit insurance around the world: A data base”, Research dataset, The World Bank.

Domaç, I. and Martinez Peria, M.S. (2000) “Banking crises and exchange rate regimes: is there a link?”, The World Bank Working Paper No. 2489.

Eichengreen, B. (1998) “Exchange Rate Stability and Financial Stability”, *Open Economies Review* 9:S1, pp. 569-607, Kluwer Academic Publishers, The Netherlands.

Eichengreen, B. and Rose, A. K. (1998) “Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises”, *Centre for Economic Policy Research,* Discussion Paper No. 1828, London.

Eichengreen, B. and Arteta, C. O. (2000) “Banking Crises in Emerging Markets: Presumptions and Evidence”, mimeo.

Eijffinger, S. and Stadhousers, P. (2003) “Monetary Policy and the Rule of Law”, Center for Economic Policy Research, International Macroeconomics, No 3698.

English, W. (1996) “Inflation and financial sector size”, Finance and Economic Discussion Papers No 96/16, Board of Governors of the Federal Reserve, Washington D.C.

Fisher, I. (1933) “The Debt-Deflation Theory of Great Depressions”, Econometrica.

Frankel, J. and Rose, A. (1998) “Currency crashes in emerging markets: an empirical treatment”, *Journal of International Economics*, Vol. 41, pp. 351-66.

Friedman, M. and Schwartz, A. J. (1963) “A Monetary History of the United States”, 1867-1960, Princeton, N. J., Princeton University Press.

García Herrero, A. (1997) “Monetary impact of a banking crisis and the conduct of monetary policy”, IMF Working Paper 97/124.

Gavin, M. and Hausmann, R. (1996) “The roots of banking crises: The macroeconomic context”, mimeo.

Goldfajn, I. and Valdes, R. (1995) “Balance of Payment Crises and Capital Flows: The Role of Liquidity”, MIT unpublished manuscript.

Gorton, G. (1999) “Pricing free bank notes”, *Journal of Monetary Economics*, Vol. 44, pp. 33-64.

Gourinchas, P.O., Valdés, R. and Landarretche, O. (2001) “Lending booms: Latin America and the world”, *Economia*, vol 1(2).

Greenwald, B. and Stiglitz, J. E. (1988) “Information, Finance Constraints, and Business Fluctuations” in M. Kohn and S. C. Tsiang (eds.) *Expectations and Macroeconomics*, Oxford University Press, Oxford.

Gupta, P. (1996) “Currency crises, banking crises and twin crises: a comprehensive review of the literature”, International Monetary Fund, mimeo.

Haldane, A., Hoggarth, G. and Saporta, V. (2001) "Assessing Financial Stability, Efficiency and Structure at the Bank of England”, Published in BIS Papers No.1, Marrying the Macro-Prudential Dimensions of Financial Stability.

Hardy, D. and Pazarbasioglu, C. (1999) “Determinants and leading indicators of banking crises: further evidence”, IMF Staff Papers, Vol.46, nº3.

International Monetary Fund. (1998) “Financial crises: characteristics and indicators of vulnerability”, in *World Economic Outlook*, Chapter IV, May 1998.

Issing, O. (2003) “Monetary and financial stability: is there a trade-off?” Conference on “Monetary stability, financial stability and the business cycle”. March 28-29, 2003. Bank for International Settlements, Basle.

Kaminsky, G. (1999) “Currency and Banking Crises: The Early Warnings of Distress”, *IMF Working Paper*, WP/99/178.

Kaminsky, G. and Reinhart, C. (1999) “The twin crises: the causes of banking and balance-of-payments problems”. *American Economic Review*, Vol. 89, No. 3, pp. 473-500.

Kaminsky, G. and Schmukler, S. (2002) “Short-run pain, lon-run gain: the effects of financial liberalization”. The World Bank Working Paper No. 2912.

Kuttner, K.N. and Posen, A.S. (2001) “Beyond bipolar: a three-dimensional assessment of monetary frameworks”, Oesterreichische Nationalbank Working Paper 52.

La Porta, R., Lopez-De-Silanes, F., Shleifer, A. and Vishny, R.W. (1998) “Law and finance”, *Journal of Political Economy*, Vol. 106, no. 6, pp. 1113-1151.

Lindgren, C.J., Garcia, G. and Saal, M.I. (eds.) (1996) *Bank soundness and macroeconomic policy*, International Monetary Fund.

Mahadeva, L., and Sterne, G. (eds.) (2000) *Monetary policy frameworks in a global context*, London, Routledge.

Mangano, G. (1998) “Measuring central bank independe: a tale of subjectivitt and of its consequences. Oxford Economic Papers, 50, 468-492.

Martinez Peria, M. S. (2000) “The impact of banking crises on money demand and price stability”, The World Bank Working Paper 2305.

McKinnon, R. I. and Pill, H. (1994) “Credible Liberalizations and International Capital Flows: the Overborrowing Syndrome”, Stanford University, Stanford.

Mehrez, G. and Kaufman, D. (2000) “Transparency, Liberalization and Banking crises”. The World Bank Working Paper No. 2286.

Mishkin, F. S. (1996) “Understanding financial crises: a developing country’s perspective”, NBER Working Paper 5600. National Bureau of Economic Research, Cambridge, Mass.

Mishkin, F. S. (1998) “International Capital Movements, Financial Volatility and Financial Instability”, Working Paper 6390, National Bureau of Economic Research, Cambridge.

Padoa-Schioppa, T. (2002) “Central banks and financial stability: exploring a land in between”, paper presented at the Second ECB Central Banking Conference “The transformation of the European financial system”, Frankfurt am Main, October 2002.

Reinhart, C.M. and Rogoff, K.S. (2002) “The modern history of exchange rate arrangements: a reinterpretation”, NBER Working Paper 8963. National Bureau of Economic Research, Cambridge, Mass.

Sachs, J., Velasco, A. and Tornell, A. (1996) "Financial crises in emerging markets: the lessons from 1995", *Brookings Papers on Economic Activity*, 1996:1, pp. 147-98.

Schinasi, G. J. (2003) “Responsibility of central banks for stability in financial markets”, IMF Working Paper 03/121.

Schwartz, A. (1995) “Systemic risk and the macroeconomy” in Kaufman, G., ed. *Banking financial markets and systemic risk*, Research in Financial Services, Private and Public Policy, Vol. 7, JAI Press Inc., Hampton

Tuya, J. and Zamalloa, L. (1994) “Issues on placing banking supervision in the central bank”, in Baliño, T. and Cottarelli, C. *Frameworks for monetary stability: policy issues and country experiences*, International Monetary Fund.

Viñals, J. (2001) “Monetary policy issues in a low inflation environment”, in Garcia Herrero A., Gaspar, V., Hoogduin, L., Morgan, J. and Winkler, B. (eds.) *Why price stability?*, European Central Bank.

Williamson, J. and Mahar, M. (1998) “A survey of financial liberalization”, *Essays in International Finance*, No. 211, November 1998. Department of Economics, Princeton University.