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The Cost of Banking Crises: Does the Policy Framework Matter?

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ABSTRACT

This paper empirically investigates how the stringency of macroeconomic policy frameworks impacts the unconditional cost of banking crises. We consider monetary, fiscal and exchange rate policies. A restrictive policy framework may promote stronger banking stability, by enhancing discipline and credibility, and by giving financial room to policymakers. At the same time though, tying the hands of policymakers may be counterproductive and procyclical, especially if it prevents them from responding properly to financial imbalances and crises. Our analysis considers a sample of 146 countries over the period 1970-2013, and reveals that extremely restrictive policy frameworks are likely to increase the expected cost of banking crises. By contrast, by combining discipline and flexibility, some policy arrangements such as budget balance rules with an easing clause, intermediate exchange rate regimes or an inflation targeting framework may significantly contain the cost of banking crises. As such, we provide evidence on the benefits of "constrained discretion" for the real impact of banking crises.

Keywords: Banking crises, Fiscal rules, Monetary policy, Exchange rate regime, Constrained discretion.

JEL classification: E44, E58, E61, E62, G01

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NON-TECHNICAL SUMMARY

Many efforts have been made previously to identify the main causes of banking crises and the drivers of their cost, especially in the aftermath of the Global Financial Crisis. Surprisingly, the effects of the macroeconomic policy framework are largely ignored.

In general terms, the macroeconomic policy framework refers to all the characteristics that define and restrict the conduct of monetary, fiscal and exchange rate policies. This covers formal arrangements such as fiscal rules, pegged or floating exchange rate regimes, inflation targeting, and the degree of central bank independence. Some further features may be less formal, such as the degree of central bank conservatism.

The objective of this paper is consequently to assess empirically how monetary policy, fiscal policy and exchange rate frameworks affect the cost of systemic banking crises. More specifically, in line with the rule versus discretion debate, we focus on how restrictive these policy frameworks are, as stringency may have ambivalent effects on the costs of banking crises. Indeed, in one way, a stringent policy framework is supposed to enhance discipline, improve credibility and enforce greater accountability, and it may give financial room to policymakers. This is conducive to greater economic and banking sector stability. Equally however, restrictive policy frameworks can be counterproductive and pro-cyclical, and while they are not sufficient to prevent banking crises, stringent frameworks lack the flexibility to respond to unforeseeable shocks. This means that tying the hands of policymakers may render banking crises more costly.

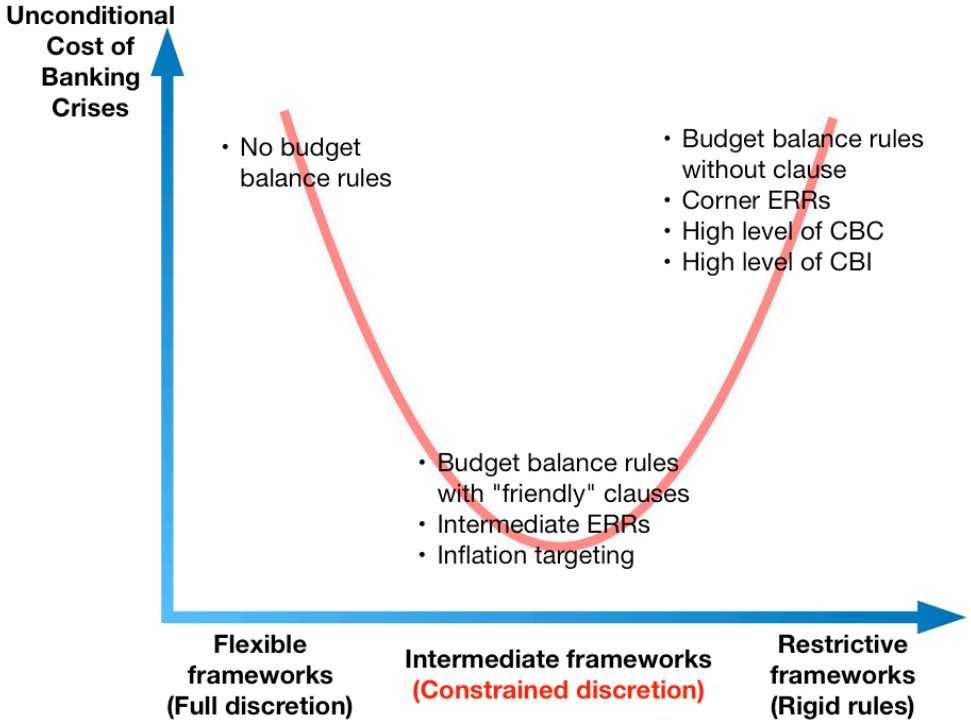
The second original contribution of this paper is the focus on the unconditional cost of banking crises. The existing literature concentrates on the cost of banking crises conditional on a banking crisis actually happening, but this produces selection bias. This leads to the factors that may explain why a crisis does or does not occur being neglected, meaning the vulnerabilities that can lead to a banking crisis are ignored. The policy frameworks can have an impact on these financial vulnerabilities, and from this point of view, the absence of a banking crisis is an important piece of information because a given policy framework can be responsible for either a crisis or a non-crisis. In this sense we propose to gauge the global effect of any policy framework on the unconditional output losses related to banking crises, in a similar way to a cost-benefit analysis, for a sample of 146 countries over the period 1970-2013.

Our results reveal that the policy framework as a whole actually matters for explaining the real costs related to banking crises. More precisely, we find a trade-off between stringency and flexibility. The absence of restriction is associated with relatively high expected costs. For instance, the expected losses are around five times higher in countries with no budget balance rules than in those having a fiscal rule with easing clauses. At the other extreme, very restrictive policy features such as corner exchange rate regimes, budget balance rules without easing clauses and a high degree of monetary policy conservatism and independence are conducive to a higher real cost for crises.

In contrast, fiscal rules with easing clauses, intermediate exchange rate regimes and an inflation targeting framework can significantly contain the expected cost of banking crises by combining discipline and flexibility. For example, the expected real losses are around twice as high in countries operating under a corner exchange rate regime as in those operating under an intermediate exchange rate regime. Similarly, pursuing an inflation targeting strategy halves the real costs related to banking crises.

In this way, we provide evidence for the benefits of policy frameworks based on "constrained discretion". Two decades ago, a seminal paper by Bernanke and Mishkin

(1997) asserted that constrained discretion is a desirable compromise for macroeconomic stability, in particular through inflation targeting. In this paper we provide evidence that constrained discretion is also suitable for minimizing the real costs of banking crises.



Le cadre de politique macro-économique influence-t-il le coût des crises bancaires ?

RÉSUMÉ

Cet article empirique vise à déterminer si le caractère plus ou moins restrictif du cadre de politique macroéconomique – politique monétaire, politique budgétaire et régimes de change – influence le coût réel espéré des crises bancaires. Dans la lignée du débat règle vs discrétion, nos estimations, fondées sur un échantillon de 146 pays sur la période 1970-2013, révèlent qu'il existe un arbitrage entre flexibilité et restriction. L'absence de contraintes, comme par exemple l'absence de règle de déficit budgétaire, tend à accroître le coût espéré des crises. De même, un cadre très contraignant, tel qu'un régime de change strictement fixe ou flottant, une règle budgétaire sans clause de flexibilité, ou un fort degré de conservatisme et d'indépendance des banques centrales augmentent le coût réel des crises bancaires. A l'inverse, parce qu'ils permettent de combiner discipline et flexibilité, des règles de déficit budgétaire avec clauses de flexibilité, un régime de change intermédiaire et un régime de ciblage d'inflation parviennent à limiter significativement le coût espéré des crises bancaires. Ce faisant, nous soulignons les bénéfices nets associés à un cadre de politique macro-économique reposant sur la « discrétion contrainte ».

Mots-clés : Crises bancaires, Règles budgétaires, Politique monétaire, Régime de change, Discrétion contrainte.

1 Introduction

Many efforts have been made previously to identify the main causes of banking crises and the drivers of their cost, especially in the aftermath of the global financial crisis. This issue remains important as a decade of easy global monetary and financial conditions may have increased financial imbalances and encouraged financial institutions to increase their risk-taking.

Banking and financial crises are the prime source of balance sheet recessions, which are more harmful than real business cycle recessions (Reinhart and Reinhart, 2010; Taylor, 2015). Surveys indicate the role played by excess credit growth and debt, GDP per capita, exchange rate developments and current account deficits.[1] Surprisingly, the effects of the macroeconomic policy framework are largely ignored.

In general terms, the macroeconomic policy framework is all the characteristics that define and restrict the conduct of monetary, fiscal and exchange rate policies. This covers formal arrangements such as fiscal rules, pegged or floating exchange rate regimes, inflation targeting, and the degree of central bank independence. Some further features may be less formal, such as the degree of central bank conservatism. The costs related to past banking crises tend to suggest that there is a trade-off in the degree to which policy frameworks are restrictive, in line with the debate over secular rules versus discretion. The objective of this paper is consequently to assess empirically how monetary policy, fiscal policy and exchange rate frameworks affect the cost of systemic banking crises. More precisely, we focus on how restrictive policy frameworks are, as this may have ambivalent effects.

It can be argued that a restrictive policy framework can yield important benefits. One is that stringent policy arrangements like fiscal rules or inflation targeting should enforce greater accountability and may discipline policymakers.[2] This should increase economic and banking sector stability, as fiscal rules may for example push the sovereign premium down (Lara and Wolff, 2014) and reduce the risk of twin sovereign debt and banking crises. By strengthening the time consistency of policies, a second benefit of restrictive policy frameworks is that they should improve the credibility of policymakers. An extensive body of literature since Kydland and Prescott (1977) has indicated how very important credibility is for policy efficiency and success. While independent and discretionary decisions are socially suboptimal because of time inconsistency and political distortions, a restrictive policy framework may strengthen policy stability and thus economic stability (Sargent, 1982). As such, financial disequilibrium and vulnerabilities that lead to financial and banking crises should be less likely. A third point is that a stringent fiscal framework gives financial room or "policy space", which a policymaker can be expected to use for a bail out in the event of a banking crisis (Romer and Romer, 2017).

It can equally be said though that restrictive frameworks may have some drawbacks, as highlighted by the traditional literature on rules versus discretion. Most notably, they lack the flexibility to respond to unforeseeable and unquantifiable shocks (Athey et al., 2005), and more

[1] See for instance the survey by Frankel and Saravelos (2012).

[2] There is a vast literature dedicated to the discipline-enhancing effect of fiscal policy rules. See the recent meta-analysis by Heinemann et al. (2018).

generally, rules cannot foresee every contingency and are inadequate if the economy has an unstable structure (Mishkin, 2017). As instability is a key feature of banking crisis episodes, tying the hands of policymakers may make such crises more costly. Next, as indicated by recent experience, restrictive policy frameworks alone are not sufficient to prevent financial and banking crises, and they may in fact be counterproductive. Berger and Kißmer (2013) demonstrate that the more independent central bankers are, the more likely they are to refrain from tightening monetary policy pre-emptively to maintain financial stability. Levieuge et al. (2019) find that the higher the degree of central bank conservatism, the greater the banking sector vulnerabilities. Similarly, while a fixed exchange rate regime *a priori* imposes market discipline, it can also create moral hazard, and by impeding the position of the central bank as the lender of last resort, an excessive focus on parity can ultimately prevent the economy stabilising after a banking crisis.[3] Finally, some stringent arrangements like fiscal rules can induce pro-cyclicality[4], which can worsen the negative impact of a banking crisis.

Against this background, we investigate empirically whether or not the discipline-enhancing effects of restrictive policy frameworks exceed the drawbacks of their lack of flexibility and their potential counter-productive effects. The issue of restrictiveness versus flexibility in policy arrangements has earlier been neglected in assessments of the cost of a banking crisis, and so this focus is the first original aspect of our contribution.

The second original contribution of this paper is the focus on the *unconditional* cost of banking crises. The existing literature concentrates on the cost of banking crises *conditional* on a banking crisis actually happening, but this produces selection bias. This leads to the factors that may explain why a crisis does or does not occur being neglected, meaning the vulnerabilities that can lead to a banking crisis are ignored. The policy frameworks can have an impact on these financial vulnerabilities, and from this point of view, the absence of a banking crisis is an important piece of information because a given policy framework can be responsible for either a crisis or a non-crisis. In this sense we propose to gauge the global effect of any policy framework on the unconditional output losses related to banking crises[5] in a similar way to a cost-benefit analysis for a sample of 146 countries, over the period 1970-2013.

Our results reveal that the policy framework as a whole matters for explaining the real costs related to banking crises. More precisely, we find a trade-off between stringency and flexibility, as extremely restrictive policy features such as corner exchange rate regimes, budget balance rules without "friendly" clauses, and a high degree of both monetary policy conservatism and independence tend to make the real costs of crises higher. In contrast, by combining discipline

[3]See Eichengreen and Hausmann (1999); Domac and Martinez Peria (2003).

[4]See Budina et al. (2012b, Tab. 1) and Bova et al. (2014).

[5]Another strand of the literature aims at explaining the probability of banking crises. Considering only the occurrence of banking crises would also give insufficient information for normative prescriptions. Firstly because a given policy arrangement could have opposite effects on the probability of a crisis occurring and on the conditional losses from it, and secondly because, by definition, such an approach does not address the severity of a crisis. See, e.g., Bussière and Fratzscher (2008). Figure A1 in the Appendix shows that the annual output losses associated with banking crises are widely dispersed. Interestingly, approximately 35% of reported banking crises imply negligible losses. Half of the banking crises identified have an annual loss that is lower than 6.50% of the real GDP trend.

and flexibility, fiscal rules with easing clauses, intermediate exchange rate regimes and an inflation targeting framework can significantly contain the costs of banking crises. As such, we provide evidence of the benefits of policy frameworks that are based on "constrained discretion" to contain the real costs of banking crises.

The remainder of this paper is organised as follows. Section 2 reviews the literature on the main determinants of the costs related to banking crises. Section 3 presents the data, methodology and baseline estimates obtained with a set of traditional control variables. Then, the effects of fiscal policy rules, exchange rate regimes, and monetary policy arrangements are addressed in Sections 4, 5 and 6, respectively, while Section 7 is devoted to robustness checks and Section 8 concludes.

2 Related literature

Given the serious economic and social damage that banking crises can generate, there is already a lot of academic literature on the causes and consequences of banking crises (see, e.g., Laeven, 2011). We focus, in this section, on studies on the economic determinants of the costs of banking crises, which are important to consider as control variables.

Several papers note that one factor that may drive the real cost of banking crises is the role of excessive leverage and credit growth, particularly when the credit growth feeds bubbles in asset and real estate prices (Berkmen et al., 2012; Frankel and Saravelos, 2012; Feldkircher, 2014). Moreover, as Sachs et al. (1996) argue, rapid credit growth before a crisis is likely to be associated with a decline in lending standards, amplifying the vulnerability of the banking sector and the risk of a credit crunch when the crisis occurs.

Empirical evidence also suggests that the severity of banking crises depends largely on the initial level of financial development and on the size of the banking sector, especially in developing and emerging countries (Kroszner et al., 2007; Furceri and Mourougane, 2012). The level of financial development partly determines the size of banking and financial shocks as economies with deeper financial systems are more severely affected during times of crisis.

Some other papers highlight the role of banking regulation and supervision (see, e.g., Giannone et al., 2011), and Angkinand (2009) finds that bank capital regulation and deposit insurance coverage are negatively related to the real cost of banking crises.

More generally, output losses after a banking crisis are related to such structural features of the economy as trade openness, export diversification, the current account balance, or the quality of domestic institutions. Economies with greater trade openness for example may rely on exports to compensate for lower domestic demand in the aftermath of a banking crisis (Gupta et al., 2007).

Recent work also investigates concerns about the role of domestic macroeconomic policies. Furceri and Mourougane (2012) find that stimulating aggregate demand through a countercyclical fiscal policy and expansionary monetary policy helps to reduce the real cost of banking crises.

Nonetheless, despite the extensive literature on banking crises, relatively little is known about how the policy framework affects the real cost of banking crises. Empirical investigation of the resilience of the inflation targeting framework to large shocks like the recent financial crisis does not provide any clear-cut conclusion (see, e.g., de Carvalho Filho, 2011; Petreski, 2014). The effect of the exchange rate regime is also discussed, and according to what is called the bipolar view, corner regimes of pegging and pure floating should provide better performance. However, this point of view has been challenged. Tsangarides (2012) finds that growth performance for pegs was not statistically different from that of floats during the global financial crisis. On the contrary, according to Berkmen et al. (2012) and Furceri and Mourougane (2012), countries with a flexible exchange rate regime recover more rapidly after a crisis. Finally, Berkmen et al. (2012) find little evidence for the importance of other policy variables.

This all suggests that additional research is needed to investigate empirically how far policy frameworks affect the resilience of economies to a banking crisis.

3 Measures, methodology and data

This section is dedicated to the data and methodology that we use in this paper. We also present some preliminary results that are obtained with a set of usual control variables.

3.1 Measuring the real cost of banking crises

As mentioned earlier, our dependent variable measures the unconditional cost of banking crises, which is defined as:

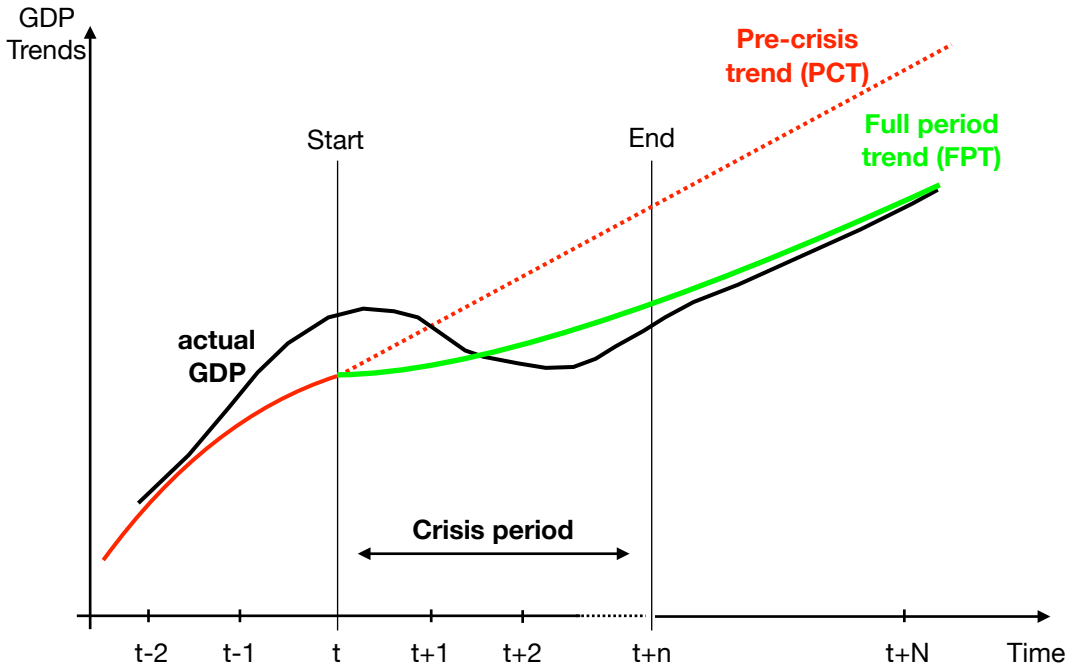
$$y_{i,t}^{k} = \begin{cases} \tilde{y}_{i,t}^{k} & \text{when a banking crisis occurs} \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

The unconditional cost is equal to $\tilde{y}_{i,t}^{k}$ in case of a banking crisis at time t in country i, while it is equal to zero otherwise. In other words, $\tilde{y}_{i,t}^{k} \in \mathbb{R}^{+}$ represents the costs conditional on a banking crisis. As is usual in the literature, these conditional costs are measured in terms of output losses. $k = \{5year, all, trend, cycle\}$ corresponds to the four alternative measures that we consider. In line with the usual potential output approach, three of them are based on the loss in GDP with respect to its trend.[6] Additionally, we provide a measure which is the loss in the trend itself.

Figure 1 illustrates these different ways of computing $\tilde{y}_{i,t}^{k}$. The two thin vertical lines indicate the start and end dates of the banking crisis. To get these, we use the information about the timing of systemic banking crises provided by Laeven and Valencia (2018). The black curve represents actual real GDP. The red dotted line shows the pre-crisis GDP trend, noted as $PCT_{i,t}$, extrapolated regardless of any possible change in the GDP trend caused by the banking crisis. The green line is the GDP trend, noted as $FPT_{i,t}$, computed over the full period and taking the possible change in the GDP trend into account.

[6] See, e.g., Abiad et al. (2009); Angkinand (2009); Feldkircher (2014).

Figure 1: Illustration of output and trend losses



In line with Wilms et al. (2018), our first measure, noted $\tilde{y}_{i,t}^{5year}$ ("$loss\_5years$" in the tables of results), is computed as the gap between actual GDP and the extrapolated Hodrick-Prescott (HP) pre-crisis trend. The extrapolation is based on the average growth rate of the HP trend over the five years preceding the beginning of the banking crisis. The loss is expressed as a percentage of the pre-crisis GDP trend, so that:

$$\tilde{y}_{i,t}^{5year} = \frac{PCT_{i,t} - GDP_{i,t}}{PCT_{i,t}} \tag{2}$$

In Figure 1, this measures refers to the difference between the dotted red line, which is the linear extrapolated pre-crisis trend, and the black curve of actual GDP over the crisis period. Such an extrapolated trend may be overstated if there was a boom in activity just before the crisis, so an alternative extrapolation following Laeven and Valencia (2018) is based on the average growth rate of the GDP trend over a longer pre-crisis period running from the first observation to the year before the crisis starts. This second measure of output loss is noted $\tilde{y}_{i,t}^{all}$ ("$loss\_all$" in the tables of results).

As banking crises can have hysteresis effects (Furceri and Mourougane, 2012; Cerra and Saxena, 2017), losses in terms of potential GDP can provide another way of gauging their real costs. For this, losses in the GDP trend, which means the difference between the pre-crisis and post-crisis trends, are computed as a proxy for losses in potential GDP.[7] In Figure 1, the corresponding measure refers to the gap between the dotted red line and the green line, over

[7]The data that are required to compute potential output are not available for all the countries in the sample.

the crisis period. It is labelled $\tilde{y}_{i,t}^{trend}$ ("$trend\_loss$") and is defined as:

$$\tilde{y}_{i,t}^{trend} = \frac{PCT_{i,t} - FPT_{i,t}}{PCT_{i,t}} \tag{3}$$

where $FPT_{i,t}$ corresponds to the HP filter trend computed over the full sample, so including the period of the banking crisis.

Finally, if a significant loss is found for a given country i in time t, it is of interest to determine whether this loss is due to a change in the GDP trend, as measured by $\tilde{y}_{i,t}^{trend}$, or due to a temporary deviation of GDP from this trend, which may now be lower and decreasing. In Figure 1, this "cycle loss" corresponds to the difference between the green line for the current trend and the black curve of actual GDP. This fourth measure of output loss is noted $\tilde{y}_{i,t}^{cycle}$ ("$cycle\_loss$") and is computed as:

$$\tilde{y}_{i,t}^{cycle} = \frac{FPT_{i,t} - GDP_{i,t}}{FPT_{i,t}} \tag{4}$$

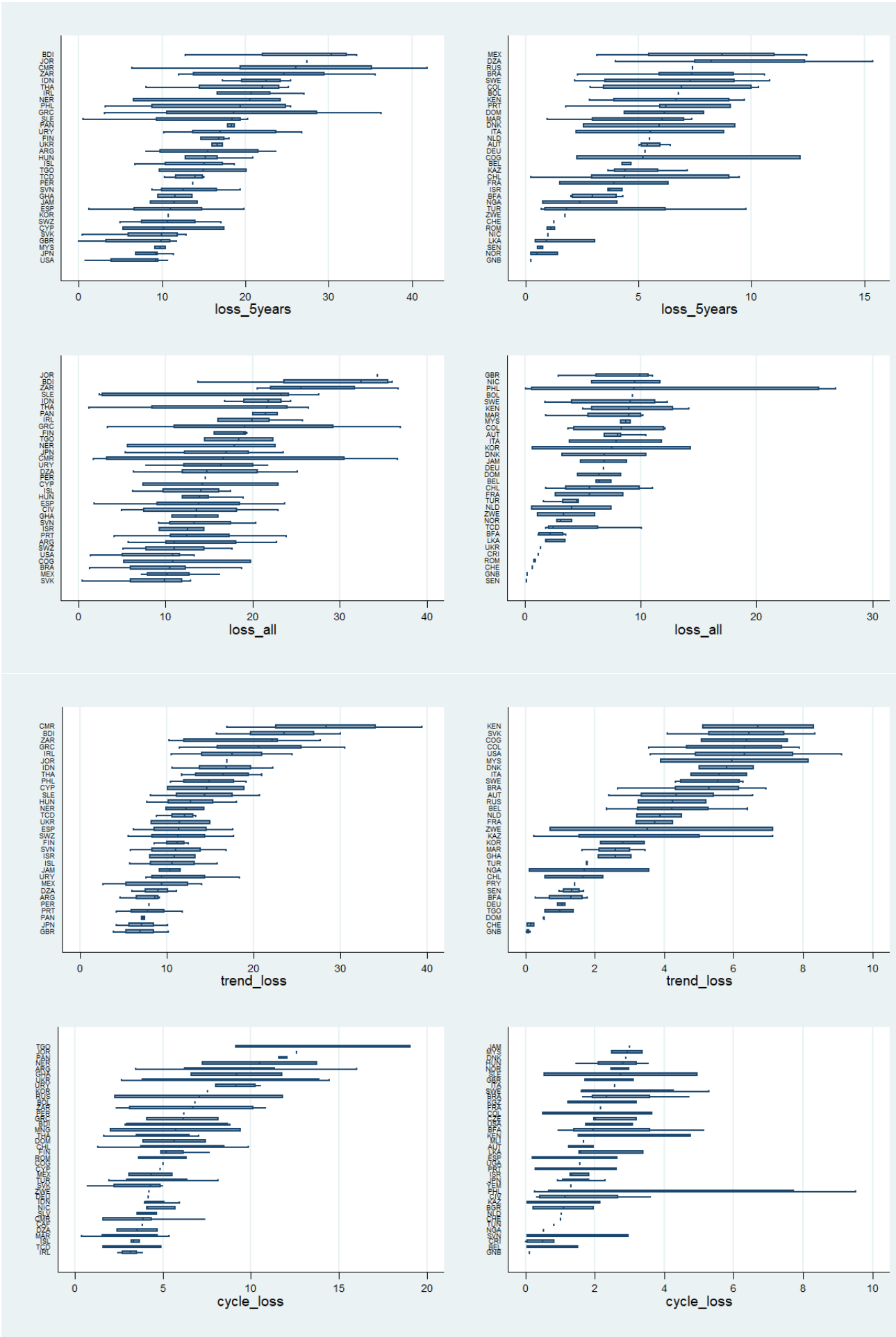
Figure A2 in the Appendix provides an illustration of the real output losses related to the 2007-2011 US banking crisis. However, it is important to note that there is no unquestioned method for measuring the output losses associated with a banking crisis, and the common potential output approach has been criticised by Devereux and Dwyer (2016) for instance. They argue that the real costs supposedly due to a banking crisis may sometimes be misidentified, in particular when a decline in GDP incidentally occurs before the crisis. Our measures $trend\_loss$ and $cycle\_loss$ are less subject to this potential caveat. In contrast, the main alternative approach, which consists of considering the changes in real GDP from peak to trough around a banking crisis, may also yield output losses for economies where there is no contraction in real GDP after a banking crisis.

We compute these four alternative measures of real output losses for an unbalanced panel of emerging and industrialised economies. Our sample contains 146 countries over the period 1970-2013. Among these countries, 84 experienced at least one banking crisis during the period considered. The crisis starting dates and the number of yearly crisis observations for each country are detailed in Table A1 in the Appendix. However, as mentioned above, a banking crisis is not necessarily costly when viewed over the entire period of the crisis[8]. The box plots in Figure 2 represent a cross-country comparison of the annual positive costs associated with banking crises for each of our measures. As can be seen, the annual costs are relatively heterogenous both across and within countries.

The next section provides details on the econometric approach used to estimate the influence of policy frameworks on our alternative variables measuring the real cost of banking crises.

[8]Following Laeven and Valencia (2018), negative losses are censored to zero. They represent around 25% of the yearly crisis observations.

Figure 2: Real output costs associated with banking crises



3.2 Econometric approach

To gauge the impact of policy framework features on the unconditional cost of banking crises, we have to deal with the nature of our alternative dependent variables. By construction, these take only positive or null values. When the values of the dependent variable of a linear regression model are bounded or censored, the Ordinary Least Squares (OLS) estimator is biased. In our case there are two main options for dealing with this issue. We can use a Tobit approach or a Poisson regression model. The Tobit-type estimator has been used by some papers for analysing the depth of banking crises (see, e.g., Bordo et al., 2001, Angkinand, 2009). However, our four dependent variables have a right-skewed distribution with a mass-point at zero. Zeros occur because some countries did not experience a banking crisis in a given year or because some crises did not trigger significant real losses. The Tobit approach may generate inconsistent and biased estimates because of this large number of zeros.

One solution proposed in the empirical international trade literature for dealing with missing bilateral trade flows is to use a Poisson model (Santos Silva and Tenreyro, 2006). As shown by Santos Silva and Tenreyro (2011), the Poisson Pseudo-Maximum Likelihood (PPML) estimator requires minimal distribution assumptions and is well behaved, even when the proportion of zeros in the sample is very large. It is clear then that the use of the PPML estimator is appropriate in our case.

Formally, the equation that we estimate is:

$$y_{i,t}^{k} = \alpha_i \exp\left(\beta_0 + \sum_{s=1}^{10} \beta_s X_{s,i,t-1} + \gamma PF_{i,t-1} + \delta_t + \epsilon_{i,t}\right) \tag{5}$$

where $y_{i,t}^{k}$ is one of our measures of real losses associated with banking crises, as defined by Eq. (1). $X_{s,i,t-1}$ is the vector of ten control variables, while $PF_{i,t-1}$ refers to the covariates of the policy framework, which are included one by one to capture the individual effect of each of them. δ_t corresponds to the time fixed effects and is introduced to control for time-varying common shocks like the recent global financial crisis. $\epsilon_{i,t}$ is the error term and α_i represents the individual random effects. It is particularly important to include such individual effects as this deals with unobserved cross-country heterogeneity. As a large number of countries in our sample did not experience a banking crisis episode over the period considered, the use of random effects is considered as an alternative to fixed effects. Indeed, using fixed effects would have dropped all these countries from the sample, and this would then have led to selection bias. Finally, the covariates are lagged by one period to deal with a potential endogeneity issue, primarily because the policy framework may evolve in response to a banking crisis.[9]

[9]However, please note that in our sample, policy framework changes during a banking crisis episode are rather rare. For instance, the adoption or abandonment of a corner exchange rate regime only occurs in 14% of yearly crisis observations, while the adoption or abandonment of a budget balance rule during a banking crisis occurs in less than 1% of yearly crisis observations. This is in line with Hallerberg and Scartascini (2015), who find that Latin American countries are less likely to implement fiscal reforms during a banking crisis, but more likely to do so during a fiscal crisis.

3.3 Preliminary results with control variables

The literature proposes several factors that seem to explain significantly the severity of banking crises. These factors have to be considered as control variables. We retain a set of ten control variables, which can be divided into five groups, and they are described below. More details on the definition and the source for all the data used in the paper are provided in the Appendix. Descriptive statistics are provided in Table A2.

Macroeconomic and financial characteristics. We consider three variables covering macroeconomic and financial characteristics. First, the logarithm of real GDP per capita captures the level of economic development. Moreover, it is expected to deal with the heterogeneity of the countries in the sample. Second, we consider the inflation rate, which is expected to affect the banking crises losses positively.[10] Indeed, a high pre-crisis inflation rate could reflect poor macroeconomic policies (Bordo et al., 2002; Angkinand, 2009) and give rise to the imbalances that encourage a banking crisis (Demirgüç-Kunt and Detragiache, 1998; von Hagen and Ho, 2007; Klomp, 2010). Third, we control for the potential effects of the size of the banking sector. Similarly to Abiad et al. (2011), we consider the credit-to-GDP ratio as a proxy for the level of development of the banking sector. This variable is expected to have a positive impact on the real cost of banking crises. These three variables are taken from the World Development Indicators (WDI) database.

Real and financial vulnerabilities. We consider the credit-to-GDP gap as a key measure of financial vulnerability. It is widely recognised that excess credit growth can cause distress for the banking sector (Schularick and Taylor, 2012; Bussière, 2013; Aikman et al., 2015). The more excess credit there is, the greater the share of non-performing loans is in a crisis, and thus the higher the inherent real cost is. We also address macroeconomic vulnerability by considering the level of public debt as a percentage of GDP, taken from the database of Abbas et al. (2010). In essence, countries with more pre-crisis debt are supposed to have less fiscal space during a crisis (Romer and Romer, 2017). In addition, some empirical studies indicate that the larger the public debt, the steeper the downturns are in a crisis, and the more severe is the risk of a sovereign-banking loop being formed (Acharya et al., 2014).

Trade and financial openness. The trade and financial openness of an economy can generate cross-border spillover effects. However, the expected impact of trade openness on the cost of banking crises is uncertain. It can be that economies with a higher degree of trade openness are more vulnerable to global trade shocks (Claessens et al., 2012), but equally a higher degree of trade openness can help sustain output during a crisis, since more internationally integrated economies have the ability to export goods when domestic demand falters (Gupta et al., 2007). The impact of the degree of financial openness is also uncertain. This is partly because it

[10] More precisely, we normalise the inflation rate as $\pi/(1+\pi)$, where π is the annual percentage change in the consumer price index, to take account of the influence of outliers caused by high inflation episodes.

depends on the nature of capital flows, as shown by Joyce (2011). An increase in foreign debt liabilities contributes to an increase in the incidence of crises, but foreign direct investment and portfolio equity liabilities have the opposite effect. Moreover, as argued by Abiad et al. (2009), more financial openness can reduce the risk of a sudden stop in capital flows, which may cushion the severity and the real output cost of banking crises. Furthermore, financial market integration makes consumption smoothing and risk sharing opportunities easier. As a result, banking crises are expected to have a smaller effect on consumption when an economy is relatively open financially. However, as shown by Giannone et al. (2011), globally integrated financial systems may be more prone to international financial shocks.

As is usual in the literature, we measure the degree of trade openness by the trade-to-GDP ratio. This ratio corresponds to the sum of exports and imports of goods and services measured as a share of GDP. This variable is taken from the WDI database. The degree of financial openness is measured using the KAOPEN index developed by Chinn and Ito (2006), which is a *de jure* measure of financial openness that considers the degree of restrictions on cross-border financial transactions and is normalised between zero and one. The higher the value of the index is, the more open the country is to cross-border capital transactions.

Twin crises. Many crises, including the Tequila and Asian crises, have seen the coincidence of banking and currency crises, and become what are called "twin crises". As the large empirical literature shows (see, e.g., Hutchison and Noy, 2005), twin crises tend to be more severe and more costly than individual banking or currency crises. Thus we control for this effect by including a dummy variable which takes the value of 1 when a domestic currency crisis occurred in time t, and 0 otherwise. Following Reinhart and Rogoff (2009), we consider that a currency crisis occurred when the annual nominal depreciation of the national currency against the US dollar exceeds 15%. Data on nominal exchange rates are taken from the International Financial Statistics (IFS) database.

Policy responses. The last set of control variables concerns the fiscal and monetary responses that are intended to sustain economic recovery in the aftermath of a crisis. Because of automatic stabilisers, public spending is endogenous to losses, and so they do not rigorously indicate a deliberate response by fiscal authorities. Discretionary government spending should be considered instead (Gupta et al., 2009; Furceri and Zdzienicka, 2012), and to this end, we use the indicator for discretionary fiscal policy suggested by Ambrosius (2017). It is obtained as the residuals of the regression of the change in fiscal expenditure relative to GDP on both contemporaneous and one-year lagged GDP growth.[11] Next, we control for the cleaning up afterwards performed by monetary policy. In light of the recent crisis, it would be insufficient to consider only the level of the interest rate. Instead, we use the level of central bank assets. Note that these policy variables are lagged one period to address the transmission delay of policy measures and the potential simultaneity bias.

[11] Similarly to Ambrosius (2017), we also include the annual inflation rate and oil prices as control variables.

Table 1 presents the results that we obtain when we regress our four alternative measures of losses from banking crises on the set of ten control variables. All the control variables except the currency crisis dummy are lagged one period. Our sample contains 4043 observations, including 330 yearly crisis observations (see Table A1 in the Appendix for more details). The results obtained confirm that GDP per capita and inflation positively affect the real cost of banking crises. The credit-to-GDP ratio also has a positive impact, which may come from the larger size of the banking and financial system. As expected, we find that the credit-to-GDP gap and the public debt ratio significantly increase the losses associated with banking crises, while the opposite effect is found for trade and financial openness. The results also confirm that a simultaneous currency crisis significantly increases the losses from a banking crisis. Finally, we find that fiscal and monetary responses significantly contain the real cost of banking crises.

These preliminary results are as expected according to the existing empirical literature. In the next section, we go a step further by investigating the impact of different fiscal, exchange rate and monetary policy features on the unconditional costs of banking crises.

Table 1: Determinants of the real cost of banking crises: Preliminary results with control variables

	loss_5years	loss_all	trend_loss	cycle_loss
GDP per capita	1.837***	0.875***	2.757***	-0.169
	(0.206)	(0.143)	(0.238)	(0.144)
Inflation	1.629***	1.196***	2.173***	1.011***
	(0.226)	(0.186)	(0.269)	(0.295)
Bank credit / GDP	0.033***	0.031***	0.030***	0.031***
	(0.001)	(0.001)	(0.001)	(0.002)
Credit-to-GDP gap	0.913***	0.823***	0.800***	0.792***
	(0.134)	(0.118)	(0.130)	(0.261)
Public debt / GDP	0.023***	0.017***	0.024***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)
Financial openness	-0.814***	-0.840***	-0.793***	-0.186
	(0.153)	(0.136)	(0.165)	(0.226)
Trade openness	-0.011***	-0.008***	-0.010***	-0.016***
	(0.002)	(0.002)	(0.002)	(0.003)
Currency crisis	0.396***	0.326***	0.292***	0.871***
	(0.060)	(0.056)	(0.064)	(0.102)
Discret. gov. consumption	-1.240***	-1.396***	-0.581***	-2.239***
	(0.173)	(0.163)	(0.186)	(0.306)
CB assets	-0.030***	-0.009***	-0.037***	0.000
	(0.004)	(0.003)	(0.005)	(0.004)
Constant	-6.380***	-4.112***	-8.215***	-1.748***
	(0.537)	(0.453)	(0.588)	(0.651)
Observations	4,043	4,043	4,043	4,043
Number of countries	146	146	146	146
Crisis obs.	330	330	330	330
Year FE	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

4 The impact of fiscal rules

We first focus on fiscal policy rules as a restrictive policy framework. According to a vast literature, fiscal policy rules are restrictions that enhance discipline.[12] This may reduce the risk of a sovereign debt crisis and the risk of twin sovereign-banking crises. Moreover, rules are a way for policymakers to forge their credibility, which is important for the efficiency and success of economic policies. However, all these advantages may be offset by a lack of flexibility and by possible pro-cyclicality in the event of a crisis, even if rules can offer policy space for a response to shocks (Klomp, 2010; Romer and Romer, 2017). Tying the hands of policymakers may make the crisis more costly. To test the global impact of fiscal rules on the cost of banking crises, we use the database provided by Schaechter et al. (2012).[13] We focus specifically on budget balance rules, for three main reasons. First, budget balance rules have gained growing support and are now the most popular type of fiscal rule around the world. Second, budget balance rules are usually expressed as a share of GDP, unlike expenditure and revenue rules, and according to Schaechter et al. (2012), this makes them easier to monitor. As a result, budget balance rules are an effective constraint for the conduct of fiscal policy. Third, they have been shown by the empirical literature to be associated with a greater probability of debt being stabilised, and they imply a strong political commitment to fiscal discipline and long-term fiscal sustainability (see, e.g., Molnár, 2012). We consider the impact of budget balance rules through a dummy variable that is equal to 1 when the national or supranational legislation includes such a rule, and 0 otherwise.

The corresponding results are reported in the left-hand side of Table 2. As we already discussed the results for the control variables in the previous section, now we focus on the coefficients associated with the dummy for the budget balance rule. It can be seen that having a budget balance rule tends to reduce the real cost of banking crises, which suggests that the discipline and enhanced credibility it brings overcome its potential adverse effects. However, the design of rules may also matter. Indeed in some countries, the budget balance rule is combined with a "cycle-friendly" clause, which usually allows the deficit ceiling to be changed to suit the position of the economy in the business cycle. It could be expected that the existence of such a clause is more effective in dampening fiscal pro-cyclicality.

To test the impact of such a flexibility clause, we consider the existence of a budget balance rule with this clause as a reference. To this end, we define two dummy variables. The first dummy variable takes the value of 1 when no budget balance rule is implemented and 0 otherwise. The second dummy variable takes the value of 1 when the rule is set without a clause and 0 otherwise. The two dummies are included together in the regressions. Then they must be interpreted with reference to a case where there is a rule with the friendly clause.

[12] See, e.g., Agnello et al. (2013); Bergman et al. (2016); Burret and Feld (2018) for the most recent contributions. Interestingly, Eyraud et al. (2018) show that fiscal rules can reduce the deficit bias even when they are not complied with.

[13] Details and updates are provided by Budina et al. (2012a); Bova et al. (2015); Lledó et al. (2017).

Table 2: The impact of a budget balance rule on the real cost of banking crises

	Budget balance rule				Budget balance rule with a flexibility clause			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	**-0.458*** **	**-0.530*** **	**-0.808*** **	**-0.287**				
	(0.132)	**(0.122)**	**(0.154)**	**(0.219)**				
No budg. bal. rule					**1.573*** **	**1.602*** **	**1.927*** **	**1.702*** **
					(0.233)	**(0.216)**	**(0.259)**	**(0.517)**
Budg. bal. rule without clause					**1.294*** **	**1.229*** **	**1.263*** **	**1.614*** **
					(0.209)	**(0.193)**	**(0.223)**	**(0.506)**
GDP per capita	3.067***	2.479***	4.136***	-0.154	3.110***	2.582***	4.185***	-0.153
	(0.346)	(0.296)	(0.408)	(0.200)	(0.342)	(0.293)	(0.406)	(0.191)
Inflation	0.133	-0.013	1.257***	0.164	0.331	0.160	1.365***	0.367
	(0.292)	(0.255)	(0.369)	(0.386)	(0.292)	(0.255)	(0.368)	(0.388)
Bank credit / GDP	0.037***	0.036***	0.035***	0.036***	0.039***	0.037***	0.037***	0.037***
	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.003)
Credit-to-GDP gap	0.942***	0.867***	0.772***	0.833***	0.912***	0.836***	0.764***	0.784***
	(0.135)	(0.120)	(0.131)	(0.266)	(0.135)	(0.120)	(0.131)	(0.266)
Public debt / GDP	0.022***	0.023***	0.023***	0.020***	0.021***	0.022***	0.022***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Financial openness	-0.340	-0.976***	-0.127	-0.208	-0.312	-0.985***	-0.173	-0.175
	(0.229)	(0.213)	(0.250)	(0.355)	(0.229)	(0.214)	(0.252)	(0.355)
Trade openness	0.008***	0.007***	0.013***	-0.006	0.008***	0.007***	0.013***	-0.007*
	(0.003)	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)
Currency crisis	0.510***	0.347***	0.197*	1.191***	0.489***	0.327***	0.209**	1.164***
	(0.094)	(0.089)	(0.103)	(0.152)	(0.094)	(0.089)	(0.103)	(0.151)
Discret. gov. consumption	-1.050***	-1.388***	-0.522*	-2.215***	-1.057***	-1.409***	-0.562**	-2.170***
	(0.236)	(0.230)	(0.275)	(0.395)	(0.236)	(0.231)	(0.276)	(0.394)
CB assets	0.019**	0.004	0.005	0.036***	0.025***	0.009	0.011	0.038***
	(0.008)	(0.008)	(0.009)	(0.013)	(0.008)	(0.008)	(0.009)	(0.013)
Constant	-9.653***	-8.310***	-12.242***	-2.489**	-11.285***	-10.090***	-14.304***	-4.163***
	(0.909)	(0.797)	(1.060)	(0.973)	(0.931)	(0.818)	(1.101)	(1.056)
Observations	1,713	1,713	1,713	1,713	1,713	1,713	1,713	1,713
Number of countries	77	77	77	77	77	77	77	77
Crisis obs.	208	208	208	208	208	208	208	208
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The results are reported in the right-hand side of Table 2. We can see that both dummies are positively and significantly linked to the real cost of banking crises. This means that having budget balance rules with flexibility clauses is the best way to contain the cost of a banking crisis. More precisely, Table A4 in the Appendix reports that the expected cost of crises is around five times higher in countries with no budget balance rule, and more than three times higher in countries with a budget balance rule without a flexibility clause. In other words, the most suitable approach in terms of the costs of banking crises is a budget balance rule with a flexibility clause, which is an intermediate solution between a strict rule and the absence of a rule.

5 The impact of exchange rate regimes

The *bipolar view* view posits that fixed and pure floating exchange rate regimes are opportune restrictive frameworks that make policymakers more responsible. By tying the hands of policymakers, pegged regimes imply more discipline and, as a rule, more credibility (Canzoneri et al., 2001; Ghosh et al., 2010; Davis et al., 2018). In emerging countries, fixed exchange rates also protect local markets from imported inflation and financial instability (see, e.g., Calvo and Reinhart, 2002). Similarly, a pure floating exchange rate regime enhances discipline because any bad political behaviour leads to immediate punishment through movements in the exchange rate (Tornell and Velasco, 2000). It follows from all this that intermediate exchange rate regimes are believed to be more prone to banking and financial crises (Eichengreen et al., 1994; Bubula and Ötker-Robe, 2003). However, this point of view has recently been challenged and Ambrosius (2017) for example reject any robust impact from the exchange rate regime on the speed of recovery after a banking crisis. Combes et al. (2016) find that intermediate exchange rate regimes are not more vulnerable to banking crises than corner regimes, whether fixed or floating.

With this debate on the bipolar view in mind, we test how the exchange rate regime affects the losses related to banking crises by defining a dummy variable, labelled *corner ERR*, which is equal to 1 if the exchange rate regime of country i at time t corresponds to a corner regime, and 0 otherwise. Information on the exchange rate regimes comes from the classification proposed by Ghosh et al. (2010), which uses entries running from 1 for the more fixed regimes to 14 for the more floating ones.

Following the recommendations of the authors, corner regimes correspond to the entries 1 to 5 for fixed exchange rate regimes and 14 for a pure floating regime, while modalities 6 to 13 represent intermediate exchange rate regimes. Then we include the dummy *corner ERR* in the regressions, with intermediate exchange rate regimes as an implicit reference. The results are reported in the left-hand side of Table 3. The *corner ERR* dummy appears significantly positive. Thus, in contrast to the bipolar view, we find that an intermediate exchange rate regime provides a better outcome in terms of the cost of banking crises. As shown in Table A4 in the Appendix, the expected cost of banking crises is around twice as high in countries operating under a corner exchange rate regime as in those operating under an intermediate exchange rate regime.

Table 3: The impact of the exchange rate regime on the real cost of banking crises

	Corner exchange rate regime dummy				Exchange rate regime (squared)			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
Corner ERR dummy	**0.745*** **	**0.952*** **	**0.896*** **	**0.377*** **				
	(0.073)	**(0.068)**	**(0.085)**	**(0.108)**				
ER regime					**-0.947*** **	**-1.089*** **	**-1.052*** **	**-0.531*** **
					(0.058)	**(0.052)**	**(0.065)**	**(0.086)**
ER regime (squared)					**0.054*** **	**0.061*** **	**0.059*** **	**0.031*** **
					(0.003)	**(0.003)**	**(0.004)**	**(0.005)**
GDP per capita	2.239***	1.268***	3.243***	-0.086	2.182***	1.105***	3.174***	-0.018
	(0.223)	(0.163)	(0.256)	(0.148)	(0.227)	(0.147)	(0.273)	(0.153)
Inflation	1.288***	0.995***	2.022***	0.542*	1.086***	0.741***	1.875***	0.522*
	(0.217)	(0.178)	(0.262)	(0.292)	(0.221)	(0.182)	(0.268)	(0.293)
Bank credit / GDP	0.032***	0.030***	0.029***	0.031***	0.029***	0.028***	0.026***	0.029***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Credit-to-GDP gap	0.923***	0.826***	0.796***	0.800***	0.881***	0.749***	0.747***	0.792***
	(0.134)	(0.118)	(0.130)	(0.261)	(0.134)	(0.119)	(0.130)	(0.261)
Public debt / GDP	0.023***	0.017***	0.024***	0.014***	0.022***	0.017***	0.024***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Financial openness	-0.933***	-1.072***	-0.784***	-0.451*	-1.156***	-1.399***	-0.965***	-0.694***
	(0.163)	(0.147)	(0.176)	(0.234)	(0.167)	(0.153)	(0.180)	(0.240)
Trade openness	-0.014***	-0.011***	-0.014***	-0.016***	-0.017***	-0.014***	-0.017***	-0.018***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Currency crisis	0.367***	0.289***	0.233***	0.867***	0.423***	0.357***	0.300***	0.882***
	(0.061)	(0.056)	(0.065)	(0.102)	(0.062)	(0.058)	(0.066)	(0.103)
Discret. gov. consumption	-1.313***	-1.410***	-0.710***	-2.134***	-1.152***	-1.292***	-0.587***	-1.984***
	(0.176)	(0.165)	(0.189)	(0.303)	(0.175)	(0.164)	(0.187)	(0.304)
CB assets	-0.034***	-0.013***	-0.040***	-0.003	-0.040***	-0.017***	-0.046***	-0.003
	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
Constant	-7.344***	-5.318***	-9.168***	-2.160***	-3.870***	-0.826	-5.318***	-0.106
	(0.551)	(0.463)	(0.609)	(0.669)	(0.601)	(0.510)	(0.662)	(0.736)
Observations	3,472	3,472	3,472	3,472	3,472	3,472	3,472	3,472
Number of countries	146	146	146	146	146	146	146	146
Crisis obs.	322	322	322	322	322	322	322	322
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

To go a step further in investigating the non-linear relationship between exchange rate regimes and the costs of banking crises, we consider the granular classification of Ghosh et al. (2010) from 1 to 14 and test whether the exchange rate regimes have a significant quadratic influence. The results are reported in the right-hand side of Table 3 and they confirm the existence of a U-shaped relationship between the exchange rate regime and the cost of banking crises, with a turning point between 8 and 9, which indicates exactly an intermediate exchange rate regime.

So in contrast to the dominant view, our results indicate that an intermediate regime tends to lower the expected cost of banking crises. This finding is in line with Eichengreen and Hausmann (1999, p. 3), according to whom "*both fixed and flexible exchange rates are problematic*". Fixed exchange rate regimes do not necessarily encourage discipline, as bad behaviour today leads to an insidious build-up of vulnerabilities that will make the peg collapse, but only in the medium or long run (Schuknecht, 1998; Tornell and Velasco, 2000). Even worse, pegged regimes may increase financial and banking vulnerabilities by providing an implicit guarantee against currency risk, thus creating moral hazard (see, e.g., Eichengreen and Hausmann, 1999). Burnside et al. (2001, 2004) show that fixed exchange rate regimes are more vulnerable to speculative attacks and more sensitive to banking and currency crises. According to Haile and Pozo (2006), announced pegged exchange rate regimes increase the risk of a currency crisis even if, in reality, the exchange rate system that is used is not pegged. Finally, a central bank that is defending its parity under a pegged regime may not be able to fulfil its role of lender of last resort, and so may not protect the economy from bank runs (Chang and Velasco, 2000). As a result, Domac and Martinez Peria (2003) find that a fixed exchange rate regime implies a higher real cost once a crisis occurs. In the same vein, Lane and Milesi-Ferretti (2011) find that countries with pegged exchange regimes experienced weaker output growth during the recent global financial crisis. At the other end of the scale, where the exchange rate regime is pure floating, agents indebted in foreign currency are threatened by an increase in their real debt burden if the domestic currency collapses (Eichengreen and Hausmann, 1999).

In contrast, intermediate exchange rate regimes present many advantages. They are not less discipline-enhancing than fixed exchange rate regimes, because punishment for bad behaviour would be quite immediate, like in a flexible regime. Moreover, countries under an intermediate exchange rate regime can use the exchange rate policy as a stabilising tool, and an intermediate exchange rate regime should imply less volatility than a pure floating regime does. This is why such an intermediate solution better contains the real costs of banking crises.

6 The impact of monetary policy features

We look at monetary policy arrangements by first addressing two features that are likely to affect the flexibility of monetary policy, these being independence and conservatism. Second, we focus on the inflation targeting framework, which is interesting in terms of restrictiveness as it is supposed to combine pre-commitment and flexibility.

6.1 Central bank independence and conservatism

The degree of central bank independence is a monetary policy feature that may impact the cost of banking crises. As it strengthens the responsibility of the policymakers and protects them from lobbying pressures, central bank independence should be discipline-enhancing, and by extension, it may imply fiscal discipline and be conducive to a sound macroeconomic environment (see, e.g., Bodea and Higashijima, 2017). Equally however, the "paradox of credibility view" suggests that central bank independence may encourage risk-taking by making monetary policy more effective (Borio and Zhu, 2012). Taking this even further, an independent central bank is less likely to clean up afterwards by supporting the recovery policies of the government after a crisis (Rosas, 2006) unless inflation is substantially affected. Independent central bankers may even refrain from leaning against the wind because this might lead to an undesirable undershooting of the inflation target (Berger and Kißmer, 2013).

To assess the global impact of central bank independence on the output costs of banking crises, we use the well-known CWN index initially developed by Cukierman et al. (1992) and recently updated by Garriga (2016).[14] This *de jure* measure is based on analysis of the statutes of central banks. It is constructed as a weighted average of four subcomponents, which are executive independence, monetary policy formulation, monetary policy objectives, and limitations on lending to the government. This last subcomponent, whose weighting represents a significant proportion of the index at 50%, is particularly interesting in our case, as it can partly capture whether a central bank can legally provide financial support for the recovery policies of the government or not.

The results are reported in the left-hand side of Table 4. We find a significant positive relationship between central bank independence and the cost of a banking crisis. The higher central bank independence is, the higher the unconditional losses are. If we consider "$loss\_5years$" as the dependent variable for example, we can see in Table A4 in the Appendix that a 1% increase in the degree of central bank independence leads on average to an increase of 2% in the expected cost of banking crises.

While more factual than institutional, the degree of central bank conservatism is another important monetary policy feature, which is related to the degree of flexibility of the monetary policy. In essence, the degree of central bank conservatism shows the preference given by the monetary authorities to the objective of price stability relative to the objective of output stabilisation. Certainly a high degree of central bank conservatism implies more monetary discipline, which may strengthen macroeconomic stability. Nevertheless, some recent papers show that financial stability is likely to be neglected when monetary policy is primarily focused on price stabilisation.[15] The induced worsening of financial imbalances may increase vulnerabilities and the loss of output in a crisis. Moreover, a conservative central banker may be reluctant to

[14]Note that empirical findings on the central bank independence-financial stability nexus are very rare and not conclusive. Klomp and de Haan (2009) empirically find a positive relationship between central bank independence and financial stability, whereas Klomp (2010) finds central bank independence has not significant effects on the probability of a banking crisis.

[15]See Bernanke (2013); Mishkin (2017); Levieuge et al. (2019).

deviate from the top priority objective of inflation[16], which may affect the pace of economic recovery in the aftermath of a banking crisis. At the other extreme, a dovish central banker is believed to respond more quickly to a crisis, so a high degree of central bank conservatism can render a banking crisis more costly because of a lack of leaning before the crisis and a lack of cleaning up afterwards.

To assess the global impact of central bank conservatism on the unconditional cost of banking crises, we use two alternative measures of central bank preferences. We first consider a *de jure* proxy for central bank conservatism, which is a subcomponent of the full CWN index of central bank independence previously mentioned. This subcomponent, called CWN_OBJ, captures the importance given to the pursuit of price stability relative to the other objectives in central bank statutes. CWN_OBJ lies between 0 and 1, with 1 corresponding to price stability as the sole or main objective of monetary policy. We also gauge the level of central bank conservatism through the CONS index suggested by Levieuge and Lucotte (2014). This *de facto* index is based on the Taylor curve, which precisely represents the trade-off between price and output volatility. It consists in measuring the relative importance assigned to the objective of inflation stabilisation through the empirical variances of inflation and output gap over a five-year rolling window. We use the shock-adjusted version of the CONS index, called CONS_W, which lies between 0 for no conservatism and 1 for the highest level of conservatism.

The results are reported in the second and third parts of Table 4. They indicate that the higher the central bank conservatism, the higher the cost of banking crises is. More precisely, as we can see in Table A4 in the Appendix, the marginal effect of a 1% increase in the degree of conservatism on the expected cost of banking crises lies between 0.31% and 2.10%.

These findings are coherent with how the costs of banking crises are computed, which is in terms of output losses. Indeed, priority given to inflation stabilisation at the expense of higher output instability, in the case of high central bank conservatism, or the low propensity of the monetary authorities to stimulate output, in the case of high central bank independence, are naturally conducive to higher output losses in times of banking crisis. At the opposite end of the scale, a dovish stance would help to contain the losses by allowing a stimulus to output in the short run. Nonetheless, these results do not mean that low levels of central bank independence or conservatism are globally desirable. Indeed, all our regressions so far show that inflation tends to increase the cost of banking crises. Furthermore, if high levels of central bank independence and conservatism are detrimental in terms of the cost of banking crises, the existing literature widely documents the harmful impact that weak central bank independence and conservatism have on macroeconomic stability as a whole.

[16]Such a view is supported by Whelan (2013) for example. See Tillmann (2008) for a more general assessment of the welfare cost related to an overly conservative central banker.

Table 4: The impact of central bank independence and conservatism on the real cost of banking crises

	Central bank independence (CWN)				Central bank conservatism (CWN_OBJ)				Central bank conservatism (CONS_W)			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
Index of CBI/CBC	**1.835*** **	**1.939*** **	**0.766*** **	**0.946*** **	**1.302*** **	**1.083*** **	**0.233**	**2.080*** **	**0.309*** **	**0.067**	**0.181**	**0.432** **
	(0.237)	**(0.213)**	**(0.263)**	**(0.358)**	**(0.174)**	**(0.154)**	**(0.194)**	**(0.276)**	**(0.108)**	**(0.099)**	**(0.119)**	**(0.178)**
GDP per capita	1.442***	0.724***	2.832***	-0.178	1.661***	0.868***	3.038***	-0.202	0.876***	0.350***	1.228***	-0.281*
	(0.221)	(0.144)	(0.265)	(0.148)	(0.228)	(0.163)	(0.252)	(0.136)	(0.175)	(0.122)	(0.227)	(0.153)
Inflation	1.166***	0.736***	1.252***	0.897***	1.369***	0.873***	1.224***	1.552***	2.731***	2.048***	3.234***	1.418***
	(0.235)	(0.192)	(0.292)	(0.304)	(0.243)	(0.197)	(0.297)	(0.320)	(0.254)	(0.204)	(0.297)	(0.319)
Bank credit / GDP	0.035***	0.033***	0.031***	0.033***	0.037***	0.035***	0.032***	0.035***	0.028***	0.026***	0.026***	0.027***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
Credit-to-GDP gap	0.941***	0.865***	0.844***	0.789***	0.961***	0.885***	0.849***	0.804***	0.791***	0.750***	0.689***	0.677**
	(0.134)	(0.119)	(0.130)	(0.261)	(0.134)	(0.119)	(0.130)	(0.261)	(0.135)	(0.119)	(0.131)	(0.263)
Public debt / GDP	0.020***	0.016***	0.021***	0.015***	0.020***	0.016***	0.022***	0.015***	0.022***	0.017***	0.021***	0.014***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Financial openness	-0.921***	-1.136***	-0.830***	-0.271	-0.651***	-0.892***	-0.744***	-0.074	-0.717***	-0.754***	-0.653***	-0.347
	(0.162)	(0.145)	(0.181)	(0.232)	(0.161)	(0.143)	(0.179)	(0.234)	(0.166)	(0.147)	(0.181)	(0.259)
Trade openness	-0.011***	-0.010***	-0.008***	-0.016***	-0.009***	-0.008***	-0.008***	-0.015***	-0.005***	-0.003	-0.003	-0.010***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Currency crisis	0.512***	0.447***	0.345***	0.922***	0.500***	0.418***	0.335***	0.940***	0.579***	0.517***	0.490***	0.948***
	(0.067)	(0.063)	(0.073)	(0.109)	(0.067)	(0.063)	(0.072)	(0.107)	(0.067)	(0.062)	(0.071)	(0.120)
Discret. gov. consumption	-1.428***	-1.716***	-0.698***	-2.346***	-1.417***	-1.711***	-0.685***	-2.287***	-1.230***	-1.532***	-0.501**	-2.843***
	(0.191)	(0.185)	(0.215)	(0.315)	(0.192)	(0.185)	(0.216)	(0.314)	(0.195)	(0.181)	(0.207)	(0.381)
CB assets	-0.015***	0.000	-0.014***	0.001	-0.012***	0.001	-0.012**	-0.001	-0.023***	-0.006*	-0.030***	0.003
	(0.005)	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
Constant	-6.722***	-4.906***	-8.408***	-2.379***	-6.500***	-4.593***	-8.246***	-3.381***	-5.093***	-3.052***	-6.127***	-1.492*
	(0.535)	(0.453)	(0.593)	(0.713)	(0.519)	(0.437)	(0.595)	(0.663)	(0.599)	(0.525)	(0.638)	(0.763)
Observations	3,682	3,682	3,682	3,682	3,682	3,682	3,682	3,682	2,437	2,437	2,437	2,437
Number of countries	142	142	142	142	142	142	142	142	97	97	97	97
Crisis obs.	307	307	307	307	307	307	307	307	272	272	272	272
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

6.2 Inflation targeting

By implying a precommitment to a certain level of inflation at a given horizon, inflation targeting constitutes a restrictive monetary policy framework for central bankers. In a seminal paper, Bernanke and Mishkin (1997) asserted that inflation targeting improves the transparency of monetary policy, the accountability of the central bank and, by extension, its credibility.[17] Woodford (2012) theoretically demonstrates that an inflation targeting regime can achieve long-term price stability while ensuring activity and financial stabilisation in the short run.

However, the influence of inflation targeting on financial stability is discussed a great deal in the literature. Some studies indicate that this monetary policy framework can have adverse effects on asset prices (Frappa and Mésonnier, 2010; Lin, 2010), while others studies show that inflation targeting allows for leaning against financial vulnerabilities. Fazio et al. (2015) for example show that inflation targeting countries have relatively sounder and more capitalised banking systems. Some studies looking at the conditional costs indicate that inflation targeting countries are less affected than their peers in a financial crisis (Walsh, 2009; Andersen et al., 2015). One reason is that they have more room for manoeuvring in terms of interest rate cuts (de Carvalho Filho, 2011). Moreover, inflation expectations are likely to be better anchored under an inflation targeting regime (Capistrán and Ramos-Francia, 2010). This implies that inflation targeting should reduce the risk of an economy falling into deflation and a liquidity trap. Nonetheless, in the aftermath of the global financial crisis, a number of economists called for a reconsideration of the desirability of inflation targeting.

In this section, we assess the global performance of inflation targeting in terms of the real costs of banking crises. To this end, we use a binary variable that takes the value of 1 once a country has fully adopted inflation targeting as a monetary policy regime and 0 otherwise.[18] Our empirical results, reported in Table 5, show that this monetary policy framework tends to lower the real losses associated with banking crises. More precisely, as shown in Table A4 in the Appendix, pursuing an inflation targeting strategy halves the expected cost of banking crises.

These results are very interesting in the light of the trade-off between restrictiveness and flexibility which has already been put forward with the policy frameworks investigated in the previous sections. As a rule, inflation targeting should imply more discipline and responsibility. At the same time, inflation targeting is a flexible framework, in that the pre-commitment to the inflation target prevails for a medium-term horizon. Meanwhile, the central bank can respond to real shocks (Svensson, 1997), and also to financial shocks that influence credit conditions (Choi and Cook, 2018).

At this stage, it is important to remember the following arguments of Bernanke and Mishkin (1997): "*Some useful policy strategies are 'rule-like', in that by their forward-looking nature they constrain central banks from systematically engaging in policies with undesirable long-run consequences; but which also allow some discretion for dealing with unforeseen or unusual*

[17] See, for instance, Gonçalves and Carvalho (2009) for empirical evidence.

[18] Fully fledged adoption occurs when all the pre-conditions of an inflation targeting framework have been met. See Mishkin and Schmidt-Hebbel (2007).

circumstances. These hybrid or intermediate approaches may be said to subject the central bank to 'constrained discretion'." Specifically, they assert that inflation targeting must be viewed as a constrained discretion framework[19], which implies discipline but allows for discretion in dealing with unusual circumstances, and this constitutes a desirable compromise for reaching macroeconomic stability.

As such, "constrained discretion" was put forward as an oxymoric concept without any formal evidence of its superiority. Since then, some empirical investigations have concluded that inflation targeting enhances macroeconomic performance. Improvements can be attributed to constrained discretion, but this is never tested per se. By focusing on the degree of restrictiveness of alternative policy frameworks in this paper, we can and do provide evidence that constrained discretion is suitable for containing the real costs of banking crises. Indeed inflation targeting is an intermediate solution between a very lax framework and a very restrictive one, like a budget balance rule with a flexibility clause and like intermediate exchange rate regimes. Hence, all the previous results can be viewed as benefits of constrained discretion.

Table 5: The impact of inflation targeting on the real cost of banking crises

	Inflation targeting			
	loss_5years	loss_all	trend_loss	cycle_loss
Inflation targeting	**-0.858*** **	**-0.845*** **	**-0.931*** **	**-0.628*** **
	(0.143)	**(0.131)**	**(0.152)**	**(0.243)**
GDP per capita	1.918***	0.985***	2.845***	-0.136
	(0.206)	(0.146)	(0.236)	(0.143)
Inflation	1.579***	1.127***	2.077***	0.999***
	(0.223)	(0.186)	(0.267)	(0.294)
Bank credit / GDP	0.032***	0.029***	0.029***	0.031***
	(0.001)	(0.001)	(0.001)	(0.002)
Credit-to-GDP gap	0.879***	0.788***	0.771***	0.770***
	(0.134)	(0.118)	(0.130)	(0.261)
Public debt / GDP	0.023***	0.018***	0.024***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)
Financial openness	-0.783***	-0.815***	-0.785***	-0.127
	(0.153)	(0.137)	(0.165)	(0.228)
Trade openness	-0.010***	-0.007***	-0.009***	-0.015***
	(0.002)	(0.002)	(0.002)	(0.003)
Currency crisis	0.410***	0.335***	0.316***	0.875***
	(0.060)	(0.056)	(0.064)	(0.102)
Discret. gov. consumption	-1.275***	-1.430***	-0.609***	-2.272***
	(0.174)	(0.163)	(0.186)	(0.307)
CB assets	-0.035***	-0.013***	-0.042***	-0.000
	(0.004)	(0.003)	(0.005)	(0.004)
Constant	-6.488***	-4.300***	-8.296***	-1.848***
	(0.532)	(0.450)	(0.586)	(0.646)
Observations	4,043	4,043	4,043	4,043
Number of countries	146	146	146	146
Crisis obs.	330	330	330	330
Year FE	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

[19]See Kim (2011) for a theoretical demonstration.

7 Robustness checks

We check the robustness of our previous findings in four ways. First, we consider an alternative set of control variables to take account of the possible relation between the policy framework and the policy responses or the currency crisis dummy. More precisely, we alternatively drop the currency crisis dummy, the variables measuring discretionary government spending and the level of central bank assets according to the policy framework under review. The results are reported in Table 6. To save space, we only report the sign of the coefficients associated with the policy frameworks. Detailed results are available upon request. As can be seen, the findings for the budget balance rule dummies remain similar when we drop the discretionary government spending variable, and indeed we still find that having a budget balance rule with a flexibility clause helps contain the real expected output losses associated with banking crises. Similarly, dropping the currency crisis dummy from the set of control variables does not change our previous conclusion about exchange rate regimes. The findings still suggest that the unconditional cost of banking crises is lower when a country operates under an intermediate exchange rate regime. The results for the monetary policy framework are also robust when we exclude the level of central bank assets from the set of control variables.

Table 6: Robustness checks when the policy responses and the currency crisis dummy are dropped

Dropping discretionary government consumption as a control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	−	−	−	N.S.
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Dropping currency crisis as a control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
Dropping central bank assets as a control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
CWN	+	+	+	+
CWN_OBJ	+	+	N.S.	+
CONS_W	+	N.S.	+	+
Inflation targeting	−	−	−	−

Note: +/− means that the variable noted has a significant positive/negative impact on the unconditional cost of banking crises. N.S. means that the estimated coefficient is not statistically significant at the conventional levels.

Second, we control for cross-country differences in terms of banking regulation. Such regulation means 1) measures aimed at controlling banking sector vulnerabilities and 2) measures defining the scope for actions by policymakers to solve crises. Papers that investigate this issue empirically usually find that banking regulation and supervision are negatively linked to the real cost of banking crises (see, e.g., Hoggarth et al., 2005; Angkinand, 2009; Fernández et al.,

2013). While banking regulation may be an important determinant of the cost of banking crises, it has been neglected thus far for sample size reasons. Indeed, information on national banking regulation is less extensive than the usual macroeconomic data are. We collected information from the Database of Regulation and Supervision of Banks around the World, detailed in Barth et al. (2013), which is a survey that was first published in 1999.[20] This means it excludes the banking crises that occurred from 1970 to the early 1990s. Nonetheless, considering a smaller sample can also serve as an additional robustness check.

More precisely, we consider three alternative measures of banking regulation and supervision: (1) "Prompt corrective action", which captures the level of automatic intervention set in the authorities' statutes for resolving banking sector vulnerabilities; (2) "Activity regulation", which measures the restrictions on bank activities regarding securities offerings, insurance and real estate services; and (3) "Supervision power", which refers to the supervision power that authorities have to impose regulatory constraints on banks to correct financial imbalances. Each measure is a polynomial variable. The higher the value, the higher the level of regulation and supervision. We expect banking regulation to be associated with a smaller expected cost for banking crises.

All the previous regressions are replicated by alternatively including these three indicators of banking regulation as additional control variables. The results are reported in Table 7. As we can see, the findings are very similar to those obtained before. We still find that a budget balance rule with an easing clause and an inflation targeting framework tend to reduce the real costs of banking crises, while the opposite effect is found for corner exchange rate regimes and for the independence and conservatism of the central bank.

Then, we consider the existence of a deposit insurance scheme as an additional control variable. Theoretically, a deposit insurance scheme can affect the severity of banking crises in contradictory ways. It is intended to prevent bank runs and to reduce the likelihood of distress at one bank causing a fully-fledged banking crisis, but such a scheme can also be a source of moral hazard that may increase the incentives for banks to take excessive risks. This may increase the likelihood and the conditional cost of banking crises. Overall, empirical findings generally suggest that the first effect dominates, and as a safety net preventing bank runs, deposit insurance coverage is negatively related to the real costs of banking crises (see, e.g., Hoggarth et al., 2005; Angkinand, 2009; Fernández et al., 2013). To check the robustness of our results once the existence of a deposit insurance is considered, we define a dummy variable equal to 1 if there is such a scheme in country i at time t and 0 otherwise. The information comes from the WDI database, and the results are reported in Table 7. As can be seen, our previous results are robust to the inclusion of this additional control variable.

[20]The database contains four surveys (1999, 2003, 2007, and 2011). To conserve the panel structure of our data, we consider the results of the first survey for the years 1990-2002, of the second survey for the years 2003-2006, of the third survey for the years 2007-2010, and of the fourth survey for years 2011 and 2013.

Table 7: Robustness checks when banking regulation is controlled for

Adding prompt corrective action as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	N.S.	−	N.S.	−
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	N.S.	+	N.S.
Inflation targeting	−	−	−	−
Adding banking activities restriction as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	N.S.	−	N.S.	−
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	N.S.	+	+
Inflation targeting	−	−	−	−
Adding supervisory power index as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	−	−	−	N.S.
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	N.S.	+	+
Inflation targeting	−	−	−	−
Adding the existence of a deposit insurance scheme as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	−	−	−	−
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	N.S.	N.S.
CWN_OBJ	+	+	N.S.	+
CONS_W	+	N.S.	+	N.S.
Inflation targeting	−	−	−	−

Note: +/− means that the variable noted has a significant positive/negative impact on the unconditional cost of banking crises. N.S. means that the estimated coefficient is not statistically significant at the conventional levels.

Table 8: Robustness checks when the quality of domestic institutions is controlled for

Adding government stability as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	−	−	−	−
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	+	N.S.
CWN_OBJ	+	+	+	+
CONS_W	+	+	+	+
Inflation targeting	−	−	−	−
Adding democratic accountability as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	−	−	−	N.S.
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	−	−	−	−
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	+	+	+
Inflation targeting	−	−	−	−

Note: +/− means that the variable noted has a significant positive/negative impact on the unconditional cost of banking crises. N.S. means that the estimated coefficient is not statistically significant at the conventional levels.

Thirdly we check the possibility that each policy framework only reflects one broader feature, which is institutional quality. As argued by Demirgüç-Kunt and Detragiache (1998), the quality of domestic institutions is highly related to the ability of the government to implement effective prudential regulation. Furthermore, a weak institutional environment is expected to exacerbate financial fragility, as it provides limited judicial protection to creditors and shareholders (Shimpalee and Breuer, 2006). Claessens et al. (2005) find that better domestic institutions, less corruption and greater judicial efficiency contribute to lower output losses and fiscal costs in the aftermath of a banking crisis. They explain this result by noting that a well-functioning legal system can help to restructure corporations in crisis, and also by noting the ability of supervisory authorities to enforce regulation and to intervene in incipient crisis situations. Consequently, it may be expected that banking crises would be less costly if there are good domestic institutions. In our study, we proxy the quality of domestic institutions by considering two variables commonly used in the literature, which are government stability and democratic accountability. These variables are taken from the International Country Risk Guide (ICRG) database and are available from 1984. In line with Claessens et al. (2005), we consider these two variables alternatively in each of our specifications. The results for the coef-

ficients of interest are reported in Table 8, and the complete results are available upon request. As can be seen, our results are robust to the inclusion of these two variables, and we still find that the policy framework is the key driver of the unconditional cost of banking crises. Of particular note, this finding confirms that the impact of the policy framework is distinct from the influence of institutional quality.

Finally, it may be possible that each variable related to a given policy framework accounts for common, and possibly unobserved, characteristics. To check this, we simultaneously include the variables capturing the frameworks for monetary policy, fiscal policy and the exchange rate in the same regression. This means that four alternative sets of variables are considered. All of them include the budget balance rule dummies, with and without a flexibility clause, and the dummy for corner exchange rate regimes. Then we successively include the variables for the monetary policy framework, which are CWN, CWN_OBJ, CONS_W index, and the inflation targeting dummy. The results are reported in Table A3 in the Appendix. Once again, we observe that our variables of interest remain statistically significant, and so our findings are largely robust.

8 Conclusion

Many efforts have been made so far, and in particular in the wake of the global financial crisis, to explain the real costs of banking crises empirically. This paper contributes to this literature by assessing whether the macroeconomic policy frameworks, which are monetary policy features, fiscal policy rules and exchange rate regimes, matter. More specifically, following the rule versus discretion debate, we focus on how restrictive these policy frameworks are, as stringency may have ambivalent effects on the costs of banking crises. In one way, a stringent policy framework is supposed to enhance discipline, improve credibility and enforce greater accountability, and it may give financial room to policymakers. This is conducive to greater economic and banking sector stability. Equally however, restrictive policy frameworks can be counterproductive and pro-cyclical, and while they are not sufficient to prevent banking crises, stringent frameworks lack the flexibility to respond to unforeseeable shocks. This means that tying the hands of policymakers may render banking crises more costly. Focusing on the degree of restrictiveness of the macroeconomic policy frameworks is the first originality of our contribution.

The second innovation consists of focusing on the unconditional real output losses related to banking crises. We argue that, like in a cost-benefit perspective, it is instructive to gauge the global effect of any policy framework, instead of only considering losses conditional to the occurrence of banking crises. Policy framework may explain why crises do not occur. To this viewpoint, the unconditional cost of banking crisis is the relevant loss measure.

Our answer to whether the degree of restrictiveness of macroeconomic policy frameworks matters is yes, even when the usual determinants of the costs of banking crises are considered. A graphical representation of our results is presented in Figure A3 in the Appendix. We find that the absence of restriction, for example the absence of a fiscal rule, is associated with higher

expected losses. Moreover, extremely restrictive policy features such as corner exchange rate regimes, budget balance rules without friendly clauses and a high degree of monetary policy conservatism and independence are conducive to a higher real cost for crises. In contrast, fiscal rules with easing clauses, intermediate exchange rate regimes and an inflation targeting framework combine discipline and flexibility and so can significantly contain the expected cost of banking crises. These results are consistent to many robustness checks, including tests that take banking regulation and institutional quality into account.

In this way, we provide evidence for the benefits of policy frameworks based on "constrained discretion". Two decades ago, a seminal paper by Bernanke and Mishkin (1997) asserted that constrained discretion is a desirable compromise for macroeconomic stability, in particular through inflation targeting. In this paper we provide evidence that constrained discretion is also suitable for minimising the real costs of banking crises.

Further research should aim to determine what the optimal mix between fiscal, monetary and exchange rate regimes should be. Some policy arrangements that are suitable individually are mutually incompatible. For instance, inflation targeters are not supposed to have an intermediate exchange rate regime. This suggests that there are some trade-offs beyond the degree of restrictiveness related to each individual policy feature. Some complementarities are also possible. Assessing the impact of policy transparency and credibility would constitute another interesting extension. Indeed, as theoretically demonstrated by Bianchi and Melosi (2018), we would expect the unconditional costs of crises to be lower whenever transparency and credibility are high, as policymakers could more easily deviate from their usual mandate without losing control over agents' expectations.

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Appendix

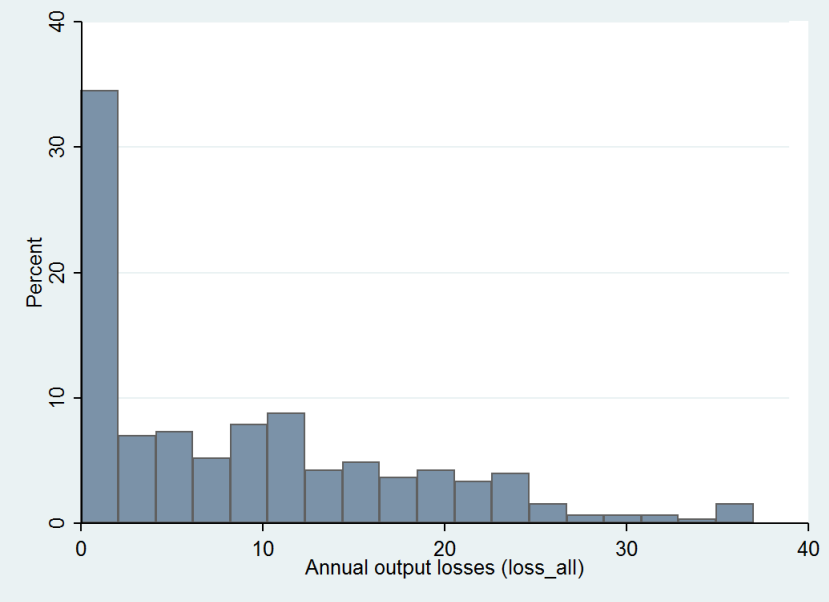

Figure A1: Distribution of annual output losses due to banking crises

Source: Laeven and Valencia (2018) and authors' calculations (see definition of *loss_all* in section 3.1).

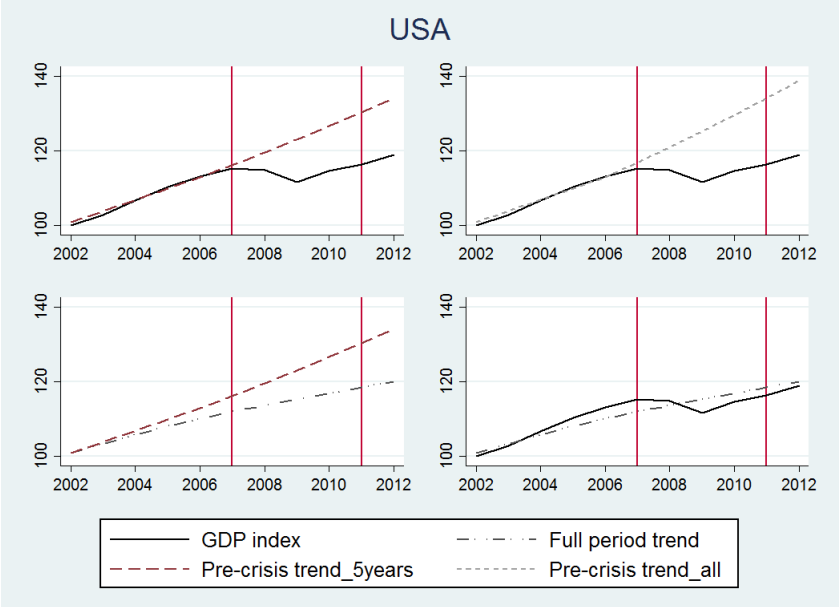

Figure A2: Measuring the real output costs associated with banking crises: the case of the United States

Source: Authors' calculations.

Table A1: Sample of countries and banking crisis episodes

Country	No. of banking crisis episode(s)	Starting date(s)	No. of yearly crisis observations	Country	No. of banking crisis episode(s)	Starting date(s)	No. of yearly crisis observations
Algeria	1	1990	5	Mexico	2	1981, 1994	7
Argentina	4	1980, 1989, 1995, 2001	7	Mongolia	1	2008	2
Austria	1	2008	5	Morocco	1	1980	5
Belgium	1	2008	5	Nepal	1	1988	1
Bolivia	2	1986, 1994	2	Netherlands	1	2008	2
Brazil	2	1990, 1994	9	Nicaragua	2	1990, 2000	5
Bulgaria	1	1996	2	Niger	1	1983	3
Burkina Faso	1	1990	5	Nigeria	2	1991, 2009	9
Burundi	1	1994	5	Norway	1	1991	3
Cameroon	2	1987, 1995	8	Panama	1	1988	2
Central African Rep.	1	1995	2	Paraguay	1	1995	1
Chad	1	1992	5	Peru	1	1983	1
Chile	2	1976, 1981	6	Philippines	2	1983, 1997	9
China	1	1998	1	Portugal	1	2008	5
Colombia	2	1982, 1998	4	Romania	1	1998	2
Congo, Dem. Rep.	2	1991, 1994	5	Russia	2	1998, 2008	3
Congo, Rep.	1	1992	3	Senegal	1	1988	4
Costa Rica	2	1987, 1994	7	Sierra Leone	1	1990	5
Cote d'Ivoire	1	1988	5	Slovak Rep.	1	1998	5
Cyprus	1	2011	3	Slovenia	1	2008	5
Czech Republic	1	1996	4	Spain	2	1977, 2008	10
Denmark	1	2008	2	Sri Lanka	1	1989	3
Dominican Rep.	1	2003	2	Swaziland	1	1995	5
Egypt	1	1980	1	Sweden	2	1991, 2008	6
El Salvador	1	1989	2	Switzerland	1	2008	2
Finland	1	1991	5	Thailand	2	1983, 1997	5
France	1	2008	2	Togo	1	1993	2
Germany	1	2008	2	Tunisia	1	1991	1
Ghana	1	1982	2	Turkey	2	1982, 2000	5
Greece	1	2008	5	Uganda	1	1994	1
Guinea-Bissau	1	1995	4	Ukraine	2	1998, 2008	5
Hungary	1	2008	5	United Kingdom	1	2007	5
Iceland	1	2008	5	United States	2	1988, 2007	6
Indonesia	1	1997	5	Uruguay	2	1981, 2002	9
Ireland	1	2008	5	Vietnam	1	1997	1
Israel	1	1983	3	Yemen	1	1996	1
Italy	1	2008	2	Zimbabwe	1	1995	5
Jamaica	1	1996	2				
Japan	1	1997	5				
Jordan	1	1989	1				
Kazakhstan	1	2008	1				
Kenya	2	1985, 1992	4				
Korea	1	1997	2				
Kyrgyz Rep.	1	1995	2				
Madagascar	1	1988	1				
Malaysia	1	1997	3				
Mali	1	1987	2				

Countries with no banking crisis episode:
Albania*, Angola, Armenia*, Australia, Azerbaijan*, Bangladesh*, Barbados, Belarus*, Belize, Benin*, Bhutan, Botswana, Cabo Verde*, Cambodia, Canada, Comoros, Croatia*, Djibouti*, Dominica, Equatorial Guinea*, Estonia*, Fiji, Gabon, The Gambia, Georgia*, Grenada, Guatemala, Guinea*, Guyana*, Haiti*, Honduras, India*, Iran Islamic Rep., Kuwait*, Lao P.D.R.., Latvia*, Lebanon*, Lesotho, Liberia*, Libya, Lithuania*, Macedonia*, Malawi, Maldives, Mauritania*, Mauritius, Moldova*, Mozambique*, Namibia, New Zealand, Pakistan, Papua New Guinea, Poland*, Rwanda, Singapore, South Africa, Sudan, Suriname, Tajikistan, Tanzania*, Trinidad and Tobago, Venezuela*.

Note: * means that, according to Laeven and Valencia (2018), these countries have experienced one or more banking crisis episodes. However, due to data availability, these banking crisis episodes are not covered by our sample.

Definition and source of variables

- **Real GDP per capita**: Logarithm of the GDP in constant 2005 U.S. dollars divided by midyear population (source: WDI, World Bank).
- **Inflation**: Normalised measure of inflation calculated as $\pi/(1+\pi)$, where π is the annual percentage change in the consumer price index (source: WDI, World Bank and authors' calculations).
- **Bank credit to GDP**: Financial resources provided to the private sector by domestic money banks as a share of GDP (source: WDI, World Bank).
- **Credit-to-GDP gap**: Difference in % between the annual domestic credit to the private sector as a share of GDP and its long-term trend, obtained using the Hodrick-Prescott filter (source: WDI, World Bank and authors' calculations).
- **Public debt**: Gross general government debt as a share of GDP (source: Abbas et al., 2010).
- **Financial openness**: Normalised KAOPEN index. This index is based on information regarding restrictions in the International Monetary Fund's *Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAER)*. The KAOPEN index is the first principal component of the variables that indicate the presence of multiple exchange rates, restrictions on current account transactions and on capital account transactions, and the requirement of the surrender of export proceeds (source: Chinn and Ito, 2006).
- **Trade openness**: Sum of exports and imports of goods and services measured as a share of GDP (source: WDI, World Bank).
- **Currency crisis**: Dummy variable equal to one if the domestic currency is subject to an annual depreciation higher than 15% against the US dollar (source: authors' calculations following Reinhart and Rogoff, 2009).
- **Discretionary government spending**: Government expenditures not driven by automatic stabilisers as a % of GDP (source: WDI and authors' calculations following Ambrosius, 2017).
- **Central bank assets**: Ratio of central bank assets to GDP. Central bank assets are claims on the domestic real non-financial sector (source: Global Financial Development Database, World Bank).
- **Budget balance rule**: Dummy variable based on country-specific information on fiscal rules collected by the IMF, equal to 1 if fiscal policy operates under a budget balance rule (source: Bova et al., 2014 and Lledó et al., 2017).

- **Exchange rate regime**: *De facto* classification of country-specific exchange rate regimes based on the IMF country team analysis and consultations with the central banks. The classification goes from 1 to 14. The higher the value, the more flexible the exchange rate regime (source: Ghosh et al., 2010).

- **Corner exchange rate regime dummy**: Dummy variable based on the IMF *de facto* classification of exchange rate regimes, equal to 1 if a country operates under a fixed or pure floating exchange rate regime and 0 otherwise (source: Ghosh et al., 2010).

- **Inflation targeting**: Dummy variable equal to one if a country has adopted a full-fledged inflation targeting framework and zero otherwise (source: Roger, 2009 and central banks' website).

- **CONS_W**: *De facto* measure of central bank conservatism based on the Taylor curve. It is computed as a shock-adjusted ratio of the variance in the output gap relative to the variance of inflation (source: authors' calculations following Levieuge and Lucotte, 2014).

- **CWN_OBJ**: *De jure* measure of central bank conservatism based on the importance given to price stability relative to other objectives, according to the central banks' legal statutes (source: Cukierman et al., 1992 and Garriga, 2016).

- **CWN index**: *De jure* index of central bank independence. It is computed as a weighted average of four subcomponents corresponding to organic independence, monetary policy objectives, monetary policy formulation and limitations of lending to the government. The index lies between 0 and 1, with 0 as the smallest level of independence and 1 as the highest (source: Cukierman et al., 1992 and Garriga, 2016).

- **Prompt corrective action**: A polynomial variable measuring whether a law establishes predetermined levels of bank solvency deterioration that force automatic actions, such as government intervention. It ranges from 0 to 6, with a higher value indicating more promptness in responding to problems (source: Barth et al., 2013).

- **Banking activities restriction**: A polynomial variable ranging between 0 and 12 and capturing the level of restrictions on banks regarding securities, insurance and real estate activities. A higher value indicates more restrictions on banking activities (source: Barth et al., 2013).

- **Supervisory power index**: Polynomial variable ranging between 0 and 16, measuring the extent to which official supervisory institutions have the authority to take specific actions to prevent and resolve banks' problems. A higher value indicates greater supervisory power (source: Barth et al., 2013).

- **Deposit insurance scheme**: Dummy variable equal to one if a country has implemented a deposit insurance scheme and zero otherwise (source: WDI, World Bank).

- **Government stability**: Index of a government's ability to carry out its declared programme(s) and its ability to stay in office. The index ranges between 0 and 12, with a higher score meaning higher stability (source: International Country Risk Guide).
- **Democratic accountability**: Index of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one. The index lies between 0 and 6, with a higher score indicating lower risk (source: International Country Risk Guide).

Table A2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Loss_5years	4,043	0.615	3.195	0	41.755
Loss_all	4,043	0.717	3.502	0	37.003
Trend_loss	4,043	0.542	2.740	0	39.408
Cycle_loss	4,043	0.201	1.169	0	19.083
GDP per capita (ln)	4,043	3.636	1.501	0.718	6.801
Inflation (normalised)	4,043	0.095	0.125	-0.559	0.996
Bank credit / GDP	4,043	38.66	34.98	0.186	312.15
Credit-to-GDP gap	4,043	0.092	3.291	-6.580	6.796
Public debt / GDP	4,043	58.82	47.45	0	629.18
Financial openness	4,043	0.440	0.347	0	1
Trade openness	4,043	72.65	43.67	6.320	531.73
Currency crisis	4,043	0.183	0.386	0	1
Discret. gov. consumption	4,043	-0.004	0.123	-0.736	1.724
CB assets	4,043	7.410	11.32	0	197.59
Budget balance rule	1,713	0.458	0.498	0	1
No budg. bal. rule	1,713	0.542	0.498	0	1
Budg. bal. rule without clause	1,713	0.375	0.484	0	1
Corner ERR dummy	3,472	0.525	0.499	0	1
ER regime	3,472	8.123	4.399	1	14
CWN	3,682	0.513	0.208	0.017	0.904
CWN_OBJ	3,682	0.531	0.267	0	1
CONS_W	2,437	0.448	0.365	0	1
Inflation targeting	4,043	0.075	0.263	0	1

Table A3: Results obtained by simultaneously considering the different policy frameworks

	Central bank independence (CWN)				Central bank conservatism (CWN_OBJ)			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
No budg. bal. rule	**1.700*** **	**1.825*** **	**2.148*** **	**1.910*** **	**1.347*** **	**1.297*** **	**1.684*** **	**1.927*** **
	(0.243)	**(0.230)**	**(0.275)**	**(0.514)**	**(0.249)**	**(0.227)**	**(0.274)**	**(0.589)**
Budg. bal. rule without clause	**1.408*** **	**1.342*** **	**1.309*** **	**1.779*** **	**1.387*** **	**1.204*** **	**1.192*** **	**1.988*** **
	(0.211)	**(0.197)**	**(0.229)**	**(0.494)**	**(0.230)**	**(0.209)**	**(0.241)**	**(0.581)**
Corner ERR dummy	**0.684*** **	**0.949*** **	**1.004*** **	**0.154**	**0.853*** **	**1.124*** **	**1.156*** **	**0.307***
	(0.111)	**(0.106)**	**(0.129)**	**(0.168)**	**(0.113)**	**(0.108)**	**(0.130)**	**(0.171)**
CWN	**2.457*** **	**3.032*** **	**2.340*** **	**2.658*** **				
	(0.307)	**(0.294)**	**(0.329)**	**(0.504)**				
CWN_OBJ					**3.411*** **	**3.028*** **	**2.911*** **	**3.029*** **
					(0.303)	**(0.262)**	**(0.320)**	**(0.462)**
Observations	1,672	1,672	1,672	1,672	1,672	1,672	1,672	1,672
Number of countries	77	77	77	77	77	77	77	77
Crisis obs.	205	205	205	205	205	205	205	205
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
	Central bank conservatism (CONS_W)				Inflation targeting			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
No budg. bal. rule	**1.346*** **	**1.530*** **	**1.802*** **	**1.334*** **	**1.497*** **	**1.525*** **	**1.884*** **	**1.712*** **
	(0.230)	**(0.217)**	**(0.260)**	**(0.493)**	**(0.238)**	**(0.224)**	**(0.271)**	**(0.516)**
Budg. bal. rule without clause	**1.454*** **	**1.296*** **	**1.481*** **	**1.717*** **	**1.369*** **	**1.348*** **	**1.360*** **	**1.659*** **
	(0.206)	**(0.193)**	**(0.221)**	**(0.481)**	**(0.212)**	**(0.199)**	**(0.233)**	**(0.503)**
Corner ERR dummy	**0.342*** **	**0.508*** **	**0.476*** **	**0.394****	**0.750*** **	**0.992*** **	**1.035*** **	**0.200**
	(0.114)	**(0.105)**	**(0.132)**	**(0.182)**	**(0.111)**	**(0.105)**	**(0.129)**	**(0.165)**
CONS_W	**1.319*** **	**0.811*** **	**0.971*** **	**1.625*** **				
	(0.177)	**(0.158)**	**(0.192)**	**(0.315)**				
Inflation targeting					**-0.167**	**-0.421****	**-0.537*** **	**0.217**
					(0.171)	**(0.166)**	**(0.186)**	**(0.306)**
Observations	1,118	1,118	1,118	1,118	1,713	1,713	1,713	1,713
Number of countries	59	59	59	59	77	77	77	77
Crisis obs.	161	161	161	161	208	208	208	208
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.
To save space, control variables and the constant are included but not reported.

Table A4: Marginal effects of policy framework variables on the expected cost of banking crises

		Policy framework	loss_5years	loss_all	trend_loss	cycle_loss
Policy change		No budg. bal. rule	382.11%	396.29%	586.89%	448.49%
		Budg. bal. rule without clause	264.73%	241.78%	253.60%	402.29%
		Corner ERR dummy	110.64%	159.09%	144.98%	45.79%
		Inflation targeting	-57.60%	-57.04%	-60.58%	-46.63%
1% increase		CWN	1.85%	1.96%	0.77%	0.95%
		CWN_OBJ	1.31%	1.09%	N.S.	2.10%
		CONS_W	0.31%	N.S.	N.S.	0.43%

Note: N.S. means that the estimated coefficient is not statistically significant at the conventional levels. Marginal effects are calculated using an exponential transformation of the estimated coefficients.

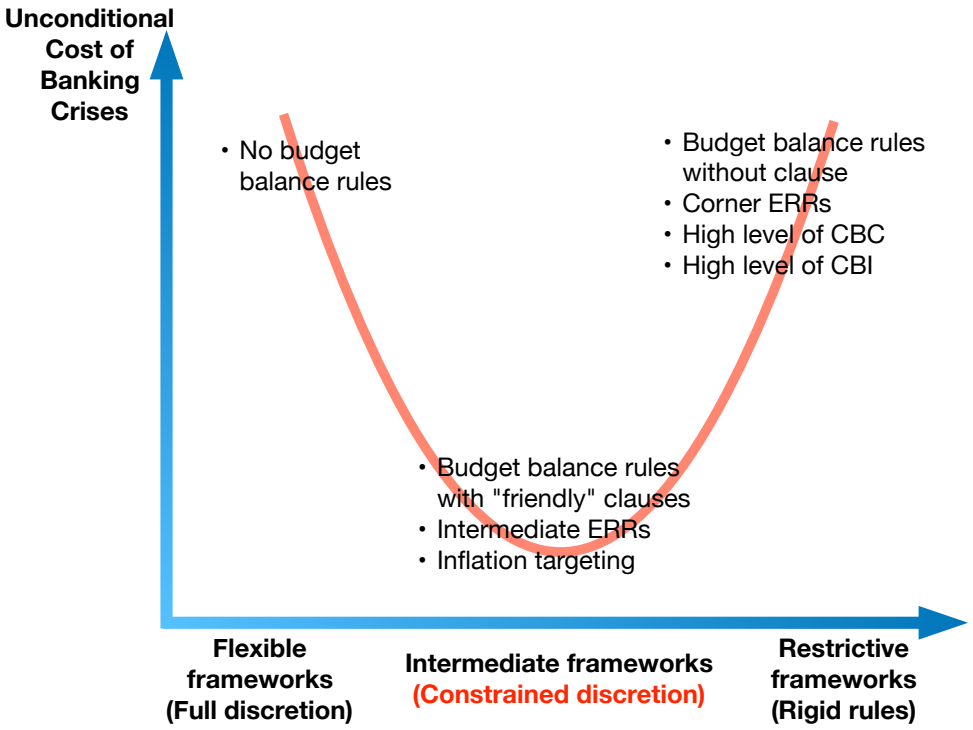

Figure A3: Graphical representation of the results