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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 monetary, fiscal and exchange rate policy frameworks impacts the expected cost of banking crises. 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 or lax 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 expected cost of banking crises. As such, we provide evidence on the benefits of “constrained discretion” for the real impact of banking crises.

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

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

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1 Introduction

Banking and financial crises are the prime source of balance sheet recessions, which have proven to be more harmful than real business cycle recessions (Reinhart and Reinhart, 2010). Many efforts have been made previously to identify the main causes of banking crises and the drivers of their real 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. Although the research in this field has allowed to highlight the role played by several factors¹ such as excess credit growth and debt, GDP per capita, exchange rate developments and current account deficits, 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 objective of this paper is consequently to assess empirically how monetary policy, fiscal policy and exchange rate frameworks affect the occurrence and the cost of systemic banking crises. More precisely, we will focus on the stringency of these policy frameworks. In line with the secular debate on rules versus discretion, the degree of restrictiveness may be interesting because it may have ambivalent effects both on the occurrence and on the real costs of banking crises.

Indeed, 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. This should increase economic and banking sector stability, as fiscal rules may for example push the sovereign premium down and reduce the risk of sovereign-bank diabolic loop. 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. As such, financial disequilibrium and vulnerabilities that lead to financial and banking crises should be less likely. Last, a stringent fiscal framework gives financial room (“policy space”), which a policymaker can be expected to use for a bail out in the event of a banking crisis (Romer and Romer, 2018).

However, it can equally be said though that restrictive frameworks may have some drawbacks. As shown by recent experience, stringent policy frameworks alone are not sufficient to prevent financial and banking crises from occurring. They may in fact be counterproductive. For instance, while a fixed exchange rate regime a priori imposes market discipline, it can also create moral hazard. Moreover, as highlighted by the traditional literature on rules versus discretion, restrictive policy frameworks lack the flexibility to respond to unforeseeable and unquantifiable shocks such as banking crises. More generally, rules cannot foresee every contingency and are inadequate if the economy has an unstable structure. As instability is a key feature of banking crisis episodes, tying the hands of policymakers may make such crises more costly. For example, by impeding the position of the central bank as the lender of last resort, an excessive focus on parity - due to a fixed exchange rate regime - can ultimately prevent the economy stabilising after a banking crisis.² Similarly, some stringent arrangements like

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

²See e.g. Domac and Martinez Peria (2003).

fiscal rules can induce pro-cyclicality, which can worsen the negative impact of a banking crisis.

These arguments suggest that the degree of restrictiveness of policy frameworks may matter to explain the occurrence and the real losses of banking crises. The issue of restrictiveness versus flexibility in policy arrangements is the first original aspect of our contribution. Moreover, considering the global effect of any policy framework is important, as a policy arrangement can have opposite effects on the occurrence and on the cost of crises. This is why our empirical assessment will rely on the *expected* - or *unconditional* - costs of banking crises. As opposed to *conditional* costs that are costs conditional on a banking crisis actually happening, *expected* - or *unconditional* - costs consist of considering the influence of any policy framework on both crises and non-crisis situations.

The Figure A1 in Appendix supports such an approach. This Figure represents the cumulative distribution function of the expected cost of crises (noted *loss_all*) conditional on different degrees of policy framework stringency. Note that a detailed definition of losses and policy frameworks will be provided later in the text. The first plot deals with the fiscal policy framework. We can observe that having a budget balance rule with a flexibility clause (i.e. intermediate stringency) increases the probability of having small losses, compared to alternative fiscal regimes that are more restrictive (budget balance rule without clause) or more lax (no rule). Next, according to the second plot, banking crises seem to occur more often under corner (i.e. fixed and pure floating regimes) exchange rate regimes (ERRs) than under intermediate ERRs. Moreover, in case of crisis, the probability to have output losses lower than 20% of GDP trend is higher with intermediate ERRs. Nonetheless, the latter exhibit higher probability of large losses. This suggests that intermediate ERRs second-order stochastically dominate corner ERRS, which are generally viewed as relatively more restrictive. Now, turning to the monetary policy framework, we can see in the third plot that a high level of central bank independence (CBI) implies a higher probability to face a banking crisis with a real cost exceeding 20% of the GDP trend. On the other hand, a low level of CBI is associated to a higher probability to have no crisis or to have minor crises in terms of losses. Then, the fourth plot does not deliver clear-cut pattern regarding the level of central bank conservatism (CBC). Last, we observe a first-order stochastic dominance of the inflation targeting (IT) regime: non inflation targeters always exhibit a higher probability to have a given loss, compared to inflation targeters.

This preliminary investigation suggests that 1) policy frameworks, and in particular their degree of stringency, may matter to explain the occurrence of banking crisis and the related conditional costs, and 2) stringency can have opposite effects on the probability and on the conditional costs (e.g. ERR). The first point supports the motivation of the paper. The second point justifies a global approach based on the expected cost of crisis, in a similar way to a cost-benefit analysis, which consists of considering simultaneously the effects of any policy framework on the occurrence of crises and on the conditional output losses.

There are additional justification for such a global approach. Notably, considering only the probability would deliver insufficient information for normative prescriptions. By definition, the sole probability does not address the severity of a banking crisis. Figure A2 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. This suggests that it is not necessarily worth trying to avoid a crisis at any cost. Real costs matter too. Moreover, it is very hard to predict when an exogenous shock will suddenly occur and provoke in turn a banking crisis³. Hence, focusing on

³See the IMF (2015, p.17) for instance: “*crises are difficult to predict, with little agreement on how to gauge potentially rising risks*”.

the sole probability provides an incomplete picture for regulators and authorities that are in charge of the policy framework. On the other hand, focusing only on the conditional costs is insufficient. 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. This point is crucial, given the objective of this paper, because by impacting these financial vulnerabilities the policy frameworks can be responsible for either a crisis or a non-crisis. Hence, the conditional costs are important, but the absence of a banking crisis is an important piece of information too. In this sense, while the literature separately questions the issues of probability and cost of banking crises, we consider that they are two sides of the same coin, which must be addressed simultaneously. This constitutes the second contribution of this paper.

Our econometric analysis, based on a sample of 146 countries, over the period 1970-2013, reveals that policy frameworks significantly matter for explaining the expected costs of 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 expected costs of crises higher. In contrast, by combining discipline and flexibility, fiscal rules with easing clauses, intermediate exchange rate regimes and an inflation targeting framework can significantly contain the expected costs of banking crises. As such, we provide evidence of the benefits of policy frameworks that are based on “constrained discretion” to contain the expected 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 the 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. Section 7 is devoted to robustness checks, while Section 8 deals with potential complementarities between policy frameworks. Section 9 concludes.

2 Literature review

Given the serious economic and social damage that banking crises can generate, the causes and consequences of banking crises have been largely studied by the academic literature. Even if banking crises have been a common phenomenon throughout history, they are rare events and occur at unknown intervals. A large part of the empirical literature initially focused on the understanding of mechanisms behind the occurrence of banking crises, before examining more recently the factors that can explain the economic severity of such crises. As we will show in this section, these two strands of the literature are closely related. Indeed, a number of factors drive both the occurrence and severity of banking crisis episodes. For instance, it is widely recognised that credit intensive booms increase the probability of a banking crisis and tend to be followed by deeper recessions and slower recoveries. Given the large number of empirical studies devoted to this issue, our literature review is not intended to be fully exhaustive. It primarily aims at embedding our research within the existing literature and at identifying the main determinants of the occurrence and severity of banking crises that should be considered as control variables in our empirical analysis. To this end, the meta-analyses recently conducted by Frankel and Saravelos (2012), Feldkircher (2014) and Wilms et al. (2018) are a good starting point.

Among the many potential causes of a banking crisis, there is a large consensus in the literature that rapid credit growth is a root cause. Considering more than a century’s worth of data, Jordà

et al. (2011), Schularick and Taylor (2012) and Aikman et al. (2015) present evidence for a sample of industrialised countries that credit growth is a powerful predictor of financial crises, and of banking crises in particular. For instance, Schularick and Taylor (2012) find that a 1 percentage point increase in the credit-to-GDP ratio raises the probability of a banking crisis by 0.3 percentage point. Gourinchas and Obstfeld (2012) find similar patterns in emerging economies. Then, according to Schularick and Taylor (2012), banking crises can be seen as “credit booms gone wrong”. As documented by a number of recent contributions, an excessive pre-crisis credit growth can also exacerbate the effects of a banking crisis and be helpful in explaining cross-country differences in crisis severity (see, e.g., Lane and Milesi-Ferretti, 2011; Berkmen et al., 2012; Feldkircher, 2014). Two main reasons can explain the positive link between credit growth and the real cost of banking crises. First, rapid credit expansion during upturns is usually accompanied by an easing of credit standards, both in terms of screening of borrowers and in collateral requirements, which in turn causes a sharp increase of non-performing loans when a crisis occurs (Jiménez and Saurina, 2006). Loan losses then lead banks to toughen credit conditions and to reduce the size of their loan portfolios, resulting in a decline in investment and consumption spending. Second, asset price bubbles tend to be followed by deeper recessions and slower recoveries if they are credit-fueled (Jordá et al., 2015).

Excessive credit and rapid private debt buildups in good times are not the only important determinants of banking crises. The level of public debt might also play a major role. Theoretically, the mechanism at work is quite straightforward and has been modeled in a number of studies (see, e.g., Bolton and Jeanne, 2011; Gennaioli et al., 2014). It is related to the strong link between sovereign and bank risk (Acharya et al., 2014). If the banking sector holds a large amount of domestic sovereign debt on their balance sheets, tensions in the sovereign debt market weaken banks’ balance sheets and then increase the probability of a banking crisis. Of course, this sovereign-bank nexus is likely to be stronger in countries where the home bias of banks in sovereign bond holdings is particularly severe. Furthermore, increases in the perceived riskiness of public debt and sovereign rating downgrades can translate into higher funding costs for bank and non-financial companies, depressing investment and economic activity. Consequently, this so-called “diabolic loop” (Brunnermeier et al., 2016) or “doom loop” (Farhi and Tirole, 2017) is expected to amplify the real cost of a banking crisis if the latter occurs. This positive link between public debt and the real cost of banking crises is empirically confirmed by Jordà et al. (2016). They find that countries entering a financial crisis recession with a high level of sovereign debt recover slowly, especially if public debt buildups were accompanied by an excessive private credit growth. Furthermore, countries with more pre-crisis debt are supposed to have less fiscal space during a crisis (Romer and Romer, 2018), and are then less able to offset the adverse effects on economic activity of private sector deleveraging.

As the experience of a number of emerging economies suggests, banking crises also frequently coincide with currency crises (Reinhart and Rogoff, 2009). The Mexican and Asian crises are the most prominent examples of “twin” crises. The simultaneous occurrence of banking and currency crises is often attributed to the so-called “original sin” syndrome (Eichengreen et al., 2003), occurring when most of the private and public debt is short-term denominated in foreign currency. Following a large domestic exchange rate depreciation, borrowers indebted in foreign currency see the value of their debt increase and are unable to service their debt, leading to a deterioration in banks’ loan portfolio. This explains why Davis et al. (2016) find that the probability that a banking crisis occurs is more important in countries where credit growth is fueled by foreign borrowing. As shown by a large empirical literature, twin crises tend also to be more severe and more costly than individual banking

or currency crises (see, e.g., Hutchison and Noy, 2005).

Interestingly, results obtained by Davis et al. (2016) further suggest that the intensity of the link between foreign borrowing and the probability of a banking crisis largely depends on the degree of financial openness. Indeed, they find that the absence of capital account restrictions exacerbates the likelihood that a banking crisis occurs. This result is in line with some papers that find that the propensity to banking and currency crises increases in the aftermath of financial liberalization (see, e.g., Detragiache and Demirgüç-Kunt, 1998; Kaminsky and Reinhart, 1999; Glick and Hutchison, 2000). Concerning the role of financial liberalization in explaining cross-country differences in crisis severity, results are more mixed. Generally speaking, evidence suggests that financial openness does not seem to be directly associated with the real cost of banking crises, even if contagion from other countries can lead to higher conditional costs (Laeven and Valencia, 2018; Cerra and Saxena, 2008). However, as Abiad et al. (2009) argue, more financial openness can also 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.

In line with this issue, some papers examine the role of the quality of banking regulation and supervision on the probability and cost of banking crises. In a recent paper, Pereira Pedro et al. (2018) do not find a significant effect of banking regulation and supervision on the likelihood of crisis for a sample of OECD countries. In line with Barth et al. (2008), this suggests that banking regulation reforms implemented in advanced and emerging economies did not clearly improve bank stability or efficiency. In a complementary way, Angkinand (2009) assesses whether banking regulation helps explain cross-country differences in crisis severity. Similarly to Pereira Pedro et al. (2018), Angkinand (2009) uses different measures of banking regulation computed by Barth et al. (2013). Similarly to Hoggarth et al. (2005) and Fernández et al. (2013), empirical findings suggest that the deposit insurance coverage is negatively linked to the conditional cost of banking crises. This result supports the role of deposit insurance as a financial safety net and as a tool to prevent bank runs. Bank capital regulation also appears negatively correlated to the severity of banking crises.

Another strand of the literature focuses on the potential role played by the size of the banking sector and the level of financial development on the occurrence of banking crises. Demirgüç-Kunt and Detragiache (1998) is the first empirical paper on this issue. As usual in the literature, they proxy the level of financial development by the bank credit-to-GDP ratio. Considering a sample of advanced and emerging economies, they fail to find a robust link between financial development and the probability of banking crises. Similar results are obtained by Davis and Karim (2008) and Mathonnat and Minea (2018) for a larger set of countries and banking crisis episodes. Financial development seems to not be a strong predictor of banking crises. On the contrary, studies that focus on the path of recovery from a banking crisis tend to support that the initial level of financial development and the size of the banking sector are positively linked to crisis incidence (Kroszner et al., 2007; Furceri and Zdzienicka, 2012). For instance, Furceri and Zdzienicka (2012) find that in the two years following a crisis the output losses are twice larger in countries with higher financial deepening. As the recent Irish crisis suggests, this result can be simply explained by the fact that the level of financial development partly explains the size of the shock.

More generally, empirical evidence suggests that the probability and the cost of banking crises are linked to the structural features of the economy, such as trade openness, the diversification of

exports, or the quality of domestic institutions. As suggested by the pioneer paper of Demirgüç-Kunt and Detragiache (1998), the quality of the legal system and of the bureaucracy significantly reduces the probability that a banking crisis occurs. Similar results are reported by more recent studies. For instance, Boukef Jlassi et al. (2018) find that the quality of domestic institutions, proxied by a number of variables taken from the International Country Risk Guide (ICRG) database, helps mitigating the adverse effects of debt liabilities on the occurrence of banking crises. Concerning trade openness, a number of recent empirical studies find that it tends to reduce the probability of banking crises (see, e.g., Caballero, 2015; Joy et al., 2017). One would also expect that economies with a higher degree of trade openness should suffer lower output decline in the aftermath of a banking crisis. Indeed, open economies have the ability to export goods and services when domestic demand falters (Gupta et al., 2007). However, as shown by Feldkircher (2014), trade openness can amplify rather than mitigate the impact of a crisis. Feldkircher (2014) find that the absence of trade and non-trade barriers significantly induces deeper recessions.

Finally, recent work investigates the role of domestic macroeconomic policies in mitigating the output losses from banking crises, especially the role of short-run demand management policies. However, the main challenge that these studies face is the endogenous nature of fiscal and monetary policy responses to the banking crisis. Indeed, the size of the supportive policy measures largely depends on the crisis intensity. Furceri and Zdzienicka (2012) address this issue by estimating an exogenous measure of discretionary fiscal policy. In line with Gupta et al. (2009), they find that stimulating the aggregate demand through a countercyclical fiscal policy helps to reduce the conditional costs of banking crises, both in the short and medium term. Similarly, their results indicate that an expansionary monetary policy significantly reduces output losses.

Despite the extensive empirical literature on banking crises, relatively little is known about the potential role of the policy framework on the probability of occurrence of banking crises and on the real cost of such crises. To the best of our knowledge, only few studies formally address this issue. In particular, they investigate whether the monetary and exchange rate regime shapes the path of recovery in the aftermath of a banking or financial crisis. For instance, some studies assess the resilience of the inflation targeting framework to the 2008-09 global financial crisis (see, e.g., de Carvalho Filho, 2011; Fouejieu, 2013; Petreski, 2014). However, they do not provide any clear-cut conclusion. The role of the exchange rate regime is also discussed in the literature. Findings are nonetheless conflicting. While results obtained by Tsangarides (2012) suggest that growth performance for pegs was not statistically different from that of floats during the global financial crisis, Berkmen et al. (2012) and Furceri and Zdzienicka (2012) find on the contrary that countries with a flexible exchange rate regime recover more rapidly after a crisis.

The conflicting results of this scarce literature on the role of the macroeconomic policy framework invite to assess in depth whether monetary policy, fiscal policy and exchange rate frameworks are strongly predictors of the occurrence and of the real cost of systemic banking crises. More precisely, the theoretical arguments and the preliminary evidence raised in the introduction suggest that the degree of restrictiveness of policy frameworks can have opposite effects on the probability and on the conditional cost of banking crises. This justifies a global approach based on the expected cost of banking crises. The next section is precisely devoted to the way we compute such an expected cost and to the approach that we use to investigate the influence of the degree of stringency of policy frameworks on it.

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 expected⁴ (or unconditional) cost of banking crises, which is defined as:

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

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.⁵ 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.

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:

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

In Figure 1, this measure 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).

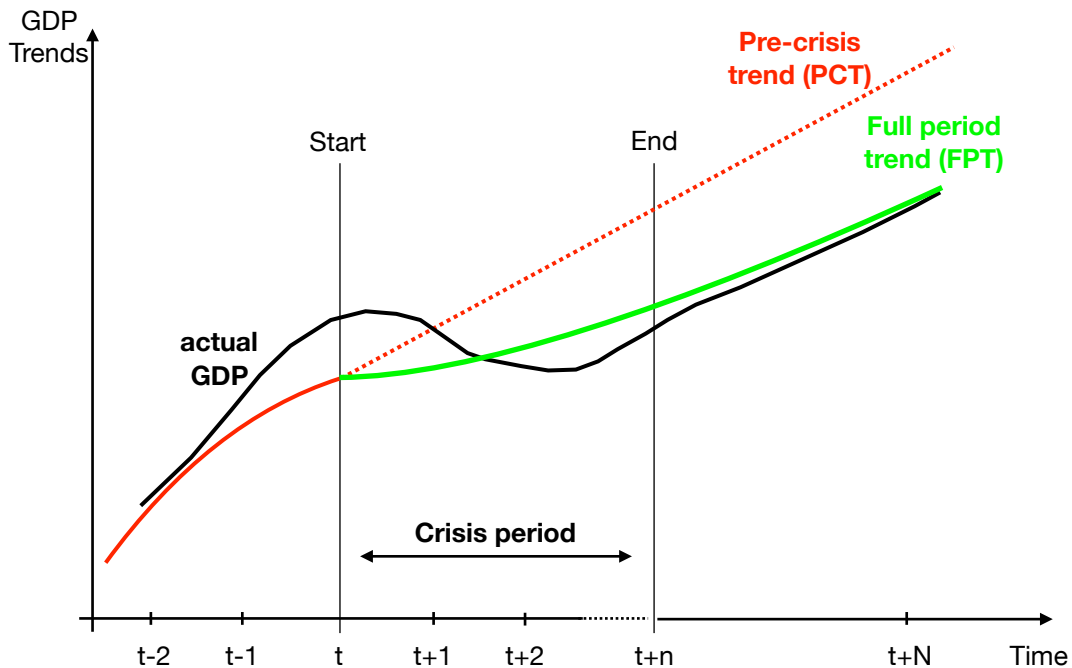
As banking crises can have hysteresis effects (Furceri and Mourougane, 2012; Cerra and Saxena, 2017), losses in terms of potential GDP can provide another way of gauging their conditional real costs. For this, losses in the GDP trend, which means the difference between the pre-crisis and post-crisis trends, are computed as a proxy for losses in potential GDP.⁶ In Figure 1, the corresponding measure

⁴Hereafter “expected costs of banking crises” and “unconditional costs of banking crises” will be used indifferently, while (real) costs in case of crisis will precisely be designated as “conditional costs”.

⁵See, e.g., Abiad et al. (2009); Angkinand (2009); Feldkircher (2014).

⁶The data that are required to compute potential output are not available for all the countries in the sample.

Figure 1: Illustration of output and trend losses



refers to the gap between the dotted red line and the green line, over the crisis period. It is labelled $\tilde{y}_{i,t}^{trend}$ (“*trend_loss*”) and is defined as:

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

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:

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

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. As mentioned above, a banking crisis is not necessarily costly when viewed over the entire period of the crisis⁷. The next section provides details on the econometric approach used to estimate the influence of policy frameworks on our four alternative measures of output losses.

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:

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

where $y_{i,t}^k$ is one of our measures of real losses associated with banking crises, as defined by Eq. (1). As a reminder, $y_{i,t}^k$ is made of positive values corresponding to conditional costs, but it is also made of zeros corresponding to situations of no crisis or non costly crises. These two dimensions are required because policy frameworks are likely to explain the probability of being in a crisis situation (i.e. zero vs non-zero value) and/or the losses in case of crisis (i.e. the values in the non-zero cases). By considering the expected cost of banking crises as the dependent variable, the model (5) rigorously addresses these two dimensions jointly. $X_{s,i,t-1}$ is the vector of ten control variables that will be presented in the next section. $PF_{i,t-1}$ 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

⁷Following Laeven and Valencia (2018), negative losses are censored to zero. They represent around 25% of the yearly crisis observations.

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. Nonetheless, 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), for example, 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

Following the main findings of the literature discussed above, we consider a large set of ten control variables that are expected to drive the expected costs of banking crises. More details on the definition and the source for all the data used in the paper are provided in the Appendix. Descriptive statistics and correlation matrix are provided in Tables A2 and A3. We classify the control variables into five categories: *(i)* macroeconomic and financial characteristics; *(ii)* real and financial vulnerabilities; *(iii)* trade and financial openness; *(iv)* twin crises; and, *(v)* policy responses.

We consider three variables capturing the macroeconomic and financial characteristics. First, the logarithm of real GDP per capita proxies the level of economic development. It primarily aims to deal with the heterogeneity of the countries in our sample. Second, we consider the annual inflation rate, which is expected to increase the probability and the real costs of banking crises.⁸ Indeed, as Bordo et al. (2002) and Angkinand (2009) argue, a high pre-crisis inflation rate could reflect poor macroeconomic policies. It is also often linked to the formation of macroeconomic and financial imbalances (Demirgüç-Kunt and Detragiache, 1998; Klomp, 2010). Third, we control for the size of the banking sector and the level of financial development, proxied by the bank credit-to-GDP ratio. In line with the results obtained by Furceri and Zdzienicka (2012), we expect a positive link between the size of the banking sector and the expected costs of banking crises. These three variables are taken from the World Development Indicators (WDI) database.

The second category of control variables aims to capture the real and financial vulnerabilities. The financial vulnerability indicator that we consider is the credit-to-GDP gap. It is defined as the difference between the credit-to-GDP ratio and its long-term trend, and it aims to capture the build-up of excessive credit in a reduced form fashion. A number of recent empirical studies find that the credit-to-GDP gap is a strong and robust predictor of banking crises (see, e.g., Giese et al., 2014; Alessi and Detken, 2018). This explains why, in practice, it plays a preponderant role in the conduct of macroprudential policies. Indeed, the Basel Committee recommends to consider the credit-to-GDP gap, the so-called “Basel gap”, for calibrating the countercyclical capital buffer. As suggested by the Basel Committee, we compute the trend using a one-sided Hodrick-Prescott (HP) filter. We also control for the level of sovereign debt with the public debt-to-GDP ratio taken from the database of Abbas et al. (2011). In line with the existing literature, we expect that both variables increase the expected costs of banking crises.

As discussed in the previous section, the financial and trade openness of an economy is an important determinant of the occurrence and costs of banking crises. As is usual in the literature, we

⁸More 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.

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. In line with Caballero (2015) and Joy et al. (2017), we expect a negative sign for the coefficient associated with this variable. Next, following Davis et al. (2016), we measure the degree of financial openness using the KAOPEN index developed by Chinn and Ito (2006). This is a *de jure* measure of financial openness that aims to traduce the degree of restrictions on cross-border financial transactions. It is an aggregate index based on information regarding restrictions in the International Monetary Fund’s *Annual Report on Exchange Rate Arrangements and Exchange Restrictions (AREAER)*. More precisely, Chinn and Ito (2006) consider four dimensions of the restrictions on external accounts: (1) the presence of multiple exchange rates, (2) restrictions on current account transactions, (3) restrictions on capital account transactions and (4) the requirement of the surrender of export proceeds. The KAOPEN index is normalised between zero and one. The higher the value of the index is, the more open is the country to cross-border capital transactions. The expected sign for the coefficient associated with the KAOPEN index is uncertain. Indeed, as discussed in the literature review, the financial openness can have opposite effects on the stability of the banking sector.

Then, to control for the fact that twin crises tend to be more severe and more costly than individual banking or currency crises (see, e.g., Hutchison and Noy, 2005), we include a dummy variable which takes the value of 1 when a domestic currency crisis occurred in time t , and 0 otherwise, in the set of control variables. 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 exceeded 15%. Data on nominal exchange rates are taken from the International Financial Statistics (IFS) database. We expect a positive sign for the coefficient associated with this dummy variable.

Finally, 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). 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.⁹ We also 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. We expect these two variables of policy responses to reduce the unconditional costs of banking crises.

Table 1 presents the results that we obtain when we regress our four alternative measures of expected cost from banking crises on the set of ten control variables.¹⁰ 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 traduces a larger shock in case of banking crisis. As expected, we find that the credit-to-GDP gap and the public debt ratio significantly increase the unconditional cost associated with banking crises, while the opposite effect is found for trade and financial openness.

⁹Similarly to Ambrosius (2017), we also include the annual inflation rate and oil prices as control variables.

¹⁰Note that we checked for the stationarity of residuals using the Phillips-Perron test. For each of the four specifications, we reject the null hypothesis that all the panels contain a unit root.

The results also confirm that a simultaneous currency crisis significantly increases this cost. Finally, we find that fiscal and monetary responses significantly contain the expected cost of banking crises.

correlation matrix are provided in Tables A2 and A3. Except the correlations between GDP per capita, bank credit-to-GDP and financial openness, it is quite remarkable how low several correlations are. Then, it is not surprising that each control variable is significant in the preliminary results.

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 unconditional cost of banking crises: Preliminary results with control variables

	loss_5years	loss_all	trend_loss	cycle_loss
GDP per capita	1.837*** (0.206)	0.875*** (0.143)	2.757*** (0.238)	-0.169 (0.144)
Inflation	1.629*** (0.226)	1.196*** (0.186)	2.173*** (0.269)	1.011*** (0.295)
Bank credit / GDP	0.033*** (0.001)	0.031*** (0.001)	0.030*** (0.001)	0.031*** (0.002)
Credit-to-GDP gap	0.913*** (0.134)	0.823*** (0.118)	0.800*** (0.130)	0.792*** (0.261)
Public debt / GDP	0.023*** (0.001)	0.017*** (0.001)	0.024*** (0.001)	0.015*** (0.001)
Financial openness	-0.814*** (0.153)	-0.840*** (0.136)	-0.793*** (0.165)	-0.186 (0.226)
Trade openness	-0.011*** (0.002)	-0.008*** (0.002)	-0.010*** (0.002)	-0.016*** (0.003)
Currency crisis	0.396*** (0.060)	0.326*** (0.056)	0.292*** (0.064)	0.871*** (0.102)
Discret. gov. consumption	-1.240*** (0.173)	-1.396*** (0.163)	-0.581*** (0.186)	-2.239*** (0.306)
CB assets	-0.030*** (0.004)	-0.009*** (0.003)	-0.037*** (0.005)	0.000 (0.004)
Constant	-6.380*** (0.537)	-4.112*** (0.453)	-8.215*** (0.588)	-1.748*** (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.¹¹ 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

¹¹See, 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.

a crisis, even if rules can offer policy space for a response to shocks (Klomp, 2010; Romer and Romer, 2018). Tying the hands of policymakers may make the crisis more costly. To test the global impact of fiscal rules on the expected cost of banking crises, we use the database provided by Schaechter et al. (2012).¹² 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 unconditional 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. 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 unconditional 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. By comparison, Table A5 in the Appendix reports that the expected cost of crises is around five times higher (+396%) in countries with no budget balance rule, and more than three times higher (+241%) in countries with a budget balance rule without a flexibility clause. In other words, the most suitable approach in terms of the expected 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.

¹²Details and updates are provided by Budina et al. (2012); Bova et al. (2015); Lledó et al. (2017).

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

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

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 Ötoker-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 unconditional 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 unconditional cost of banking crises. As shown in Table A5 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.

To go a step further in investigating the non-linear relationship between exchange rate regimes and the expected 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 unconditional cost of banking crises, with a turning point between 8 and 9, which indicates exactly an intermediate exchange rate regime.

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

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

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*”. Regarding the occurrence of crises, 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, regarding the conditional costs, 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 expected 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 expected 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 Kießmer, 2013).

To assess the global impact of central bank independence on the unconditional costs of banking crises, we use the well-known CWN index initially developed by Cukierman et al. (1992) and recently updated by Garriga (2016).¹³ 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 expected 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 A5 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.¹⁴ 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 deviate from the top priority objective of inflation¹⁵, 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.

¹³Note 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.

¹⁴See Bernanke (2013); Mishkin (2018); Leveuge et al. (2019).

¹⁵Such 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 unconditional cost of banking crises

	Central bank independence (CWN)			Central bank conservatism (CWN_OBj)			Central bank conservatism (CONS_W)			
	loss_5years	loss_all	trend_loss	loss_5years	loss_all	trend_loss	loss_5years	loss_all	trend_loss	
Index of CBI/CBC	1.835***	1.939***	0.766***	1.302***	1.083***	0.253	0.309***	0.067	0.181	0.432**
	(0.237)	(0.213)	(0.263)	(0.174)	(0.154)	(0.194)	(0.108)	(0.099)	(0.119)	(0.178)
GDP per capita	1.442***	0.724***	2.832***	1.661***	0.868***	3.038***	0.876***	0.350***	1.228***	-0.281*
	(0.221)	(0.144)	(0.265)	(0.228)	(0.163)	(0.136)	(0.175)	(0.122)	(0.227)	(0.153)
Inflation	1.166***	0.736***	1.252***	1.369***	0.873***	1.224***	2.731***	2.048**	3.234***	1.418***
	(0.235)	(0.192)	(0.292)	(0.243)	(0.197)	(0.297)	(0.254)	(0.204)	(0.319)	(0.319)
Bank credit / GDP	0.035***	0.033***	0.031***	0.037***	0.035***	0.032***	0.028***	0.026***	0.026***	0.027***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Credit-to-GDP gap	0.941***	0.865***	0.844***	0.961***	0.885***	0.849***	0.791***	0.750***	0.689***	0.677**
	(0.134)	(0.119)	(0.130)	(0.134)	(0.119)	(0.130)	(0.135)	(0.119)	(0.131)	(0.263)
Public debt / GDP	0.020***	0.016***	0.021***	0.020***	0.016***	0.022***	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)
Financial openness	-0.921***	-1.136***	-0.830***	-0.651***	-0.892***	-0.744***	-0.717***	-0.754***	-0.653***	-0.347
	(0.162)	(0.145)	(0.181)	(0.161)	(0.143)	(0.179)	(0.166)	(0.147)	(0.181)	(0.259)
Trade openness	-0.011***	-0.010***	-0.008***	-0.009***	-0.008***	-0.008***	-0.005***	-0.003	-0.003	-0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Currency crisis	0.512***	0.447***	0.345***	0.500***	0.418***	0.335***	0.579***	0.517***	0.490***	0.948***
	(0.067)	(0.063)	(0.073)	(0.067)	(0.063)	(0.072)	(0.067)	(0.062)	(0.071)	(0.120)
Discret. gov. consumption	-1.428***	-1.716***	-0.698***	-1.417***	-1.711***	-0.685***	-1.230***	-1.532***	-0.501**	-2.843***
	(0.191)	(0.185)	(0.215)	(0.192)	(0.185)	(0.216)	(0.195)	(0.181)	(0.207)	(0.381)
CB assets	-0.015***	0.000	-0.014***	-0.012***	0.001	-0.012**	-0.023***	-0.006*	-0.030***	0.003
	(0.005)	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)
Constant	-6.722***	-4.906***	-8.408***	-6.500***	-4.593***	-8.246***	-5.093***	-3.052***	-6.127***	-1.492*
	(0.535)	(0.453)	(0.593)	(0.519)	(0.437)	(0.595)	(0.599)	(0.525)	(0.638)	(0.763)
Observations	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	97	97	97	97
Crisis obs.	307	307	307	307	307	307	272	272	272	272
Year FE	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.

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 Leveuge 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 choice of using both *de jure* and *de facto* measures of central bank conservatism is mainly explained by the fact that the CWN_OBJ and the CONS indexes are complementary. Indeed, as Cukierman et al. (1992) argue, in some countries, especially emerging and developing countries, the CWN index does not perfectly reflect the actual level of independence of the central bank. In this category of countries, deviations from the law are not infrequent. Furthermore, in comparison to the CWN_OBJ index, the CONS index has the advantages to capture all the institutional and legal arrangements governing monetary policy that can drive the relative preferences of a central bank, whatever the monetary regime in place.

The results that we obtain are reported in the second and third parts of Table 4. They indicate that the higher the central bank conservatism, the higher the expected cost of banking crises is. More precisely, as we can see in Table A5 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 unconditional cost of banking crises. Furthermore, if high levels of central bank independence and conservatism are detrimental in terms of the expected 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.

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. 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. 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 expected 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.¹⁶ 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 A5 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 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 framework¹⁷, 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 expected 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.

¹⁶Fully fledged adoption occurs when all the pre-conditions of an inflation targeting framework have been met. See Mishkin and Schmidt-Hebbel (2007).

¹⁷See Kim (2011) for a theoretical demonstration.

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

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

7 Robustness checks

We check the robustness of our previous findings in five ways. First, we address the fact that our sample includes industrialised, emerging and developing countries that are not necessarily impacted in the same manner by the policy framework. Second, we check how our results are sensitive to alternative sets of control variables. Third, we propose to gauge some potential indirect effects of the policy frameworks which may be transmitted through various control variables. Fourth, we check the sensitivity of our results when additional covariates capturing the banking regulation, the globalisation and the institutional quality are included in the regressions. Finally, we combine different policy frameworks to verify that our results are not due to a possibly unobserved common feature shared by each policy arrangement.

Sample heterogeneity. As shown by the recent crisis episodes, industrialized, emerging, and developing countries are not impacted in a similar way by banking crises. This suggests that the effect of the policy framework on the expected cost of banking crises could differ regarding the level of development. Moreover, assuming that global shocks are symmetric for all countries may be not appropriate in case of heterogeneity. Against this background, we check the robustness of our results in three ways.

First, we consider as an additional control variable a dummy variable which takes the value of 1 if the country is a member of the OECD, and 0 otherwise. By doing this, the constant term is allowed to differ according to the categories of countries and captures potential differences in the irreducible expected cost of banking crises between OECD and non-OECD countries. Second, we take into account the fact that common shocks are not necessarily the same in these two groups of countries. In order to capture potential asymmetry in the transmission of global shocks to the real GDP, we substitute the standard time fixed effects by time-group fixed effects, with "group" referring to OECD and non-OECD countries. Results that we obtain with these two robustness checks, available upon request, confirms our initial findings that the policy framework is an important driver of expected cost of banking crises and highlight benefits of constrained discretion. Finally, we check whether our results are driven by a specific group of countries. To this end, we re-estimate all the previous models separately for OECD and non-OECD countries. The results (available upon request) suggest that the results previously obtained for the full sample hold for both groups. Admittedly, the impact of some policy features (in particular CBC) on the expected costs (in particular cycle loss), appears to be slightly less significant than with the full sample, but overall constrained discretion appears to be beneficial for both OECD and non-OECD countries.

Alternative set of control variables. Then, we check whether the impact of policy frameworks remains significant while dropping some control variables that may be precisely related to these policy arrangements. More precisely, we check the significance of BBR while dropping the discretionary government spending variable, the significance of monetary policy regimes while dropping the level of central bank assets, and the significance of ERRs when the currency crisis dummy is dropped from the set of control variables. The results are reported in Table 6. To save space, we only report the sign of the coefficients associated with the policy frameworks (details 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: we still find that having a budget balance rule with a flexibility clause helps contain the real expected output losses. Similarly, dropping the currency crisis dummy from the set of control variables does not change our previous conclusions 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: policy responses and currency crisis dummy dropped

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

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

Policy framework interactions with control variables. A given policy framework may be a conditioning variable for some control variables. In particular, one can suspect that the impact of the public debt ratio depends on the fiscal policy framework, while the influence of economic openness might be driven by the exchange rate regime. Hence, we perform some additional tests to gauge such a potential *indirect* effect of policy frameworks.

First, we extend our previous results to assess whether the fiscal policy framework is likely to impact the cost of banking crises through the public debt. To this end, we interact the public debt ratio with a dummy variable, which is equal to 1 when a budget balance rule with a clause is implemented, and 0 otherwise. The results are reported in the top part of Table 7. It appears that the inclusion of the interaction term does not change the sign of the coefficient associated to the public debt ratio, which remains significantly positive. Nonetheless, the negative sign of the interaction term indicates that the impact of public debt ratio is mitigated by the fiscal policy framework. More precisely, a budget balance rule with a clause seems to make countries less vulnerable to an increase of public debt.

Second, to gauge the possible *indirect* impact of the exchange rate regime, through financial openness, we include an interaction term between the KAOPEN index and the corner exchange rate regime dummy (that takes the value of 1 if a country operates under fixed or floating exchange rate, and 0 otherwise) in the estimates. We follow the same strategy with trade openness, whose impact may also depend on the stringency of the exchange rate regime. The bottom part of Table 7 shows that the inclusion of the interaction terms do not affect the impact of financial and trade openness, respectively. Both variables remain significantly negative, which means that more open economies are less vulnerable to banking crises. However, as suggested by the negative sign of the coefficient associated with

the interaction terms, this effect is mitigated if a country has a corner exchange rate regime. On the contrary, an intermediate exchange rate regime tends to reinforce the benefits of financial and trade openness.

Table 7: Robustness checks: policy framework as a conditioning variable

The impact of a budget balance rule with clause and interaction with the public debt ratio				
	loss_5years	loss_all	trend_loss	cycle_loss
Public debt / GDP	+	+	+	+
Public debt / GDP \times BBR with clause	-	-	-	-
The impact of exchange rate regime and interaction with the financial openness				
	loss_5years	loss_all	trend_loss	cycle_loss
Financial openness	-	-	-	-
Financial openness \times Corner ERR dummy	+	+	+	+
The impact of exchange rate regime and interaction with the trade openness				
	loss_5years	loss_all	trend_loss	cycle_loss
Trade openness	-	-	-	-
Trade openness \times Corner ERR dummy	+	+	+	+

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

Controlling for banking regulation, globalisation and institutional quality. Now, we check the results while controlling for cross-country differences in terms of banking regulation, namely 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 unconditional 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 1999.¹⁸ 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 8. 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 expected cost of banking

¹⁸The 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.

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 8. As can be seen, our previous results are robust to the inclusion of this additional control variable.

Next, we focus on the globalisation and the economic integration, which can explain differences in the expected cost of banking crises across countries. To this end, we insert the so-called KOF globalisation index proposed by Dreher (2006) as an additional control variable.¹⁹ This global indicator of globalisation covers three dimensions: economic integration (35% of the overall index), social integration (28%), and political integration (38%). It lies between 0 to 100, with 100 being the highest level of globalisation. Results obtained when the KOF globalisation index is included in the set of control variables are displayed in Table 9. All the previous results are robust and remain unchanged.

Last, 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 are reported in Table 10. As can be seen, we still find that the policy frameworks are key drivers of the unconditional cost of banking crises. Their impact is distinct from the influence of institutional quality.

¹⁹The effect of globalisation can also be gauged by re-estimating our models over the 1992-2013 period, when countries across the world have been well advanced in the liberalisation process. Results obtained on this shorter period do not change compared with the baseline estimates and are available upon request.

Table 8: Robustness checks: Controlling for banking regulation

With prompt corrective action as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	ns	–	ns	–
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	–	–	–	–
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	ns	+	ns
Inflation targeting	–	–	–	–
With banking activities restriction as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	ns	–	ns	–
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	–	–	–	–
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	ns	+	+
Inflation targeting	–	–	–	–
With supervisory power index as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	–	–	–	ns
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	–	–	–	–
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	ns	+	+
Inflation targeting	–	–	–	–
With 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	+	+	ns	ns
CWN_OBJ	+	+	ns	+
CONS_W	+	ns	+	ns
Inflation targeting	–	–	–	–

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

Table 9: Robustness checks: Controlling for globalisation

With KOF globalisation index as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	–	–	–	ns
No. budg. bal. rule	+	+	+	+
Budg. bal. rule without clause	+	+	+	+
Corner ERR dummy	+	+	+	+
ER regime	–	–	–	–
ER regime (squared)	+	+	+	+
CWN	+	+	+	+
CWN_OBJ	+	+	+	+
CONS_W	+	ns	+	+
Inflation targeting	–	–	–	–

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

Table 10: Robustness checks: Controlling for the quality of domestic institutions

With 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	+	+	+	ns
CWN_OBJ	+	+	+	+
CONS_W	+	+	+	+
Inflation targeting	–	–	–	–
With democratic accountability as an additional control variable				
	loss_5years	loss_all	trend_loss	cycle_loss
Budget balance rule	–	–	–	ns
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. “ns” means that the estimated coefficient is not statistically significant at the conventional levels.

Considering simultaneously the different policy frameworks. 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. More precisely, 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 A4 in the Appendix. Once again, we observe that our variables of interest remain statistically significant, and so our findings are largely robust.

Considering different policy arrangements together raises the issue of possible complementarities. This point is precisely addressed in the next section.

8 Policy complementarities

Figure 2 provides a graphical representation of the results obtained so far. We have found that the absence of restriction, for example the absence of a fiscal rule, is associated with a higher expected cost of banking crises. 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 unconditional costs 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 unconditional cost of banking crises. These results suggest that policy frameworks based on “constrained discretion” provide better outcomes in terms of expected cost of banking crises.

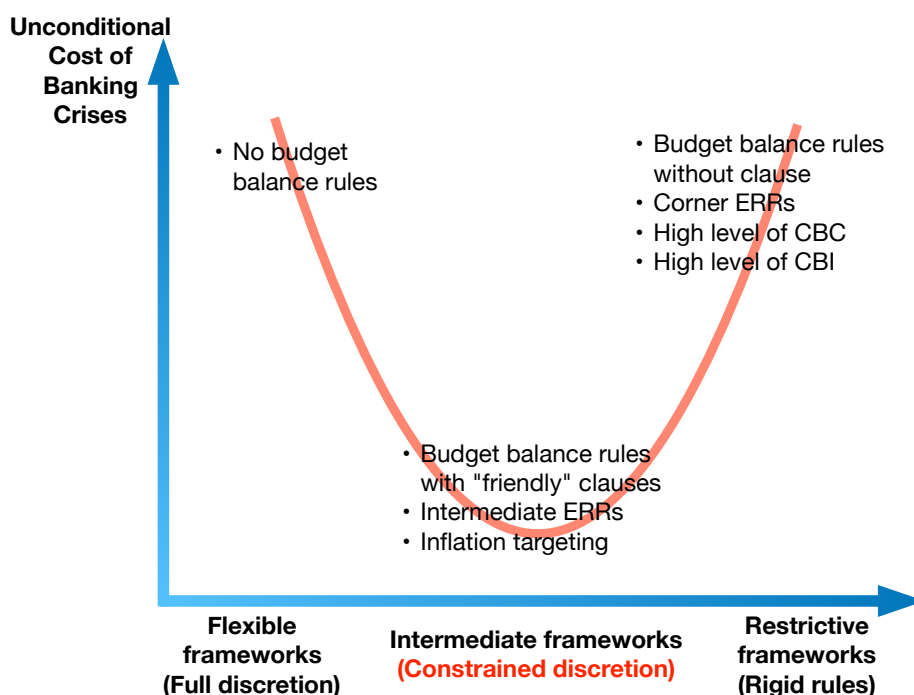


Figure 2: Graphical representation of the results

While the monetary, fiscal and exchange rate regimes have been previously treated independently of each other, we now investigate what the most suitable *global* policy framework might be (i.e. while combining monetary, fiscal and exchange rate arrangements). Absent of side effects, Figure 2 suggests that the most effective mix should combine policy frameworks that are based on constrained discretion. To check this assertion, we propose an indicator of Global Constrained Discretion (GCD), which is a polynomial variable ranging from 0 to 5, computed as the sum of constrained discretion frameworks that are simultaneously effective in a country i at time t . $GCD_{it} = 0$ if the country i at time t has no feature of constrained discretion at all, i.e. only very flexible and/or restrictive policy frameworks. This concerns countries who have no BBR or no BBR with clause, which follow a corner ERR, which have not adopted an IT regime, and with high level of CBI and CBC.²⁰ Then, $GCD_{it} = 1$ if the country i at time t has only one out of five characteristics that are related to constrained discretion. $GCD_{it} = 2$ if the country i at time t has two out of five characteristics corresponding to constrained discretion, and so on. Finally, the highest level of constrained discretion, $GCD_{it} = 5$, is reached by countries i who have at time t all their policy features corresponding to constrained discretion: BBR with a friendly clause, intermediate ERR, IT regime, low level of CBI and low level of CBC.

Table 11: Global Constrained Discretion index and the unconditional cost of banking crises

	Global Constrained Discretion index			
	loss_5years	loss_all	trend_loss	cycle_loss
GCD index	-0.652*** (0.060)	-0.703*** (0.055)	-0.803*** (0.067)	-0.488*** (0.101)
GDP per capita	2.944*** (0.335)	2.782*** (0.293)	3.824*** (0.378)	-0.008 (0.197)
Inflation	1.554*** (0.309)	1.326*** (0.274)	2.638*** (0.362)	1.214*** (0.431)
Bank credit / GDP	0.035*** (0.002)	0.032*** (0.001)	0.031*** (0.002)	0.035*** (0.003)
Credit-to-GDP gap	0.889*** (0.135)	0.831*** (0.120)	0.767*** (0.131)	0.777*** (0.266)
Public debt / GDP	0.021*** (0.002)	0.023*** (0.002)	0.021*** (0.002)	0.019*** (0.002)
Financial openness	-0.532** (0.229)	-1.382*** (0.219)	-0.656** (0.256)	-0.215 (0.351)
Trade openness	0.006** (0.003)	0.004 (0.002)	0.009*** (0.003)	-0.006* (0.004)
Currency crisis	0.528*** (0.094)	0.368*** (0.090)	0.272*** (0.104)	1.226*** (0.151)
Discret. gov. consumption	-0.982*** (0.235)	-1.393*** (0.232)	-0.528* (0.272)	-2.128*** (0.391)
CB assets	-0.008 (0.008)	-0.027*** (0.008)	-0.029*** (0.009)	0.023* (0.013)
Constant	-9.335*** (0.876)	-8.711*** (0.786)	-11.524*** (0.989)	-2.882*** (0.957)
Observations	1,672	1,672	1,672	1,672
Number of countries	77	77	77	77
Crisis obs.	205	205	205	205
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.

The Table 11 reports the results that we obtain while including the GCD indicator in the regressions. The coefficient for GCD is negative and highly significant, irrespective of the way losses are measured. Hence, the higher the number of policy features corresponding to constrained discretion, the lower the expected costs of banking crises. This suggests that individual policy features are complementary

²⁰The degrees of CBI and CBC are considered as “low” (“high”) if the variable considered is lower (higher) to its median value in the sample.

when they operate under constrained discretion. As a result, the most effective policy-mix frameworks are actually those that combine the maximum of characteristics related to constrained discretion.²¹

Then we propose another way of checking whether increasing the number of policy frameworks based on constrained discretion is always beneficial, by defining three dummy variables notes *GCD1*, *GCD2* and *GCD3* such as²²:

GCD1 = 1 if the country *i* at time *t* has only one framework that is related to constrained discretion among the five regimes previously identified as constrained discretion regimes, and 0 otherwise.

GCD2 = 1 if the country *i* at time *t* has two characteristics that are related to constrained discretion, and 0 otherwise.

GCD3 = 1 if the country *i* at time *t* has at least three characteristics corresponding to constrained discretion, and 0 otherwise.

These three dummies are simultaneously inserted in the regressions. The results are reported in the Table 12 below. The coefficients must be interpreted with respect to the case in which the global framework does not embed any constrained discretion regime at all. We observe that coefficients are negative and significant (with the only exception of *GCD1* in the *cycle_loss* regression). This confirms the previous results, as it means that any regime with at least one constrained discretion feature is better than no constrained discretion at all. Furthermore, we can see that the coefficients grow up in absolute value while the number of constrained discretion features embedded in the global policy framework increases. As confirmed by the tests of coefficient equality reported at the bottom of the table, this suggests that there is a significant benefit (at 1% level in most of the cases) of having two rather than one constrained discretion characteristic, as well as having at least three rather than two policy frameworks under constrained discretion. In other words, the benefits are increasing with the number of policy frameworks corresponding to constrained discretion. This means that there is no conflicts between frameworks based on constrained discretion.

²¹Additional tests (available upon request) reject the hypothesis of non-linear effects of GCD.

²²The number of observations in these respective global regimes is reported in Table A6 in Appendix.

Table 12: Number of constrained discretion features and the unconditional cost of banking crises

	Global Constrained Discretion Frameworks			
	loss_5years	loss_all	trend_loss	cycle_loss
GCD1	-0.673*** (0.142)	-0.765*** (0.130)	-1.278*** (0.160)	-0.363 (0.238)
GCD2	-1.545*** (0.169)	-1.586*** (0.152)	-2.162*** (0.189)	-1.304*** (0.275)
GCD3	-1.932*** (0.183)	-2.090*** (0.169)	-2.454*** (0.205)	-1.368*** (0.304)
GDP per capita	2.798*** (0.343)	2.645*** (0.303)	3.533*** (0.387)	-0.019 (0.202)
Inflation	1.609*** (0.316)	1.393*** (0.281)	2.860*** (0.371)	1.255*** (0.433)
Bank credit / GDP	0.034*** (0.002)	0.032*** (0.001)	0.030*** (0.002)	0.035*** (0.003)
Credit-to-GDP gap	0.914*** (0.135)	0.851*** (0.120)	0.792*** (0.131)	0.797*** (0.265)
Public debt / GDP	0.021*** (0.002)	0.024*** (0.002)	0.021*** (0.002)	0.020*** (0.003)
Financial openness	-0.608*** (0.232)	-1.429*** (0.220)	-0.837*** (0.261)	-0.185 (0.359)
Trade openness	0.006** (0.003)	0.004 (0.002)	0.009*** (0.003)	-0.006 (0.004)
Currency crisis	0.558*** (0.095)	0.380*** (0.090)	0.265** (0.105)	1.288*** (0.154)
Discret. gov. consumption	-0.937*** (0.235)	-1.338*** (0.232)	-0.463* (0.272)	-2.067*** (0.388)
CB assets	-0.016* (0.009)	-0.032*** (0.009)	-0.040*** (0.010)	0.013 (0.014)
Constant	-9.164*** (0.882)	-8.533*** (0.794)	-10.968*** (0.993)	-2.985*** (0.976)
Observations	1,672	1,672	1,672	1,672
Number of countries	77	77	77	77
Crisis obs.	205	205	205	205
Year FE	YES	YES	YES	YES
Coefficient equality test (1)				
GCD1 = GCD2	0.000	0.000	0.000	0.000
GCD2 = GCD3	0.004	0.000	0.057	0.770
GCD1 = GCD3	0.000	0.000	0.000	0.000

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

(1) Figures are the p-value related to hypothesis tests for equality of parameters.

9 Conclusion

Many efforts have been made so far, and in particular in the wake of the global financial crisis, to explain the occurrence and 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, as the degree of stringency may be important according to the rule versus discretion debate, we empirically assess the global impact of policy frameworks depending on how restrictive they are. This focus on restrictiveness versus flexibility is the first original aspect of our contribution.

Furthermore, as a given policy arrangement can have opposite effects on the occurrence and on the cost of crises, our analysis relies on the expected costs of banking crises. This consists of considering the net global impact of any policy framework while considering simultaneously crises and non-crisis situations, which constitute the two sides of the same coin that must be addressed. This original approach constitutes the second contribution of this paper.

Our econometric analysis, based on a sample of 146 countries, over the period 1970-2013, reveals that policy frameworks significantly matter for explaining the expected costs of banking crises. More precisely, we find that the absence of restriction, for example the absence of a fiscal rule, is associated with higher expected losses. Moreover, 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 expected costs of crises higher. In contrast, by combining discipline and flexibility, fiscal rules with easing clauses, intermediate exchange rate regimes and an inflation targeting framework can significantly contain the expected costs of 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 minimising the expected costs of banking crises, and that its benefits prevail not only for monetary but also for fiscal and exchange rate regimes. Finally, considering monetary, fiscal and exchange rate arrangements simultaneously, we find that the most efficient policy-mix frameworks in terms of expected cost of banking crises are those that combine the maximum of features corresponding to constrained discretion.

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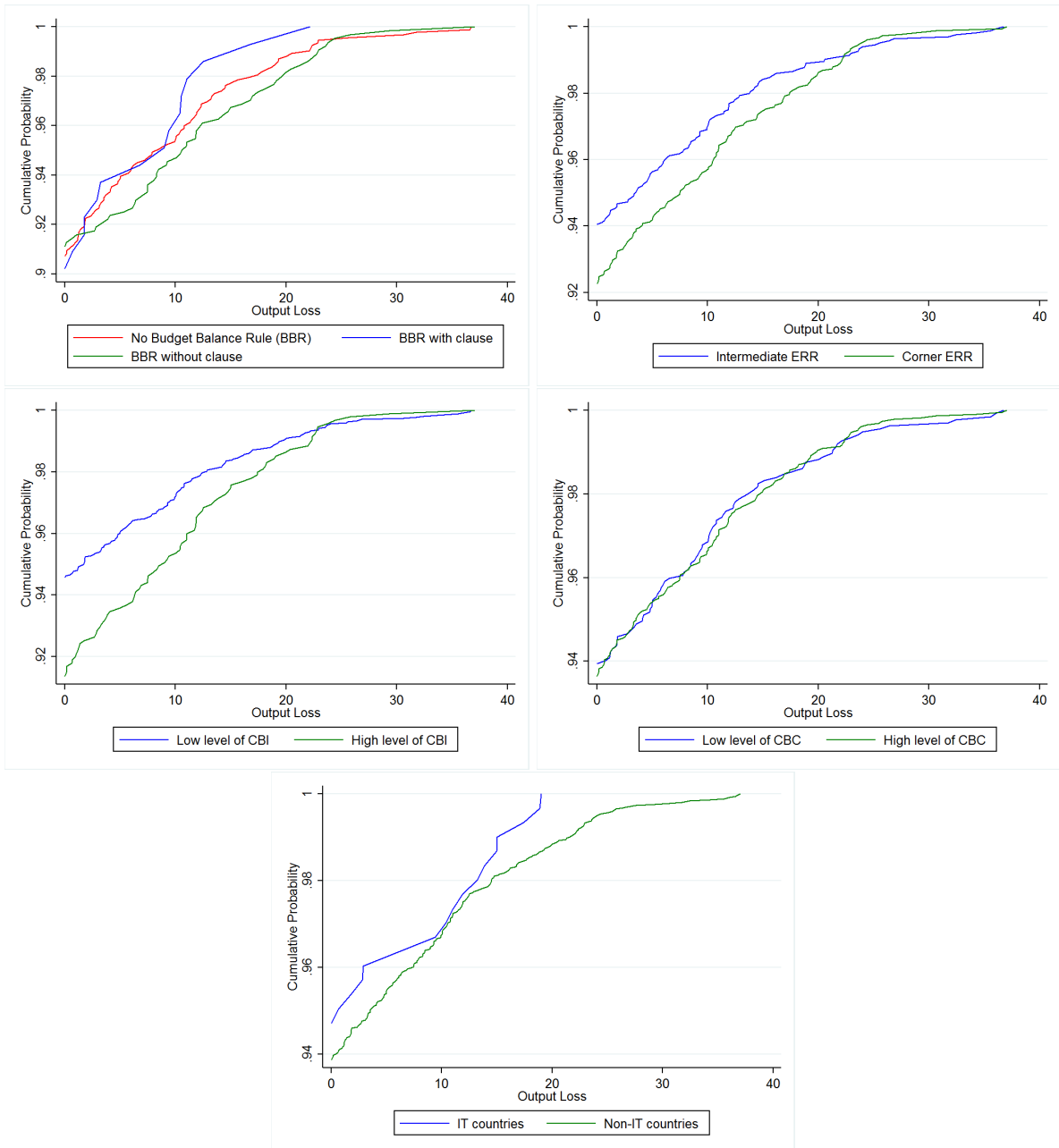
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Appendix

Figure A1: Policy frameworks - Descriptive statistics



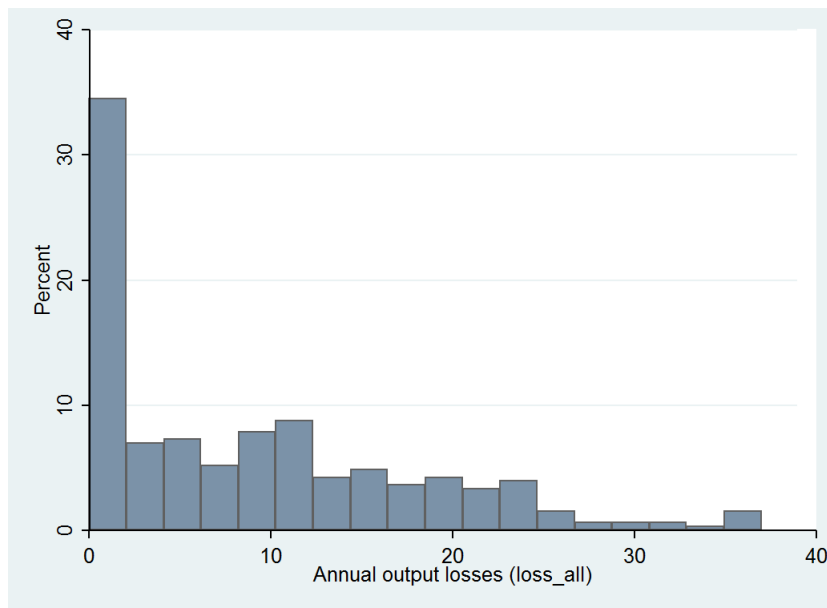


Figure A2: Distribution of annual output losses due to banking crises

Source: Author's calculations (see definition of *loss_all* in section 3.1). Dates of crises are based on Laeven and Valencia (2018).

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	4	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				

Country	No. of banking crisis episode(s)	Starting date(s)	No. of yearly crisis observations
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*			
Kuwait*			
Lao P.D.R.*			
Latvia*			
Lebanon*			
Lesotho			
Liberia*			
Lithuania*			
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., 2011).
- **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).
- **KOF globalisation index:** Index measuring the degree of economic, social and political globalisation of economies. (source: Dreher, 2006).

Table A2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Time span
Loss_5years	4,043	0.615	3.195	0	41.755	1971-2013
Loss_all	4,043	0.717	3.502	0	37.003	1971-2013
Trend_loss	4,043	0.542	2.740	0	39.408	1971-2013
Cycle_loss	4,043	0.201	1.169	0	19.083	1971-2013
GDP per capita (ln)	4,043	3.636	1.501	0.718	6.801	1970-2012
Inflation (normalised)	4,043	0.095	0.125	-0.559	0.996	1970-2012
Bank credit / GDP	4,043	38.66	34.98	0.186	312.15	1970-2012
Credit-to-GDP gap	4,043	0.092	3.291	-6.580	6.796	1970-2012
Public debt / GDP	4,043	58.82	47.45	0	629.18	1970-2012
Financial openness	4,043	0.440	0.347	0	1	1970-2012
Trade openness	4,043	72.65	43.67	6.320	531.73	1970-2012
Currency crisis	4,043	0.183	0.386	0	1	1970-2012
Discret. gov. consumption	4,043	-0.004	0.123	-0.736	1.724	1970-2012
CB assets	4,043	7.410	11.32	0	197.59	1970-2012
Budget balance rule	1,713	0.458	0.498	0	1	1985-2012
No budg. bal. rule	1,713	0.542	0.498	0	1	1985-2012
Budg. bal. rule without clause	1,713	0.375	0.484	0	1	1985-2012
Corner ERR dummy	3,472	0.525	0.499	0	1	1980-2012
ER regime	3,472	8.123	4.399	1	14	1980-2012
CWN	3,682	0.513	0.208	0.017	0.904	1970-2012
CWN_OBJ	3,682	0.531	0.267	0	1	1970-2012
CONS_W	2,437	0.448	0.365	0	1	1970-2012
Inflation targeting	4,043	0.075	0.263	0	1	1970-2012

Table A3: Correlation matrix of control variables

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
GDP per capita (a)	1								
Inflation (b)	-0.12*	1							
Bank credit / GDP (c)	0.63*	-0.23*	1						
Credit-to-GDP gap (d)	0.03	-0.01	0.08*	1					
Public debt / GDP (e)	-0.18*	0.16*	-0.06*	-0.07*	1				
Financial openness (f)	0.50*	-0.29*	0.44*	-0.01	-0.02	1			
Trade openness (g)	0.14*	-0.18*	0.16*	0.01	0.08*	0.16*	1		
Discret. gov. consumption (h)	-0.03	-0.03	-0.01	0.05*	-0.03*	-0.04*	-0.01	1	
CB assets (i)	-0.21*	0.18*	-0.15*	-0.02	0.51*	-0.09*	-0.01	-0.04*	1

Note: * denotes statistical significance at the 5% level.

Table A4: Results obtained by considering simultaneously the different policy frameworks

	Central bank independence (CWN)				Central bank conservatism (CWN OBI)			
	loss_5years	loss_all	trend_loss	cycle_loss	loss_5years	loss_all	trend_loss	cycle_loss
No budg. bal. rule	1.700*** (0.243)	1.825*** (0.230)	2.148*** (0.275)	1.910*** (0.514)	1.347*** (0.249)	1.297*** (0.227)	1.684*** (0.274)	1.927*** (0.589)
Budg. bal. rule without clause	1.408*** (0.211)	1.342*** (0.197)	1.309*** (0.229)	1.779*** (0.494)	1.387*** (0.230)	1.204*** (0.209)	1.192*** (0.241)	1.988*** (0.581)
Corner ERR dummy	0.684*** (0.111)	0.949*** (0.106)	1.004*** (0.129)	0.154 (0.168)	0.853*** (0.113)	1.124*** (0.108)	1.156*** (0.130)	0.307* (0.171)
CWN	2.457*** (0.307)	3.032*** (0.294)	2.340*** (0.329)	2.658*** (0.504)				
CWN_OBI					3.411*** (0.303)	3.028*** (0.262)	2.911*** (0.320)	3.029*** (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
	Inflation targeting							
	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*** (0.230)	1.530*** (0.217)	1.802*** (0.260)	1.334*** (0.493)	1.497*** (0.238)	1.525*** (0.224)	1.884*** (0.271)	1.712*** (0.516)
Budg. bal. rule without clause	1.454*** (0.206)	1.296*** (0.193)	1.481*** (0.221)	1.717*** (0.481)	1.369*** (0.212)	1.348*** (0.199)	1.360*** (0.233)	1.659*** (0.503)
Corner ERR dummy	0.342*** (0.114)	0.508*** (0.105)	0.476*** (0.132)	0.394** (0.182)	0.750*** (0.111)	0.992*** (0.105)	1.035*** (0.129)	0.200 (0.165)
CONS_W	1.319*** (0.177)	0.811*** (0.158)	0.971*** (0.192)	1.625*** (0.315)				
Inflation targeting					-0.167 (0.171)	-0.421** (0.166)	-0.537*** (0.186)	0.217 (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 A5: Marginal effects of policy framework variables on the unconditional cost of banking crises

		Policy framework	loss_5years	loss_all	trend_loss	cycle_loss
Policy change		No budg. bal. rule ⁽¹⁾	382.11%	396.29%	586.89%	448.49%
		Budg. bal. rule without clause ⁽¹⁾	264.73%	241.78%	253.60%	402.29%
		Corner ERR dummy ⁽²⁾	110.64%	159.09%	144.98%	45.79%
		Inflation targeting ⁽³⁾	-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%	ns	2.10%
		CONS_W	0.31%	ns	ns	0.43%

Note: “ns” 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. They are evaluated with respect to (1) BBR with clause, (2) Intermediate ERR, and (3) non-IT, respectively. For example, Being an inflation targeter reduces the unconditional cost of banking crisis - as computed by *loss_all* - by 57% compared to not being an inflation targeter, ceteris paribus.

Table A6: Number of observations in different global regimes

Number of global regimes with			
No constrained discretion regime (Reference)	One constrained discretion regime (GCD1)	Two constrained discretion regimes (GCD2)	More than two constrained discretion regimes (GCD3)
613	433	330	296