

Replacing a “disobedient” central bank governor with a
“docile” one. A novel measure of central bank independence
and its effect on inflation*

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Abstract

This paper identifies two mechanisms that empirical papers on central bank independence assume to be embedded in the yardstick measure of turnover rate of central bank governor: i) the removal of a governor who is perceived as a challenger by the government and ii) whether his/her replacement is an ally of the government. We identify the first mechanism with premature exits of central bankers and the second by examining whether or not the incoming governor is drawn from the ranks of the executive branch of the government. We find that only premature exits and replacements with government allies increase inflation.

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Argentine President Fires Central Bank Chief: President Cristina Fernández fired Argentina’s central bank chief Thursday after he refused to step down in a dispute over whether the country’s international reserves should be used to pay debt.

New York Times (1/7/2010)

Argentine President Picks Ally to Head Bank: Mercedes Marcó del Pont has close links to the government and was appointed this week by Cristina Fernández...Ms. Marcó del Pont, who had been head of the state-run Banco de la Nación, takes the helm amid growing expectations in financial markets and among opposition politicians that the government will now dilute the autonomy of the institution as it seeks to push ahead with plans to tap reserves.

Financial Times (2/3/2010)

1 Introduction

Over the past three decades, around 9,000 research and policy articles have studied the influence of central bank independence (CBI) on inflation.¹ While the theories arguing that independent central banks are better at fighting inflation appear to have been accepted (Rogoff, 1985; Cukierman, 1992; Lohmann, 1992), the empirical evidence to support them is relatively scarce.² The early empirical evidence, relying on legal measures of CBI, finds that CBI and inflation are negatively related in developed countries and unrelated in developing economies (Alesina and Summers, 1993; Grilli et al, 1991; Cukierman, 1992; Cukierman et al, 1992). This puzzling result observed for developing countries is not surprising considering the weak link between legal and actual independence derived from low levels of rule of law and transparency. To fill the gap between law and actual practice, Cukierman (1992) and Cukierman et al (1992) suggest a behavioral or de facto oriented measure of CBI based on the turnover rate of central bank governors.³ Since then, the turnover rate of central bank governors has become the yardstick measure of de facto CBI, especially for less developed countries.⁴

The basic presumption of this de facto measure is that, at least above some threshold, a more

¹From a Google Scholar search with the heading “central bank independence” and “inflation.”

²Eijffinger and de Haan (1996), Berger et al (2001), Crowe and Meade (2007), and Cukierman (2008) provide useful summaries.

³We call the heads of the central bank “governors” regardless of whether their actual job title is governor, director or president.

⁴Several studies (Cukierman, 1992; Cukierman et al, 1992; de Haan and Siermann 1996; Klomp and de Haan, 2010a) suggest that legal indicators work best for advanced economies, while the turnover rate of central bank governor works best for developing countries.

rapid turnover of central bank governors indicates less CBI.⁵ Behind this presumption are two further assumptions: first, the nature of the exit of central bank governors in circumstances where turnover is rapid and, second, the nature of their replacement with a new candidate.

Frequent replacement of the central bank governor may reflect the removal of those who challenge the government. It is well known in the policy arena, and the above New York Times' quote illustrates, that the government frequently fires or pressures the highest monetary authority to quit when he/she does not accommodate its wishes to finance the budget deficit or pursue expansionary monetary policy to exploit the short-run trade-off between output and inflation. In the recent Argentinean case, after defying calls to resign at the request of the President Cristina Fernández, central bank governor Martín Redrado was fired by a presidential emergency decree. The decree stated that Mr. Redrado was fired due to "bad behavior" and failure to fulfill "the duties of a public servant" (Presidential Emergency Decree 18/2010, Article 1). The cabinet chief Aníbal Fernández (no relation to the president) said to reporters, "Redrado has taken on economic positions that do not correspond to the government's economic policy. It was not Redrado who gathered the reserves, it was the government." He also asserted that "in this country, decisions are made by the president, not by the president of the Central Bank" (Buenos Aires, Argentina. January 6, 2010).

On the other hand, frequent changes of the central bank governor give political authorities the "opportunity to pick those who will do their will" (Cukierman et al 1992, page 363). As illustrated by the above Financial Times' quote, the Argentinean President not only fired a "disobedient" central banker, but also appointed Mercedes Marcó del Pont, head of the state-run Banco de la Nación. The selection was perceived, both domestically and internationally, as a strong signal of executive branch capture of the central bank. Not surprisingly, Marcó del Pont defended the use of international reserves to pay government debt, qualifying such measure as "virtuoso and legit" (Buenos Aires, Argentina. March 4, 2010).

Taking into account these two implicit mechanisms, the involuntary dismissal of challengers and

⁵As discussed by early literature, this is an imperfect measure as low turnover rate may also indicate that the central bank governor behaves as the government prefers.

the appointment of government allies, several researchers have studied the relationship between the turnover rate of central bank governors and inflation. While not uncontested, many studies find that turnover rate of central bank governors is positively related with inflation, particularly for developing countries (Cukierman, 1992; Cukierman et al, 1992; Cukierman and Webb, 1995; de Haan and Siermann, 1996; Al-Marhubi, 2000; Cukierman et al, 2002; Neyapti, 2003; Crowe and Meade, 2007 and 2008).⁶ This empirical regularity is consistent with the hypothesis that a lack of CBI increases inflation. However, the previous studies do not explicitly identify the two mechanisms described above, but rather implicitly assume their presence in the turnover rate measure. Thus the extent to which empirical findings effectively support the theoretical implication is severely compromised.

Taking into account this limitation, our paper has two objectives. First, we aim to identify, in a more direct way, the two channels described above: i) the involuntary exit of a central bank governor who is perceived as a challenger by the government and ii) his/her replacement with a government ally. That is to say, we aim to differentiate voluntary exits that are part of the naturally occurring process of the labor supply/attachment decisions of central bank governors from the involuntary departures associated with central bank governors who are perceived as challengers by the government. We also aim to identify whether or not central bank governor replacements have strong ties with the government.

For this purpose, we built a new dataset for 42 countries for the period 1972-2006 which proxy for these two key features. First, we discern whether or not each central bank governor was replaced prematurely, i.e. before the expiration of his/her official first term in office. Premature changes are more likely to be associated with involuntary departures of central bank governors perceived as challengers by the government. Our dataset also captures whether or not each central bank governor's

⁶These findings have been contested on several grounds. Some authors argue that the observed negative relationship between CBI and inflation may derive from a latent variable such as society's aversion to inflation (Posen, 1993; Posen, 1995; Mas 1995), national attitudes towards inequality (de Jong, 2002) or preference for delegation (Crowe, 2008).

Cukierman et al (1992) point out that reverse causality between inflation and CBI can also exist to the extent that low inflation tends to make central bank more reputable which in turn allows the central bank to seek greater autonomy. Dreher et al (2008) find that past inflation increases the likelihood that a central bank will be replaced and, in line with de Haan and Kooi (2000) and Sturm and de Haan (2001), that turnover rate only becomes significant if high inflation countries are included in the sample.

Allowing for heterogeneity in coefficients estimated, Klomp and de Haan (2010b) argue that central bank independence has a significant effect for a minority of countries.

replacement directly emanates from any ministry or top government agency that relates to the economy, commerce, trade or industry in the executive branch. Arguably, hiring someone as a central bank governor who is, at the time of the hiring, the highest official in any of these ministries or government agencies represents the clearest case of central bank capture. Second, we test how these new measures of CBI affect inflation.

We can summarize our main empirical findings in the following seven points:

1. Premature changes of central bank governors are more prevalent in developing countries (64 percent) than in advanced economies (30.1 percent).
2. While the ministers or the heads of top government agencies relating to economy, commerce, trade or industry in the executive branch do not replace central bank governors in advanced economies, they represent about 8.5 percent of changes in developing countries.
3. The replacement of a central bank governor with a minister or head of a top government agency is more prevalent when the exit of its predecessor is premature (42.8 percent higher), suggesting that this type of replacement tends to complement –rather than substitute– the premature exit of a central bank governor.
4. Non-premature replacements of central bank governors are not associated with high inflation.
5. Premature replacements of central bank governors increase inflation in developing countries.
6. The replacement of a central bank governor with a minister or head of a top government agency increases inflation.
7. The influence of our new measures of CBI on inflation described in points 4, 5, and 6 hold to the inclusion of country fixed effects, world inflation, degree of trade openness and alternative exchange and monetary arrangements such as fixed exchange rate regimes and inflation target. Our results also remain strong even after controlling for “stressful” times variables, such as systemic banking crises and default episodes.

These findings support the presumption that the exit of a likely challenger central bank governor gives governments the possibility that the new central bank governor is less of a challenger than their predecessor, which, ultimately, increases inflation. This mechanism is particularly strong in developing countries where the rule of law and institutional transparency is low. Moreover, if a known government ally is hired, more dependency is ensured and inflation increases by a greater margin. We also find that both types of opportunities are less prevalent in advanced countries than in developing economies.

The paper is structured as follows. Section 2 describes the new measures of CBI. Section 3 discusses and explains the calculation of the turnover rates. Section 4 performs a preliminary analysis regarding the effect of CBI on inflation using non-parametric approaches. Section 5 turns to regression analysis. Section 6 presents final remarks.

2 New measures of CBI

Our annual dataset consists of 42 countries for the period 1972-2006. According to the IMF World Economic Outlook country classification, 21 are advanced economies and 21 are developing countries. The dataset is almost perfectly balanced with 1,226 observations.^{7,8}

Using information from central bank websites and emails exchanged with these institutions, we identified 257 central bank governor changes. This implies an overall period average turnover rate of 0.210 and, consequently, an average change of central bank governor every 4 years and 9 months. Table 1 shows these averages for advanced and developing countries. These findings are consistent with previous studies in that the frequency of replacement in developing countries is much higher –almost two times higher– than in advanced economies. Argentina has the highest turnover rate in the sample with a central banker replaced, on average, every 1 year and 3 months. On the other end of the spectrum, Dutch governors are replaced, on average every 13 years.

INSERT TABLE 1

⁷We do not include observations for Eurozone members since their entrance to the Euro Area.

⁸The list of countries and the period covered for each of them is detailed in the Appendix of Data, Section 6.1.

We contribute to this literature by identifying circumstances in which i) there is an involuntary exit of a central bank governor who is perceived as “disobedient” to the administration and ii) when the central bank governor’s replacement is an ally of the government. We proxy the first circumstance using premature changes in the central bank governor. If a central bank governor is replaced before the expiration of his/her first official term in office it is classified as premature (*PREM*), while it is classified as non-premature (*NON-PREM*) if it is not. Premature changes are more likely to be associated with involuntary departures of central bank governors who are perceived as challengers by the government. For this purpose, we combine changes in central bank governor data with legal term of office of central bank governor. We obtain the legal term of office information from central bank websites.

Irregular departures of central bank governors that do not coincide with the legal term of office also occur after first term in office. However, this is not a typical phenomenon, especially in developing countries. For this group of countries, about 83 percent of irregular exits occur during the first term in office. Furthermore, empirical findings do not change if irregular departures that took place after the first term are also included to proxy involuntary exits. Contrary to what we would have expected, irregular departures are quite common in advanced countries. About 58.1 percent of all central bank governor exits are irregular. However, only half of them correspond to departures that occurred during the first term. Moreover, irregular exits that occurred after the first term are heavily concentrated in Scandinavian countries, which are typically associated with high degree of central bank independence. Also, for many of these episodes, central bank governors leave office after more than a decade of service. Taking into account these considerations, we do not focus on irregular exits that take place after the first term as they are less likely to be associated with involuntary exits of central bank governors who are perceived as challengers to the administration.

Measuring whether the central bank governor’s replacement is less of a challenger or more “obedient” than the one being replaced is by no means an easy task. Such consideration would involve a subjective evaluation of each central bank governor’s replacement at the time in which he/she was

selected for such position. Considering this limitation, we aim to capture extreme cases in which the central bank governor’s replacement has strong ties to the executive branch, which would imply low CBI. To this end, we identify whether the central bank governor’s replacement was the highest authority in any ministry or top government agency that relates to the economy, commerce, trade or industry in the executive branch within a one-year frame.^{9,10,11} We focus on the highest ranked members of these institutions because of data limitations. Arguably, hiring someone as a central bank governor who is, at the time, the highest official in any of these ministries, represents the clearest case of central bank capture.¹² We measure this by matching the names of ministers or heads of government agencies with those of central bank governors. Names for central bank governors are from central bank websites and emails exchanged with these institutions. Names for ministers are from the *Rulers of the World* dataset, ministries’ and government agencies’ websites, as well as emails with these institutions. If the central bank governor’s replacement is drawn from the ranks of the executive branch of the government, the change is classified as *ALLY*; if it is not, it is classified as *NON-ALLY*.¹³

Table 2 shows the distribution of central bank governor changes according to the two dimensions, *PREM* vs. *NON-PREM* and *ALLY* vs. *NON-ALLY*. About 52 percent of total central bank governor changes are *PREM*. This figure increases to 64 percent for developing countries and represents about 30 percent for advanced economies. The replacement of a central banker with an *ALLY* is relatively infrequent for the overall sample, representing 5.4 percent of all changes. Interestingly, but not surprisingly, this hiring circumstance differs notably between advanced and developing countries. While central bank governors do not emanate from top-ranked positions in ministries or government agencies from the executive branch in advanced countries, this pattern of replacement represents 8.5 percent of all central bank governor changes in developing economies. In each *ALLY* replacement case,

⁹While several ministries and top government agencies are considered, 85.7 percent of these type of replacements involve the ministry of finance or economy.

¹⁰While the central bank governor replacement could in principle emanate from any other ministry such as defense, justice, education or science and research we, sensibly, do not observe this pattern in the dataset.

¹¹Appendix of Data, Section 6.1, describes the list of ministers and government agencies considered for each country.

¹²We restrict to a one-year time frame because it represents the most obvious case of dependency. If, for example, the central bank governor’s replacement was the minister of finance 10 years before becoming a central banker, it would not clear that this replacement would involve the capture of the central bank in hands of the executive branch.

¹³Description and source of central bank governor change data is detailed in Appendix of Data, Section 6.3.

he/she was appointed a high-rank civil servant in the executive branch by the same administration under which he/she was later selected to be the central bank governor.¹⁴ Moreover, this trend is quite widespread across developing countries, affecting 11 out of the 21 developing countries in our sample.¹⁵

INSERT TABLE 2

Another interesting pattern is that the replacement with an *ALLY* is remarkably more prevalent when the exit of its predecessor is *PREM*. *ALLY* replacement conditional on having a *PREM* exit is almost 140 percent higher than conditional on *NON-PREM* for the whole sample and 41.8 percent for developing countries.¹⁶ Therefore, hiring an *ALLY* appears to be a complement –rather than a substitute– to the exit of a central bank governor perceived as a challenger.

3 Calculation of turnover rates

Similar to Klomp and de Haan (2010b), we calculate the turnover rate (TOR) using a rolling average over four years preceding a central bank governor change.¹⁷ The time interval used to calculate average turnover rate of central bank governors varies across studies. Al-Marhubi (2000) and Temple (1998) use the average for the entire period under analysis, which was 1980-1995 and 1974-1994 respectively. Cukierman et al (1992) and de Haan and Kooi (2000) calculate decade averages, while Dreher et al (2008) use the averages or starting values for each lustrum. The use of long time periods to calculate average turnover rate of central bank governors, implicitly assumes that actual independence and institutional characteristics rarely change. On the contrary, the use of decades or lustra allows for some moderate institutional change that seems to be consistent with some empirical evidence. For

¹⁴This empirical regularity reinforces our presumption that *ALLY* replacements have very strong ties to the government. We want to thank an anonymous referee for pointing out this issue.

¹⁵Replacements of central bank governor classified as *ALLY* are present in Argentina, Chile, Hungary, India, Lithuania, Mexico, Pakistan, Poland, Russia, Thailand and Uruguay.

¹⁶The probability of having an *ALLY* replacement conditional on having a *PREM* (*NON-PREM*) exit is 0.081 (0.034) for the whole sample, and 0.095 (0.067) for developing countries.

¹⁷Our results not do vary significantly if the length of windows are moderately changed. We select a window of four years to match the overall period average turnover rate of central bank governors.

example, while central bank governors of Chile were replaced on average every 1 year and 3 months during the 1980s, they were replaced every 5 years –coinciding with the legal term of office– during the 1990s.

While the use of decades or lustra are more flexible in allowing for moderate institutional change, the use of fixed windows implicitly assumes that those changes only occur in arbitrary years; for example at the very beginning or at the very end of a decade. By using rolling windows to calculate average turnover rate of central bank governors, we allow for a more gradual and continuous institutional change.

It is important to remark that because we calculate the rolling average over four years preceding a central bank governor change, we do not include current or future changes of central bank governor in our current calculation of TOR. This strategy purges reverse causality concerns, a crucial distinction because Dreher et al (2008) find that past inflation increases the likelihood of a central banker to be replaced.

4 CBI and inflation. Preliminary analysis

In this section we perform a preliminary analysis regarding the effect of CBI on inflation. We start by replicating basic results from literature using the turnover rate of central bank governors. Later, we examine the relevance of the condition of exit (*PREM* vs. *NON-PREM*) and of replacement (*ALLY* vs. *NON-ALLY*). Inflation data are from *Global Financial Data*.¹⁸

From a methodological point of view we use non-parametric analysis. First, we plot probability density functions (PDF) of inflation when turnover rate categories are equal to zero and when they are positive.¹⁹ For example, $\text{PDF}_{\text{TOR}=0}$ represents the PDF of inflation when $\text{TOR}=0$ (i.e. central bank governor has not changed in the past 4 years) while $\text{PDF}_{\text{TOR}>0}$ represents the PDF of inflation when $\text{TOR}>0$ (i.e. central bank governor has changed in the past 4 years). Second, we test whether or not these distributions are alike using the Wilcoxon rank-sum test. Last, we test whether different

¹⁸Description and source of data is detailed in Appendix of Data, Section 6.2.

¹⁹In this preliminary analysis we do not distinguish among positive levels of turnover rates.

TOR categories have equal medians using the 1-sided Fisher’s exact test.²⁰

In this section, instead of using the inflation rate π , we use $D \equiv (\pi / (1 + \pi)) \cdot 100$. D is a normalization that takes a value from 0 to 100 for positive rates of inflation. This non-linear transformation reduces the effect of outliers, allowing for a more reasonable eye inspection of PDF.²¹

4.1 Traditional measure of CBI

Figure 1 shows $\text{PDF}_{\text{TOR}=0}$ and $\text{PDF}_{\text{TOR}>0}$. $\text{PDF}_{\text{TOR}>0}$ has more observations associated with extremely high inflation than does $\text{PDF}_{\text{TOR}=0}$. Tables 3 and 4 show that both distributions are effectively different and that the median inflation when $\text{TOR}>0$ ($D = 6.34$) is statistically higher than when $\text{TOR}=0$ ($D = 5.07$). These findings match those of the traditional literature.

INSERT FIGURE 1

INSERT TABLE 3

INSERT TABLE 4

More recent studies (de Haan and Kooi, 2000; Sturm and de Haan, 2001; Dreher et al, 2008; Klomp and de Haan, 2010b) find that the positive relationship between inflation and TOR described above is severely weakened if outliers with high inflation are excluded. This suggests that either the overall relevance of the topic is circumscribed to a small group of countries or that relatively few high inflation observations, more likely to be tainted with endogeneity concerns, could be driving the results. Indeed, the results change dramatically if we exclude the observations with the highest 10 percent of inflation from the analysis.²² As Figure 2 suggests and Wilcoxon rank-sum test confirms (Table 3), we cannot reject that $\text{PDF}_{\text{TOR}=0}$ and $\text{PDF}_{\text{TOR}>0}$ have identical PDFs. We also cannot reject that their median levels of inflation are the same in statistical terms (Table 4).²³ Moreover, the highest 10 percent

²⁰Similar results are obtained if alternative median tests, such as the Pearson’s chi-squared, are used.

²¹Wilcoxon rank-sum and 1-sided Fisher’s exact tests are not affected by non-linear transformations.

²²The average and median inflation of the observations with 10 percent highest inflation are 85.53 and 29.59 percent, which are in clear contrast with the 6.98 and 5.16 percent of the remaining sample.

²³The median inflation is $D = 5.14$ when $\text{TOR}>0$ and $D = 4.66$ when $\text{TOR}=0$.

inflationary observations are heavily concentrated in only a few countries, such as Argentina, Chile, Mexico, Poland, Romania, Turkey and Uruguay.²⁴ In summary, if we exclude these high inflation outlying observations, the standard results found in traditional literature tend to vanish.

INSERT FIGURE 2

4.2 New measures of CBI

Now we test the relevance of the proposed new measures of CBI one at a time, later interacting one with the other. We focus on the reduced sample, less contaminated with high inflation outliers.

First, we decompose $TOR > 0$ (i.e. central bank governor has changed in the past 4 years) into $TOR_{PREM} > 0$ (i.e. central bank governor has changed prematurely in the past 4 years) and $TOR_{NON-PREM} > 0$ (i.e. central bank governor has changed non-prematurely in the past 4 years). Figure 3 suggests, and Wilcoxon rank-sum tests confirm (Table 3), that while $PDF_{TOR=0}$ is identical to $PDF_{TOR_{NON-PREM} > 0}$, $PDF_{TOR_{PREM} > 0}$ is significantly different from both $PDF_{TOR=0}$ and $PDF_{TOR_{NON-PREM} > 0}$. We cannot reject that the median levels of inflation of $TOR=0$ ($D = 4.66$) equals that of $TOR_{NON-PREM} > 0$ ($D = 4.79$). Median tests also confirm that median inflation of $TOR_{PREM} > 0$ ($D = 6.33$) is bigger than those of $TOR=0$ and $TOR_{NON-PREM} > 0$ (Table 4). These findings support the presumption that only replacements more likely to be associated with an involuntary departure of a challenger central bank governor, trigger more dependency, which ultimately increases inflation.²⁵

INSERT FIGURE 3

Second, we decompose $TOR > 0$ into $TOR_{NON-ALLY} > 0$ (i.e. central bank governor has changed in the past 4 years and was not replaced with an ALLY) and $TOR_{ALLY} > 0$ (i.e. central bank governor has

²⁴About 40 percent of all excluded observations belong to this set of countries.

²⁵In a related paper, Dreher et al (2010) analyze the determinants of irregular central bankers' replacements. Irregular replacements also include those that occur after the first term in office. They find no evidence that past inflation or its volatility increase the likelihood of central banker to be replaced before the end of his/her official term.

changed in the past 4 years and was replaced with an ALLY). Figure 4 suggests, and Wilcoxon rank-sum tests confirm (Table 3), that while $\text{PDF}_{\text{TOR}=0}$ is identical to $\text{PDF}_{\text{TOR}_{\text{NON-ALLY}}>0}$, $\text{PDF}_{\text{TOR}_{\text{ALLY}}>0}$ is significantly different from both $\text{PDF}_{\text{TOR}=0}$ and $\text{PDF}_{\text{TOR}_{\text{NON-ALLY}}>0}$. We cannot reject that the median levels of inflation of $\text{TOR}=0$ ($D = 4.66$) equals that of $\text{TOR}_{\text{NON-PREM}}>0$ ($D = 5.07$). Median tests also show that the median inflation of $\text{TOR}_{\text{PREM}}>0$ ($D = 9.82$) is much greater than those of $\text{TOR}=0$ and $\text{TOR}_{\text{NON-PREM}}>0$ (Table 4). These findings confirm our presumption that when ministers or heads of top government agencies take the position of central bank governor, inflation rates increase by a greater margin than they would if the replacement does not have obvious ties to the government. This finding reveals the crucial relevancy regarding the origin of the central bank governor's replacement on inflation.

INSERT FIGURE 4

Last, we decompose $\text{TOR}>0$ into $\text{TOR}_{\text{NON-PREM} \ \& \ \text{NON-ALLY}}>0$ (i.e. central bank governor has changed non-prematurely in the past 4 years and was not replaced with an ALLY), $\text{TOR}_{\text{NON-PREM} \ \& \ \text{ALLY}}>0$ (i.e. central bank governor has changed non-prematurely in the past 4 years and was replaced with an ALLY), $\text{TOR}_{\text{PREM} \ \& \ \text{NON-ALLY}}>0$ (i.e. central bank governor has changed prematurely in the past 4 years and was not replaced with an ALLY) and $\text{TOR}_{\text{PREM} \ \& \ \text{ALLY}}>0$ (i.e. central bank governor has changed prematurely in the past 4 years and was replaced with an ALLY). Figure 5 suggests, and Wilcoxon rank-sum tests confirm (Table 3), that while $\text{PDF}_{\text{TOR}=0}$ is identical to $\text{PDF}_{\text{TOR}_{\text{NON-PREM} \ \& \ \text{NON-ALLY}}>0}$, the remaining pairs of PDF comparisons are mostly different amongst themselves.²⁶ We cannot reject that the median level of inflation of $\text{TOR}=0$ ($D = 4.66$) equals that of $\text{TOR}_{\text{NON-PREM} \ \& \ \text{NON-ALLY}}>0$ ($D = 4.69$). Median tests displayed in Table 4 also confirm that median inflation is the highest when $\text{TOR}_{\text{PREM} \ \& \ \text{ALLY}}>0$ ($D = 10.89$), followed by $\text{TOR}_{\text{NON-PREM} \ \& \ \text{ALLY}}>0$

²⁶The remaining PDFs are different amongst themselves with the exception of $\text{PDF}_{\text{TOR}_{\text{NON-PREM} \ \& \ \text{ALLY}}>0}$, which is identical to $\text{PDF}_{\text{TOR}_{\text{PREM} \ \& \ \text{NON-ALLY}}>0}$ and $\text{PDF}_{\text{TOR}_{\text{PREM} \ \& \ \text{ALLY}}>0}$. This result is not surprising considering the relatively few observations associated with $\text{TOR}_{\text{NON-PREM} \ \& \ \text{ALLY}}>0$.

($D = 8.29$) and $TOR_{PREM \& NON-ALLY} > 0$ ($D = 6.35$).

INSERT FIGURE 5

In summary, non-premature changes in central bank governors do not induce high levels of inflation. Premature exits of central bank governors are associated with higher inflation than non-premature exits, especially when replaced with ministers or heads of government agencies that depend on the executive branch.

5 CBI and inflation. Regression analysis

In this section we turn to regression analysis. We proceed as we did in Section 4. We start by replicating basic results from literature using the turnover rate of central bank governors. Later, we examine the relevance of the condition of exit (*PREM* vs. *NON-PREM*) and of replacement (*ALLY* vs. *NON-ALLY*).

5.1 Traditional measure of CBI

In this section we test whether turnover rate of central bank governors is associated with high inflation. We consider the following specification:

$$\pi_{it} = \alpha_0 + \beta TOR_{it} + \sum_{h=1}^H \gamma_h x_{it}^h + \eta_i + \mu_{it},$$

where x are H additional control variables and η_i represents a country fixed effect. Columns 1, 2, and 3 in Table 5 report basic OLS regressions for all, advanced, and developing countries. No control variables or fixed effects are included, and residuals μ_{it} are assumed to be homoscedastic and have no autocorrelation. These regressions include all observations, including outliers with high inflation. The results show that higher TOR is associated with higher inflation for each group of countries.

Quantitatively speaking, the results are quite large, especially for developing countries.

INSERT TABLE 5

The regressions reported in columns 4, 5, and 6 relax the assumption of homoscedasticity and no autocorrelation by calculating robust variances and allowing the presence of error autocorrelation within countries. It should come as no surprise that these modifications increase the standard errors, reducing the t-statistics. The statistical significance of TOR vanishes for advanced economies and remains strong for developing countries. These results coincide with past literature findings and confirm that turnover rate of central bank governors works better for developing countries than in advanced economies (Cukierman, 1992; Cukierman et al, 1992; de Haan and Siermann 1996; Klomp and de Haan, 2010a).

The regressions reported in columns 7, 8, and 9 also exclude the 10 percent of observations with the highest inflation. The relevance of TOR holds when all countries are analyzed altogether (column 7). However, it vanishes when countries are separated in groups (columns 8 and 9). These results are in line with recent studies (de Haan and Kooi, 2000; Sturm and de Haan, 2001; Dreher et al, 2008; Klomp and de Haan, 2010b), which find that this relationship tends to weaken if observations with high inflation are excluded.

The regressions reported in columns 10, 11, and 12 also include a country fixed effect η_i . Plausible factors captured by such effect include society's aversion to inflation and attitudes toward fiscal discipline. By including this effect, the main source of identification originates from within country variability as opposed to cross-country variability. This issue is particularly relevant considering the important differences in inflation history across countries. Table 6 shows median inflation for advanced and developing countries. Median inflation ranges between 1.404 and 14.403 percent in advanced countries with an average of 5.190 percent. These figures notably increase for developing countries, with a maximum median inflation of 64.149 and a group average of 17.270 percent. Historical inflation

rates also notably differ within each of these groups. For example, among advanced countries, Greece exhibits a median inflation rate of 14.403 while Japan’s median inflation is 1.404. The regression analysis results coincide with past findings and confirm that turnover rate of central bank governors works better in developing countries than in advanced economies.²⁷

INSERT TABLE 6

5.1.1 “Tranquil” times determinants of inflation

In Table 7, we estimate panel fixed effect regressions like those estimated in columns 10, 11, and 12 of Table 5, also including additional “tranquil” times determinants of inflation to ameliorate the omitted variable bias. Columns 1, 2, and 3 include the trend of world inflation rate (π^{world}), proxied by the Hodrick-Prescott trend of inflation rate of G7 countries. This variable controls for external inflation/disinflation trends (Jácome and Vázquez, 2008). We find that external inflation/disinflation trends indeed affect inflation almost proportionately.

INSERT TABLE 7

Columns 4, 5, and 6 include trade openness (*Openness*) defined as the percentage ratio of exports plus imports to GDP. Romer (1993) argues that in economies more open to trade, central banks find currency fluctuations to be more painful and therefore exercise more restraint than their closed economy counterparts.²⁸ We find indeed that inflation decreases with trade openness.

While delegating monetary authority to an independent and credible central banker can achieve price stability, implementing a fixed exchange rate regime or an explicit target on inflation can also obtain it. Columns 7, 8, and 9 include inflation target (*Inflation target*), a dummy variable equal to 1

²⁷Results are not affected if Greece is considered a developing country.

²⁸The openness-inflation correlation itself has generated considerable controversy. Terra (1998) challenges Romer’s empirical findings, arguing that the openness-inflation correlation is confined to severely indebted countries and, even then, is only evident during the 1980’s debt crisis period. Romer (1993) himself finds no significant inflation-openness relationship among OECD economies.

if there is inflation target policy, and 0 otherwise. Columns 10, 11, and 12 include fixed exchange rate regime (*Fixed ERR*), a dummy variable equal to 1 if Reinhart-Rogoff de facto exchange rate regime coarse classification equals 1 or 2, and 0 otherwise. Our findings support that inflation target policies are associated with lower inflation; however, fixed regimes do not seem to affect inflation.

Columns 13, 14, and 15 consider all “tranquil” times controls. The coefficients of the control variables do not change with the exception of trade openness. This occurs mainly because of multicollinearity. Important for our purposes, when introduced one at a time or all together, these additional controls do not affect the strength of our benchmark findings regarding the influence of TOR on inflation.

5.1.2 “Stressful” times determinants of inflation

In Table 8, we estimate panel fixed effect regressions like those estimated in columns 10, 11, and 12 of Table 5, also including additional “stressful” times determinants of inflation such as banking crises (*Bank crisis*) and default episodes (*Default*).²⁹ Columns 1, 2, and 3 include *Bank crisis* and columns 4, 5, and 6 *Default* one at a time. Columns 7, 8, and 9 include both control variables together.

INSERT TABLE 8

We find that banking crises as well as default episodes increase inflation in developing countries. There are no episodes of default in advanced countries for the period analyzed. While banking crises are not associated with higher inflation at 10 percent significance level in advanced economies, they are at 12 percent. Important for our study, when introduced one at a time or all together, these additional “stressful” controls do not affect the strength of our benchmark findings regarding the influence of TOR on inflation. Similarly, if we include both “tranquil” and “stressful” controls simultaneously, the relationship between TOR and inflation strongly holds (columns 10, 11, and 12 in Table 8).

In summary, after i) considering a rich structure of errors that allows heteroscedasticity and auto-

²⁹ *Bank crisis* is a dummy variable which equals 1 if there is a systemic bank crises and 0 otherwise. *Default* is a dummy variable which equals 1 if there is foreign sovereign default on bonds or banks and 0 otherwise.

correlation, ii) excluding high inflation outliers, iii) including country fixed effects, and iv) controlling for “tranquil” and “stressful” times variables that are considered to be determinants of inflation, we confirm that an increase in TOR increases inflation for developing countries.

5.2 New measures of CBI

In this section we estimate regressions similar to those of columns 10, 11, and 12 in Table 8, using instead the proposed new measures of CBI one at a time and, later, interacting one with the other. First, we decompose turnover rates of central bank governors (TOR) into premature (TOR_{PREM}) and non-premature ($TOR_{NON-PREM}$).³⁰ Table 9 shows that for the whole sample of countries, as well as for advanced and developing economies, changes that are less likely to be associated with challenger central bank governors ($TOR_{NON-PREM}$) are not associated with high inflation. Changes that are likely to be associated with challenger central bank governors (TOR_{PREM}) are strongly associated with high inflation; this is found in the whole sample of countries and the subsample of developing economies, though not for advanced countries. These findings support the presumption that i) only replacements that tend to be associated with an involuntary departure of a challenger central bank governor trigger more dependency, ultimately increasing inflation and ii) the opportunities that the departure of a supposed challenger central bank governor opens to governments are less intense in advanced economies than in developing countries, where the rule of law and institutional transparency is lower.

INSERT TABLE 9

Second, we separate changes in central bank governor depending on whether or not his/her replacement emanates from a ministry or government agency of the executive branch (TOR_{ALLY} vs. $TOR_{NON-ALLY}$).^{31,32} Columns 1 and 2 in Table 10 confirm our presumption that when ministers or heads of top government agencies take the position of central bank governor, inflation rates increase

³⁰Naturally, $TOR = TOR_{PREM} + TOR_{NON-PREM}$.

³¹Naturally, $TOR = TOR_{ALLY} + TOR_{NON-ALLY}$.

³²We do not include separate regressions for advanced countries as they do not present $ALLY$ observations.

by a greater margin than they would if the replacement does not have obvious ties to the government. This finding reveals the significance of the effect of the origin of the central bank governor's replacement on inflation. When the central bank governor's replacement comes from a ministry or top executive branch agency, inflation is about 5 times higher than when the replacement is not.

INSERT TABLE 10

It is reasonable to think that there would be fewer potential candidates in the private banking sector in countries with poorly developed domestic financial sectors, making a civil servant appointment more likely. Therefore, the effect on inflation attributed to the replacement of the central bank governor with a government ALLY may be a proxy for lack of financial development or financial sophistication in the economy.³³

We address this concern by including two variables typically used to proxy for financial development and intermediation; *Liquid liabilities* and *Private credit* (Levine et al, 2000; Loayza and Ranciere, 2006; Levine et al, 2010). *Liquid liabilities* equals liquid liabilities of the financial system (currency plus demand and interest-bearing liabilities of banks and nonbank financial intermediaries) divided by GDP. This is a typical measure of financial depth and the overall size of the financial intermediary sector. *Private credit* equals the value of credits by financial intermediaries to the private sector divided by GDP. This measure isolates credit issued to governments, government agencies, and public enterprises. Furthermore, it excludes credits issued by the central bank. While *Private credit* does not directly measure information and transaction costs, most studies interpret higher levels of *Private credit* to indicate higher levels of financial services and, thus, greater financial intermediary development.

Columns 4 to 8 in Table 10 include, both one at a time and all together, *Private Credit* and *Liquid liabilities*. We find that indeed lower (higher) financial development increases (decreases) inflation in developing countries. While the magnitude of the coefficient TOR_{ALLY} is slightly reduced, it strongly

³³We want to thank an anonymous referee for pointing out this issue.

holds to be positively related to inflation.³⁴ In summary, the influence of ALLY replacements on inflation is not driven by lack of financial development.

Lastly, we combine both dimensions, i.e. the circumstances regarding the exit of the central banker with the origin of the incoming replacement. Table 11 shows the results from using the following four self-explanatory categories: $TOR_{NON-PREM \& NON-ALLY}$, $TOR_{NON-PREM \& ALLY}$, $TOR_{PREM \& NON-ALLY}$ and $TOR_{PREM \& ALLY}$.^{35,36,37} When using these categories, the results obtained in Tables 9 and 10 are upheld. Non-premature changes in central bank governors do not induce high levels of inflation. Premature exits of central bank governors are associated with higher inflation than non-premature ones, especially when replaced with ministers or heads of government agencies that depend on the executive branch.

INSERT TABLE 11

6 Conclusions

Our paper contributes to the literature on CBI. The problems with legal measures of CBI are well established. In many countries, particularly in developing ones, de jure institutional rules and laws are poor guides to actual independence. To fill this gap, researchers have turned to de facto measures, the most popular being the turnover rate of central bank governors.

The basic presumption of this de facto measure is that, at least above some threshold, a more rapid turnover of central bank governors indicates less CBI. Behind this presumption are two further assumptions about the nature of the exit of central bank governors in circumstances where turnover is rapid and the nature of their replacement with a new candidate. Our paper contributes to the literature

³⁴The effect of *Private Credit* on inflation vanishes when *Liquid liabilities* is also included as a control variable (column 8 in Table 10). This occurs because of multicollinearity; the correlation between *Private Credit* and *Liquid liabilities* is 0.6689.

³⁵Naturally, $TOR = TOR_{NON-PREM \& NON-ALLY} + TOR_{NON-PREM \& ALLY} + TOR_{PREM \& NON-ALLY} + TOR_{PREM \& ALLY}$.

³⁶Since there are no ALLY observations in advanced countries, results from column 2 in Table 11 coincide with those of column 2 in Table 9.

³⁷It is worth remarking that, as discussed in Section 2, $TOR_{NON-PREM \& ALLY}$ has very few observations. Therefore, it is not surprising that such variable is not statistically relevant.

by collecting evidence relating to both assumptions. First, we assess whether governors are replaced before the expiration of their first official term in office. Second, we assess whether the replacement is an ally of the government, which is defined as a candidate drawn from the ranks of the executive branch of the government.

We find that while more rapid turnover rates of central bank governors are associated with inflation (a well-known fact), high rates of turnover associated with premature exits, and replacement with more “docile” candidates are driving this result. Thus, our findings provide deeper empirical justification for the use of the traditional TOR measure. At the same time, our paper provides clearer measures of de facto independence by focusing specifically on these mechanisms, allowing researchers to move beyond the coarse aggregate TOR measure.

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6 Appendix of data

6.1 Period covered and ministries and government agencies covered for each country

Country	Period covered	Ministries and government agencies considered
Advanced countries		
Australia	1972-2006	Ministry of Finance; Treasury; Ministry of Employment; Ministry of Industrial Relations; Ministry of Trade; Ministry of Transportation; Ministry of Administrative Services; Ministry of Home Affairs; Ministry of Interior; Ministry of Customs; Ministry of Industry
Austria	1972-1997	Ministry of Finance; Ministry of Economy ; Ministry of Interior; Ministry of Labour, Social Affairs and Consumer Protection
Belgium	1972-1997	Ministry of Finance; Ministry of Budget; Ministry of Development ; Ministry of Economic Affairs; Ministry of Public Service; Ministry of Pensions; Ministry of Labor; Ministry of Welfare; Ministry of Interior
Canada	1972-2006	Ministry of Finance; Treasury Board; Ministry of National Revenue; Ministry of Industry ; Ministry of Agriculture; Ministry of Labour; Ministry of Transport; Ministry of Fisheries and Ocean; Ministry of International Trade
Czech Republic	1994-2003	Ministry of Finance; Ministry of Industry and Trade; Ministry of Interior
Denmark	1972-2006	Ministry of Finance; Ministry of Economic and Business Affairs; Ministry of Interior; Ministry of Taxation; Ministry of Food, Agriculture and Fisheries; Ministry of Labour
Finland	1972-1997	Ministry of Finance; Ministry of Trade and Industry; Ministry of Labour; Ministry of Interior; Ministry of Agriculture and Forestry ;
France	1972-1997	Ministry of Finance; Ministry of National Economy; Ministry of Budget; Ministry of Industry; Ministry of Agriculture; Ministry of Planning; Ministry of Employment; Ministry of Labour and Social Affairs; Ministry of Public Works; Ministry of Transport; Ministry of Housing; Ministry of Trade; Ministry of Foreign Trade; Ministry of Interior
Germany (West Germany before unification)	1972-1997	Ministry of Finance; Ministry of Economic Cooperation and Development; Ministry of Federal Treasury; Ministry of Economics and Technology; Ministry of Interior
Greece	1972-2000	Ministry of Finance; Ministry of Interior; Ministry of Industry, Energy and Technology; Ministry of Trade; Ministry of Development
Italy	1972-1997	Ministry of Finance; Treasury; Ministry of Interior; Ministry of Economic Development; Ministry of Labour
Japan	1972-2006	Ministry of Finance; Ministry of Economy, Trade and Industry; Ministry of Agriculture, Forestry and Fisheries; Ministry of Health,
Malta	1972-2003	Ministry of Finance, Economy and Investment; Ministry of Home Affairs
Netherlands	1972-1997	Ministry of Finance; Ministry of Economic Affairs; Ministry of Development ; Ministry of Social Affairs and Employment; Ministry of Agriculture; Ministry of Interior
New Zealand	1972-2006	Ministry of Finance; Treasury; Ministry of Agriculture
Norway	1972-2006	Ministry of Finance; Ministry of Trade ; Ministry of Labour; Ministry of Agriculture
Slovak Republic	1993-2003	Ministry of Finance; Ministry of Economy; Ministry of Labour; Ministry of Interior; Ministry of Agriculture; Ministry of Construction and
Spain	1972-2000	Ministry of Economy and Finance; Ministry of Industry; Ministry of Interior; Ministry of Labour; Ministry of Planning; Ministry of
Sweden	1972-2006	Ministry of Finance; Ministry of Enterprise, Energy and Communications; Ministry of Employment; Ministry of Agriculture
United Kindom	1972-2006	Ministry of Exchequer; Treasury; Ministry of Trade; Ministry of International Development; Ministry of Work and Pension
United States	1972-2006	Treasury; Department of Commerce; Department of the Interior; Department of Agriculture; Department of Labor; Department of Housing and Urban Development
Developing countries		
Albania	1992-2006	Ministry of Finance; Ministry of Interior
Argentina	1972-2006	Ministry of Economy ; Ministry of Federal Planning, Public Investments and Services; Ministry of Interior; Ministry of Labour
Bulgaria	1992-2006	Ministry of Finance; Ministry of Economy, Energy and Tourism ; Ministry of Interior; Ministry of Agriculture; Ministry of Labour and
Chile	1972-2006	Ministry of Finance; Ministry of Economy, Development and Tourism; Ministry of Interior; Ministry of Planning Cooperation; Ministry of Labor; Ministry of Housing and Urban Development; Ministry of Public Works; Ministry of Mining; Ministry of National Property;
China	1979-2006	Ministry of Finance; Ministry of Commerce; Ministry of Civil Affairs ; National Development and Reform Commission; Ministry of
Hungary	1972-2003	Ministry of Finance; Ministry of Interior
India	1972-2006	Ministry of Finance; Ministry of Home Affairs; Ministry of Agriculture
Indonesia	1972-2006	Ministry of Finance; Ministry of Trade; Ministry of Industry; Ministry of Agriculture; Ministry of Public Works; Ministry of Social
Jamaica	1972-2006	Ministry of Finance and Public Service
Lithuania	1993-2003	Ministry of Finance; Ministry of Economy; Ministry of Interior; Ministry of Energy; Ministry of Social Security and Labour; Ministry of Agriculture; Ministry of Transport
Malaysia	1972-2006	Ministry of Finance; Treasury; Ministry of Trade and Industry; Ministry of Housing
Mexico	1972-2006	Ministry of Finance and Public Credit; Ministry of Economic Affairs; Ministry of Social Development; Ministry of Interior; Ministry of Energy; Ministry of Agriculture; Ministry of Communication and Transportation; Ministry of Labour and Social Welfare; Ministry of
Pakistan	1972-2006	Ministry of Finance; Federal Board of Revenue; Ministry of Interior
Philippines	1972-2006	Ministry of Finance; Ministry of Public Works; Ministry of Energy; Ministry of Agriculture; Ministry of Agrarian Reform
Poland	1972-2003	Ministry of Finance; Ministry of Economy; Ministry of Treasury; Ministry of Internal Affairs; Ministry of Industry and Trade; Ministry of Foreign Economic Cooperation; Ministry of Labour and Social Policy; Ministry of Agriculture and Rural Development; Ministry of
Romania	1991-2006	Ministry of Finance; Ministry of Interior; Ministry of Economy; Ministry of Labour, Family and Social Protection
Russia	1993-2006	Ministry of Economy; Ministry of Interior; Ministry of Trade; Ministry of Economic Development ; Ministry of State Properties; Ministry of Natural Resources; Ministry of Industry; Ministry of Labour; Ministry of Energy; Ministry of Agriculture; Ministry of Transportation
South Africa	1972-2006	Ministry of Finance; Ministry of Home Affairs
Thailand	1972-2006	Ministry of Finance; Ministry of Interior
Turkey	1972-2006	Ministry of Finance; Ministry of Industry and Commerce; Ministry of Public Works and Housing; Ministry of Agriculture; Ministry of Transport; Ministry of Labour; Ministry of Energy and Natural Resources
Uruguay	1972-2006	Ministry of Economy and Finance; Ministry of Labour and Social Affairs; Ministry of Agriculture and Fishing; Ministry of Industry; Ministry of Transport and Public Works; Ministry of Housing; Ministry of Social Development; Ministry of Interior

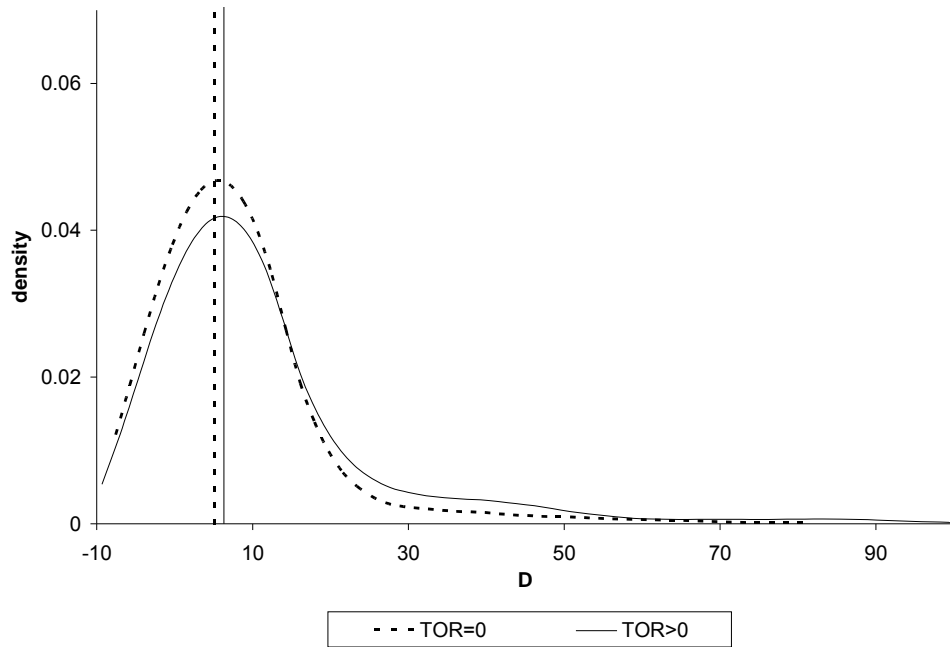
6.2 Description of macroeconomic variables

Variable name	Description	Source
π	Inflation rate based on consumer price index.	Global Financial Data
π^{world}	Trend of inflation rate of G7 countries based on consumer price index and Hodrick-Prescott filter.	Global Financial Data
Openness	Percentage ratio of trade openness (exports+imports) to GDP.	Direction of Trade Statistics, IMF
Inflation target	Dummy variable equal to 1 if there is an inflation target policy; 0 otherwise.	Thórarinn (2004) and central bank websites
Fixed ERR	Dummy variable equal to 1 if Reinhart-Rogoff de facto exchange rate regime coarse classification equals 1 or 2; 0 otherwise.	Reinhart and Rogoff (2004) and 2007 update
Bank crisis	Dummy variable equal to 1 if there is a systemic bank crises; 0 otherwise.	Kindleberger (2000) and Reinhart (2010)
Default	Dummy variable equal to 1 if there is foreign sovereign default on bonds or banks; 0 otherwise.	Reinhart et al. (2003) and Reinhart (2010)
Liquid liabilities	Percentage ratio of liquid liabilities to GDP.	Loayza and Ranciere (2006) and Levine et al (2010).
Private credit	Percentage ratio of private credit by deposit money banks and other financial institutions to GDP.	Loayza and Ranciere (2006) and Levine et al (2010).

6.3 Description of central bank governor change variables

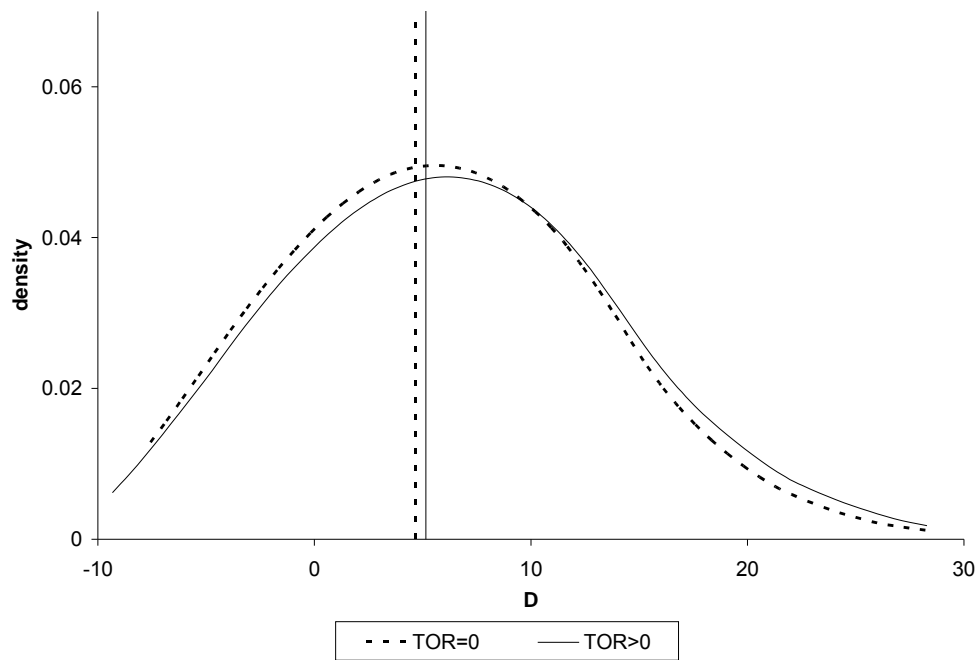
Variable name	Description	Source
PREM	Dummy variable equal to 1 if central bank governor change occurs before the expiration of his/her official first term in office; 0 otherwise.	Authors' calculation, based on change in central bank governor and central bank governor legal term of office.
NON-PREM	Dummy variable equal to 1 if central bank governor change does not occur before the expiration of his/her official first term in office; 0 otherwise.	See PREM variable source.
ALLY	Dummy variable equal to 1 if central bank governor's replacement emanates from a ministry or government agency depending on the executive branch within one-year frame; 0 otherwise.	Authors' calculation. Central bank governor names are from central bank websites and emails exchanged with those institutions. Ministers and heads of government agencies names are from Rulers of the World dataset (www.rulers.org), ministries or government agencies websites and emails exchanged with those institutions. Appendix of data, Section 6.1 specifies ministries or government agencies considered for this calculation.
NON-ALLY	Dummy variable equal to 1 if central bank governor's replacement does not emanate from a ministry or government agency depending on the executive branch within one-year frame; 0 otherwise.	See ALLY variable source.

Figure 1. Probability density functions and median values of inflation across TOR categories for all countries and all observations.



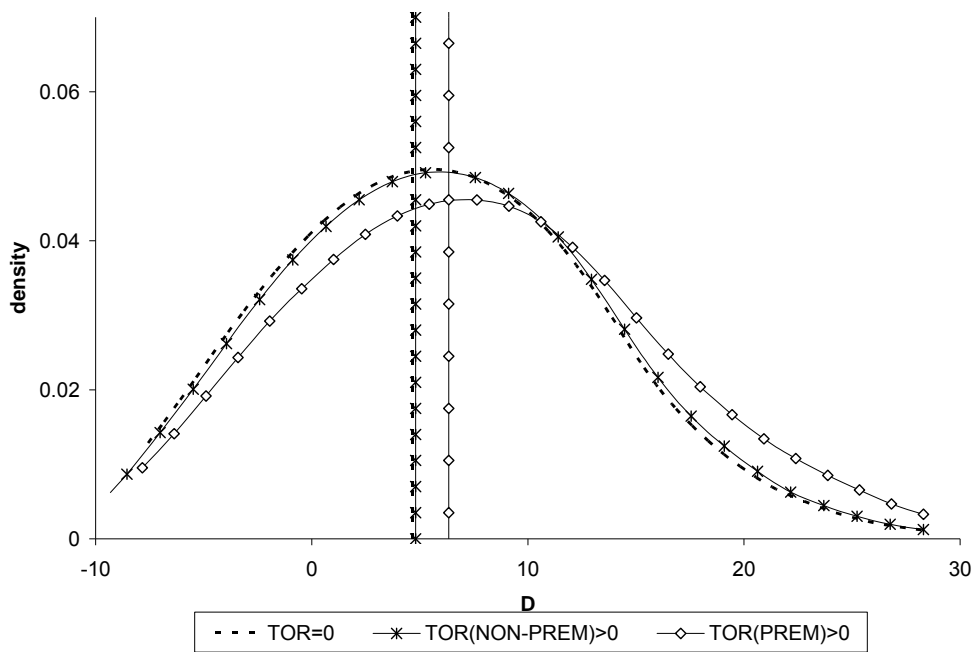
Note: D represents the transformed inflation rate defined as $(\pi/(1+\pi)) \cdot 100$.

Figure 2. Probability density functions and median values of inflation across TOR categories for all countries excluding high-inflation observations.



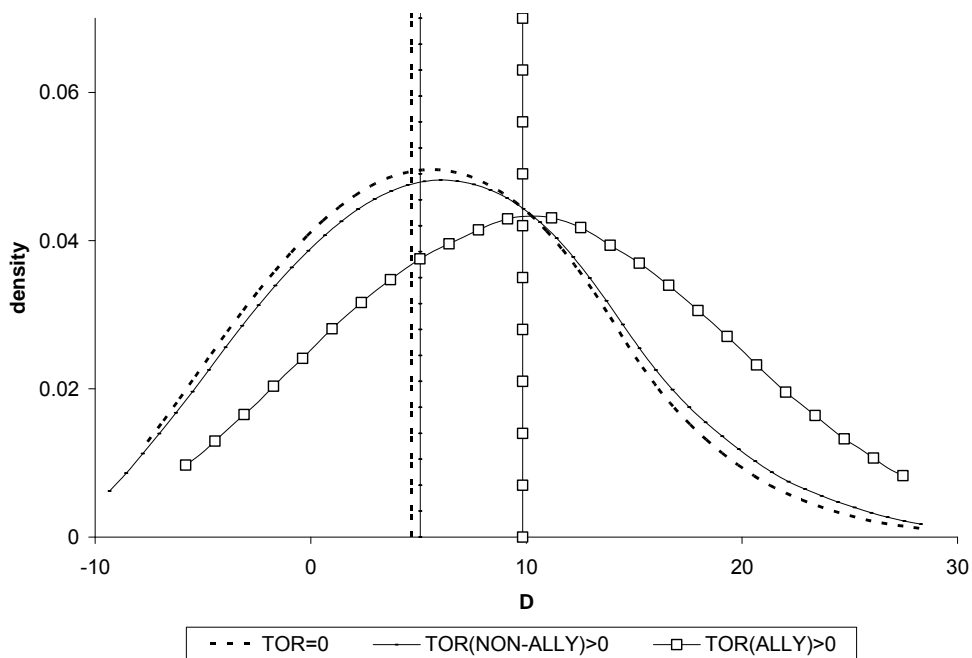
Note: D represents the transformed inflation rate defined as $(\pi/(1+\pi)) \cdot 100$.

Figure 3. Probability density functions and median values of inflation across TOR categories for all countries excluding high-inflation observations.



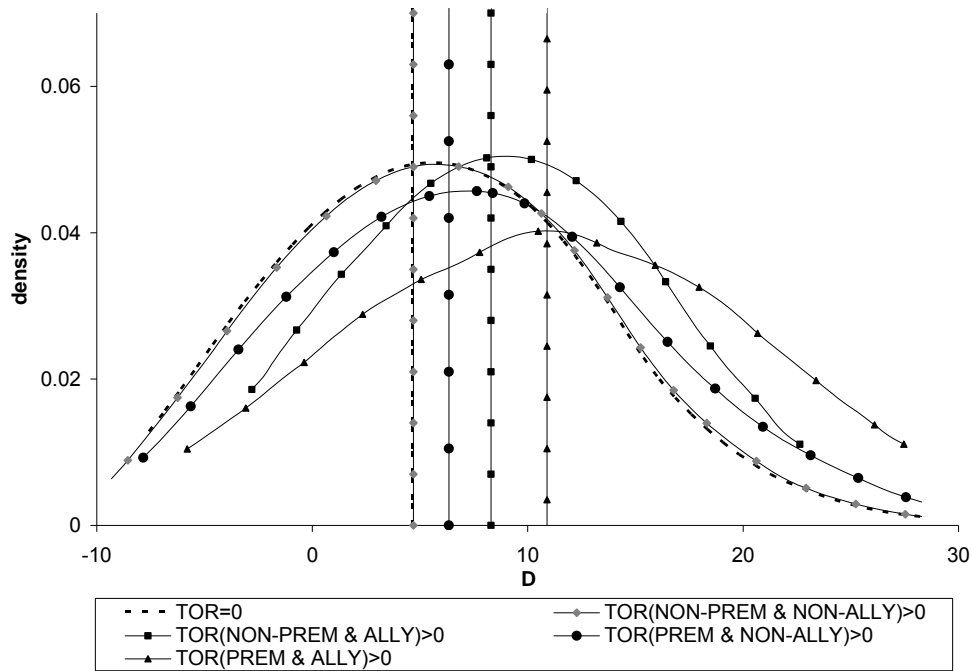
Note: D represents the transformed inflation rate defined as $(\pi/(1+\pi)) \cdot 100$.

Figure 4. Probability density functions and median values of inflation across TOR categories for all countries excluding high-inflation observations.



Note: D represents the transformed inflation rate defined as $(\pi/(1+\pi)) \cdot 100$.

Figure 5. Probability density functions and median values of inflation across TOR categories. All countries. Excluding high-inflation observations.



Note: D represents the transformed inflation rate defined as $(\pi/(1+\pi)) \cdot 100$.

Table 1. Overall period average turnover ratio and frequency of change of central bank governor.

	Advanced countries		Developing countries		
	Average turnover ratio of central bank governor	Average frequency of central bank governor replacement	Average turnover ratio of central bank governor	Average frequency of central bank governor replacement	
Australia	0.143	7 years	Albania	0.333	3 years
Austria	0.192	5 years and 2 months	Argentina	0.800	1 year and 3 months
Belgium	0.115	8 years and 8 months	Bulgaria	0.200	5 years
Canada	0.114	8 years and 9 months	Chile	0.429	2 years and 4 months
Czech Republic	0.200	5 years	China	0.214	4 years and 8 months
Denmark	0.143	7 years	Hungary	0.188	5 years and 4 months
Finland	0.115	8 years and 8 months	India	0.286	3 years and 5 months
France	0.192	5 years and 2 months	Indonesia	0.143	7 years
Germany	0.115	8 years and 8 months	Jamaica	0.286	3 years and 5 months
Greece	0.276	3 years and 7 months	Lithuania	0.273	3 years and 7 months
Italy	0.115	8 years and 8 months	Malaysia	0.143	7 years
Japan	0.200	5 years	Mexico	0.114	8 years and 9 months
Malta	0.250	4 years	Pakistan	0.229	4 years and 4 months
Netherlands	0.077	12 years and 11 months	Philippines	0.171	5 years and 9 months
New Zealand	0.143	7 years	Poland	0.313	3 years and 2 months
Norway	0.114	8 years and 9 months	Romania	0.063	16 years
Slovak Republic	0.182	5 years and 5 months	Russia	0.286	3 years and 5 months
Spain	0.172	5 years and 9 months	South Africa	0.086	11 years and 7 months
Sweden	0.171	5 years and 9 months	Thailand	0.257	3 years and 10 months
United Kingdom	0.114	8 years and 9 months	Turkey	0.286	3 years and 5 months
United States	0.114	8 years and 9 months	Uruguay	0.371	2 years and 8 months
<i>Average</i>	<i>0.155</i>	<i>6 years and 5 months</i>	<i>Average</i>	<i>0.255</i>	<i>3 years and 11 months</i>

Table 2. Distribution of central bank governor changes according to categories PREM/NON-PREM and ALLY/NON-ALLY.

All countries

	<i>NON-PREM</i>	<i>PREM</i>	<i>total</i>
<i>NON-ALLY</i>	46.7%	47.9%	94.6%
<i>ALLY</i>	1.6%	3.9%	5.4%
<i>total</i>	48.2%	51.8%	100.0%

Advanced countries

	<i>NON-PREM</i>	<i>PREM</i>	<i>total</i>
<i>NON-ALLY</i>	69.9%	30.1%	100.0%
<i>ALLY</i>	0.0%	0.0%	0.0%
<i>total</i>	69.9%	30.1%	100.0%

Developing countries

	<i>NON-PREM</i>	<i>PREM</i>	<i>total</i>
<i>NON-ALLY</i>	33.5%	57.9%	91.5%
<i>ALLY</i>	2.4%	6.1%	8.5%
<i>total</i>	36.0%	64.0%	100.0%

Note: All, advanced, and developing countries have 257, 93, and 164 observations, respectively.

**Table 3. Wilcoxon rank-sum tests of inflation across TOR categories for all countries.
Pairwise comparisons. p-values are reported.**

All observations

TOR=0 and TOR>0 distributions

	TOR>0
TOR=0	0.0008

Excluding high-inflation observations

TOR=0 and TOR>0 distributions

	TOR>0
TOR=0	0.1055

TOR=0, TOR_{NON-PREM}>0 and TOR_{PREM}>0 distributions

	TOR _{NON-PREM} >0	TOR _{PREM} >0
TOR=0	0.3924	0.001
TOR _{NON-PREM} >0		0.0087

TOR=0, TOR_{ALLY}>0 and TOR_{NON-ALLY}>0 distributions

	TOR _{NON-ALLY} >0	TOR _{ALLY} >0
TOR=0	0.1394	0.00003
TOR _{NON-ALLY} >0		0.0002

**TOR=0, TOR_{NON-PREM & NON-ALLY}>0, TOR_{NON-PREM & ALLY}>0, TOR_{PREM & NON-ALLY}>0
and TOR_{PREM & ALLY}>0 distributions**

	TOR _{NON-PREM & NON-ALLY} >0	TOR _{PREM & NON-ALLY} >0	TOR _{NON-PREM & ALLY} >0	TOR _{PREM & ALLY} >0
TOR=0	0.5842	0.0005	0.0075	0.0008
TOR _{NON-PREM & NON-ALLY} >0		0.0025	0.0128	0.0012
TOR _{PREM & NON-ALLY} >0			0.1912	0.0268
TOR _{NON-PREM & ALLY} >0				0.4441

Note: The Wilcoxon rank-sum test is a non-parametric test for which the null hypothesis is that density distributions are identical and, alternative hypothesis is that one distribution is "shifted" to the right or left of the other.

**Table 4. Median tests of inflation across TOR categories for all countries.
Pairwise comparisons. p-values are reported.**

All observations				
TOR=0 and TOR>0 distributions				
				TOR>0
			TOR=0	0.003

Excluding high-inflation observations				
TOR=0 and TOR>0 distributions				
				TOR>0
			TOR=0	0.255

TOR=0, TOR_{NON-PREM}>0 and TOR_{PREM}>0 distributions

	TOR _{NON-PREM} >0	TOR _{PREM} >0
TOR=0	0.457	0.002
TOR _{NON-PREM} >0		0.005

TOR=0, TOR_{ALLY}>0 and TOR_{NON-ALLY}>0 distributions

	TOR _{NON-ALLY} >0	TOR _{ALLY} >0
TOR=0	0.253	0.001
TOR _{NON-ALLY} >0		0.001

**TOR=0, TOR_{NON-PREM & NON-ALLY}>0, TOR_{NON-PREM & ALLY}>0, TOR_{PREM & NON-ALLY}>0
and TOR_{PREM & ALLY}>0 distributions**

	TOR _{NON-PREM & NON-ALLY} >0	TOR _{PREM & NON-ALLY} >0	TOR _{NON-PREM & ALLY} >0	TOR _{PREM & ALLY} >0
TOR=0	0.515	0.001	0.044	0.008
TOR _{NON-PREM & NON-ALLY} >0		0.002	0.043	0.007
TOR _{PREM & NON-ALLY} >0			0.285	0.007
TOR _{NON-PREM & ALLY} >0				0.25

Note: The median test is a non-parametric test for which the null hypothesis is that density distributions have same median and, alternative hypothesis is that their medians are different. 1-sided Fisher's exact statistics are reported.

Table 5. TOR regressions without control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries
TOR	103.2*** [5.011]	3.006** [2.264]	119.1*** [3.485]	103.2** [2.159]	3.006 [1.439]	119.1** [2.506]	4.864** [2.510]	3.006 [1.439]	3.489 [1.381]	4.764** [2.493]	1.397 [0.539]	6.960*** [3.102]

Statistics:

	standard	standard	standard	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster
Standard errors												
Country fixed effect	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes
High-inflation obs.	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Observations	1058	524	534	1058	524	534	952	524	428	952	524	428
R ²	0.023	0.010	0.022	0.023	0.010	0.022	0.028	0.010	0.016	0.031	0.003	0.066
Number of countries	42	21	21	42	21	21	42	21	21	42	21	21

Note: Dependent variable is inflation rate. R² reported for fixed effect regressions correspond to within R². Constant coefficient is not reported.

Table 6. Overall period median inflation.

Advanced countries		Developing countries	
Australia	5.802	Albania	4.208
Austria	3.723	Argentina	64.149
Belgium	3.943	Bulgaria	7.393
Canada	3.986	Chile	18.658
Czech Republic	5.452	China	3.748
Denmark	3.571	Hungary	8.336
Finland	6.297	India	8.000
France	5.696	Indonesia	9.924
Germany	3.255	Jamaica	14.092
Greece	14.403	Lithuania	2.446
Italy	8.386	Malaysia	3.356
Japan	1.404	Mexico	20.020
Malta	2.968	Pakistan	8.513
Netherlands	2.884	Philippines	7.658
New Zealand	4.762	Poland	16.086
Norway	4.363	Romania	40.631
Slovakia	7.158	Russia	19.461
Spain	7.334	South Africa	10.903
Sweden	5.578	Thailand	4.478
United Kingdom	4.603	Turkey	44.603
United States	3.416	Uruguay	46.011
<i>Average</i>	<i>5.190</i>	<i>Average</i>	<i>17.270</i>

Table 7. TOR regressions with "tranquil" times control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	
TOR	4.162** [2.364]	-0.847 [-0.465]	7.063*** [3.496]	4.779** [2.566]	0.937 [0.374]	7.131*** [3.393]	4.125** [2.451]	0.237 [0.105]	6.653*** [3.754]	4.773** [2.437]	1.405 [0.537]	6.984*** [2.936]	3.521** [2.022]	-1.029 [-0.619]	6.586*** [3.450]	
π^{world}	0.987*** [7.420]	1.256*** [10.592]	0.652** [2.827]										0.934*** [5.945]	1.221*** [9.675]	0.555* [1.798]	
Openness				-5.950*** [-2.977]	-10.45** [-2.102]	-5.239** [-2.757]								3.265** [2.379]	5.901** [2.182]	1.216 [0.528]
Inflation target							-6.353*** [-9.659]	-6.314*** [-7.688]	-6.580*** [-6.056]				-3.836*** [-5.191]	-2.723** [-2.801]	-5.274*** [-4.689]	
Fixed ERR										1.617 [1.200]	2.191 [0.981]	1.235 [0.716]	-0.078 [-0.093]	-1.071 [-1.160]	0.676 [0.562]	
<i>Statistics:</i>																
Standard errors	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
High-inflation obs.	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
Observations	952	524	428	952	524	428	952	524	428	931	524	407	931	524	407	
R ²	0.263	0.562	0.134	0.063	0.045	0.100	0.172	0.196	0.179	0.040	0.025	0.070	0.324	0.595	0.209	
Number of countries	42	21	21	42	21	21	42	21	21	42	21	21	42	21	21	

Note: Dependent variable is inflation rate. R² reported corresponds to within R². Constant coefficient is not reported.

Table 8. TOR regressions with "tranquil" and "stressful" times control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries	all countries	advanced countries	developing countries
TOR	4.974** [2.597]	1.481 [0.568]	7.309*** [3.302]	4.085** [2.343]	1.397 [0.539]	5.964*** [2.938]	4.303** [2.457]	1.481 [0.568]	6.340*** [3.158]	3.411* [1.992]	-0.929 [-0.567]	6.732*** [3.464]
Bank crisis	2.326** [2.116]	1.363 [1.100]	3.210* [1.815]				2.210* [1.962]	1.363 [1.100]	3.011 [1.660]	1.872* [1.802]	1.340 [1.384]	2.686 [1.435]
Default				2.896* [1.984]		2.569* [1.811]	2.814* [1.956]		2.443* [1.759]	1.410 [1.041]		0.528 [0.463]
π_{world}										0.949*** [5.867]	1.230*** [9.378]	0.563* [1.804]
Openness										3.345** [2.444]	6.306** [2.490]	1.111 [0.486]
Inflation target										-3.551*** [-4.686]	-2.635** [-2.694]	-4.919*** [-4.182]
Fixed ERR										-0.053 [-0.063]	-1.063 [-1.151]	0.697 [0.585]

Statistics:

	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster
Standard errors												
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High-inflation obs.	No	No	No	No	No	No	No	No	No	No	No	No
Observations	952	524	428	952	524	428	952	524	428	931	524	407
R ²	0.040	0.006	0.081	0.046	0.003	0.085	0.054	0.006	0.098	0.332	0.598	0.220
Number of countries	42	21	21	42	21	21	42	21	21	42	21	21

Note: Dependent variable is inflation rate. R² reported corresponds to within R². Constant coefficient is not reported.

Table 9. TOR_{NON-PREM} and TOR_{PREM} regressions with "tranquil" and "stressful" times control variables.

	(1)	(2)	(3)
	all countries	advanced countries	developing countries
TOR _{NON-PREM}	0.038 [0.036]	-0.029 [-0.028]	0.221 [0.116]
TOR _{PREM}	5.394** [2.351]	-2.232 [-0.751]	8.497*** [3.961]
π_{world}	0.955*** [6.152]	1.228*** [9.317]	0.566* [1.970]
Bank crisis	1.938* [1.840]	1.311 [1.365]	2.795 [1.473]
Default	1.002 [0.773]		0.213 [0.197]
Openness	3.394** [2.417]	5.943** [2.268]	0.879 [0.384]
Inflation target	-3.480*** [-4.758]	-2.594** [-2.633]	-4.482*** [-4.148]
Fixed ERR	0.067 [0.079]	-1.068 [-1.154]	0.964 [0.848]

Statistical test:

Ho: $\beta(\text{TOR}_{\text{NON-PREM}}) \geq \beta(\text{TOR}_{\text{PREM}})$ 0.0116 0.785 0.00217

Statistics:

	robust and cluster	robust and cluster	robust and cluster
Standard errors			
Country fixed effect	Yes	Yes	Yes
High-inflation obs.	No	No	No
Observations	931	524	407
R ²	0.344	0.600	0.243
Number of countries	42	21	21

Note: Dependent variable is inflation rate. R² reported corresponds to within R². Constant coefficient is not reported.

Table 10. TOR_{ALLY} and TOR_{NON-ALLY} regressions with "tranquil" and "stressful" times control variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	all countries	developing countries	all countries	developing countries	all countries	developing countries	all countries	developing countries
TOR _{NON-ALLY}	1.966 [1.340]	4.361** [2.458]	2.039 [1.366]	4.497** [2.756]	2.032 [1.360]	4.476** [2.480]	2.200 [1.479]	4.539** [2.760]
TOR _{ALLY}	18.889** [2.275]	20.720** [2.589]	15.955** [2.228]	18.900** [2.741]	15.768** [2.161]	18.767** [2.779]	15.746** [2.172]	18.972** [2.800]
π^{world}	0.928*** [5.683]	0.519 [1.664]	0.969*** [6.386]	0.544** [2.180]	1.030*** [6.730]	0.597** [2.475]	1.006*** [6.125]	0.520* [2.012]
Bank crisis	1.881* [1.777]	2.652 [1.401]	1.841* [1.810]	2.837 [1.587]	1.774* [1.740]	3.082 [1.659]	1.788* [1.759]	3.051 [1.674]
Default	1.462 [1.109]	0.668 [0.613]	1.367 [1.025]	0.574 [0.537]	1.343 [0.990]	0.485 [0.449]	1.353 [1.005]	0.569 [0.536]
Openness	3.259** [2.661]	1.179 [0.581]	4.001*** [2.743]	5.182* [1.767]	3.718*** [2.745]	3.744 [1.444]	4.098*** [2.759]	5.546* [1.883]
Inflation target	-4.061*** [-4.611]	-5.954*** [-3.911]	-3.994*** [-4.388]	-6.220*** [-3.915]	-4.043*** [-4.633]	-6.125*** [-3.847]	-3.962*** [-4.425]	-6.136*** [-3.862]
Fixed ERR	-0.123 [-0.165]	0.603 [0.603]	-0.505 [-0.814]	0.107 [0.124]	-0.382 [-0.632]	0.256 [0.293]	-0.470 [-0.779]	0.082 [0.094]
Liquid liabilities			-0.019 [-0.840]	-0.096*** [-3.022]			-0.027 [-1.227]	-0.086** [-2.694]
Private credit					0.003 [0.330]	-0.044* [-1.869]	0.010 [1.310]	-0.017 [-1.011]
<i>Statistical test:</i>								
H ₀ : $\beta(\text{TOR}_{\text{NON-ALLY}}) \geq \beta(\text{TOR}_{\text{ALLY}})$	0.0247	0.0302	0.03035	0.0266	0.0342	0.0264	0.03545	0.02445
<i>Statistics:</i>								
Standard errors	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster	robust and cluster
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
High-inflation obs.	No	No	No	No	No	No	No	No
Observations	931	407	886	373	888	373	885	372
R ²	0.354	0.249	0.384	0.303	0.384	0.288	0.388	0.308
Number of countries	42	21	42	21	42	21	42	21

Note: Dependent variable inflation rate. R² reported corresponds to within R². Constant coefficient is not reported.

Table 11. TOR_{NON-PREM & NON-ALLY}, TOR_{NON-PREM & ALLY}, TOR_{PREM & NON-ALLY} and TOR_{PREM & ALLY} regressions with "tranquil" and "stressful" times control variables.

	(1)	(2)	(3)
	all countries	advanced countries	developing countries
TOR _{NON-PREM & NON-ALLY}	-0.372 [-0.352]	-0.029 [-0.028]	-1.098 [-0.537]
TOR _{NON-PREM & ALLY}	2.320 [0.332]		7.404 [0.932]
TOR _{PREM & NON-ALLY}	2.900 [1.422]	-2.232 [-0.751]	5.524** [2.731]
TOR _{PREM & ALLY}	26.012** [2.362]		25.087** [2.584]
π_{world}	0.953*** [6.188]	1.228*** [9.317]	0.546* [1.899]
Bank crisis	1.953* [1.818]	1.311 [1.365]	2.760 [1.442]
Default	1.198 [0.905]		0.458 [0.417]
Openness	3.612*** [3.171]	5.943** [2.268]	1.213 [0.635]
Inflation target	-3.798*** [-4.662]	-2.594** [-2.633]	-5.332*** [-3.869]
Fixed ERR	0.000 [0.001]	-1.068 [-1.154]	0.850 [0.861]
<i>Statistical tests:</i>			
Ho: $\beta(\text{TOR}_{\text{NON-PREM \& NON-ALLY}}) \geq \beta(\text{TOR}_{\text{NON-PREM \& ALLY}})$	0.3495		0.14
Ho: $\beta(\text{TOR}_{\text{NON-PREM \& NON-ALLY}}) \geq \beta(\text{TOR}_{\text{PREM \& NON-ALLY}})$	0.0595	0.785	0.01045
Ho: $\beta(\text{TOR}_{\text{NON-PREM \& NON-ALLY}}) \geq \beta(\text{TOR}_{\text{PREM \& ALLY}})$	0.0105		0.00665
Ho: $\beta(\text{TOR}_{\text{NON-PREM \& ALLY}}) \geq \beta(\text{TOR}_{\text{PREM \& NON-ALLY}})$	0.468		0.5915
Ho: $\beta(\text{TOR}_{\text{NON-PREM \& ALLY}}) \geq \beta(\text{TOR}_{\text{PREM \& ALLY}})$	0.02395		0.0555
Ho: $\beta(\text{TOR}_{\text{PREM \& NON-ALLY}}) \geq \beta(\text{TOR}_{\text{PREM \& ALLY}})$	0.0249		0.0357
<i>Statistics:</i>			
Standard errors	robust and cluster	robust and cluster	robust and cluster
Country fixed effect	Yes	Yes	Yes
High-inflation obs.	No	No	No
Observations	931	524	407
R ²	0.369	0.600	0.273
Number of countries	42	21	21

Note: Dependent variable inflation rate. R² reported corresponds to within R². Constant coefficient is not reported.