2013

Does Exchange Market React to Central Bank Governor Replacements: Evidence from a New Dataset using Narrative Approach

Siyang Xu
Colby College

Does Exchange Market React to Central Bank Governor Replacements: Evidence from a New Dataset using Narrative Approach

Siyang Xu
Honors Thesis
Colby College
Advisor: Prof. Guillermo Vuletin
Second Reader: Prof. David Findlay

May 17, 2013

Abstract:
This paper contributes to the literature that analyzes the exchange market reaction to the event of a central bank governor replacement. In order to solve the endogeneity problem, we develop a narrative approach-based on reports from credible newspapers-that classifies central bank governor replacements by their nature and causes. Using this new dataset on central bank independence for 31 countries over the period 1967-2012, we decompose all replacements into endogenous and exogenous cases with respect to inflation and financial market performance. We find that such a distinction is critical in understanding the exchange market reactions. We show that i) endogenous replacements, particularly the ones in developing countries, are the source of the negative exchange market "reaction" observed in previous literature, thus the causality is actually the other way around from exchange market performance to central bank governor replacement; ii) exchange markets in both developing and advanced countries do not respond to exogenous replacements. Our findings hold for the inclusion of country fixed effects, after controlling for international liquidity and exchange rate regimes.

"After arguing behind the scenes with his central bank governor over the direction of interest rates, Prime Minister Thaksin Shinawatra of Thailand . . . dismissed the banker . . . brought a sharp reaction of financial markets, where it cast doubts over the political independence of the Thai central bank." -*The New York Times* ["Chief of Thai Bank Is Dismissed Over Rates," May 30, 2001, Source: Proquest]

1. Introduction

It is now generally accepted that more degree of central bank independence (CBI) is associated with lower inflation (Cukierman, Webb, & Neyapti, 1992; Lohmann, 1992; Rogoff, 1985). This theory is based on the fact that one of the main objectives of central bank is to maintain price stability, while pursuing such an objective sometimes competes with other tasks that central bank can perform, such as financing the budget deficit or implementing expansionary monetary policy. These policy decisions usually lead to direct short-run benefits of reducing unemployment and stimulating GDP growth. Therefore, assuring price stability requires that the central bank would not be forced by the executive branch of the government to perform functions that could cause inflation. To put it another way, a more independent central bank should be better at fighting inflation, theoretically. There is some empirical evidence (Alesina & Summers, 1997; Cukierman, 1992; Cukierman et al., 1992) to support such a theoretical point of view, especially for developing countries. However, due to the difficulty of obtaining an accurate measurement of CBI, the evidence is muted depending on which type of CBI measurement is used, and debates and concerns about whether low CBI would cause high inflation have lasted for decades[1].

Financial market participants as well care about the degree of CBI and react to central bank governor[2] changes, given the role of central bank in implementing monetary policies and the importance of central bank governor in decision-making process. There are mainly two channels

[1] The new data set presented in this paper is also used in another paper to address the endogeneity concern and to test empirically that whether low CBI causes high inflation.
[2] The central bank governors refer to the heads of central banks regardless of whether their actual job title is governor, director, or president, etc.

in which central bank governor replacement may cause financial market reaction. One channel is through its impact on inflation. As stated above, the inflationary bias is determined by the degree of CBI, which is believed by most economists and practitioners in this area. Considering that most asset prices are sensitive to expected inflation to some extent, if market participants' perceptions about CBI change and thus leading to changes in inflation expectations, then asset prices should change. The other channel is more straightforward. In much of the theoretical work on monetary policy, governor-specific attributes play a central role. The differences in central bank decision-makings are characterized in terms of the objective function attributed to the central bank governor under the current framework for modeling policymakers' incentives (Barro & Gordon, 1983; Kydland & Prescott, 1977). By this presumption, replacements of central bank governors would convey new information about future monetary policy based on the new governor's preferences and degree of risk aversion, thus central bank governor change would directly influence market participants' perceptions and expectations of future monetary policies, future economic growth, banking regulations, and many other aspects that jointly determine asset prices.

While the belief that higher CBI corresponds to low inflation has been established for a while and tested empirically with a blossoming literature, the financial market reactions to central bank governor replacements and the relationship between market performance and the degree of CBI has not been investigated intensively. Nevertheless, there is a large literature on how monetary policy affects stock market (Bernanke & Kuttner, 2005; Rigobon & Sack, 2004), bond market (Gurkaynak, Sack, & Swanson, 2005; Kuttner, 2001), and exchange market (Faust, 2003). If financial market participants believe that the central bank governor is critical in making monetary policy decisions, this group of literature could indirectly suggest that the markets care

about who governs the central bank. There is few other literature which aims to access how financial markets react to central bank governor changes. Kuttner and Posen (2010) concludes that markets do care about who chairs the central bank, drawing on a sample of 15 industrialized countries and showing that central bank governor changes indeed affect domestic bond yields and exchange rates. Their study focuses on central bank governor appointments of industrialized countries and the systematic credibility problem at the beginning of a central bank's governor's tenure, but not the changes in the CBI. As Santiso (2003) demonstrates, replacing central bank governor is among the most sensitive decisions for emerging markets government, as these policymakers play a crucial role in communication with international markets. Moser and Dreher (2010) uses a daily dataset on 20 emerging markets over period of 1992-2006 and considers whether the replacement is regular or irregular, and the appointment is anticipated or not. They find that, in general, the replacement of a central bank governor negatively affects financial markets on the announcement day, especially if the change is irregular and has not been anticipated.

For a more systematic and comprehensive analysis of the financial market reaction to central bank governor replacement, we built a new central bank governor dataset for 17 developing countries from 1967 to 2012 and 13 advanced countries from 1973 to 2012. Using high-frequency daily exchange rate data, this paper focuses on foreign exchange market, because it is most relevant to the objectives of a central bank among all the other financial market indicators. Our new dataset of central bank governor replacements not only covers more countries for a longer period with specific date, but also identifies the reason and/or nature of each replacement using the narrative approach introduced by Romer and Romer (2004, 2010). With these detailed identifications, we can distinguish between the exogenous central bank governor changes and the

endogenous ones that are "contaminated" by high inflation and financial market turmoil. This helps us to access the true impact of central bank governor changes on exchange market in both developing and advanced countries, and to address the endogeneity problem that remains as a major concern in the literature of CBI for decades.

Our main empirical findings can be summarized in the following 6 points.

1) Central bank governors in developing countries are more likely to be replaced because of high inflation, financial market turmoil, and conflict with the executive branch of the government. This is consistent with the belief that CBI is generally lower in developing world than in advanced countries.
2) The endogenous central bank governor replacements mostly happened in non-fixed exchange rate regime by the IMF official classification.
3) In developing countries, on the day of the central bank governor replacement, the domestic currency depreciated against US dollars. In advanced countries, such a pattern is not observed.
4) For developing countries, the observed negative "reactions" to central bank governor changes in exchange market are mainly driven by the endogenous changes. This means that the mechanism is actually the other way around: massive currency devaluation or depreciation would increase the likelihood that central bank governors would lose their jobs.
5) In both developing and advanced countries, exchange market does not react to central bank governor replacements if they are exogenous to high inflation and financial market movements.

6) The relationship between exchange market and central bank governor replacements described in points 3, 4,5 hold to the inclusion of country fixed effects, global liquidity conditions, and exchange rate regime arrangements.

The paper is structured as follows. Section 2 discusses the previous measurements of CBI and corresponding problems, and describes our new dataset of central bank governor replacements based on narrative approach. Section 3 describes the financial market data and exchange rate regime classification. Section 4 performs a non-parametric preliminary analysis and static panel data analysis including country fixed effects. Section 5 presents the dynamic panel vector autoregression (VAR) analysis and discussed the results. Section 6 is the robustness check. Section 7 concludes.

2. CBI measurements, endogeneity, and the narrative approach

2.1 CBI Measurements and problems

In the previous literature of CBI, there are two main measures for it. One is the de jure (legal) measurement which is based on the laws and charters detailing the central bank's power, objectives, functions, administrative rules and so on. However, such a measurement suffers from three critical problems. First, it is not exactly comparable across countries; second, the laws and charters in many developing countries are rather incomplete in that they cannot specify explicitly the limits of authority between the central bank and the political authorities under all contingencies; last but not the least, actual practice and independence usually deviate from the law due to its incompleteness and lack of transparency.

To overcome these shortcomings, Cukierman (1992) and Cukierman et al (1992) propose a de facto measurement of CBI based on the turnover rate (TOR) of central bank governors. The basic

presumption of this de facto measure is that, a more rapid turnover of central bank governors indicate less CBI, at least above some threshold. Frequent replacements of central bank governor may reflect the firings of those who challenge the government. For example, the government would 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, especially during election periods. Moreover, if the political authorities frequently take the opportunity to choose a new governor, they will at least have "the opportunity to pick those who will do their will" (Cukierman et al, 1992). Under this context, the TOR is a better measurement of CBI than the legal one, since it reflects the actual situations in central banks. However, when the TOR is used to proxy the actual degree of CBI and to measure its impact on inflation, the endogeneity problem emerges. There is evidence that higher TOR is related with higher inflation, which implies that countries with lower degree of CBI is more likely to experience high inflation, given the presumption discussed before. Yet, as Dreher et al (2008) suggests, the causality between high CBI and low inflation is difficult to evaluate using only the TOR measure. Intuitively, central bank governor might be dismissed by the president if there is extremely high inflation or the governor is unable to keep the inflation low. If it is the case, then the TOR of central bank governors is endogenous to inflation, thus the estimated the impact of CBI on inflation using TOR would be biased.

In the perspective of such a reverse causality from financial markets to CBI, the situation is very similar. As stated before, asset prices are sensitive to inflation, thus high inflation is often associated with changes in financial markets. If it is the case, then the observed correlation between high turnover rates and any financial market reactions would be both caused by high inflation, which could not demonstrate any impact of central bank governor replacements on

financial markets. More importantly, similar to inflation, variations in exchange rate would directly cause the replacements of central bank governors, as managing the country's exchange rate is one of the main responsibilities of a central bank. In some instances, though rare, financial (stock) market scandals and the subsequent damage in financial markets would also lead to the resignation of a central bank governor.

2.2 Solutions and the new measure based on narrative approach

To solve the endogeneity problem, one of the most popular approaches is to find an instrumental variable (IV) for the endogenous explanatory variable, which is the TOR in our context. To evaluate the impact on inflation, a good IV is required to be correlated with TOR; it could not be directly affected by inflation, nor could it directly influence inflation. Nevertheless, in reality, such an IV which not only satisfies the above qualifications but also is time-varying is too demanding to construct.

Another solution, which is the one we use in this paper, is the narrative approach introduced by Romer and Romer (2004) which focuses on the impact of taxation policies changes on output. This approach filters out the endogenous cases and includes only the exogenous changes in the analysis in order to obtain an unbiased estimator. To distinguish between endogenous and exogenous cases, we built our narratives using information mainly from newspaper reports. We relied mostly on the credible newspapers and media which are able to exert international influence and are not influenced and restrained by the domestic governments. The newspapers we used in our narratives include *The New York Times*, *The Wall Street Journal*, *Financial Times*, *The Global and Mail*, and so on. Drawing from relevant newspaper articles and numerous cross-references across different sources, we built our new dataset with the exact date of each central bank governor replacement and identified the nature and cause of each case. Appendix A

summarizes the data coverage of this new dataset by country. It includes 17 developing countries and 14 advanced countries, covering three decades on average, with in total 137 central bank governor replacements (90 for developing and 47 for advanced). The nature and cause of each replacement is classified into six main categorizations as follows:

1) Inflation and financial market turmoil-induced[3] (INF&FM);
2) Term of office ends[4] (TOF);
3) New government president (NPRES);
4) Leave for another position (LEAVE);
5) Conflict with executive authorities (CONF);
6) Other reasons: health/personal reasons (OTHER).

Below cites some newspaper excerpts for each of the six categories to provide details and illustrate how we identify the causes and natures of each central bank governor replacement from newspaper and other media resources.

1) Inflation and financial market turmoil-induced (INF&FM):

Inflation-induced:

[Brazil] Ibrahim Eris, 03/15/1990-05/17/1991.

"Ms. Cardoso resigned after clashes within the government and failure to bring Brazil's high inflation under control. The rest of Ms. Cardoso's team, including Central Bank President Ibrahim Eris, quit en masse within hours of Ms. Cardoso's departure." -*Wall Street Journal* (05/10/1991)

Financial market-induced:

[Argentina] Roque Maccarone, 4/25/2001-1/18/2012.

"Struggling to get control of the economic crisis, the government of President Eduardo Duhalde reopened the country's stock exchange today, forced the resignation of the central

[3] This category also includes conflicts with executive authorities over issue related to inflation or financial market performance and/or regulation. The disagreeing issues include management of exchange rate, requirement of foreign reserves, debt repayment plan, etc.

[4] We consider death as term of office ends as well.

bank president and moved toward easing some restrictions on bank accounts… The government is clearly hoping that easing some of the banking restrictions will encourage consumers to begin spending and halt the country's economic free fall… The president of the central bank, Roque Maccarone, was forced to resign this morning after repeated disagreements with President Duhalde over how to minimize the damage done to the banking system by devaluation."-*The New York Times* (1/18/2002).

2) Term of office ends (TOF):

[Japan] Toshihiko Fukui, 05/20/2003-05/19/2008.

"As expected, the government on Friday proposed to promote Bank of Japan Deputy Governor Toshiro Muto to the next governor of the central bank to succeed Toshihiko Fukui, whose five-year term expires on March 19." -*Jiji Press English News Service* (03/07/2008)

3) New government president (NPRES):

[Brazil] Henrique de Campos Meirelles, 01/01/2003-01/01/2011.

"Dilma Rousseff, Brazil's president-elect, is expected to confirm this week that Guido Mantega, finance minister, will remain in his job from January 1. But rumors were circulating on Monday evening that Henrique Meirelles, president of the central bank and a long-standing orthodox foil to Mr Mantega's "develop mentalist" wing in government, would not be kept on."-*Financial Times* (11/23/2010)

"As predicted, Ms Rousseff retained Guido Mantega as finance minister as well as making two changes: Alexandre Tombini replaces Henrique Meirellesas president of the central bank, ..."-*Financial Times* (11/25/2010)

4) Leave for another position (LEAVE);

[France] Jean-Claude Trichet, 09/16/1993-11/01/2003.

"Mr. Noyer will succeed Jean-Claude Trichet, who moves to Frankfurt next month to become ECB president."-*Wall street Journal* (10/23/2003)

5) Conflict with executive authorities (CONF);

[Peru] Richard Webb Duarte, 09/11/2001-07/25/2003.

"Central Bank President Richard Webb resigned over conflicts with the bank's board, Economy and Finance Minister Javier Silva said… Silva, in an interview with RPP radio station, said Webb clashed with the other six members of the Central Bank of Reserve board on "administrative" questions. "There were no differences in terms of monetary policy," Silva said…A report in newspaper Gestion Tuesday said Webb's disagreed with the board on the dismissal of some bank officials in the recent weeks."-*Bloomberg* (7/11/2003)

6) Other reasons: health/personal reasons (OTHER).

[Brazil] Gustavo Franco, 08/20/1997-03/04/1999.

"Gustavo Franco, the resigning president of the Central Bank has just said: '…I took part in numerous battles and devoted all my energy and dedication to working for Brazil. People have no notion of how tiring and lonely is the task of defending principles and of implementing objective policies that are intended to benefit the majority of the people." … Franco said that he is leaving his post for personal reasons. He added: "There are also professional reasons: the natural erosion provoked by five years of uninterrupted work as deputy secretary for economic policy, director of the BC Foreign Department, and as BC president."- *BBC Monitoring Americas* (1/14/1999)

Table 1 tabulates the number of central bank governor replacements of each category by country, and presents the percentage of each category in developing and advanced countries. For developing countries, the replacements induced by high inflation or financial market instability counts for the largest share of 28.89%; 27.78% of the turnovers happened as term of office ended; 14.44% are caused by conflict with other government braches over issues not related to inflation or financial markets; 7.78% is due to a new president assumed office; and 8.89% of the central bank governors left the office for another position. For advanced countries, the composition is quite different. More than half (55.32%) of the turnovers are due to the end of official terms; the second most common causes is leaving for another position, which counts for 19.15%. This large share is reasonable since half of our advanced countries sample is countries in the European Union. Central bank governors in these countries were often seen to leave the position in their

domestic countries for a position in the European Central Bank. Only 6.38% of the replacements are caused by some conflicts with the executive authorities, and none of the turnovers is associated with a new president's inauguration. More importantly, the replacements caused by inflation or financial market turmoil counts for only 4.26%, or 2 cases out of 47 replacements in our advance countries sample. The strikingly different shares for each category between developing and advanced countries clearly indicate the discrepancy of the actual level of CBI between these two groups of countries, and are consistent with the findings in previous literature. Central bank governors in developing countries were more likely to be replaced before the official terms ended; their inability to maintain price and financial market stability was more often the reason of their replacements; in addition, their chances of being replaced were higher than those in advanced countries when there was a transition of power in the executive branch of the government, or when they disagreed over some issues with the president, financial minister, or head of the department of treasurer, etc. All of these demonstrate that central bank governors in developing countries experienced lower degree of independence, as their decision-making is constrained by the executive branches of the government, and the will and preferences of the executive branch exerted strong influence on their replacements. By contrast, central bank governors in advanced countries usually served till the end of their official term. Most of the early departures were voluntary without the influence and pressure from the executive branch. These facts illustrate that the central banks in our subsample of advanced countries are generally more independent than their counterparts in developing countries.

For the analysis of the impact of central bank governor replacements on exchange market, those in the category "inflation and financial market turmoil-induced" are all classified as the endogenous changes. There are 26 endogenous changes out of 90 (28.89%) in our sample of

developing countries, and only 2 out of 47 replacements (4.26%) in the advanced countries sample. The rationale to include inflation-induced turnovers is high inflation is typically associated with large domestic depreciation. High inflation which caused the replacements was usually related to some financial market reactions simultaneously. Moreover, we include not only the replacements caused by domestic currency depreciation, but also stock and bond markets instability because the performances of these three financial markets are closely linked together[5]. Replacements in other categories are identified as exogenous changes, as they were not caused by turmoil in exchange market or other financial instability that would lead to large reactions in exchange market.

With our dataset, we are able to distinguish between the endogenous changes that are caused by exchange market turmoil and the exogenous changes, and use only the exogenous changes to access the impact of CBI on financial markets. In addition, our dataset provides a more refined measurement of CBI compared to other measures used in previous literature. Previously, TOR is the most common proxy of CBI, which is calculated using all central bank governor turnovers. However, among all the turnovers, some were regular and scheduled, which did not change the degree of independence. For the irregular and early replacements, some literature argues that these were usually involuntary, thus reflect changes in CBI and serve as a good proxy. Yet in reality, even some of the irregular turnovers were not associated with a loss of independence. For example, the central bank governors stepped down before the official term ended because he/she accepted a new position somewhere else, either in the government or private sector. Our dataset provides detailed information on each central bank governor replacement, which makes it

[5] As a robustness check, we also identify endogenous changes including only the central bank governor replacements caused by high inflation or exchange market instability. Such "narrow" identification does not change the number of endogenous replacements significantly. There are 21 endogenous changes out of 90 in developing sample, and 1 out of 47 in advanced sample.

possible to identify the turnovers that truly reflect or are associated with any change in the degree of CBI.

3. Data

Our financial market data is all obtained from *Global Financial Data* (*GFD*), including the daily exchange rate data, 90-day U.S. Treasury bill yields, and 10-year U.S. government bond yields. The latter two are used to control for global liquidity in our robustness check. The exchange rate of a specific country is expressed as the value of one U.S. dollar in terms of the domestic currency of this country, or the domestic country currency vis-à-vis the U.S. dollar. An increase in the exchange rate means that domestic currency depreciated against U.S. dollars. We use the daily percentage change of exchange rate[6] as the measurement of exchange market performance in order to eliminate cross-country differences in levels of exchange rates[7]. A positive value indicates currency depreciation, and a negative number means appreciation. Appendix B presents the basic descriptive statistics for daily percentage change of exchange rate by developing and advanced countries, and for the U.S. 90-day T-bill yields and 10-year government bond yields.

For the purpose of robustness check, we use the IMF yearly classification of exchange rate regime, which is the official (de jure) classification. As Reinhart and Rogoff (2004) indicated, the actual exchange rate management is usually different from the de jure announcement of the

[6] The daily percentage change of exchange rate is calculated as:

$$\Delta ER_{i,t}\% = \frac{ER_{i,t} - ER_{i,t-1}}{ER_{i,t-1}}, i \text{ is the county}, t \text{ is the date}$$

[7] Exchange rate data is available for workdays. This means that we do not have data for weekends and holidays. We exclude all weekends in our sample. For central bank governor replacement happened during weekends, it is moved to next Monday or the nearest date for which the exchange rate data is available, if the specific Saturday or Sunday is part of a long weekend. Because holidays are different across countries and vary from year to year, it is not feasible to check holiday arrangements for each country of each year in our sample. We assume that after removing weekends, the remaining one-day or two-day period in which exchange data is not available are the "implicit" holidays and we remove these one-day and two-day "gaps" from our sample. Similarly, for central bank governor replacement happened during these "implicit" holidays, it is moved to the nearest date in which the exchange rate data is available. We do not exclude any "gaps" longer than two days, considering that the missing exchange market data is possibly not due to holidays but some fundamental issues in the domestic economy.

choice of exchange rate regime. We identify countries as fixed exchange rate regime if the IMF classification code for the specific year is 1 or 2[8], and non-fixed otherwise. In our developing sample, fixed exchange regime counts for about one quarter; in advanced countries, fixed regime is about half of the sample. This is consistent with the fact that half of our advanced country sample is Euro zone countries.

4. Preliminary Analysis

4.1 Non-parametric analysis:

Before conducting any regression analysis, we first look at the average daily percentage change of exchange rate on the days of central bank governor replacements. Table 2 shows the means of percentage changes on days of all, exogenous and endogenous central bank governor replacements by developing and advanced countries, and presents the p-value of one-sample mean-comparison test (t-test) for each subsample. The alternative hypothesis is that the average percentage change is positive on days of central bank governor replacements. The hypothesis is based on the presumption that financial market participants tend to associate central bank governor turnovers with loss of CBI and greater uncertainty about future monetary policy, which would usually lead to negative reactions in financial markets. In foreign exchange market, the negative response is reflected in domestic currency depreciation, which means that the exchange rate (domestic currency vis-à-vis U.S. dollars) would rise.

In developing countries, the average exchange rate percentage changes on the days of all, exogenous and endogenous replacements are all positive, but the magnitudes differ greatly. Column (1) indicates that for all 89 central bank governor replacements, the exchange rate

[8] IMF code 1 includes, no separate legal tender, pre announced peg or currency board arrangement, pre announced horizontal band that is narrower than or equal to +/-2%, and de facto peg; code 2 includes, pre announced crawling peg, pre announced crawling band that is narrower than or equal to +/-2%, de factor crawling peg, and de facto crawling band that is narrower than or equal to +/-2%.

increases by 1.45% on average on the day when the replacement happens. Column (2) shows that on the day of exogenous replacement, the average exchange rate increase is only 0.20%, while it is 4.65% on the day of endogenous change as shown in column (3). Standard errors demonstrate that exchange rate reactions are most volatile (3.91) on the days when there are endogenous central bank governor replacements; and more stable (0.14) when exogenous changes happen. The p-values show that means on the days of all and exogenous changes are statistically greater than zero at 10% level; the mean on the days of endogenous changes are statistically greater than zero at 15% level, possibly due to a smaller sample size and reduced degree of freedom.

For advanced countries, the general picture is rather different. First, the magnitudes of average changes (all, exogenous, endogenous) are significantly smaller than those in developing countries. Second, the standard errors are relatively smaller and similar among the three subsamples, indicating more stable foreign exchange markets in advanced countries on the days of central bank governor replacements. Third, only the mean on the days of endogenous changes (0.24%) are marginally greater than zero at 20% level, while the other two means are not statistically different from zero.

This basic non-parametric analysis illustrates that foreign exchange markets' reactions to central bank governor replacements are different between developing and advanced countries. The negative exchange market reaction is stronger in developing countries. Moreover, the market reactions to exogenous and endogenous changes clearly vary in terms of magnitude, especially in developing countries. Such a discrepancy again emphasizes the importance of addressing the endogeneity problem by distinguishing exogenous and endogenous central bank governor replacements, which could be achieved using our new dataset.

4.2 Panel Data Analysis:

Next, we conduct panel data analysis which includes country fixed effects. The baseline regression takes the following form:

$$\Delta ER_{i,t} = \alpha + \gamma \Delta ER_{i,t-1} + \beta CBG_{i,t} + \eta_i + \varepsilon_{i,t} \quad (1)$$

where the subscripts *i* and *t* represent country and time, respectively. ΔER is the daily percentage change of exchange rate. The one-day lagged value of the dependent variable is also included in the equation to control for trending effects. The country-fixed effect is denoted as η_i, and all omitted factors are included in the error term $\varepsilon_{i,t}$. The coefficient of interest is β, which estimated the change in the dependent variable (daily percentage change of exchange rate) on the day of central bank governor replacement. The CBG variable takes the value of 1 on the day of the certain type of central bank governor change and 0 otherwise.

Table 3 reports the results of the panel data analysis. Colum (1)-(5) are results for developing countries, and column (6)-(10) are for advanced countries. We consider different natures of central bank governor replacements in separate regressions. Based on the definitions discussed in Section 2, we use all central bank governor turnovers (*CBGall*), and also decompose them into exogenous ones (*CBGexog*), and endogenous ones (*CBGendog*). In addition, we use a narrower definition of endogenous replacements which are caused only by high inflation or exchange market instability (*CBGendog_er*), and the rest are defined to be exogenous to exchange market performance (*CBGexog_er*). The variable *CBGall* takes the value of 1 if there is any type of central bank governor replacement on that day in a country, and 0 otherwise; similarly, *CBGexog* equals 1 if there is an exogenous turnover.

The results show that the lagged dependent variable is positive and significant at 1% level for developing countries, but it is close to zero and insignificant for advanced countries. Turning to our coefficients of interest, column (1) of Table 3 shows that on the days of any type of central bank governor replacement in developing countries, the domestic currency depreciates by 1.38% on average and it is significant at 1% level. This coincides with the results in previous literature that exchange market reacts negatively to central bank governor turnovers as it reflects a loss of CBI. However, if we only consider the exogenous central bank replacements, the statistical significance vanishes, as illustrated in column (2). Column (3) indicates that there is a 4.53% depreciation of domestic currency on the day of an endogenous replacement and it is statistically significant at 1% level. The magnitude of this point estimate is about three times larger than the point estimate on the day of any type of replacement. It is clear that the association of depreciation and central bank governor turnover illustrated in column (1) is mostly driven by the negative exchange market performance on the days of endogenous replacements, while exchange market does not fluctuate significantly on the days of exogenous turnovers. Moreover, the correlation between depreciation and endogenous replacements is very strong given the fact that endogenous cases count for only about 29% of all central bank governor turnovers. This means that even though the majority of (71%) all turnovers are not associated with domestic currency depreciation, the negative exchange market performance on the days of the rest 29% endogenous turnovers are large and significant enough to make the exchange market appear to react negatively to any central bank governor replacement. Because we identify the endogenous cases as the central bank governor replacements caused by high inflation or financial market turmoil, these results suggest that the causal effect argued in previous literature might be the other way around: it is not that exchange market react negatively to central bank governor changes, but that

some replacements are caused by poor exchange market performance. Furthermore, the results confirm and validate our narrative approach to some extent, as they demonstrate that the association between endogenous cases and depreciation are much stronger than for exogenous cases.

Column (5) uses the narrower and more specific definition of endogenous replacements. The coefficient estimate for *CBGendog_er* (5.68) is positive and significant at 1% level. The corresponding exogenous turnovers do not show any correlation with domestic currency depreciation as the coefficient estimate for *CBGexog_er* in column (4) is insignificant. Results in column (4) and (5) demonstrate that our finding is not caused by our identifications of endogenous and exogenous cases.

Such a pattern described above is not observed in advanced countries. Column (6) shows that the point estimate for *CBGall* is positive but statistically insignificant at all levels. The point estimates for endogenous replacements in column (8) and (10) are larger than those for exogenous ones, but they are as well insignificant[9]. The results are consistent with the fact that central banks in advanced countries generally enjoy higher level of CBI. There are possibly two reasons: first, financial market participants in these countries do not respond a central bank governor change because such a turnover is usually regular and scheduled, which does not convey any new information about future monetary policy; second, central bank governor in advanced countries are less likely to be replaced because of high inflation or financial market instability due to their higher level of CBI and much more stable financial markets, thus the reverse causality from depreciation to replacements observed in developing countries hardly

[9] Nevertheless, for advanced countries, there are only two endogenous central bank governor replacements by the "broad" definition in column (8), and only one endogenous case by the "narrow" definition in column (10).

exists. The results also coincide with previous findings that turnover rate of central bank governors works better in developing countries than in advanced ones when they are used to study the impact of CBI on inflation.

In summary, after including a country fixed effect and controlling for one-day lag of dependent variable, we find that only the endogenous central bank governor replacements in developing countries are correlated with domestic currency depreciation on the same day. This suggests that past findings of negative exchange market reactions to central bank governor changes are potentially due to reverse causality.

5. Vector Autoregression Analysis

In this section, we estimate the impact of central bank governor replacements on exchange rate using panel vector autoregression (VAR) analysis (Canova & Cicarreli, 2013). This identification strategy is more dynamic compared to the panel data analysis presented in Section 4. The method is inspired by and follows the identification strategy used in the monetary policy strategy (Bernanke, Boivin, & Eliasz, 2005; Bernanke, Gertler, & Watson, 1997; Christiano, Eichenbaum, & Evans, 1999; Leeper, Sims, & Zha, 1996). It relies on the use of VAR including country fixed effects, together with an identification method based on a particular ordering of relevant variables. Specifically, the variable that is ordered first in the Cholesky ordering is assumed to be more exogenous and slow-moving, and it is not affected by the variable that is ordered after it; while the variable ordered last in the Cholesky ordering is more endogenous or fast-moving.

5.1 Evidence from traditional CBI measures: developing countries

Because we are using high-frequency daily data, we include thirty-day lags in the panel VAR model. Analysis in previous sections indicates that central bank governor replacements matter more for exchange markets in developing countries, thus we focus on developing countries sample in the following analysis. Figure 1 replicates the findings in previous literature that foreign exchange market reacts negatively to any central bank governor turnovers. We use the ordering of the variables, central bank governor changes first and daily percentage change of exchange rate last, to capture the basis assumption in previous literature. Such an ordering assumes that the central bank governor replacements are exogenous to and not affected by exchange market performance immediately when the shock occurs. Figure 1, panel A shows that a one standard deviation increase in the likelihood of central bank governor change raises the daily percentage change of exchange rate by 0.04 percentage points on the same day, and is statistically significant at 90%. The negative response of the foreign exchange market (an increase in exchange rate) vanishes quickly as the response of daily percentage change reduces to about zero on the same day of the shock.

However, as discussed in previous sections, there is no evidence to guarantee the validity of the assumption that central bank governor replacements are exogenous. Figure 2 presents the results using the ordering that daily percentage change of exchange rate first and central bank governor changes last. This assumes that central bank governor replacements are not exogenous and they are induced by exchange market performance at the first place. Figure 2, panel A shows the response of the likelihood of a central bank governor replacement to a one standard deviation increase in the daily percentage change of exchange rate. The response is positive (0.08 percentage points increase) on the day of the shock and diminishes to zero quickly, which is

similar to the response pattern in Figure 1, panel A. The results shown in Figure 2 indicate that the causality runs the other way around: it is the domestic currency depreciation that causes the central bank governor to lose his/her job, rather than the common notion that exchange market interprets a central bank governor turnover as a loss of CBI and reacts negatively in response.

Figure 1 and 2 illustrate that the story told could be of opposite directions depending on the model assumptions. If central bank governor turnovers are believed to be exogenous, then panel VAR results give a story that central bank governor turnovers affect the exchange market negatively. However, if the turnovers are viewed as endogenous, then the results could be interpreted as central bank governor changes are induced by poor exchange market performance. It is exactly the endogeneity problem we discussed in Section 2, and it can be solved using our new CBI dataset which differentiates endogenous and exogenous changes.

5.2 Evidence from the narrative analysis: developing countries

We now use our new CBI dataset to distinguish between exogenous and endogenous central bank governor replacements and examine the "purified" effects of these replacements on exchange market behavior. For this purpose, we estimate similar panel VAR using the following order of variables: exogenous central bank governor changes first and daily percentage change of exchange rate last. We order exogenous central bank governor changes first because (i) our narrative analysis has established that there changes are not caused by high inflation or financial market instability, and (ii) it is reasonable to allow central bank governor changes to affect exchange market on the same day given that financial markets around the world are all somewhat efficient and respond to news quickly.

Figure 3 shows the findings using our new exogenous replacements. Panel A shows that a one standard deviation increase in the likelihood of endogenous central bank governor change does not lead to any statistically significant response in the daily percentage change of exchange rate on the same day and the next five days. This result differs substantially from that obtained using traditional CBI measures in which a central bank governor replacement causes domestic currency to depreciate on the same day. This striking difference supports the practical relevance of our narrative approach to identify exogenous central bank governor turnovers that are not caused by financial market movements.

Turning to the endogenous central bank governor replacements, we estimate similar panel VAR using the reverse order of variables: daily percentage change of exchange rate first and endogenous central bank governor replacements last. We order endogenous central bank governor replacements last because these replacements are indeed directly caused by inflation or financial market turmoil based on our narrative analysis. Therefore, we would like to allow them to contemporaneously (on the same day) respond to movements in foreign exchange market. Figure 4 shows the results. Panel A illustrates that the likelihood of endogenous central bank governor replacements increases by 0.08 percentage points in response to a one standard deviation increase in the daily percentage change of exchange rate. Such a response is strong and statistically significantly at 90%. This finding suggests that the negative exchange market reactions discovered in previous literature are strongly driven by a sample "contaminated" by endogenous central bank governor replacements. Moreover, the reverse causality from financial market performance to endogenous central bank governor turnovers is extremely strong. This is reflected from the fact that even the majority of the turnovers are exogenous (64 out of 90), the estimated negative impact on exchange market (significant increase in exchange rate) is quite

dramatic when using all turnovers versus the impact (no significant change in exchange rate) using only exogenous ones. Nevertheless, the negative "impact" on exchange market estimated using all central bank governor changes is mainly driven by the reverse causality among the endogenous cases, as presented in Figure 4. These findings again reinforce the importance of our identification strategy based on narrative approach.

Figure 5 and 6 shows the results using our "narrow" identification of endogenous central bank governor replacements, which restrict the endogenous cases to only those replacements that are caused by inflation or exchange market instability. Figure 5 focuses on exogenous changes and uses the ordering: exogenous central bank governor changes first and daily percentage change of exchange rate last. Figure 6 is on endogenous cases and uses the reverse ordering in which daily percentage change of exchange rate first and endogenous central bank governor replacements last. Patterns of Figure 5 and 6 are similar to those in Figure 3 and 4, respectively. Therefore our results are robust and are not sensitive to our "broad" or "narrow" definition of endogenous and exogenous central bank governor turnovers.

5.3 Evidence in advanced countries

Results from the panel data analysis in Section 4 indicate that exchange markets in advanced countries do not respond to any type of central bank governor turnovers. Panel VAR analysis confirms these results. Figure 7 and 8 are the results using all turnovers in our advanced countries sample. Figure 7 is under the assumption that all the turnovers are exogenous and thus the central bank governor turnover variable is ordered first; on the contrary, Figure 8 assumes that they are endogenous and the corresponding variable is ordered last. It is clear that in advanced countries, there is no significant response of exchange rate to any central bank governor turnovers on the same day and the next five days, and this result is independent of the

timing assumption. Figure 9 and 10 focuses on the exogenous changes in advanced countries. Figure 9 uses exogenous cases (45 out of 47) excluding the endogenous changes under our "broad" definition; Figure 10 uses our "narrow" definition, which leads to 46 exogenous cases out of 47. Given such a small fraction of endogenous replacements, it is not surprising that figure 7, 9, and 10 are nearly identical. The findings reinforce our arguments that CBI in advanced countries is relatively high, and consequently, exchange market participants in advanced countries care little about central bank governor changes, and they do not to tend to interpret such changes as a loss in CBI.

Summarizing the results from our panel VAR analysis, we (i) reinforce the importance of and validate our new CBI dataset constructed based on narrative approach; (ii) demonstrate the practical relevance of differentiating between endogenous and exogenous central bank governor replacements, especially in developing countries; (iii) find that the negative exchange market reactions to central bank governor turnovers observed in previous literature are driven by a sample "contaminated" by endogenous replacements; (iv) conclude that the exchange market does not respond to a central bank governor turnover if it is exogenous to inflation or financial market movements.

6. Robustness Check

6.1 Panel Data Analysis

We employ three control variables in the panel data analysis for robustness check. We use the daily percentage change of the yield of 10-year U.S. Treasury bonds ($\Delta Tbond10yr$) and 3-month U.S. T-bills ($\Delta Tbill3mo$) to control for U.S. financial market indicators. Both variables are widely used to control for global liquidity (Moser & Dreher, 2010). We also control for the

official (de jure) exchange rate regime (ERR) arrangements using the IMF ERR classification ($floatERR$). With these three control variables, we estimate the following equation:

$$\Delta ER_{i,t} = \alpha + \gamma \Delta ER_{i,t-1} + \beta CBG_{i,t} + \lambda_1 \Delta Tbond10yr_t + \lambda_2 \Delta Tbill3mo_t + floatERR_{i,t} + \eta_i + \varepsilon_{i,t} \quad (2)$$

The variable $floatERR_{i,t}$ takes the value of 1 if the IMF classification code for country *i* at time *t* is 3 or 4, and 0 if the code is 1 or 2, as discussed in Section 3.

Table 4 shows the results. Colum (1)-(5) are for developing countries, and column (6)-(10) advanced countries[10]. Different natures of central bank governor replacements (*CBGall, CBGexog, CBGendog; CBGexog_er, CBGendog_er*) are considered in separate regressions. For developing countries, the coefficient estimates for the variable *float ERR* are positive and statistically significant at 1% level. This means that if the de jure ERR of the specific country on the specific day is non-fixed, all else fixed, the domestic currency tends to depreciate more. This is consistent with the intuition that if the country announces a fixed ERR, it is more likely that the central bank would do its job to prevent large exchange rate fluctuations. More importantly, after controlling for the de jure ERR and global liquidity, the pattern we observe in Section 4 remains. Column (1) indicates that the coefficient estimate of *CBGall* (1.53) is positive and significant at 1% level, and so is that of *CBGendog* (5.01), which is also larger in its magnitude as shown in column (3). In contrast, column (2) reports that the coefficient estimate for *CBGexog* (0.17) is smaller and insignificant at any conventional level, even though exogenous cases count for the majority of the central bank governor changes. Column (4) and (5) confirms the results using the "narrow" definition of endogenous cases. For advanced countries, adding control

[10] We do not report the coefficient estimates of the daily percentage change of the yield of 10-year U.S. Treasury bonds and 3-month T-bills since they are not of major interest.

variables does not change the results either. The coefficient estimates for the variable *float ERR* are positive (0.016), but the significance is weaker, which is only marginally significant at 20% level. Given that exchange markets are more stable in advanced countries, we do not think such a result is surprising and counterintuitive. As column (6)-(10) show, the coefficient estimate of each type of central bank governor changes in advanced countries are insignificant at any conventional level, even though the point estimates are all slightly larger than those without controls as presented in Section 4.2.

To summarize, our results from the panel data analysis in Section 4.2 are robust after controlling for global liquidity conditions and official exchange rate regime arrangements. We confirm that only the endogenous central bank governor replacements in developing countries are correlated with domestic currency depreciation on the same day.

6.2 Panel VAR Analysis

We present panel VAR results for fixed and non-fixed ERR to illustrate the robustness of our results. We use the official yearly IMF ERR classification to show that our results from panel VAR analysis in Section 5 are not driven by the ERR arrangements. We identify countries as fixed exchange rate regime if the IMF classification code for the specific year is 1 or 2, and non-fixed otherwise. Table 5 presents the numbers of endogenous and exogenous central bank governor replacements in fixed and non-fixed ERR by developing and advanced countries. For both developing and advanced countries, the majority of central bank governor replacements happen when the ERR is non-fixed. For developing countries, 75 out of 90 turnovers happen during non-fixed ERR; and it is 28 out of 47 for advanced countries. Such a pattern remains if we decompose all turnovers into exogenous and endogenous cases. It is rather interesting that there are only two endogenous replacements in fixed ERR of developing countries and none of

advanced countries. This finding is on the contrary of our expectation, as we think that central bank governor would be more likely to lose his/her job because of their inability to stabilize exchange market under a fixed ERR. The deviation from our expectation might be due to the fact that actual (de facto) exchange rate management is usually different from the de jure announcement of the choice of exchange rate regime (Reinhart & Rogoff, 2004). The issue that whether the de facto ERR arrangement plays a role in the degree of CBI and its impact on financial markets may require further research. The bottom line is that our results discussed in Section 5 are robust after including the de jure ERR arrangements in the analysis.

6.2.1 Developing Countries

6.2.1.1 Fixed ERR

Figure 11 and 12 show the panel VAR results using all central bank governor turnovers in the subsample of fixed ERR. Figure 11 uses the ordering of variables in which central bank governor changes first and daily percentage change of exchange rate last; while Figure 12 uses the reverse ordering. The results indicate that foreign exchange markets in developing countries under fixed ERR do not respond to any type of central bank governor turnovers, regardless of the timing assumption. This finding makes sense as the exchange rate is expected to be fixed within some bands given the definition of fixed ERR. Figure 13 shows the results using only exogenous cases in fixed ERR. As expected, the response of exchange rate to exogenous changes is not statistically different from zero[11].

6.2.1.2 Non-Fixed ERR

Figure 14 and 15, using the same ordering of variables as Figure 11 and 12 respectively, present results by analyzing all central bank governor turnovers in the subsample of non-fixed ERR.

[11] Because there are only two endogenous central bank governor replacements in developing countries under fixed ERR, panel VAR analysis cannot be applied to this subsample.

Compared to Figure 1 and 2 which apply the panel VAR analysis on the whole sample without distinguishing fix and non-fixed ERR, Figure 14 and 15 appear to be very similar to Figure 1 and 2, respectively. Figure 16 shows the results for exogenous cases in non-fixed ERR using the ordering: exogenous central bank governor changes first and daily percentage change of exchange rate last; Figure 17 is for endogenous cases using the reverse ordering: daily percentage change first and endogenous changes last. The rationale of the choices of the corresponding timing assumption is discussed with details in Section 4. Clearly, the general patterns shown in Figure 16 and 17 are very much similar to those in Figure 3 and 4, which are generated using the same method while for the whole sample of developing countries. This means that, the results we discuss in Section 4 for developing countries are mainly driven by the exchange market behavior when the ERR is non-fixed. In general, the results that exchange market does not respond to exogenous turnovers and the observed negative "reaction" is due to reverse causality hold if the sample is restricted to non-fixed ERR only.

6.2.2 Advanced Countries[12]

6.2.2.1 Fixed ERR

Figure 18 and 19 show the results for all central bank governor changes in advanced countries under fixed ERR using the two reverse orderings of variables. Figure 20 illustrate results for exogenous changes, with these changes order first. As expected, under fixed ERR, the exchange market does not react to the event of a central bank governor turnover, regardless of the timing assumption and the nature of the turnover.

[12] For advanced countries, there is no endogenous central bank governor replacements under fixed ERR and only two cases under non-fixed ERR, thus panel VAR analysis for endogenous cases are not feasible in this subsample.

6.2.2.2 Non-Fixed ERR

Figure 21, 22, and 23 are generated following the same analysis applied to Figure 18, 19, and 20, respectively, for advanced countries under non-fixed ERR. The general patterns emerged are the same as those in fixed-ERR: the exchange market reaction to a central bank governor change is insignificant and close to zero on the same day and the following five days in all three figures.

In summary, our results presented in Section 4 are not caused by the official ERR arrangements. In developing countries, the results are mostly driven by exchange market behavior under non-fixed ERR; in advanced countries, the irresponsiveness of exchange market to central bank governor turnovers is not a consequence of the ERR arrangement, but rather is a demonstration of higher degree of CBI believed by financial market participants in these countries.

6.3 Exogenous Turnovers Caused by Conflicts

Our final robustness check focuses on the exogenous central bank governor turnovers that are caused by conflicts with executive authority as defined in our dataset. These conflicts are not associated with issues over inflation, financial market performance and regulation, and are usually related to administrative decisions and economic reforms. If the central bank governor is dismissed because of this type of conflict, it is reasonable to argue that such an event indicates a loss of degree of CBI. We identify 13 such cases in developing countries and 3 in advanced countries, and apply the panel VAR analysis for this certain type of central bank governor replacements. We consider both timing assumptions to address potential endogeneity concern. Figure 24 (exogenous, conflict-induced replacements ordered first) and Figure 25 (the reverse ordering) are the results for developing countries; Figure 26 and 27 are the results for advanced countries. In both groups of countries, independent of the timing assumptions, exogenous replacements induced by conflicts unrelated to inflation and financial markets do not cause any

significant exchange market reactions on the same day[13]. This means that, empirically, exchange market participants do not respond to this type of central bank governor replacements, even though in theory they could be interpreted as a loss of CBI.

7. Conclusion

This paper contributes to the literature on CBI and focuses on the response of exchange market on the day of a central bank governor replacement. We build a dataset which identifies the nature and cause of each replacement using narrative approach. With the new dataset, we are able to distinguish between endogenous and exogenous central bank governor changes, and thus solve the endogeneity problem existed in the literature for decades.

The endogeneity problem stems from the usage of central bank governor turnover rate (TOR) as a proxy of the degree of CBI. However, the aggregate TOR measure is potentially too coarse to be a good proxy. The main problem is that some central bank governor replacements are caused by high inflation or financial market turmoil, which gives rise to the endogeneity problem. In order to solve this problem, with our narratives, we classify all the turnovers into six categories based on the nature and cause of each case, and analyze endogenous and exogenous turnovers separately in order to investigate the impact on exchange market free of endogeneity concern.

We find that the observed negative exchange market "reaction" to a central bank governor replacement in previous literature is driven by the reverse causality, particularly in developing countries. This means that, central bank governors who were dismissed because of high inflation or financial market instability (endogenous cases) are the source of the negative "reaction", thus

[13] Figure 16, panel A, and Figure 27, panel B both show a significant positive response of exchange rate five days after the central bank governor replacement. It is possible that exchange market participants in advanced countries respond to this type of replacement with a lag. However, considering that many other factors affect the exchange market at the same time and there are only three such replacements in our sample, we conclude that, on the bottom line, exchange market does not respond on the same day of such a replacement.

the causality is actually the other way around from exchange market performance to central bank governor replacement. Moreover, exchange markets in both developing and advanced countries do not respond to an exogenous turnover. Therefore, our findings reject the previous argument that the replacement of a central bank governor negatively affects exchange market on the same day. At the same time, by identifying the nature and cause of each central bank governor replacement, our paper provides a clearer and more refined measure of de facto CBI.

Table 1. Categories of Central Bank Governor Replacements.

	Country	INF&FM	TOF	NPRES	LEAVE	CONF	OTHER	Total
Developing Countries	Argentina	10			1	3	2	16
	Brazil	5		2	1	0	2	10
	Chile	2	2			1		5
	Cyprus*		3					3
	Czech Rep*				1	1	2	4
	Greece*		1	1	1	1		4
	Indonesia	1	2		1		1	5
	Korea*		3					3
	Malaysia	1	1			1	1	4
	Mexico	2	2	1		0		5
	Peru			2	1	1		4
	Slovenia*		2					2
	South Africa		4					4
	Thailand	2	1		1	1	1	6
	Turkey	2	2			1	1	6
	Uruguay	1			1		1	3
	Venezuela		2	1		3		6
	Total	26	25	7	8	13	11	90
	Percentage	28.89%	27.78%	7.78%	8.89%	14.44%	12.22%	100.00%
Advanced Countries	Australia		2					2
	Belgium		3					3
	Canada		4					4
	Finland				1		1	2
	France				3	1		4
	Germany		2			1	2	5
	Italy	1			2		0	3
	Japan		4				1	5
	Norway		2			1	1	4
	Portugal				2			2
	Spain	1	3					4
	Sweden		1		1		1	3
	Switzerland		3				1	4
	USA		2					2
	Total	2	26	0	9	3	7	47
	Percentage	4.26%	55.32%	0.00%	19.15%	6.38%	14.89%	100.00%

Source: Author's calculation.

Table 2. Non-Parametric Analysis.

	Developing countries			Advanced countries		
	(1) CBGall	(2) CBGexog	(3) CBGendog	(4) CBGall	(5) CBGexog	(6) CBGendog
Mean	1.45*	0.20*	4.65++	0.00	-0.01	0.24+
Std. err.	1.11	0.14	3.91	0.11	0.12	0.13
Min	-5.66	-1.77	-5.66	-1.30	-1.30	0.11
Max	93.68	5.85	93.68	2.09	2.09	0.36
Obs.	89	64	25	45	43	2
H_0	avg. $\Delta ER\%=0$					
p-value	0.10	0.08	0.12	0.49	0.53	0.16

Note:

1) On December 20th, there was an endogenous central bank governor change in Argentina, but the exchange market data is not available on that day, thus there are 89 observations in the developing countries sample (25 endogenous ones and 64 exogenous). For advanced countries, since exchange rate is expressed as domestic country currency vis-à-vis the U.S. dollar, the two Fed chairman changes of U.S. are excluded from the analysis and thus there are 45 observations in the advanced countries sample (2 endogenous ones ad 43 exogenous).
2) *** significant at 1%; ** significant at 5%; * significant at 10%; ++ significant at 15%; + significant at 20%.

Table 3. Panel Regressions including Country Fixed Effects.

	Developing Countries					Advanced Countries				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CBGall	1.378***					0.008				
	(0.152)					(0.153)				
CBGexog		0.147					-0.003			
		(0.179)					(0.156)			
CBGendog			4.527***					0.243		
			(0.287)					(0.723)		
CBGexog_er				0.131					0.000	
				(0.173)					(0.154)	
CBGendog_er					5.679***					0.377
					(0.320)					(1.023)
ΔER%_1	0.010***	0.010***	0.010***	0.010***	0.010***	0.001	0.001	0.001	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of CBG changes	89	64	25	69	20	45	43	2	44	1
Number of countries	17	17	17	17	17	13	13	13	13	13
Observations	106237	106237	106237	106237	106237	93843	93843	93843	93843	93843

Note:

1) Standard errors are in parentheses.
2) *** significant at 1%; ** significant at 5%; * significant at 10%; ++ significant at 15%; + significant at 20%.

Table 4. Robustness Check: Panel Regressions including Country Fixed Effects.

	Developing					Advanced				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CBGall	1.523***					0.044				
	(0.155)					(0.163)				
CBGexog		0.170					0.033			
		(0.183)					(0.167)			
CBGendg			5.050***					0.245		
			(0.295)					(0.739)		
CBGexog_er				0.153					0.035	
				(0.177)					(0.165)	
CBGendog_er					6.134***					0.390
					(0.325)					(1.045)
ΔER%_1	0.009***	0.009***	0.009***	0.009***	0.009***	0.002	0.002	0.002	0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
FloatERR	0.030**	0.030***	0.029**	0.030**	0.029**	0.015+	0.016+	0.015+	0.015+	0.015+
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Global Liquidity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of CBG changes	83	60	23	64	19	41	39	2	40	1
Number of countries	17	17	17	17	17	13	13	13	13	13
Observations	98986	98986	98986	98986	98986	87764	87764	87764	87764	87764

Note:

3) Standard errors are in parentheses.

4) *** significant at 1%; ** significant at 5%; * significant at 10%; ++ significant at 15%; + significant at 20%.

Table 5. Number of Central Bank Governor Replacements by ERR.

	Developing Countries			Advanced Countries		
	Fixed ERR	Non-Fixed ERR	Total	Fixed ERR	Non-Fixed ERR	Total
Exog.	12	52	64	19	26	45
Endog.	2	23	26	0	2	2
Total	15	75	90	19	28	47

Source: Author's calculation.

Figure 1. Developing Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

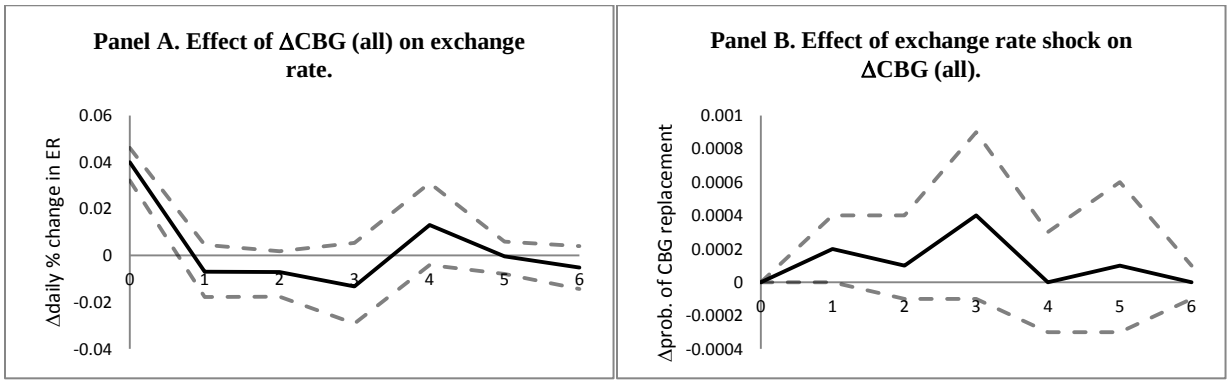


Figure 2. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

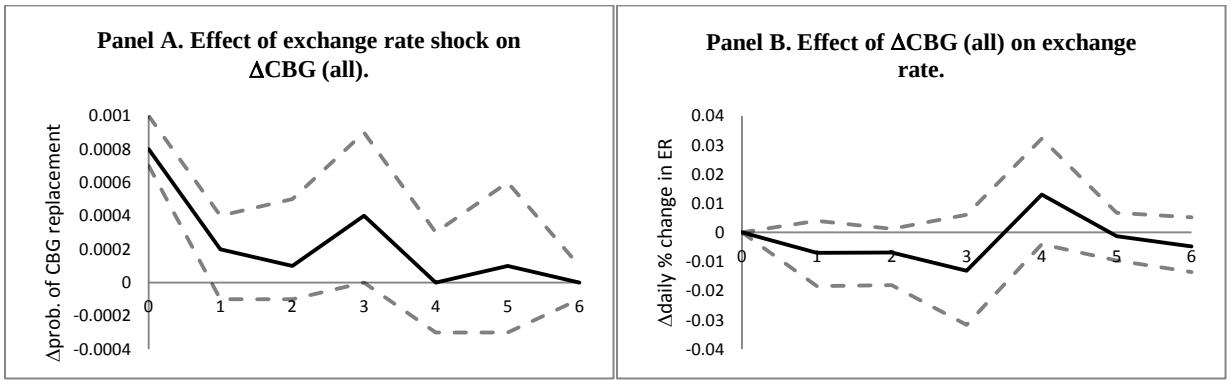
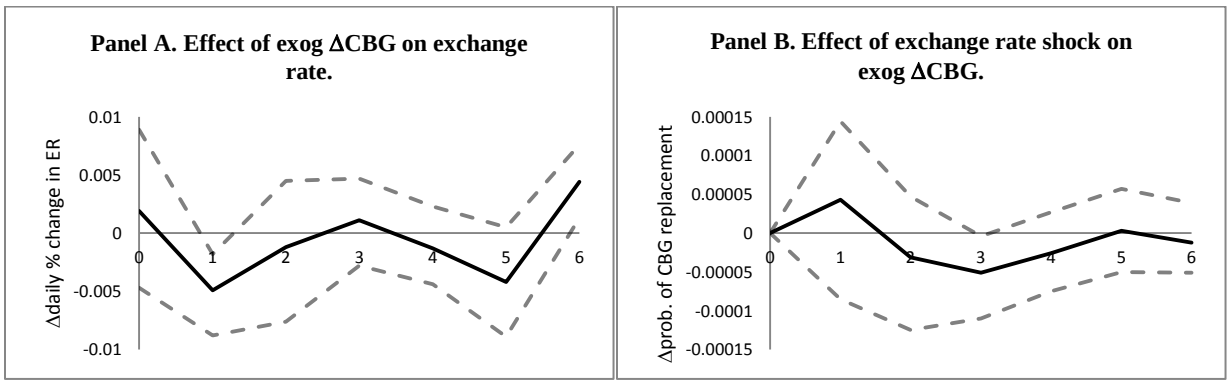


Figure 3. Developing Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.



Note: For Figure 1-27, the order of the two variables are specified in the title of each figure. Dashed lines refer to 90 percent confidence intervals constructed using Monte Carlo simulations.

Figure 4. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and endogenous CBG replacements. One standard-deviation shocks.

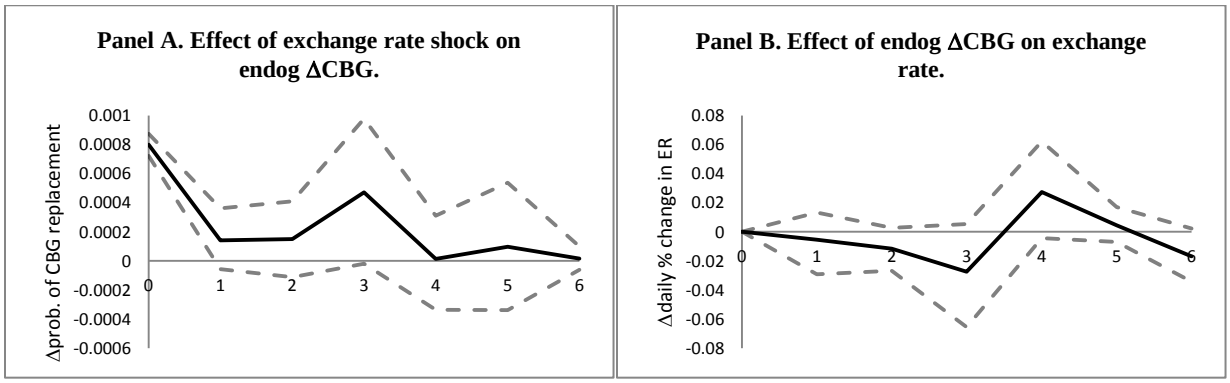


Figure 5. Developing Countries. Two-variable panel VAR: exogenous (to only inflation and exchange market turmoil) CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

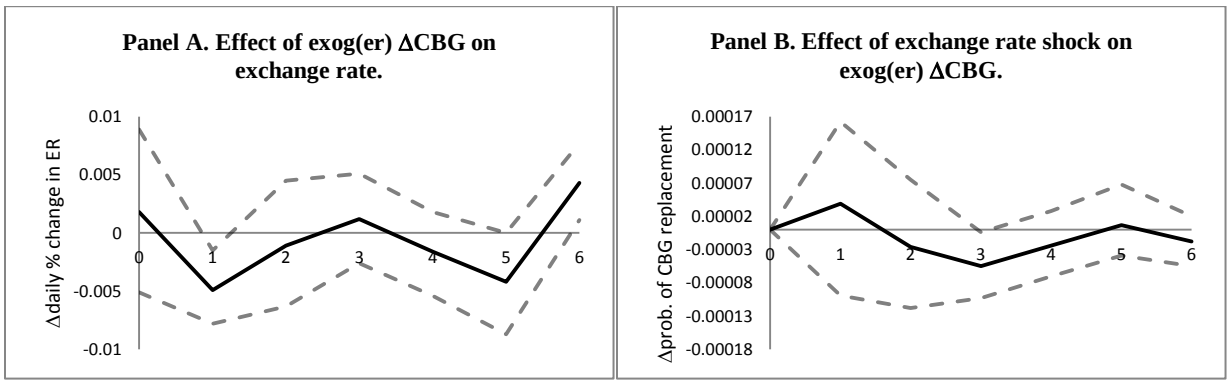


Figure 6. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and endogenous (to only inflation and exchange market turmoil) CBG replacements. One standard-deviation shocks.

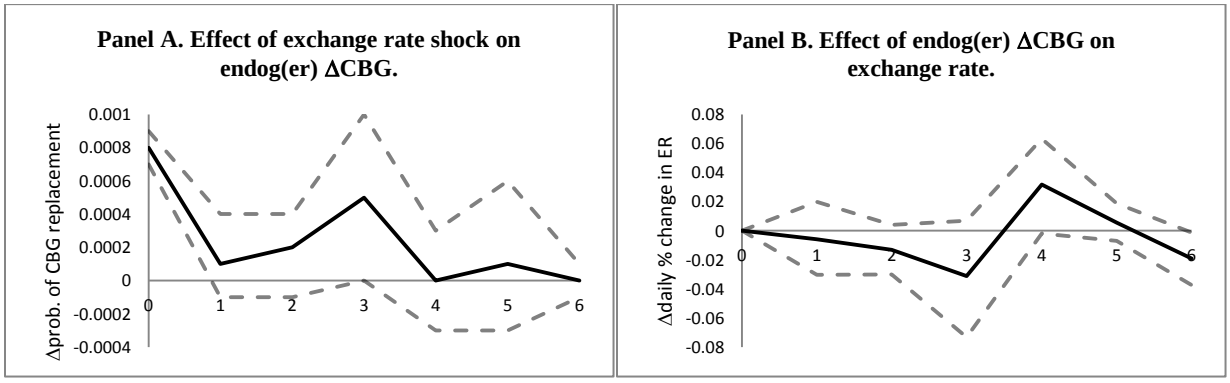


Figure 7. Advanced Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

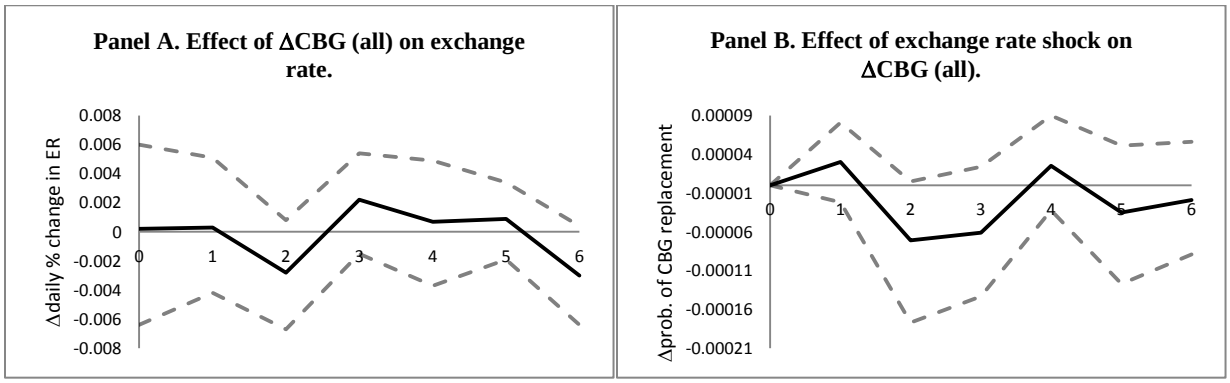


Figure 8. Advanced Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

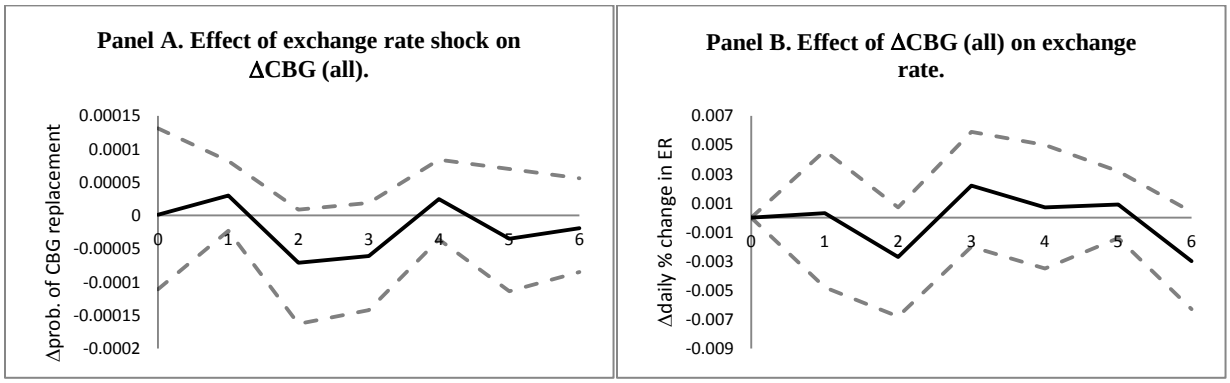


Figure 9. Advanced Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

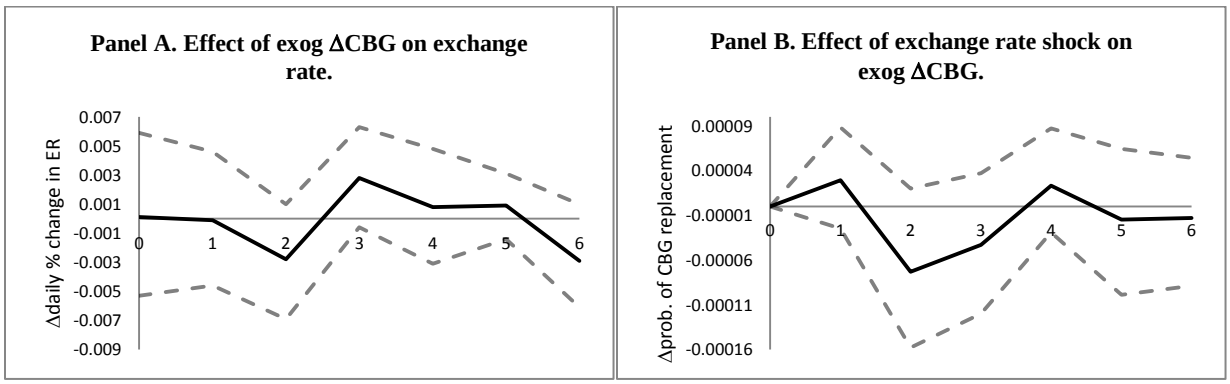


Figure 10. Advanced Countries. Two-variable panel VAR: exogenous (to only inflation and exchange market turmoil) CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

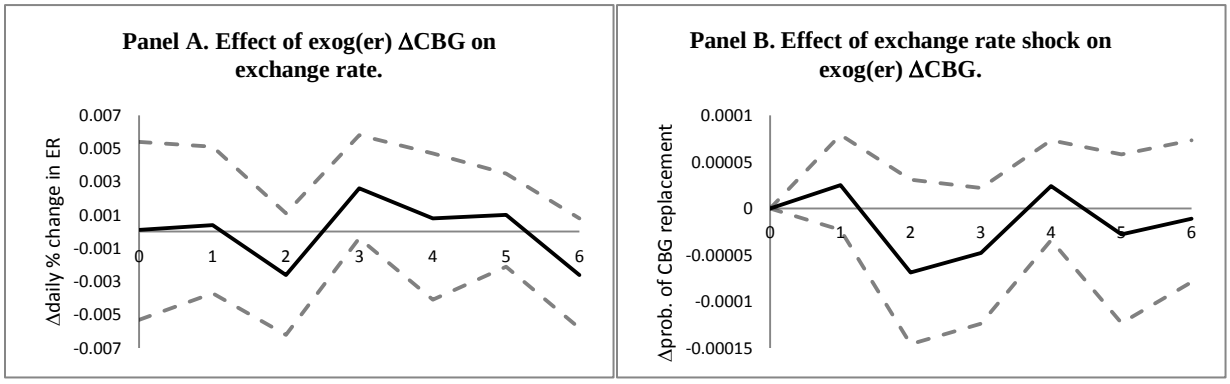


Figure 11. Fixed ERR. Developing Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

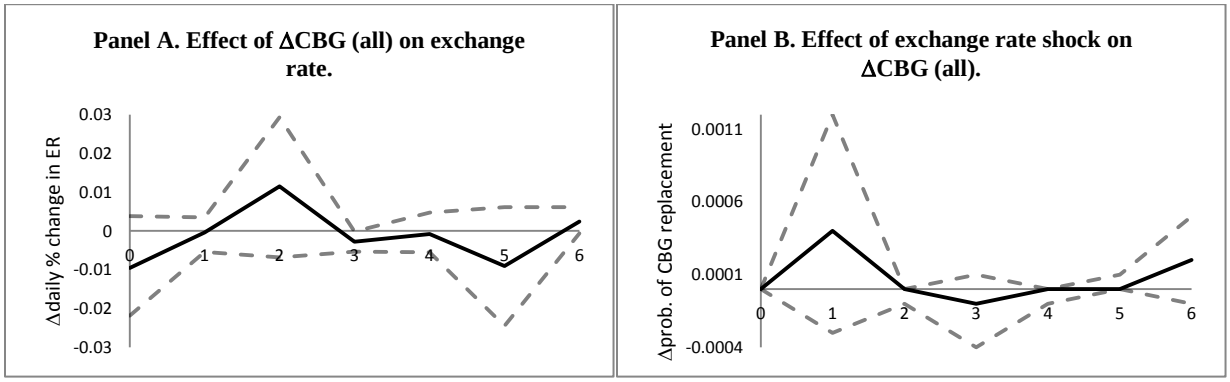


Figure 12. Fixed ERR. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

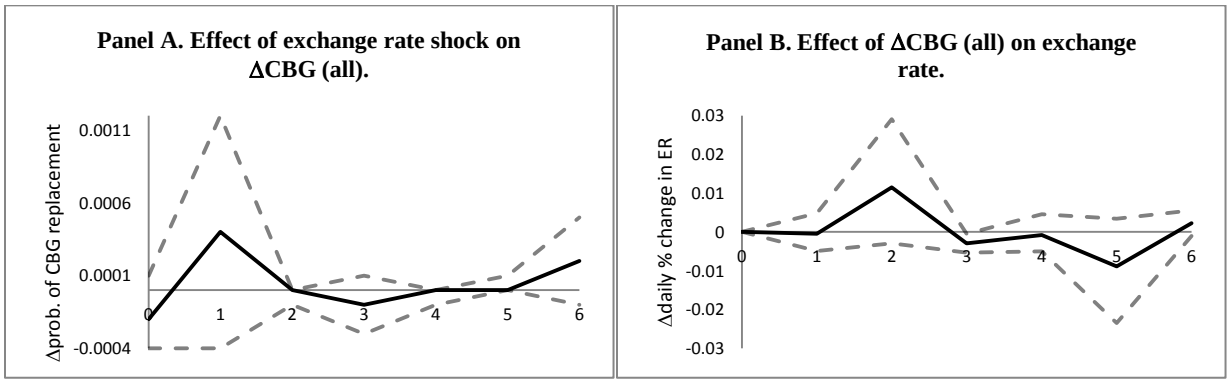


Figure 13. Fixed ERR. Developing Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

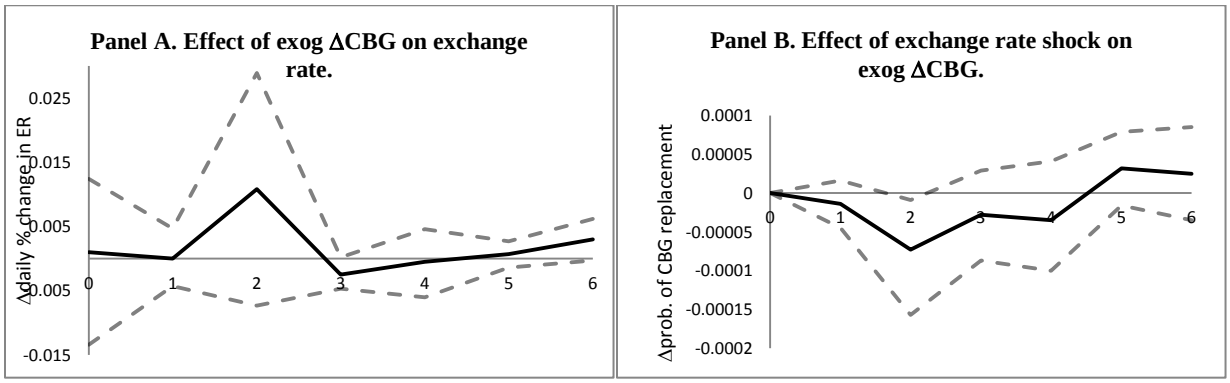


Figure 14. Non-Fixed ERR. Developing Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

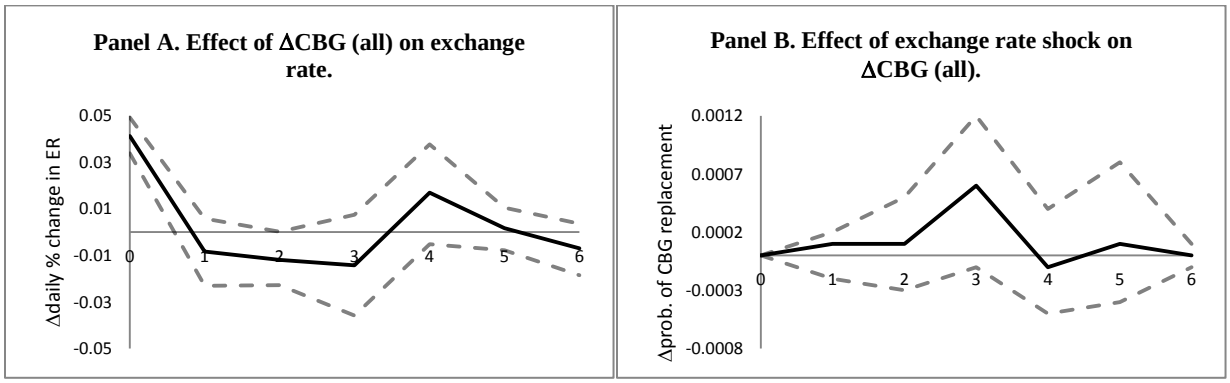


Figure 15. Non-Fixed ERR. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

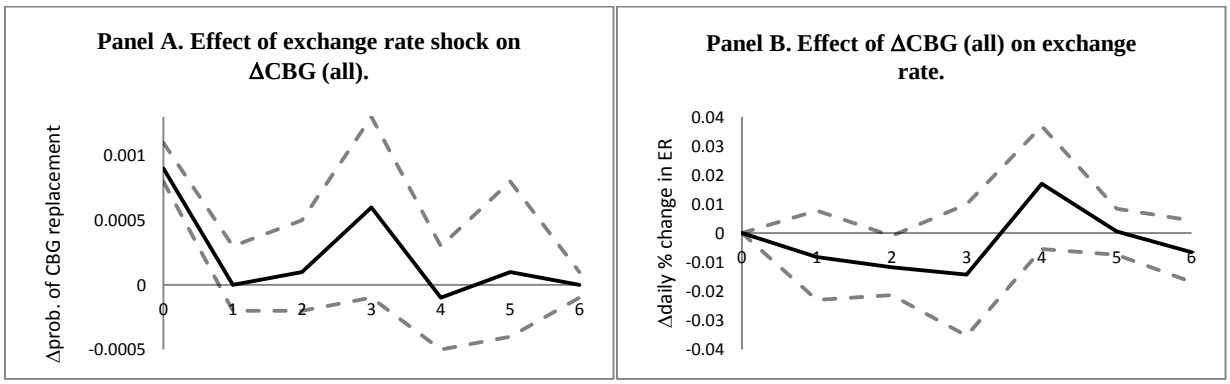


Figure 16. Non-Fixed ERR. Developing Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

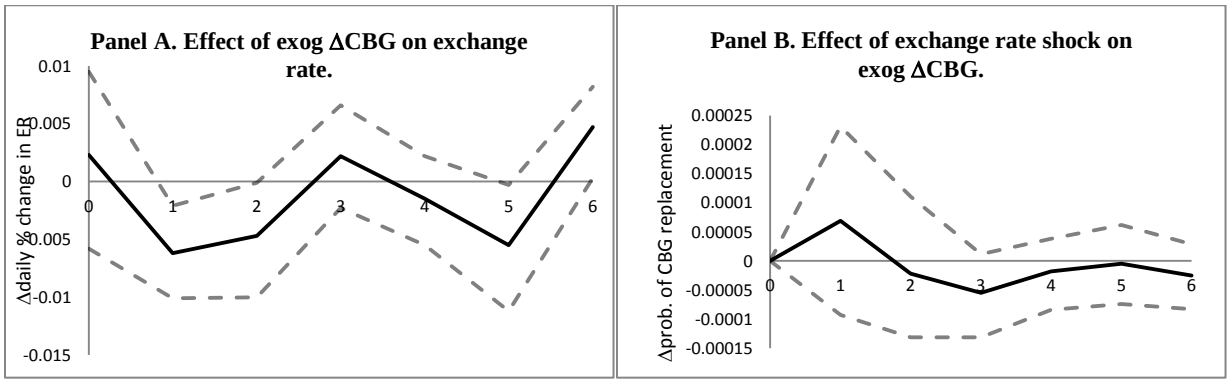


Figure 17. Non-Fixed ERR. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and endogenous CBG replacements. One standard-deviation shocks.

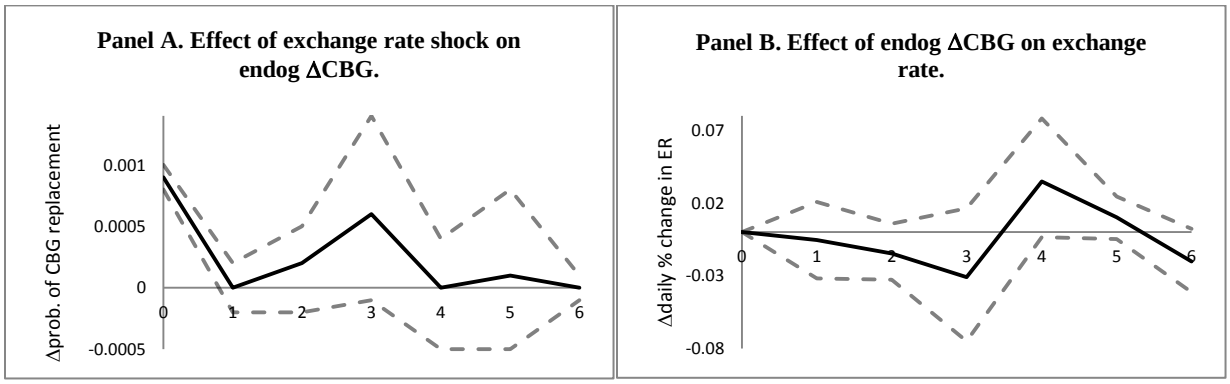


Figure 18. Fixed ERR. Advanced Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

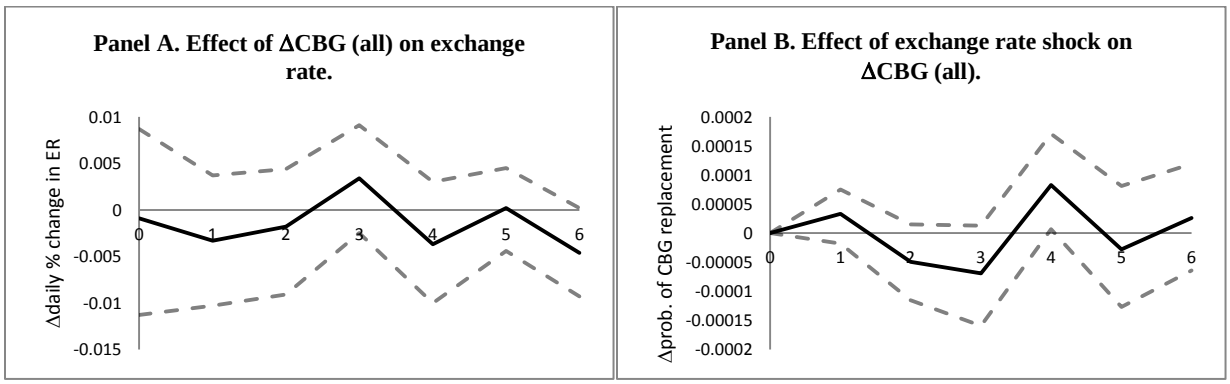


Figure 19. Fixed ERR. Advanced Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

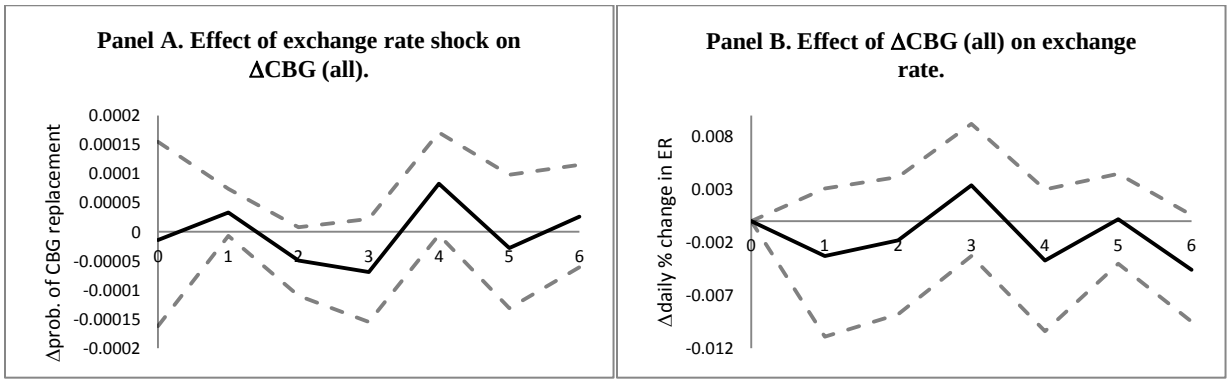


Figure 20. Fixed ERR. Advanced Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

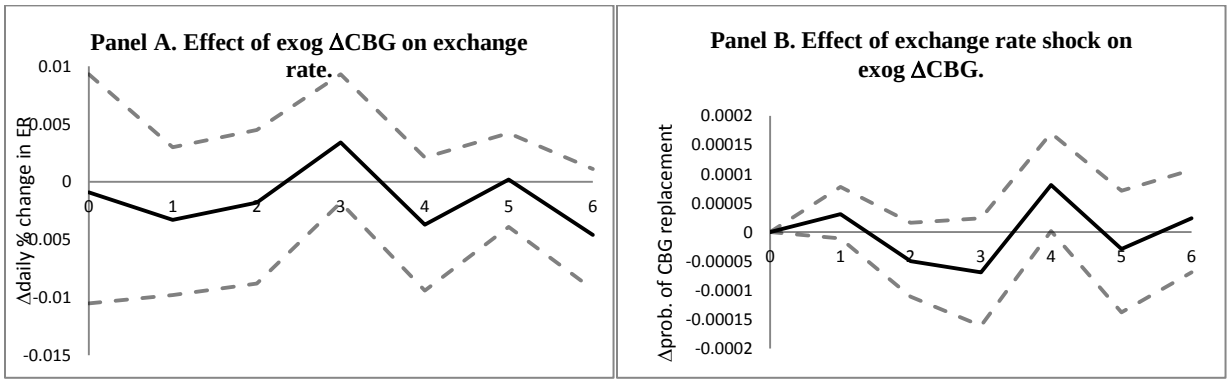


Figure 21. Non-Fixed ERR. Advanced Countries. Two-variable panel VAR: all CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

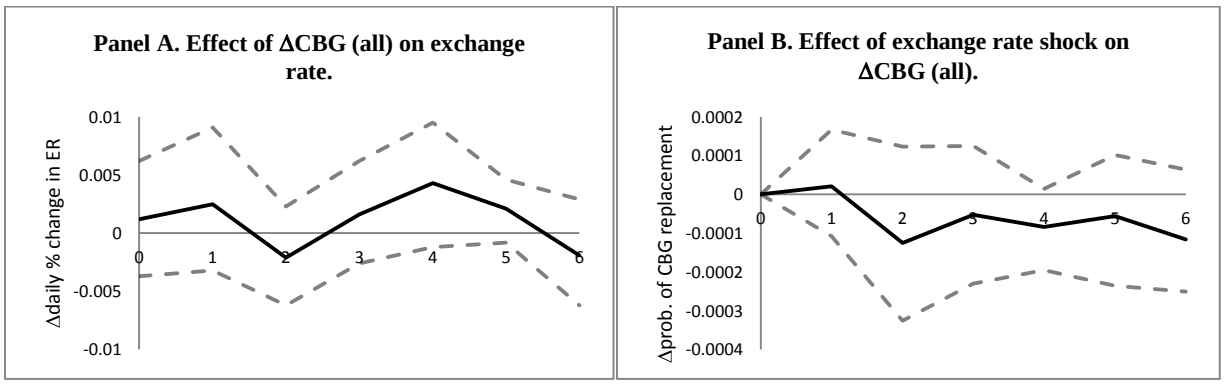


Figure 22. Non-Fixed ERR. Advanced Countries. Two-variable panel VAR: daily percentage change of exchange rate, and all CBG replacements. One standard-deviation shocks.

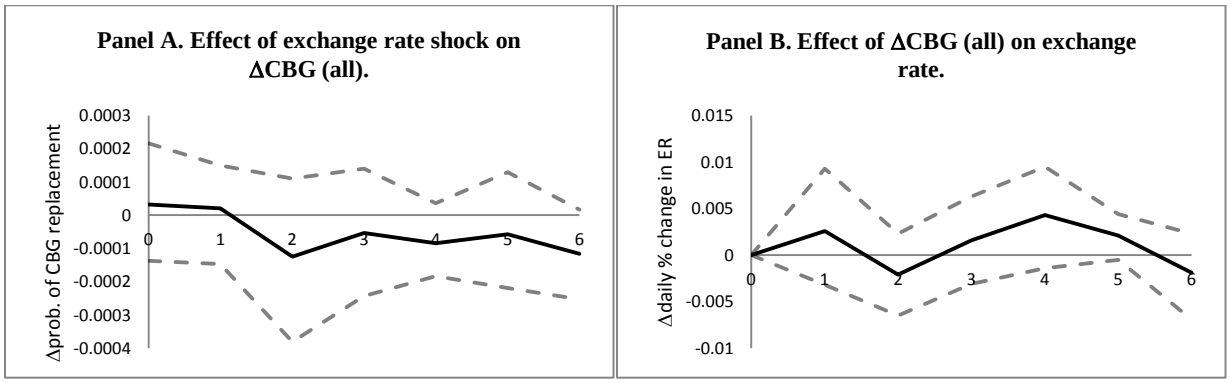


Figure 23. Non-Fixed ERR. Advanced Countries. Two-variable panel VAR: exogenous CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

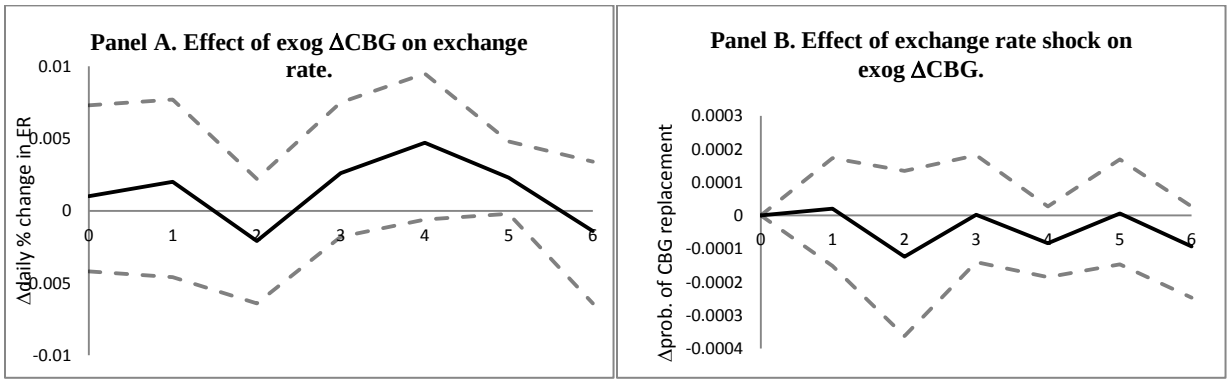


Figure 24. Developing Countries. Two-variable panel VAR: exogenous (conflict-induced) CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

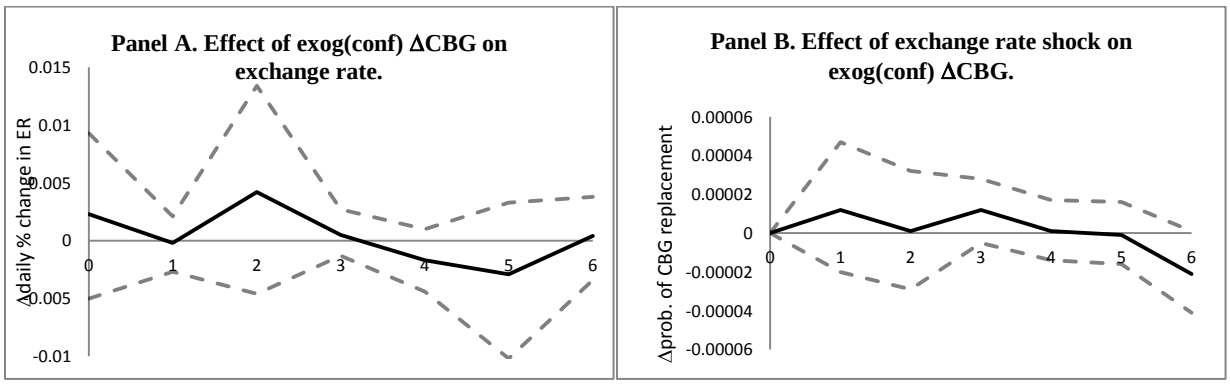


Figure 25. Developing Countries. Two-variable panel VAR: daily percentage change of exchange rate, and exogenous (conflict-induced) CBG replacements. One standard-deviation shocks.

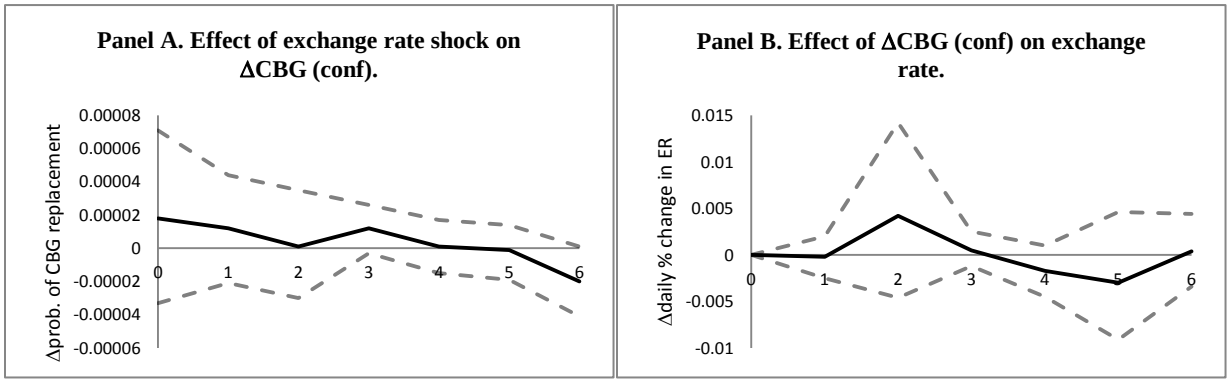


Figure 26. Advanced Countries. Two-variable panel VAR: exogenous (conflict-induced) CBG replacements, and daily percentage change of exchange rate. One standard-deviation shocks.

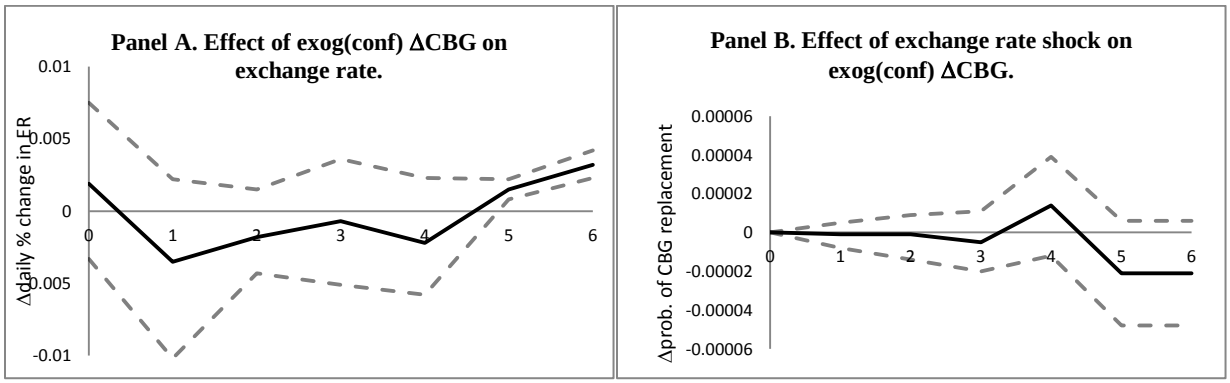
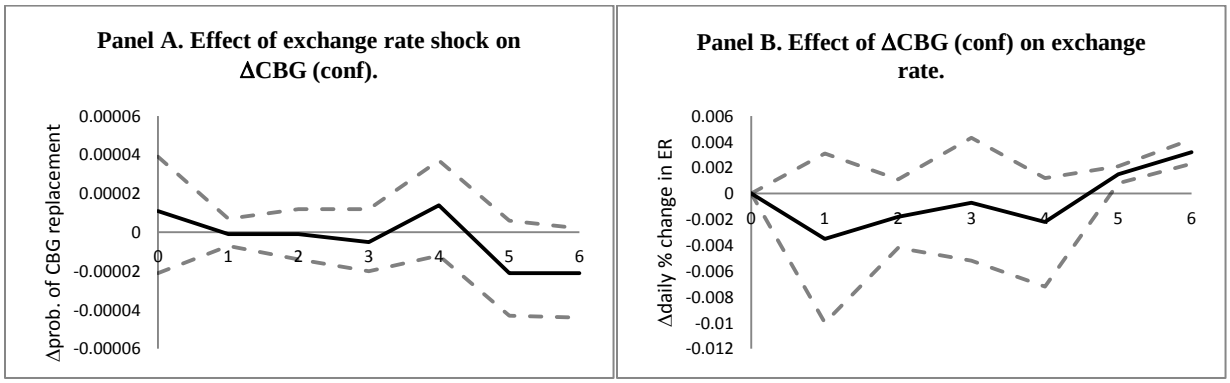


Figure 27. Advanced Countries. Two-variable panel VAR: daily percentage change of exchange rate, and exogenous (conflict-induced) CBG replacements. One standard-deviation shocks.



Appendix A. Summary of the Central Bank Governor Replacement Dataset.

	Country	From	To	Number of Central Bank Governor Replacements
Developing Countries	Argentina	2/19/1985	6/30/2012	16
	Brazil	3/15/1990	6/30/2012	10
	Chile	12/10/1989	6/30/2012	5
	Cyprus*	5/1/1982	6/30/2012	3
	Czech Rep*	1/20/1993	6/30/2012	4
	Greece*	2/20/1992	6/30/2012	4
	Indonesia	3/21/1988	6/30/2012	5
	Korea*	3/6/1998	6/30/2012	3
	Malaysia	7/1/1980	6/30/2012	4
	Mexico	1/1/1977	6/30/2012	5
	Peru	4/28/1992	6/30/2012	4
	Slovenia*	4/1/1991	6/30/2012	2
	South Africa	7/1/1967	6/30/2012	4
	Thailand	10/1/1990	6/30/2012	6
	Turkey	7/23/1987	6/30/2012	6
	Uruguay	4/13/2000	6/30/2012	3
	Venezuela	2/2/1989	6/30/2012	6
	Subtotal			90
Advanced Countries	Australia	9/1/1989	6/30/2012	2
	Belgium	3/1/1982	6/30/2012	3
	Canada	2/1/1973	6/30/2012	4
	Finland	4/5/1992	6/30/2012	2
	France	11/21/1979	6/30/2012	4
	Germany	1/1/1980	6/30/2012	5
	Italy	10/8/1979	6/30/2012	3
	Japan	12/17/1984	6/30/2012	5
	Norway	1/1/1986	6/30/2012	4
	Portugal	7/1/1994	6/30/2012	2
	Spain	7/19/1984	6/30/2012	4
	Sweden	1/1/1983	6/30/2012	3
	Switzerland	5/1/1988	6/30/2012	4
	USA	8/6/1979	6/30/2012	2
	Subtotal			47
	Total			137

Source: Author's calculation.

Note: * stands for countries that are considered as advanced countries by IMF classification, but we consider them as developing countries since they are more in between the developing and advanced world. Our results hold if these countries are classified in the advanced countries sample.

Appendix B. Descriptive Statistics.

Variable	Mean	Std. dev.	Min	Max
ΔER% (developing)	0.05	1.44	-100.00	116.54
ΔER % (advanced)	-0.01	1.02	-99.95	12.80
U.S. T-bill 90 days	5.27	3.14	0.00	17.14
U.S. Govt bond 10 years	6.88	2.73	1.43	15.84

Source: Author's calculation.

References:

[1] Alesina, Alberto, & Summers, Lawrence H. (1997). Central Bank Independence and Macroeconomic Performance: Some Comparative Evidence. In S. C. W. Eijffinger (Ed.), *Independent central banks and economic performance* (pp. 372-383): Elgar Reference Collection. International Library of Critical Writings in Economics, vol. 82. Cheltenham, U.K. and Lyme, N.H.:Elgar; distributed by American International Distribution Corporation, Williston, Vt. (Reprinted from: [1993]).

[2] Barro, Robert J., & Gordon, David B. (1983). Rules, Discretion and Reputation in a Model of Monetary Policy. *Journal of Monetary Economics, 12*(1), 101-121.

[3] Bernanke, Ben S., Boivin, Jean, & Eliasz, Piotr. (2005). Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach. *Quarterly Journal of Economics, 120*(1), 387-422.

[4] Bernanke, Ben S., Gertler, Mark, & Watson, Mark. (1997). Systematic Monetary Policy and the Effects of Oil Price Shocks. *Brookings Papers on Economic Activity*(1), 91-142.

[5] Bernanke, Ben S., & Kuttner, Kenneth N. (2005). What Explains the Stock Market's Reaction to Federal Reserve Policy? *Journal of Finance, 60*(3), 1221-1257.

[6] Christiano, Lawrence J., Eichenbaum, Martin, & Evans, Charles L. (1999). Monetary Policy Shocks: What Have We Learned and to What End? In J. B. Taylor & M. Woodford (Eds.), *Handbook of macroeconomics. Volume 1A* (pp. 65-148): Handbooks in Economics, vol. 15.Amsterdam; New York and Oxford: Elsevier Science, North-Holland.

[7] Cukierman, Alex. (1992). *Central bank strategy, credibility, and independence: Theory and evidence*: Cambridge and London: MIT Press.

[8] Cukierman, Alex, Webb, Steven B., & Neyapti, Bilin. (1992). Measuring the Independence of Central Banks and Its Effect on Policy Outcomes. *World Bank Economic Review, 6*(3), 353-398.

[9] Dreher, Axel, Sturm, Jan-Egbert, & de Haan, Jakob. (2008). Does High Inflation Cause Central Bankers to Lose Their Job? Evidence Based on a New Data Set. *European Journal of Political Economy, 24*(4), 778-787.

[10] Faust, Jon. (2003). Identifying the Effects of Monetary Policy Shocks on Exchange Rates Using High Frequency Data. *Journal of the European Economic Association, 1*(5), 1031-1057.

[11] Gurkaynak, Refet S., Sack, Brian, & Swanson, Eric T. (2005). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking, 1*(1), 55-93.

[12] Kuttner, Kenneth N. (2001). Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. *Journal of Monetary Economics, 47*(3), 523-544. doi:

[13] Kuttner, Kenneth N., & Posen, Adam S. (2010). Do Markets Care Who Chairs the Central Bank? *Journal of Money, Credit, and Banking, 42*(2-3), 347-371.

[14] Kydland, Finn E., & Prescott, Edward C. (1977). Rules Rather Than Discretion: The Inconsistency of Optimal Plans. *Journal of Political Economy, 85*(3), 473-491.

[15] Leeper, Eric M., Sims, Christopher A., & Zha, Tao. (1996). What Does Monetary Policy Do? *Brookings Papers on Economic Activity*(2), 1-63.

[16] Lohmann, Susanne. (1992). Optimal Commitment in Monetary Policy: Credibility versus Flexibility. *American Economic Review, 82*(1), 273-286.

[17] Moser, Christoph, & Dreher, Axel. (2010). Do Markets Care about Central Bank Governor Changes? Evidence from Emerging Markets. *Journal of Money, Credit, and Banking, 42*(8), 1589-1612.

[18] Reinhart, Carmen M., & Rogoff, Kenneth S. (2004). The Modern History of Exchange Rate Arrangements: A Reinterpretation. *Quarterly Journal of Economics, 119*(1), 1-48.

[19] Rigobon, Roberto, & Sack, Brian. (2004). The Impact of Monetary Policy on Asset Prices. *Journal of Monetary Economics, 51*(8), 1553-1575.

[20] Rogoff, Kenneth. (1985). The Optimal Degree of Commitment to an Intermediate Monetary Target. *Quarterly Journal of Economics, 100*(4), 1169-1189.

[21] Romer, Christina D., & Romer, David H. (2004). A New Measure of Monetary Shocks: Derivation and Implications. *American Economic Review, 94*(4), 1055-1084.

[22] Romer, Christina D., & Romer, David H. (2010). The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks. *American Economic Review, 100*(3), 763-801.

[23] Santiso, Javier. (2003). *The political economy of emerging markets: Actors, institutions and financial crises in Latin America*: CERI Series in International Relations and Political Economy. Houndmills, U.K. and New York: Palgrave Macmillan.