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Macroeconomic Gains from Structural Fiscal Policy Adjustments: The Case of Colombia

Policymakers worldwide are drawing key lessons from recent academic debates on the role of fiscal policy in the recovery of advanced economies. Many emerging markets have already addressed some of the focal issues currently being discussed, in response to the collapse of their economies in the late 1990s. Some of the key issues include the timing of adjustments and their progressive nature; the need for fiscal stimulus programs and their scope; the proper choice of fiscal instruments and their potential effectiveness along the cycle; and the appropriate public-debt threshold to avoid hampering economic growth.[1] Regardless of the tenets followed, many governments were compelled to adopt tight financial stances in this earlier episode, mostly due to credit market restrictions.

By the turn of the century, Colombia, like several other Latin American countries, was on a growth-recovery path based on a broad set of structural economic reforms. In particular, the Central Bank of Colombia had adopted an inflation-targeting regime with a floating exchange rate, which enhanced the institution's credibility and counteracted external shocks. The government also implemented prudential measures to strengthen the financial system and labor market policies to promote flexibility and competitiveness, and the economy was becoming increasingly integrated into global trade and financial

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1. On the timing of adjustments, see Blanchard and Leigh (2013); Perotti (2011a). On fiscal stimulus programs, see Ilzetzki, Mendoza, and Végh (2013); Corsetti, Meier, and Müller (2012). On the choice of fiscal instruments, see Auerbach and Gorodnichenko (2012); Perotti (2011b). On public-debt thresholds, see Reinhart and Rogoff (2010); Panizza and Presbitero (2013).

markets. However, the cornerstone of all the reforms was the rebalancing of the government's finances by improving its revenues, rationalizing expenditures, and establishing new and effective institutions. The overarching goal was to attain a sustainable path for the country's public debt, as well as its long-term economic growth.

Not surprisingly, this set of cautious policies had further effects on the short- and long-term behavior of the macroeconomy, particularly its response to exogenous shocks. First, the country overcame a rising and unsustainable debt path through a series of reforms that decreased the ratio of debt to gross domestic product (GDP) between 2003 and 2008 and fostered its current stability. Second, explicit policies to diminish the currency mismatch of the government's finances lessened their vulnerability to sharp depreciation episodes and adverse external shocks. Third, the composition of the public debt was shifted toward fixed-rate, peso-denominated bonds with longer maturities, thereby deepening the local sovereign debt market.

This paper highlights some relevant aspects of Colombia's fiscal policy and public debt management during the past ten years and assesses some of their short-term macroeconomic effects. In particular, we analyze the influence of fiscal policy changes on the short-term output response to fiscal shocks and the impact of monetary policy shocks on market interest rates. To do so, we used the structural nonlinear impulse response functions suggested by Auerbach and Gorodnichenko and by Jordà.[2] We also identify the unexpected fiscal and monetary policy shocks through methods inspired by the narrative approach of Romer and Romer and also Ramey.[3] We conclude that a sound fiscal policy brings strong countercyclical benefits to both monetary and fiscal decisions.

Fiscal Policy in Colombia

The adoption of a new constitution in 1991 implied a strong expansion of the size of government in Colombia. Increased demand for public spending on health, education, and justice drove the central government's primary expenditures from 7.2 percent of GDP in 1990 to 12.4 percent of GDP in 2000. At the same time, the constitution of 1991 and legal reforms extended fiscal decentralization and imposed a regime in which an increasing fraction of the central government's current revenues was transferred to local governments. The tax increases adopted to pay for the additional expenditures were not sufficient and

2. Auerbach and Gorodnichenko (2012); Jordà (2005).
3. Romer and Romer (2004); Ramey (2011).

had to be shared with local governments, which, in turn, increased their spending. In addition, the intertemporal solvency of the pay-as-you-go national pension system was questionable, given its prevailing parameters and the coexistence of a defined-contribution private pension fund system.

By the end of the 1990s, fiscal sustainability in Colombia was uncertain. The ratio of central government debt to GDP was rising fast, and several local governments were over-indebted. The external shocks of that period (especially the Russian crisis) triggered the largest output drop in Colombia since the Great Depression, together with a financial crisis. The cost of the latter had to be absorbed by the government, thus worsening an already weak fiscal situation.

Starting in the early 2000s, an adjustment was implemented that included four tax reforms, two reforms to the transfers to subnational governments, and other measures that substantially reduced the nonfinancial public sector deficit from 4.9 percent of the GDP in 1999 to a balanced position in 2008. During this period, the central government deficit was reduced from 6 percent to 2.3 percent of GDP, while the remaining nonfinancial public sector recorded surplus balances. The central government primary structural deficit declined throughout the first decade of the century (figure 1).[4] As a result, the ratio of central government debt to GDP declined throughout the 2000s and has been stable in recent years (figure 2), while the negative gap between the actual government primary balance and the debt-stabilizing primary balance closed (figure 3).[5] Moreover, a reform to the general pension regime in 2003 made progress toward ensuring the sustainability of the pay-as-you-go system.

Since 2003, Colombia has been implementing its fiscal policy through a qualitative rule: Law 819 on transparency and fiscal responsibility. Under this mandate, the central government must prepare a medium-term fiscal framework every year as its main tool for financial programming. This fiscal framework sets a numerical target for the primary balance of the nonfinancial public sector for the following year, as well as some indicative targets for the subsequent ten years, so that public indebtedness remains in line with a sustainable path. Among other aspects, the framework includes an assessment of the contingent liabilities of the public sector, the cost of tax benefits, and some sections on the fiscal programming of subnational governments. Fiscal forecasts are made based on macroeconomic assumptions jointly formulated by the Ministry of Finance, the Central Bank, and the National Planning Department.

4. For details on the technique used for this estimation, see Lozano and Toro (2007).
5. See Julio, Lozano, and Melo (2013) for details on the construction of this series.

FIGURE 1. Primary Structural Balance of the Central Government

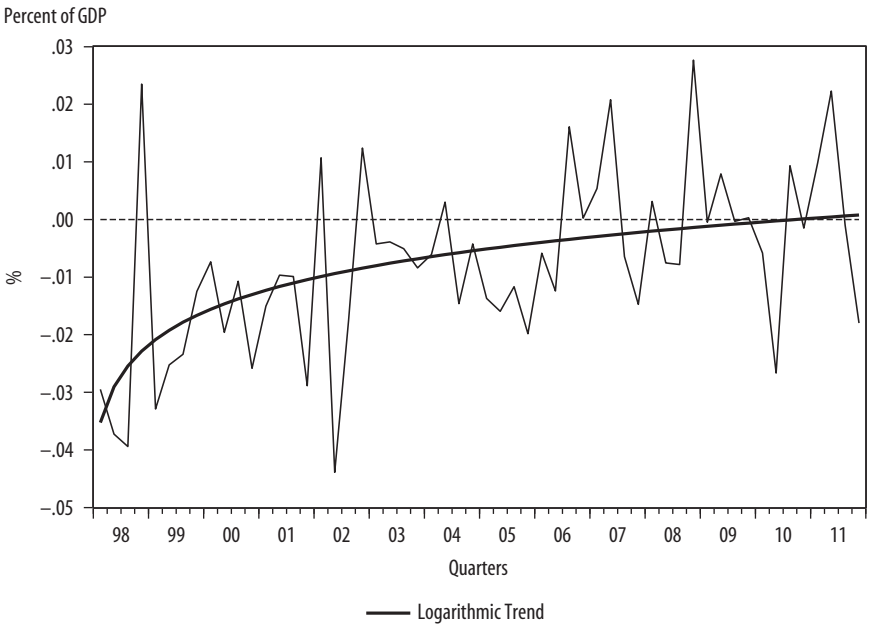


FIGURE 2. Ratio of Central Government Debt to GDP

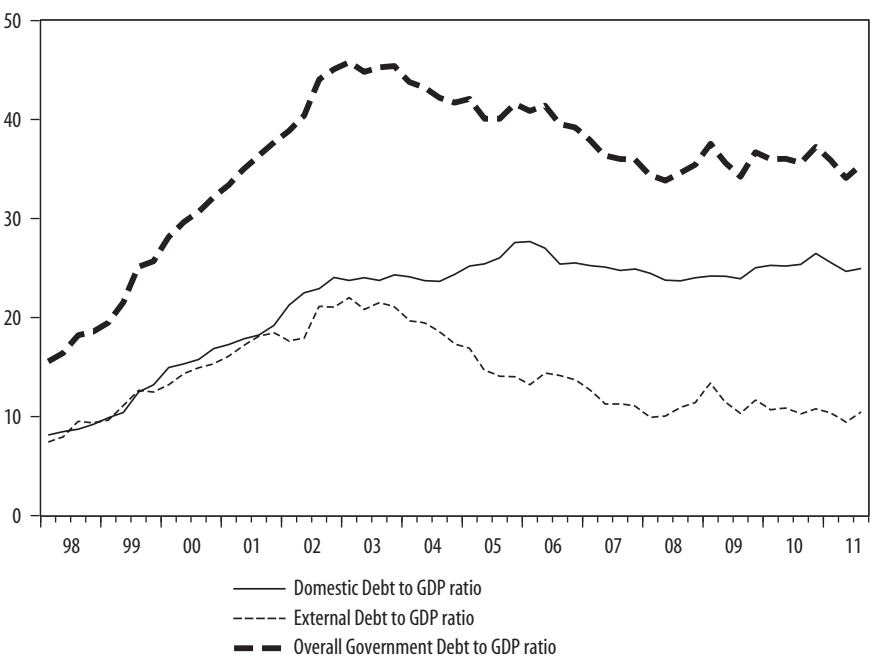
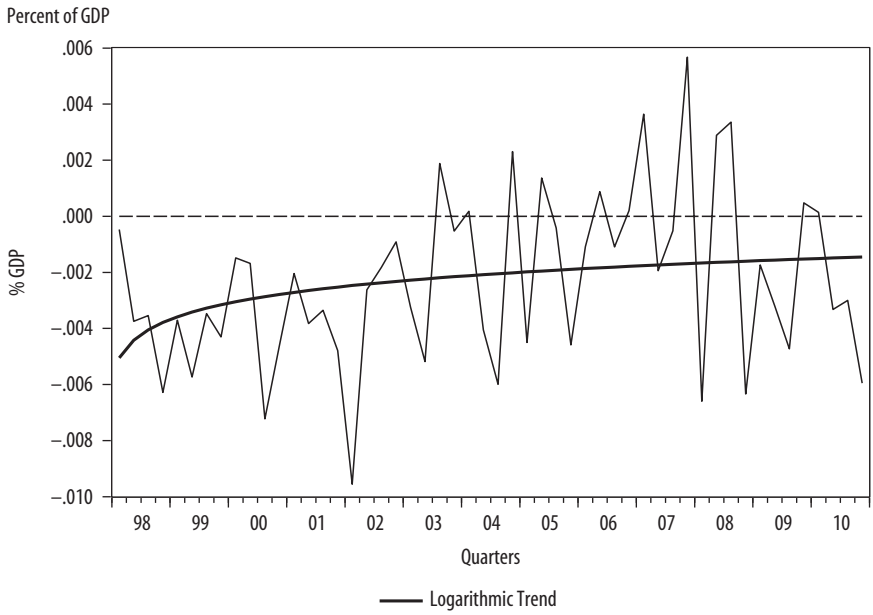


FIGURE 3. Difference between Actual and Debt-Stabilizing Primary Balances



Although the medium-term fiscal framework is a valuable tool for fiscal stance programming, it has some constraints from a macroeconomic perspective. First, the multi-annual primary balance targets are adjusted repeatedly for diverse reasons, thus lessening the government's initial commitments. Second, the framework does not explicitly assess the effects of the business cycle on tax revenues and expenditures, which increases the risk of procyclicality in fiscal policy. In fact, some studies find evidence of procyclicality in the fiscal policy in Colombia and other emerging economies.[6]

To overcome the limitations of the medium-term fiscal framework, the central government adopted a quantitative fiscal rule in mid-2011, as specified in Law 1473. In addition to ensuring the sustainability of the public debt and promoting a countercyclical fiscal policy stance, the rule is expected to alleviate the effects of exchange rate volatility on the economy's tradable activities, by fostering better management of the resources generated by the mining and energy sectors. Colombia's fiscal policy framework was further supplemented with a royalty law for the exploitation of natural resources, which was

6. Cárdenas, Mejía, and Olivera (2006); Lozano (2011); Ilzetzki and Végh (2008).

approved in 2011. This law aims at distributing royalty funds more equitably among the country's several regions and saving their transitory component.

Along with fiscal consolidation, the Colombian authorities have sought to improve the composition of the public debt in the last decade, in order to reduce the government's financial fragility and to encourage the development of capital markets in the country. To that end, steps were taken to decrease the currency mismatch of the public sector, by shifting the composition of its debt from foreign-currency-denominated bonds and loans (mostly external debt) toward local-currency-denominated bonds (mostly internally issued). Figure 2 disaggregates the public debt into its domestic and foreign components. As a result of these changes in the composition of public debt, the central government was able to achieve a substantial drop in its currency mismatch (figure 4).[7]

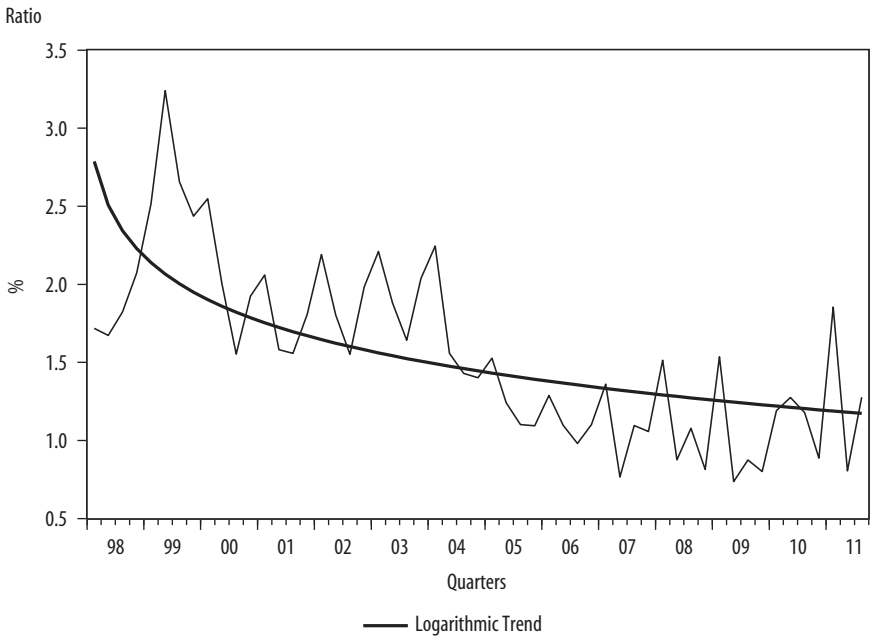
In turn, an effort has been made to change the composition of domestic debt from inflation- or dollar-indexed bonds toward fixed-rate peso-denominated bonds (figure 5). This process began in the late 1990s with the inception of a market-makers program, but was greatly enhanced by fiscal consolidation, the achievement of single-digit inflation, and a consistent convergence toward the long-term inflation target (3 percent) in the 2000s. In September 2011 the stock of local fixed-interest peso-denominated Treasury bonds (or TES bonds) accounted for 51.4 percent of total central government debt and represented 18.3 percent of GDP.

In addition to increasing the share of these instruments in total debt, government policy has successfully extended the maturity of the new issues throughout the last decade (figure 6), a sign of credibility in both fiscal and monetary policy.[8] The share of the outstanding stock of bonds with a residual maturity of less than one year has declined in the past ten years in favor of issues with a maturity greater than five years, while the share of issues with a residual maturity between three and five years has remained stable (figure 7). Today the longest maturity in the TES market is fifteen years. This attainment

7. This indicator, inspired by Goldstein and Turner (2004) and Rojas-Suárez and Montoro (2012), captures the central government's ability to serve its foreign-currency-linked debt on the basis of its foreign-currency-linked revenues. It is constructed as the following ratio for the central government: (FCD/TD) / (FCR/TR), where FCD is foreign currency debt; TD is total debt; FCR is foreign-currency-linked revenue, which includes external value added tax (VAT), import tariffs, Ecopetrol (the state oil company) dividends, income taxes paid by mining companies and other exporting firms, and income derived from external assets; and TR is total revenue. The data sources used are from the Central Bank of Colombia, the National Administrative Department of Statistics (DANE), the Colombia Tax and Customs Authority (DIAN), Ecopetrol, the Superintendency of Corporations, and Hamann, Lozano, and Mejía (2011).

8. Hamann and González (2011).

FIGURE 4. Currency Mismatch Indicator for Central Government



contributed to the development of a fixed-rate mortgage loan market in the 2000s.[9] It may also have influenced the transmission of monetary policy shocks to other financial system interest rates, as discussed below.

The Macroeconomic Effects of the Fiscal Policy Changes

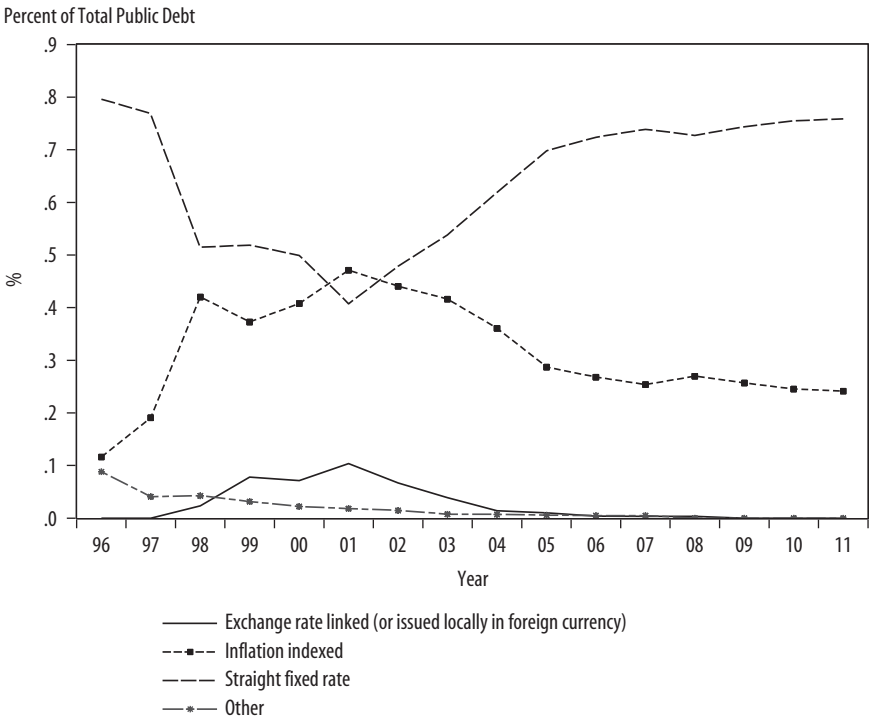
The improvements in fiscal policy and public debt management were large enough to have an impact on the behavior of the macroeconomy in response to exogenous shocks. This section explores the short-run reaction of the economy to government expenditure shocks and the effects of fiscal consolidation on the transmission of policy interest rate shifts to market interest rates.

The Short-Run Response of Output to Government Expenditure Shocks

How households, firms, and investors perceive the sustainability of the public debt and the financial fragility of the government is likely to influence their

9. Galindo and Hoffstetter (2008); Hamann, Vargas, and González (2010).

FIGURE 5. Composition of the Domestic Public Debt



reaction to fiscal policy shocks. An unexpected increase in public expenditure may prompt an expectation of higher taxes in the short run if the government is in a dire financial situation, thereby offsetting the possibly expansionary effect of the spending on output. Moreover, a similar shock in a small, open economy may sharply raise the sovereign risk premium, bringing about a tightening response by the monetary authority to curb currency depreciation and inflation or triggering a contraction of external finance and credit.[10] When the sustainability of public debt is more certain or government currency or liquidity mismatches are low, the expansionary effects of a public expenditure shock may be greater.

To explore this hypothesis, the empirical strategy must carefully consider the problems of identification of a fiscal shock (finding the movement of fiscal variables that are not contemporaneous responses to output) and the

10. Ilzetzki and Végh (2008).

FIGURE 6. Average Maturity of New Issues of TES Bonds

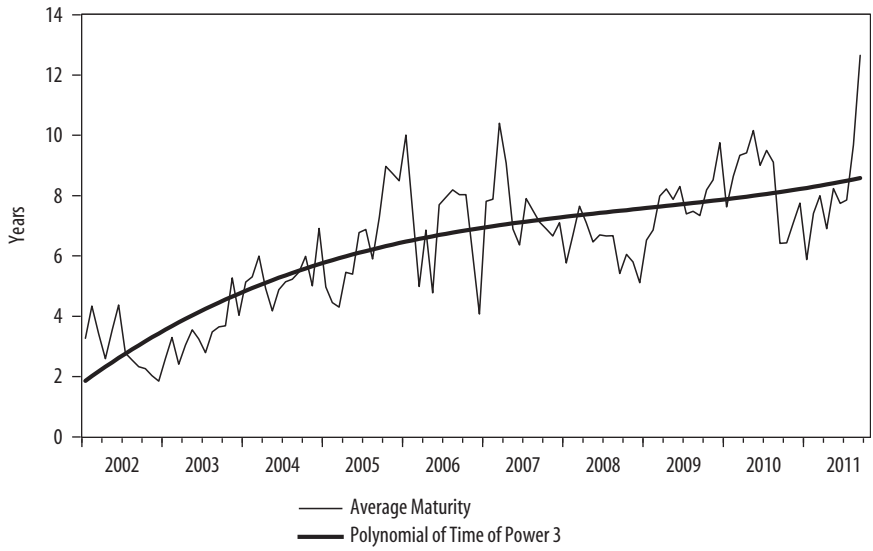
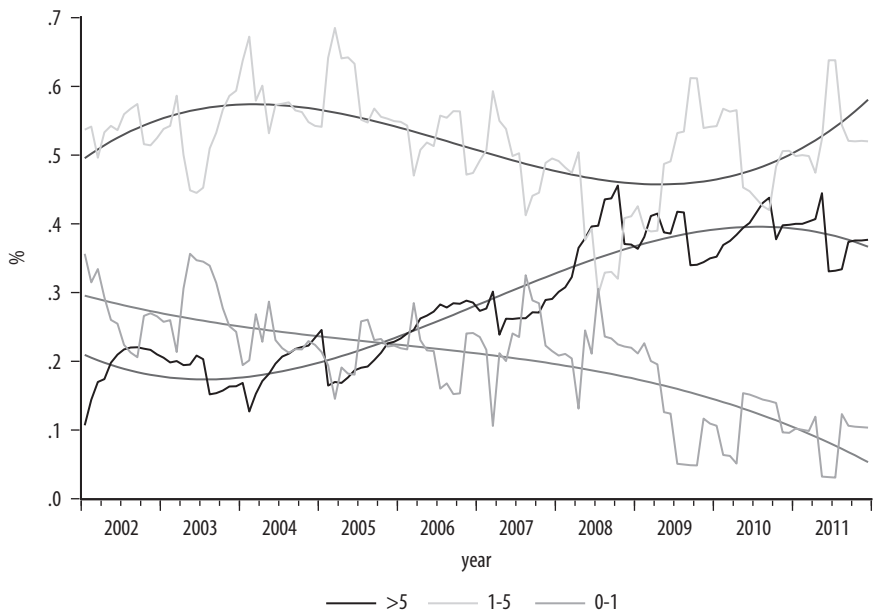


FIGURE 7. Maturity Composition of the Stock of Fixed-Rated TES Bonds



anticipation of fiscal policy by the private sector. The first issue is crucial to avoid a bias in the estimation of the response of output to an exogenous fiscal shock and requires isolating the part of the movement in the fiscal variables that corresponds to purely discretionary, non-output-related changes. The second issue is important because an anticipated fiscal policy shift may induce an anticipated response by private consumption or output, so that the estimated response after the realization of the shift could be biased.[11]

Structural vector autoregressive (SVAR) models are widely used in the literature to identify fiscal shocks.[12] Another technique, the so-called narrative approach, uses dummy variables to measure the effects of fiscal policy shocks that are not related to movements of output (such as wars, ideological policy shifts, and output-independent cross-sectional effects).[13] In Colombia, SVAR models for estimating the effect of fiscal policy shocks on output have rendered results that range from negligible impacts to positive expenditure multipliers between 1.1 and 1.2.[14] However, these studies include a relatively long subperiod in which the exchange rate was not as flexible as after 1999 (crawling peg or target-zone regimes). Consequently, their estimated impacts may be affected by a structural break related to the adoption of a floating exchange rate regime.[15]

Our approach differs from the previous work on three important dimensions. First, our sample covers only the floating exchange rate period (1999–2011). Second, we are interested in capturing a possibly changing effect of public expenditure shocks, as fiscal policy became sounder throughout the 2000s. This implies the use of a nonlinear technique that allows for a smooth transition between regimes that are defined according to indicators of fiscal health. Third, since we do not estimate an SVAR, we identify the government expenditure shock based on innovations in the publicly known spending announcements for the central government.[16]

11. Perotti (2007).

12. See, for example, Blanchard and Perotti (2002) for the U.S.; Perotti (2004) and Caldara and Kamps (2008) for the OECD countries.

13. See Perotti (2007); Romer (2011).

14. Restrepo and Rincón (2006); Lozano and Rodríguez (2011).

15. Standard Mundell-Fleming theory suggests that the exchange rate regime makes a difference for the effect of fiscal policy shocks in a small open economy. See Ilzetzki and Végh (2008) for evidence on the differences of output responses to fiscal shocks in economies with flexible and pegged exchange rates.

16. Ramey (2011). We do not study the effects of tax shocks due to the difficulties involved in their identification and the problems deriving from the sensitivity of the theoretical results to the time profile of distortionary tax responses (Perotti 2007).

Instead of estimating an SVAR and deriving standard impulse response functions, we approximate the nonlinear impulse response function by the following linear projection:[17]

$$Y_{t+h} = G(z_t)\left[\Psi_1^h F_t + \Lambda_1(L)Y_{t-1}\right] + \left[1 - G(z_t)\right]\left[\Psi_2^h F_t + \Lambda_2(L)Y_{t-1}\right] + \varepsilon$$

The impulse response function of output (Y_{t+h}) to an unexpected government expenditure shock (F_t) is estimated directly by $G(z_t)\,\Psi_1^h + [1 - G(z_t)]\,\Psi_2^h$, where Ψ_1^h and Ψ_2^h are estimated by least squares.[18] By construction, F_t is orthogonal to the elements in the information set, Ω_t, which ensures that Ψ_1^h and Ψ_2^h are unbiased estimates of the output response to the fiscal shock.

The impulse response function depends on the value of the variable z_t. In our case, z_t is a fiscal health indicator. At a given point in time, the impulse response function may be understood as a combination or average of the responses (Ψ_1^h and Ψ_2^h) corresponding to the extreme states of the fiscal health indicators. The weight of each extreme state will be given by the transition function $G(z_t) = e^{-\gamma z t}/(1 + e^{-\gamma z t})$, which measures how close the fiscal health indicator of the moment is to one extreme state or to the other.

The above technique requires the definition of an exogenous government spending shock, F_t, outside the model that meets the criteria of no anticipation and no contemporaneous correlation with output. To do so, we define the shock as the difference between the central government's actual primary expenditures (overall spending without interest payments on public debt) and the forecast made of this variable.[19] For the member countries of the Organization for Economic Cooperation and Development (OECD), these predictions are typically taken from professional forecasting surveys. This type of information is not available for Colombia, however, so we derived the forecasts from Financial Plans announced by the Ministry of Finance, as explained in the next section. The fiscal shocks thus computed are not anticipated by construction, nor are they correlated with current output because of the lag with which output and other real activity data are available and the lag with which expenditure decisions are executed.[20]

17. This follows Auerbach and Gorodnichenko (2012).

18. For details, see Jordà (2005).

19. Due to data availability, we use central government primary expenditure, which corresponds roughly to two-thirds of total general government primary expenditure.

20. A potential drawback of our measure of the expenditure shock is that we cannot separate public consumption, investment, transfers, and subsidies, since the government's Financial Plans do not disaggregate the outlays in these categories. We are thus capturing the effects of a shock to aggregate central government expenditure. This may be a problem if the macroeconomic effects of public consumption, investment, and transfer shocks are very different or if the composition of the aggregate shocks changes significantly from year to year.

FISCAL SHOCK IDENTIFICATION. As explained above, the fiscal shock must be unexpected by the private sector and contemporaneously uncorrelated with output. With this in mind, we chose a suitable forecast error as a proxy for the fiscal shock. We define a government expenditure shock as the following forecast error:

$$G_{t+1} - E\left[G_{t+1}\middle|\Omega_t\right],$$

where G_{t+1} is the actual government expenditure level at time $t + 1$ and $E[G_{t+1}|\Omega_t]$ is its expected value given the information available at time t, denoted by Ω_t.[21]

To construct the spending forecast of the central government, we followed these steps:

(a) The annual spending announcements (AGA) made by the government at the beginning of each year in its Financial Plans (FP) were considered as the annual spending forecast.

(b) The FP execution rate for each quarter in a year was obtained from the annual and quarterly historical data of actual expenditures.

(c) Based on (a) and (b), we predicted the government spending for each quarter of each year by multiplying a forecast FP execution rate by the annual spending announcements. We forecast the quarterly FP execution rate using a fourth-order moving average of the actual FP execution rate for each quarter. We chose a fourth order to capture the recent quarterly FP execution trend (see table 1 for an example).

(d) By the end of the second quarter, information on the actual expenditure in the first quarter is available. Thus, we add an adjustment to the forecast of the third and fourth quarters that results from the assumptions that the annual expenditure plan will be fulfilled and that the first quarter forecast error is uniformly distributed between the second, third, and fourth quarters. The assumption that the annual expenditure plan is fulfilled holds, on average, for the sample. The mean annual forecast error is COP −88.88 billon in real 2010 prices, which represents 0.15 percent of primary government expenditure.

(e) By the end of the third quarter, information on the actual expenditure in the second quarter is available. Thus, we add an adjustment to the forecast of the fourth quarter that results from the assumptions that the annual

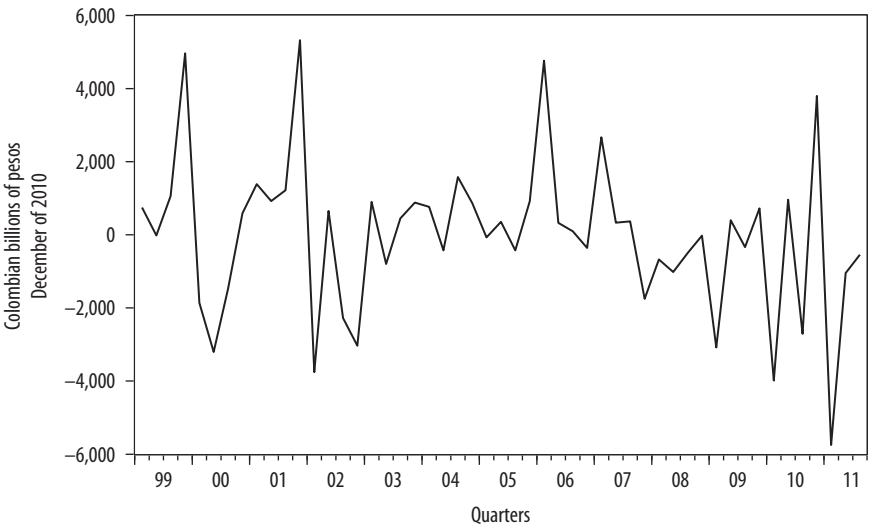
21. Ramey (2011) uses a similar approach.

TABLE 1. Expenditure Execution Rates

	Quarter				
Year	*I*	*II*	*III*	*IV*	*Total*
1 (historical data)	α_1	α_2	α_3	α_4	$\sum_{i=1}^{4}\alpha_1 = 1$
2 (historical data)	β_1	β_2	β_3	β_4	$\sum_{i=1}^{4}\beta_1 = 1$
3 (historical data)	γ_1	γ_2	γ_3	γ_4	$\sum_{i=1}^{4}\gamma_1 = 1$
4 (historical data)	μ_1	μ_2	μ_3	μ_4	$\sum_{i=1}^{4}\mu_1 = 1$
5 (forecast)	$\delta_1 = \frac{\alpha_1 + \beta_1 + \gamma_1 + \mu_1}{4}$	$\delta_2 = \frac{\alpha_2 + \beta_2 + \gamma_2 + \mu_2}{4}$	$\delta_3 = \frac{\alpha_3 + \beta_3 + \gamma_3 + \mu_3}{4}$	$\delta_4 = \frac{\alpha_4 + \beta_4 + \gamma_4 + \mu_4}{4}$	$\sum_{i=1}^{4}\delta_1 = 1$

a. Years 1–4 are based on historical data (before 1999).

FIGURE 8. Fiscal Shock



expenditure plan will be fulfilled and that the second quarter forecast error is uniformly distributed between the third and fourth quarters.

(f) The series of forecast errors (calculated with respect to the adjusted forecasts in the case of the third and fourth quarters) is the expenditure shock for each quarter. Figure 8 graphs the fiscal shock (measured in 2010 COP billions), and table 2 illustrates its construction. Figure 9 shows that there is no significant correlation between the fiscal shock and the cyclical component of output, which is expected because there are no automatic stabilizers related to government expenditure in Colombia.

OUTPUT EFFECTS OF FISCAL SHOCKS. As fiscal health variables, z_t, we used the difference between the observed government primary surplus and the value of the primary surplus that would stabilize the debt-to-GDP ratio at each point in time (figure 3) and the government currency mismatch (figure 4). The first indicator measures the solvency of the fiscal sector and captures the trend of the debt-to-GDP ratio. It is not significantly affected by the business cycle because of the small size of the automatic stabilizers in Colombia.[22] The

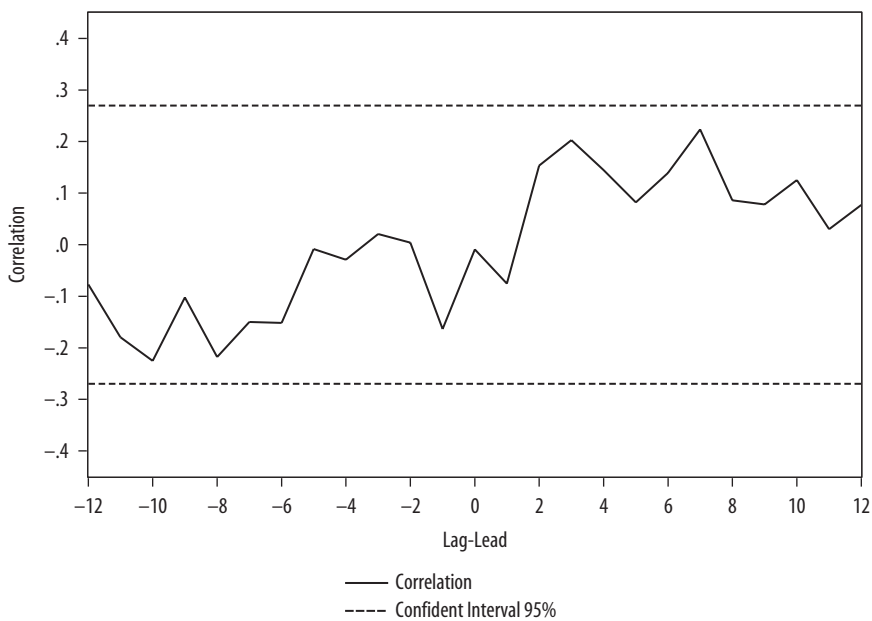
22. Lozano and Toro (2007). We also used the structural primary balance as an indicator of fiscal health and obtained similar results. We think the ratio of public debt to GDP is not informative enough for the purpose of the empirical exercise because a given level of this ratio may correspond to a situation of increasing deficit or increasing surplus. Nevertheless, we also used this ratio in our exercise as a fiscal health indicator, obtaining similar results (available on request).

TABLE 2. Forecast of Primary Expenditures[a]

Quarter (at the beginning of the year)	*Forecast*			
	I	*II*	*III*	*IV*
I	$\boldsymbol{\delta_1 \cdot AGA}$	$\delta_2 \cdot AGA$	$\delta_3 \cdot AGA$	$\delta_4 \cdot AGA$
II	$\delta_1 \cdot AGA$	$\boldsymbol{\delta_2 \cdot AGA}$	$\delta_3 \cdot AGA$	$\delta_4 \cdot AGA$
III	$G_1(obs)$	$\left(\delta_2 \cdot AGA\right) - \left(\frac{FE_1}{3}\right)$	$\left(\boldsymbol{\delta_3 \cdot AGA}\right) - \left(\frac{\boldsymbol{FE_1}}{\mathbf{3}}\right)$	$\left(\delta_4 \cdot AGA\right) - \left(\frac{FE_1}{3}\right)$
IV	$G_1(obs)$	$G_2(obs)$	$\left(\delta_3 \cdot AGA\right) - \left(\frac{FE_1}{3}\right) - \left(\frac{FE_2}{2}\right)$	$\left(\boldsymbol{\delta_4 \cdot AGA}\right) - \left(\frac{\boldsymbol{FE_1}}{\mathbf{3}}\right) - \left(\frac{\boldsymbol{FE_2}}{\mathbf{2}}\right)$

δ_i = Execution rate forecasted for quarter *i*.
AGA = Annual Expenditure Announcement.
$G_i(obs)$ = Observed Expenditure in quarter *i*.
FE_1 = Forecasted error in quarter I, $FE_1 = G_1(obs) - (\delta_1 \cdot AGA)$
FE_2 = Forecasted error in quarter II, $FE_2 = G_2(obs) - (\delta_2 \cdot AGA) - (FE_3/3)$

FIGURE 9. Correlation between the Fiscal Shock and the Cyclical Component of Output



second indicator measures the vulnerability of public finances to shocks that produce large depreciations of the currency. The impulse response functions of output to a government expenditure shock are estimated using quarterly data for the 1999–2011 sample.

The results suggest that there were important changes in the response of output to the fiscal shock over the course of the decade, as fiscal health indicators improved markedly (see figures A1 and A2 in the appendix).[23] The responses at the beginning of the decade were, when positive, small and short-lived. When the primary surplus deviation from its debt-stabilizing level increased (2003–04), output responses turned positive and remained significantly different from zero for several periods. The positive reactions seem to be clearer and larger when the primary surplus is higher (2007–08) (figure A1). Similarly, the output responses related to low government currency mismatches (2005–11) were in general significantly positive for several quarters, unlike the responses observed in years of high currency mismatches (1999–2004) (figure A2).[24] The estimated conditional government expenditure multipliers increased with the fiscal health indicators, starting with insignificant values that turned positive as the fiscal position improved, in some cases reaching levels around one.[25]

Hence, the power of fiscal (expenditure) policy to affect output is greater when the financial position of the government is stronger. The implication of this result for assessing the convenience of countercyclical fiscal policy is apparent: a sound public finance situation seems to enhance the effectiveness of countercyclical fiscal policy.

23. The technique used allows us to estimate the impulse response functions with confidence intervals for each quarter in the sample. The results presented in figures A1 and A2 correspond to the average responses for each year with the confidence interval calculated appropriately. We used four lags of the GDP in the estimation.

24. The impulse response functions presented in figures A1 and A2 are conditional on the state of the fiscal variable used to define the regime. For example, in 2004 the responses of output to the fiscal shock were generally positive when the fiscal variable is measured as the difference between the primary surplus and its debt-stabilizing level, but essentially zero when the fiscal variable is measured as the government currency mismatch. This means that the response of output conditional on the surplus variable of that year was significantly positive, but the response conditional on the currency mismatch in the same year was insignificant. Overall, it may be concluded that the probability of a positive impact of a fiscal shock on output increased in 2004 with respect to previous years in which all conditional responses were insignificant, but it is smaller than in later years, when all conditional responses were statistically positive.

25. Following the methodology of Auerbach and Gorodnichenko (2012) and Jordà (2005), the accumulated multiplier values of the expenditure shocks correspond directly to the impulse response results (vertical axis of figures A1 and A2).

The Transmission of Monetary Policy Shocks to Market Interest Rates

As the fiscal situation improved structurally and monetary policy gained credibility throughout the 2000s, the transmission of monetary policy to financial market interest rates may have been strengthened.[26] Under a more credible monetary policy regime, a movement in overnight policy rates is more likely to be incorporated in longer-term public bonds and financial system interest rates because the policy change will most probably be perceived by market participants as a persistent signal on the policy stance, instead of a noisy policy error to be undone in the near future.

Furthermore, the enhanced credibility of a low and stable inflation rate, together with a stronger public perception that the public debt was sustainable, allowed the government to lengthen the maturity of fixed-rate public bonds. Consequently, the depth and liquidity of longer-term public bond markets may have been increased, thereby making their prices a better guide to interest rate setters in the financial system and allowing them to better filter the news from a monetary policy shock.

To explore the relevance of these hypotheses, we use the same nonlinear model of the previous section to test whether the transmission of monetary policy shocks to public bond (TES) interest rates and deposit or loan rates changed as the maturity of the government fixed-income market was lengthened throughout the 2000s. As shown in figure 6, the average maturity of new TES issues went from approximately two years in 2002 to seven years in 2005, while between 2005 and 2011 it increased by two years only.

Specifically, we estimate the following monthly models for TES rates and market interest rates:

$$ites_{t+h} = H\left(z_t\right)\left[\Pi_1^h M_t + \Gamma_1\left(L\right) ites_{t-1}\right] + \left[1 - H\left(z_t\right)\right]\left[\Pi_2^h M_t + \Gamma_2\left(L\right) ites_{t-1}\right] + \varepsilon_t;$$

$$im_{t+h} = J\left(z_t\right)\left[\Phi_1^h M_t + B_1\left(L\right) im_{t-1}\right] + \left[1 - J\left(z_t\right)\right]\left[\Phi_2^h M_t + B_2\left(L\right) im_{t-1}\right] + \varepsilon_t.$$

The response of TES rates, $ites_{t+h}$, to an unanticipated monetary shock, M_t, is approximated directly by $H(z_t)\ \Pi_1^h + [1 - H(z_t)]\ \Pi_2{}^h$ in a linear projection estimated by least squares.[27] This response is allowed to change as a function of the maturity of the new issues of fixed-rate TES bonds (as z_t = long-term

26. Hamann and González (2011).
27. Jordà (2005).

component of the average maturity of new issues) (figure 6). A similar model is estimated for the response of market (deposit or loan) interest rates, im_{t+h}, to an unanticipated monetary shock, M_t.

The definition of a monetary shock is crucial to minimize the bias of the estimated impulse response functions. If a change in the policy interest rate is anticipated by market participants, then it would be incorporated in longer-term TES or financial system interest rates before it happens. When the change occurs, the reaction of longer interest rates will be null, leading to an estimated negligible transmission of monetary policy. Therefore, the estimated monetary policy shock must be unanticipated and thus orthogonal to all information that might be relevant to predict the policy rate at each point in time.

ESTIMATION OF THE MONETARY POLICY SHOCK. In line with the VAR literature, the monetary policy shock is identified as an unexpected movement of the policy rate. That is, we suppose that there is a policy rule that relates the state of the economy to the actions of the monetary authorities, so a monetary policy shock is a movement in the policy rate that is not explained by the rule. For example, under the assumption that the central bank follows a standard Taylor rule, a movement in the policy rate that is not explained by the observed behavior of inflation and output will be a monetary shock. However, if the central bank follows an expectations-based rule—that is, a rule in which the expected value of inflation and output are important—then an estimated Taylor rule should include not only current inflation and output, but also any other variables that can be useful indicators of their future behavior.

Under the VAR recursive identification, a monetary policy shock, defined as an unexpected movement of the policy rate, is also orthogonal to the information set of the central bank. In other words, it is assumed that a variable that is observed by the central bank cannot react contemporaneously to the policy shock. Therefore, a forecast error can serve as a proxy of a policy shock. In fact, we defined the policy shock through the forecast error:

$$i_{t+1} - E\left[i_{t+1} \middle| \Omega_t \right],$$

where i_{t+1} is the actual policy rate at time $t + 1$ and $E[i_{t+1}|\Omega_t]$ is its expected value given the information set at time t, denoted by Ω_t.

To make this definition of the policy shock operational, one needs to be particularly carefully about the definition of the information set, Ω_t, and the way $E[i_{t+1}|\Omega_t]$ is estimated. Empirically, the main concern with Ω_t is to avoid the inclusion of variables that are not observed at time t. In our exercise, the information set contains information on inflation, output, credit, the exchange

rate, and so forth. However, some of these variables are observed with a lag, so their current values cannot be included in Ω_t.

We approximate $E[i_{t+1}|\Omega_t]$ with linear projections. That is,

$$E\left[i_{t+1} \middle| \Omega_t \right] = \alpha_0 + \alpha_1 x_t,$$

where x_t is an element of Ω_t and α_0 and α_1 are estimated by OLS. We select the components of x_t by minimizing the Akaike information criterion (AIC).

Finally, to construct a sequence of monetary policy shocks, we carried out a rolling exercise in which we forecast i_{t+1} at time t and compare it with the actual value of i_{t+1}. At each t, the information set is updated, and the elements of x_t are selected by minimizing the AIC. The initial sample of the experiment is January 2002 to December 2011.

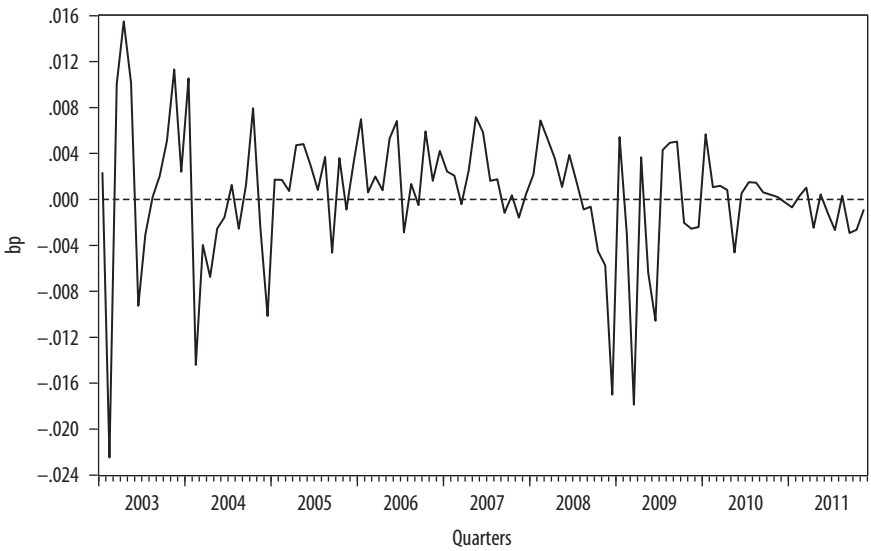
The policy shocks are constructed using monthly data on the interbank rate, the Colombian inflation target, the growth rate of the industrial production index, the growth rate of credit, the index of capacity utilization, the nominal average unit labor cost, the nominal depreciation of the Colombian peso, the Index of Consumer Confidence (ICC), and the U.S. inflation rate.[28] The shocks are shown in figure 10.

MONETARY POLICY TRANSMISSION RESULTS. The results for the transmission of policy rates to TES interest rates are shown in figures A3 to A6 (in the appendix).[29] There seem to be two clearly different regimes: one between 2003 and 2004; the other between 2005 and 2011. This change corresponds to the sharp increase of our state variable, z_t (the average maturity of new TES issues), in the first period and its stabilization thereafter (figure 6). According to figures A3 to A6, the responses of TES rates to the monetary shock were either insignificant or negative in 2003 and 2004 across maturities. In the second period, responses became positive, significant, and increasing throughout the decade in accordance with the evolution of our proxy for public bond market depth (the long-term component of the average maturity of new issues, z_t). For instance, in 2005 the maximum response of a TES

28. All growth rates are annual, and the index of capacity utilization and the nominal average unitary labor cost are included in annual changes. Data are seasonally adjusted using TRAMO-SEATS in Eviews. Most of these variables are available with a lag of one month, although the industrial production index, the unitary labor cost, and the ICC are observed with a lag of two months.

29. The technique used allows us to estimate the impulse response functions with confidence intervals for each month in the sample. The results presented in figures A3 to A6 correspond to the average responses for each year with the confidence interval calculated as before. We used one lag of TES rates in the estimation.

FIGURE 10. Monetary Policy Shock



bond with a maturity of less than one year occurs ten months after the shock, reaching around 1.2 times the value of the shock.[30] In 2011 the maximum response also occurs ten months after the shock, but is around three times the value of the shock. A similar pattern is observed for other maturities. Also in the second period, the zero coupon curve generally flattened after the shock, as can be seen by comparing the impacts across time and maturity.

With respect to the transmission of monetary policy shocks to market interest rates, there is also evidence of a structural change linked to the average maturity of new TES issues. The main findings in this regard may be summarized as follows:

—For all loan and deposit rates considered there are two regimes: One in which a positive monetary shock produces insignificant or, in a few cases, negative responses of market rates (2003–04); and one in which market rates generally have positive, significant responses to the monetary shock (2005–11) (figures A7–A20 in the appendix). As in the case of TES rates, responses are increasing following the public debt market deepening and greater than one-on-one twelve months after the shock.

30. Given the units of the TES rates and the monetary shock, an impulse response value of 100 corresponds to a one-on-one transmission of the monetary shock.

—The response of commercial loan rates after 2005 is monotonically increasing and greater than those of TES rates at similar maturities, suggesting that corporate credit risk premiums may rise after a positive monetary shock.

The extension of the maturity of new TES issues (figure 6) and the TES stock may have enhanced the role of the public debt market in the determination of financial system interest rates, by providing liquid, reliable risk-free benchmarks at more maturities than before. In turn, this may have reinforced the transmission of monetary shocks to lending and deposit rates. In the absence of reliable risk-free benchmarks, interest rate setters had to produce an individual forecast of the future path of short-term policy rates to determine longer-term deposit or loan interest rates. They could compare their forecasts with other agents' projections only with lags and noise, through the examination of competitors' interest rates. Under these circumstances, future policy forecasts may be rather inaccurate, and a policy shock may be more frequently associated with a forecast error than with a signal of a changing policy stance. Transmission could be low as a result.

In the presence of a liquid TES market, interest rate setters have an immediate, common source of information regarding others' views on future monetary policy. Their forecasts of future policy rates may therefore have become more precise, and a monetary policy shock could be more frequently interpreted as a signal of a changing policy stance than as simple forecast error noise. Given that monetary policy shifts have some persistence (they are rarely undone in the short term), the surprise involved in the shock is informative of a change in the future path of central bank interest rates, which is likely to be higher or lower than previously expected. Consequently, transmission could be greater.

Conclusion

In the past decade the Colombian authorities undertook a series of measures that reduced the structural fiscal deficit, corrected a possibly unsustainable public debt path, decreased the government currency mismatch, and deepened the local fixed-rate public bond market. The evidence shown in this paper suggests that these improvements had profound effects on the behavior of the macroeconomy. More specifically, they increased the reaction of output to (unexpected) government expenditure shocks (with multipliers around one) and may have strengthened the response of market interest rates to (unanticipated) monetary policy interest rate shocks. As a corollary, increased soundness of fiscal policy brings strong countercyclical benefits to both monetary and fiscal decisions.

Appendix: Impulse Response Functions

FIGURE A1. Fiscal Policy Shock: Output Responses Conditional on the Difference between Actual Primary Balance and Its Debt-Stabilizing Level

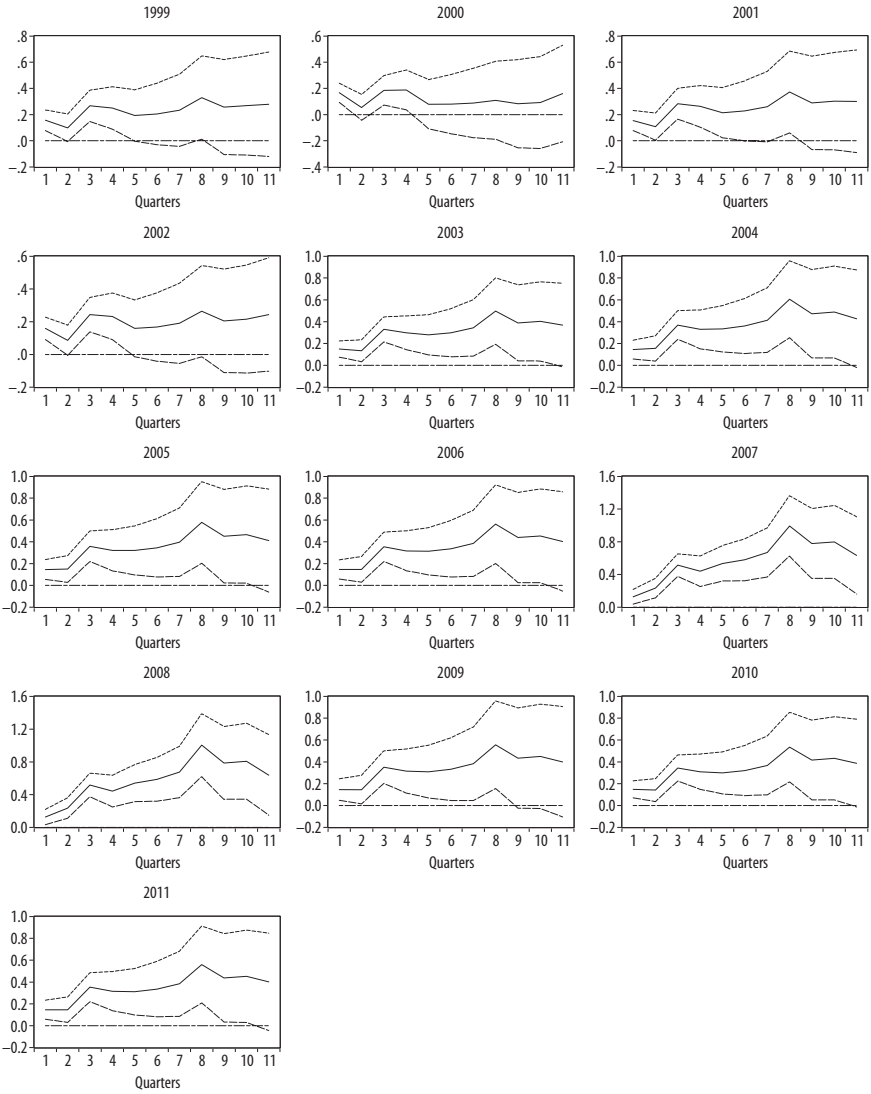


FIGURE A2. Fiscal Policy Shock: Output Responses Conditional on the Currency Mismatch Indicator

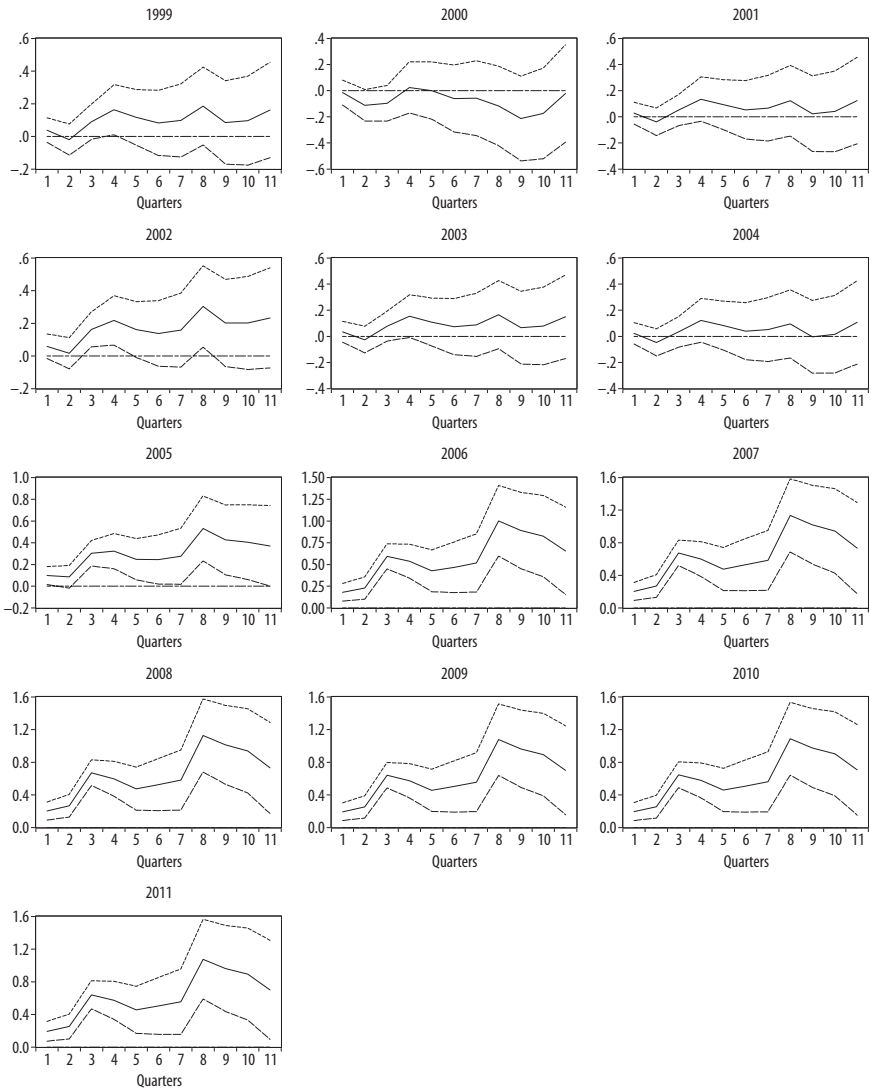


FIGURE A3. Monetary Policy Shock: Response of TES Bonds with Maturity Less than One Year, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

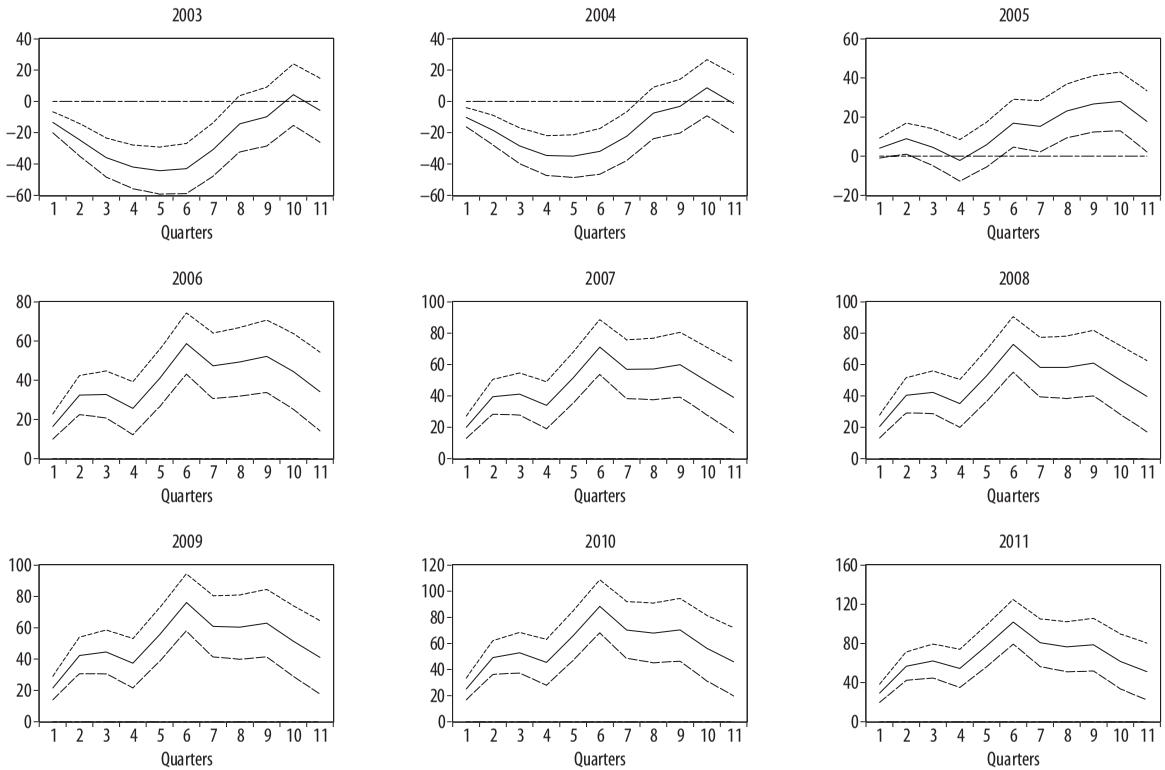


FIGURE A4. Monetary Policy Shock: Response of TES Bonds with Maturity between One and Three Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

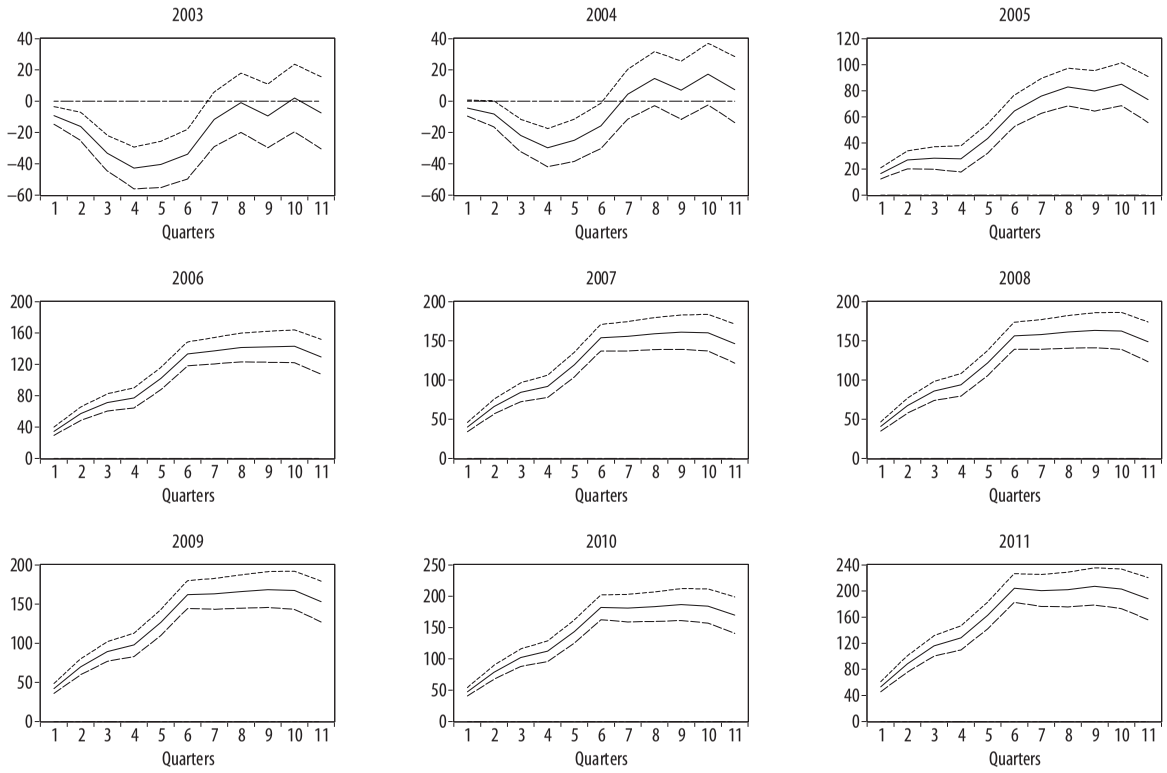


FIGURE A5. Monetary Policy Shock: Response of TES Bonds with Maturity between Three and Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

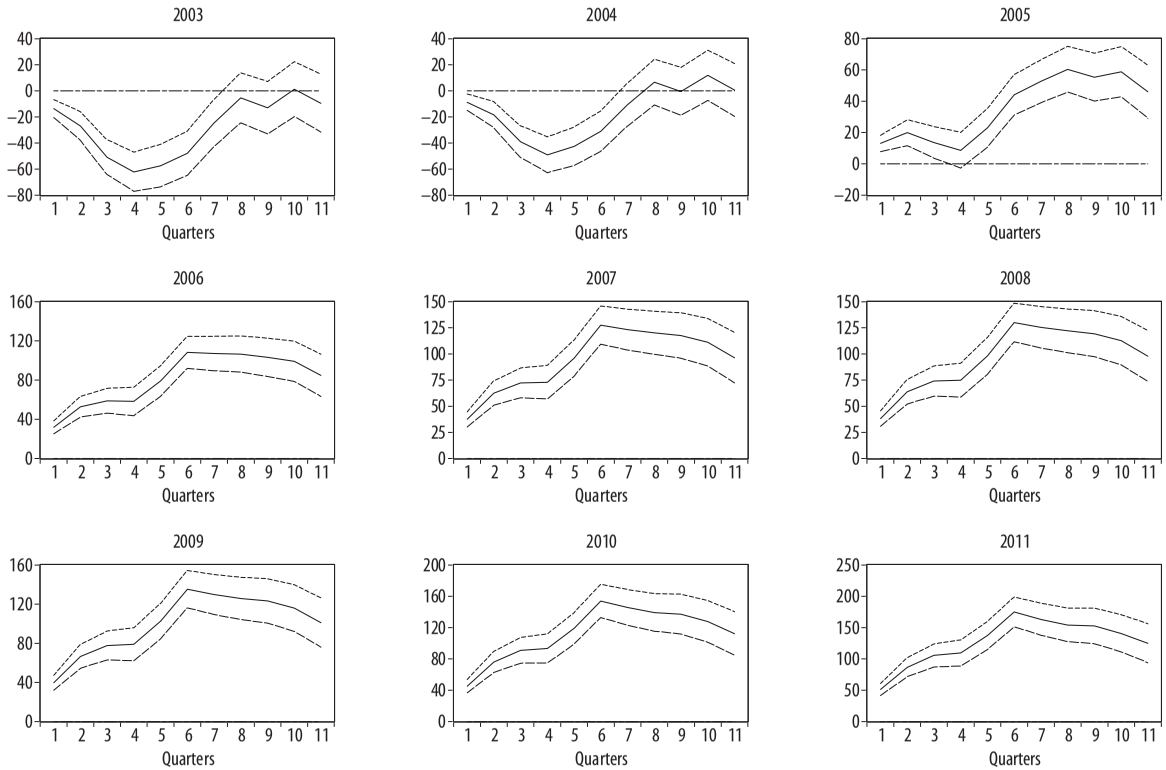


FIGURE A6. Monetary Policy Shock: Response of TES Bonds with Maturity Greater than Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

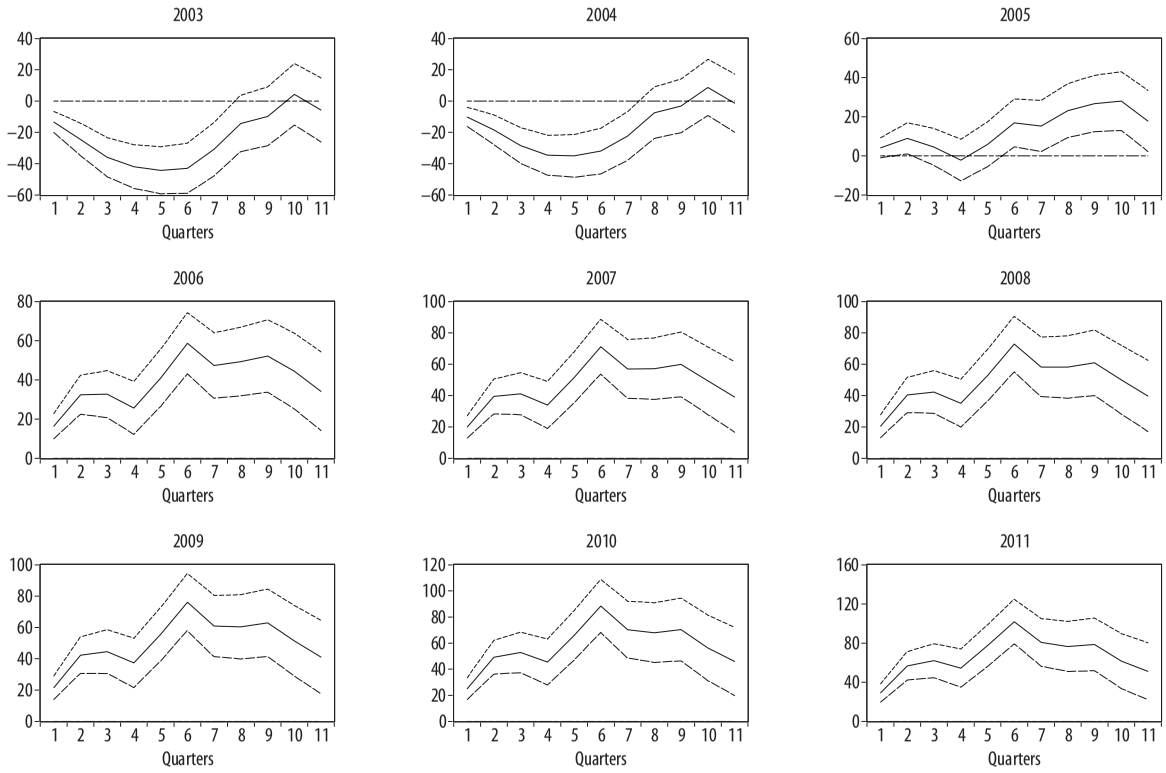
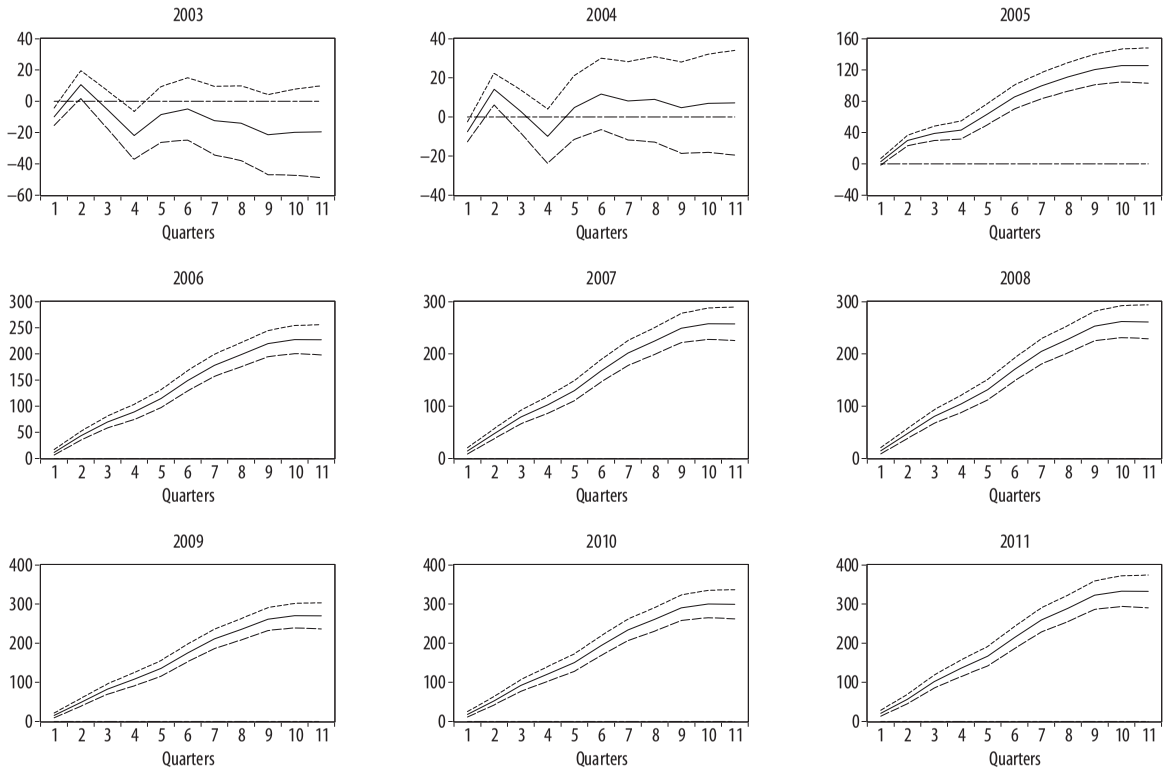


FIGURE A7. Monetary Policy Shock: Response of Commercial Loan Rate with Maturity Less than One Year, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds



F I G U R E A 8 . Monetary Policy Shock: Response of Commercial Loan Rate with Maturity between One to Three Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

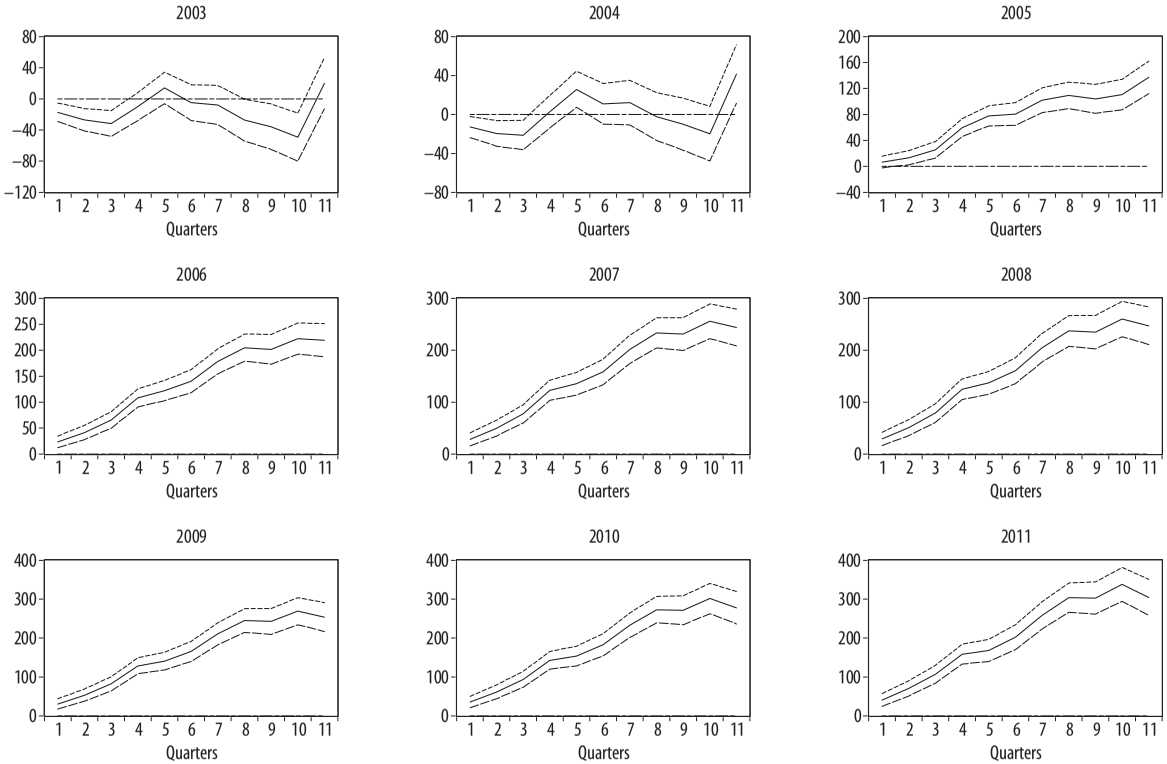


FIGURE A9. Monetary Policy Shock: Response of Commercial Loan Rate with Maturity between Three to Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

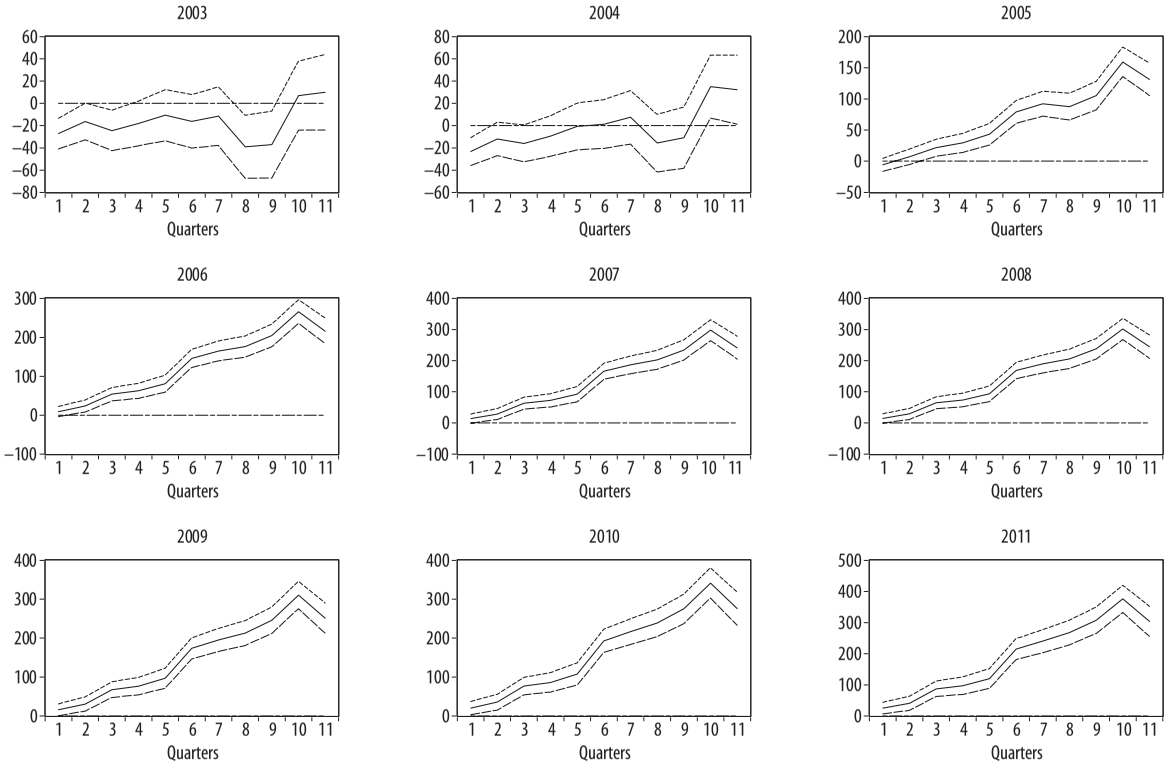


FIGURE A10. Monetary Policy Shock: Response of Commercial Loan Rate with Maturity Greater than Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

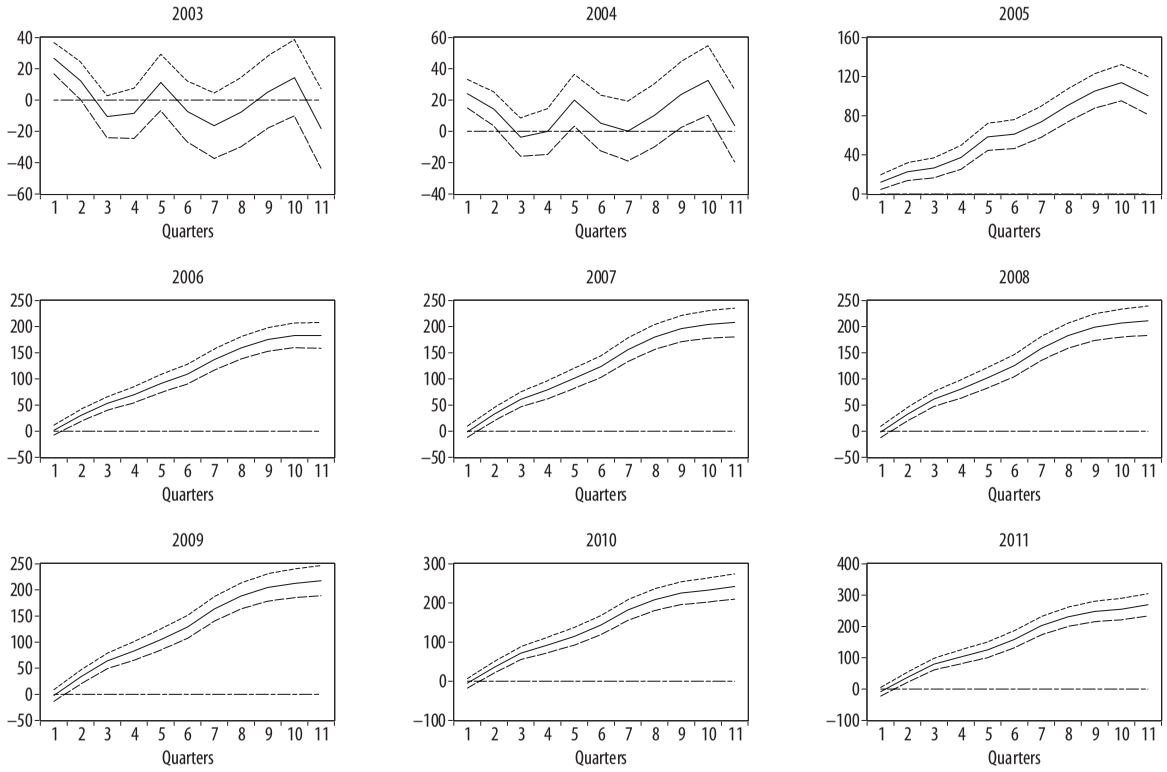


FIGURE A11. Monetary Policy Shock: Response of the Consumer Loan Rate with Maturity Less than One Year, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

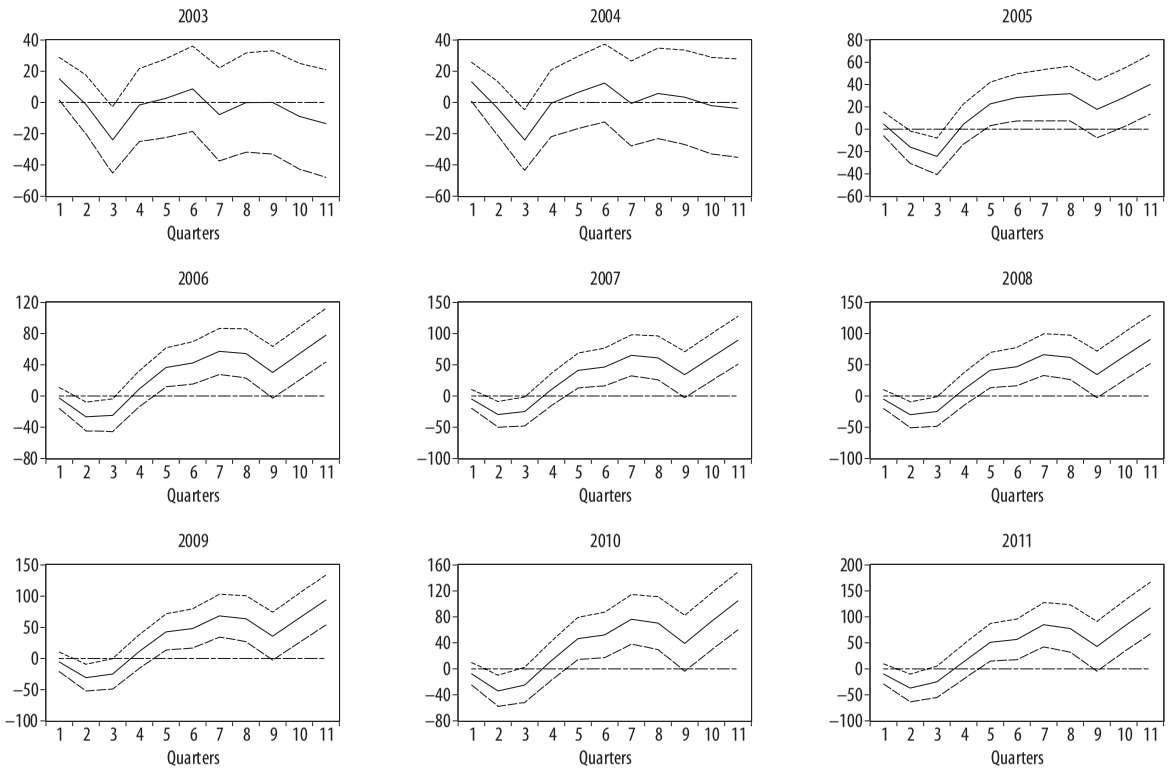


FIGURE A12. Monetary Policy Shock: Response of the Consumer Loan Rate with Maturity between One and Three Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

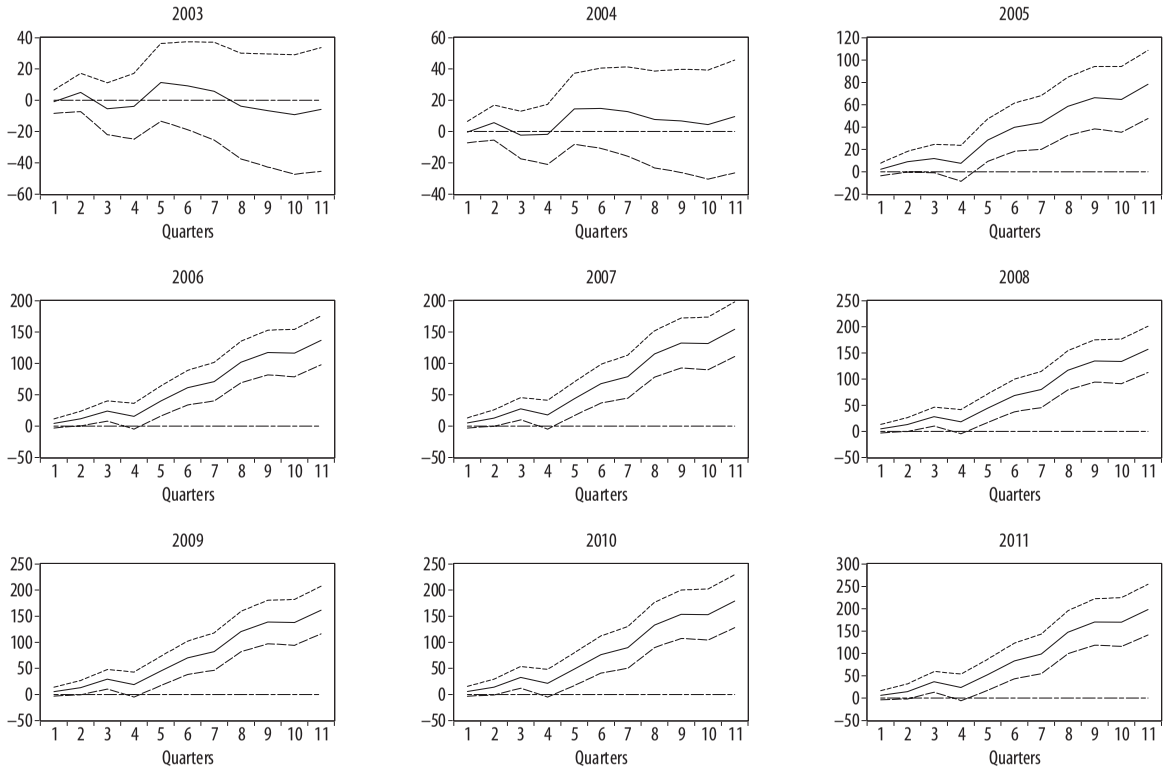


FIGURE A13. Monetary Policy Shock: Response of the Consumer Loan Rate with Maturity between Three and Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

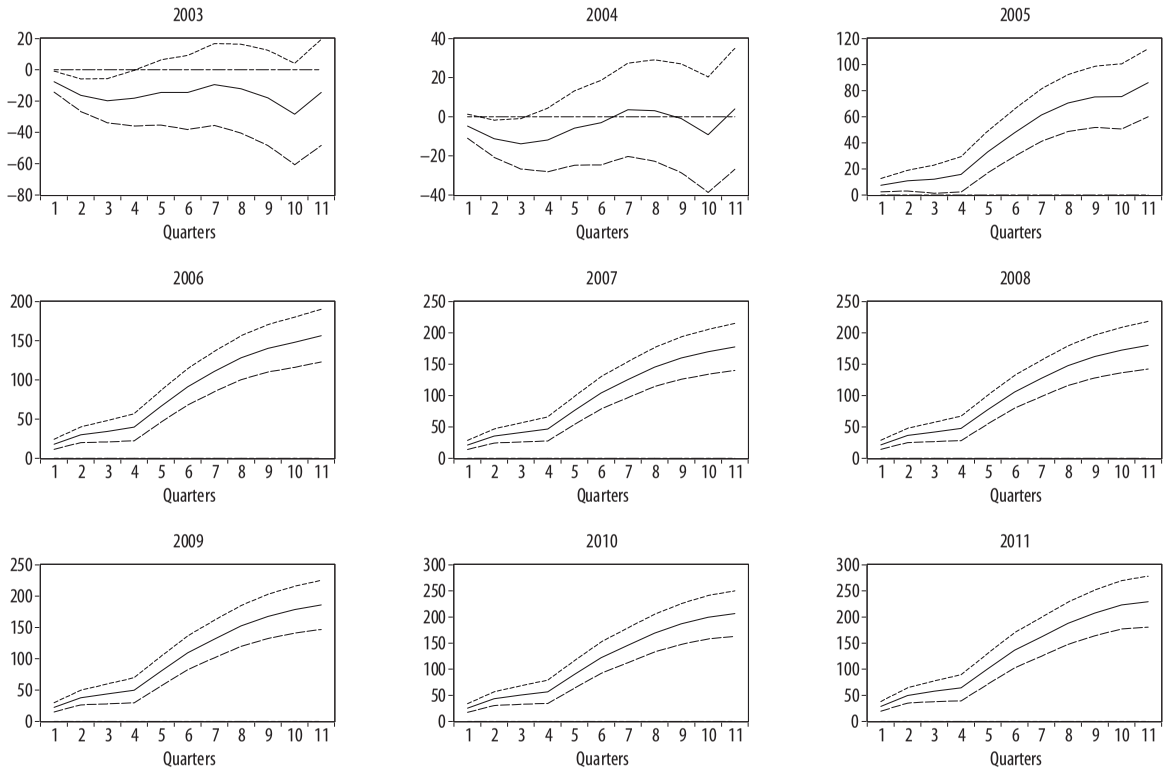


FIGURE A14. Monetary Policy Shock: Response of the Consumer Loan Rate with Maturity Greater than Five Years, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

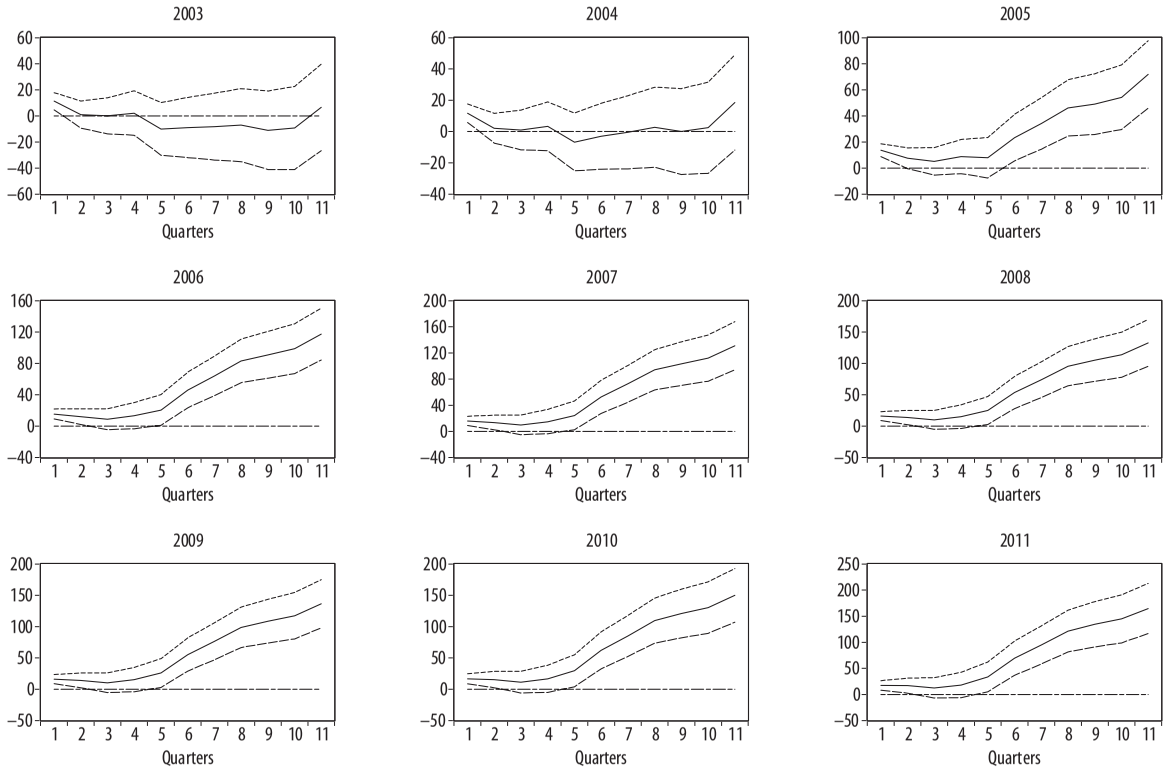


FIGURE A15. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity Less than 90 Days Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

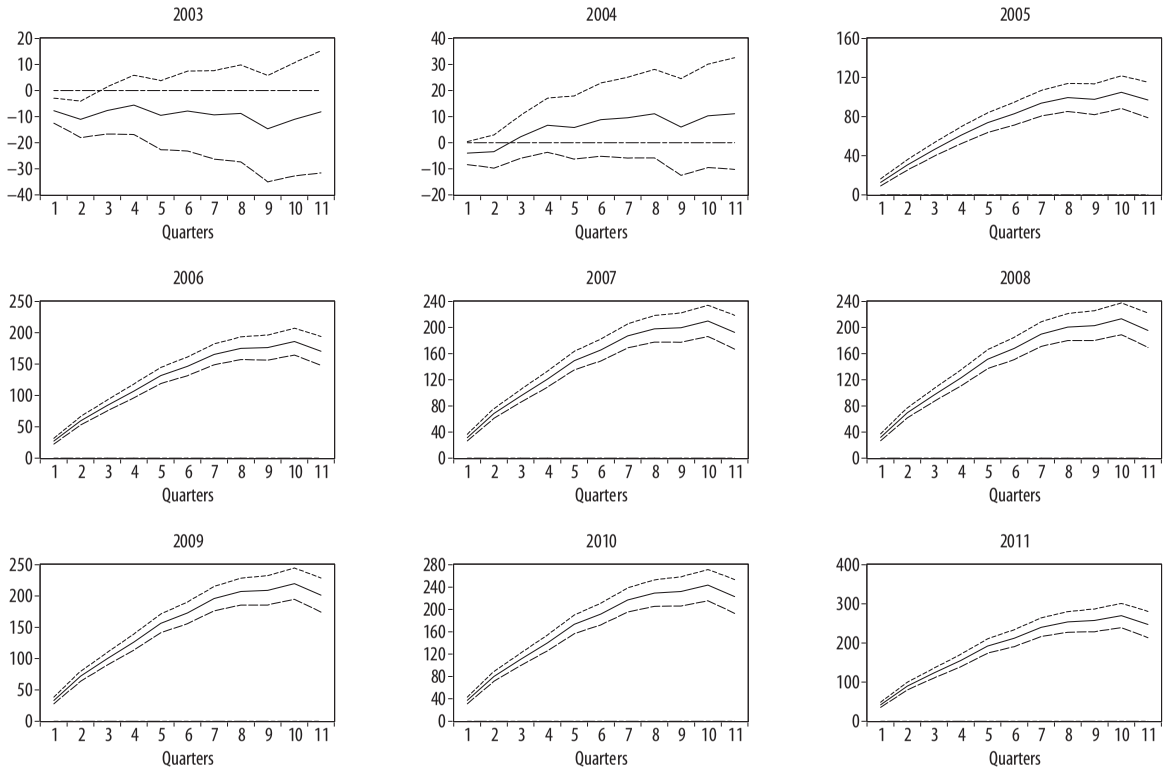


FIGURE A16. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity of 90 Days, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

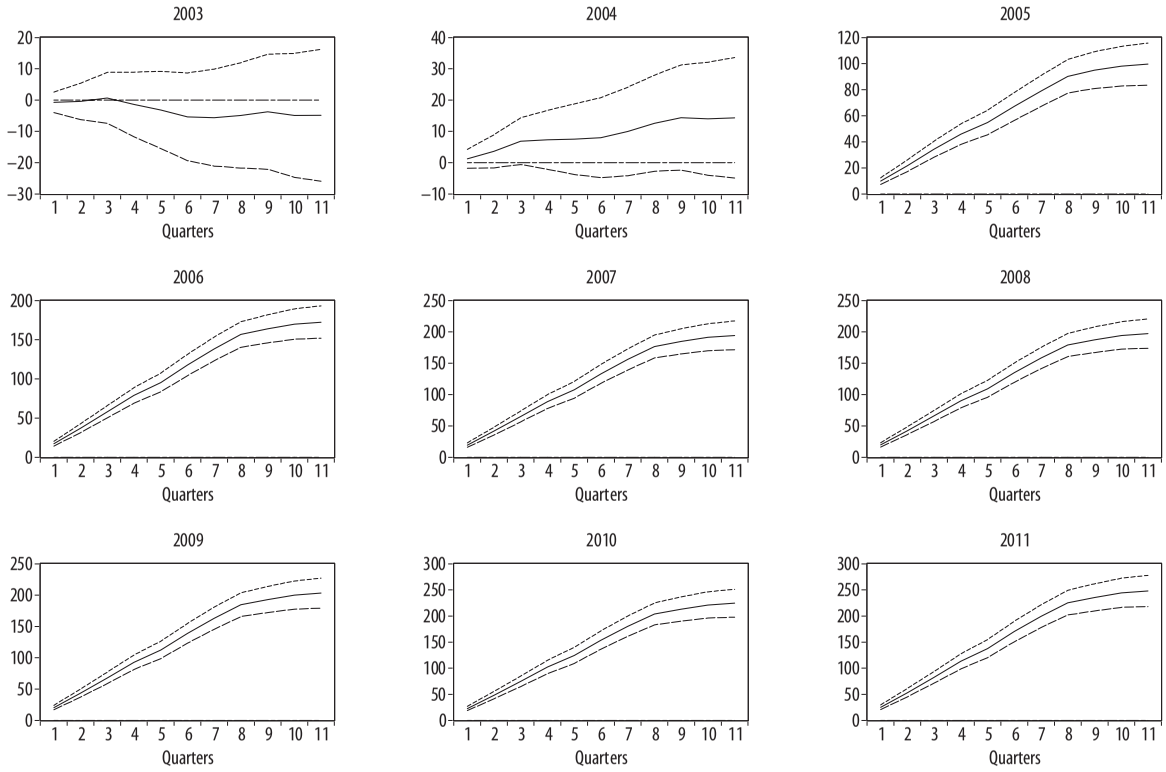


FIGURE A17. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity between 91 and 170 Days, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

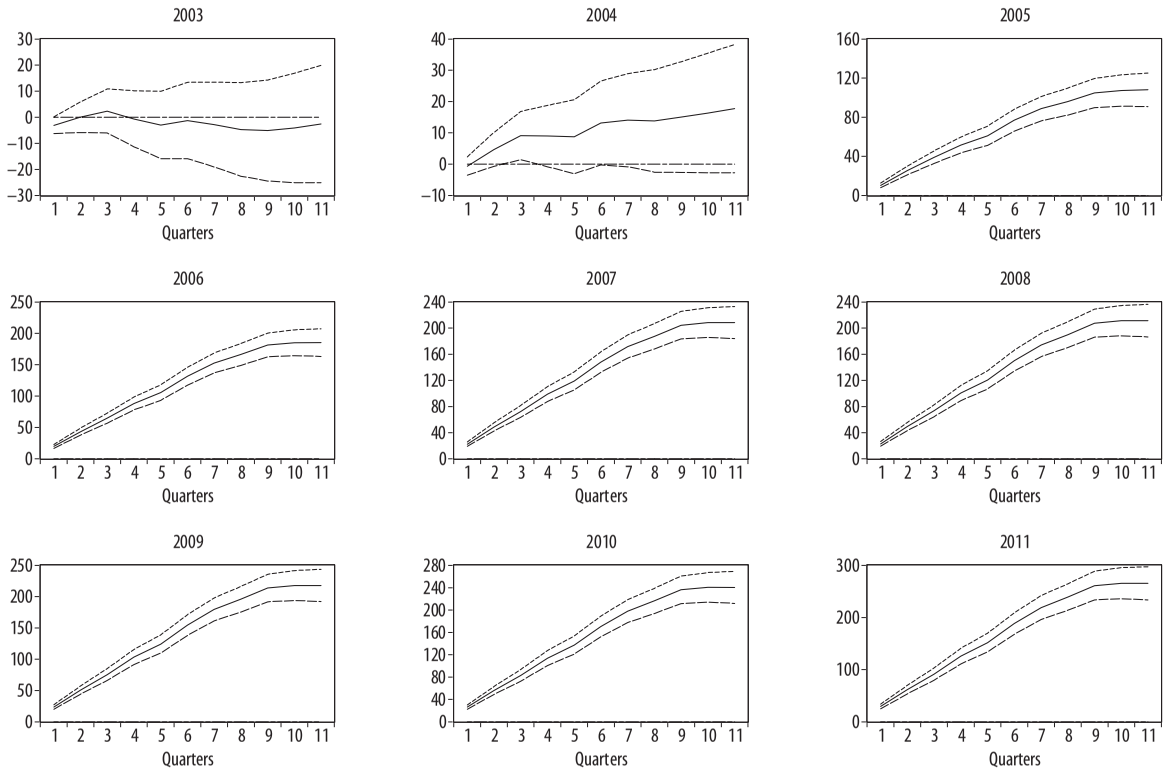


FIGURE A18. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity of 180 Days, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

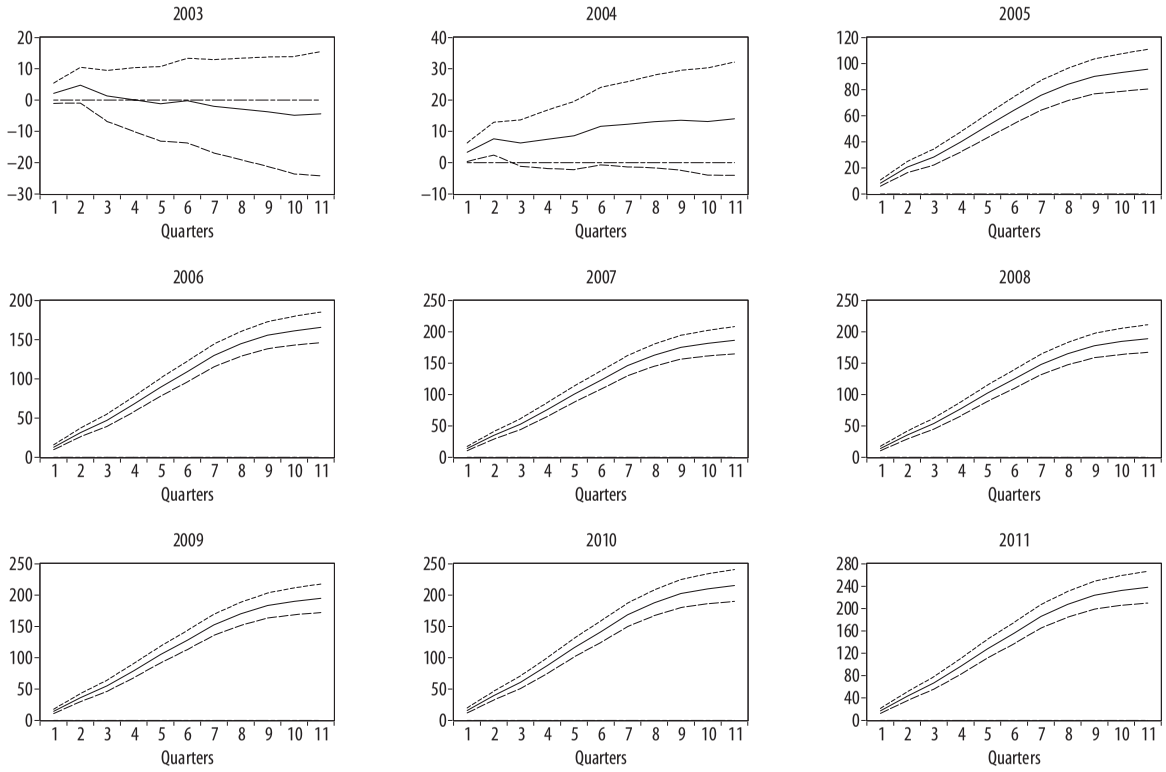


FIGURE A19. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity between 181 and 360 Days, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds

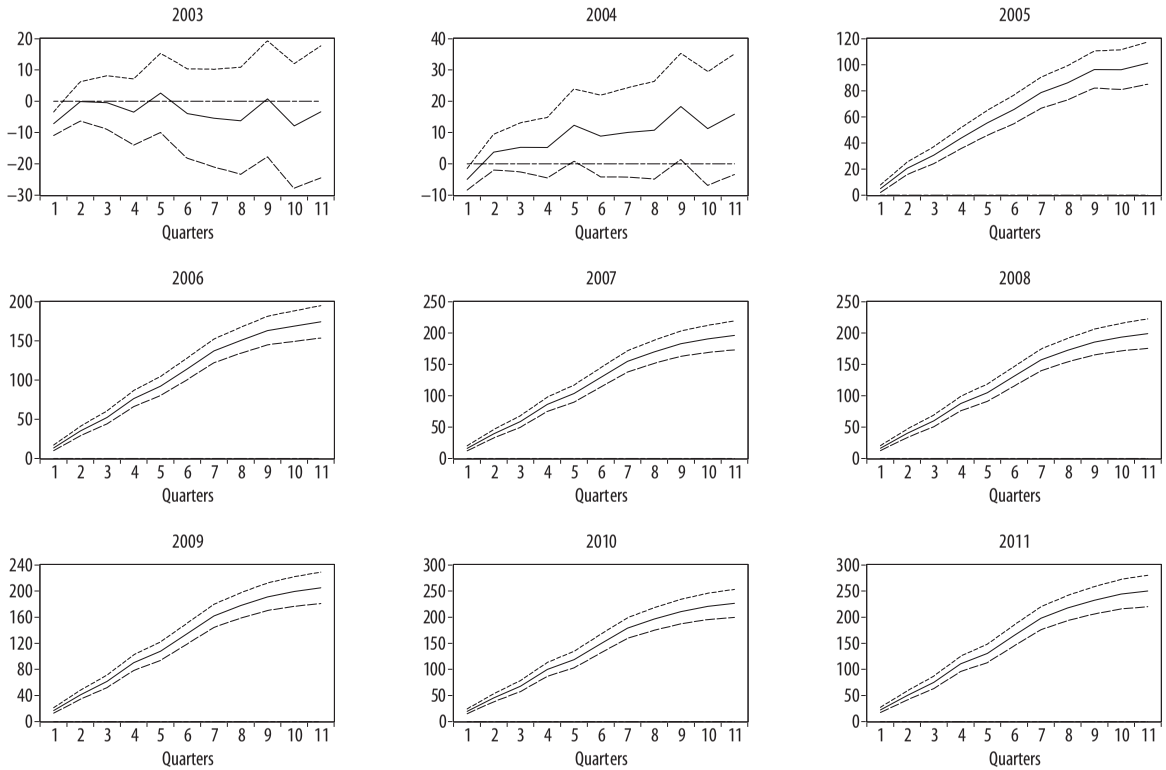
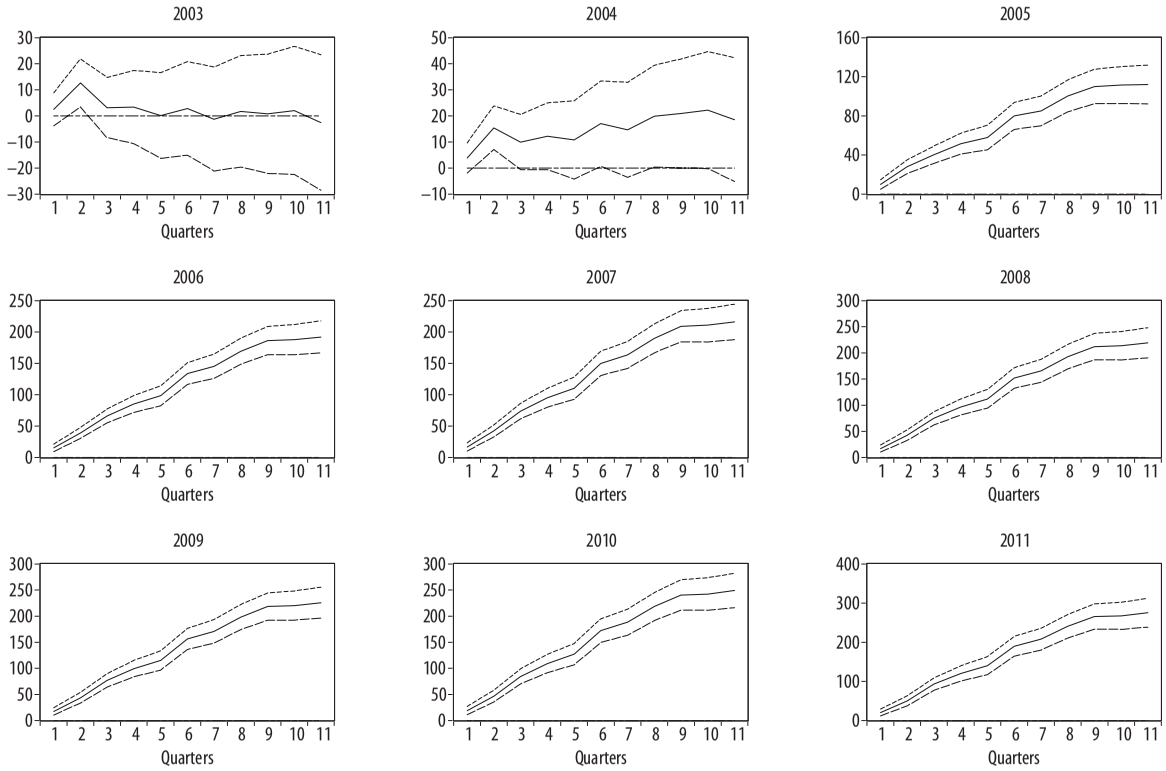


FIGURE A20. Monetary Policy Shock: Response of the Time Deposit Rate with Maturity Greater than 360 Days, Conditional on the Average Maturity of New Issues of Fixed-Rate TES Bonds



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