Por:
Hernando Vargas
Andrés González
Ignacio Lozano

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Macroeconomic Effects of Structural Fiscal Policy Changes in Colombia

Hernando Vargas
Andrés González
Ignacio Lozano*

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Abstract

In the past decade the Colombian Economic Authorities undertook a series of measures that reduced the structural fiscal deficit, decreased the Government currency mismatch and deepened the local fixed-rate public bond market. This paper presents some evidence suggesting that these improvements had important effects on the behavior of the macroeconomy. They seem to have permanently reduced the sovereign risk premium, increased the reaction of output to Government expenditure shocks and strengthened the response of market interest rates to monetary policy shocks.

1. Introduction

Over the last decade the Colombian Government and Congress undertook a series of measures and reforms that significantly shifted the trend of public debt, reduced the financial fragility of the Government and deepened the domestic public bond market. First, starting from a rising, unsustainable debt path, several structural fiscal reforms were instrumental in the decline of the public debt-GDP ratio between 2003 and 2008, and its more recent stability. Second, an explicit policy of diminishing the currency mismatch of the public finances decreased their vulnerability in the face of a sharp depreciation following an adverse external shock. Third, there has been an effort to shift the composition of public debt toward fixed-rate, peso-denominated bonds and to lengthen its maturity.

One would expect that this set of prudent policies had important effects on the behavior of the macroeconomy both in the long term and in response to exogenous shocks. After briefly highlighting some aspects of fiscal policy and public debt management in the past ten years, this paper assesses some of those effects. Specifically, the influence of fiscal policy changes on the country´s sovereign risk premium, the short-run response of output to a fiscal shock and the transmission of monetary policy shocks to market interest rates are evaluated.

2.   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 in health, education and justice drove Central Government primary expenditure from 7.2% of GDP in 1990 to 12.4% of GDP in 2000. At the same time, the Constitution of 1991 and the Law extended fiscal decentralization and imposed a regime in which an increasing fraction of Central Government current revenues was transferred to local governments. The tax increases adopted to pay for the additional expenditure were not sufficient and 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 in doubt, given its prevailing parameters and the co-existence of a defined-contribution private pension fund system.

By the end of the nineties fiscal sustainability in Colombia was uncertain. Central Government debt to GDP ratio 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 and 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 had to be implemented that included four tax reforms, two reforms to the transfers to sub-national governments and other measures that substantially reduced the Non Financial Public Sector (NFPS) deficit from 4.9% of the GDP in 1999 to a balanced position in 2008. During this period, the deficit of the central government was reduced from 6% to 2.3% of the GDP while the remaining NFPS recorded surplus balances. As a result, the Central Government debt to GDP ratio declined

throughout the 2000s and has been stable in recent years (Graph 1). 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 every year a *Medium Term Fiscal Framework* as its main tool for financial programming (*Marco Fiscal de Mediano Plazo,* MFMP for its acronym in Spanish). The MFMP sets a numerical target for the primary balance of the NFPS 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 MFMP includes an assessment of the contingent liabilities of the public sector, the cost of tax benefits, and some sections on the fiscal programming of sub-national governments. Fiscal forecasts are made based on macroeconomic assumptions jointly formulated by the Ministry of Finance (MoF), the Central Bank (CB), and the National Planning Department (NPD).

Even though the MFMP is a valuable tool for fiscal stance programming, it has some constraints from a macroeconomic perspective. On the one hand, the multi-annual primary balance targets are adjusted repeatedly for diverse reasons, thus lessening the initial commitments of the Government. On the other hand, it does not assess explicitly the effects of the business cycle on tax revenues and expenditures, which increases the risk of procyclicality in fiscal policy. In fact, some studies have found some evidence of pro-cyclicality of fiscal policy in Colombia and other emerging economies (Cárdenas et al., 2006, Lozano, 2011 and Ilzetzki and Vegh, 2008).

To overcome the MFMP limitations, Law 1473, by which the Central Government adopted a quantitative fiscal rule, was passed by mid-2011. In addition to ensuring the sustainability of public debt and promoting a countercyclical fiscal policy stance, it is expected to alleviate the effects of exchange rate volatility on the economy's tradable activities, for it would foster a better management of the resources generated by the mining and energy sectors. Furthermore, the framework of fiscal policy in Colombia was supplemented with a royalty-law for the exploitation of natural resources approved in 2011. This law aims at distributing royalty funds more equitably among the country's several regions and at saving their transitory component.

3. Public Debt Management in Colombia

Along with fiscal consolidation, in the last decade the Colombian Authorities have sought to improve the composition of public debt in order to reduce the financial fragility of Government 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). As a

result, a substantial drop in a currency mismatch indicator was achieved for the Central Government (Graph 2)[1].

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 (Graph 3). This process began in the late nineties 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%) in the 2000s. In September 2011 the stock of local, fixed-interest, peso denominated bonds (TES) accounted for 51.4% of total Central Government debt and represented 18.3% of GDP.

Besides increasing the participation of these instruments in total debt, Government policy has successfully extended the maturity of the new issues throughout the last decade (Graph 4), a sign of credibility in both fiscal and monetary policy (Hamann and González, 2011). The share of the outstanding stock of bonds with less than one year residual maturity has declined in the past ten years in favor of issues with maturity greater than five years, while the share of issues with residual maturity between three and five years has remained stable (Graph 5). Today the longest maturity in the TES market is fifteen years. This attainment has been important for the development of a fixed rate mortgage loan market in the 2000s (Galindo and Hoffstetter, 2008, and Hamann et al., 2010), and may have influenced the transmission of monetary policy shocks to other financial system interest rates, as will be discussed below.

4. The Macroeconomic Effects of the Fiscal Policy Changes

The aforementioned improvements in fiscal and public debt management policy were large enough to have an impact on the behavior of the macroeconomy both in the long term and in response to exogenous shocks. This section explores some of those effects.

a. Effects on the sovereign risk premium

Among the most important goals of the structural adjustment process undertaken since the early 2000s were ensuring the sustainability of the public debt and strengthening the resilience of the economy in the face of external shocks. Specifically, the correction of structural imbalances and the shift in the trend of the public debt to GDP ratio must have reduced the probability of default of the Colombian Government and the vulnerability of the latter to shocks hitting its revenues and expenses. Further, the fall of its currency

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[1] The indicator, inspired by Goldstein and Turner (2004) and Rojas-Suárez and Montoro (2011), attempts to capture the ability of the Central Government to serve its foreign currency-linked debt on the basis of its foreign currency-linked revenues. It is constructed as the ratio: (FCD/TD) / (FCR/TR) for the Central Government. FCD = Foreign Currency Debt. TD = Total Debt. FCR = Foreign-currency-linked revenue, which includes external 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. TR = Total revenue. Data sources: Banco de la República, DANE, DIAN, Ecopetrol, Supersociedades and Hamann, Lozano and Mejía (2011).

mismatch must have reinforced the ability of the Government to withstand a depreciation shock. At a more aggregate level, the decline in the Government currency mismatch was part of a general trend that also included the private sector and allowed a greater scope for exchange rate flexibility and the possibility of a countercyclical monetary policy response to external shocks. This, in turn, moderated the effect those shocks on output and fiscal revenues.

Overall, the reduction in the public debt to GDP ratio and Government currency mismatch must have decreased the credit risk of the Government and the country. Hence, they must have contributed to a permanent drop in the sovereign risk premium and to a decline in its sensitivity to global risk aversion shocks.

To test the first implication, we estimated a model for the Colombian sovereign risk premium, measured by the EMBI Colombia, based on the following specification:

$$embic_t = \alpha_o + \alpha_1\,gra_t + \alpha_2\,(d/y)_t + \alpha_3\,cm_t + \varepsilon_t$$

embic is the EMBI Colombia, *gra* is a measure of global risk aversion, *d/y* is the Central Government debt to GDP ratio and *cm* is the currency mismatch indicator calculated above. As measures of global risk aversion, the VIX and the 5-year high yield spread were used. All variables were expressed in logs and were non-stationary in the sample 1999.Q2-2011.Q4 (quarterly data). Cointegration was found for these systems based on the Hansen test (Hansen, 1992).

The long run relationships presented in Table 1 confirm the importance of local fiscal variables in the determination of the Embi Colombia, beyond the effect of global risk aversion. In both specifications (with the VIX and the high yield spread as measures of global risk aversion) the Government currency mismatch appears significant and with the expected positive sign. The debt to GDP ratio is also significant and with the expected positive sign in the specification that uses the VIX as the global risk aversion variable (Table 1, upper panel). It is positive, but not significant in the specification that includes the high yield spread as the measure of global risk aversion (Table 1, lower panel).

The second implication, changing sensitivity of the sovereign risk premium to global risk aversion as a result of improved fiscal policy, is tested by Julio et al (2012). Following Favero and Giavazzi (2004), these authors estimate a model in which the response of the Embi Colombia to the spread between the US BAA corporate bonds and the 10-year US Treasury Bonds depends on 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. They posit a non-linear relationship in which large observed primary surpluses relative to their debt ratio-stabilizing values drive the sensitivity of the Embi Colombia to global risk aversion toward zero, while the opposite situation increases that sensitivity.

Working on a monthly sample between 1998 and 2010, Julio et al. (2012) find that the sensitivity of the Embi Colombia to their measure of global risk aversion does depend significantly on their fiscal health indicator. Furthermore, they find a structural break in the

sensitivity function around mid-2006. After this period, there seems to be a substantial reduction of the sensitivity function, which the authors associate both to a permanent improvement in the Colombian fiscal health indicators and to the deterioration of public debt ratios in advanced economies.

In sum, the evidence presented in this section and in Julio et al. (2012) supports the hypothesis that the aforesaid improvements in fiscal policy and public debt management did reduce permanently the sovereign risk premium in Colombia and its sensitivity to global risk aversion shocks. The macroeconomic implications of this result are important.

First, it means that, *ceteris paribus*, the long term level of the real interest rate must be lower today than a decade ago[2]. Based on the long run relationship presented in Table 1 (upper panel), on average, local factors (the decline in the Government currency mismatches and the debt to GDP ratio) would imply roughly a 60% decrease in the Embi Colombia between 2002.Q1-2006.Q4 and 2007.Q1-2011.Q4[3].

Also, a permanent decrease in the risk premium entails a permanent adjustment in the long run level of the real exchange rate. Hence, it could be argued that part of the real appreciation of the COP in the past decade could be attributed to better fiscal policy. The permanent movement of the long run level of both the real interest rate and the real exchange rate has important consequences for the design and operation of monetary policy. It implies that the mean value of the *natural* interest rate must be lower than ten years ago and that indicators of trend real exchange rates that give large weights to values from the early 2000s are probably biased.

Second, the empirical results suggest that the economy is generally less vulnerable to global risk aversion shocks because of the reduced sensitivity of the risk premium to them. This implies lower responses of the exchange rate and capital flows to those shocks, and, consequently, lower pressure on inflation, output and monetary policy.

b. Effects on the short-run response of output to Government expenditure shocks

It is likely that the perception of households, firms and investors about the sustainability of the public debt and the financial fragility of the Government influences their reaction to fiscal policy shocks. An unexpected increase in public expenditure may prompt an expectation of higher taxes in the short run in a dire financial situation of the Government, thereby offsetting its possibly expansionary effect on output. Moreover, a similar shock in a small, open economy may sharply raise the sovereign risk premium, bringing about a tightening response of the monetary authority to curb currency depreciation and inflation, or a contraction of external finance and credit (Ilzetzki et al., 2009). When public debt sustainability is more certain or Government currency or liquidity mismatches are low, the expansionary effects of a public expenditure shock may be greater.

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[2] Interestingly, the external real interest rate decreased in the same period, reinforcing the effect of a lower sovereign risk premium on domestic real interest rates.

[3] We computed the changes in the logarithm of the average Government currency mismatch indicator and the debt to GDP ratio between 2002.Q1-2006.Q4 and 2007.Q1-2011.Q4, and multiplied them by the corresponding elasticities from Table 1. We then added the calculated impacts.

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 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 are purely discretionary, non-output related changes. The second issue is important because an anticipated fiscal policy shift may induce an anticipated response by the private sector consumption or output, so that the estimated response after the realization of the shift could be biased (Perotti, 2007).

SVAR models have been widely used in the literature to identify fiscal shocks[4]. 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 (e.g. wars, "ideological" policy shifts, output-independent cross sectional effects etc.)[5]. In Colombia SVAR models used to estimate the effect of fiscal policy shocks on output have rendered results that range from negligible impacts (Restrepo and Rincón, 2006) to positive expenditure multipliers between 1.1 and 1.2 (Lozano and Rodríguez, 2011). However, these studies include a relatively long sub-period 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[6].

Our approach differs from the previous work in 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 non-linear technique that allows for a smooth transition between regimes that are defined according to indicators of fiscal health. Third, since we do not estimate a SVAR, we identify the Government expenditure shock based on innovations on the publicly known spending announces for the Central Government[7].

Following Auerbach and Gorodnichenko (2012), instead of estimating a SVAR and deriving standard impulse response functions, we approximate the non-linear impulse-response function by the following linear projection:

$$Y_{t+h} = G(z_t) \, (\, \Psi_1^h \, F_t + \Lambda_1(L) \, Y_{t-1}) + (1-G(z_t)) \, (\, \Psi_2^h \, F_t + \Lambda_2(L) \, Y_{t-1}) + \varepsilon_t$$

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

[5] See Perotti (2007) and Romer (2011).

[6] Standard Mundell-Fleming theory suggests that the exchange rate regime makes a difference regarding the effect of fiscal policy shocks in a small open economy. See Ilzetzki et al. (2009) for some evidence about the differences of output responses to fiscal shocks in economies with flexible and pegged exchange rates.

[7] We do not study the effects of tax shocks due to the difficulties involved in their identification and the problems derived from the sensitivity of the theoretical results to the time profile of distortionary tax responses (Perotti, 2007).

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 (see for details Jordà, 2005).

Notice that 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 combination or "average" of the functions corresponding to the extreme states of the fiscal health indicators (e.g. "High Debt" vs. "Low Debt", or "High Currency Mismatch" vs. "Low Currency Mismatch"). 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 actual primary expenditures (overall spending without interest payments on public debt) and the forecast made of this variable[8]. For the OECD countries, these predictions are typically taken from professional forecasting surveys. Since this type of information is not available for Colombia, we derived it from the Ministry of Finance announced Financial Plans as explained in the Appendix 1. The fiscal shocks so 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[9].

As fiscal health variables, z_t, we used the Central Government debt to GDP ratio, the Government currency mismatch and 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 (Graph 6)[10]. The impulse response functions of output to a Government expenditure shock are estimated using quarterly data for the 1999-2011 sample.

The results in Graphs 7 and 8 suggest that there were important changes in the response of output to the fiscal shock throughout the decade, as fiscal health indicators improved markedly[11]. The responses in the beginning of the decade were, when positive, small and short-lived; in other cases, they were negative on impact and non-significant afterwards. When the debt to GDP ratio stopped rising or the primary surplus deviation

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[8] Due to data availability, we use Central Government primary expenditure, which corresponds roughly to two thirds of total General Government primary expenditure.

[9] A potential drawback of our measure of expenditure shock is that we cannot separate public consumption, investment, transfers and subsidies expenses, since the Government Financial Plans do not disaggregate the outlays in these categories. We are then 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 transfers shocks are very different, and if the composition of the aggregate shocks changes significantly from year to year.

[10] See Julio et al. (2012) for details on the construction of this series.

[11] The technique used allows us to estimate the impulse response functions with confidence intervals for each quarter in the sample. The results presented in Graphs 8 to 10 correspond to the average responses for each year with the confidence interval calculated appropriately. We used four lags of the GDP in the estimation.

from its debt-stabilizing level increased (2002-2003), output responses turned positive and remained significantly different from zero for several periods. Interestingly, the positive reactions seem to be clearer and larger when the primary surplus is higher (2007-2008) (Graph 8), although in no case the estimated conditional Government expenditure multipliers exceed one. Similarly, the output responses related to low Government currency mismatches (2005-2011) were in general significantly positive for several quarters, unlike the responses observed in years of high currency mismatches (1999-2004) (Graph 9)[12].

Hence, the power of fiscal (expenditure) policy to affect output is greater, the stronger the financial position of the Government. The implication of this result for the assessment of the convenience of countercyclical fiscal policy is apparent. I.e., a sound public finance situation not only has benefits in terms of permanently lower real interest rates and lower vulnerability of the economy to global risk aversion shocks, but also seems to enhance the effectiveness of countercyclical fiscal policy.

c. <u>Effects on the transmission of monetary policy shocks to market interest rates</u>

As the fiscal situation improved structurally and monetary policy gained credibility throughout de 2000s (Hamann and González, 2011), the transmission of monetary policy shifts to financial market interest rates may have been strengthened. To begin, under a more credible monetary policy regime, a movement in overnight policy rates is likelier 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, as mentioned above, the enhanced credibility of a low and stable inflation rate as well as a stronger perception of public debt sustainability permitted the extension of 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 non-linear model of the foregoing section to test whether the transmission of monetary policy shocks to public bond interest rates (TES) and deposit or loan rates changed as the maturity of the Government fixed income market was expanded throughout the 2000s. Specifically, we estimate the following monthly models for TES and market interest rates:

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[12] When interpreting the impulse response functions presented in Graphs 8-10, it must be recalled that they 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 regime is measured by the difference between the primary surplus and its debt-stabilizing level, but essentially zero when the fiscal variable regime is measured by 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 observed in the same year was non-significant. 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 non-significant, but is smaller than in later years, when all conditional responses were statistically positive.

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

$$im_{t+h} = J(z_t) \left(\Phi_1^h M_t + B_1(L)\, im_{t-1} + K_1(L)\, ites_{t-1} \right) + (1-J(z_t)) \left(\Phi_2^h M_t + B_2(L)\, im_{t-1} + K_2(L)\, ites_{t-1} \right) + \varepsilon_t$$

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 (Jordà, 2005)[13]. Notice that this response is allowed to change as a function of the maturity of the new issues of fixed rate TES (z_t = long term componenet of the average maturity of new issues) (Graph 4). 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, but the controls include lagged values of both market and TES rates with similar maturities.

The definition of 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, so, orthogonal to all information that might be relevant to predict the policy rate at each point in time. Appendix 2 provides some details on the estimation of the monetary policy shock that is used in our estimations.

The results for the transmission of policy rates to TES interest rates are shown in Graphs 10 to 13[14]. There seems to be two clearly different regimes: one between 2002 and 2003, the other between 2005 and 2011, and a transition year in 2004. Between 2002 and 2003 there were *negative* monetary shocks (Graph 29), meaning that the market expected policy rate increases that did not happen. According to Graphs 10 to 13, 0-5 year TES rates increased and the zero coupon curve steepened up to the sixth month after the shock. TES rates for maturities greater than five years, slightly declined on impact, but rose sharply afterwards[15]. In contrast, between 2005 and 2011, the monetary shock took both positive and negative values and its volatility was substantially smaller (Graph 29). In this period all TES rates rose with a positive monetary shock, while the zero coupon curve generally flattened afterwards, as can be seen by comparing the impacts across time and maturity.

A possible interpretation of these results is that the monetary policy response to the risk aversion shock, the COP depreciation and rising core inflation observed between 2002 and 2003[16] was deemed insufficient by the market, so it was judged as a policy mistake that would require a correction over the short term (hence the response of the 0-3 year bond prices) or would risk a future rise of inflation (hence the response of the bonds with

[13] The equation for the TES rates controls for the influence of the Embi Colombia, ρ_t.

[14] The technique used allows us to estimate the impulse response functions with confidence intervals for each month in the sample. The results presented in Graphs 11 to 14 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.

[15] 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.

[16] Following a sharp increase in the EMBI the second semester of 2002, the COP depreciated by 23.3% between June 2002 and March 2003, while annual CPI without food inflation rose from 5.5% on average in the first semester of 2002 to 6.6% on average in the first semester of 2003.

maturity greater than 3 years). Alternatively, there may be omitted variables that account for the negative response of the TES rates to the monetary policy shock, even though the econometric model controls for the effects of the contemporaneous sovereign risk premium shock[17]. After 2004 monetary policy shocks are smaller and the curve seems to shift upward and flatten after a positive shock, a plausible sign of greater credibility of monetary policy[18].

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 issues of TES. The main findings in this regard may be summarized as follows:

- For all loan and deposit rates considered there are two regimes: One, between 2002 and 2003, in which a positive monetary shock produces non-significant or, in few cases, negative responses of market rates. The other, between 2005 and 2011, in which there are generally positive, significant responses of market rates to a monetary shock. As in the case of the TES rates responses, 2004 seems to have been a transition year (Graphs 10-27).

- The response of commercial loan rates after 2004 is monotonically increasing, reaching values that indicate a reaction greater than one-on-one after one year. This contrasts with the responses of the TES rates at similar maturities and suggests that corporate credit risk premia may rise after a positive monetary shock.

- The response of consumer loan rates with maturity less than one year after 2004 is initially negative, but positive six months after the monetary shock and less than one-on-one. For longer maturities, the response is very small for the first five or six months after the shock, but increases afterwards, reaching values that indicate a reaction greater than one-on-one after one year.

- Deposit (CD) interest rates with maturities less than one year increase with the monetary shock, reaching values that indicate a reaction close to one-on-one. CD interest rates with maturity greater than one year show a response larger than one-on-one after one year.

The contrast between the responses before and after 2004 may be a sign of rising credibility of monetary policy throughout the decade, as in the case of the TES rates responses. The lengthening of the maturity of TES could serve as a proxy for this increased credibility. However, it is indicative that, unlike the TES rates reaction in 2002-2003, several market rates did not display a negative, significant response to the monetary shock in the same years. Thus, other phenomena could have influenced the estimated change in the transmission.

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[17] In particular, during those years there was a strong disturbance in the TES market after a sovereign risk aversion shock because banks cut funding to brokers that had leveraged to invest in these securities. It is possible then that, due to fire-sales of TES, their prices fell beyond what could be explained by fundamentals.
[18] This response implies that the monetary surprise is expected to persist and is therefore transmitted to longer rates (i.e. is not considered a policy mistake).

The extension of the maturity of new TES issues and the TES stock may have enhanced to 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. Without reliable "risk-free" benchmarks, interest setters had to produce an individual forecast of the future path of short term policy rates in order to determine longer term deposit or loan interest rates. Such a forecast could be compared with other agents´ forecast only with lags and noise, through the examination of competitors´ interest rates. In these circumstances, future policy forecasts may be rather inaccurate and a policy shock may be more frequently associated to a forecast error than to a signal of a changing policy stance. Hence, transmission could be low.

In the presence of a liquid TES market, interest rate setters could have an immediate, centralized source of information regarding others´ views on future monetary policy. As a consequence, the forecasts of future policy rates may have become more precise and a monetary policy shock could be more frequently interpreted as a signal of changing policy stance than as a 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 path of future Central Bank interest rates that is likely to be higher or lower than previously expected. Hence, transmission could be greater.

5. 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 permanently reduced the sovereign risk premium (with the ensuing consequences on the real interest and exchange rates), increased the reaction of output to (unexpected) Government expenditure shocks (but still with multipliers lower than one) and may have strengthened the response of market interest rates to (unanticipated) monetary policy interest rate shocks. As a corollary, an increased soundness of fiscal policy may not only result in permanently lower costs of funding for all agents in the economy, but it may also enhance the power of fiscal and monetary policy to act counter-cyclically.

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Graph 1: Central Government Debt to GDP ratio
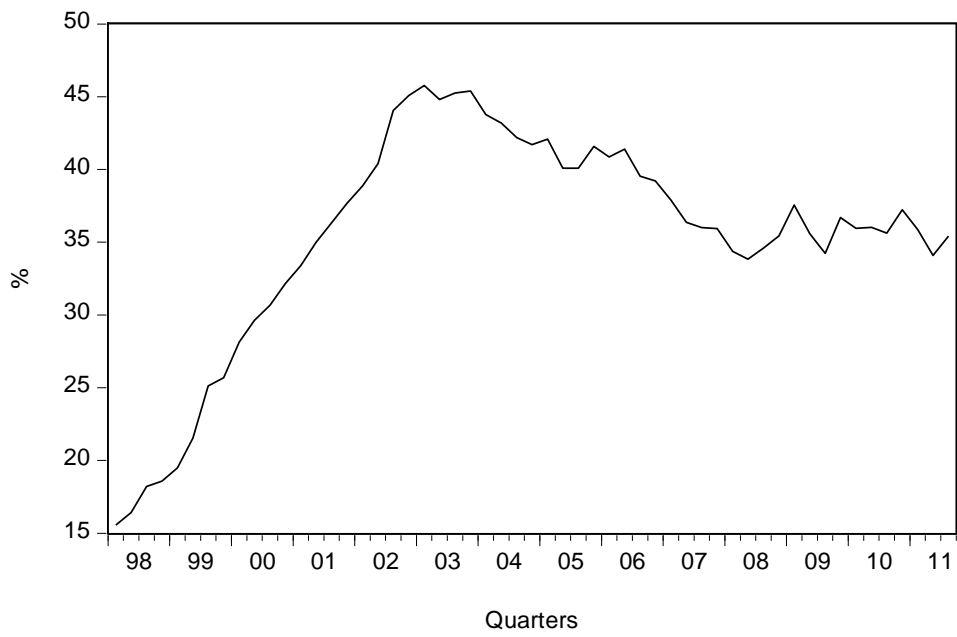
Graph 2: Currency Mismatch Indicator for Central Government
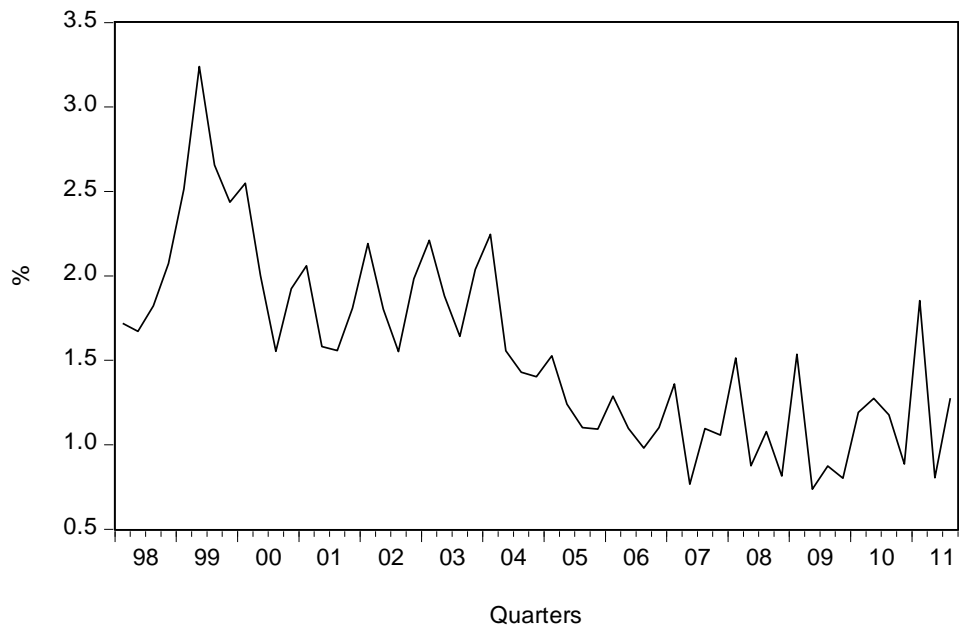
Graph 3: Composition of the Domestic Public Debt

Exchange rate linked (or issued locally in foreign currency)
Inflation indexed
Straight fixed rate
Other
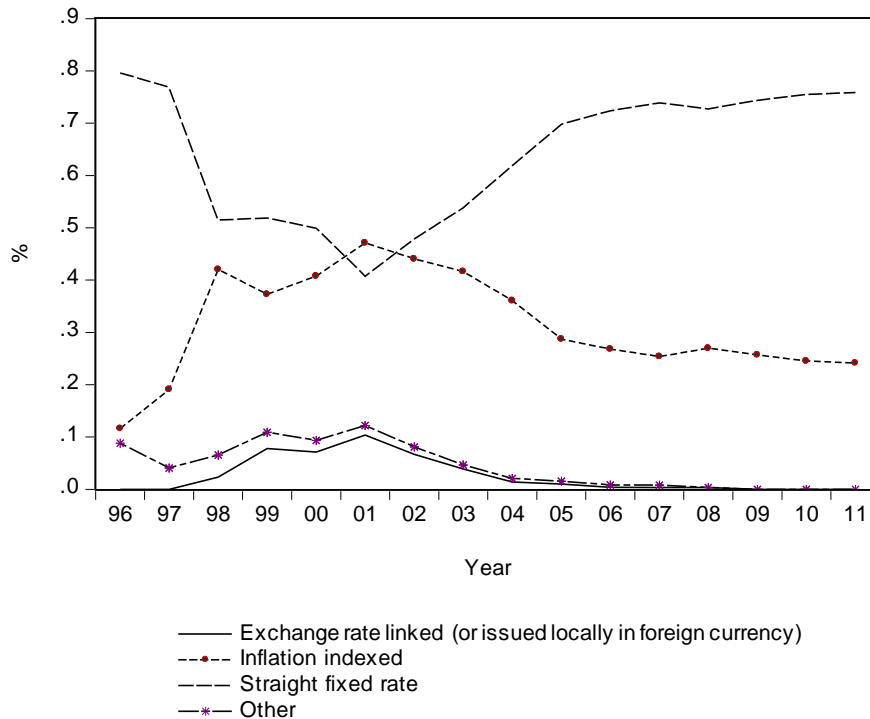
Graph 4: Average Maturity of New Issues of TES

Polynomial of time of power 3
Average Maturity
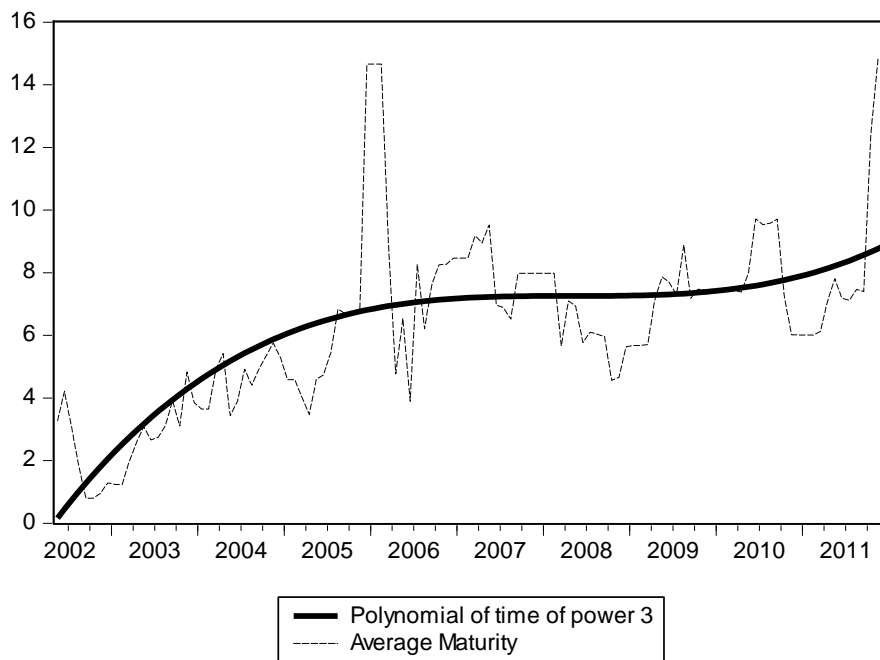
Graph 5: Maturity Composition of the fixed-rated TES stock
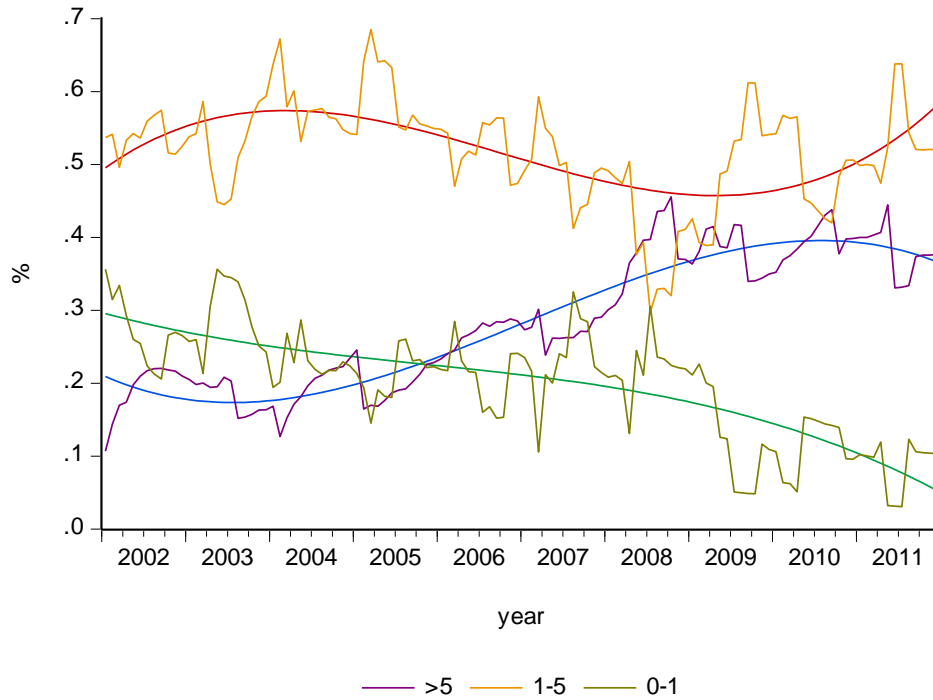
Table 1: Determination of the EMBI Colombia: Long run relationships

Dependent variable: EMBI Colombia				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
gra: LVIX	0.6266	0.1700	3.6847	0.0006
log(d/y)	0.8529	0.3850	2.2153	0.0321
log(cm)	1.2614	0.1669	7.5569	0.0000
C	0.4002	1.6093	0.2487	0.8048

Cointegration Test Hansen(1992)
LM= 0.392339 p-value >0.20

Dependent variable: EMBI Colombia				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
gra: LSPREAD	0.5565	0.1229	4.5281	0.0000
log(d/y)	0.5061	0.3247	1.5586	0.1264
log(cm)	1.3208	0.1446	9.1328	0.0000
C	2.5258	1.2213	2.0681	0.0447

Cointegration Test Hansen(1992)
LM=0.474112 p-value >0.20

Graph 6: Difference between actual and debt-stabilizing primary Balances (% of GDP)
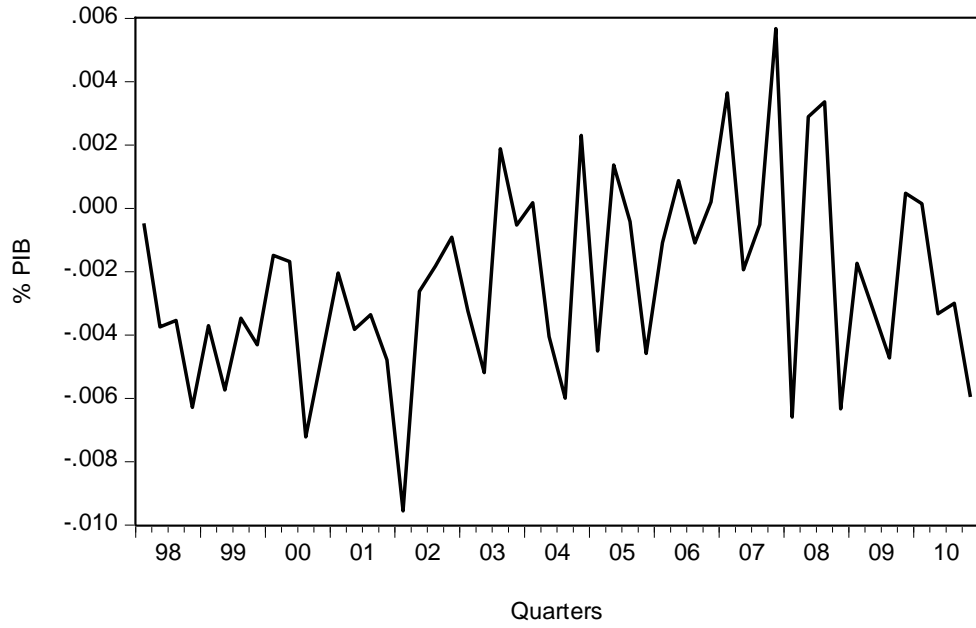
Graph 7: Fiscal Policy Shock:
Output Responses conditional on the Debt to GDP ratio
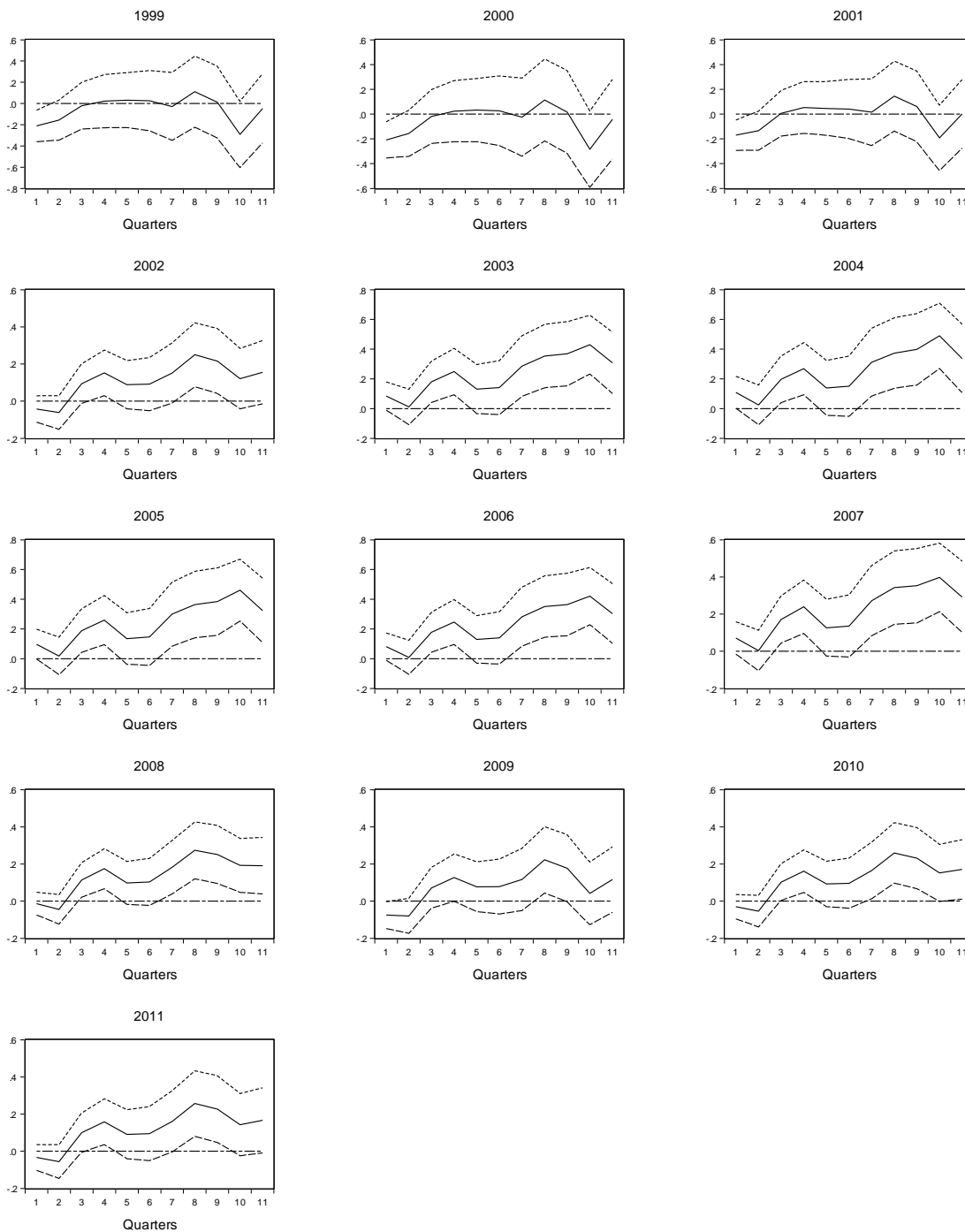
Graph 8: Fiscal Policy shock:

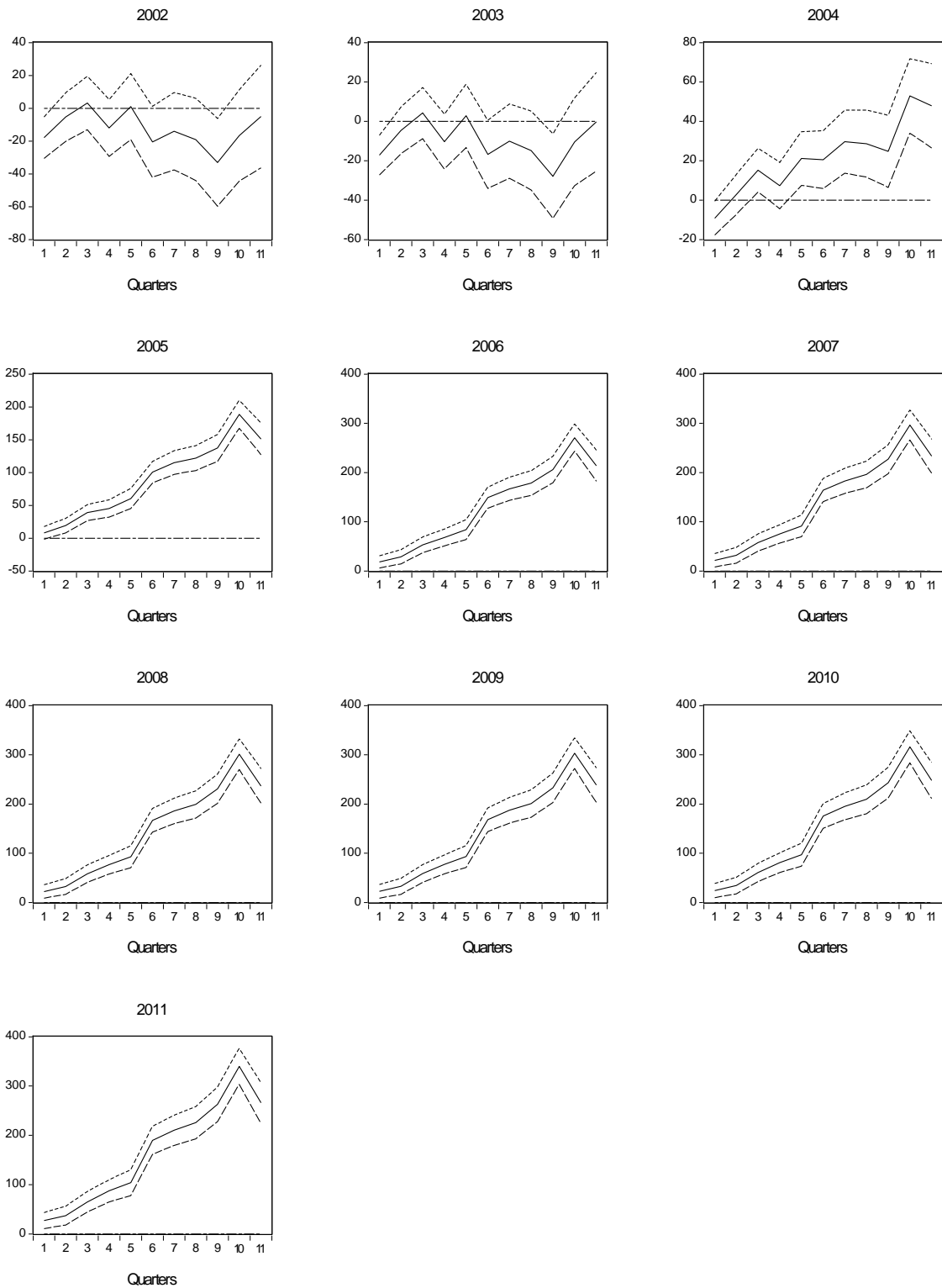**Output Responses conditional on the difference between actual primary balance and its debt-stabilizing level**
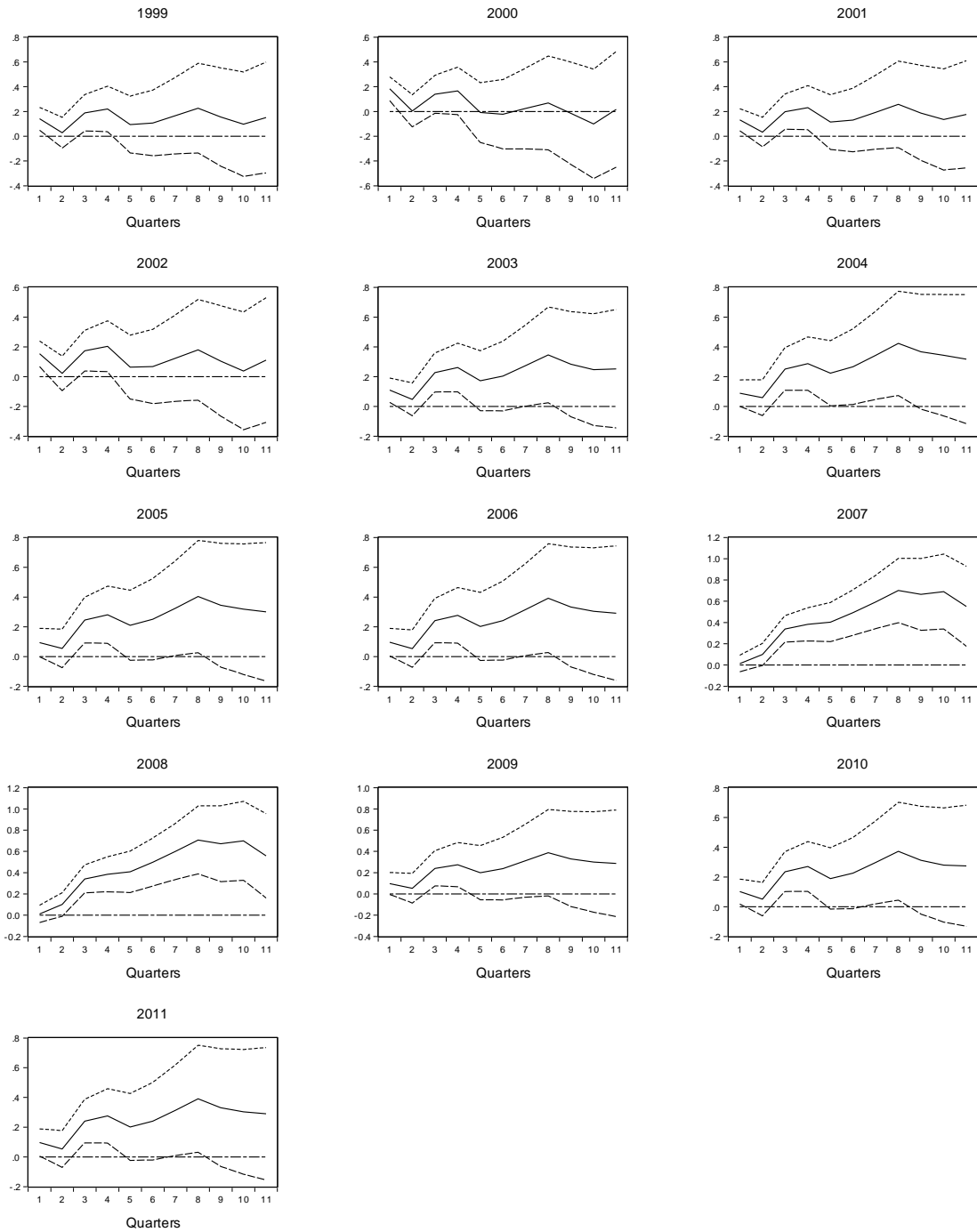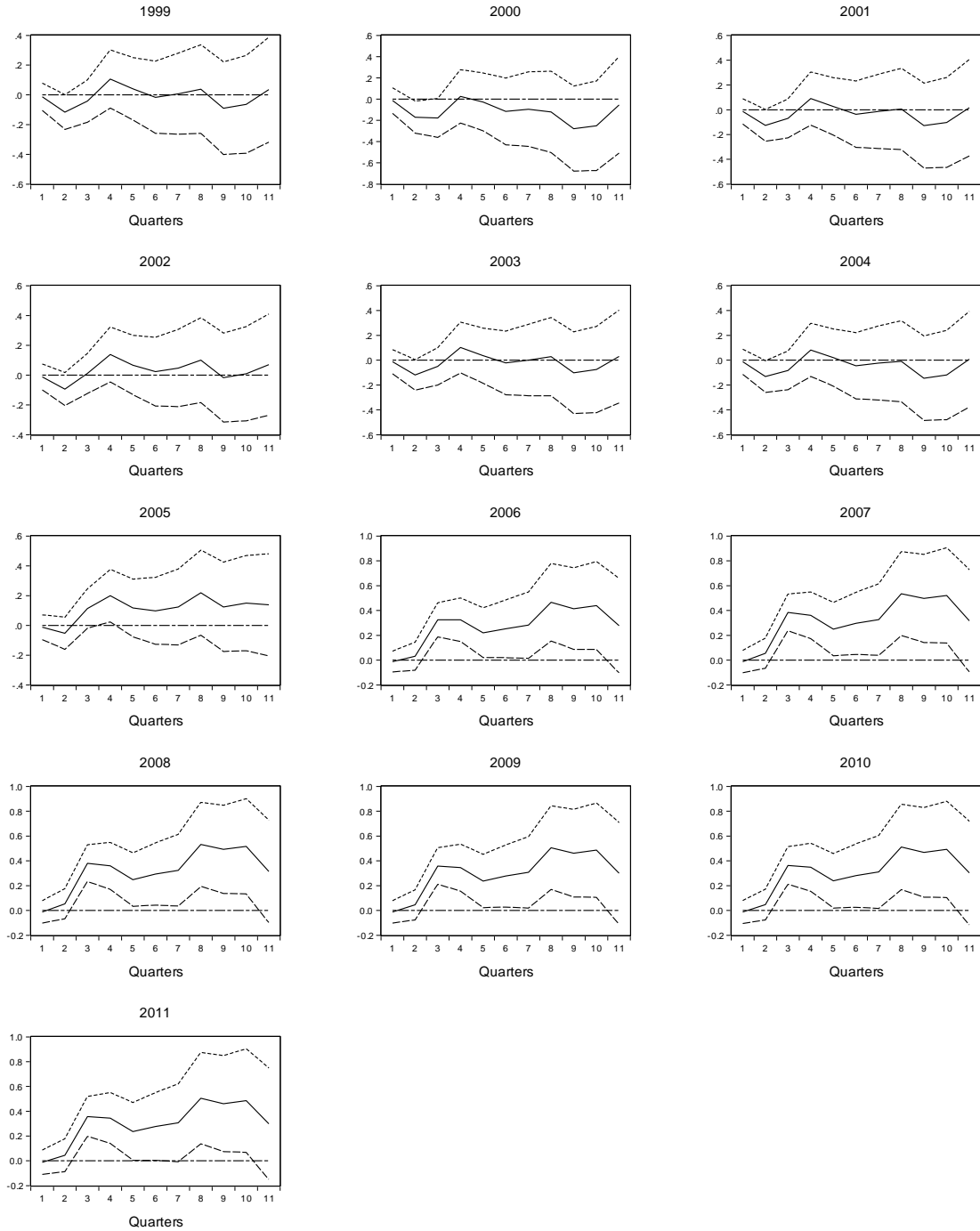
Graph 10: Monetary policy shock:
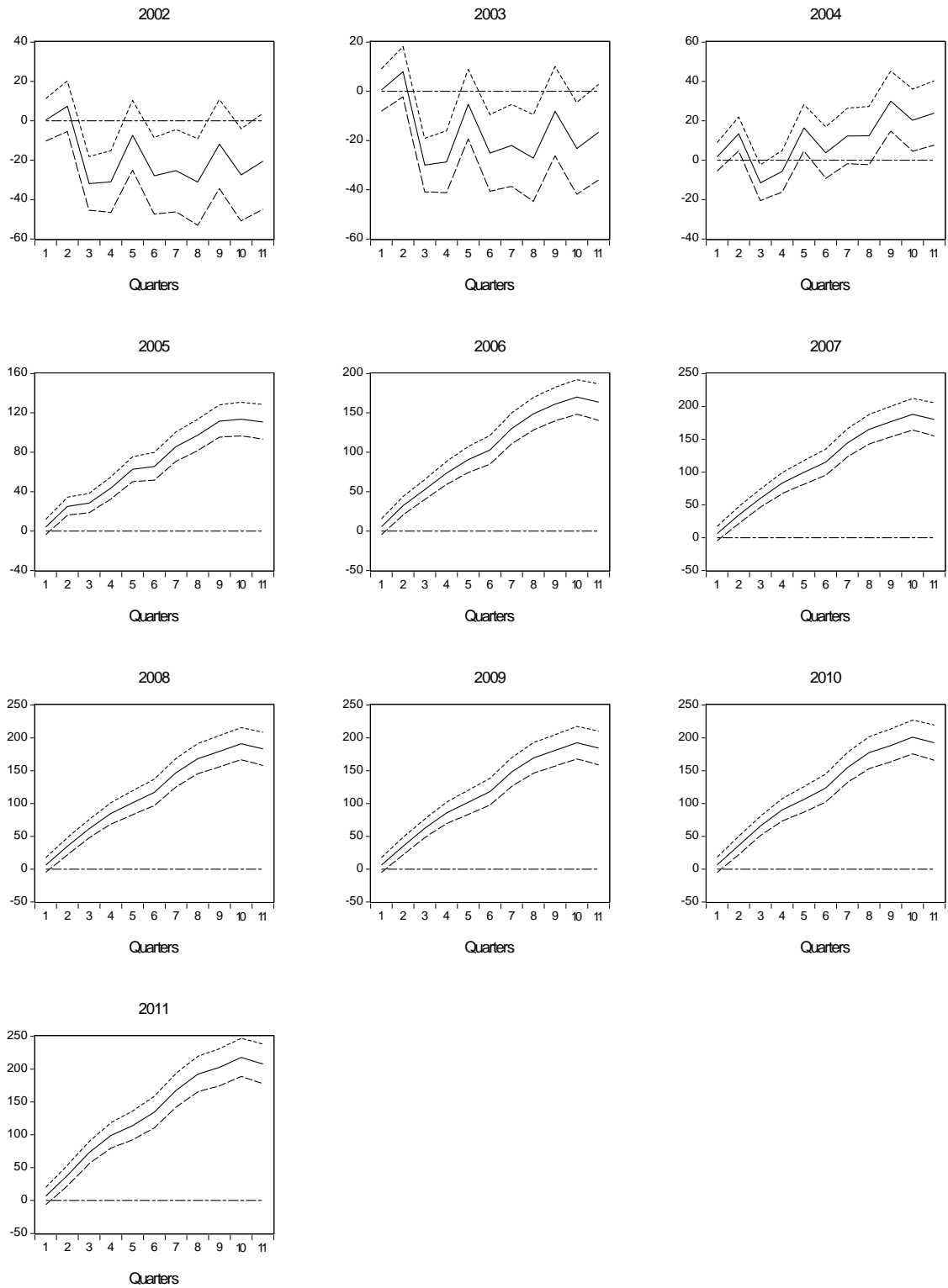**Response of TES with maturity less than one year conditional on the average maturity of new issues of fixed-rated TES**

2002

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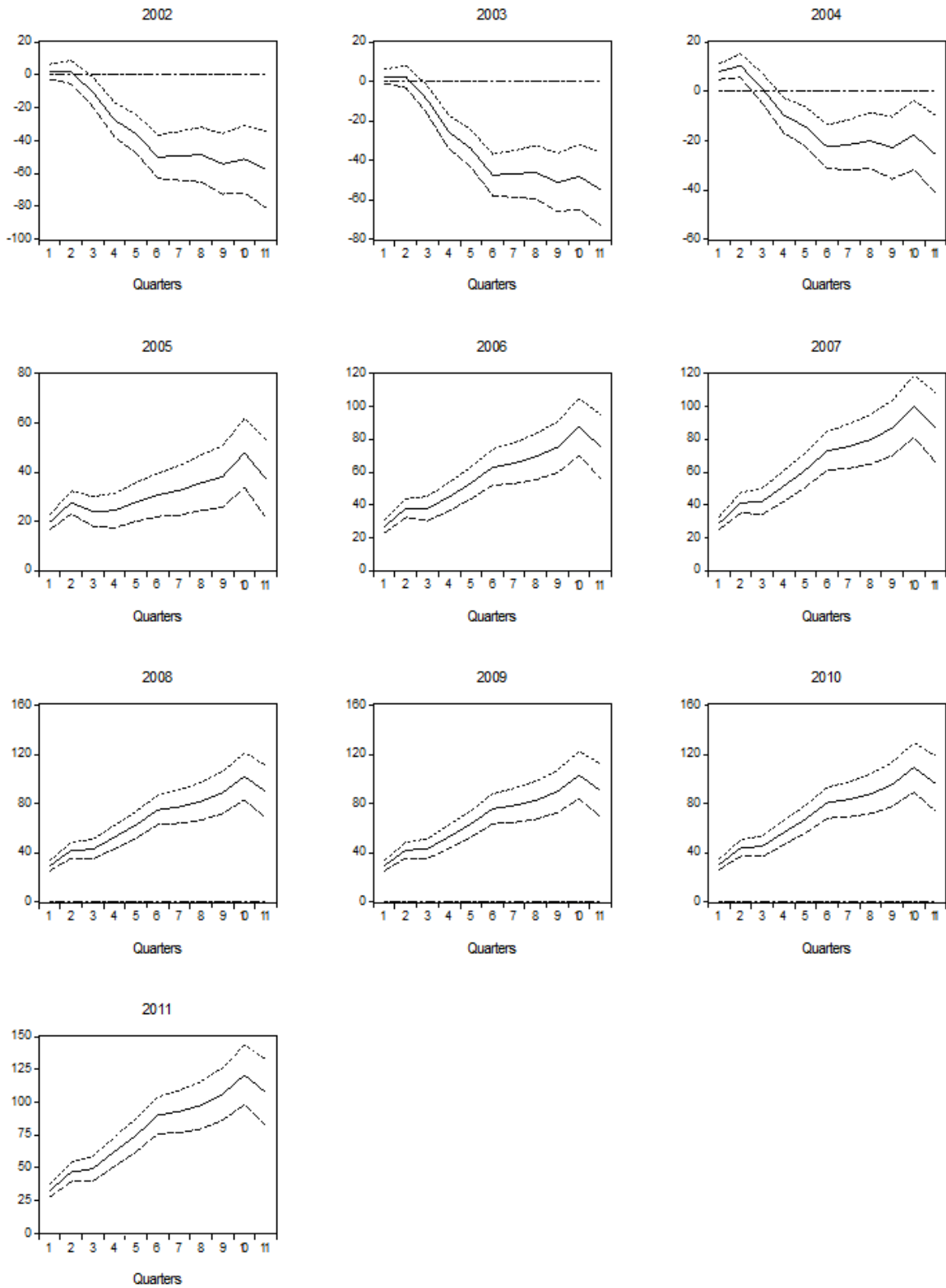
Graph 11. Monetary policy shock:
Response of TES with maturity between one and three years conditional on the average maturity of new issues of fixed-rated TES
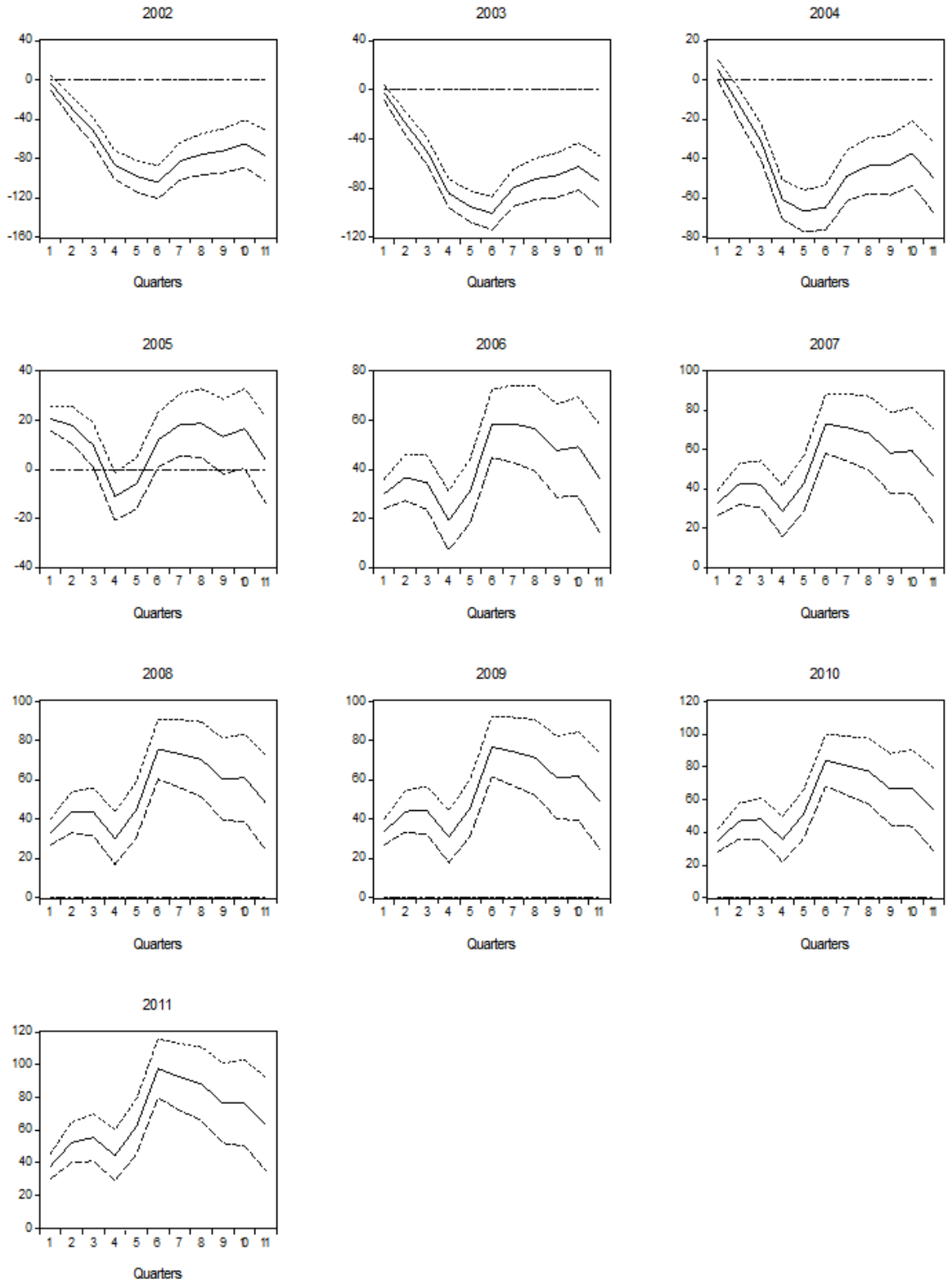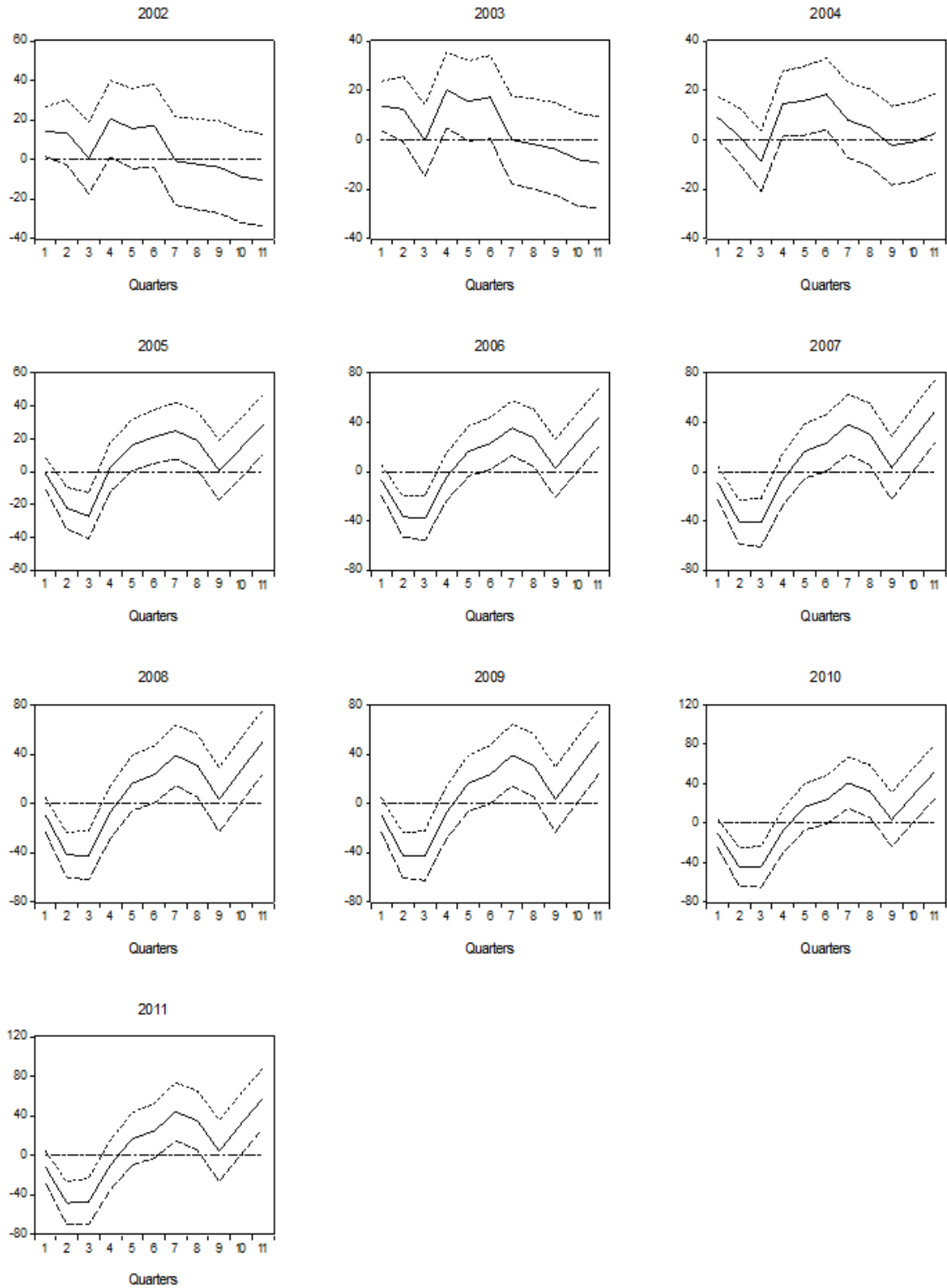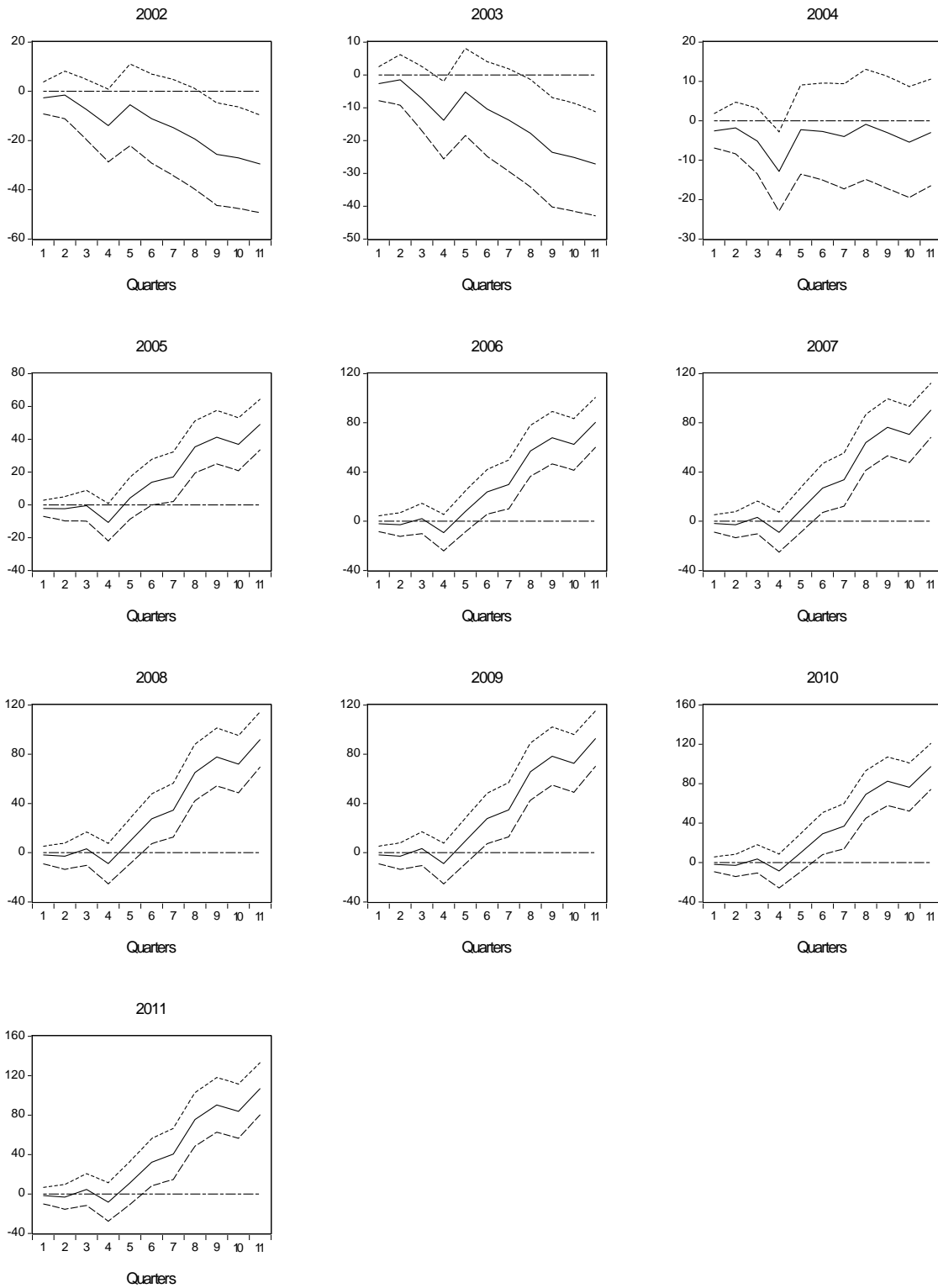
Graph 12. Monetary policy shock:
Response of TES with maturity between three and five years conditional on the average maturity of new issues of fixed-rated TES
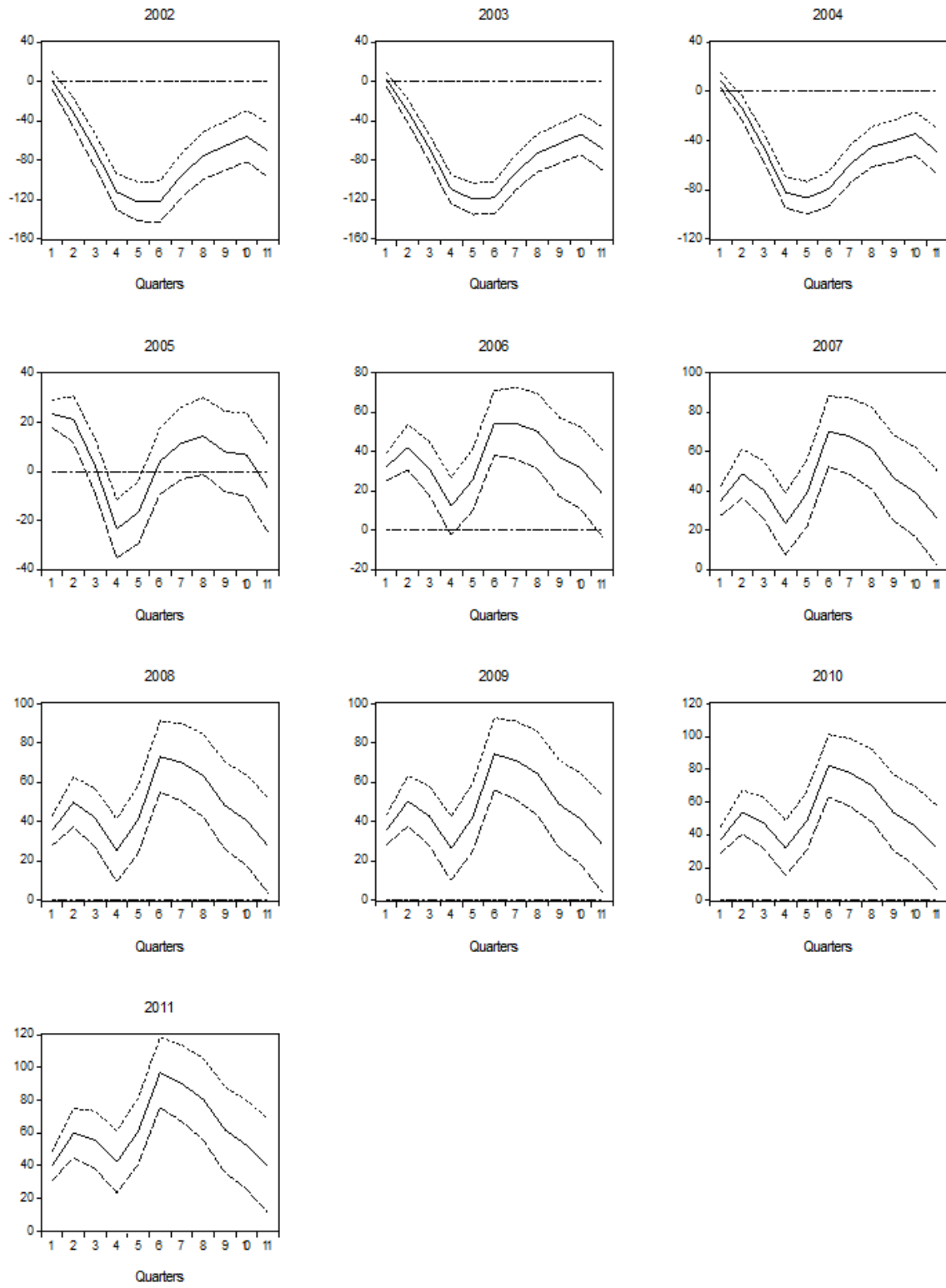
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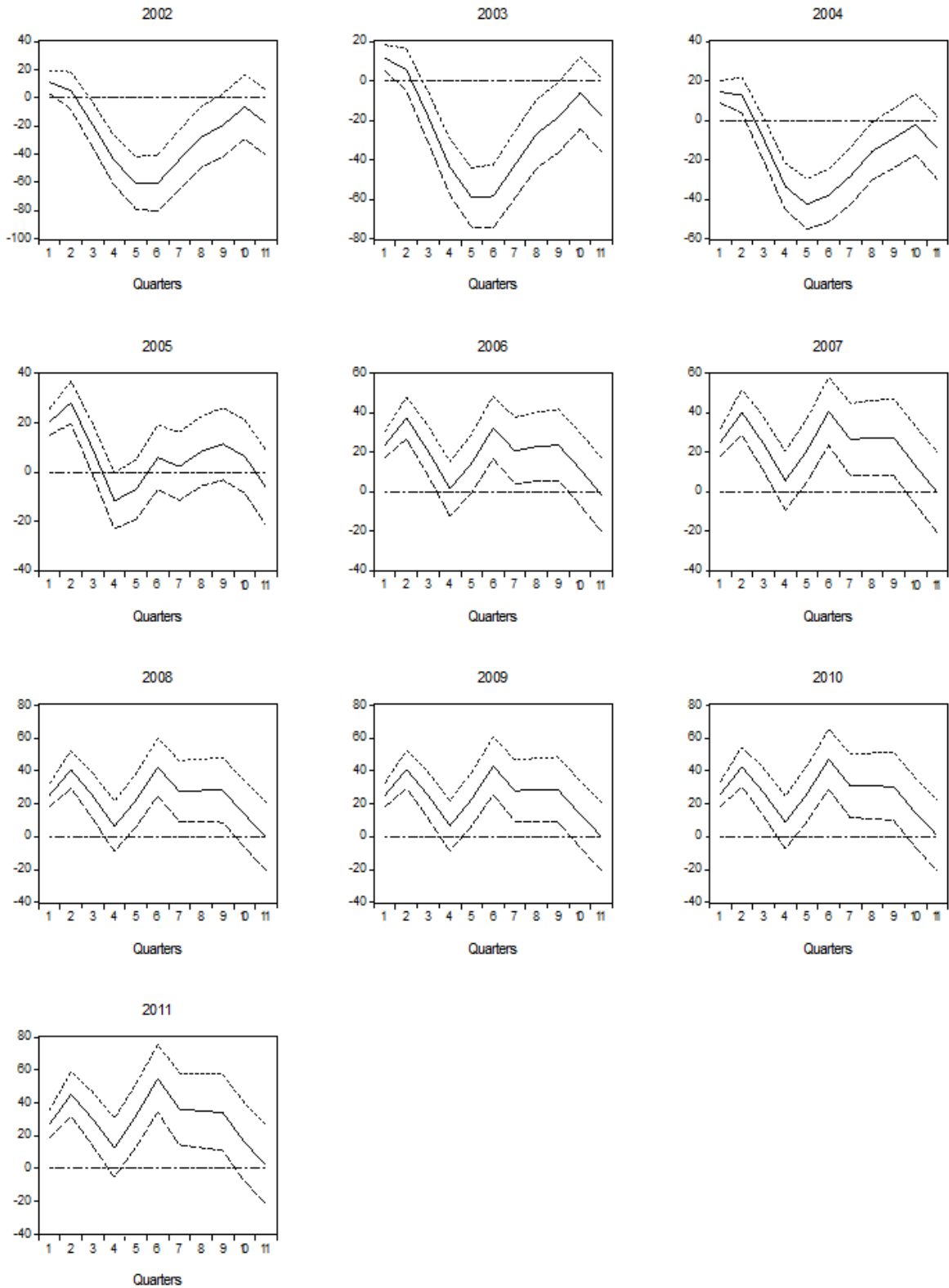
Graph 14. Monetary policy shock:
Response of Commercial loan rate with maturity less than 1 year conditional on the average maturity of new issues of fixed-rated TES
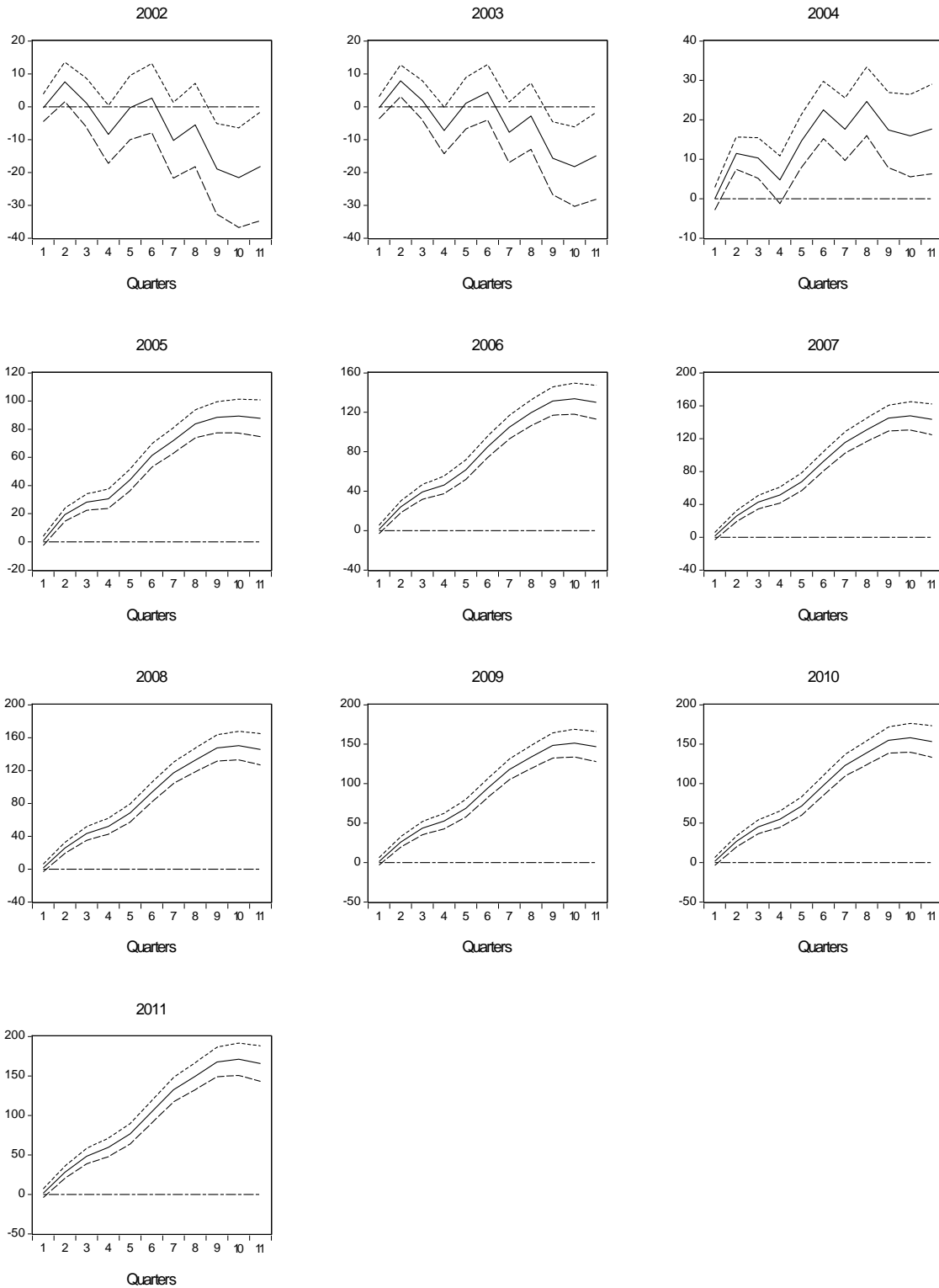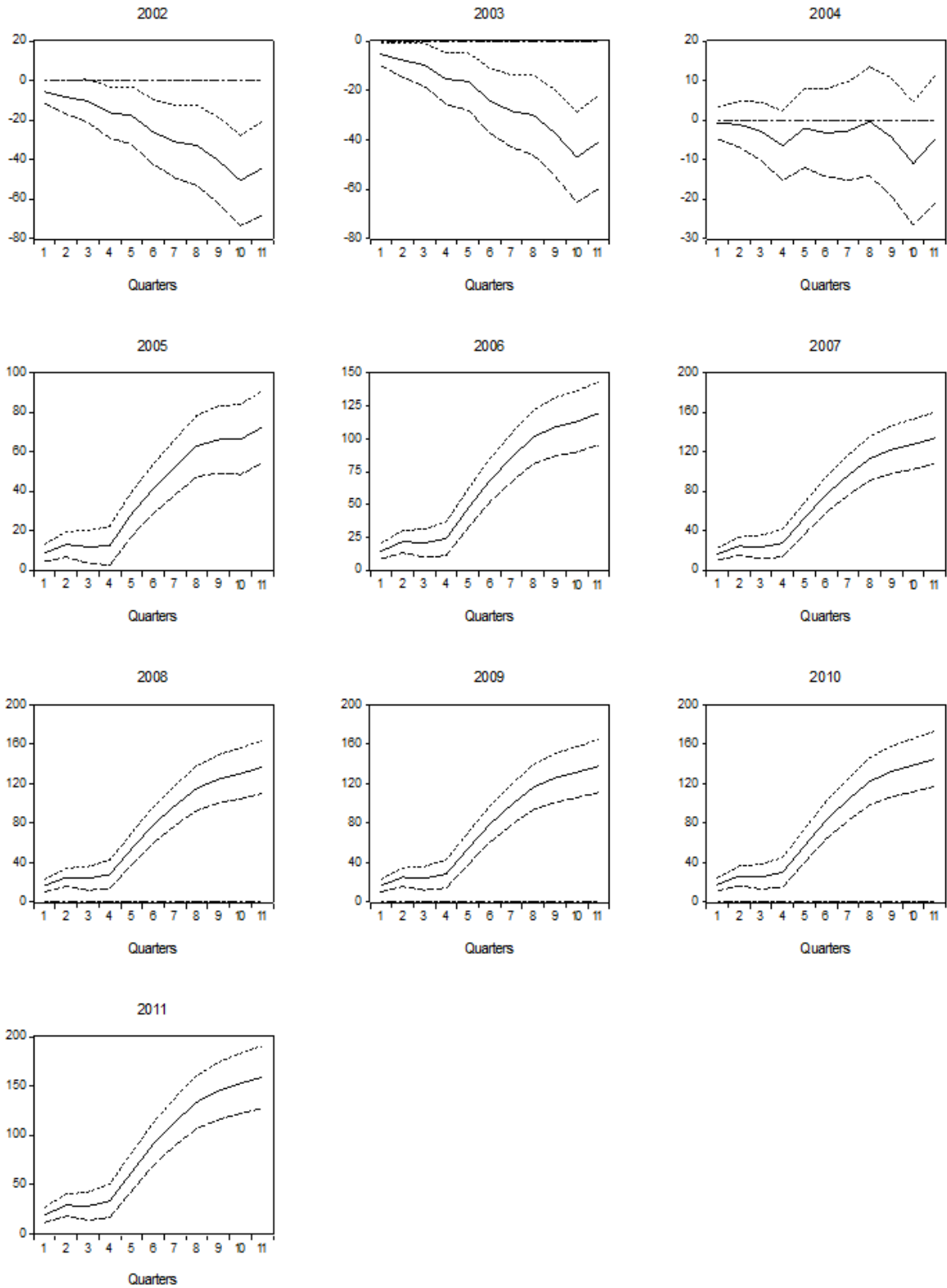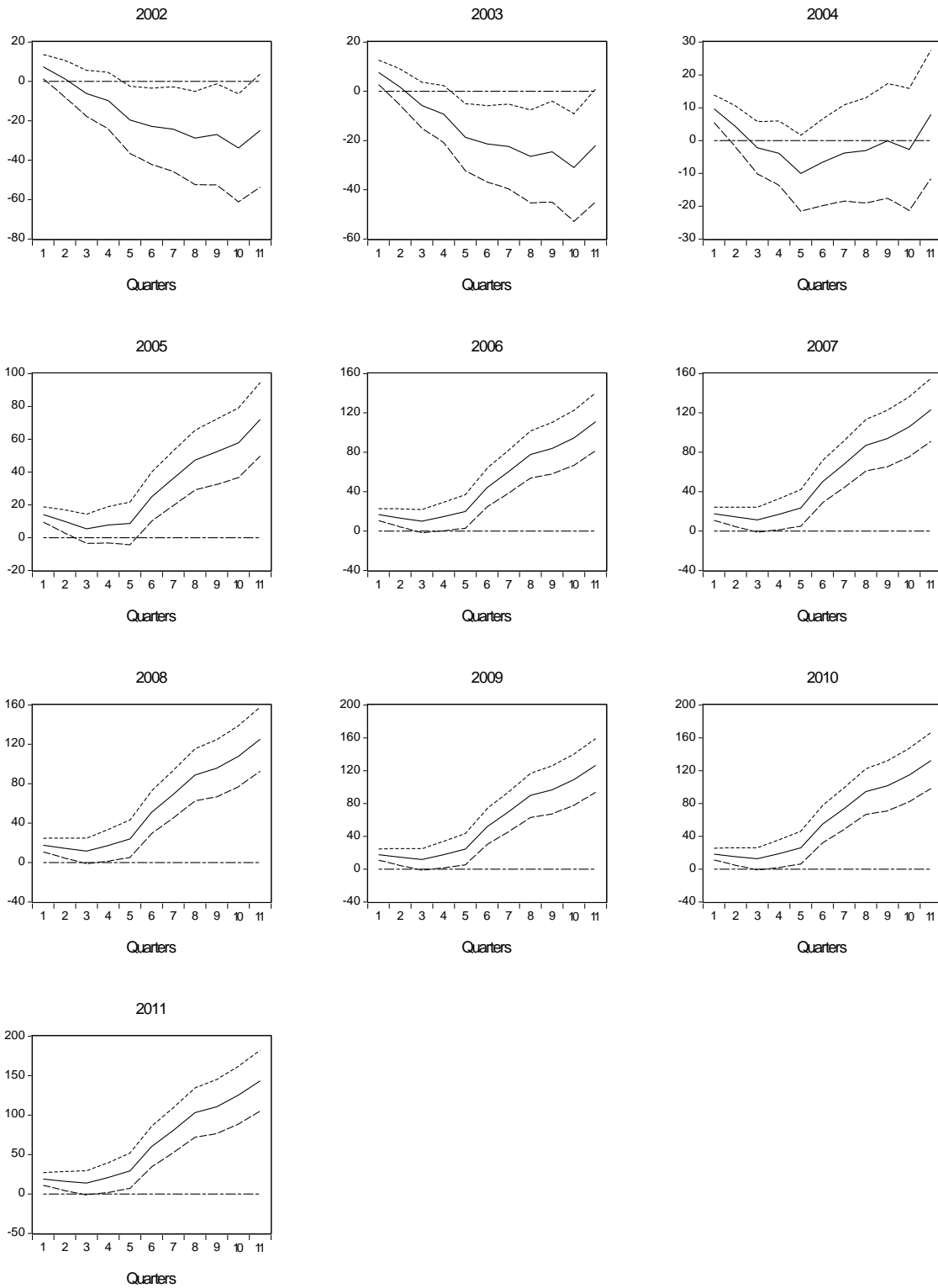
Graph 15. Monetary policy shock:
Response of Commercial loan rate with maturity between 1 to 3 years conditional on the average maturity of new issues of fixed-rated TES

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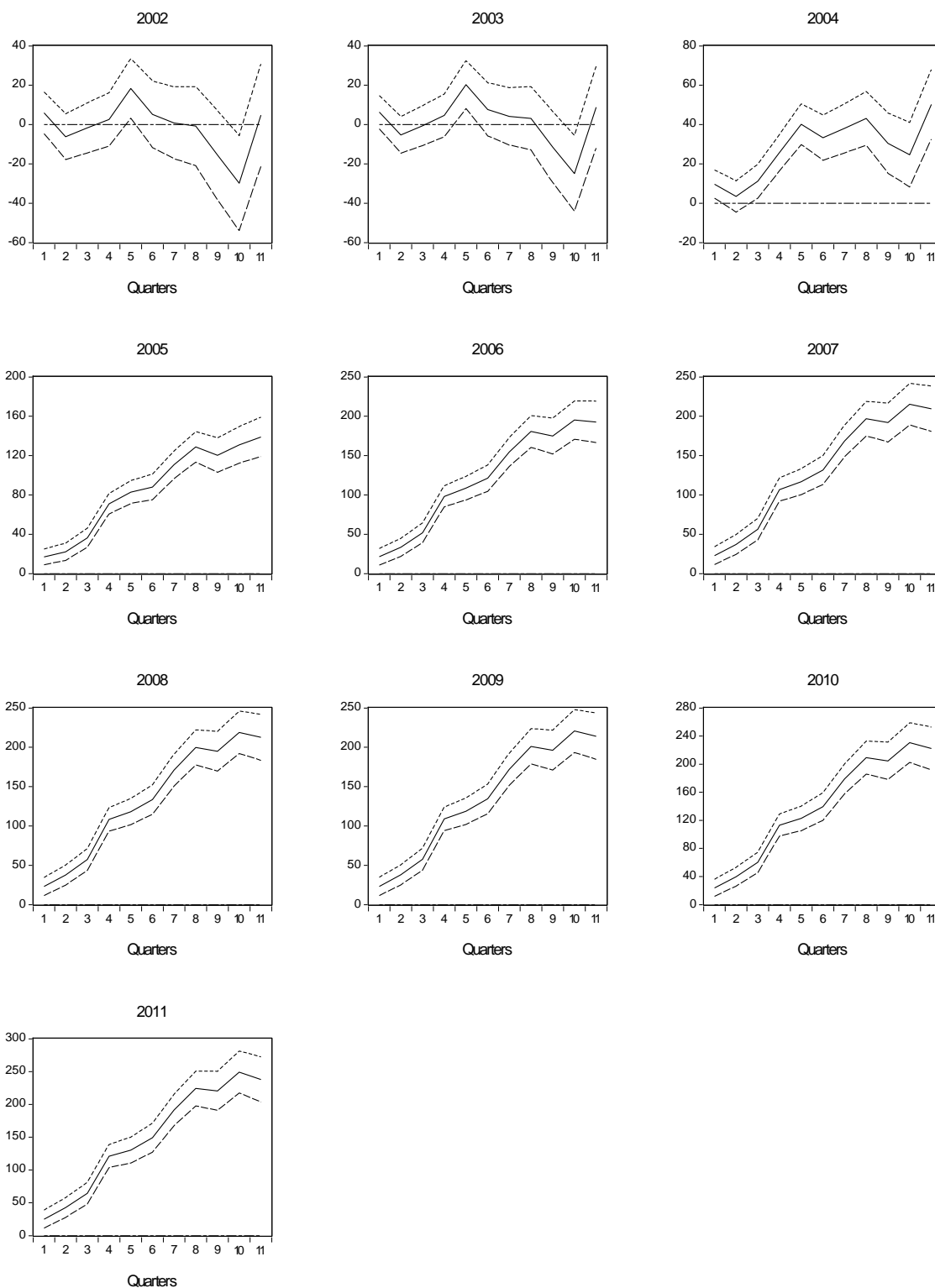
Graph 16. Monetary policy shock:
Response of Commercial loan rate with maturity between 3 to 5 years conditional on the average maturity of new issues of fixed-rated TES

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Graph 18. Monetary policy shock:
Response of the consumer loan rate with maturity less than 1 year conditional on the average maturity of new issues of fixed-rated TES

Graph 19. Monetary policy shock:
Response of the consumer loan rate with maturity between 1 and 3 years conditional on the average maturity of new issues of fixed-rated TES


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Graph 20. Monetary policy shock:
Response of the consumer loan rate with maturity between 3 and 5 years conditional on the average maturity of new issues of fixed-rated TES

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Graph 21. Monetary policy shock:
Response of the consumer loan rate with maturity greater than 5 years conditional on the average maturity of new issues of fixed-rated TES
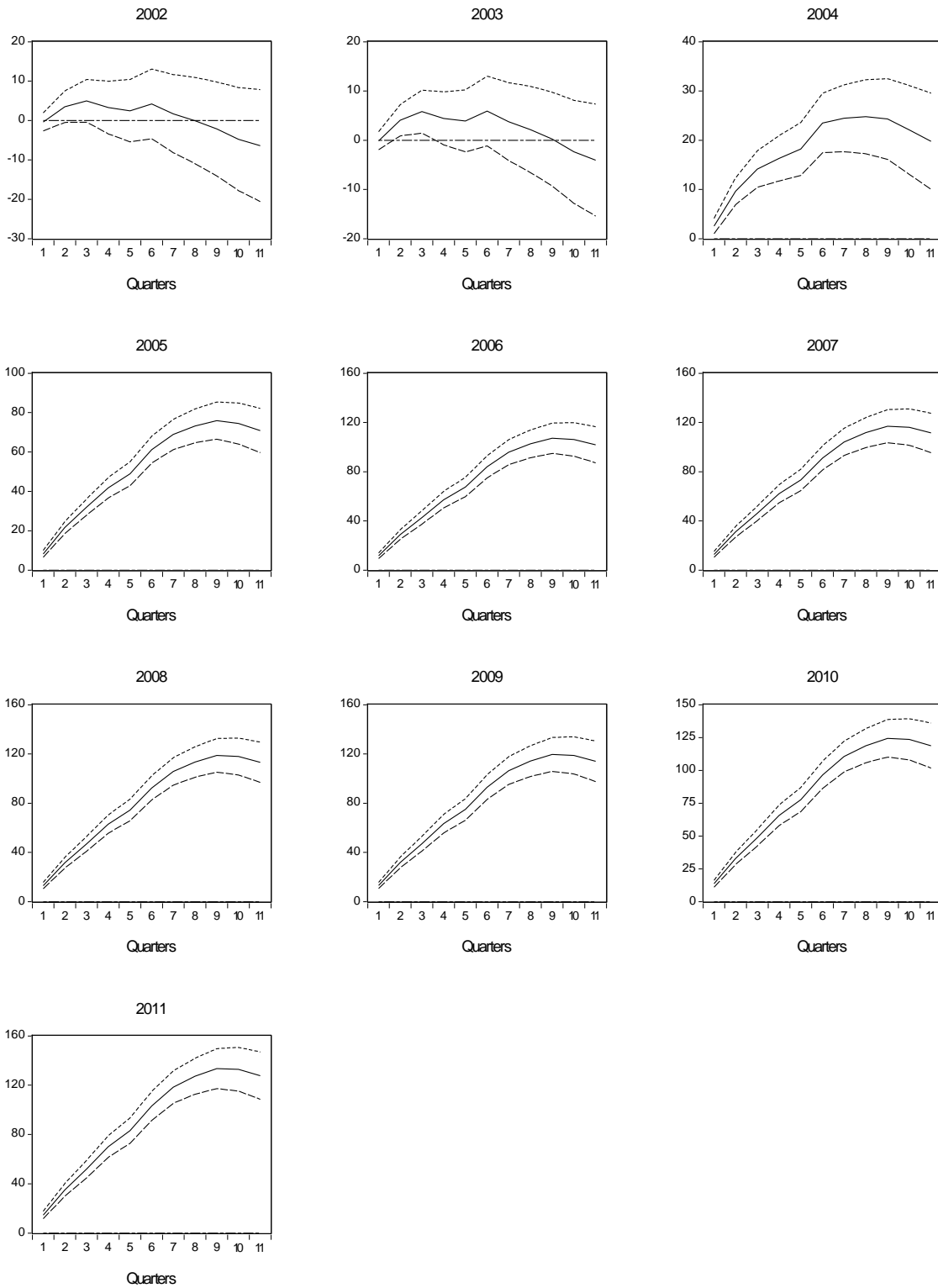
Graph 22. Monetary policy shock:
Response of the CDT rate with maturity less than 90 days conditional on the average maturity of new issues of fixed-rated TES
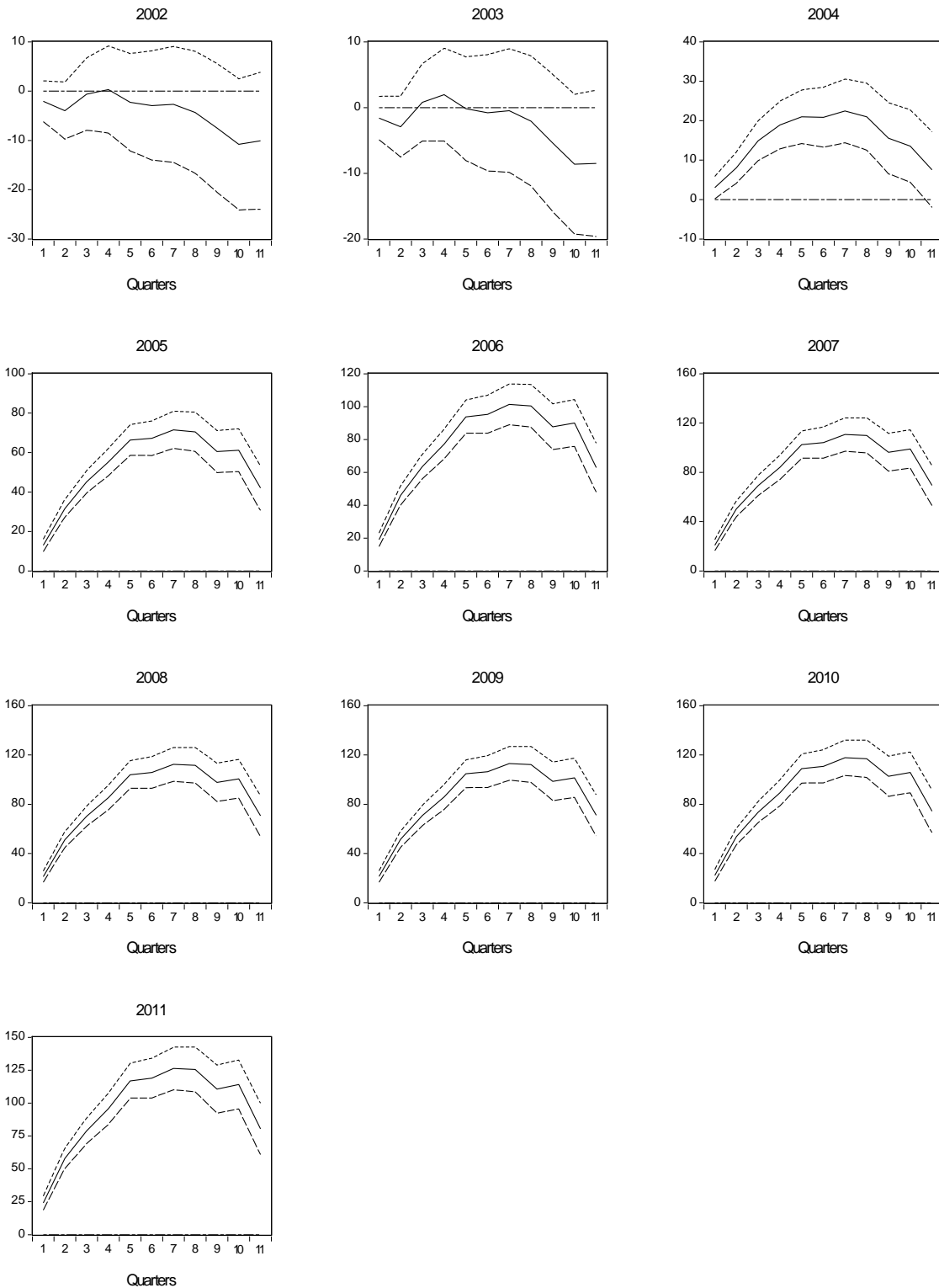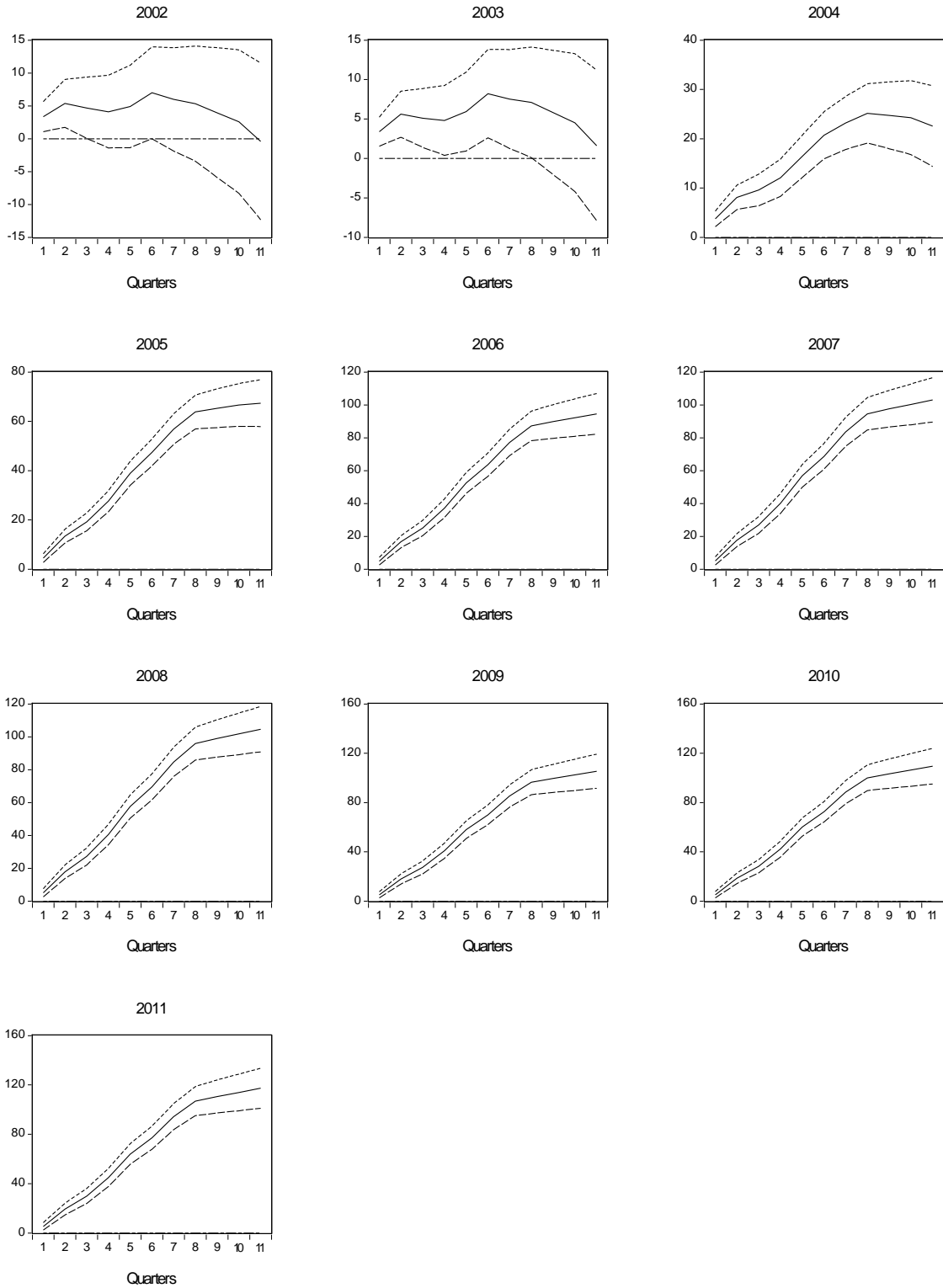
Graph 23. Monetary policy shock:
Response of the CDT rate with maturity of 90 days conditional on the average maturity of new issues of fixed-rated TES
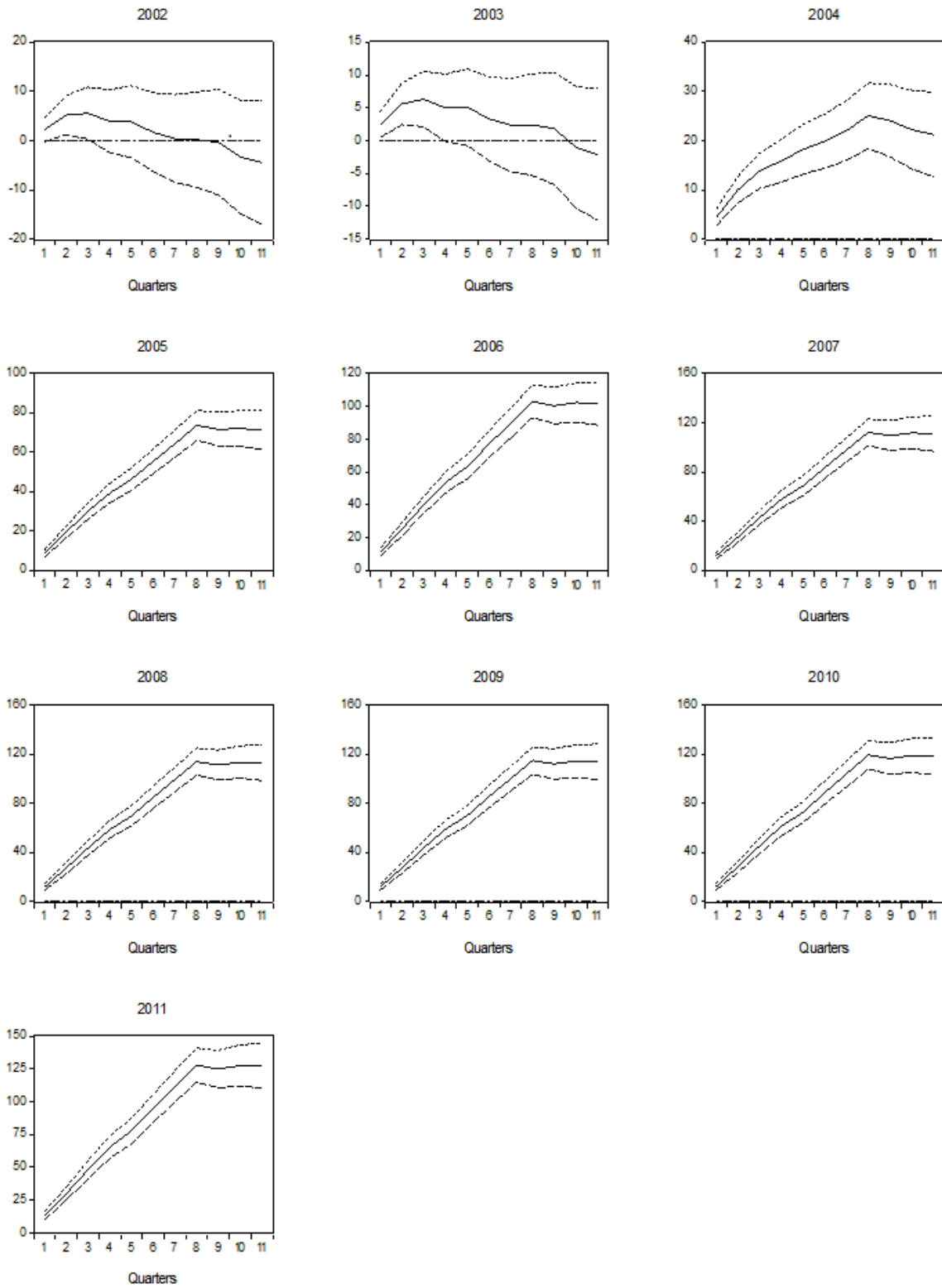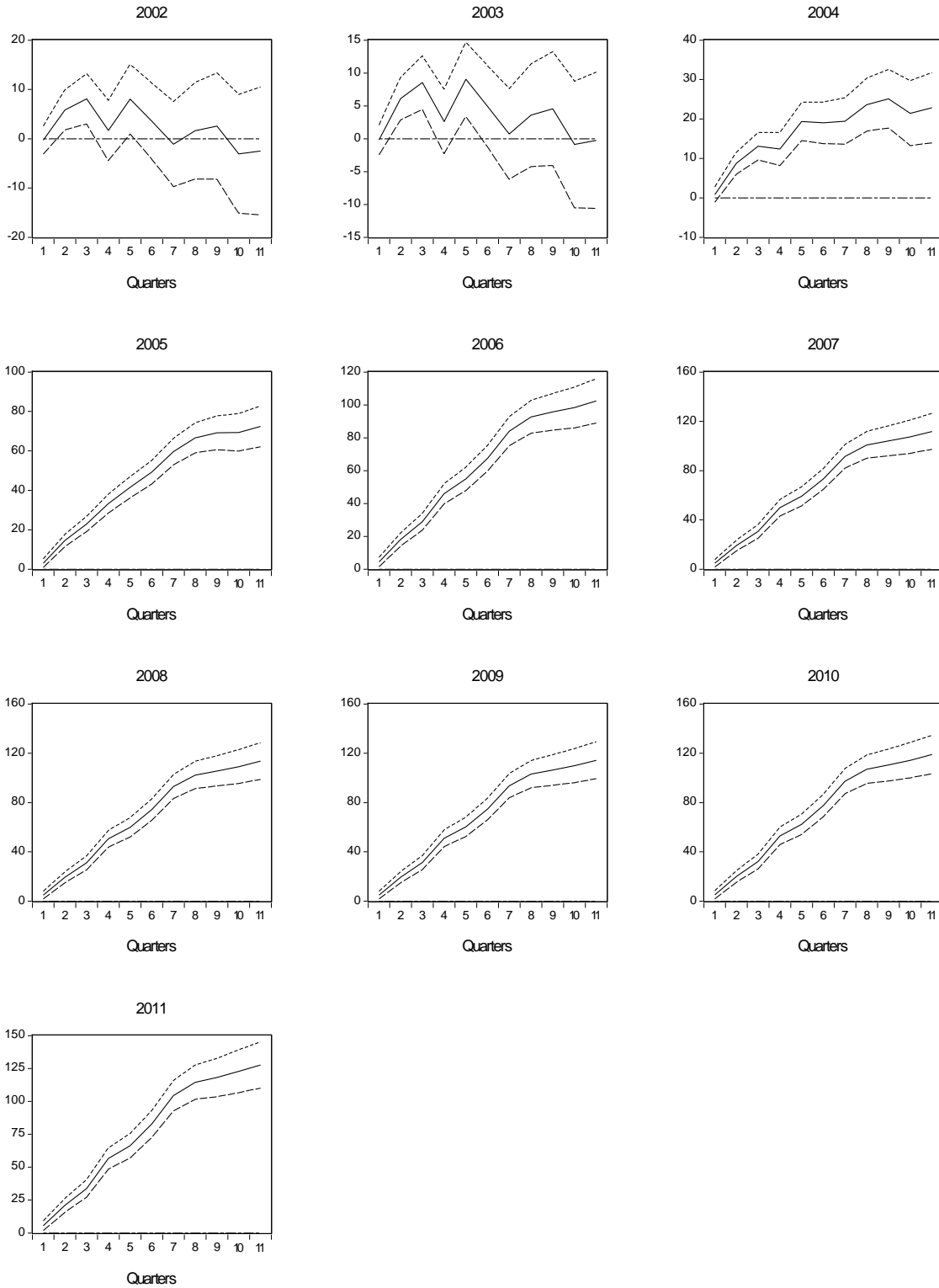
Graph 24. Monetary policy shock:
Response of the CDT rate with maturity between 91 and 170 days conditional on the average maturity of new issues
**of fixed-rated TES**

Graph 25. Monetary policy shock:
Response of the CDT rate with maturity of 180 days conditional on the average maturity of new issues of fixed-rated TES
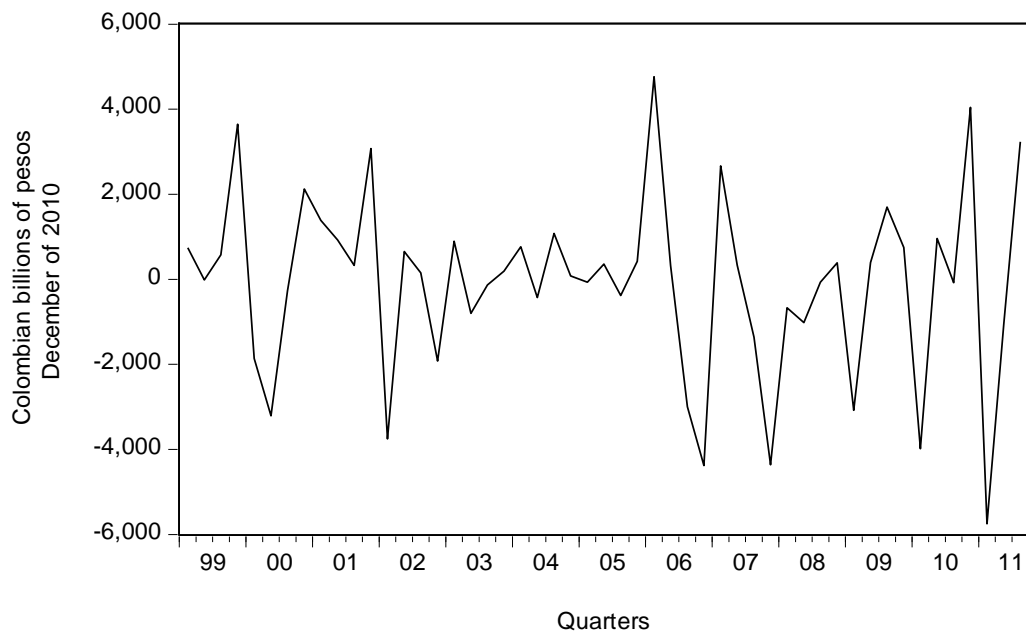
Graph 26. Monetary policy shock:
Response of the CDT rate with maturity between 181 and 360 days conditional on the average maturity of new issues of fixed-rated TES
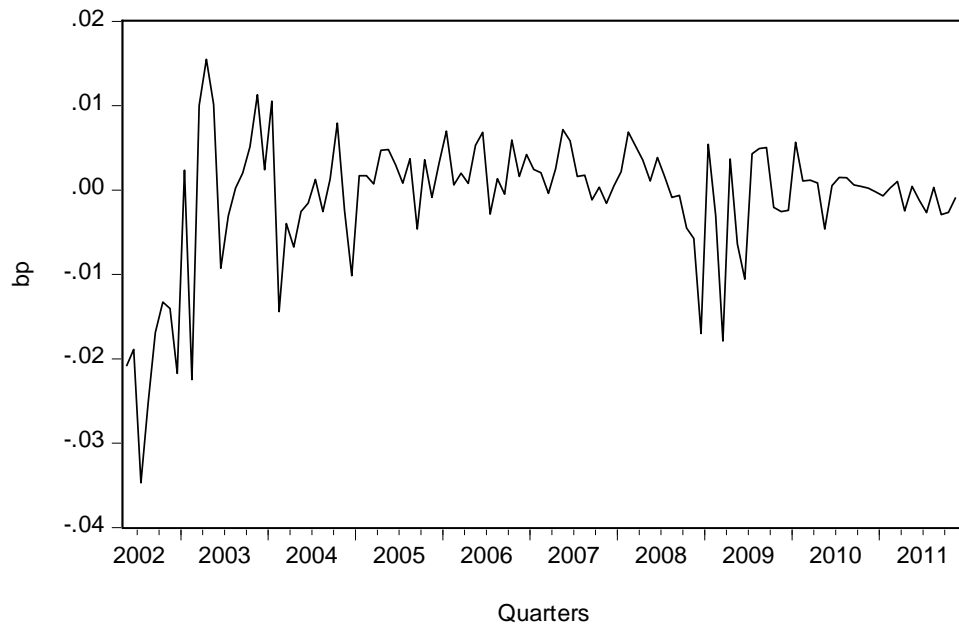
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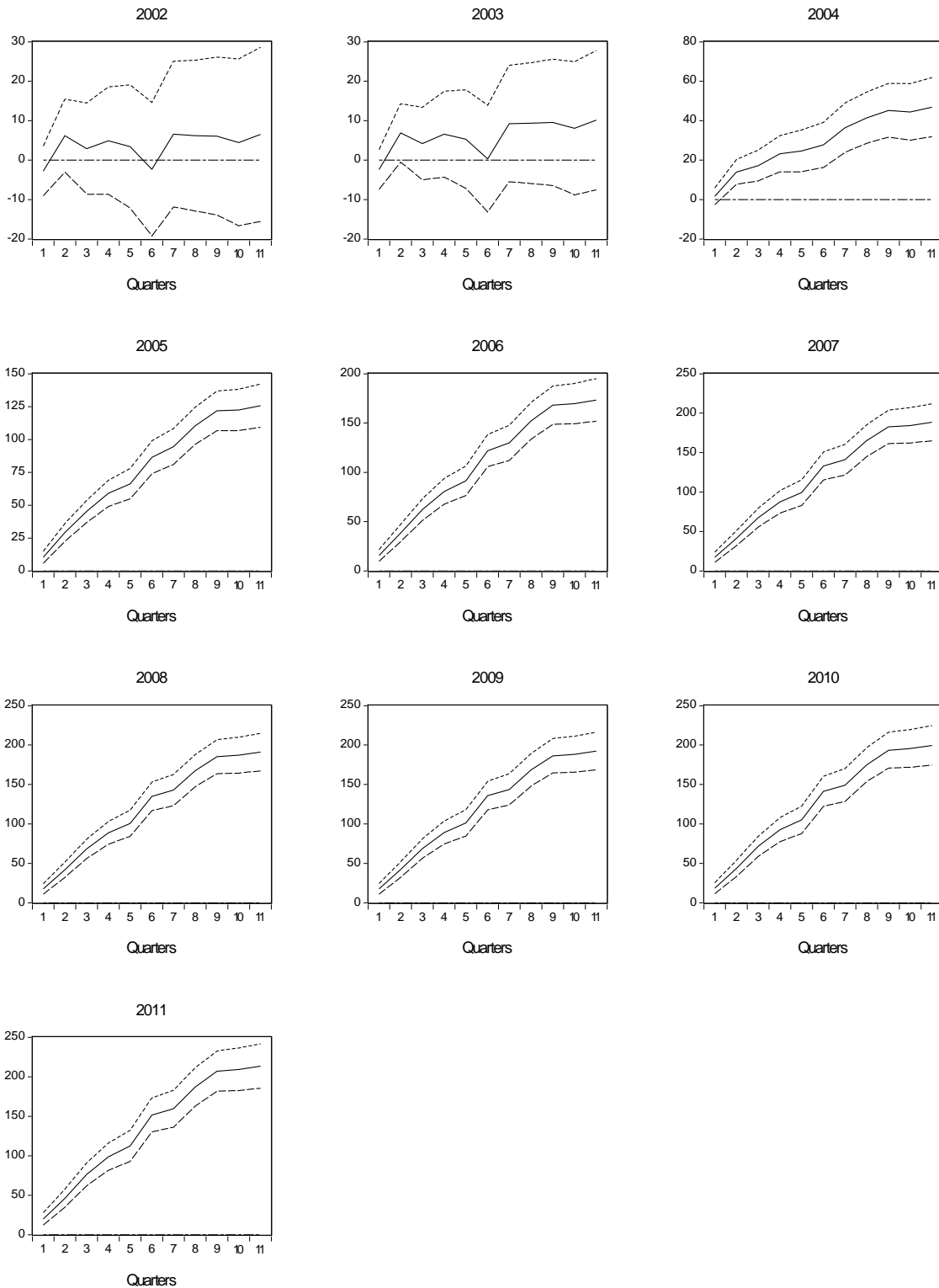
Graph 28. Fiscal shock

Graph 29. Monetary policy shock

Appendix 1

Calculation of the Government Expenditure Shocks

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

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

b. The annual spending announcements made by the Government in the beginning of each year in its Financial Plans are considered as the annual spending forecast.

c. Based on (i) and (ii) we predict the Government spending for the four quarters of each year by multiplying the corresponding budget execution rate (using a moving average of 4th-order) by the annual spending announcements.

d. By the end of the second quarter, information on the first quarter actual expenditure 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.

e. By the end of the third quarter, information on the second quarter actual expenditure is available. Thus, we add an adjustment to the forecast of the fourth quarter that results from the assumptions that the annual 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. Graph 28 shows the fiscal shock (measured in 2010 COP billions).

Appendix 2

Estimation of the Monetary Policy Shock

Similar to what is usually done in 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 with the actions of the monetary authorities and consequently a monetary policy shock will be a movement in the policy rate 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 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 it is natural to include within an estimated Taylor rule not just current inflation and output but also any other variables that can be useful indicators about the future behavior of these variables.

Notice also that under the VAR recursive identification, a monetary policy shocks is not only an unexpected movement of the policy rate but it 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. With this is in mind it is possible to see that a forecast error can serve as proxy of a policy shock. In fact, we defined the policy shock through the forecast error: $i_{t+1} - E[i_{t+1}/\Omega_t]$ 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.

Our definition of the policy shocks is coherent with the definition of the policy shock in a VAR model for two reasons: First, it captures unexpected movements in the policy rate and second because, by definition, it is orthogonal the information set. However, given our definition of a policy shock, we can capture policy shocks that are policy errors or changes in the policy stance not necessarily expected at time t. In the first case, the policy rate is, unintentionally, too low or too high with respect to what is dictated by a policy rule, whereas in the second case, the policy shock signals a change in the monetary policy stance. The source of the policy shocks can have very different effects on the economy.

To make operational this definition of the policy shock 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 not to include variables that are not observed at time t. In our exercise, the information set contains information on inflation, output, credit, the exchange rate, etc. However, some of these variables are observed with delay and consequently its current values cannot be in Ω_t.

We approximate $E[i_{t+1}/\Omega_t]$ with linear projections. That is, $E[i_{t+1}/\Omega_t] = \alpha_o + \alpha_1 x_t$ where x_t is an element of Ω_t. α_o and α_1 are estimated by OLS. We select the elements in x_t by minimizing the AIC criterion.

Finally, to construct a sequence of monetary policy shocks we carried out a rolling exercise where we forecast i_{t+1} at time t and compared 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

criterion. The initial sample of the rolling experiment is 1999m9-2000m12 and is expanded until 2011m12.

The policy shocks are constructed using monthly data on the interbank rate, the Colombian inflation target, the growth rate of the index industrial production, 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 US inflation rate[19]. The shocks are shown in Graph 29.

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[19] All growth rates are annual, the index of capacity utilization, and the nominal average unitary labor cost are included in annual changes. Data is seasonally adjusted using TRAMO-SEATS in Eviews). All these variables are in general available with a delay of one month, however the Index of Industrial Production, the Unitary Labor cost and the ICC are observed with a delay of two months.