Reserve Requirements in Inflation Targeting

The Case of Colombia

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- How do Reserve Requirements (RR) work in an Inflation Targeting (IT) regime?

- What is the evidence on the effects of RR in an IT regime (Colombia and LATAM)?

- When should RR be used as a policy instrument in addition to the interest rate?

  I.e. How to use RR in an optimal monetary policy framework?

How do RR work in an IT regime?

- In IT the Central Bank (CB) stabilizes the short term interest rate …

  … It accommodates changes to money demand in order to sustain an interest rate level deemed compatible with the inflation and output smoothing objectives

- An increase in RR raises the demand for monetary base, but this does not affect the short term interest rate …

  … since the CB itself provides the additional liquidity demanded at the policy interest rate (unlike its reaction in a monetary targeting regime)

- If CB credit is perfect substitute of other sources of bank funding (e.g. deposits), RR will simply reduce deposit interest rates, with no effect on lending rates

Explanation:

- Banks will substitute deposits (made more expensive by the RR hike) for CB credit …
- … Hence, bank credit supply remains stable as well as lending interest rates
- As banks reduce their demand for deposits, deposit rates fall
- The lending-deposit interest rate spread widens through the decrease of deposit rates

However,

- Under <u>imperfect substitution</u> between CB credit and other bank sources of funds, …

… RR increase lending interest rates and have an ambiguous effect on deposit rates (e.g. Betancourt y Vargas (2009))

Explanation:

- As RR are raised, banks try to substitute the (now more expensive) deposits for CB credit, but this substitution is incomplete due to the different characteristics of the two sources of funds…

- … Therefore, credit supply is cut and lending rates rise

- Higher RR make deposits more expensive, decreasing banks' demand for deposits,…

- … but, on the other hand, depending on the magnitude of the decline in equilibrium loans, bank's demand for deposits may increase since the expansion of CB credit may be insufficient to offset the resources frozen by the additional RR:

$$\nabla L = \Delta CB - D\,\Delta r + (1-r')\,\Delta D$$

- Hence, the NET effect on banks' demand for deposits and deposit interest rates is uncertain

- The lending-deposit interest spread widens through an increase in lending rates and an ambiguous movement in deposit rates

- In addition, RR affect the <u>transmission of policy rate movements</u>

- When CB credit and deposits are perfect substitutes, a rise in RR does not influence pass through from policy to lending rates…

… But pass-through from policy to deposit rates is reduced …

… as higher RR imply costlier additional deposits and less willingness by banks to pay for them to substitute for CB credit

- When BC credit and deposits are imperfect substitutes, a rise in RR may affect pass through from policy to both lending and deposit rates

- F. ex. In Betancourt and Vargas (2009), higher RR imply greater interest rate risk for banks when deposits and CB credit have different maturities…

  … When RR are higher, a policy rate hike increases this risk more strongly and implies a larger cut in loan supply (greater pass-through to lending rates)

  … While the impact on deposit rate pass-through is ambiguous as higher RR make deposits costlier (inducing a smaller expansion of banks' demand for deposits), …

  … but the enlarged interest rate risk embodied in CB credit may reinforce deposit demand by banks

Effects of RR in IT: Some Evidence for Colombia and LATAM

Effects on Credit:

- García-Escribano et al. (2012) use event analysis and a dynamic data panel VAR to estimate the impact of RR and other "macro-prudential" policies on bank credit

- Sample is made up by LATAM countries that have used these measures (Brazil, Peru, Colombia) and countries that have not (Chile, Mexico) between 2003 and 2011

- Main results:

  ✓ Short-lived effect on credit, especially from shocks to other "macro-prudential" measures (dynamic provisioning, countercyclical capital requirements)

  ✓ Smaller effects of average RR

  ✓ Non-significant effects of marginal RR

Effects on Interest Rates:

- Vargas et al. (2010) study the effect of RR on lending and deposit interest rates in Colombia between 2002 and 2009 using an error-correction model:

$$i_{m_t} = \beta_o \; i_{b_t} + \beta_1 \; s_t + f(X_t) + \varepsilon_t$$

$$\Delta i_{m_t} = \alpha \; \varepsilon_{t-1} + \left(\Phi(L) + \gamma \; e_t\right)\Delta i_{b_{t-1}} + \Gamma(L)\Delta i_{m_{t-1}} + \Lambda(L)\Delta s_{t-1} + \Omega(L)\Delta X_{t-1} + u_t$$

- Main Results (Appendix):
  - ✓ Positive, long term effects of RR on commercial, prime and “treasury” lending rates
  - ✓ Positive, long term effects of RR on average CD rates and CD rates longer than one year (the latter are exempt from RR)
  - ✓ No significant long term effects on other lending and deposit rates
  - ✓ RR strengthen the transmission of policy rate shifts to lending and deposit interest rates

Macroeconomic Effects:

- Glocker and Towbin (2012) explore the macroeconomic effects of RR and interest rate shocks for Brazil between 1999 and 2010 by means of a Structural VAR that includes the nominal exchange rate, loans, CB reserves, reserve requirements, the policy interest rate, the interest rate spread, the current account, prices and unemployment

- Main Results:

  ✓ Both RR and interest rate shocks decrease loans and increase unemployment

  ✓ However, unlike the interest rate shock, the RR shock depreciates the currency, improves the current account balance and raises prices

  ✓ The authors conclude RR are useful to preserve financial stability (contain leverage without currency appreciation), …

…but are not a substitute of interest rates for the achievement of price stability

What do we know about RR in IT?: Summary

- Theoretically, RR may have a positive impact on bank lending interest rates and an ambiguous effect on deposit rates
- Evidence from Colombia supports positive effect on some (not all) lending rates and on deposit rates that are not subject to RR
- No negative effect is detected for other deposit rates
- RR seem to reinforce the transmission of policy rate movements to loan and deposit rates
- Evidence from LATAM points to a weak and short-lived effect of RR on bank credit, although the study for Brazil finds a stronger, longer-lasting influence
- Evidence from Brazil suggests that RR hikes tend to depreciate the currency
- Overall mixed (contradictory?) results. Effects must vary with specific features of each economy (e.g. structure of the financial system, capital account openness etc.) and the scope/application of RR
- Depending on those features, when and how should RR be used?

The use RR in an optimal monetary policy framework

- Simple closed-economy IT model based on Walsh (2002)
- CB determines optimal policy, acknowledging the short term "trade-off" that may arise between inflation, π, and the output gap, *x*
- RR are included as a policy tool, considering two issues:

1. RR, *z*, affect π and *x* through their impact on lending and deposit interest rates and, consequently, on aggregate expenditure:

$$x = x(i,z) \qquad \text{(IS)}$$

A rise in RR increases lending rates and reduces aggregate demand. It may also decrease deposit rates and expand aggregate demand:

$$x_i < 0, \;\; x_z > or < 0$$

2. RR are distortionary taxes on financial intermediation.

Thus, an optimal, long-term RR level is assumed, z^{LP}, that stems from optimal taxation or liquidity risk considerations

Deviations from this optimal level are costly for the economy
These costs are incorporated in the CB loss function:

$$\rho \frac{\left(z - z^{LP}\right)^2}{2}$$

- Hence, the CB problem is as follows:

$$\underset{i,z}{Min} \quad \frac{\pi^2}{2} + \lambda \frac{x^2}{2} + \rho \frac{\left(z - z^{LP}\right)^2}{2}$$

$$s.t.$$

$$\pi = \pi^e + \alpha\ x + \varepsilon \qquad (Phillips\ \ Curve)$$

$$x = x(i, z) + u \qquad (IS\ \ Curve)$$

- First order conditions:

$$\left(\alpha\ \pi + \lambda\ x\right) x_i = 0$$

$$\left(\alpha\ \pi + \lambda\ x\right) x_z + \rho\left(z - z^{LP}\right) = 0$$

- *z* and *i* work through the same transmission channel (aggregate demand)

- Therefore, the use of RR does not improve the trade-off between inflation and output, but it implies costs if RR deviate from the long term optimal level

- So, optimal policy minimizes the RR cost by setting $z = z^{LP}$ and uses the interest rate to solve the "trade-off" between inflation and the output gap:

$$z^* = z^{LP}$$

$$\pi(x^*) = -\left(\frac{\lambda}{\alpha}\right) x^*$$

$$i^*\ such\ that\ x^* = x(i^*, z^{LP})$$

- This result holds regardless of the power of the transmission mechanism from i to x and π, or from z to x and π

- Hence, a weaker transmission of shifts in policy rates does not justify the use of RR as a monetary policy instrument in this model

- However, RR may play a role as a monetary policy tool if more transmission channels are considered or if more CB objectives are included

More transmission channels

- Similar macro model, but for a <u>small, open economy</u>
- CB has the same objectives as before, but there is now an additional transmission channel associated with the exchange rate
- The CB problem is as follows:

$$\underset{i,z}{Min} \quad \frac{\pi^2}{2} + \lambda \frac{x^2}{2} + \rho \frac{\left(z - z^{LP}\right)^2}{2}$$

$$s.t.$$

$$\pi = \pi^e + \alpha\ x + \beta\ s + \varepsilon \qquad (Phillips\ \ Curve)$$

$$x = x(i, z, s) + u \qquad (IS)$$

$$s = s(i, z) + v \qquad (No\min al\ \ Depreciation)$$

- From first order conditions:

$$z^* = z^{LP} + \frac{\beta\pi}{\rho}\left(\frac{x_z s_i - x_i s_z}{x_i + x_s s_i}\right)$$

- RR play a role in an optimal monetary policy setting if:
  - Inflation is off-target $\pi \neq 0$
  - There a pass-through from the exchange rate to local prices, $\beta > 0$
  - The ratio between the effects of the policy interest rate and the RR on the exchange rate differs from the ratio of the effects that these instruments have on aggregate demand $s_i/s_z \neq x_i/x_z$

- The magnitude of the use of RR is inversely related to the weight of their deviations in the CB loss function, ρ

- To better understand the role of RR in an optimal policy setting, it is useful to explore their adjustment in response to shocks that may hit the economy

- For that purpose, a comparative statics exercise is performed on the basis of the first order conditions, assuming that the slope parameters x_s, x_i, x_z, s_i and s_z are constant and making some assumptions about their sign:

$$x_s > 0,\ x_i < 0,\ x_z < 0,\ s_i < 0 \text{ and } s_z > or < 0$$

- $x_z < 0$: The effect of RR on lending rates prevails in the response of aggregate expenditure to a shift in RR, or the impact of RR on deposit rates is not negative

- $s_z > or < 0$:

  – $s_z < 0$: capital flows are more responsive to lending (not deposit) rates, or the impact or RR on deposit rates is not negative

  – $s_z > 0$: RR affect deposit rates negatively and capital flows respond strongly to these rates

- Positive Demand shocks ($u > 0$):

✓ Interest rates are increased
✓ RR response:

$$\frac{dz}{du} = \frac{\beta^2 \lambda \; s_i \left(s_z x_i - s_i x_z \right)}{D}$$

- When $s_z > 0$, RR are increased: With an active exchange rate channel, the adjustment in the interest rate necessary to drive x to zero appreciates the currency and causes inflation to fall below target

  - An increase in RR improves the CB "trade-off" by depreciating the currency and increasing inflation, while contributing at the same time to curb aggregate demand

  - RR work as complements of interest rates

- When $s_z < 0$,RR and the interest rate influence the exchange rate in the same direction. Hence, the benefits of RR as a policy tool are lower

  - If $s_i / s_z > x_i / x_z$, RR are raised. They are attractive with respect to the interest rate to offset the demand shock because they curb aggregate demand with a milder impact on the exchange rate. They act as substitutes of interest rates

  - If $s_i / s_z < x_i / x_z$, RR are reduced. Their effect on the exchange rate is strong relative to their impact on expenditure, so they are used to moderate the appreciation with a relatively low positive impact on aggregate demand.

- Negative Supply shocks ($\varepsilon > 0$):

✓ Interest rates are increased
✓ RR response:

$$\frac{dz}{d\varepsilon} = -\frac{\beta\lambda \left(x_i + x_s s_i\right)\left(s_z x_i - s_i x_z\right)}{D}$$

- When $s_z > 0$, RR are reduced: With an active exchange rate channel, the adjustment in the interest rate lowers inflation at the expense of output.

  - A decrease in RR improves the CB "trade-off" by appreciating the currency and reducing inflation, while contributing at the same time to stimulate aggregate demand

  - RR work as complements of interest rates

- When $s_z < 0$ and $s_i / s_z > x_i / x_z$, RR are reduced. Their effect on output is strong relative to their impact on the exchange rate, so they are used to stimulate output with a relatively low positive impact on depreciation and inflation.

- When $s_z < 0$ and $s_i / s_z < x_i / x_z$, RR are raised. They are attractive with respect to the interest rate to offset the supply shock because they reduce depreciation and inflation with a milder impact on output. They act as substitutes of interest rates

- Nominal depreciation and inflation expectation shocks bring about optimal RR responses that are qualitatively similar to the responses to supply shocks

- An application: A nominal <u>appreciation</u> shock

  - When $s_z > 0$, the optimal policy response involves a decrease in interest rates and a RR hike

  - With only the interest rate as a tool, the decline required to stabilize inflation causes an undesired positive output gap

  - Higher RR improve the CB "trade-off" by depreciating the currency and increasing inflation, while constraining demand and output at the same time

More CB objectives

- RR also play an active role as part of optimal monetary policy when there are additional CB objectives. E.g. Financial Stability
- A credit variable is added to the CB loss function (Disyatat, 2005)
- Closed economy model with credit channel (Bernanke and Blinder (1988). Credit supply shocks are introduced
- CB Problem:

$$\underset{i,z}{Min} \quad \frac{\pi^2}{2} + \lambda \frac{x^2}{2} + \gamma \frac{c^2}{2} + \rho \frac{\left(z - z^{LP}\right)^2}{2}$$

$$s.t.$$

$$i_d = i_d(i, z)$$

$$i_i = i_l(i, z) + \xi$$

$$x = x(i_d, i_l) + u \qquad (IS)$$

$$\pi = \pi^e + \alpha\ x + \varepsilon \qquad (Phillips\ \ Curve)$$

$$c = c_y\ x + c_l\ i_l \qquad (Credit\ \ demand - Excess\ \ leverage)$$

- From first order conditions:

$$z = z^{LP} + \frac{\gamma\ c_l\ c}{\rho}\left(\frac{x_d}{x_d i_i^d + x_l i_i^l}\right)\left(i_z^d\ \ i_i^l - i_i^d\ \ i_z^l\right)$$

- RR play a role in an optimal monetary policy setting if:
  - There are credit imbalances ($c > 0$)
  - The CB is concerned about financial stability ($\gamma > 0$)
  - The ratio between the effects of the policy rate and RR on the lending interest rate differs from the ratio of the effects of those instruments on deposit rates:

$$i^l{}_i / i^l{}_z \neq i^d{}_i / i^d{}_z$$

- As before, comparative statics with FONC assuming constant “slopes” and: $i^d_i > 0$, $i^d_z > ó < 0$, $i^l_i > 0$, $i^l_z > 0$

- Negative demand shocks ($u < 0$): (with no direct effect on credit supply)

✓ Interest rates are decreased
✓ RR response:

$$\frac{dz}{du} = -\frac{x_d \; {c_l}^2 \gamma \left(\alpha^2 + \lambda\right) i_i^l \left(i_z^d \; i_i^l \; - i_i^d \; i_z^l\right)}{H}$$

- When $i^d_z < 0$, RR are increased: The adjustment in the interest rate necessary to push x back to zero generates excess leverage

  ➢ An increase in RR improves the CB "trade-off" by increasing lending rates and curbing credit, while stimulating expenditure through lower deposit rates at the same time

  ➢ RR work as complements of interest rates

- When $i^d_z > 0$, RR and the interest rate influence both lending and deposit rates in the same direction. Hence, the benefits of RR as a policy tool are lower

  ➢ If $i^l_i \; / \; i^l_z \; > \; i^d_i \; / \; i^d_z$, RR are reduced. They are attractive with respect to the interest rate to confront the demand shock because they fuel aggregate demand with a milder impact on credit. They act as substitutes of interest rates

  ➢ If $i^l_i \; / \; i^l_z \; < \; i^d_i \; / \; i^d_z$, RR are raised. They moderate leverage (through a higher lending rate) with only a small offsetting effect on the impulse provided by the reduction in the policy rate

- The same logic applies to the analysis of (positive) supply shocks

- F. ex. in an open economy an appreciation shock calls for a decline in policy rates that may encourage undesired leverage growth

- If $i^d_z < 0$, an increase in RR may improve the CB "trade-off" by encouraging demand and inflation (through lower deposit rates/depreciation), while curbing leverage (through higher lending rates) at the same time

- RR work as complements of interest rates in this case

• Positive credit supply shocks ($\xi < 0$): (better risk perception, reallocation of bank asset portfolio)

• It also stimulates aggregate demand (lower lending rates)

✓ Interest rates are raised

✓ RR response:

$$\frac{dz}{d\xi} = \frac{x_d^2 \; c_l^2 \; i_i^d \; \gamma\left(i_z^d \; i_i^l \; - i_i^d \; i_z^l\right)\left(\alpha^2 + \lambda\right)}{H}$$

- When $i^d_z < 0$, RR are raised. They help contain leverage through higher lending rates with a milder effect on output and inflation since deposit rates fall. Substitutes of interest rates

- If $i^d_z > 0$ and $i^l_i \; / \; i^l_z \; > \; i^d_i \; / \; i^d_z$, RR are reduced. Interest rates have a relatively stronger effect on lending rates, so they are used to contain leverage. RR are lowered to mitigate the effect on aggregate demand

- If $i^d_z > 0$ and $i^l_i \; / \; i^l_z \; < \; i^d_i \; / \; i^d_z$, RR are raised. They are attractive with respect to interest rates to curb leverage because of their relatively stronger effect on lending rates. Hence, they can contain credit with a smaller effect on output. Substitutes of interest rates

Summary:

- From the perspective of optimal monetary policy, it is difficult to establish a general procedure for the use of RR in an IT regime.

- As RR act as distortionary taxes, their volatility is costly for the economy. Hence, in principle, it is undesirable to move them frequently and in large magnitudes.

- Theoretically, the use of reserve requirements is justified when monetary policy has several transmission channels, the CB has additional objectives such as financial stability and, especially, when their effects differ from the policy rate's.

- However, the relevance, magnitude and direction of the movements of reserve requirements depend on the parameters of the economy and the shocks that affect it.

- Depending on these factors, reserve requirements may act as complements or substitutes of the policy interest rate.

- As a result, each CB should determine the relevance and the way to use reserve requirements.

- For example, in Colombia:
  - No evidence of a negative effect of RR on deposit rates
  - Low and decreasing pass-through from the exchange rate to local prices
  - Capital flows (other than FDI) seem to respond more to the lending or public bond rates than to deposit rates
- Therefore a frequent use of RR is not justified on the basis of the model presented above
- In addition, uncertainty on the macroeconomic effects of RR suggests limiting RR responses to large shocks (for which the Brainard principle is less restrictive)

- That is why RR have been used sparsely to contain credit growth or to reinforce the transmission of policy rate shifts (e.g. in 2007-2008)

- Interestingly, the model above implies that if $i^d{}_z \geq 0$ (a condition that may hold in Colombia), a weakening in the transmission from policy to lending rates (drop in $i^l{}_i$) may justify higher optimal RR

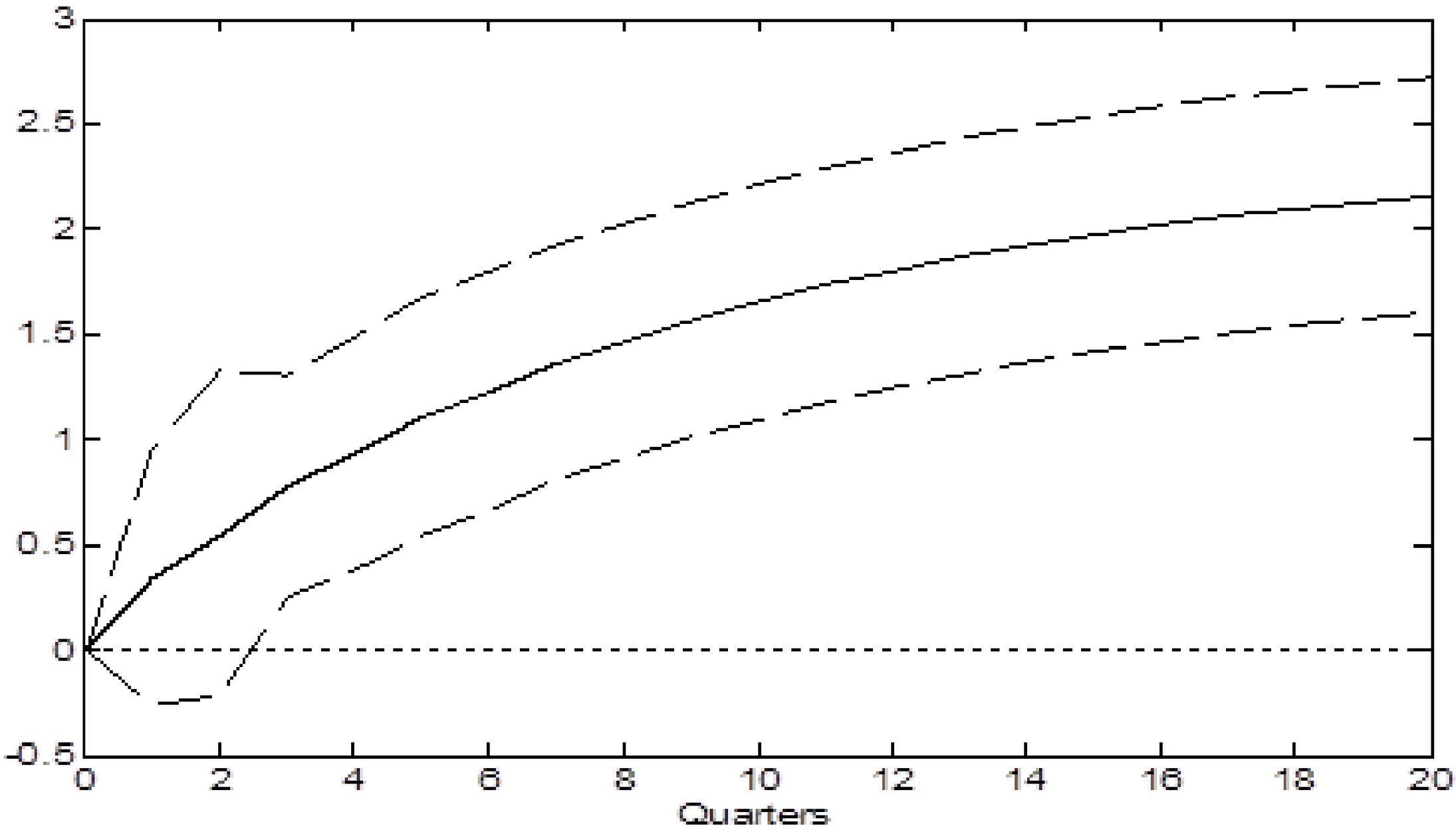
$$\frac{\partial z}{\partial i^l{}_i} = \frac{\gamma c c_l x_d i^d{}_i}{\rho(x_d i^d{}_i + x_l i^l{}_i)^2}\left(x_d i^d{}_z + x_l i^l{}_z\right) < 0$$

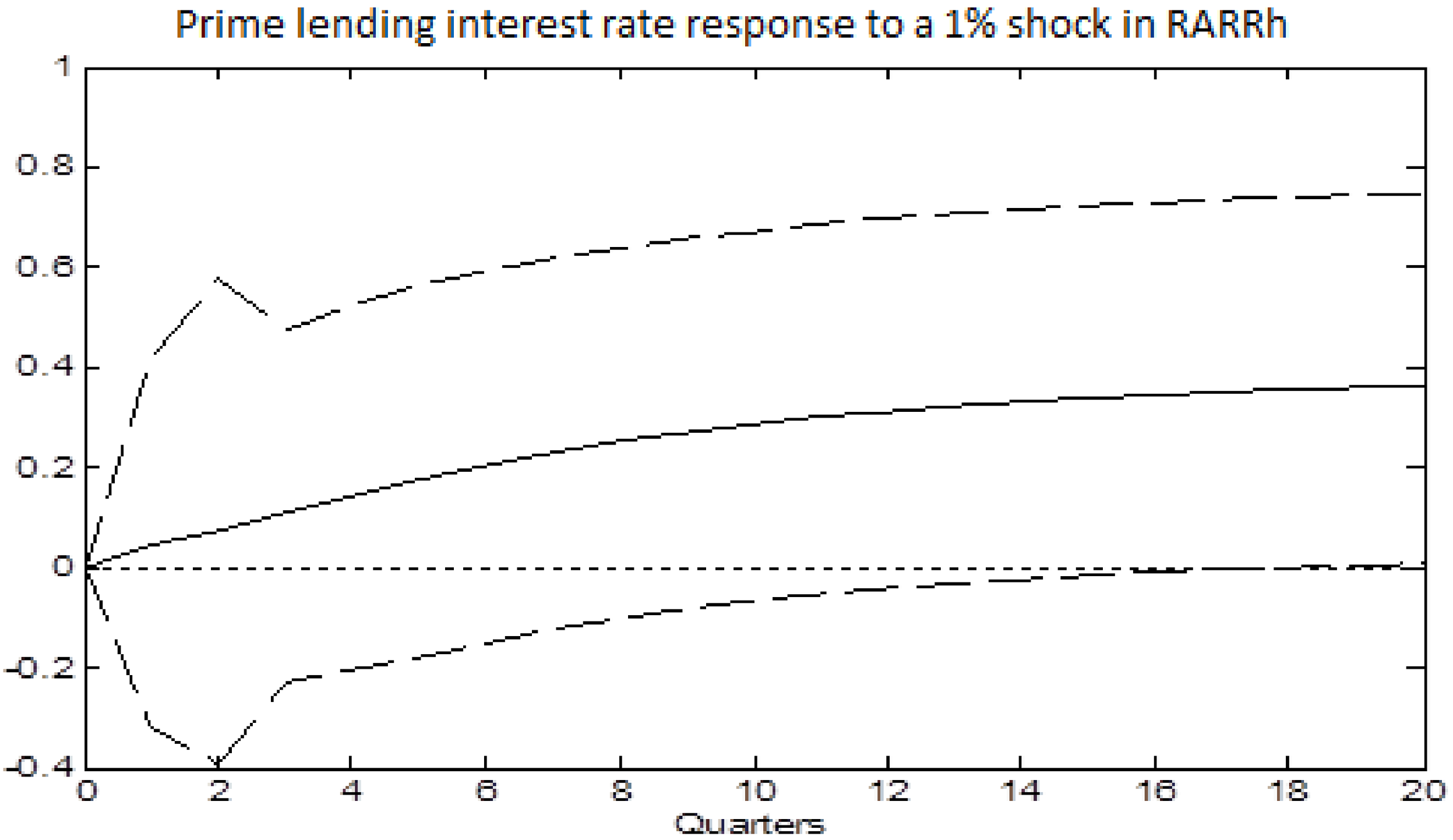
Appendix

Responses of some interest rates to RR shocks in Colombia

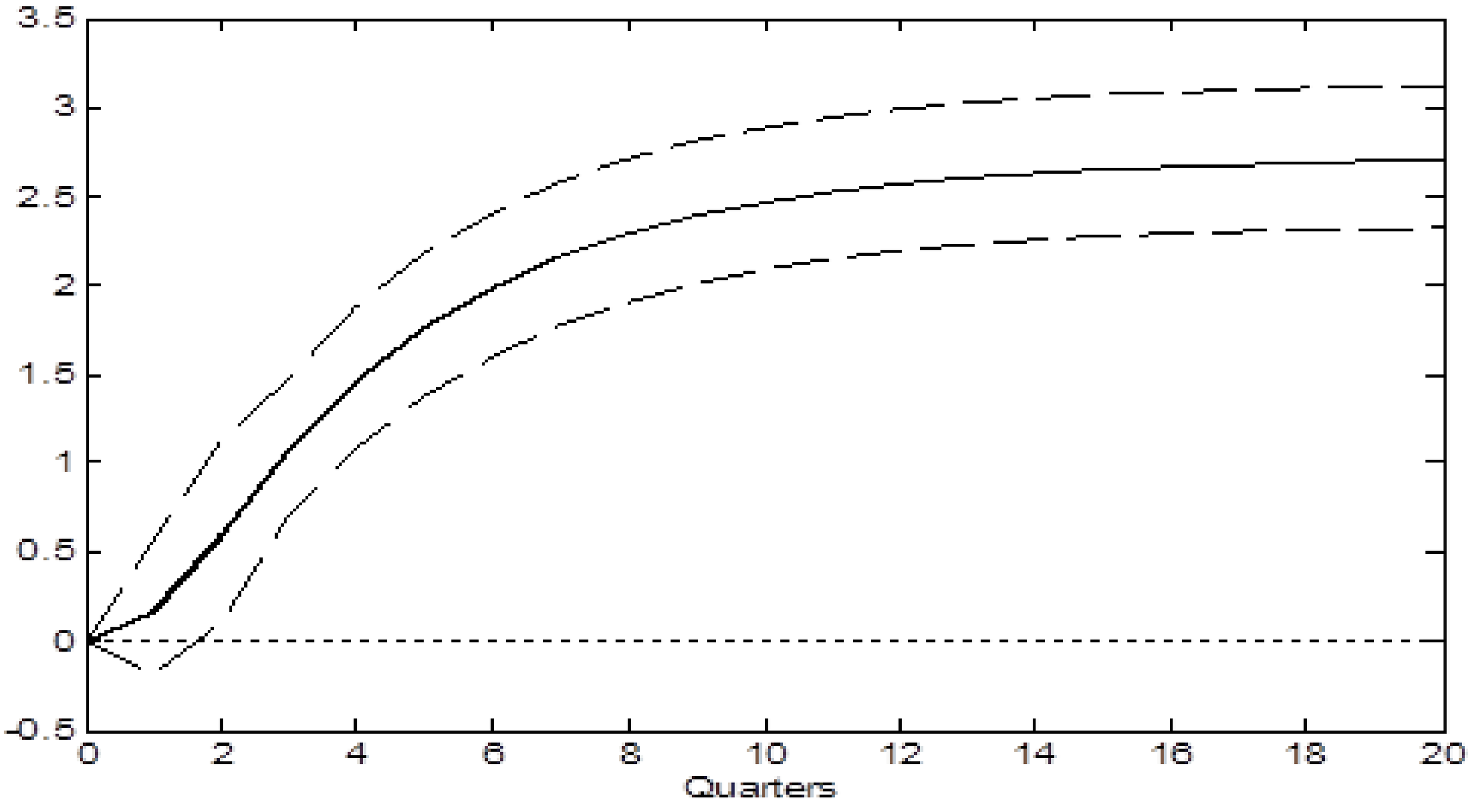
Interest rate pass-through for varying RR in Colombia

Commercial loan interest rate response to a 1% shock in RARRh

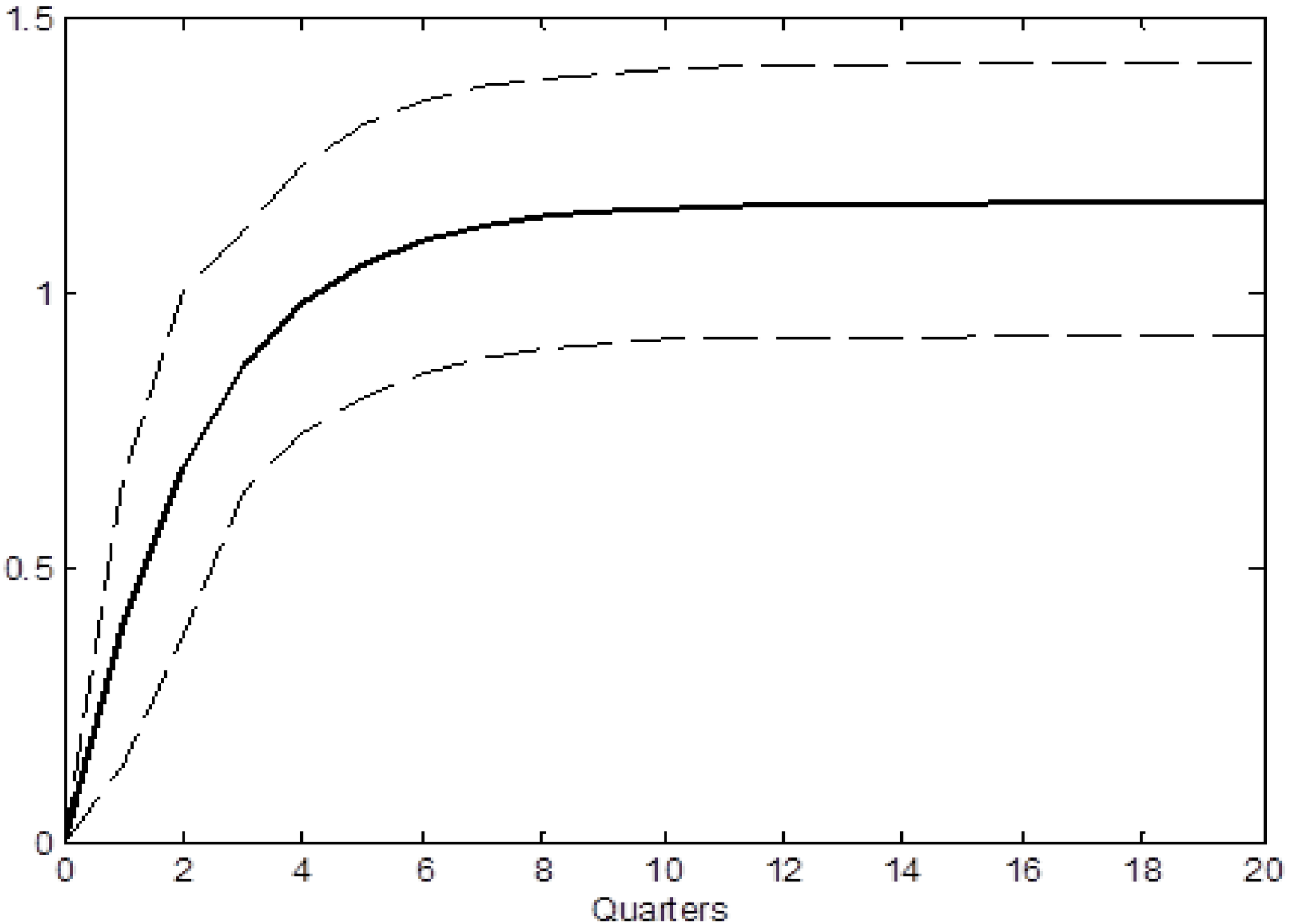



Prime lending interest rate response to a 1% shock in RARRh
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
2
4
6
8
10
12
14
16
18
20
Quarters

Commercial bank treasury loan interest rate response to a 1% shock in RARRh



Long term (>360 days) CD interest rate response to a 1% shock in RARRh



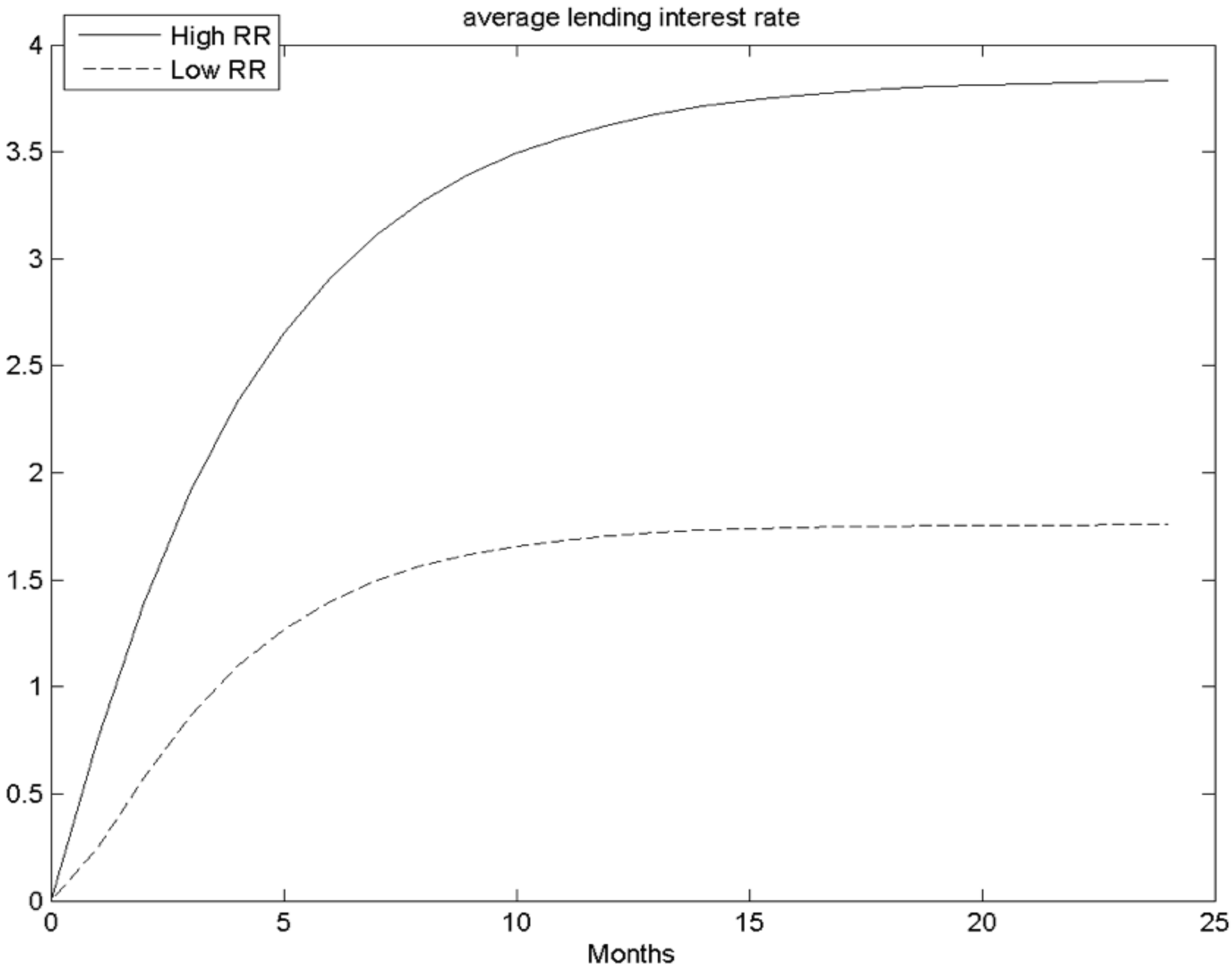
Average CD interest rate response to a 1% shock in RARRh

0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1

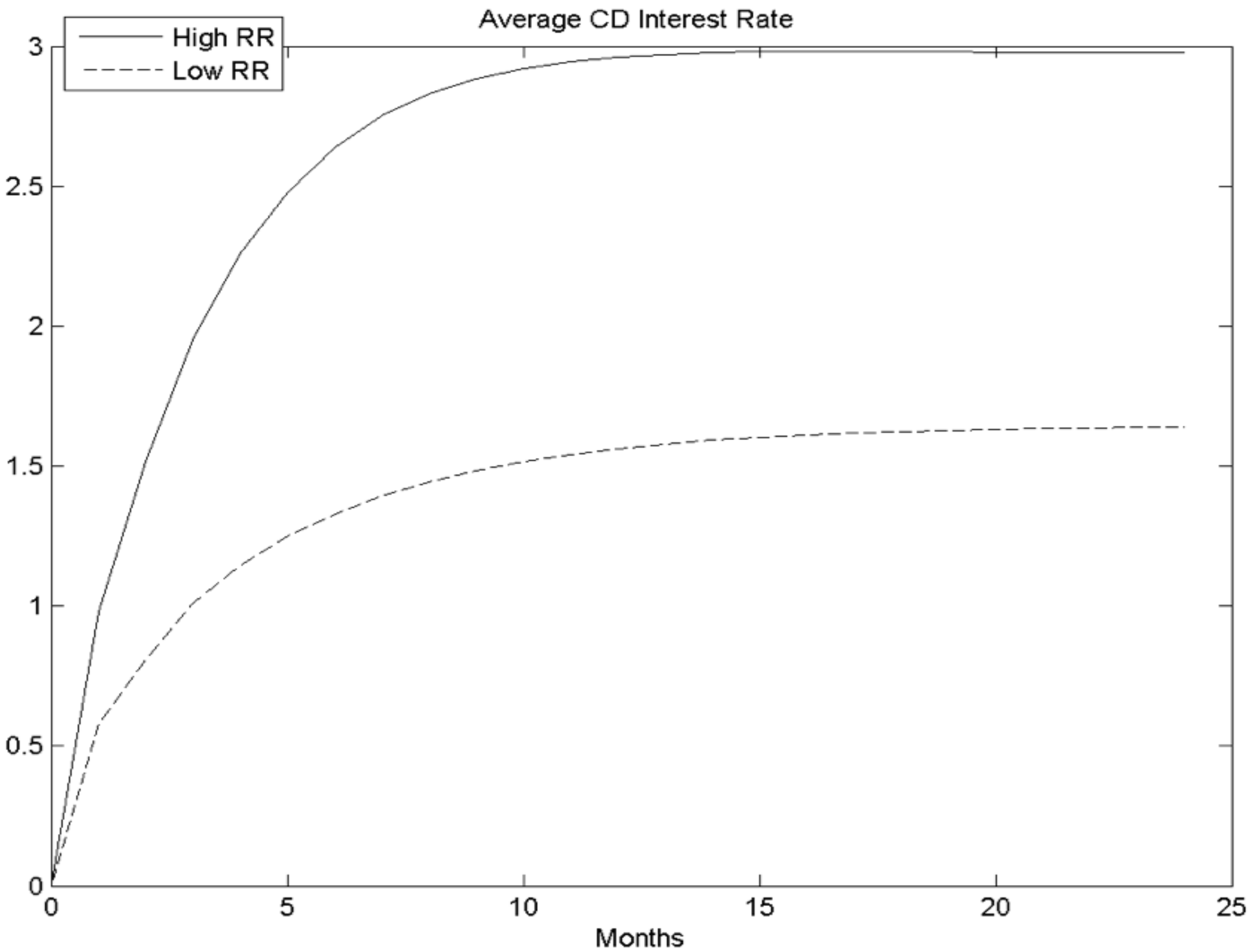
0 2 4 6 8 10 12 14 16 18 20

Quarters

Response of lending rates to a policy rate shock



Response of CD rates to a policy rate shock



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