Disinflation, Uncertainty and Monetary Policy: Evidence from Mexico

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II. Disinflation in the Mexican Economy

III. Monetary Policy and Uncertainty

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I. Introduction

- In an environment with no uncertainty, the appropriate MP decisions can be derived theoretically from an optimal control problem.
- In practice, however, MP authorities face several types of uncertainty. In the case of EME, which typically do not have a long history of low inflation, there are additional elements to consider:
  - ✓ There is more uncertainty with respect to the magnitude and persistence of shocks since EME are, in general, more vulnerable.
  - ✓ There is more uncertainty about the structure of the economy (models), since deviations from a baseline scenario for a particular model do not necessarily have a low probability of realization.
  - ✓ Data measurement is difficult.

I. Introduction

- This paper analyzes the effect that uncertainty about some model's parameters in Mexico has on the assessment of the appropriate response of monetary policy to shocks.
- It has been said that parameter uncertainty could imply a stronger response from monetary policy (Craine (1979)) or a more caution one (Brainard (1967)).
- It has also been argued that parameter uncertainty is negligible.

➢ However for an economy with structural changes and a monetary authority still consolidating credibility, it is important to asses the effects of uncertainty.

II. Disinflation in the Mexican Economy

- Over the last years the Mexican economy has been converging towards a low inflation equilibrium.
- This has induced changes in the structure of the Mexican economy and also a transformation of the monetary transmission mechanism:
  - ✓ The persistence of inflation has been reduced.
  - ✓ The pass-through from the ER to inflation has decreased.
  - ✓ Expectations are more anchored, thus the slope of the Phillips Curve might be smaller.
  - ✓ A stronger effect of policy interest rates over aggregated demand due to more developed financial markets.
  - ✓ Changes in the level and volatility of some macroeconomic aggregates.

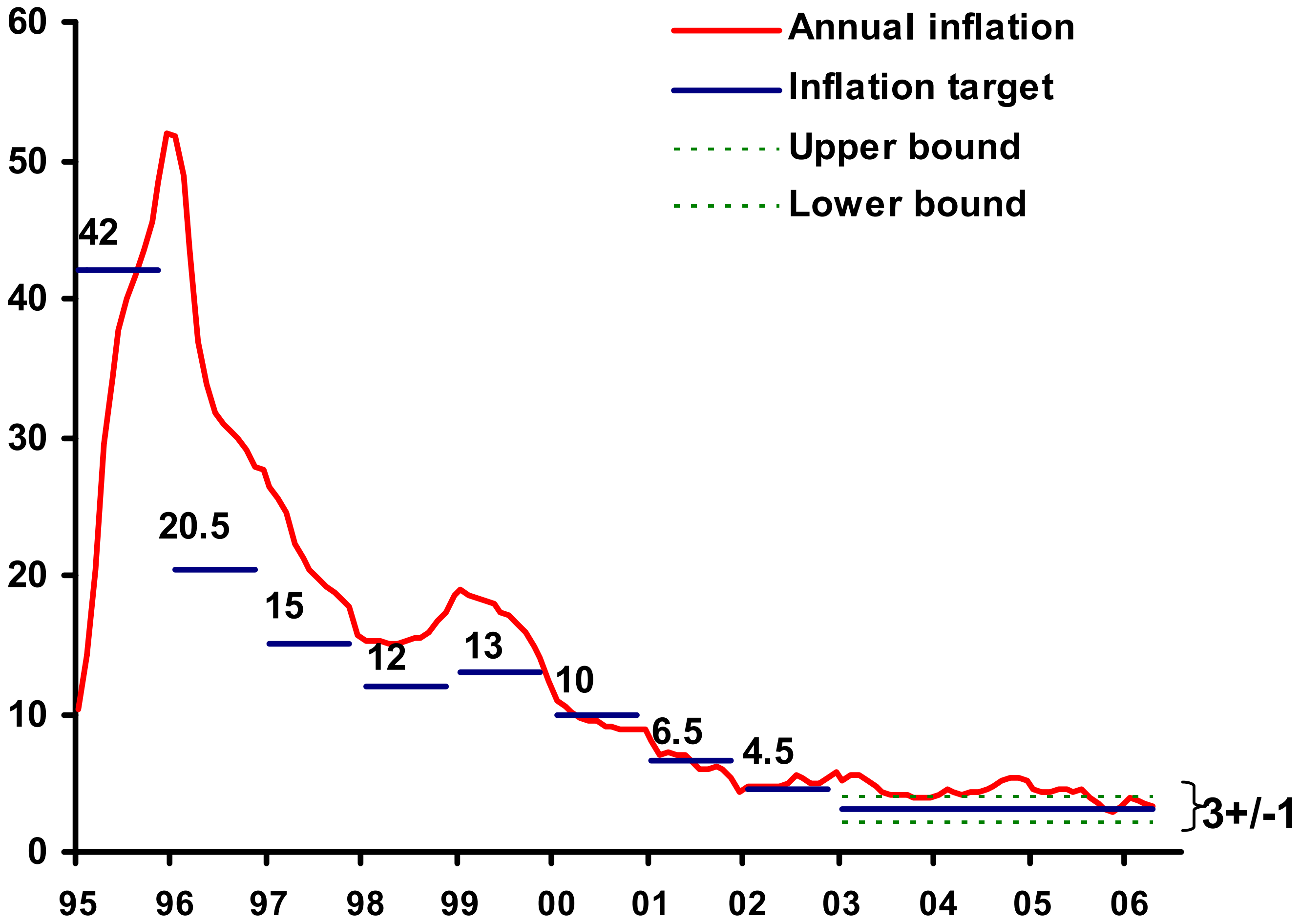
II. Disinflation in the Mexican Economy

- However price stability has not been achieved yet and the inflation target has not been fully incorporated in long-term inflation expectations.
- Under the above circumstances, shocks, e.g. cost-push shocks, represent a challenge for monetary authorities.
- A key element to define the appropriate response of monetary policy to shocks is the consideration of changes in the parameters describing macroeconomic relationships.
- Uncertainty regarding the actual level of the parameters mentioned presented a trade-off for monetary policy authorities:
  - ✓ If response assumes that some channels are still weak, monetary policy could be too restrictive.
  - ✓ If response assumes that some channels are already strong, monetary policy could be not restrictive enough.

II. Disinflation in the Mexican Economy

- Over the last years, the Mexican economy has been transiting form a high to a low inflation equilibrium.

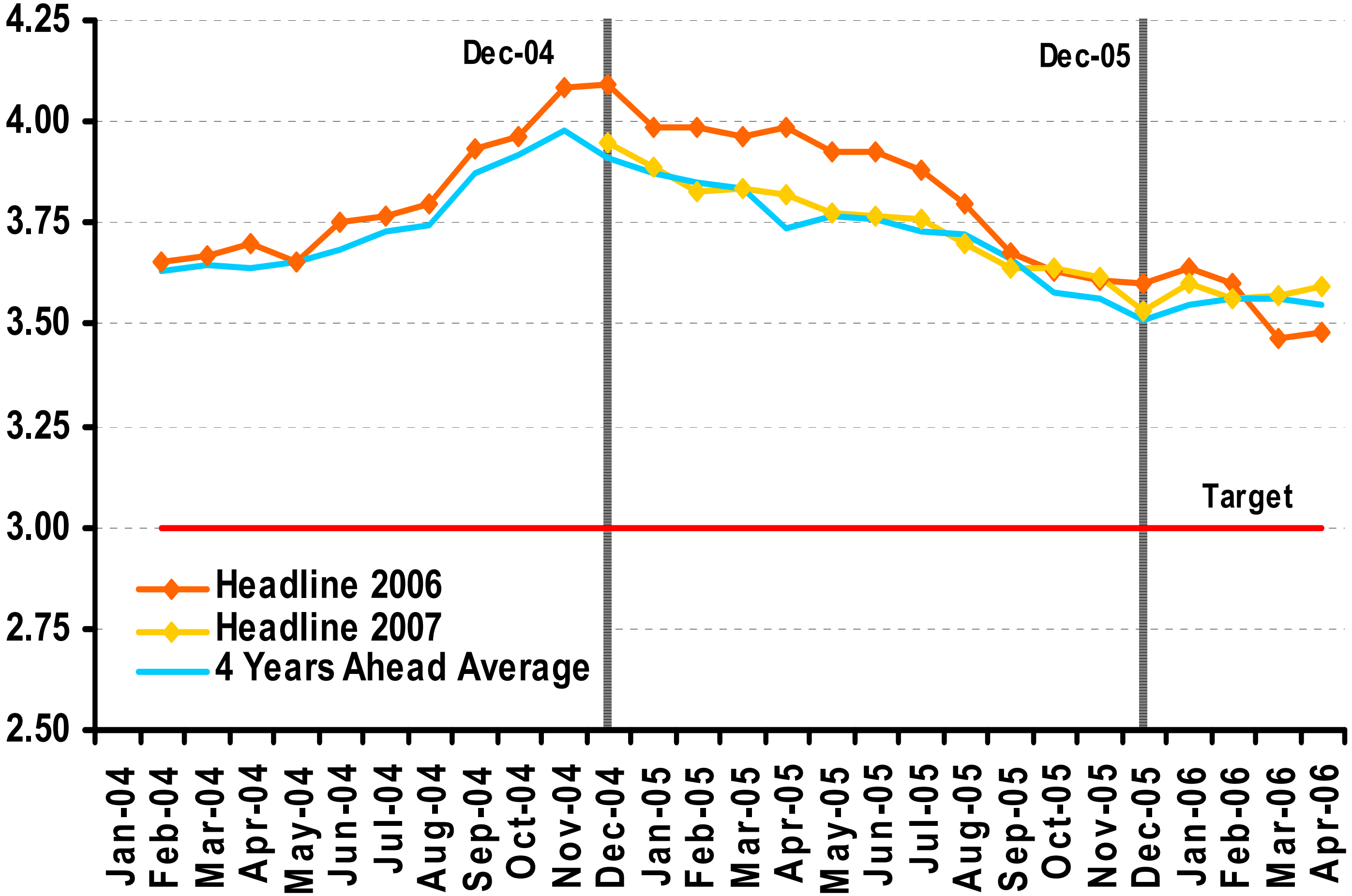
Annual CPI Inflation



II. Disinflation in the Mexican Economy

- Inflation expectations are stable but not anchored at the long run inflation target of 3%.

Inflation Expectations*

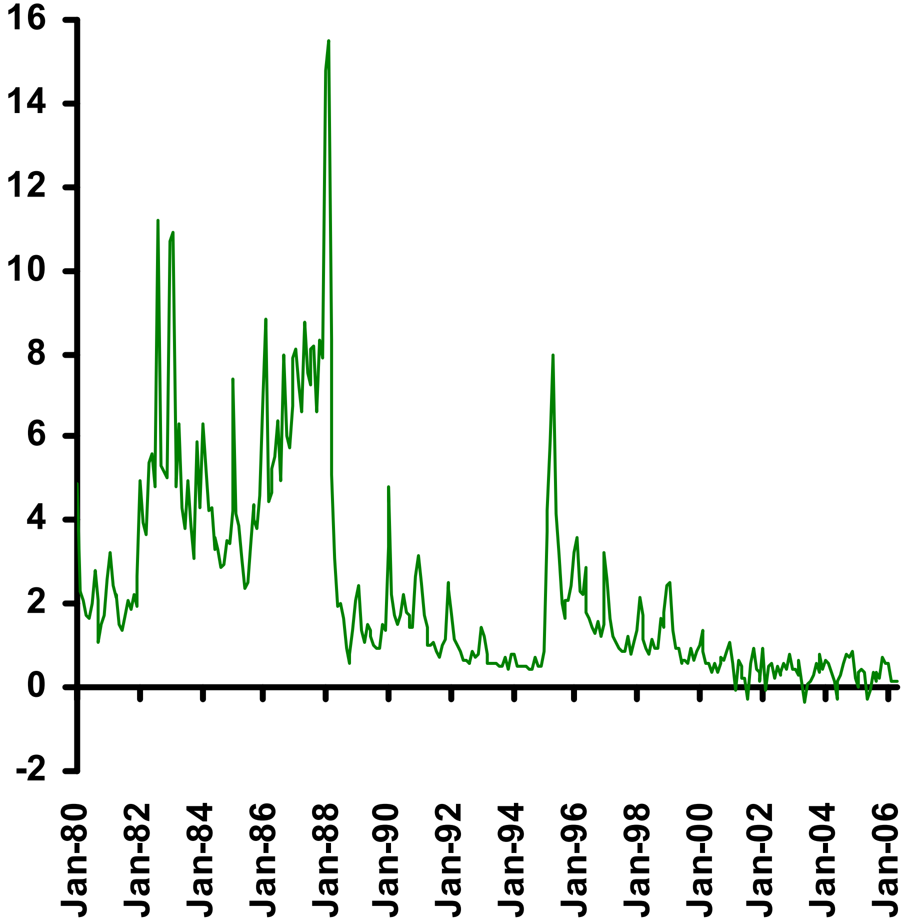


* Source: Banco de México's survey.

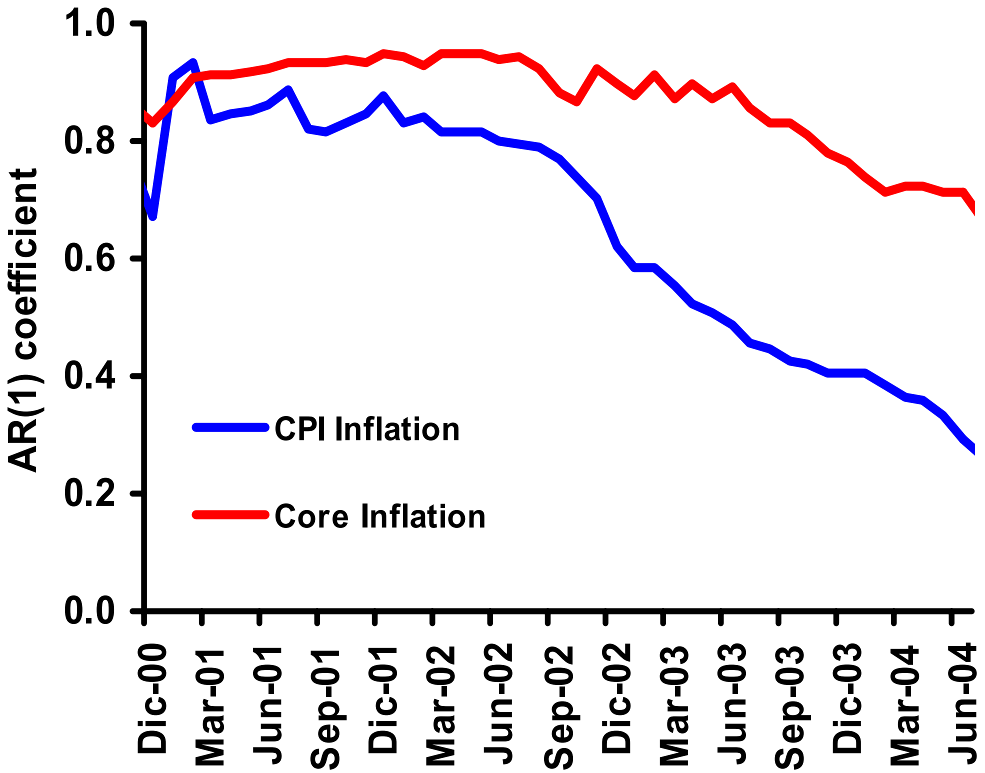
II. Disinflation in the Mexican Economy

- The reduction in inflation has been accompanied by a reduction in the persistence of inflation.

Monthly Rate of Inflation



Inflation Persistence*

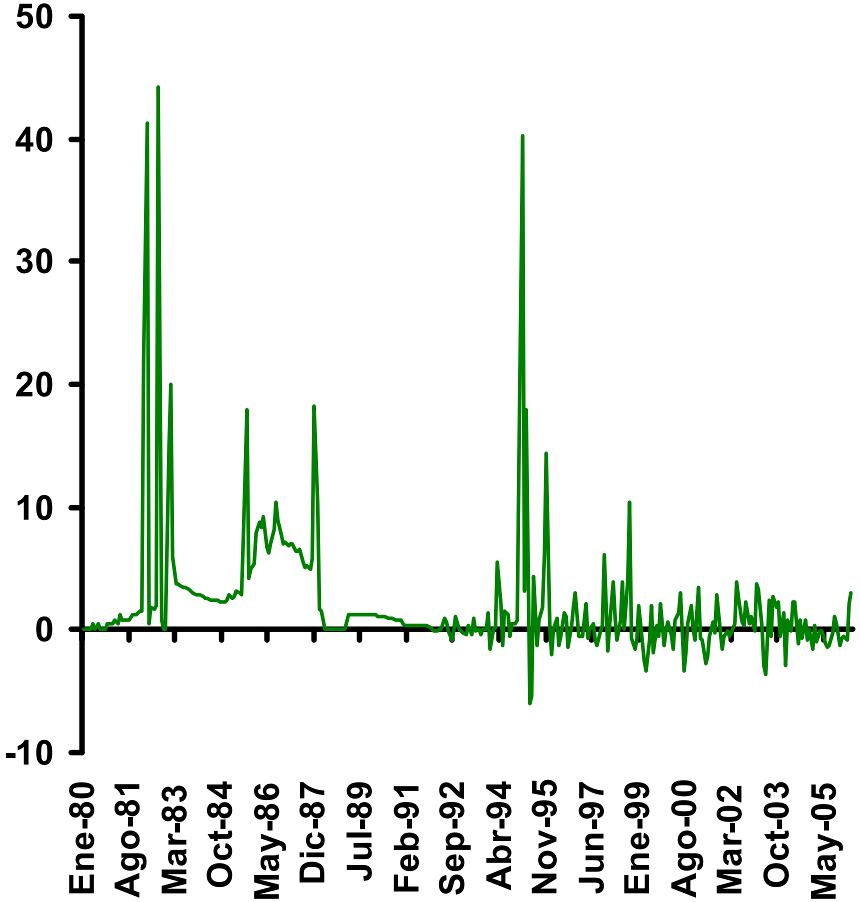


* The reported coefficient corresponds to the coefficient on lagged monthly inflation from rolling regressions on a AR(1) process using a window of 4 years prior to the indicated data.

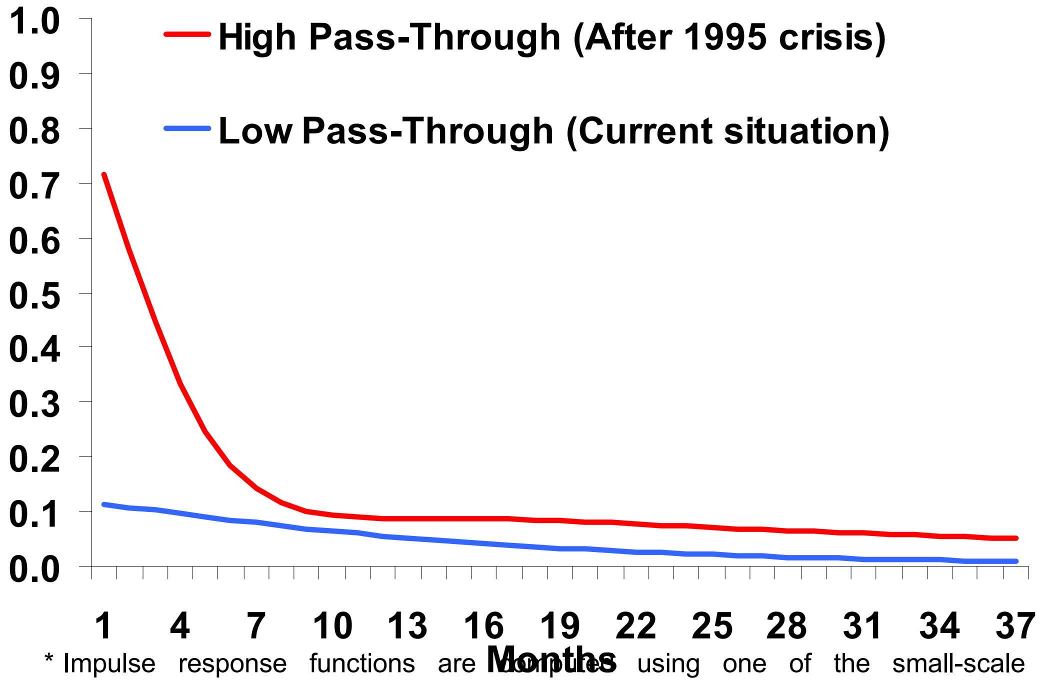
II. Disinflation in the Mexican Economy

- Exchange rate volatility has decreased, as well as the pass through to inflation.

Monthly Nominal Exchange Rate Depreciation (%)



Response of Inflation to a 1% Depreciation in the RER

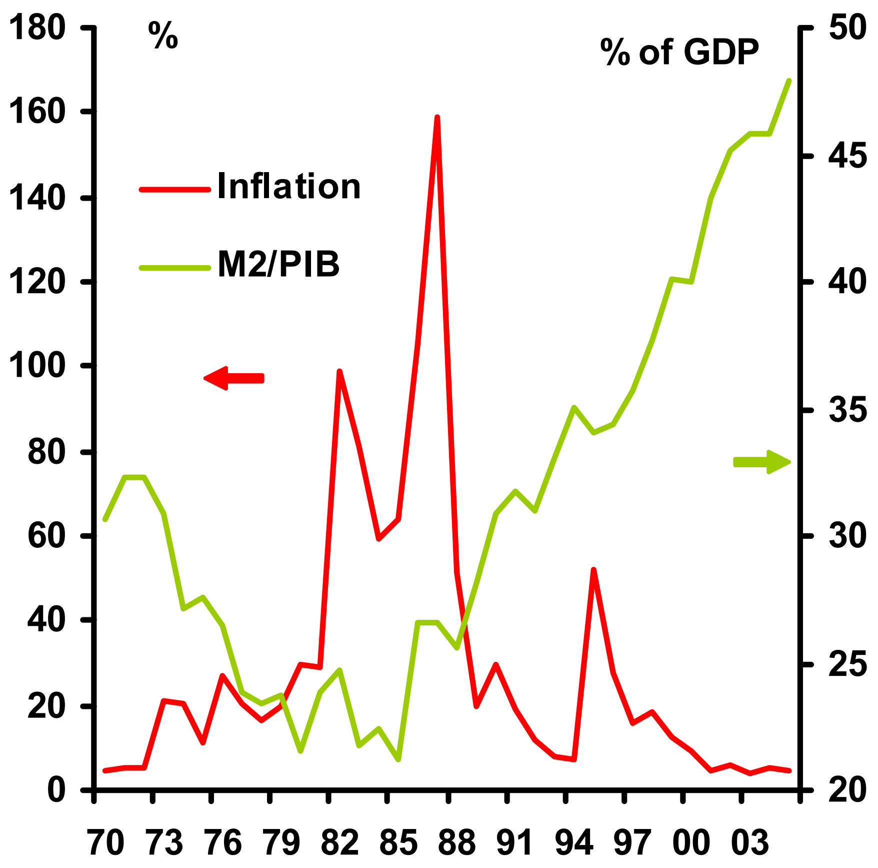


* Impulse response functions are computed using one of the small-scale macroeconomic models used at Banco de México. The model includes a standard hybrid Phillips curve, an hybrid IS equation, an equation for the real exchange rate and an optimal monetary policy rule.

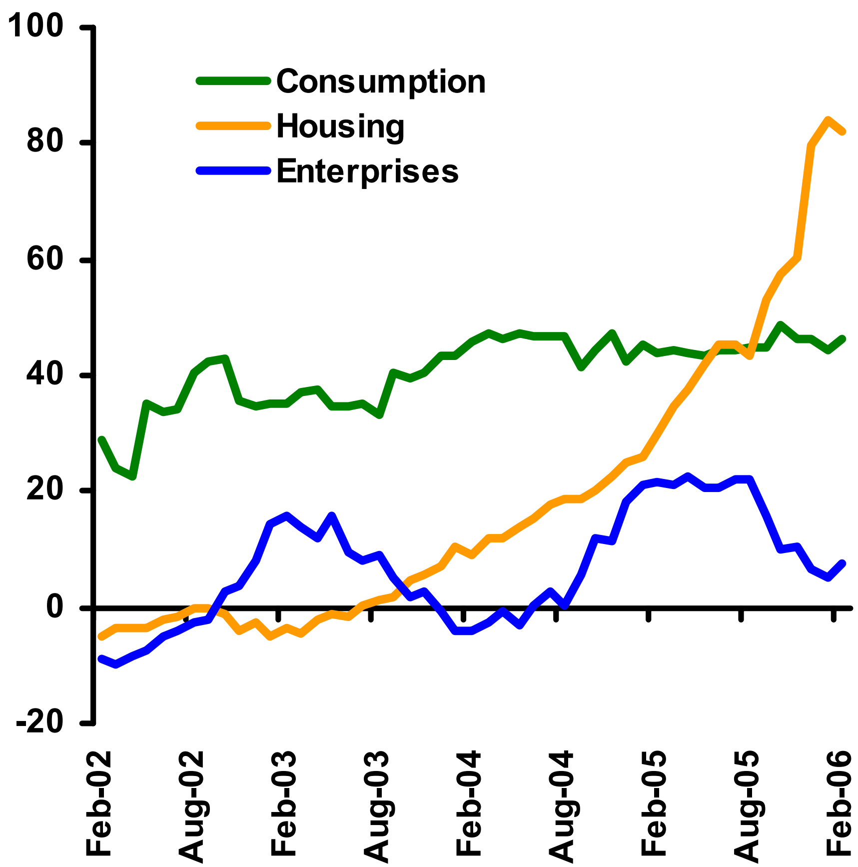
II. Disinflation in the Mexican Economy

- The development of the financial system has helped to increase the effect of the interest rate on aggregate demand.

M2 to GDP and Inflation



Outstanding Commercial Bank Lending to the Private Sector /*



**/ Restructuring programs portfolio not included*

III. Monetary Policy and Uncertainty

3.1 Uncertainty in the parameters

- We analyze an optimal discretionary MP using an New Keynesian small-scale model for the Mexican economy and an ad hoc objective function for the central bank.
- Uncertainty is introduced with a technique used by Moessner (2005), which consists of modifying the loss function so that the central bank incorporates parameter uncertainty in its decision making.
- A discrete uniform distribution over the parameter is assumed. The structure of the economy is not modified by uncertainty because private agents do not incorporate uncertainty in their decisions.
- The policy maker has a prior probability distribution of some parameters and minimize the expected loss subject to the structure of the economy described by the model's equations and the prior distributions.

3.2 A Small-scale Macro Model for the Mexican Economy

- ✓ New-Keynesian small-scale model estimated for a small open economy like Mexico.
- ✓ Three fundamental equations:
  - Phillips curve.
  - IS curve.
  - Equation for the exchange rate.
- ✓ Monetary policy rule.
- ✓ Four exogenous variables: non-core inflation, economic activity in the USA, interest rate in the USA and inflation in the USA.

III. Monetary Policy and Uncertainty

- Hybrid New Keynesian Model, from Banco de Mexico (2006):

$$\pi_t^G = w_S \pi_t^s + w_{NS} \pi_t^{NS}$$ Headline Inflation

$$\pi_t^s = a_1 \pi_{t-1}^s + a_2 E_t\{\pi_{t+1}^s\} + a_3 x_{t-1} + a_4(\Delta tcn_t + \pi_t^{EU})$$ Phillips Curve

$$x_t = c_0 + c_1 x_{t-1} + c_2 E_t\{x_{t+1}\} + c_3 r_{t-1} + c_4 x_{t-1}^{US} + c_5 tcr$$ IS Curve

$$tcr_t = d_1 tcr_{t-1} + d_2(E_t\{tcr_{t+1}\} + (r_t^{US} - r_t))$$ RER Equation

$i =$ *monetary policy rule*

III. Monetary Policy and Uncertainty

✓ Monetary policy rule:

- Optimal.
- Standard numerical methods following Svensson (2000) and Söderlind (1999).
- Defined to minimize a standard *ad hoc* loss function:

$$L = E_t\left\{\sum_{j=0}^{\infty}\beta^j\left[(1-\theta)\left(\alpha(\pi_{t+j}^{A}-\pi_{t+j}^{A*})^2+(1-\alpha)x_{t+j}^2\right)+\theta(i_{t+j}-i_{t+j-1})^2\right]\right\}$$

where:

α : relative weight given to inflation deviations form its target;

$1-\alpha$: relative weight assigned to output gap;

θ : importance of interest rate variations.

✓ Authority minimizes *annual* inflation deviations from the target, instead of *monthly annualized* inflation.

IV. Monetary Policy Rules: Certainty

4.1 Certainty

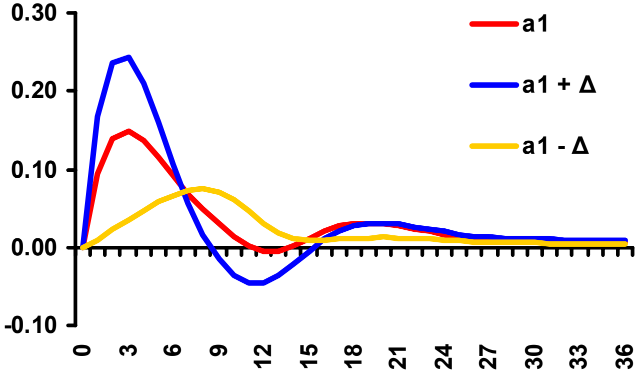
- Different MP rules would arise when a change in any parameter is observed in the re-estimation of the equation.
- Difficult to estimate stable parameters in an EME. Re-estimation has to be done on regular basis to incorporate the new information.
- The following exercises analyze the appropriated responses with the corresponding optimal rule for a change in three parameters:
  - i. Inflation persistence,
  - ii. ER pass-through to inflation,
  - iii. Effect of interest rates on aggregated demand.
- The change parameter is assumed to be of +/- Δ (a standard deviation from the estimated parameter).
- Response to cost-push shocks are analyzed, because with those disturbances the MP faces an inflation output gap trade-off.

IV. Monetary Policy Rules: Certainty

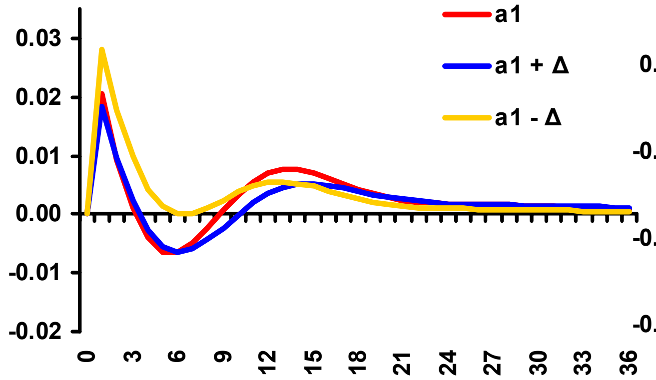
4.1.1 Changes in Inflation Persistence (a1)

Response to a Shock in Non-core Inflation

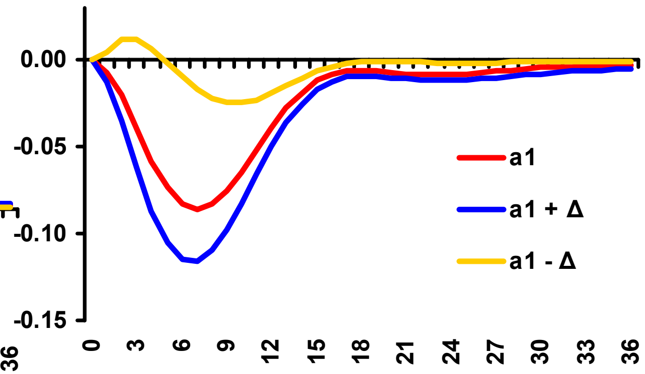
Nominal Interest Rate



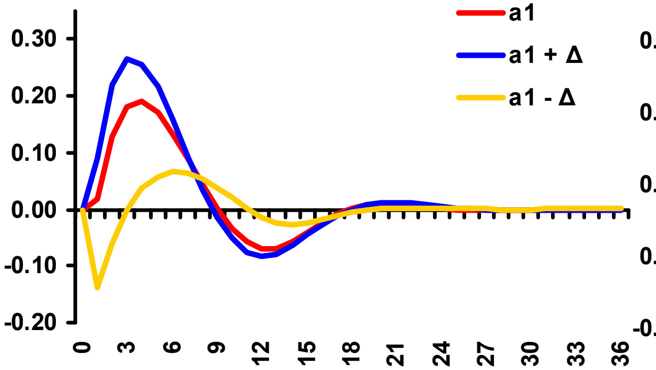
Core inflation



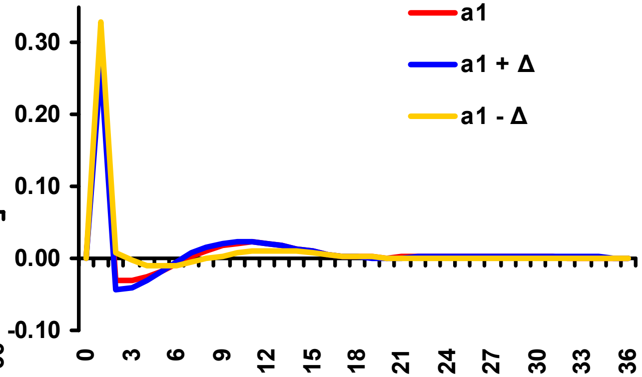
Output Gap



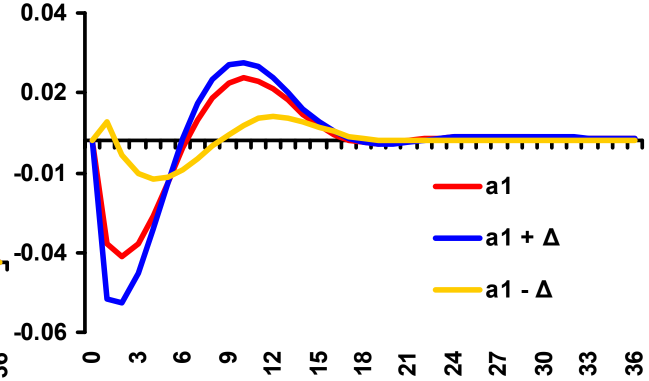
Real Interest Rate



Nominal Depreciation

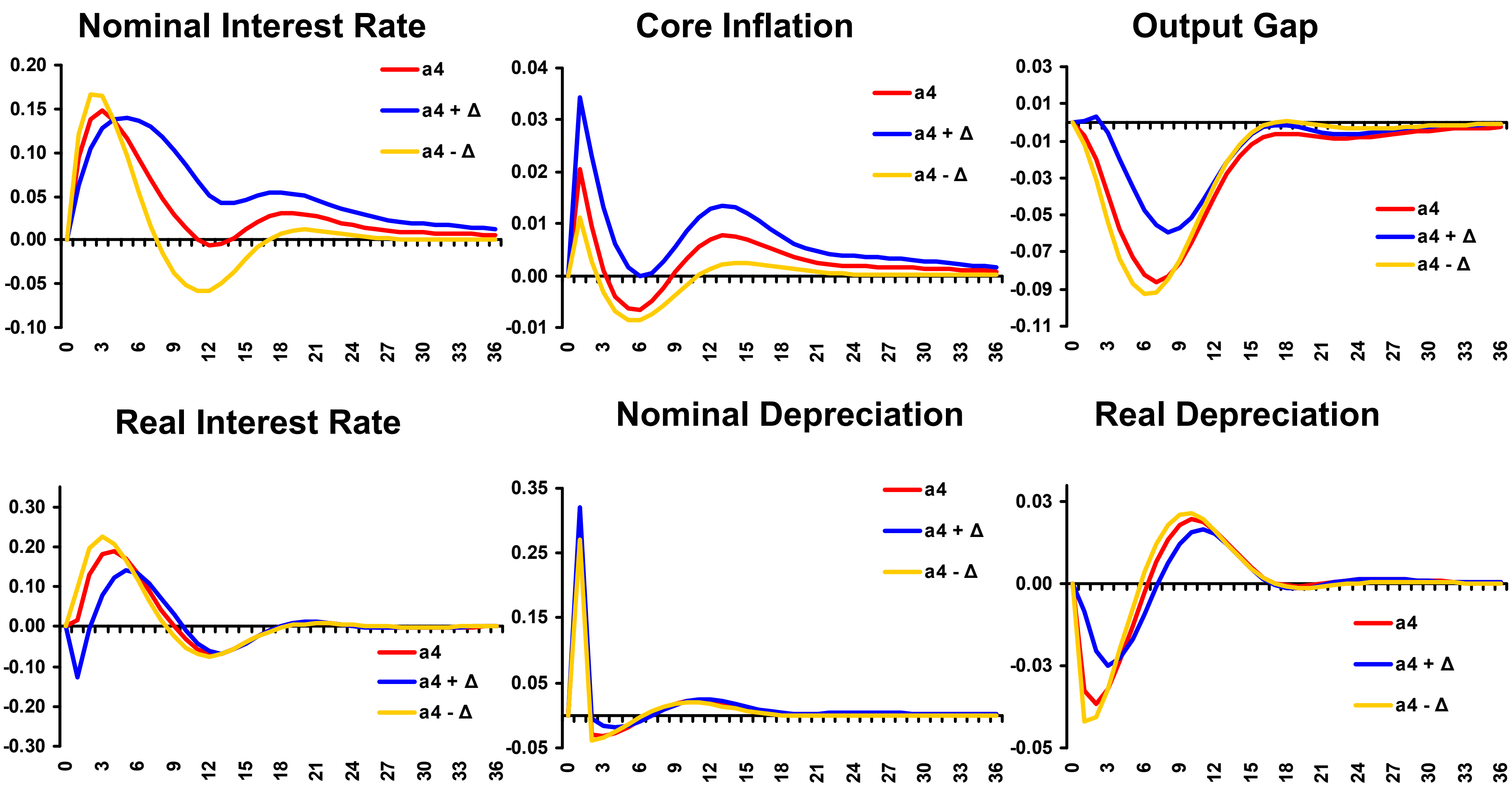


Real Depreciation



4.1.2 Changes in the Exchange Rate Pass Through (a4)

Response to a Shock in Non-core Inflation

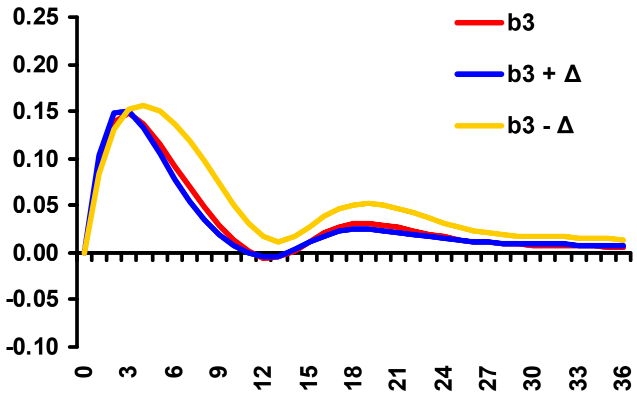


IV. Monetary Policy Rules: Certainty

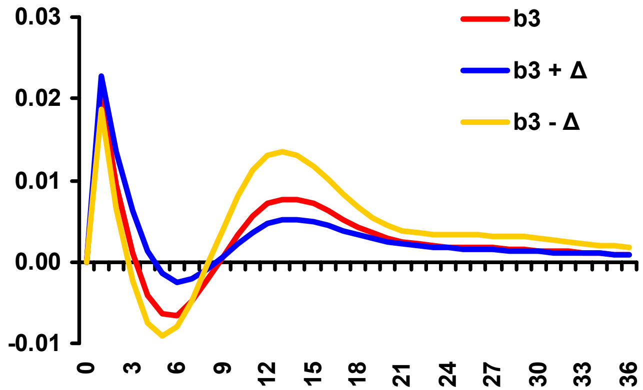
4.1.3 Changes in the Credit Channel (b3)

Response to a Shock in Non-core Inflation

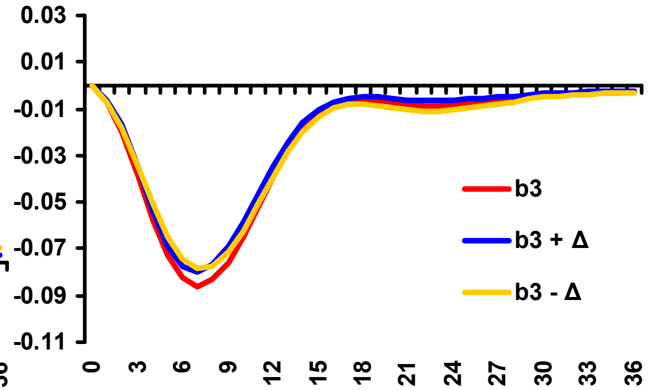
Nominal Interest Rate



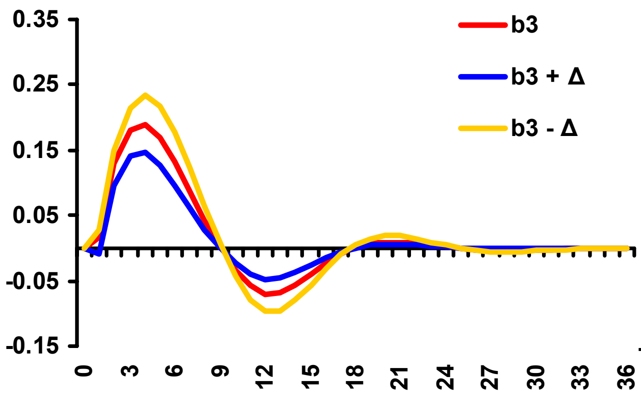
Core Inflation



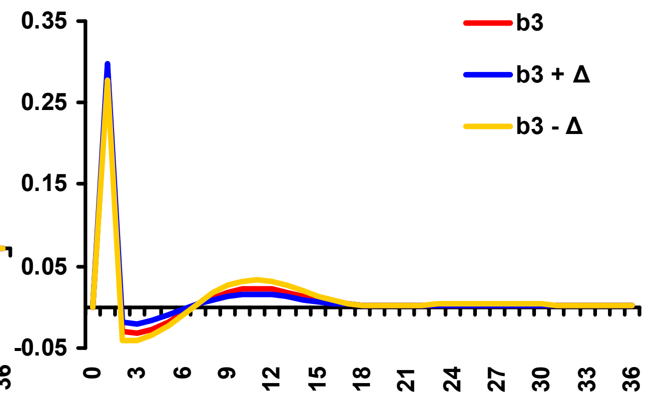
Output Gap



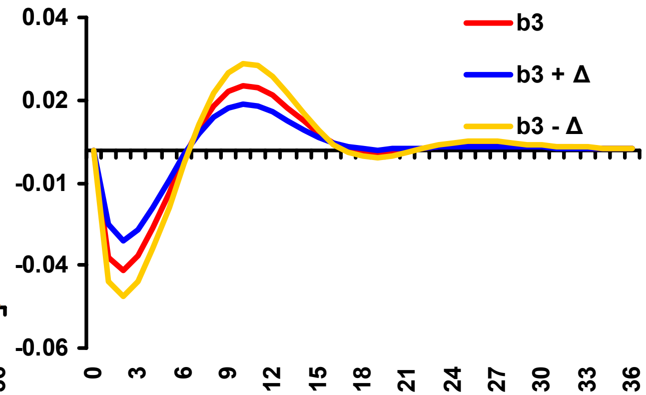
Real Interest Rate



Nominal Depreciation



Real Depreciation



IV. Monetary Policy Rules: Uncertainty

4.2 MP Rule with certainty vs. MP Rule with uncertainty

- Now, we consider the situation where the policy maker incorporates its prior distribution of some parameters for the optimal rule, instead of having a different rule for a given change in the parameters.
- In this case, the policy maker minimizes the expected loss. The resulting loss function is a weighted average of the loss evaluated for each possible value of the parameter in the distribution.
- A prior uniform distribution for each parameter within an interval of $[a - \Delta , a + \Delta]$, where "a" is the estimated parameter.

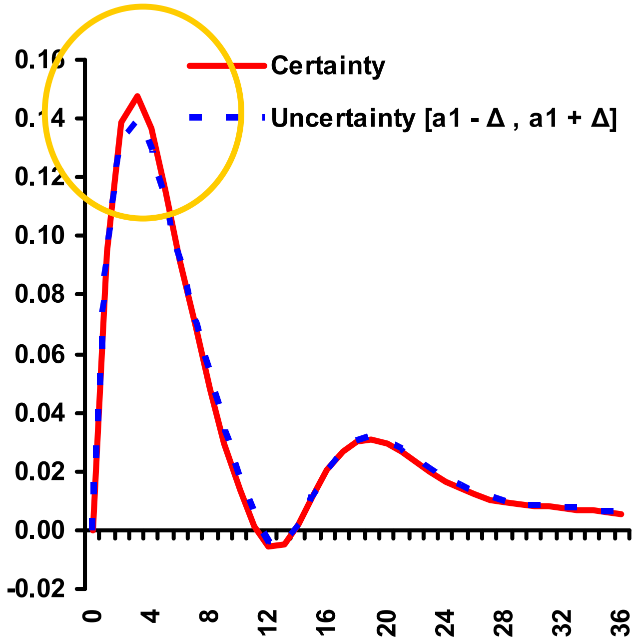
[————————————————]

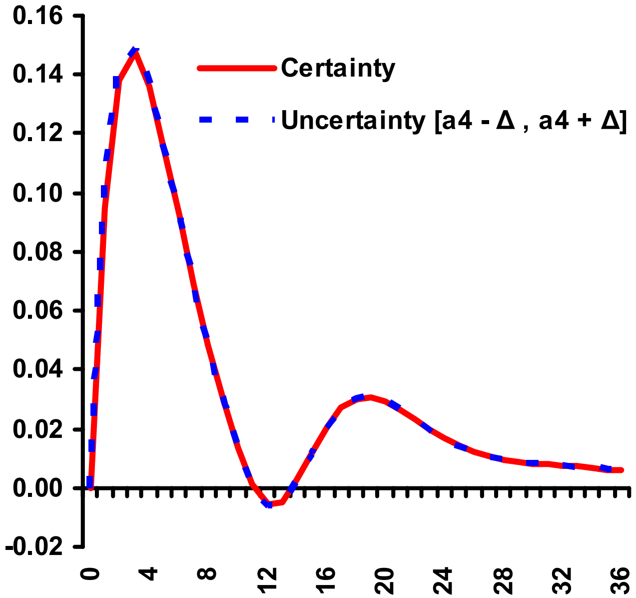
$a - \Delta$ a $a + \Delta$

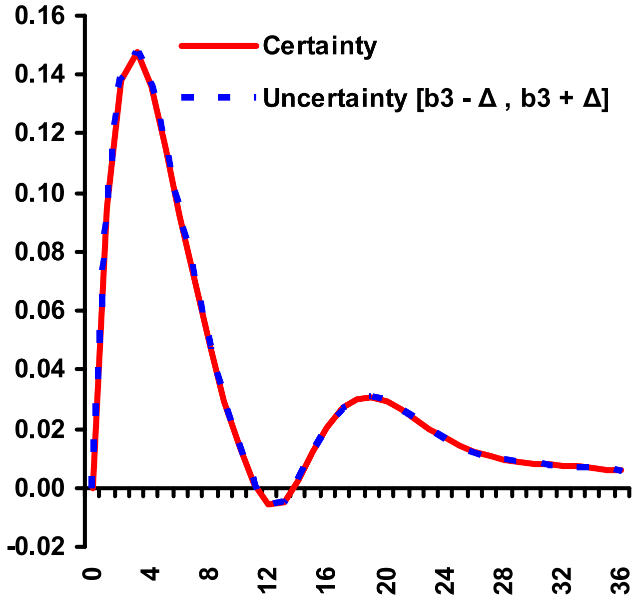
IV. Monetary Policy Rules: Uncertainty

- The results suggest that the optimal policy is certainty equivalent even though we are assuming that the central bank's loss function penalizes inflation as well as output gaps.
- In addition, for the inflation persistence parameter, the response of the certainty rule is marginally stronger than the uncertainty rule.

Nominal Interest Rates Response to a Shock in Non-core Inflation with Annual Inflation in Loss Function







IV. Monetary Policy Rules: Uncertainty

- One explanation for this outcome, could be the definition of the central bank objective function, since it is set to minimize in terms of the annual inflation gap.
- The central bank has an annual inflation target. Therefore the loss function must consider deviations of current annual inflation from the target. Since the model has a monthly frequency, it is important to analyze the different alternatives of introducing annual inflation in the loss function.
- One way of constructing annual inflation supposes that current monthly inflation would be constant for the rest of the year, and it is added to produce an annual figure.

$$\pi_t^A = \pi_t^M * 12$$

- An alternative considers the summation of observed monthly inflation throughout the year.

$$\pi_t^A = \sum_{i=0}^{11} \pi_{t-i}^M$$

IV. Monetary Policy Rules: Uncertainty

- The corresponding loss functions are:

$$L = E_t\left\{\sum_{j=0}^{\infty}\beta^j\left[(1-\theta)\left(\alpha(12*\pi_{t+j}^{M}-\pi^*)^2+(1-\alpha)x_{t+j}^2\right)+\theta(i_{t+j}-i_{t+j-1})^2\right]\right\}$$

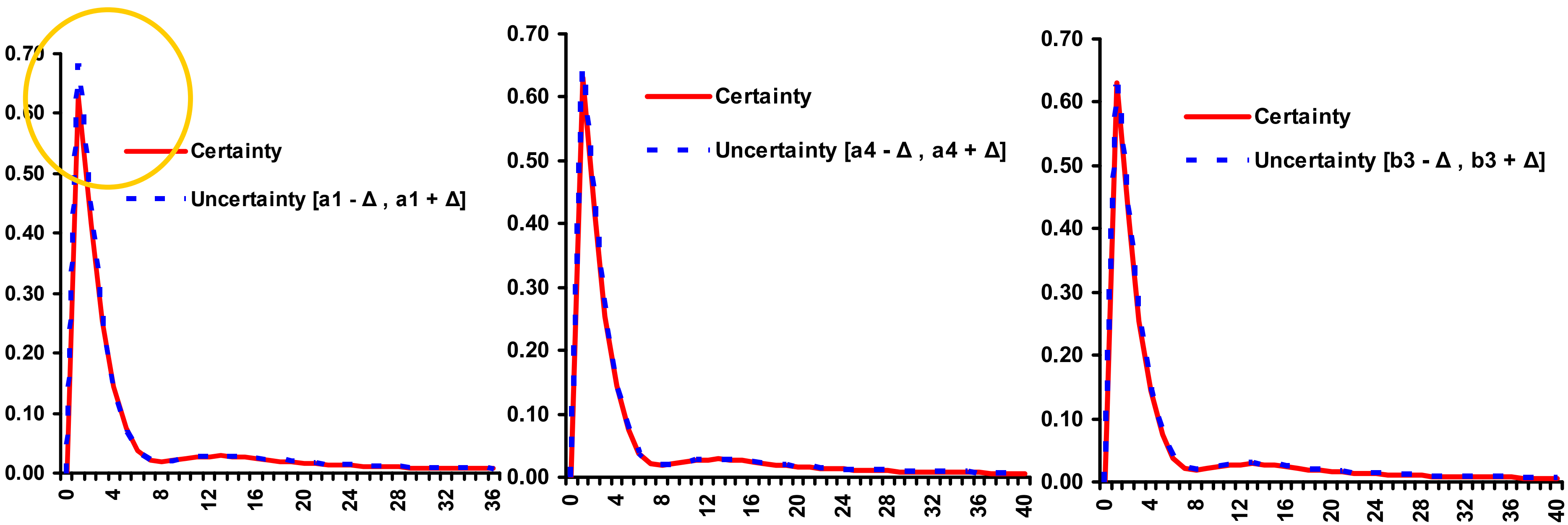
$$L = E_t\left\{\sum_{j=0}^{\infty}\beta^j\left[(1-\theta)\left(\alpha(\sum_{t=0}^{11}\pi_{t-i}-\pi^*)^2+(1-\alpha)x_{t+j}^2\right)+\theta(i_{t+j}-i_{t+j-1})^2\right]\right\}$$

- This distinction is important because, it modifies the behavior of the \ monetary policy response.

IV. Monetary Policy Rules: Uncertainty

- If we define the objective function in terms of the annualized monthly inflation, the results change. The response of the optimal rule under uncertainty is slightly stronger, as in Moessner (2005) for the case of the persistence parameter. However, the difference is marginal.
- Furthermore, for the other parameters certainty equivalence still holds.

Response to a Shock in Non-core Inflation with Annualized Monthly Inflation in Loss Function



IV. Monetary Policy Rules: Uncertainty

1. The strength of the response of the monetary authority, depends in this model, on the form of the loss function.
    i. Annualized monthly inflation would have a stronger response from MP under a cost push shock.
    ii. Annual inflation would have more caution response.
2. In general, the effects are small either way are small.

V. Monetary Policy Rules: Uncertainty and Judgment

5.1 Changes in the Intervals

- As mentioned before, while converging towards a low inflation equilibrium, some parameters will change. However, economic theory might help us to analyze the direction of these changes, i.e. which parameters will be weaker or stronger.

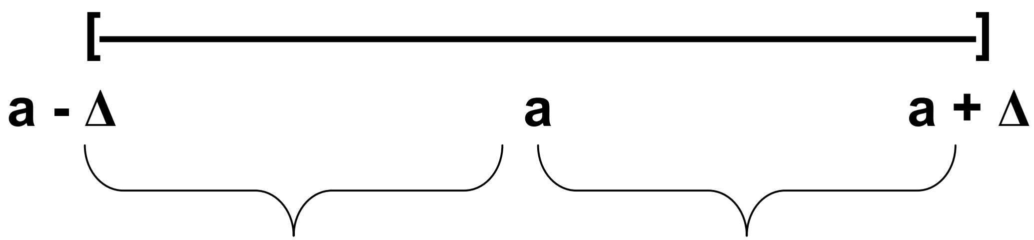
  i. Persistence of inflation: likely to be weaker:

  ii. Exchange rate pass-through: likely to be weaker.

  iii. Interest rates on aggregate demand: likely to be stronger.

- Introducing this into the model we get a “biased” interval:

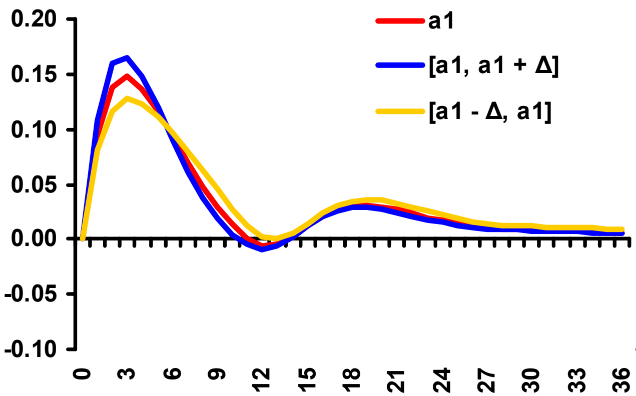
  ➢ Left: [a - Δ , a] and right: [a, a + Δ] instead of [a - Δ , a + Δ],



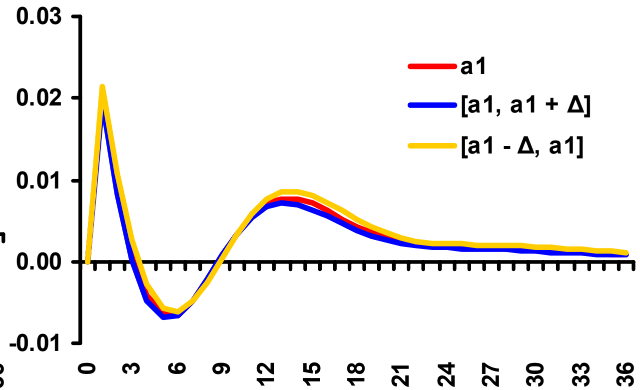
5.1.1 Changes in Inflation Persistence (a1)

Response to a Shock in Non-core Inflation

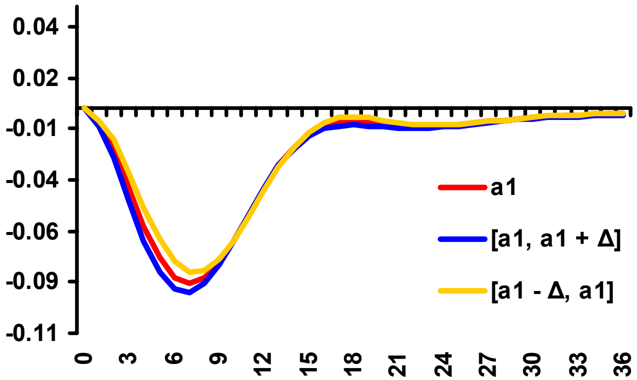
Nominal Interest Rate



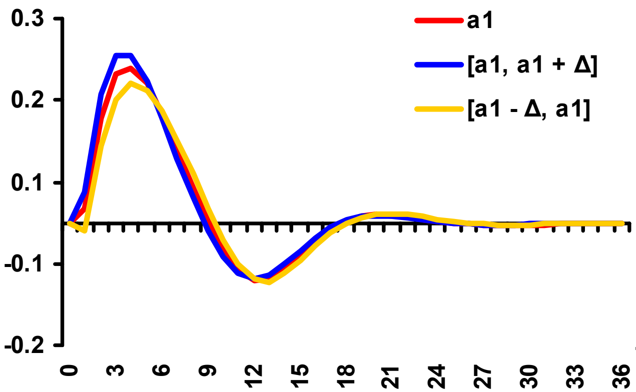
Core inflation



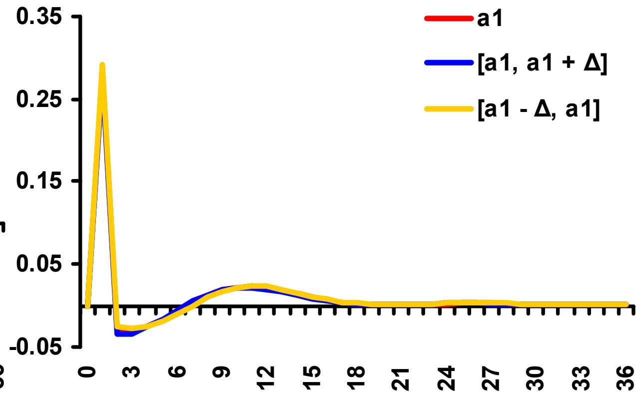
Output Gap



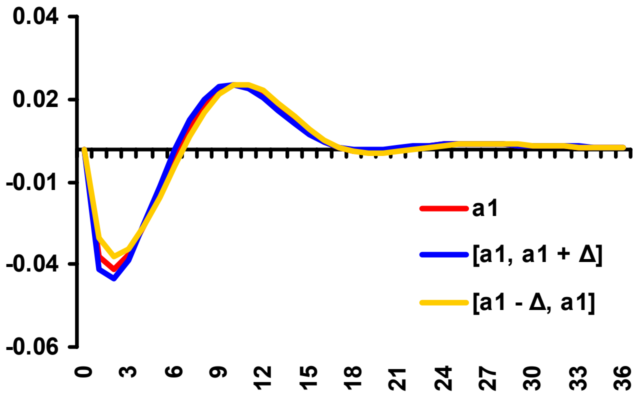
Real Interest Rate



Nominal Depreciation



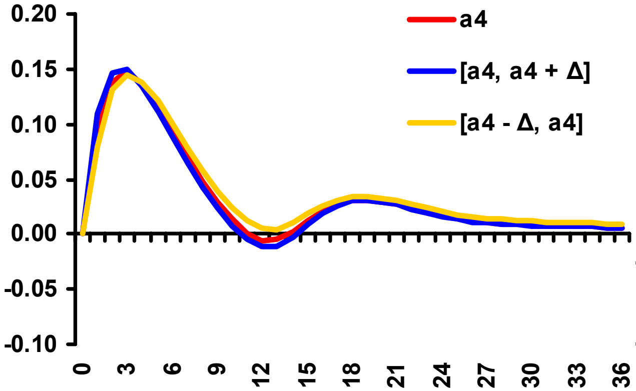
Real Depreciation



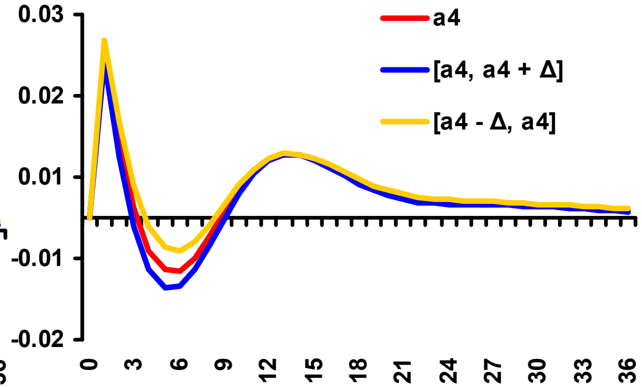
5.1.2 Changes in the Exchange Rate Pass Through (a4)

Response to a Shock in Non-core Inflation

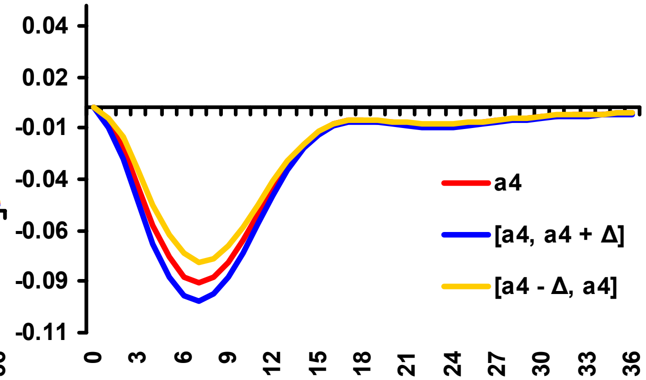
Nominal Interest Rate



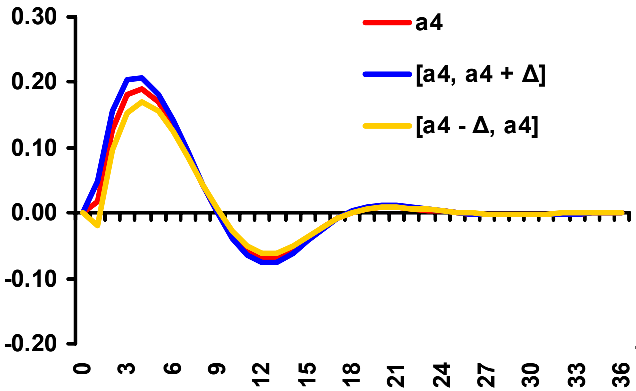
Core inflation



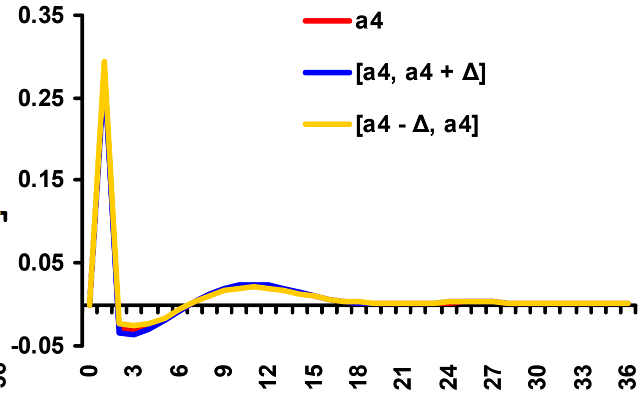
Output Gap



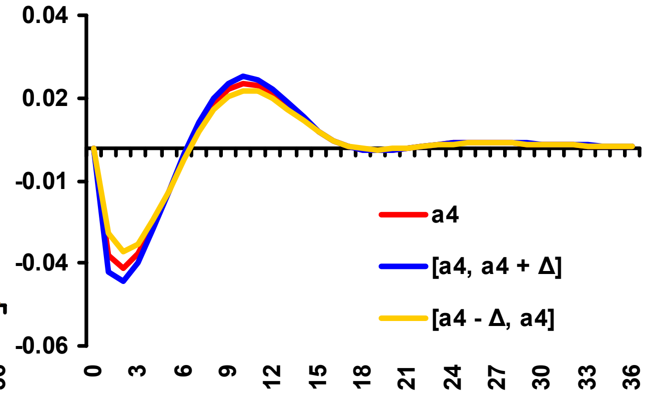
Real Interest Rate



Nominal Depreciation

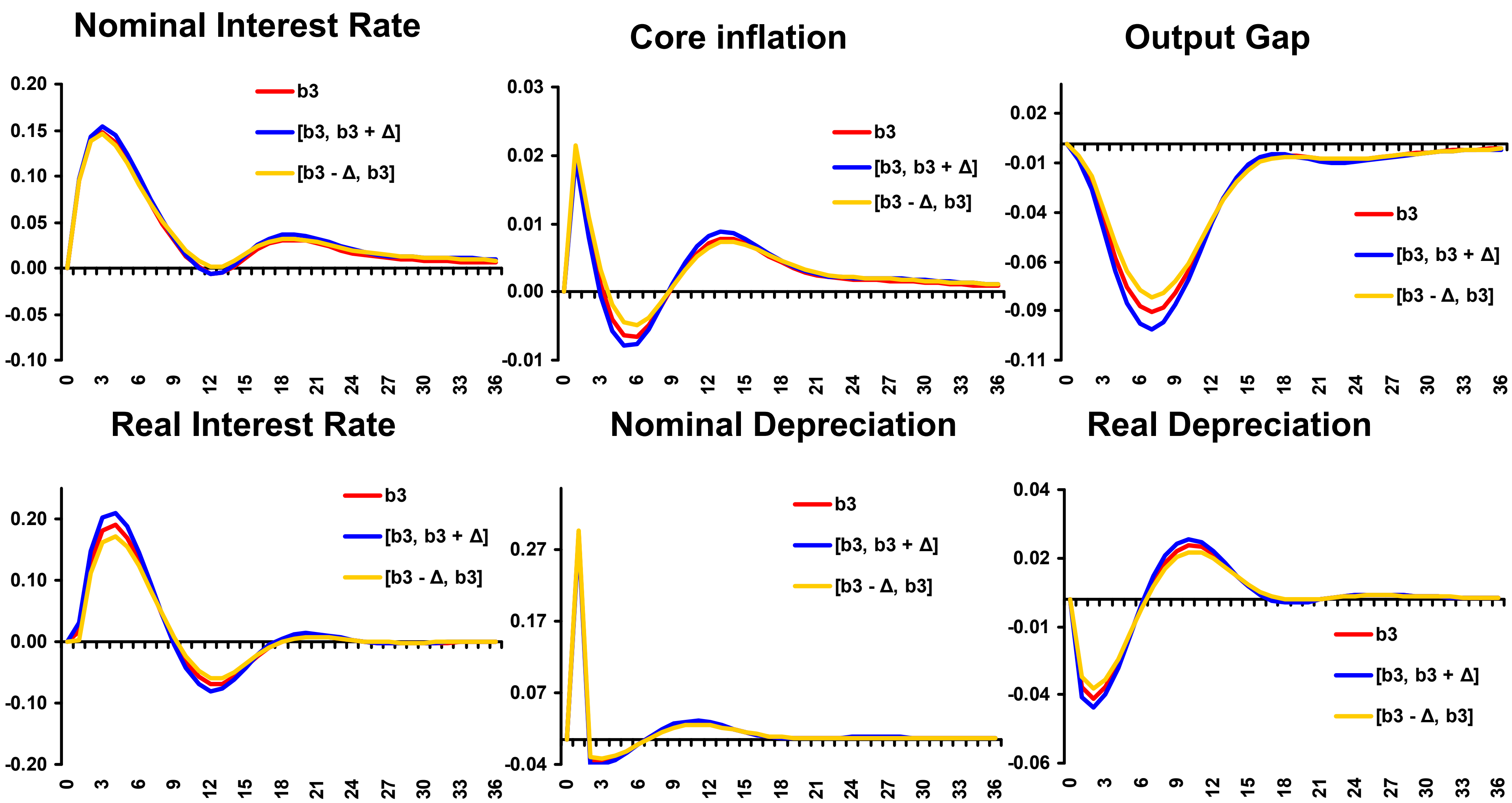


Real Depreciation



5.1.3 Changes in the Credit Channel (b3)

Response to a Shock in Non-core Inflation



VI. Conclusions

- Uncertainty is a challenge for monetary policy.
- The optimal response of monetary policy depends on the model, particularly on the central bank's objective function.
- The results show that for a small New Keynesian macro model estimated for the Mexican economy, parameter uncertainty has little effect.
- However, for a small open economy in transit to a low-inflation equilibrium and a monetary authority consolidating its credibility, parameter uncertainty becomes relevant. In particular, when some structural parameters are changing, judgment on how to incorporate uncertainty into the analysis could be important.
- Improving the tools to quantify the risks associated to parameter uncertainty will allow for better monetary policy.

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