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Macroeconomic Responses to Terms-of-Trade Shocks: A Framework For Policy Analysis For the Argentine Economy

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Abstract

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This paper presents a version of the global integrated monetary fiscal (GIMF) model adapted and calibrated to the Argentine economy. The model replicates the effect of the strong improvement in Argentina's terms of trade stemming from higher world commodity prices as well as other key economic trends in Argentina during the period 2003-2007. The model can be used to assess the potential impact of different combinations of monetary and fiscal policies on output, inflation, and the external trade.

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I. Introduction

This paper calibrates the global integrated monetary fiscal (GIMF) model (Kumhof and Laxton, 2008) with a commodity sector to capture the economic and policy characteristics of Argentina in the period 2003–2007. The model is modified to incorporate a managed floating exchange rate regime. Among other things, this framework allows for a comparison of the effects of different macroeconomic responses to terms of trade shocks.

Many previous papers on Argentina mainly analyze monetary policy. In particular, Elosegui and others (2007) and Escudé (2007) develop small open economy models to analyze various monetary policy options. Other papers, such as Neumeyer and Perri (2004), focus on business cycle properties, in particular the relation between real interest rate and output volatility.

This paper differs from previous models in three aspects. First, fiscal policy is incorporated to allow for a full policy exercise with various combinations of alternative fiscal and monetary policies. Second, the GIMF has non-Ricardian features that amplify domestic demand responses, which helps to capture the recent behavior of Argentine economy. Finally, the paper is able to reflect various characteristics of the Argentine economy in a more realistic fashion than the small-scale models. For example, the commodity sector is separately modeled and shocked, which permits a more detailed assessment of a terms of trade shock. In addition, endogenous capital formation allows us to track investment dynamics as well. Furthermore, the model is not log linearized around a constant steady state; therefore the model can be used for policy exercises involving different steady states and their corresponding transition paths.

The results indicate that, in the absence of an active monetary policy, fiscal policy would need to be highly countercyclical to offset the stimulative effects of a strong terms of trade shock and to contain inflation. If, however, monetary and fiscal policies are used in tandem, the output costs of containing inflation could be reduced substantially.

The next section briefly reviews the existing literature. Section III presents a summary of the model. Section IV calibrates the model to Argentina. Section V discusses the baseline and alternative policy scenarios. Section VI concludes.

II. Literature

Elosegui and others (2007) build a small open economy model to analyze various monetary policy options. A standard small scale model, with Phillips and IS curves, an uncovered interest parity condition, and a monetary policy rule, is extended to incorporate intervention. Four alternative monetary regimes are considered: a fixed exchange rate against the dollar, a fixed exchange rate against a basket of currencies, a pure float inflation targeting, and managed floating. Then the system is estimated by GMM. They find that a managed floating exchange rate regime dampens the real exchange rate appreciation and interest rate responses.

Similarly, Escudé (2007) develops a small open economy model with tradable and non-tradable sectors and exogenous path for fiscal policy. The model is set up to perform four different scenarios: fixed exchange rate against a single currency, against a basket of currencies, floating exchange rate with inflation targeting, and managed floating with inflation targeting. The calibration of the model is left for future analysis.

Escudé (2008) builds a model with nominal and real rigidities—such as habit in consumption, adjustments costs in investment and capacity utilization, and sticky prices and wages—and incorporates direct foreign exchange intervention as well as a banking sector. A primary goods sector is included to capture terms of trade effects. The model is calibrated for Argentine economy.

In a different context, Neumeyer and Perri (2004) build a dynamic general equilibrium model for a small open economy to explore the contribution of real interest rate fluctuations to the output volatility. They found that eliminating country risk lowers Argentine output volatility by 27 percent, while stabilizing international rates lowers it by less than 3 percent.

III. The GIMF Model

This paper modifies the quarterly version of the model presented in Kumhof and Laxton (2008) to capture the main characteristics of Argentina. It is a two country dynamic general equilibrium model with multiple nominal and real rigidities, where nominal rigidities are limited to final goods production and to labor markets. The model incorporates several non-Ricardian features, including overlapping generations (OLG) of agents, life-cycle income profiles, liquidity constrained consumers, and distortionary taxes. The details of the model are presented at Kumhof and Laxton (2008). The broad structure includes:

> **Households**: There are two types of households: (a) overlapping generations households with finite planning horizons and exhibiting habit persistence, and (b) liquidity constrained households.
>
> **Firms**: Companies produce both tradable and non-tradable goods. For inputs, manufacturers buy investment goods and labor from monopolistically competitive unions. Manufacturers are subject to real rigidities in investment— there are adjustment costs— but not to nominal rigidities in price setting. Manufacturers' domestic sales are purchased by distributors while foreign sales are purchased by import agents that are domestically owned but are located in foreign country (who then sell their product to foreign distributors).
>
> **Distributors**: A distribution sector assembles domestic non-tradable goods along with domestic and foreign tradable goods with imported inputs subject to some

adjustment cost. This private sector output is then combined with a publicly owned capital stock (infrastructure), maintained through public investment spending, and foreign output in order to produce domestic final output which is sold to consumption good retailers, domestic manufacturing firms, the government, and to final goods import agents located at foreign country. Distributors are subject to nominal rigidities (sticky prices) in their price mechanism.

Retailers: A monopolistically competitive retail sector sells the goods to consumers at flexible prices but with adjustment costs associated with changes in sale volumes.

Growth: Growth is exogenous with the world economy growing at a constant trend and population growing at a constant rate.

Asset markets: There is complete home bias in government debt, so that all debt is held by domestic investors in the form of nominal, one-period bonds denominated in domestic currency. The only internationally traded assets are nominal one-period bonds denominated in foreign currency. Firms are also owned domestically, and households receive lump-sum dividend payments from their shareholding in domestic firms. Commodity sector is owned by both domestic and foreign households.

Risk premium: Risk premium is composed of a foreign exchange risk premium and a government debt risk premium.

The foreign exchange risk premium is a non-linear function of current account to GDP ratio of the following form:

$$fxprem_t = y_1^{fx} + \frac{y_2^{fx}}{\left(\frac{ca_t}{gdp_t} - y_4^{fx}\right)^{y_3^{fx}}},$$

where, y_1^{fx}, y_2^{fx}, y_3^{fx} and y_4^{fx} are parameters and ca_t is current account. As the current account-to-GDP approaches to y_1^{fx} (some negative number) the premium curve gets extremely steep.

Similarly the government debt risk premium is a non-linear function of government debt to GDP:

$$gbprem_t = y_1^{gb} + \frac{y_2^{gb}}{\left(y_4^{gb} - \frac{B_t}{gdp_t}\right)^{y_3^{gb}}},$$

where B_t is the government debt. As the debt to GDP reaches to some y_4^{gb} (some positive number), the government debt risk premium becomes prohibitive.

IV. Calibration

This section calibrates the GIMF model to replicate key features of the Argentine economy. When there are no specific estimates for Argentina, main structural parameters are kept the same as Kumhof and Laxton (2008) in line with the literature. Other parameters are derived from national accounts and historical data.

Argentina represents 0.6 percent of world population and 1 percent of world GDP (PPP adjusted). It faces a long-run world real interest rate of 3 percent per annum. The risk premium function is calibrated to produce about 390 basis points premium over international interest rates at steady state net foreign liabilities to GDP ratio of 0 percent and government debt-to-GDP ratio of 60 percent. The premium is 250 basis points with steady state debt-to-GDP ratio of 40 percent. The real world growth rate is assumed to equal 2 percent per annum, the population growth rate is 1 percent per annum. The long-run inflation in is assumed to equal 3 percent in Argentina, and 2 percent in the rest of the world. The liquidity constrained agents are assumed to represent 50 percent of the Argentine and world population. The share of these agents in dividend income is assumed to be half of their share in the population. The real and price adjustments costs are calibrated to yield plausible dynamics over the first couple of years following the shock.

Labor shares are set to 55 percent in Argentina in line with labor income share in GDP (including the mixed income) and 66 percent in the rest of the world. The share of non-tradables is calibrated 56 percent for Argentina based on the CPI basket, and 50 percent for the rest of the world.[1] The steady state shares of investment spending in GDP are calibrated at 20 percent for both economies, based on historical averages. The steady state share of government spending is 16 percent in Argentina and 18 percent for the rest of the world, and government consumption is 12 percent in Argentina and 15 percent in the rest of the world. Transfers constitute 9 percent of GDP in Argentina and 10 percent in the rest of the world. 55 percent of the tax revenues are consumption tax revenues, 16 percent are capital income tax revenues, and 23 percent are labor income tax revenues. The corresponding revenues for the rest of the world are 30, 10, 30 percent.

Commodity endowments and demand share parameters are calibrated such that Argentina's commodity output is about 17 percent of GDP, and commodity exports are 10.2 percent of GDP. Commodity sector is defined in general terms and covers a wide range of agricultural

[1] Although tradable sectors represent only 44 percent of the total economy, supply and demand conditions in the rest of the world are still transmitted to domestic economy through both traded quantities and terms of trade effects.

and energy products. 70 percent of commodity revenues are assumed to accrue to domestic factors of production, 15 percent of the remainder goes to foreign privates sector and the rest to the government.

Exports of intermediate goods are 5.44 percent of GDP, exports of final goods (excluding commodities) are 1.36 percent of GDP, imports of intermediate goods excluding commodities are 8 percent of GDP.

V. Policy Analysis

A. Baseline Scenario

A combination of factors are incorporated into the model to capture the main economic and policy characteristics prevailing in Argentina during 2003–2007:

1. *Monetary policy* is constrained by the relative stability of the peso vis-à-vis the U.S. dollar).

2. *Fiscal policy* is assumed to target a constant overall surplus in line with a variant of a balanced budget rule. In particular, the overall surplus is set according to a policy rule:

$$\frac{gs_t}{gdp_t} = \overline{\varphi} + d_{tax}\left(\frac{\tau_t - \overline{\tau_t}}{gdp_t}\right) + d_{com}\left(\frac{\tau_t^{com} - \overline{\tau_t^{com}}}{gdp_t}\right),$$

where *gs* is overall government surplus, $\overline{\varphi}$ is the target/steady state overall government surplus to GDP; $\overline{\tau}_t$ is tax revenue at potential (current tax rates multiplied by the tax base at the steady state); $\overline{\tau}_t^{com}$ is government's commodity revenue evaluated at long-run value for the world commodity prices. In the baseline, the response of the cyclical surplus to excess tax and commodity revenue (i.e. d_{tax}, d_{com} are set to zero). This implies that the fiscal policy targets a constant overall surplus. The government uses lump sum transfers as its instruments while both government consumption and investment are kept constant as a share of GDP.

3. *Economic context*: Four key factors are introduced to capture features of the economic environment prevailing in this period: a strong terms of trade shock, an increase in the government revenues from the commodity sector through higher export taxes, a consumption boom and positive output gap, and a real exchange rate that is initially below its long-run equilibrium.

These four components of the economic environment are captured by starting the simulation initially away from the long-run equilibrium through:

- A shock to world commodity demand, which drives up commodity prices by 1.5 standard deviations (around 8 percent) and increases consumption, investment and output. Inflation is also higher, and the real exchange rate appreciates.

- The government's take from the commodity sector is increased by one percentage point of GDP to simulate the impact of higher export taxes. In the short-term, higher commodity revenues are transferred to consumers, raising consumption since part of the transfers accrue to liquidity constrained agents in the model.

- An exogenous boost to private consumption is included—through a temporary increase in the rate of time preference—to capture strong consumption demand.

- A reduced mark-up in the non-tradables sector is used to simulate a real exchange rate below its long-run equilibrium.

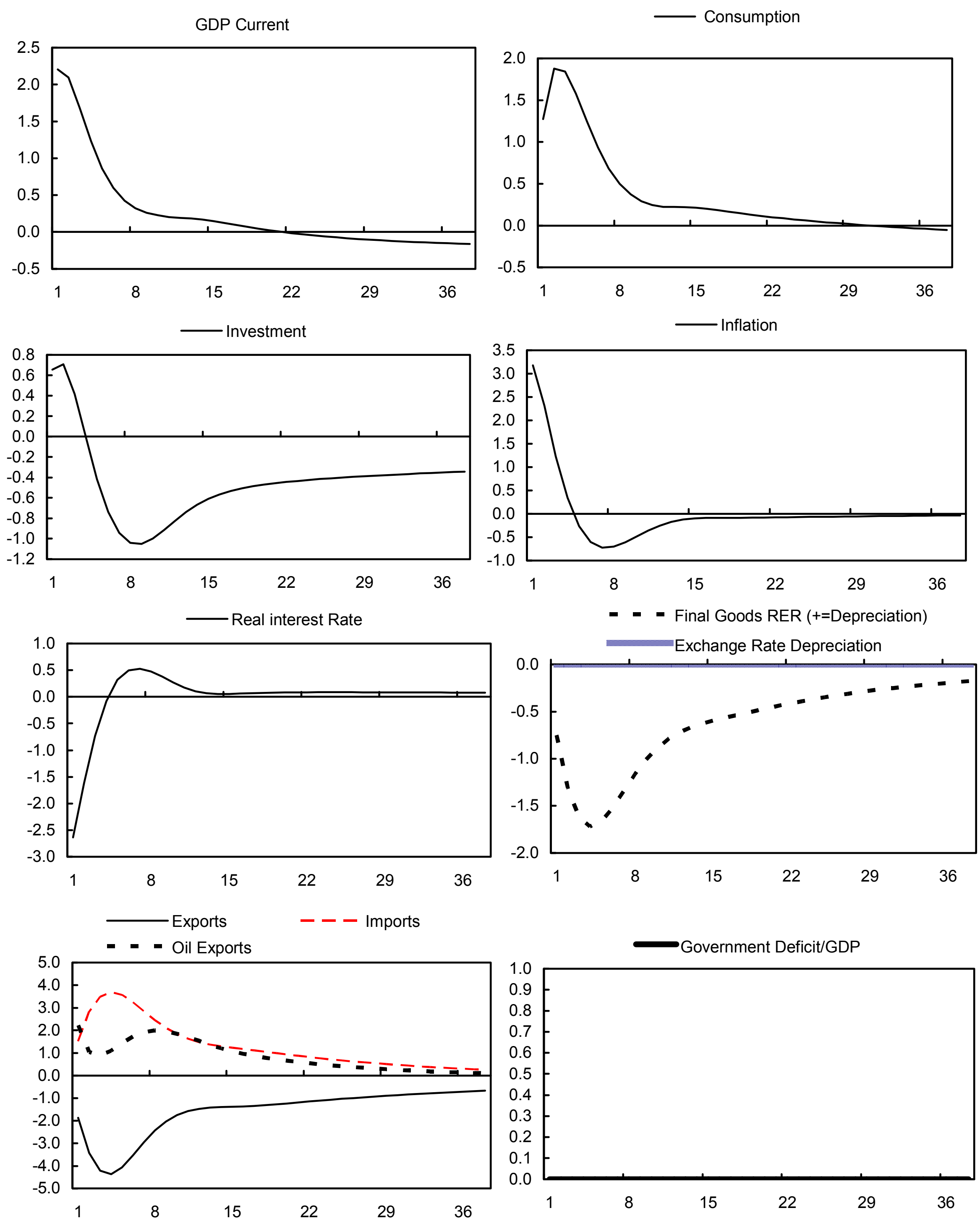
4. *The path for public debt in the baseline* is assumed to decline from 60 to 40 percent of GDP. This implies an initial increase in the overall government surplus of 1.2 percent of GDP, which is achieved through a reduction in transfers. In the short-run, domestic demand contracts as a result, lowering GDP. However, over the medium-run, lower debt reduces the risk premium, real interest rates fall, and domestic demand settles at a higher level in the new steady state. Since long-run interest rates are lower in the new steady state, private sector agents offset some of the fiscal tightening, and the current account surplus responds less than one-to-one to the higher overall surplus. Overall, the change in steady-state allows the model to capture the rapid decline in debt-to-GDP observed during the period in question.

Summary

Under the baseline simulation, high commodity prices increase private wealth and raise consumption. The government's increased take from the commodity sector (as a result of high commodity prices and higher export taxes) is distributed via higher transfers to maintain the overall surplus target which further stimulates consumption. Inflation increases, pushing down real interest rates (since nominal rates are linked to world interest rates under the fixed exchange rate regime), which adds to both investment and consumption over the short-term. The trade balance and current account move into surplus initially due to the terms of trade shock although, over time, higher imports eat into the surpluses. The currency appreciates in real terms, although the suppression of margins in non-tradable sectors helps to slow that process.

Overall, the baseline tries to capture the economic features in Argentina during 2003–2007 of strong economic growth, an appreciating real exchange rate, albeit with some degree of undervaluation.

Summary: Argentina: Baseline with debt reduction (change in steady state)



B. A More Active Monetary Policy

In this alternative scenario, monetary policy is assumed to rely on the interest rate as the policy instrument and has more independence because exchange rate policy is assumed to be set in line with a forward looking policy reaction function. Accordingly policy makers use interest rates to react to expected inflation, the output gap, and exchange rate depreciation (and to allow for some smoothing of interest rates).

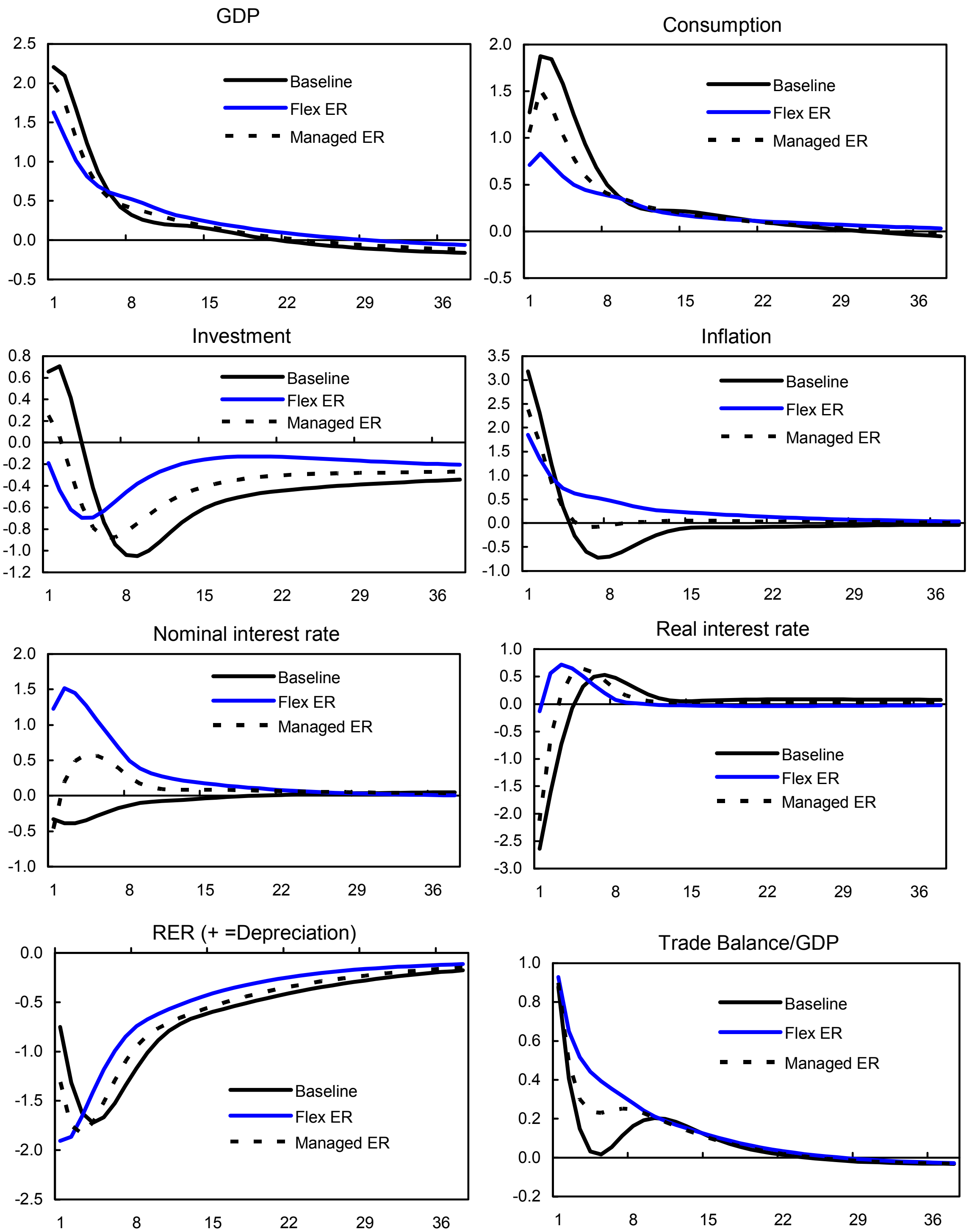
$$i_t = \left(i_{t-1}\right)^{\mu_i} \left(\bar{r}_t \pi_{4,t+4}\right)^{1-\mu_i} \left(\frac{\pi_{4,t+4}}{\bar{\bar{\pi}}}\right)^{(1-\mu_i)\mu_\pi} \left(\frac{gdp_t}{\overline{\overline{gdp}}}\right)^{(1-\mu_i)\mu_y} \left(\frac{\Delta e_t}{\overline{\overline{\Delta e}}}\right)^{(1-\mu_i)\mu_e},$$

where μ_i is the degree of interest rate smoothing (set equal to 0.5); μ_π is response to deviation of one year ahead year-on-year inflation from inflation target (set equal to 1.1); μ_y is the response to output gap (with a weight of 0.1); and finally μ_e is the response to variations in exchange rate depreciation.

In a pure floating exchange rate regime μ_e is set to zero. In this case, the exchange rate is flexible and is determined through uncovered interest parity, reacting to the difference between domestic and foreign interest rates. This becomes an important factor in reducing the inflationary pressures in the economy seen in the baseline case. In particular, in response to higher inflation and an economy operating above potential, the monetary authority raises nominal interest rates, and the currency appreciates in nominal terms. Investment initially declines, and the stimulus to consumption is reduced, leading both GDP and inflation to increase by less than the baseline scenario. This lessens inflationary pressures, virtually halving them in comparison to the baseline. Overall, a more activist monetary policy reduces the swings in both inflation and real activity by much more than the baseline.

In a managed floating exchange rate regime, the monetary policy reacts to variations in exchange rate depreciation (with a weight of 1). As a result, nominal interest rates are initially reduced in response to exchange rate appreciation pressures, but then raised in response to higher inflation and positive output gap. Consequently, stimulus to consumption and investment is reduced compared to baseline, but overall demand pressures are still high compared to floating exchange rate regime. Inflationary pressures are lowered, but not as much as in the pure floating case.

Summary: Argentina: Comparison of baseline with more active monetary policies (change in steady state)



C. Countercyclical Fiscal Policy

This section assesses the path of the economy around a given steady state (public debt at 40 percent of GDP) for two alternative fiscal rules:

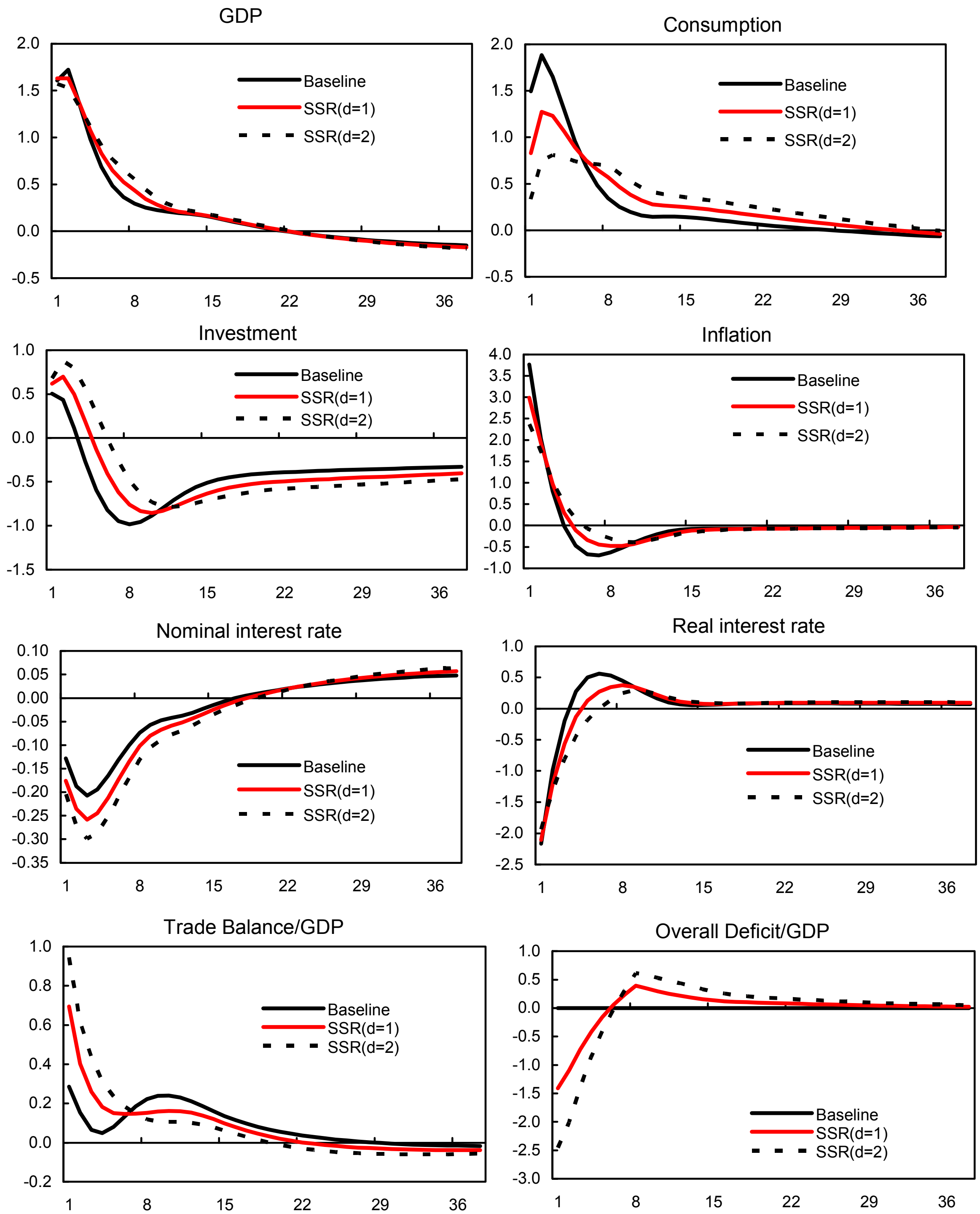
1. **Structural Surplus Rule and Fixed Exchange Rate**: Rather than a balanced budget rule the fiscal authorities raise the fiscal surplus when the economy is above potential and lower it in downturns. In terms of the fiscal policy reaction function, d_{tax} and d_{com} are both set to 1.

b. **Activist Countercyclical Fiscal Policy and Fixed Exchange Rate**: A stronger countercyclical response to output fluctuations is assumed (d_{tax} and d_{com} are both set to 2).

Under the structural surplus rule both the overall and primary surplus increase in response to the positive shocks facing the economy which moderates the consumption boom somewhat. However, the fiscal policy reaction serves to increase investment in the short-run relative to the baseline, which implies that the output boom is only modestly contained, and inflationary pressures are slightly lower than that under the overall balance rule. Even if fiscal policy is made considerably more countercyclical, the impact on the volatility of both inflation and output is rather muted.

It is worth noting that the response would not be symmetric with a negative shock particularly for high debt-to-GDP ratios. A countercyclical policy would imply reduction in overall surplus, increasing debt accumulation and the corresponding risk premium, and therefore reducing investment and consumption. Therefore, the degree of countercyclicality and the corresponding impact on the economy would depend on initial conditions regarding debt and current account.

Summary: Argentina: Comparisons of baseline with countercyclical fiscal policies
(Constant steady state)



D. A Combination of Both Fiscal and Monetary Policies

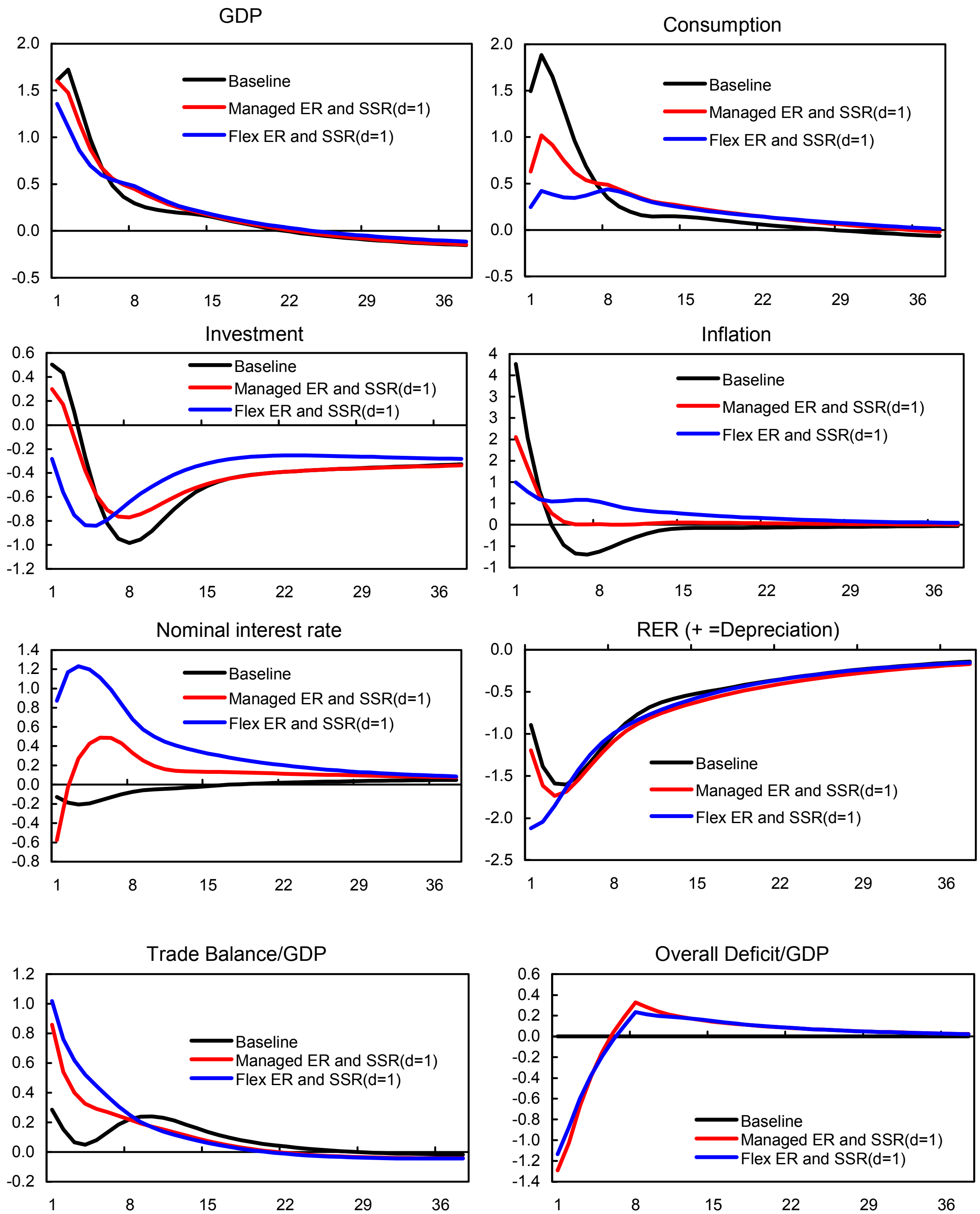
Finally, the baseline scenario is repeated but allowing for both the structural surplus rule described in Section C and the activist monetary policies (both pure and managed floating exchange rate regimes) in Section B to operate in tandem.

In these scenarios, monetary policy reacts quickly to inflationary pressures and is supported by a countercyclical fiscal policy. The nominal exchange rate is allowed to appreciate over the short-term (less so for managed floating regime), quickly lowering tradable goods prices. Higher real interest rates contain both consumption and investment. And the tighter fiscal policy ensures that a greater portion of the commodity windfall is saved. As a result, inflationary pressures decrease quickly and substantially, and economy converges to its new equilibrium with a significant reduction in both output and inflation variability. In addition, when monetary and fiscal policy works together the amount of interest rate increases needed is much less than the case in with active monetary policy alone.

Table. Volatilities of Main Variables Under Alternative Policy Scenarios

		Real GDP	Inflation	Nominal Interest Rate
Baseline (debt= 40)	Standard deviation	**0.24**	**0.33**	0.04
	Maximum	1.72	3.77	0.05
	Minimum	-0.18	-0.70	-0.21
Flexible ER (debt =40)	Standard deviation	0.22	0.27	0.26
	Maximum	1.50	2.72	**1.81**
	Minimum	-0.12	0.00	-0.01
Managed ER (debt =40)	Standard deviation	0.23	0.25	0.10
	Maximum	1.63	3.04	0.64
	Minimum	-0.15	-0.12	-0.09
Structural Surplus Rule (SSR) (debt =40)	Standard deviation	0.25	0.28	0.05
	Maximum	1.63	2.99	0.06
	Minimum	-0.21	-0.48	-0.26
Structural Surplus Rule (SSR, d=2) (debt =40)	Standard deviation	0.26	0.23	0.06
	Maximum	1.57	2.37	0.07
	Minimum	-0.23	-0.39	-0.30
Combination of policies (SSR and Managed ER) (debt =40)	Standard deviation	0.23	0.18	0.09
	Maximum	1.60	2.05	0.49
	Minimum	-0.18	-0.01	-0.58
Combination of policies (SSR and Flexible ER) (debt =40)	Standard deviation	**0.20**	**0.15**	0.21
	Maximum	1.36	0.99	**1.23**
	Minimum	-0.17	0.00	-0.01

Summary: Argentina: Comparison of alternative policies



VI. CONCLUSION

This paper has analyzed the implications of various monetary and fiscal policy options available for Argentina and assessed their impact on short-run dynamics of the economy using the global integrated monetary fiscal (GIMF) model. The model is calibrated to reflect the main economic and policy characteristics of Argentina during 2003-2007. As with any modeling exercise, it is hard to simulate every aspect of the economy simultaneously, leaving many details unexplored. Overall, the paper finds that using either an activist monetary policy or a countercyclical fiscal policy to respond to strong growth in domestic demand would have only a partial effect on inflationary pressures. Relying either on monetary or fiscal policies alone to contain inflation would require either a dramatic increase in nominal interest rates or a highly countercyclical fiscal stance, both of which would imply larger output costs. However, the model suggests that using both fiscal and monetary policy tools in a coordinated way could help contain the growth in domestic demand to bring inflation down with a relatively small cost in terms of output.

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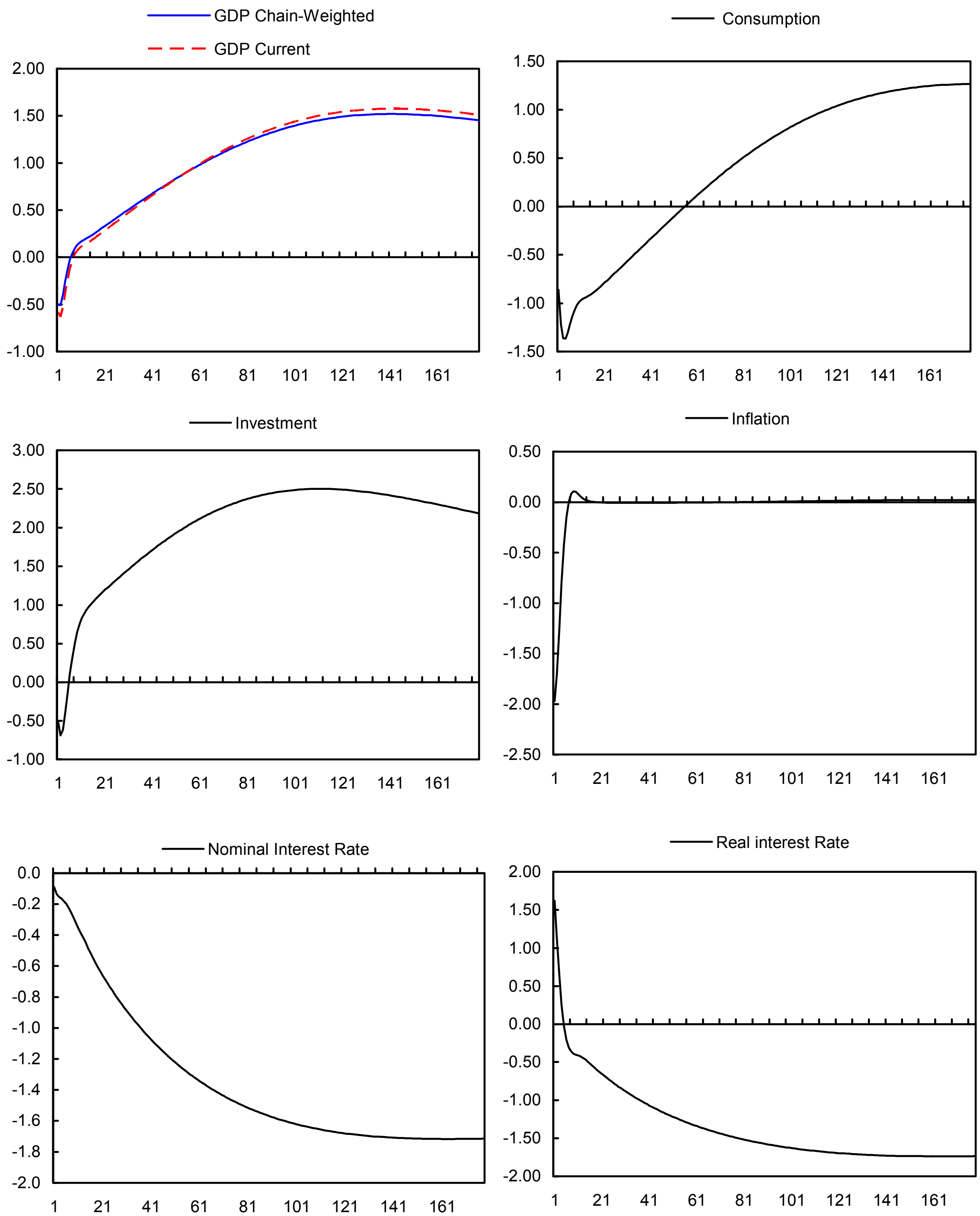
APPENDIX 1. CALIBRATION

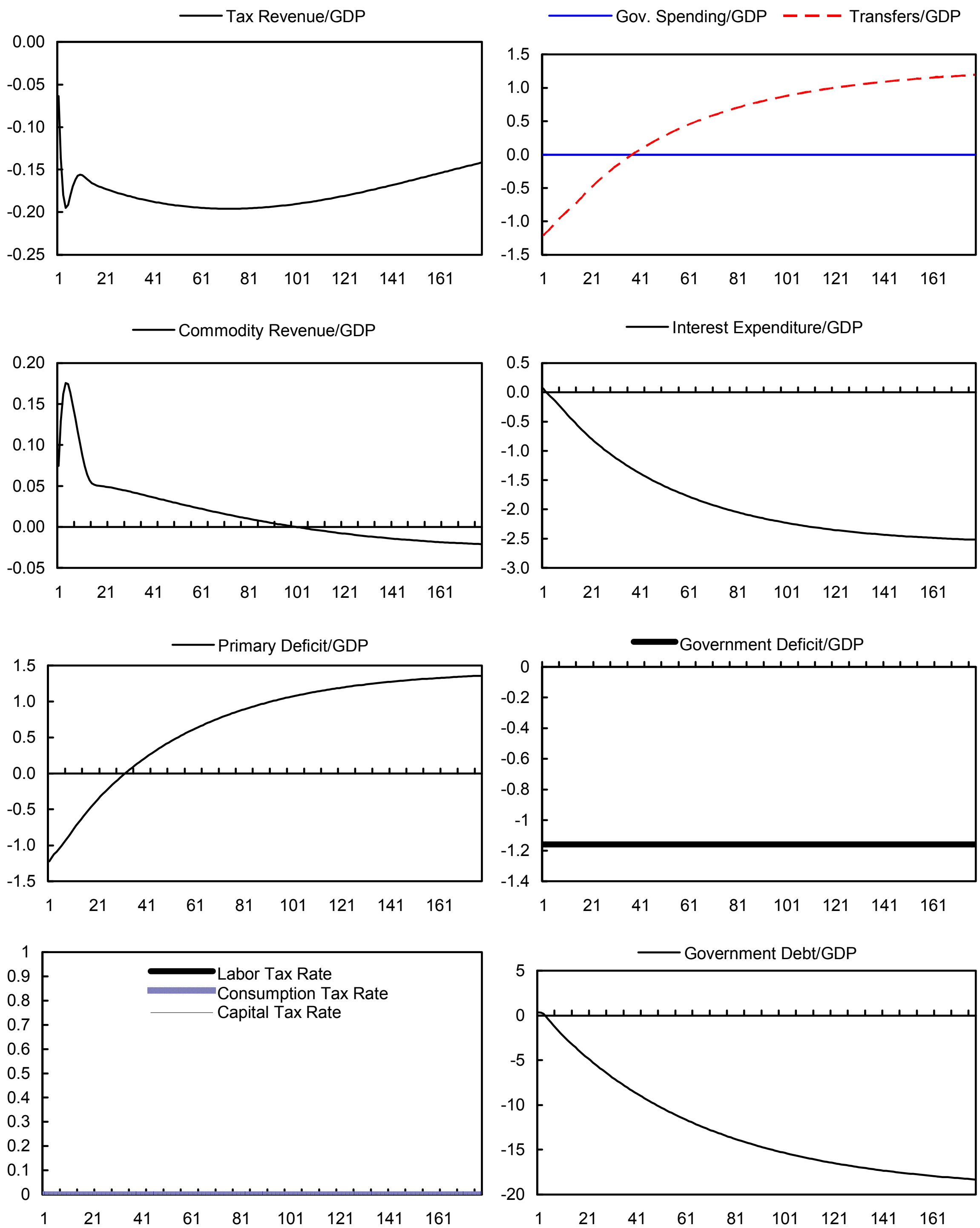
Parameters	(in percent, unless otherwise stated)
Size of GDP (PPP adjusted) in world GDP	0.6
Size of population in world population	1
World real interest rate	3
Risk premium at 60 percent debt to GDP	390 basis points
Risk premium at 40 percent debt to GDP	250 basis points
Real world growth rate	2
Population growth rate	1
Steady state world inflation	2
Steady state inflation	3
Share of liquidity constrained agents in world population	50
Share of liquidity constrained agents in Argentine population	50
Labor share (world)	66
Labor share (Argentina)	55
The share of non-tradables (world)	50
The share of non-tradables (Argentina)	56
Share of investment spending in GDP (world and Argentina)	20
Share of government spending in GDP (world)	18
Share of government spending (Argentina)	16
Share of government consumption (world)	15
Share of government consumption (Argentina)	12
Share of transfers in GDP(world)	9
Share of transfers in GDP(Argentina)	10
Share of consumption tax revenues in total (world)	30
Share of consumption tax revenues in total (Argentina)	55
Share of capital income tax revenues in total (world)	16
Share of capital income tax revenues in total (Argentina)	10
Share of labor income tax revenues in total (world)	23
Share of labor income tax revenues in total (Argentina)	30
Share of commodity output in total GDP	17
Share of commodity exports in total GDP	10.2
Share of domestic factors of prod. in total commodity revenue	70
Share of exports of intermediate goods in GDP	5.44
Share of exports of final goods excluding commodities in GDP	1.36
Share of imports of intermediate goods excl. commod. in GDP	8

Changing Steady State: 20 percentage point decline in debt-to-GDP ratio

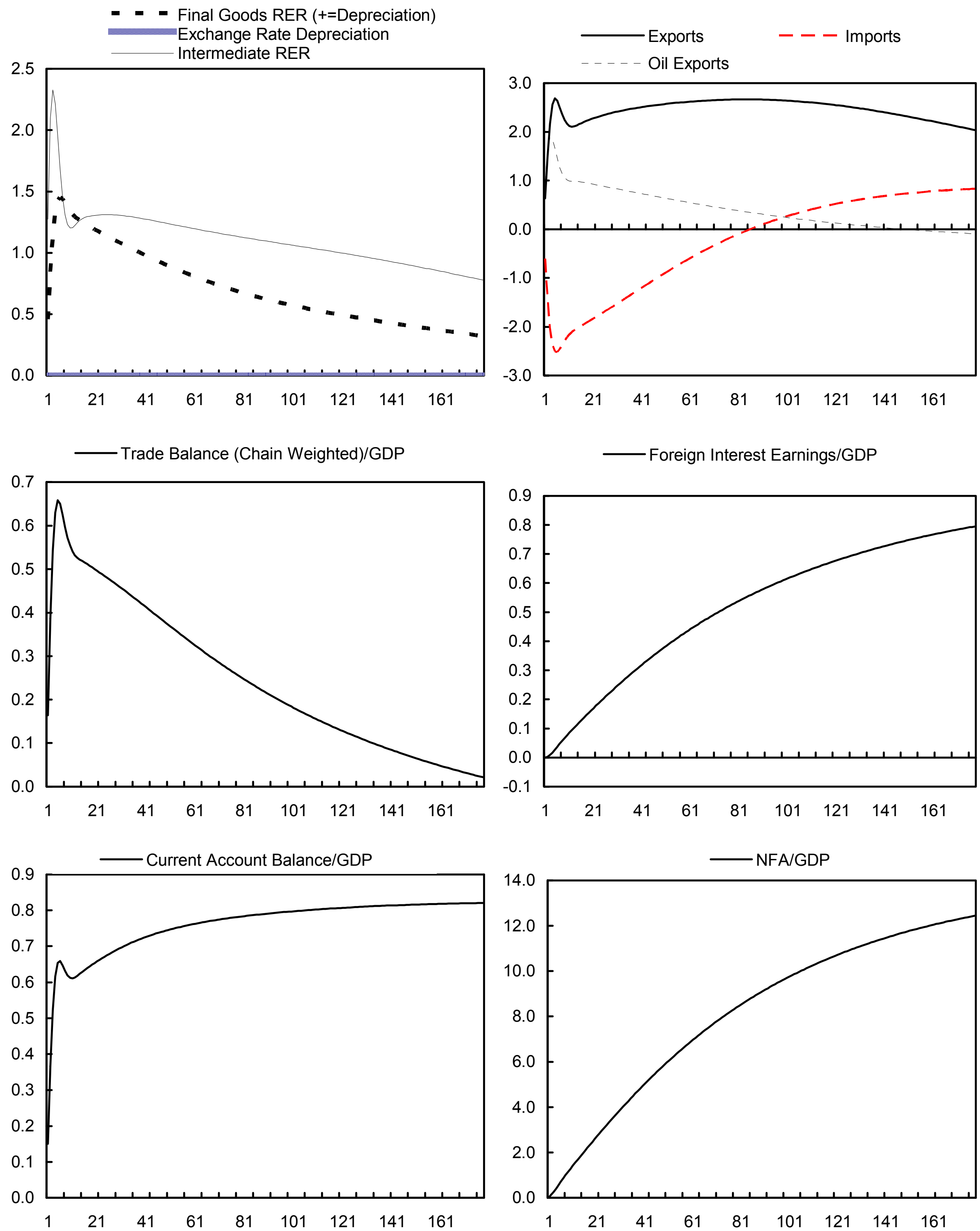
Summary: Argentina: 20 percentage point decline in debt-to GDP ratio



Fiscal: Argentina: 20 percentage point decline in debt-to GDP ratio

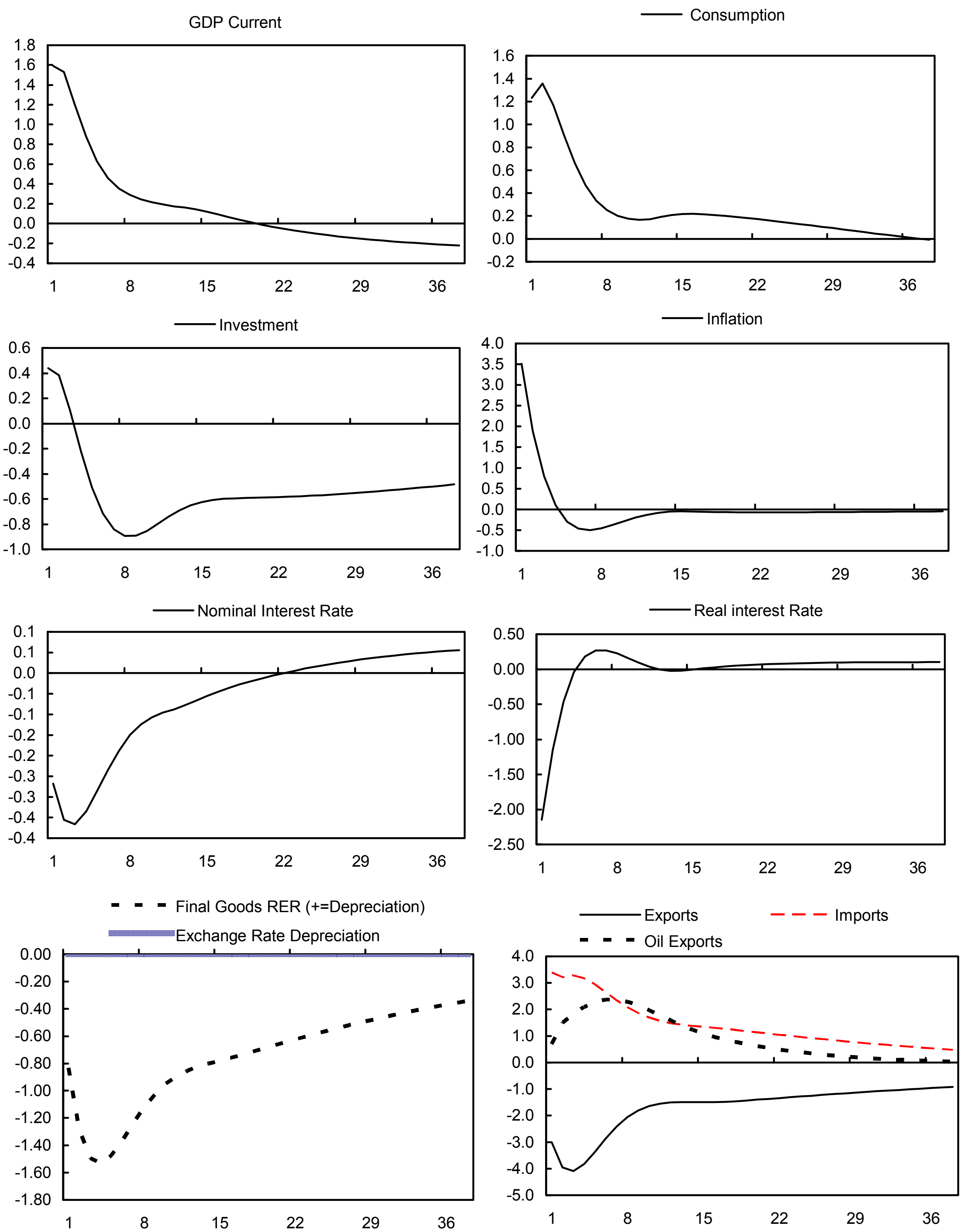


Trade. Argentina: 20 percentage point decline in debt-to GDP ratio

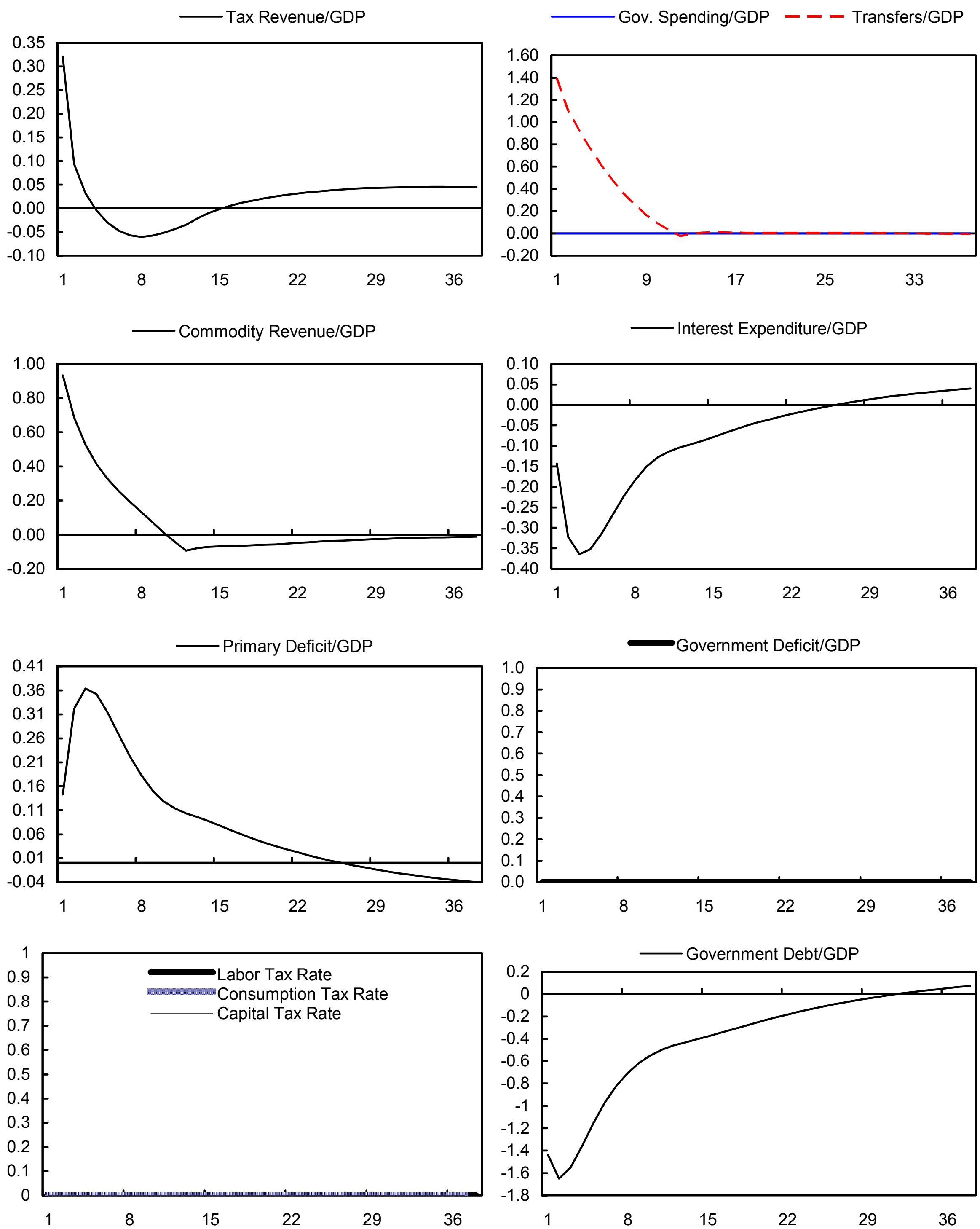


Commodity price shock

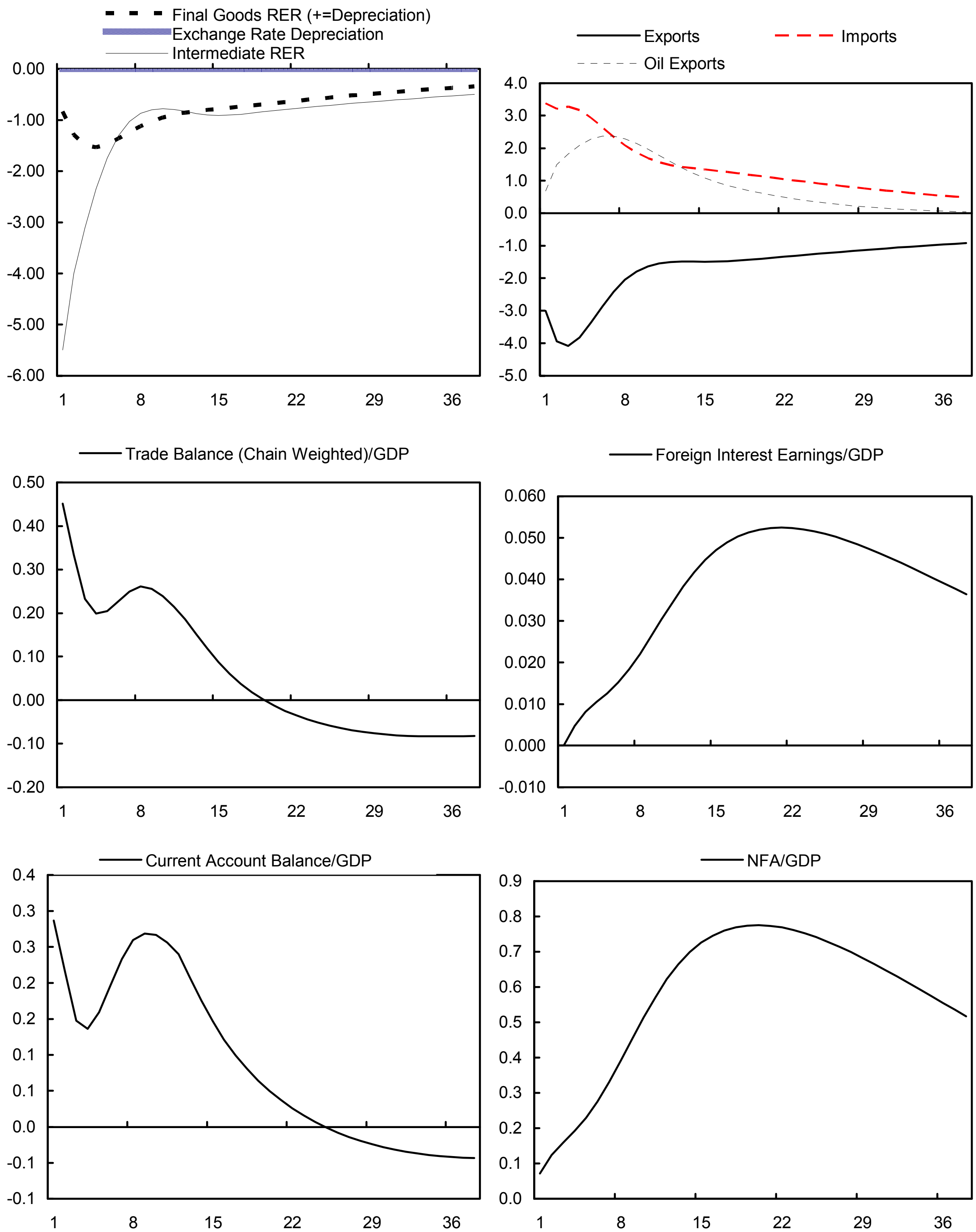
Summary: Argentina: One and half standard deviation commodity price shock



Fiscal: Argentina: One and a half standard deviation commodity price shock

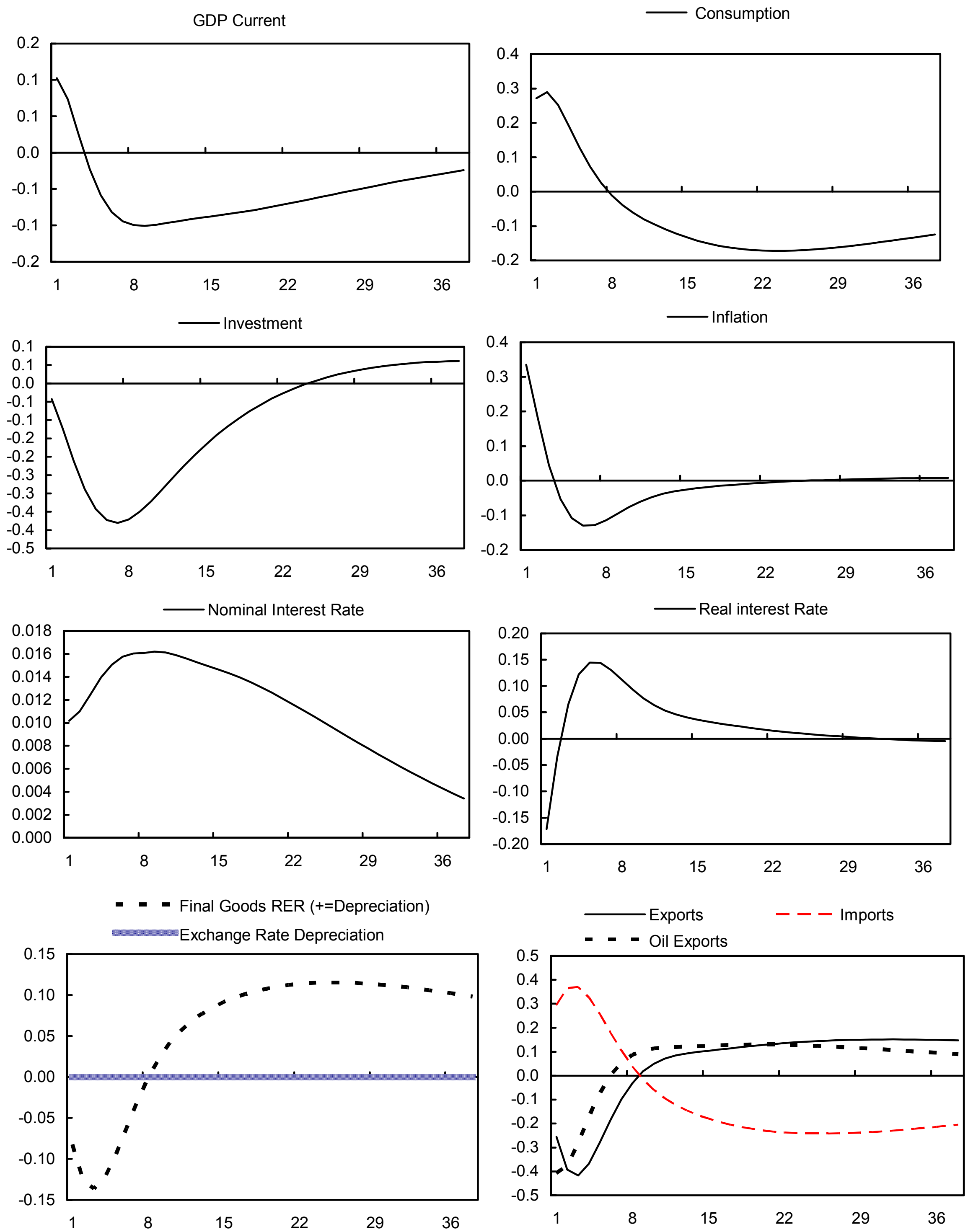


Trade. Argentina: One and a half standard deviation commodity price shock

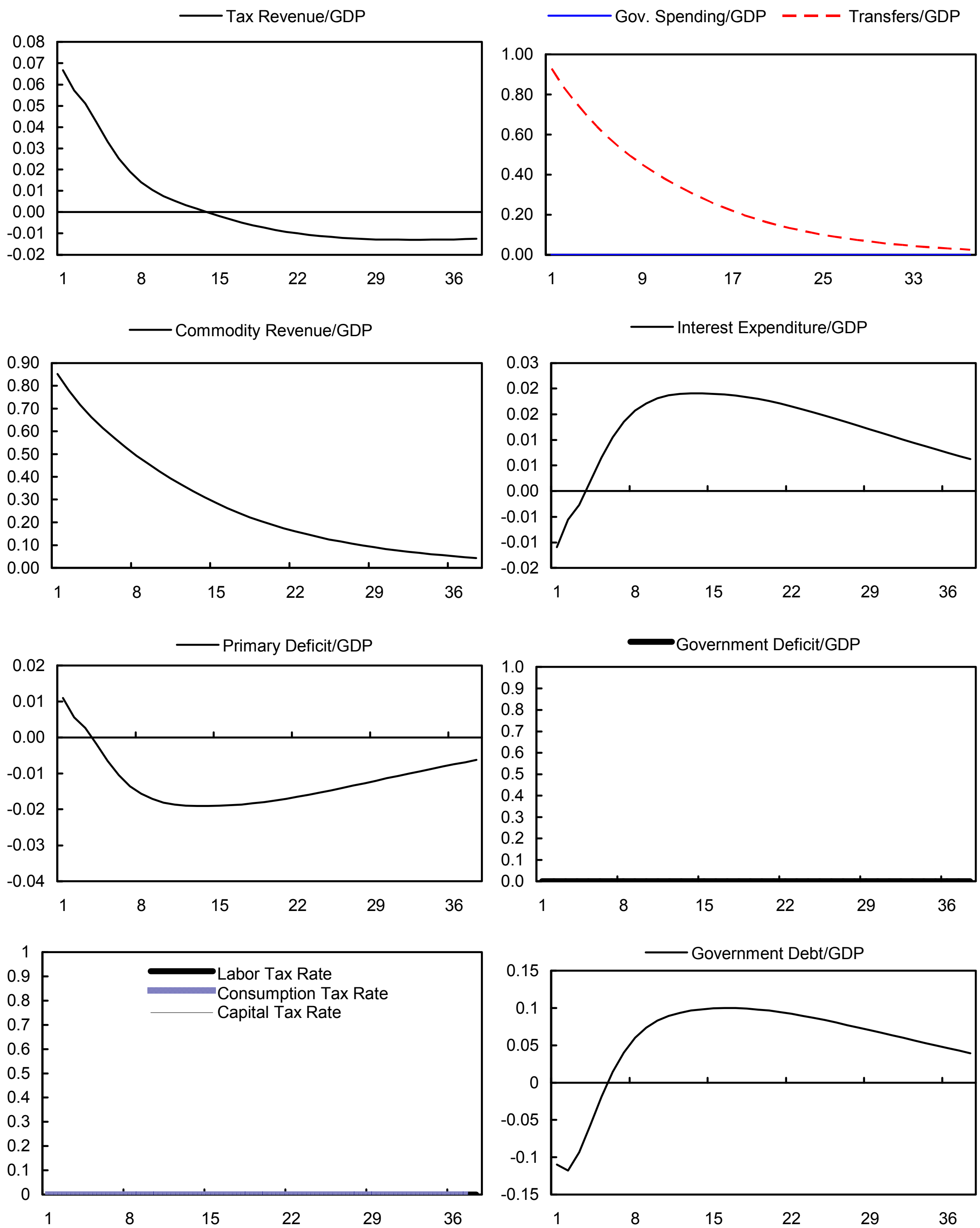


Increase in government's commodity revenues by one percentage point of GDP

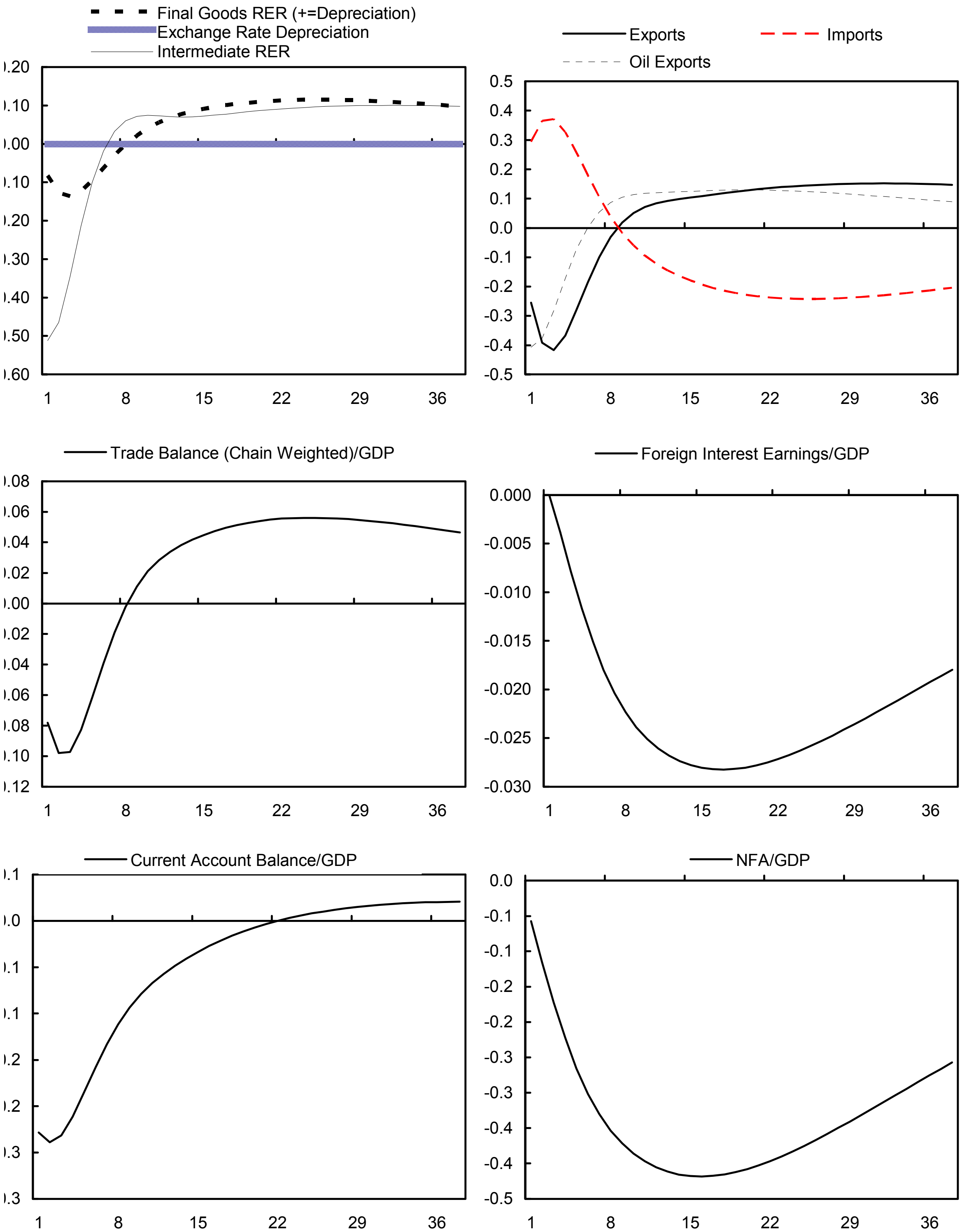
Summary: Argentina: Increase in government's commodity revenues by one percentage point of GDP



Fiscal: Argentina: Increase in government's commodity revenues by one percentage point of GDP

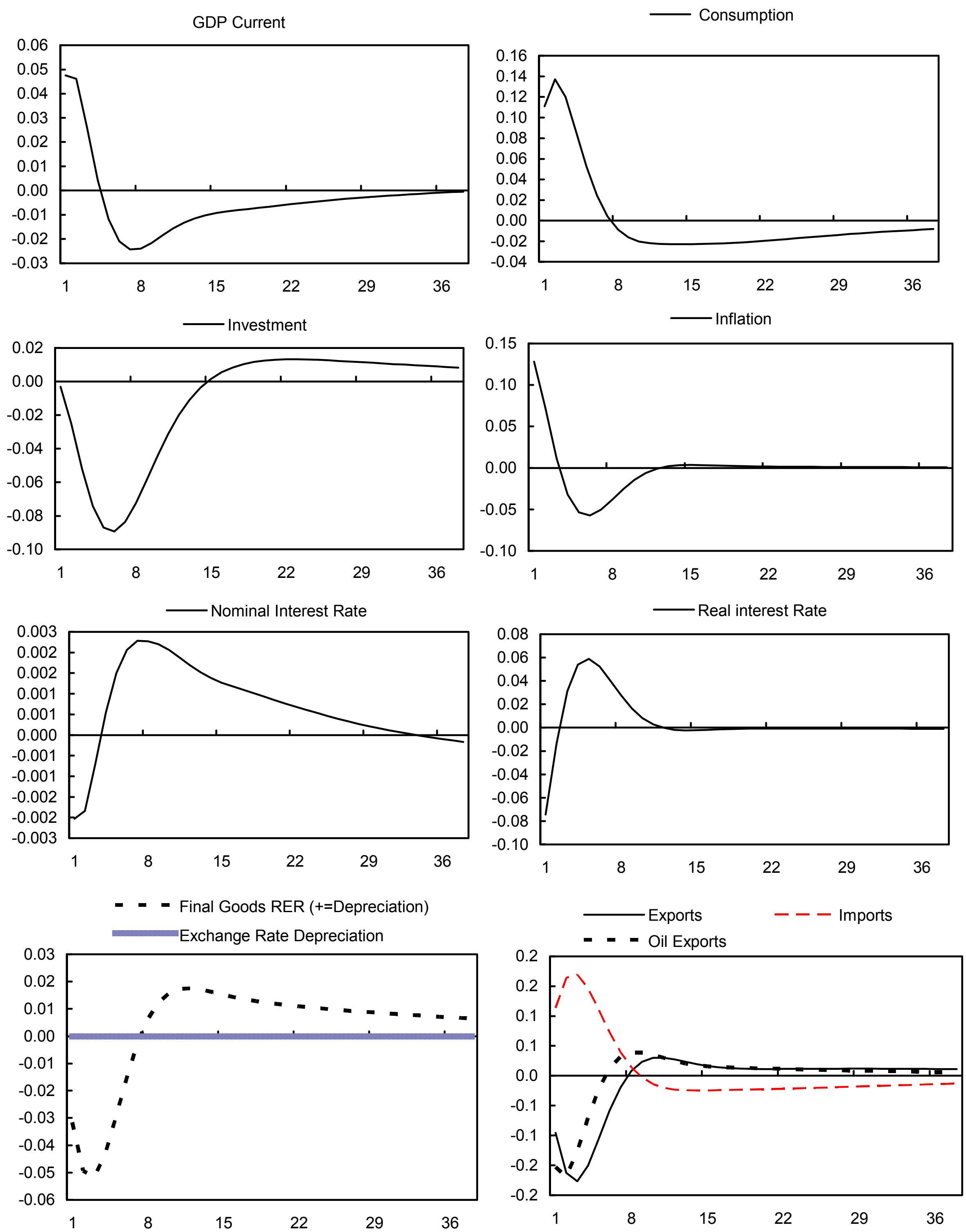


Trade. Argentina: Increase in government's commodity revenues by one percentage point of GDP

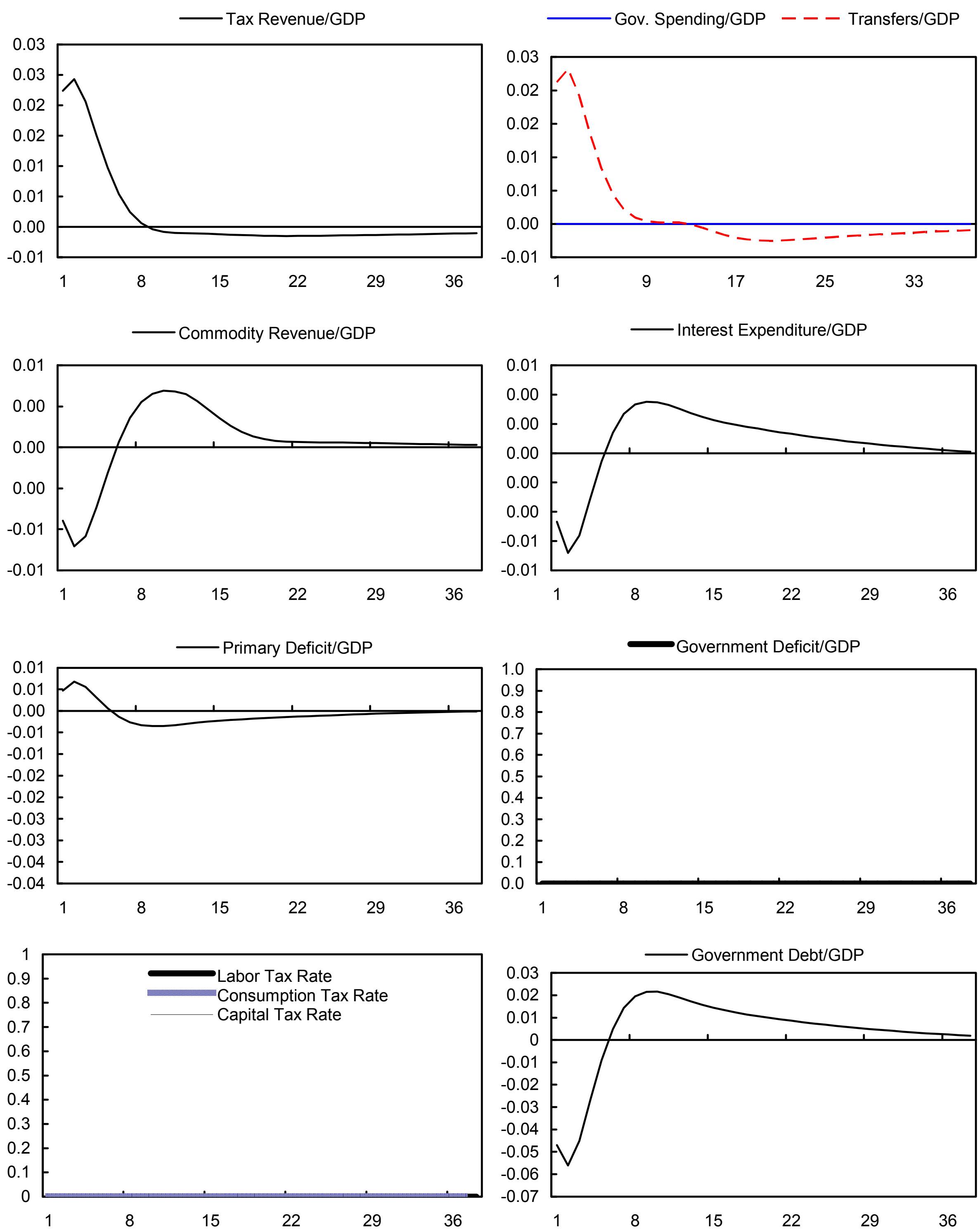


Consumption boom

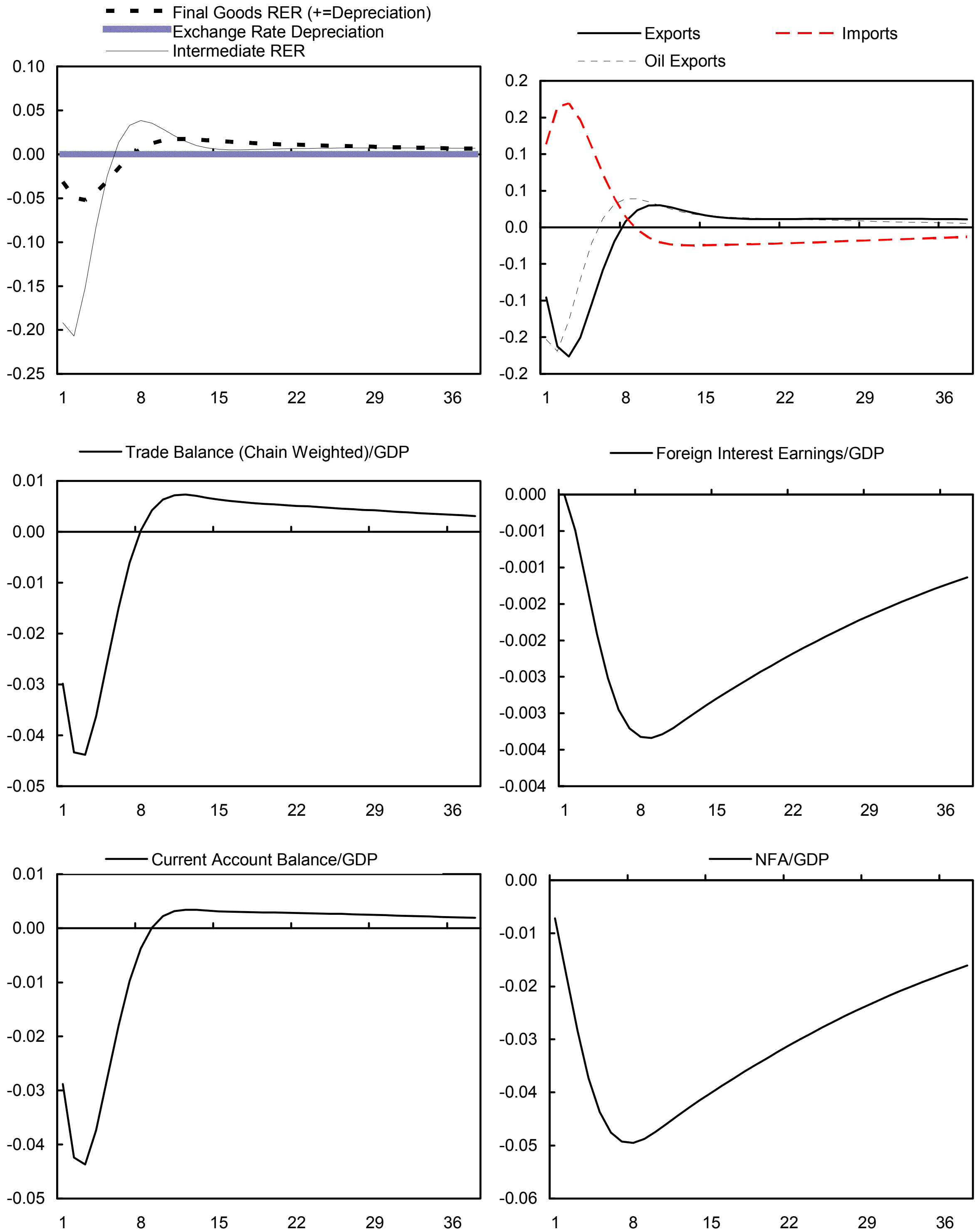
Summary: Argentina: One percent increase in time preference



Fiscal: Argentina:One percent increase in time preference

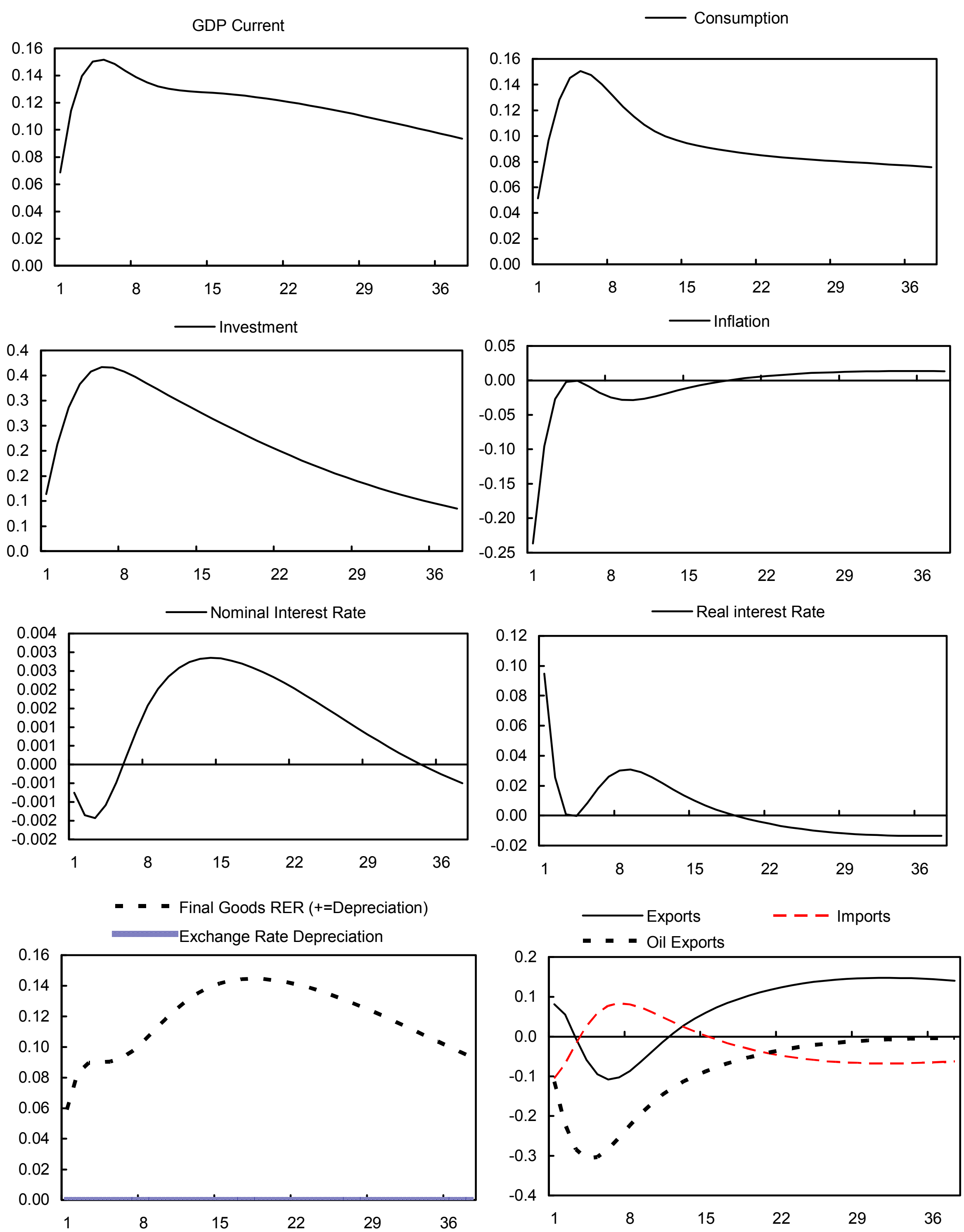


Trade. Argentina: One percent increase in time preference

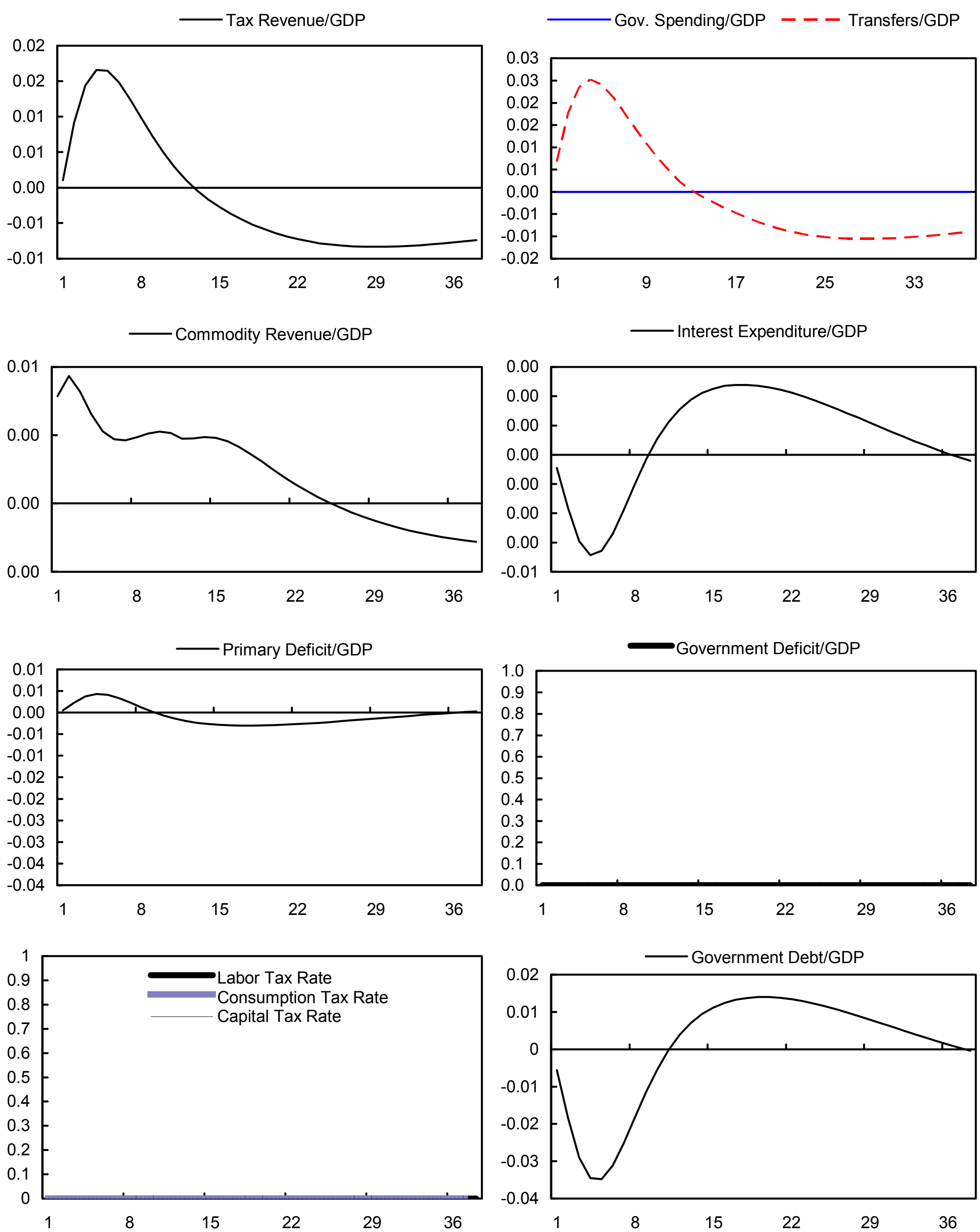


Decline in mark-up in the non-tradable goods sector

Summary: Argentina: One percentage point decline in mark-up in NTG sector



Fiscal: Argentina: One percentage point decline in mark-up in NTG sector



Trade. Argentina: One percentage point decline in mark-up in NTG sector