Commodity Prices and Monetary Policy
The Chilean Experience

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Introduction

- Fluctuations in commodity prices play a key role in Inflation Targeting monetary policy frameworks.

- This role is often-times complex.

- Commodity price fluctuations affect:

  - Inflation through direct effects.

  - Aggregate demand through income effects on households and firms.

 - Aggregate supply through measured productivity and cost structures.

Introduction

- Commodity price fluctuations can have different degrees of transience/ persistence.

- The implications for monetary policy are therefore non-trivial, and more complex than for instance simple aggregate demand shocks.

- In what follows I will present how some of these different issues have been addressed over time by the Central Bank of Chile.

- Seminal work is DSGE framework in Medina and Soto (2007).

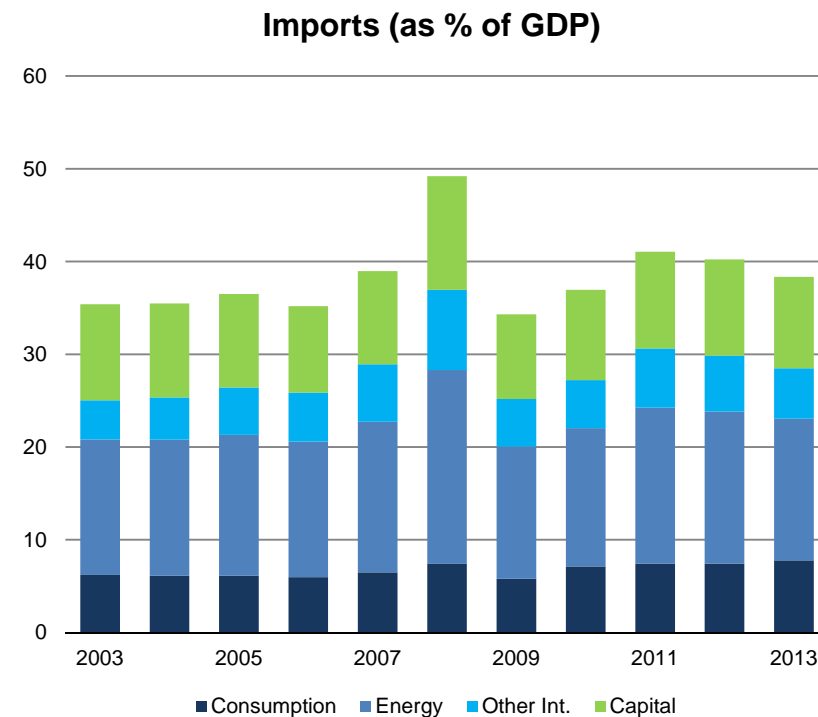# Commodity prices have experienced significant swings over the past two decades.
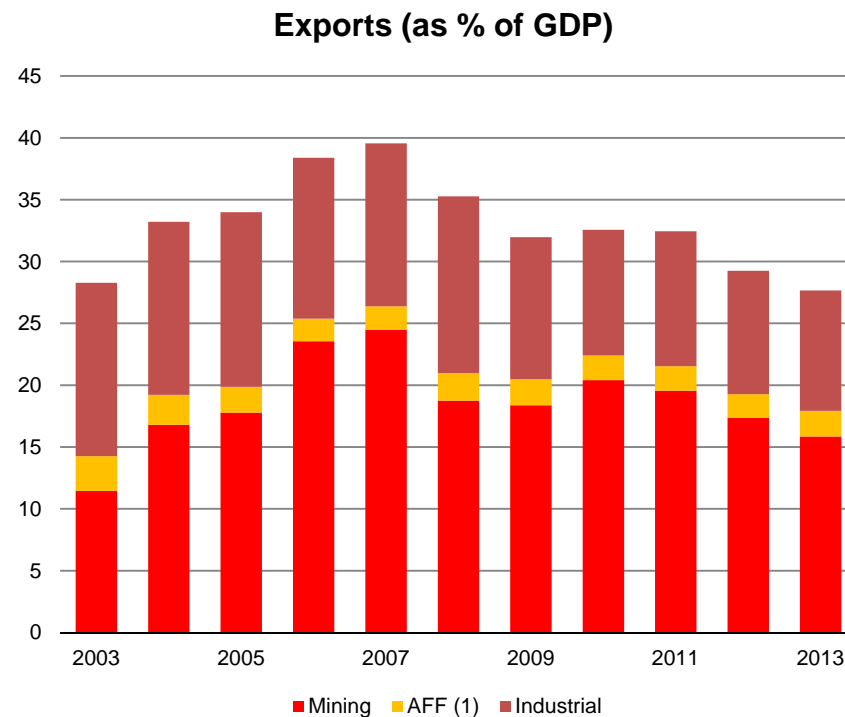
Commodity prices
(index, average 1995–2013=100)
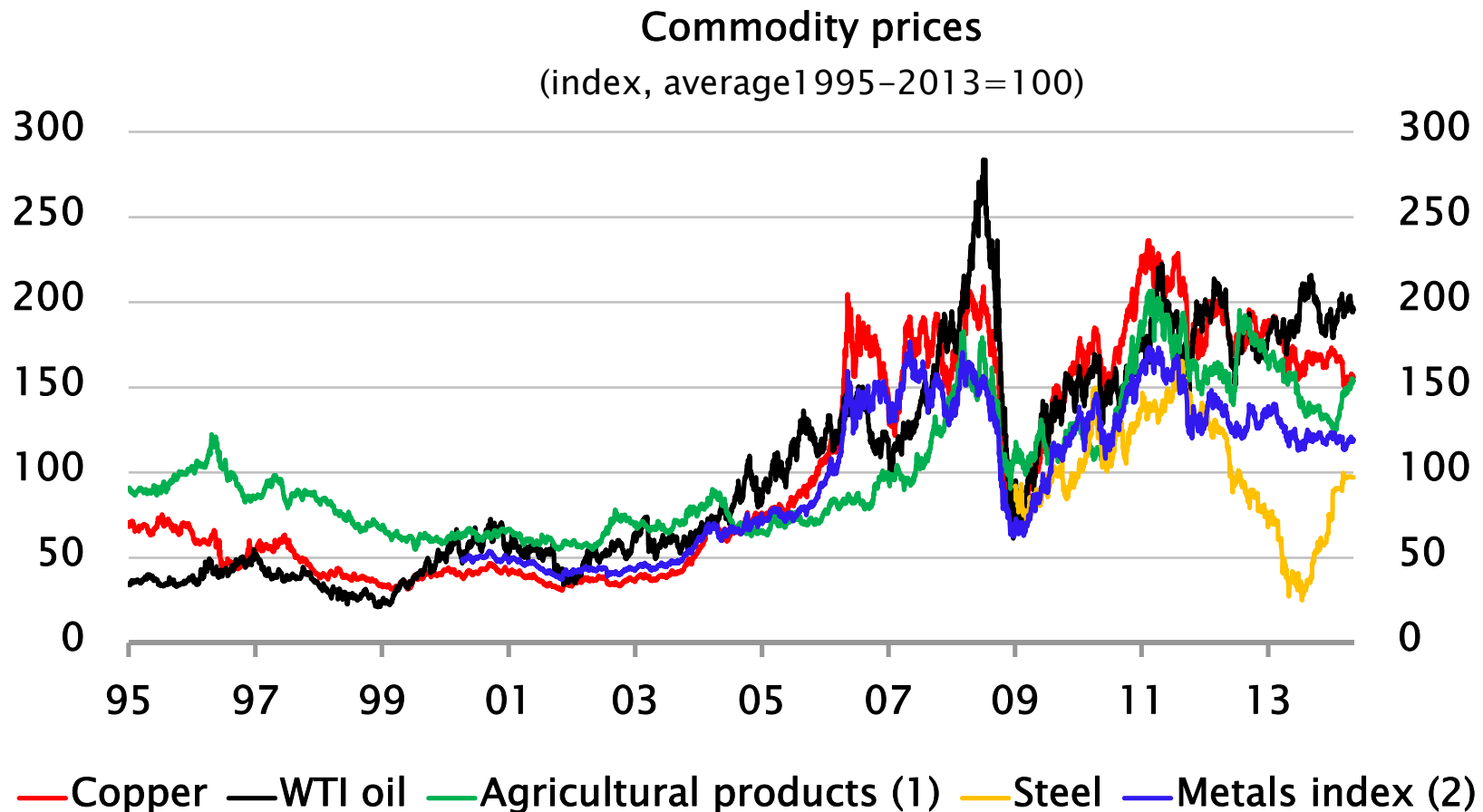
(1) Corresponds to the Goldman Sachs aggregate index.
(2) London Metal Exchange (LME) aggregate index.

Source: Bloomberg.

Chile´s trade patterns make the economy sensitive to commodity price shocks.

Exports (as % of GDP)

Mining — AFF (1) — Industrial

Imports (as % of GDP)

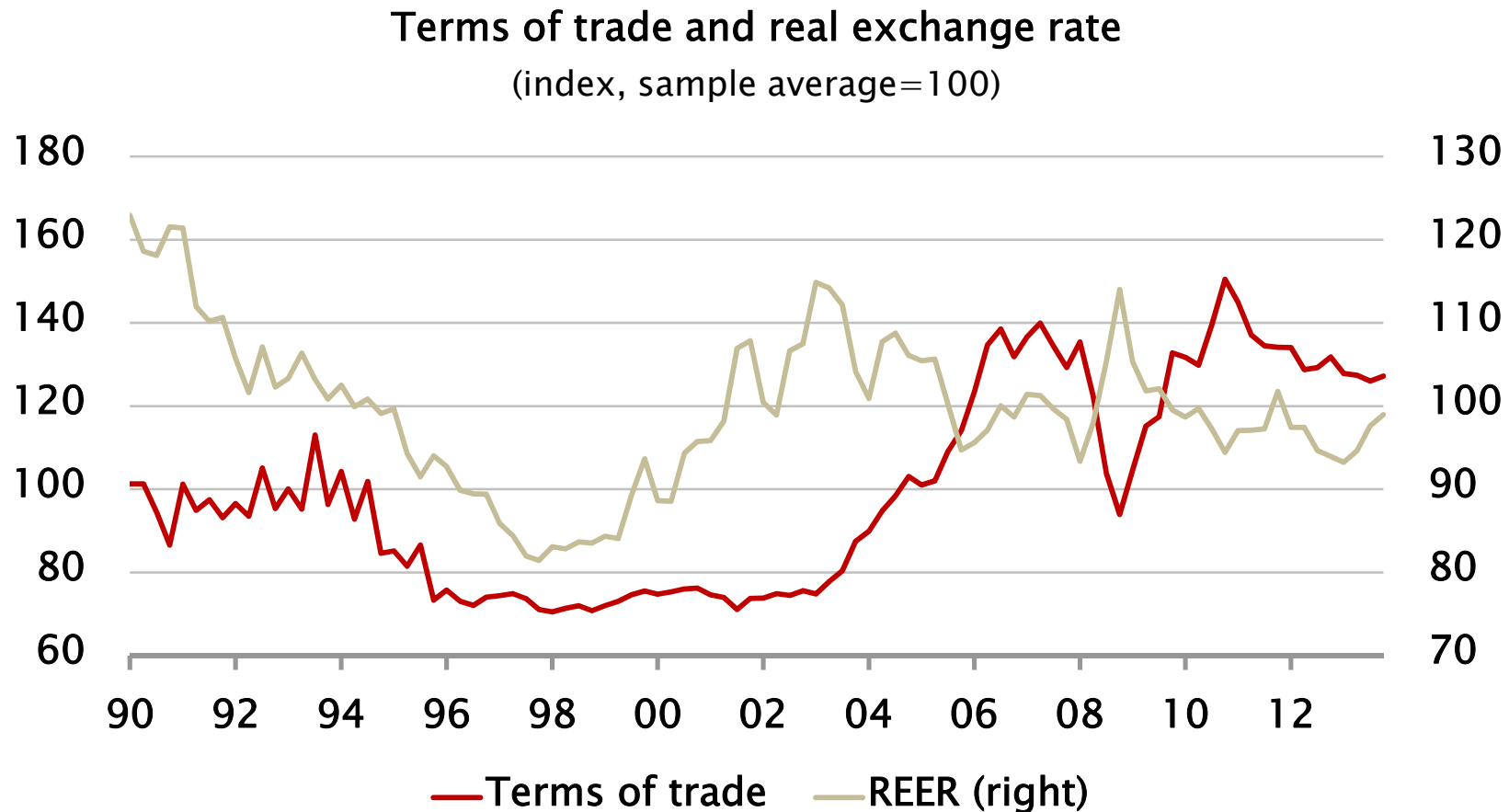Consumption — Energy — Other Int. — Capital

(1) Agriculture, Fisheries and Forestry.

Source: Central Bank of Chile

The terms of trade and the real exchange rate display significant swings ...

Terms of trade and real exchange rate

(index, sample average=100)

Source: Central Bank of Chile.

GDP and consumption deflators, and terms of trade

(year–on–year percentage change)

Source: Central Bank of Chile.
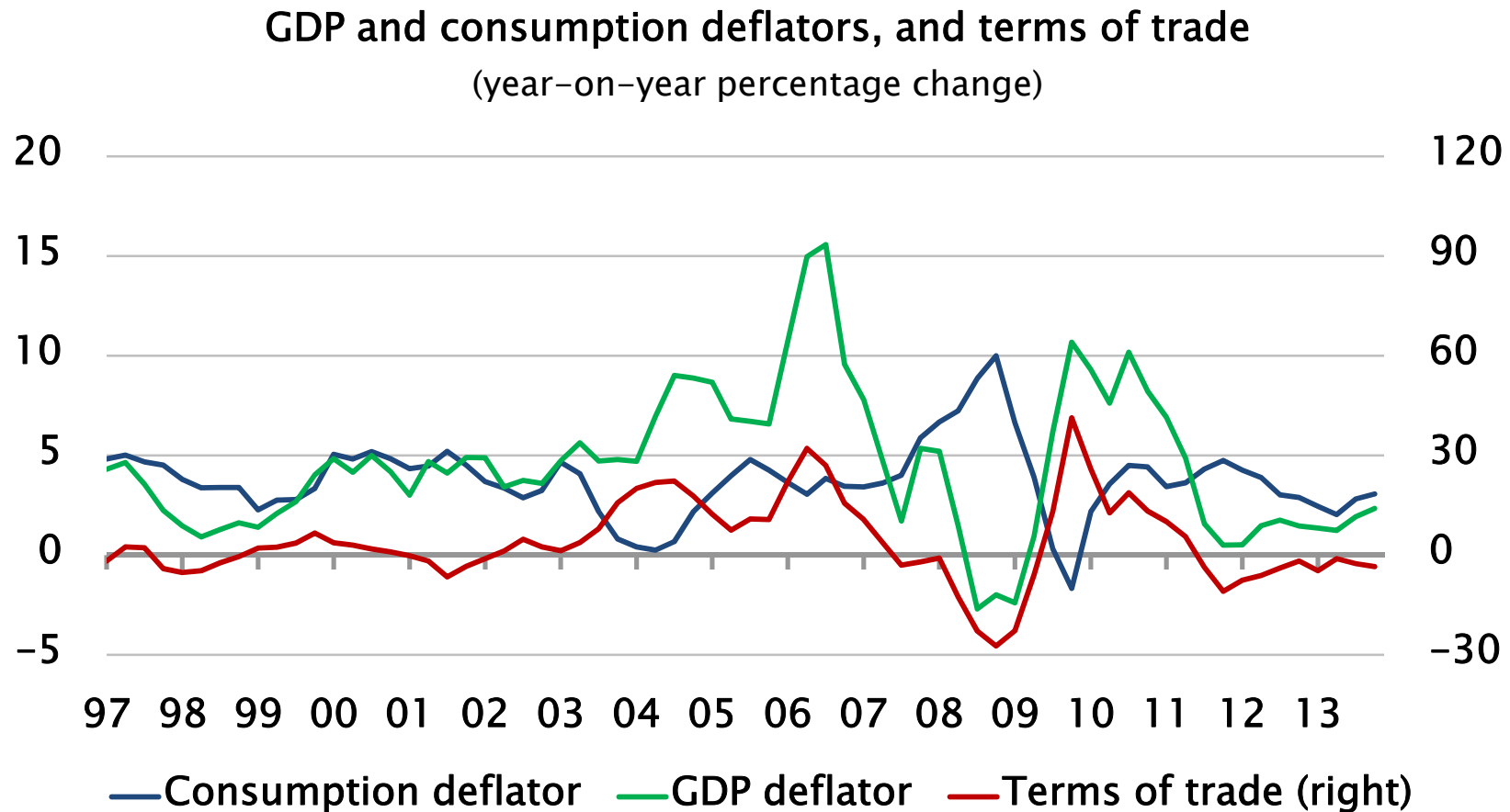
Focus at the BCCh

- Since adopting full-fledged IT framework in 1999, the Central Bank's analytical focus on this issue has been three-fold:

  1) The pass-through of international inflation (esp. food & energy prices) to domestic inflation.

  2) The implications of copper price movements for macroeconomic aggregates.

  3) The effect of higher energy prices on measured productivity and growth.

1) Rigobón (2010) uses micro-data to evaluate different pass-throughs across economies.

Estimates for Wheat Shocks on Bread Average Prices
Wheat in local currency

	Max	HL (max)		Max	HL (max)
Belgium	8%	9	Iceland	94%	9
Denmark	3%	10	Lithuania	14%	6
France	4%	7	Poland	89%	13
Germany	3%	24	Slovenia	49%	4
Ireland	17%	5	Chile	94%	7
Italy	2%	9	Colombia	29%	6
Japan	24%	5	Israel	58%	6
Netherlands	9%	23	Japan	24%	5
USA	8%	12	Singapore	117%	18
Bulgaria	70%	5	Philippines	39%	9
Czech Republic	60%	21	Russia	34%	2
Estonia	28%	21			

Source: Rigobón (2010).

1) Pass-through from energy to gasoline is similar across developed economies...
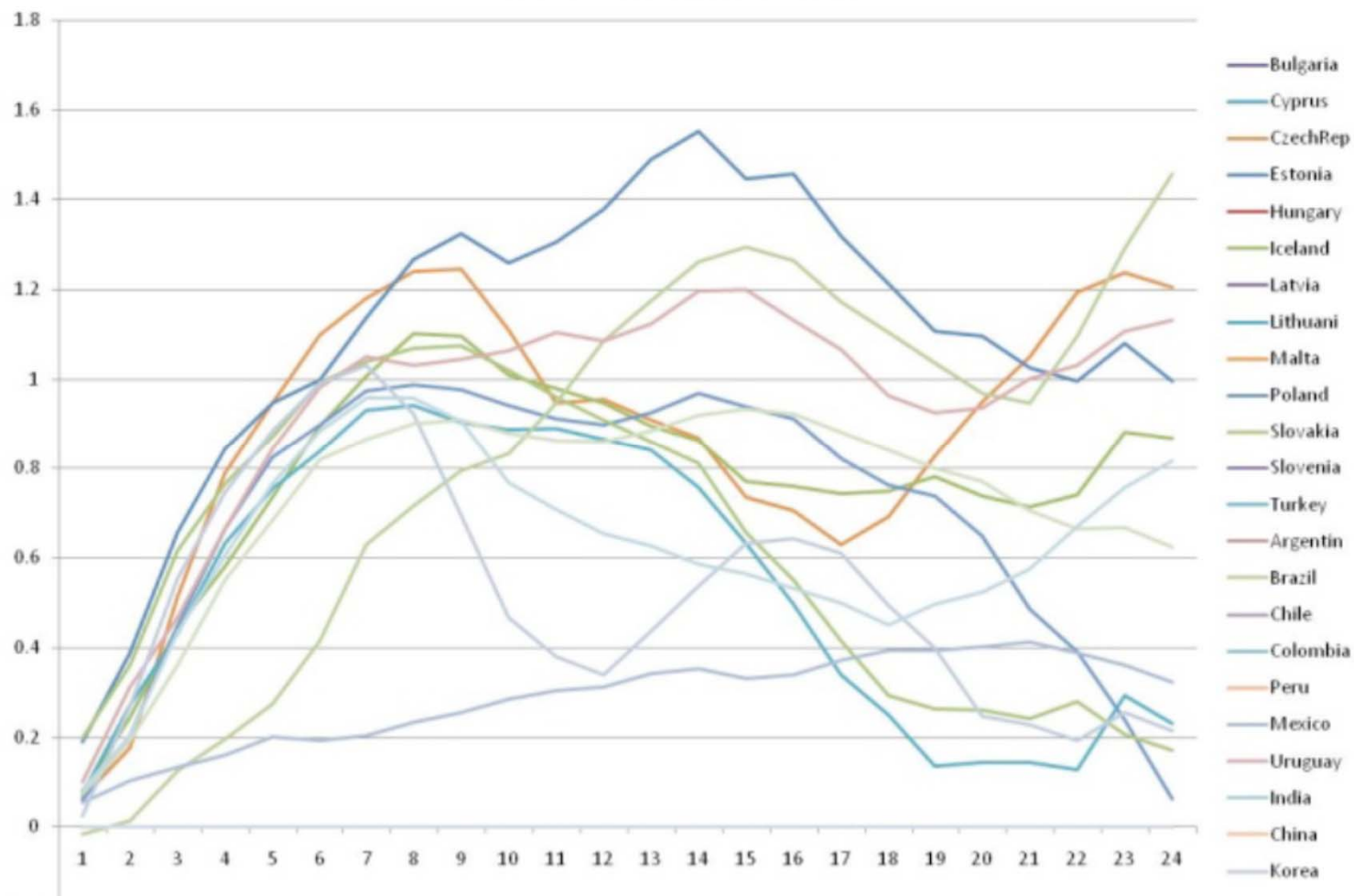

Impact of oil prices on gasoline
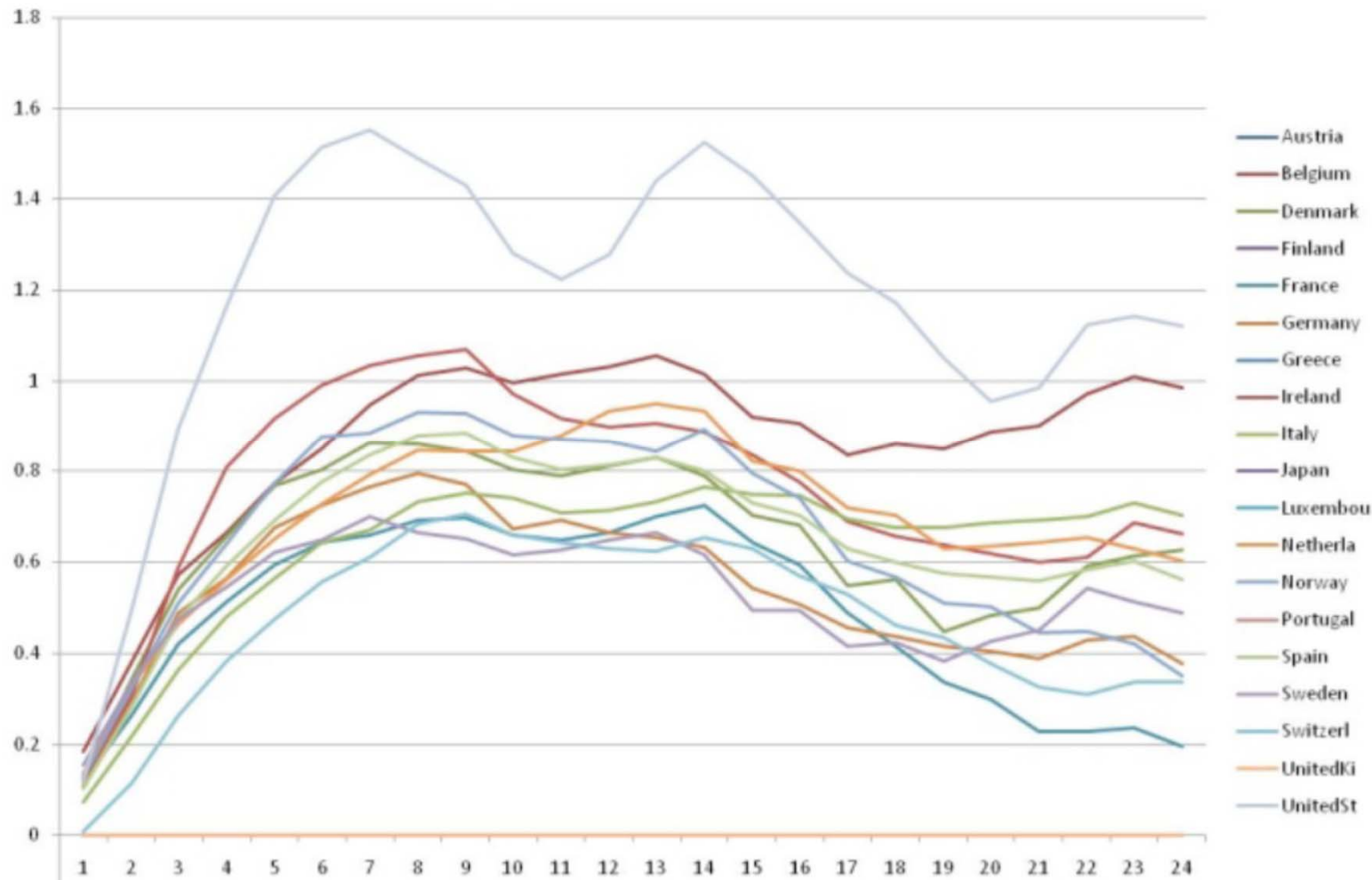
1) But much more heterogeneous across emerging economies.

Impact of oil prices on gasoline

1) Country and sectoral fixed effects play a significant role.

Variance Decomposition of Country fixed effect, and Sector fixed effects.
Commodity prices in Dollars

Commodities in Dollars

	Max Pass Through			Max Half Life		
Shock	Country	Sector	Total	Country	Sector	Total
Oil	27.0%	26.8%	53.7%	32.3%	17.0%	49.3%
Rice	24.7%	22.8%	47.5%	8.3%	19.1%	27.4%
Maize	55.4%	11.4%	66.7%	19.7%	18.0%	37.7%
Wheat	56.5%	11.8%	68.3%	19.6%	16.3%	35.8%
Copper	26.3%	27.1%	53.4%	29.8%	10.8%	40.6%
	LR Pass Through			LR Half Life		
Oil	18.4%	27.5%	46.0%	33.4%	18.8%	52.2%
Rice	23.4%	19.0%	42.5%	6.1%	20.8%	27.0%
Maize	50.8%	10.8%	61.5%	19.3%	20.1%	39.3%
Wheat	51.4%	11.3%	62.7%	20.5%	18.0%	38.6%
Copper	23.1%	23.8%	46.8%	24.4%	11.3%	35.7%

Source: Rigobón (2010).

1) Global factors improve forecasting accuracy.

Figure 1
Inflation in Chile and International Inflation Factors Based on OECD Economies
1995:01 – 2013:03

Legend: Chile — Fac. Average — Fac. PCA — Fac. PLS
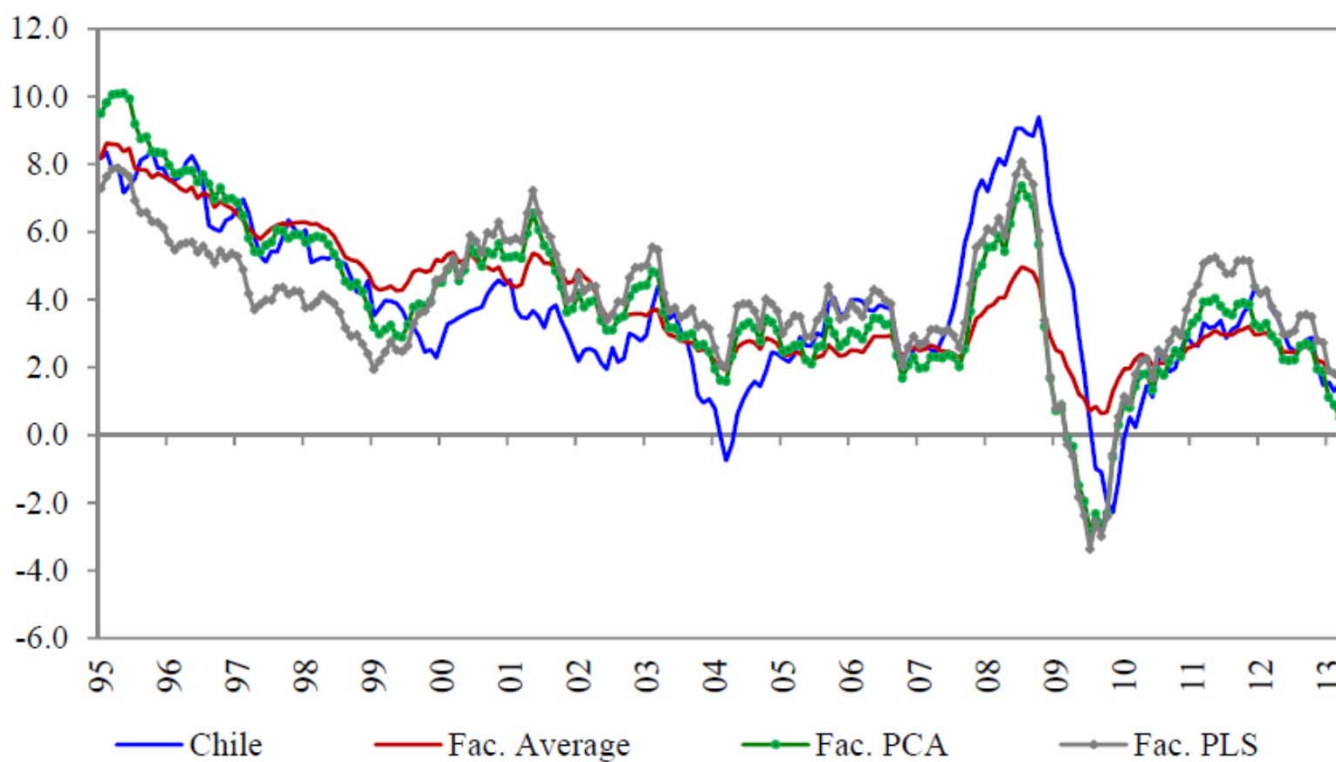
Source: Authors' elaboration

Source: Pincheira and Gatty (2014).

2) DSGE approach to model commodity price within IT framework.

- Seminal work is DSGE model developed in Medina and Soto (2007): *Modelo de Análisis y Simulación* (MAS)

- Forms an important part of IT forecasting framework since 2008.

- Allows to answer structural questions such as:

  - Imperfect credibility,

  - Terms of trade shocks,

  - The incidence of fiscal and monetary policy rules,

 - Macroeconomic impact of large natural disasters (2010 earthquake and tsunami).

2) DSGE approach to model commodity price within IT framework.

- Supply side considers three sectors: T, N and S (Copper).

- A fraction of agents is Ricardian.

- Persistence is derived from costs of adjustment in investment and habit formation in consumption.

- New Keynesian Phillips curve with inertia.

- Dynamics from labor-leisure choice needs to be carefully examined.

- Risk premium in UIP depends on NFA as % of GDP.

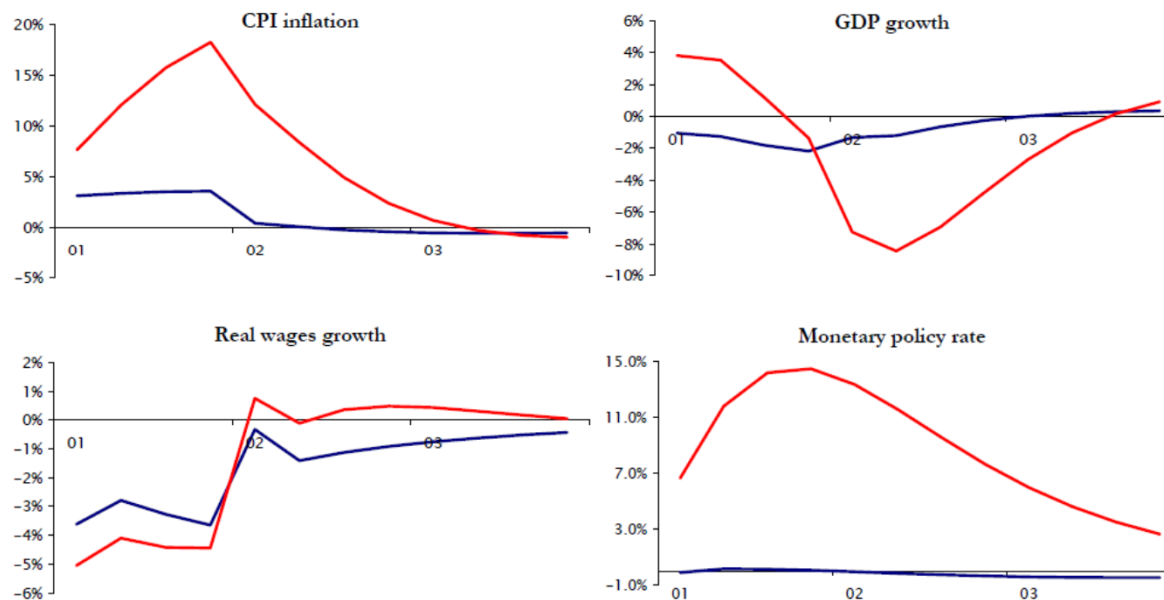# 2) Schematic structure of MAS
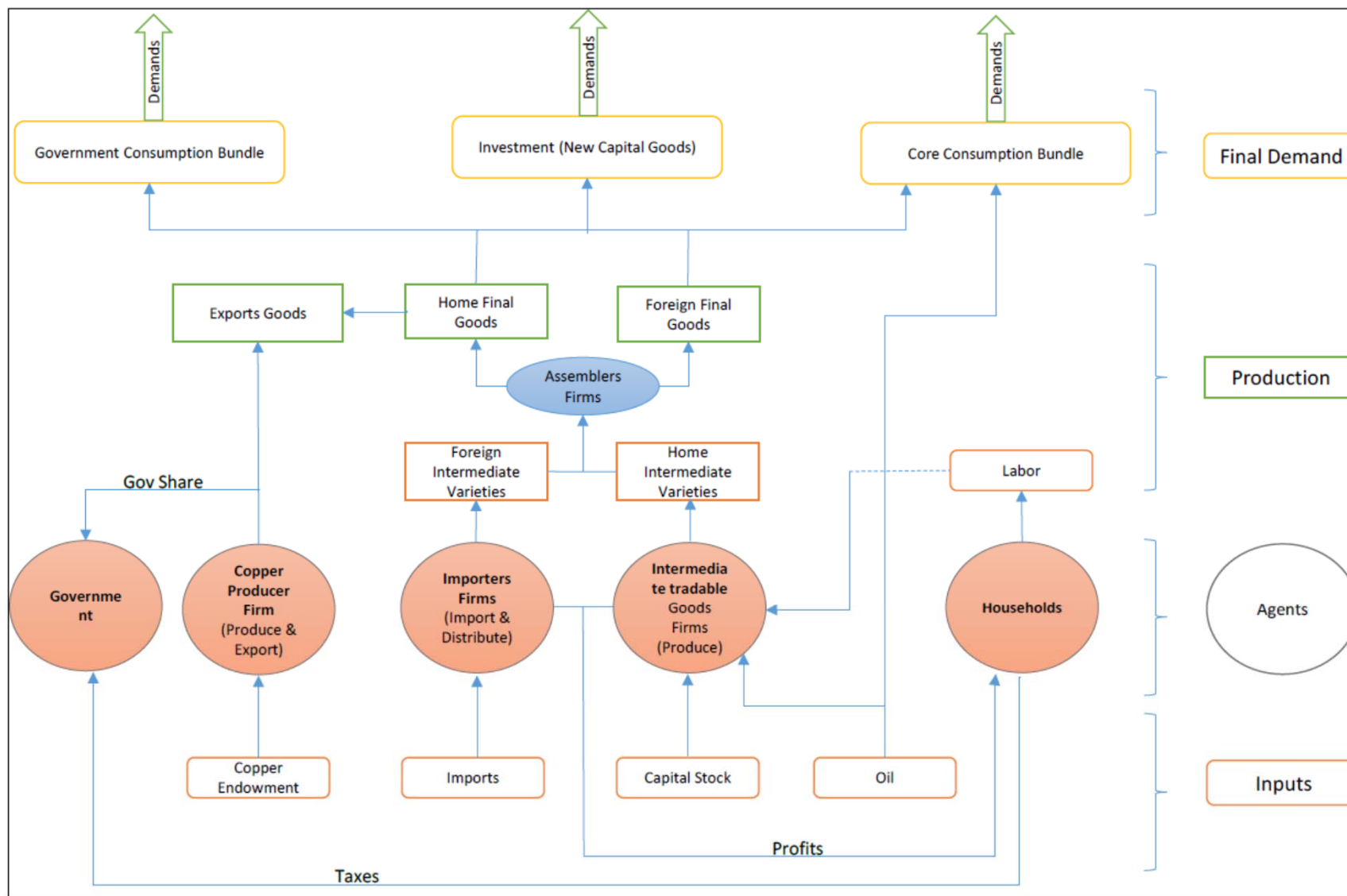
2) The credibility of the Central Bank determines if oil shocks can be accommodated.

Quarterly impulse response to an oil price shock under perfect and imperfect credibility

(year-on-year percentage change from steady-state)

- Credibility that the central bank will not deviate from the target and/or compensate the contractionary effect of oil prices in growth caps inflation expectations and diminishes the contemporaneous effect of oil prices in inflation.

- This therefore limits the need for a monetary policy response to the shock.

Source: Desormeaux et.al. (2010).

2) The copper price boom has been significant, with evolving expected persistence.

Actual copper price and market projection (*)
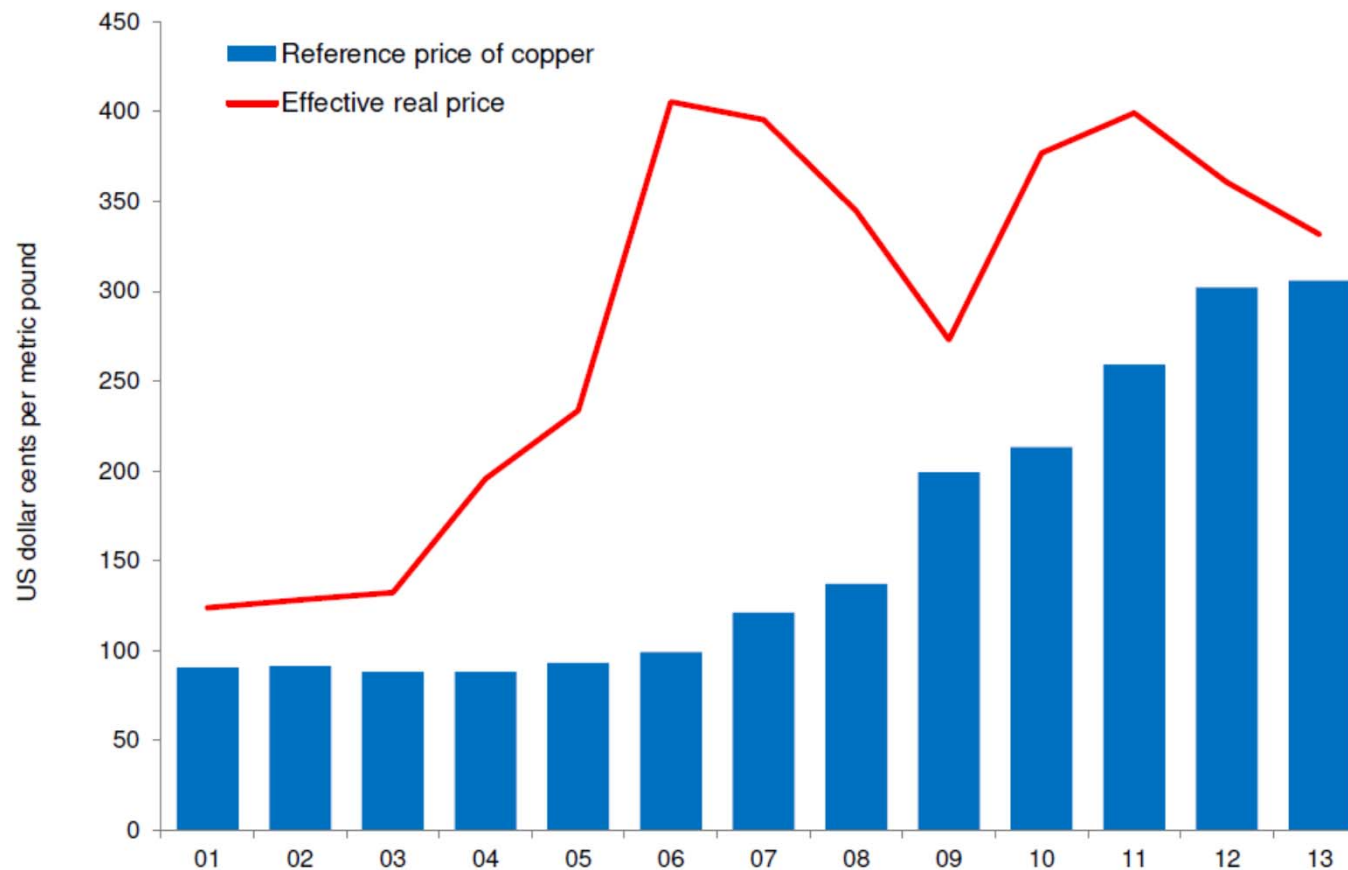(US$c/lb)
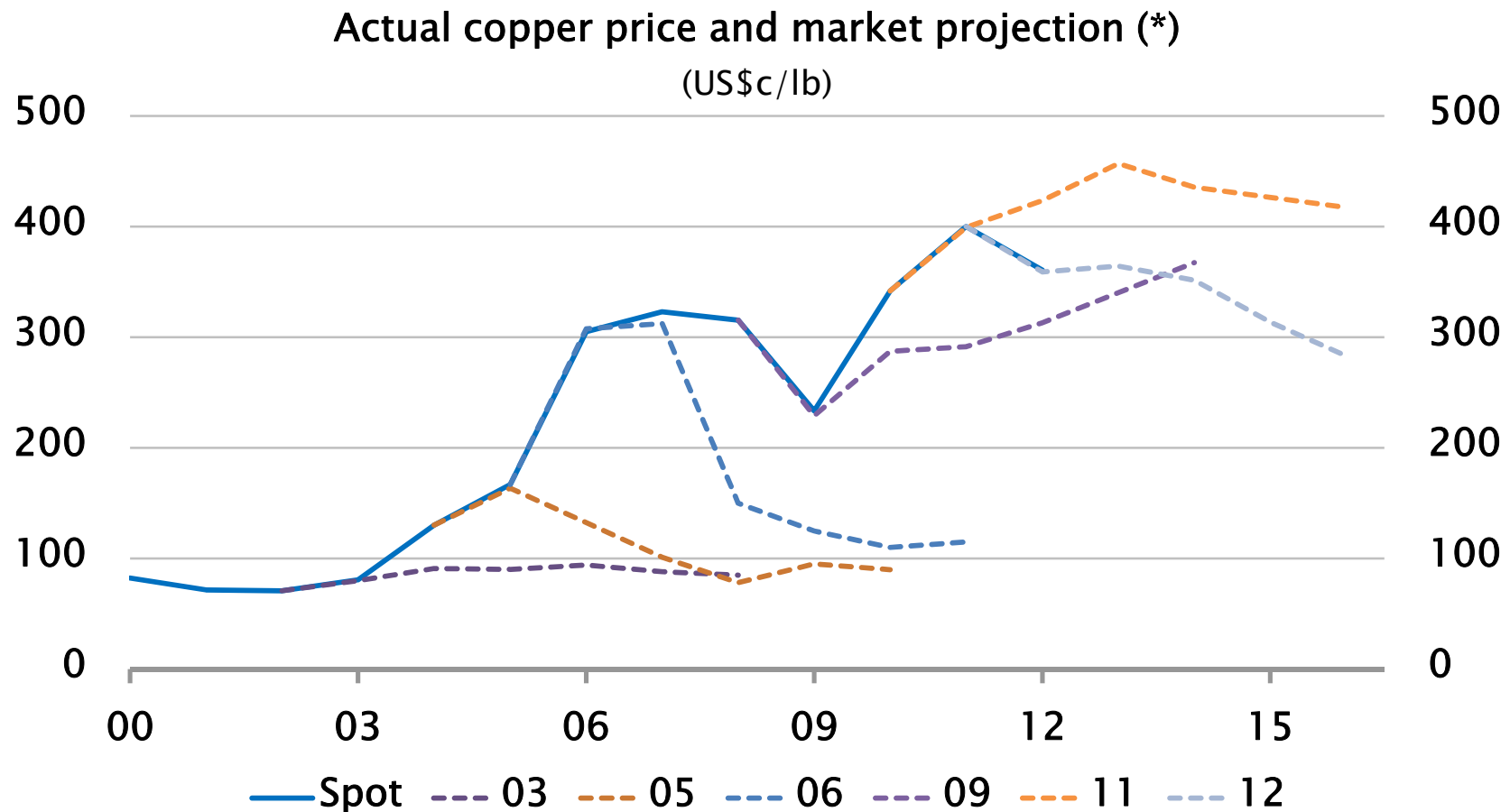
(*) Dotted lines indicate projection available in October of each year.
Sources: Central Bank of Chile and CRU Group.

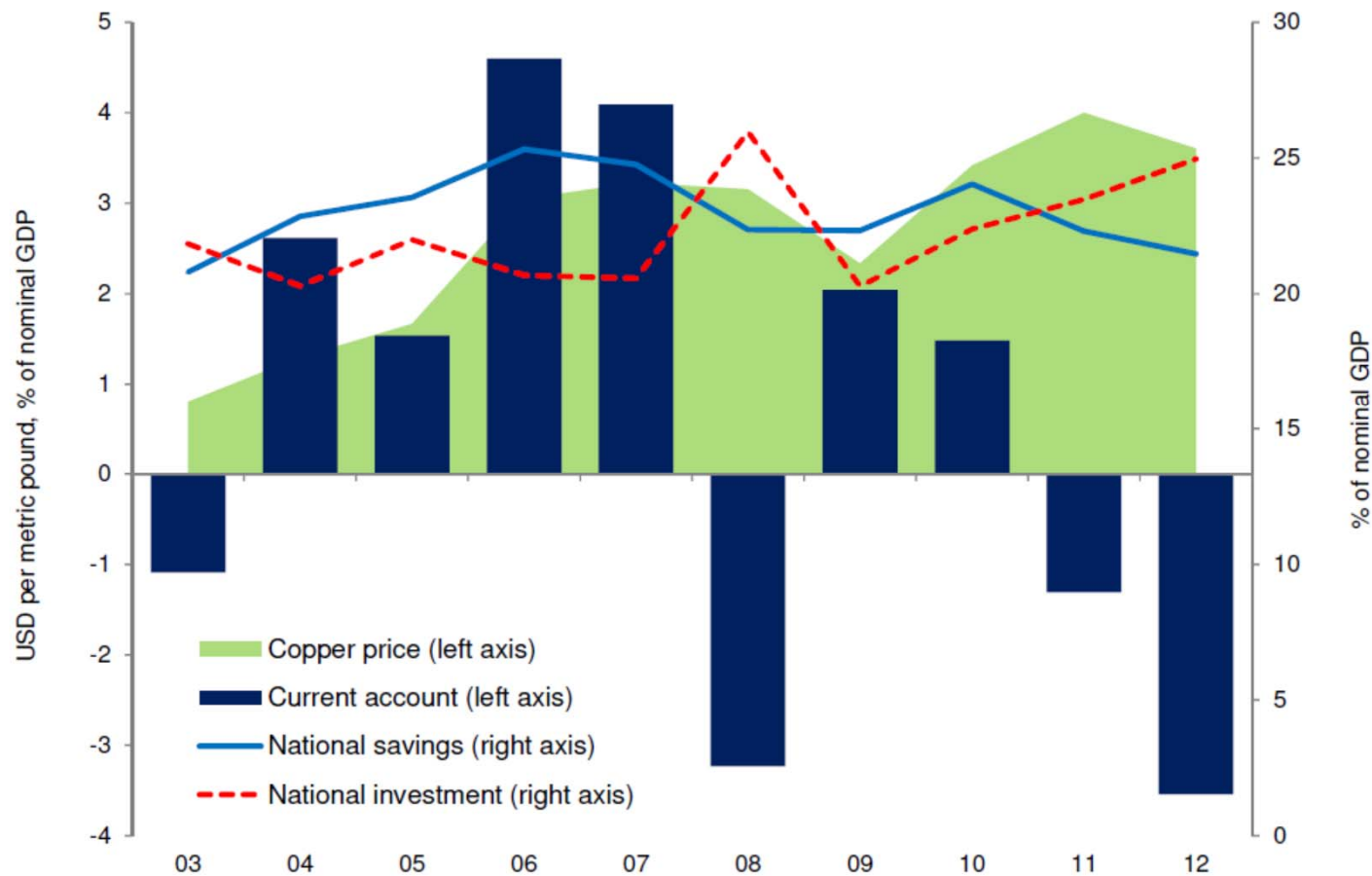## 2) The copper price boom has been significant, with evolving expected persistence.

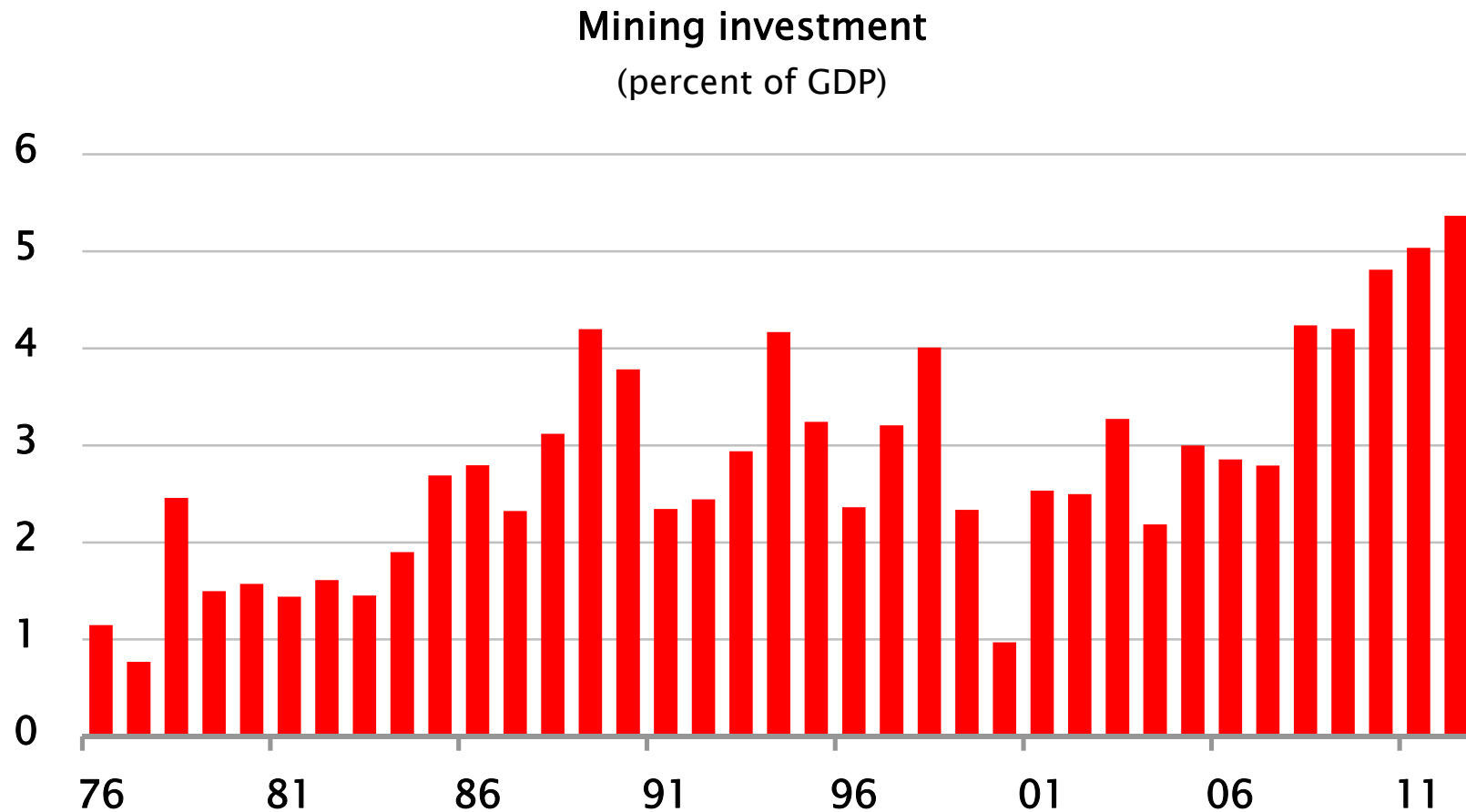Figure 7: Government reference price of copper vs. effective real price of copper, 2000-2013.

Source: Fornero and Kirchner (2013).

Figure 2: Savings, investment, and the current account in Chile vs. copper price, 2003-2012

Copper price (left axis)
Current account (left axis)
National savings (right axis)
National investment (right axis)

Source: Fornero and Kirchner (2013).

2) Particularly with a significant pick-up in mining investment in recent years.

Mining investment
(percent of GDP)

Sources: Central Bank of Chile and Cochilco.

2) Imperfect information and learning allow a better representation of Copper price shocks.

- Extension of MAS considers endogenous supply of copper through sector specific investment, based on long term expectations of the price.

- Spot price of copper is observable, and follows a process that considers persistent and transitory components:

$$P_{S,t}^* = a_t + b_t \qquad b_t = \rho b_{t-1} + u_t \qquad a_t \sim N(0, \sigma_a^2) \qquad u_t \sim N(0, \sigma_u^2)$$

- Agents infer the persistent component through a learning process (Kalman filter):

$$\hat{b}_t = \rho \hat{b}_{t-1} + K_t \rho^{-1}\left(P_{S,t}^* - \rho \hat{b}_{t-1}\right)$$

- Using current information agents forecast the expected price of copper over the longer term to base their spending and investment decisions.

2) Imperfect information and learning allow a better representation of Copper price shocks.


Gráfico 3: Descomposición del Shock positivo sobre el Precio del Cobre de 10% en el Modelo Extendido

(Δ% de estado estacionario inicial)
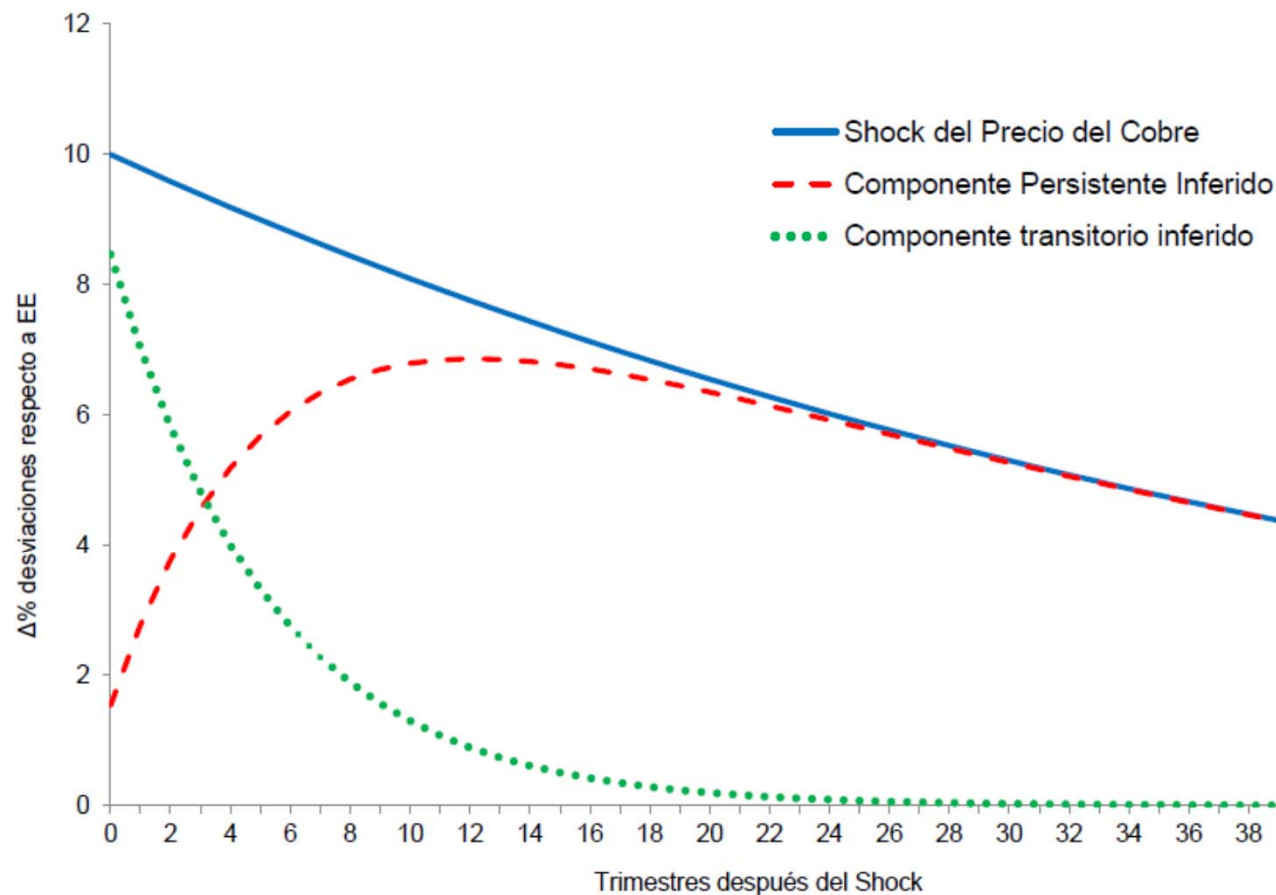
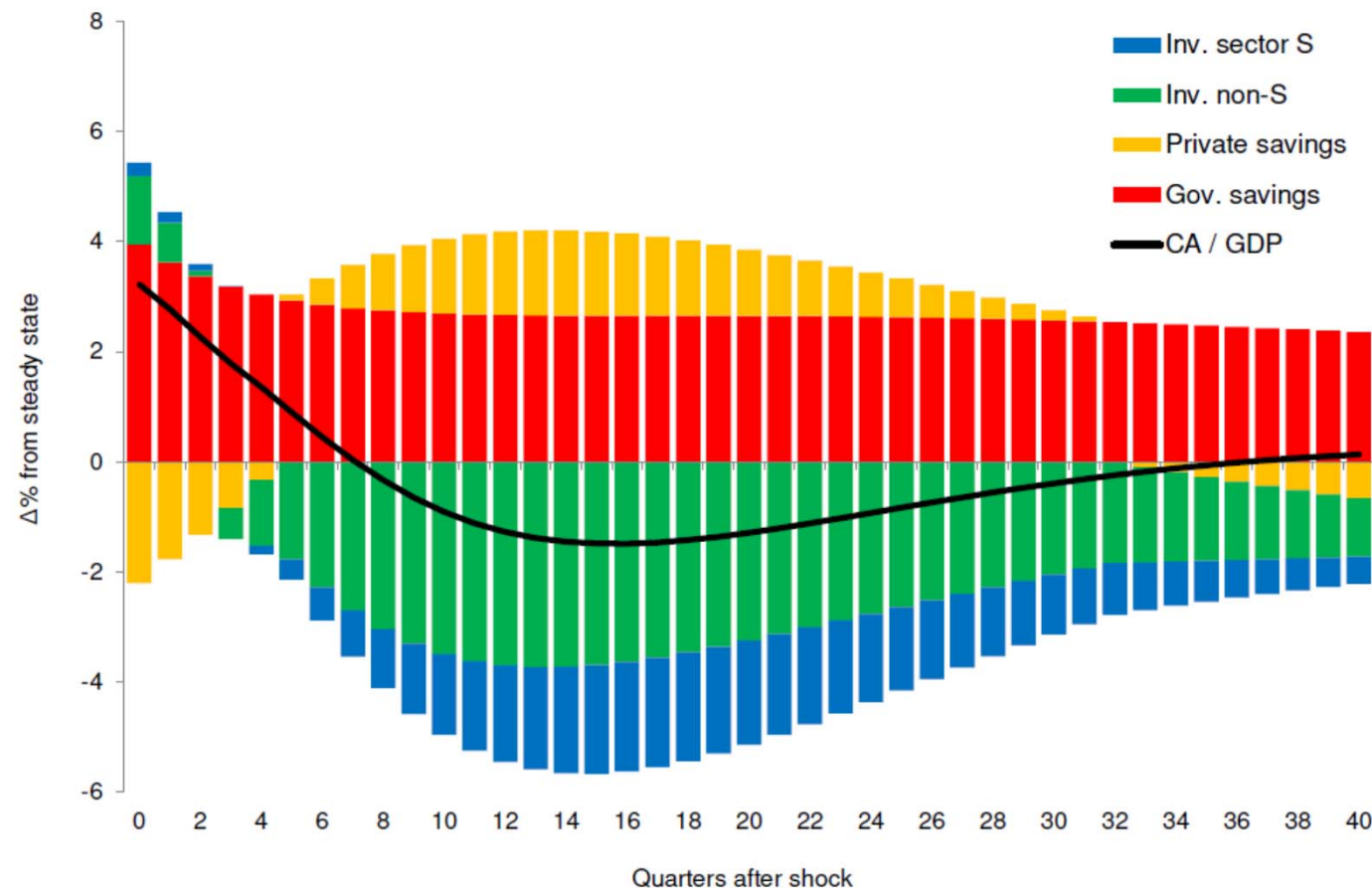# 2) Learning implies that higher prices are only gradually assessed as persistent.

Figure 8: Historical decomposition of the real price of copper into a persistent component and a transitory component computed from the Kalman filter.

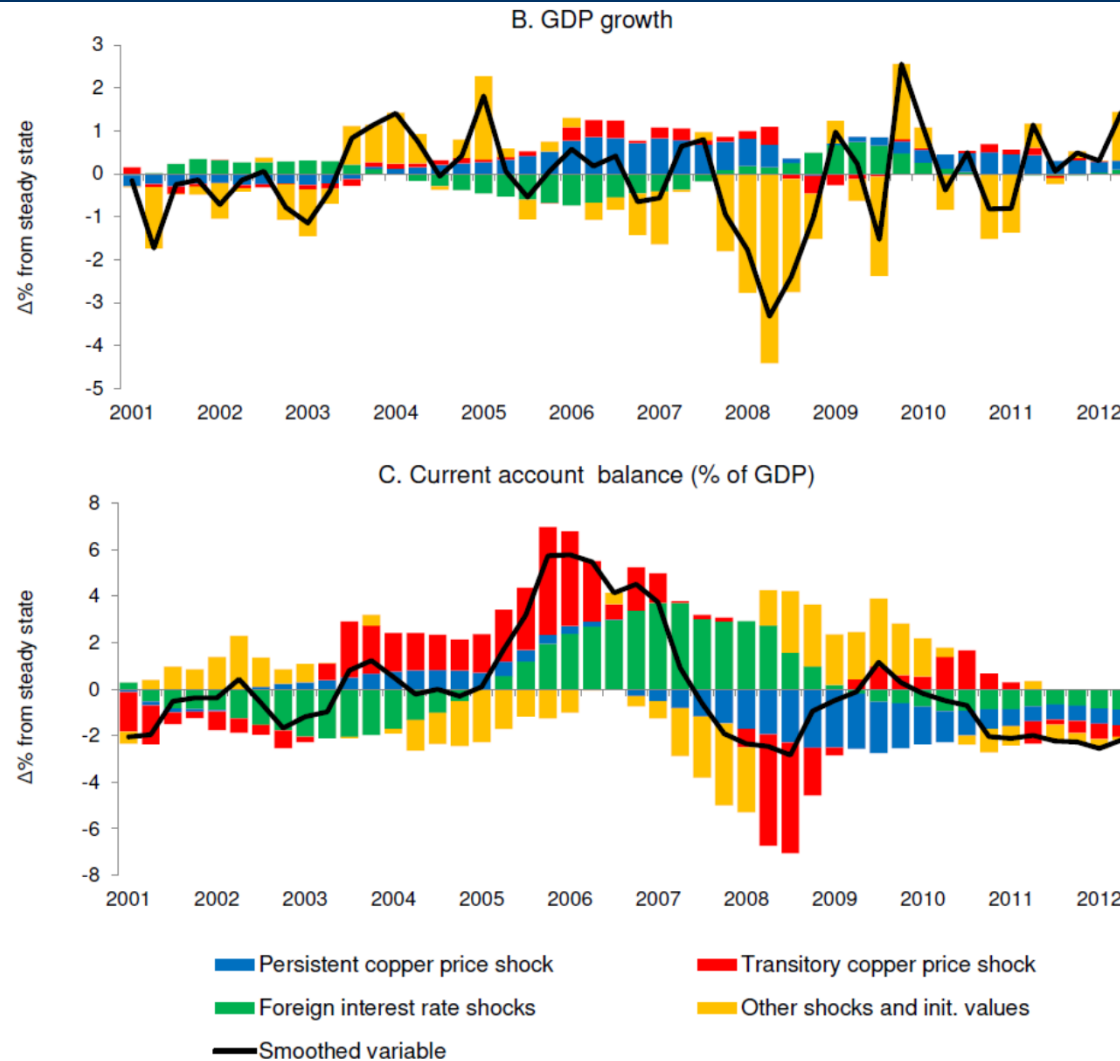Source: Fornero and Kirchner (2013).
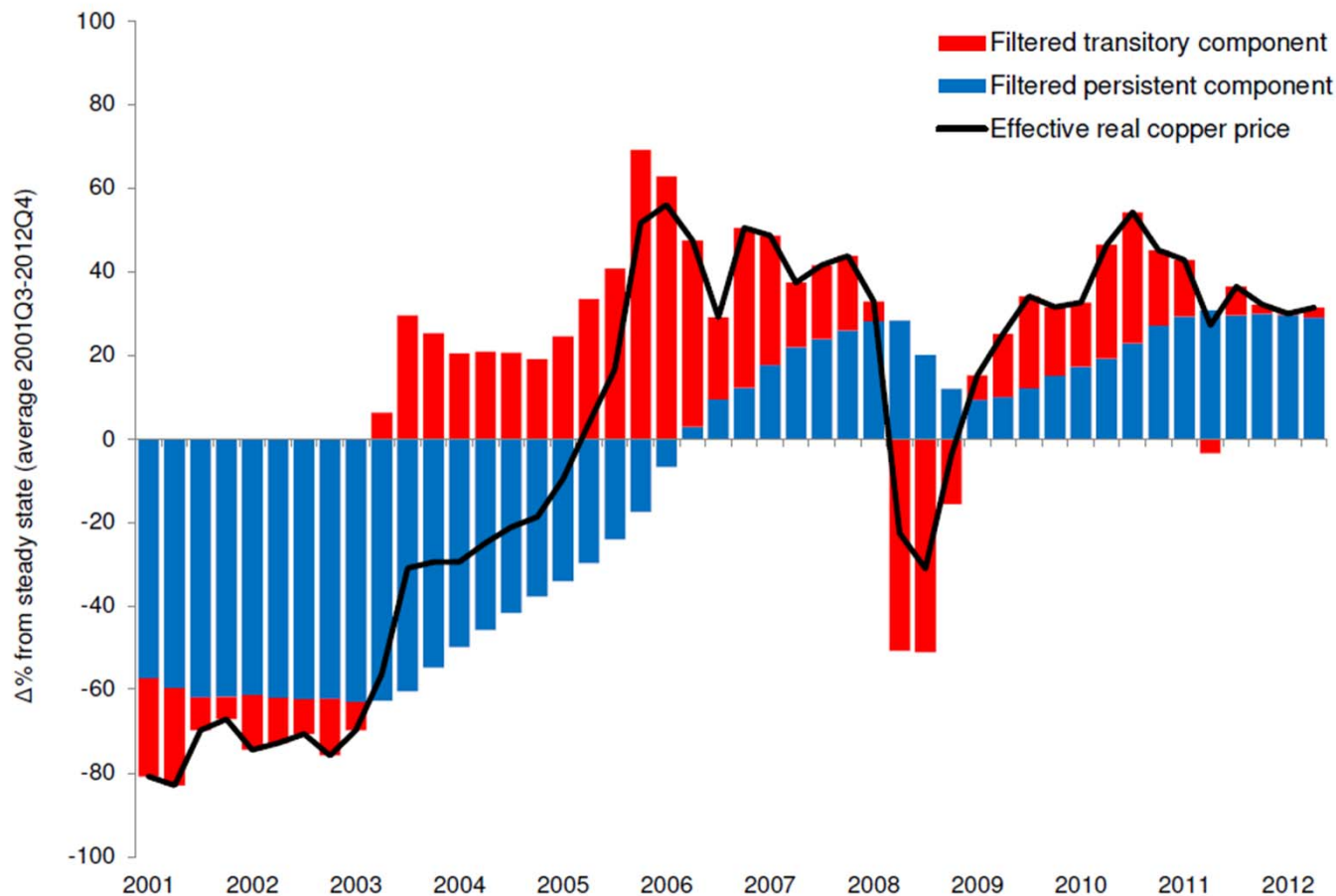
2) And this has significant macroeconomic implications in the DSGE model with learning.

Figure 9: Impulse responses of savings, investment, and the current account balance (% of GDP) to a persistent commodity price shock of 50 percent.

Source: Fornero and Kirchner (2013).

2) This broadly explains actual dynamics in Chile.

B. GDP growth

C. Current account balance (% of GDP)

Persistent copper price shock
Transitory copper price shock
Foreign interest rate shocks
Other shocks and init. values
Smoothed variable

Source: Fornero and Kirchner (2013).

2) Imperfect information on persistence have relevant implications for monetary policy.

Inflation — Interest rate — Current account / GDP

Persistent shock, imperfect information — — Persistent sh., full info. — · — Transitory sh., full info.

Source: Fornero and Kirchner (2013).
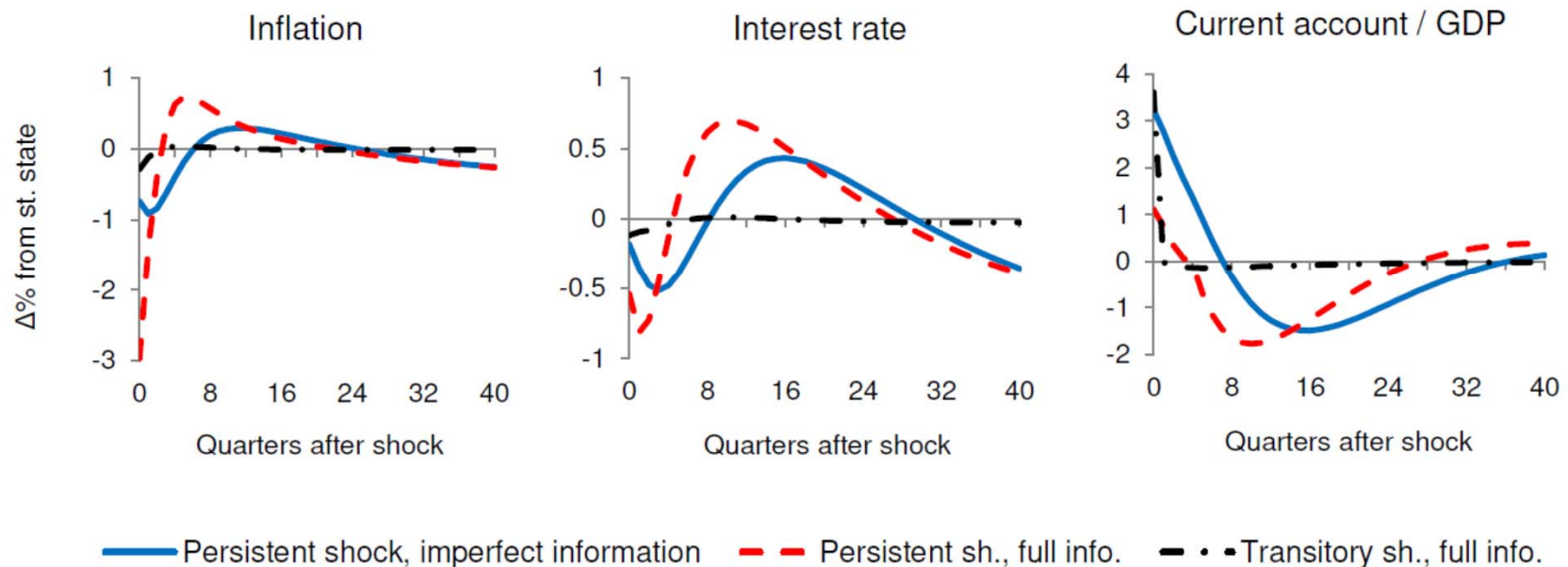
2) Fiscal policy response to copper price windfall has also first order effects for monetary policy.

Quarterly impulse response to a copper price shock under alternative fiscal policies

(year-on-year percentage change from steady-state)

Structural fiscal rule   Expansive fiscal rule

Source: Desormeaux et.al. (2010).
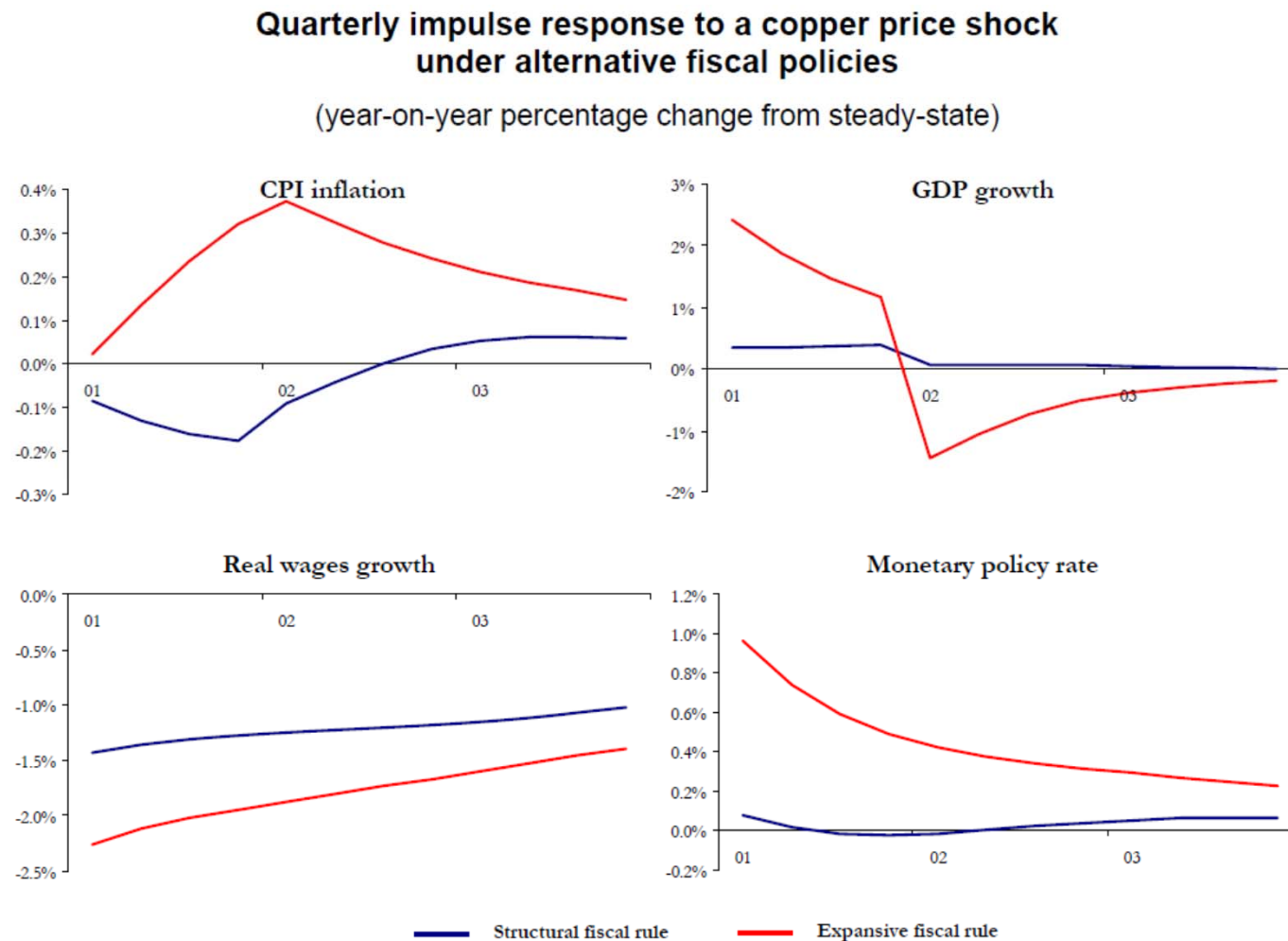
3) There has been a shift in the composition of energy generation.

Contribution of projects built or under construction to the
Central Interconnected System (SIC) (*)
(megawatts)

Hydro   **Natural gas**   **Coal**   **Diesel**   **Biomass**   **Solar**   **Wind**
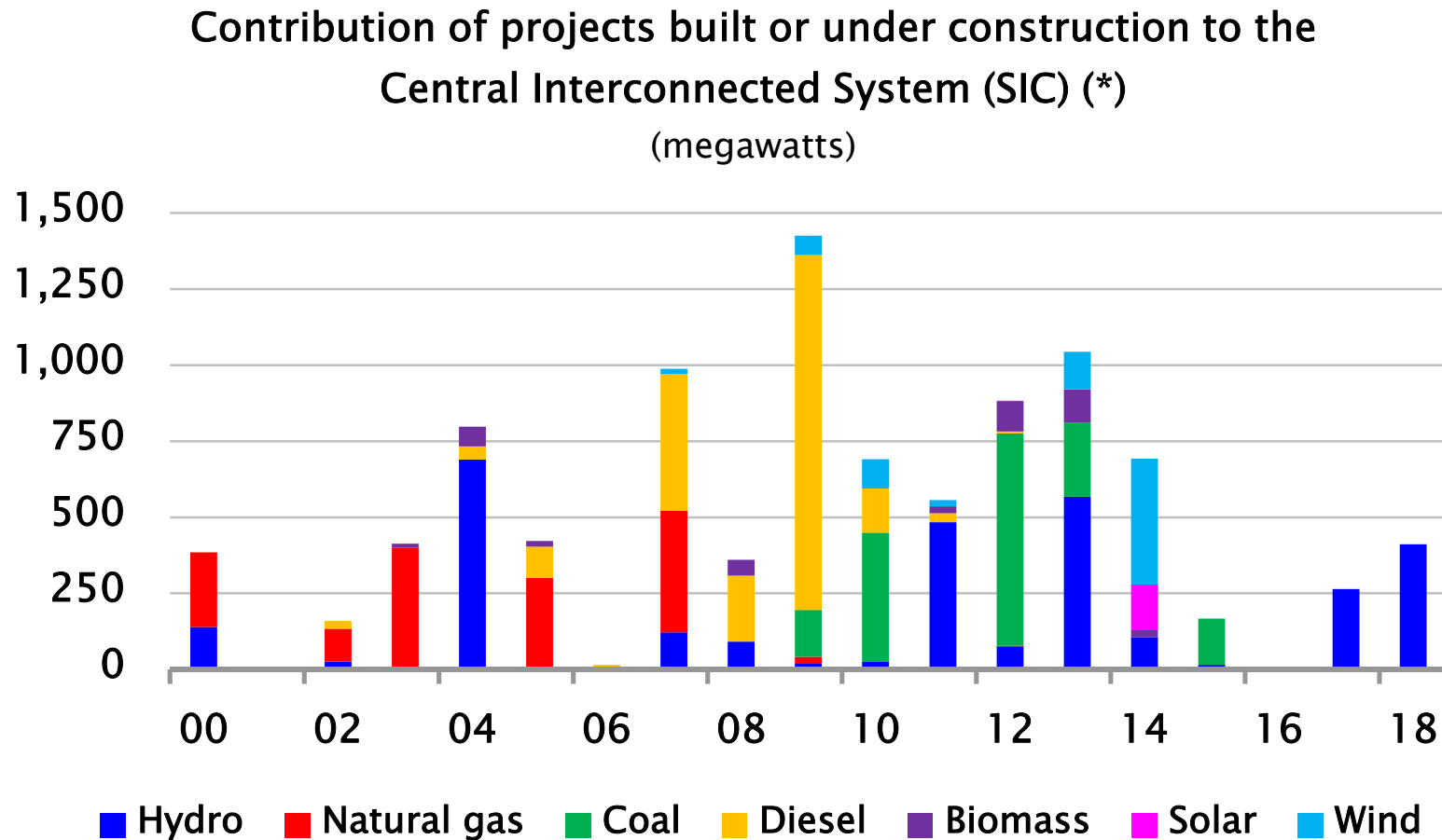
(*) Excludes plant factor of respective technologies.
Source: National Energy Commission (CNE).

3) Coupled with international price developments, energy costs have increased.

Energy generation by type of technology and marginal cost
(megawatts, US$/MW)

Legend: Hydro, Gas, LNG, Coal, Diesel, NCRE, MCG (right)

3) This has been translated into final prices for households and firms.

Price of electricity

(US$/MW, index 2009 = 100)

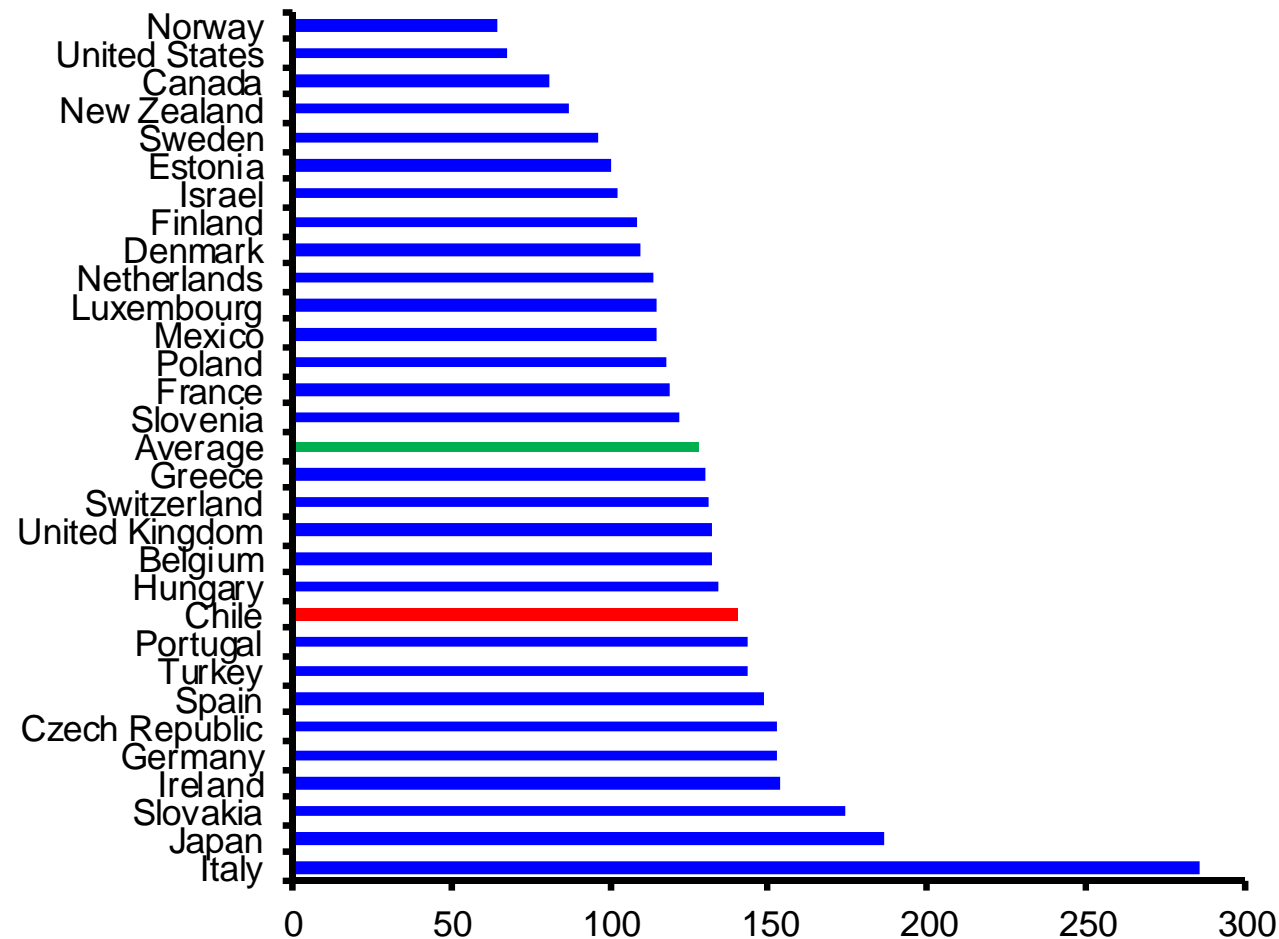Legend: Average price for free clients — Regulated rate (knot) — Electricity CPI
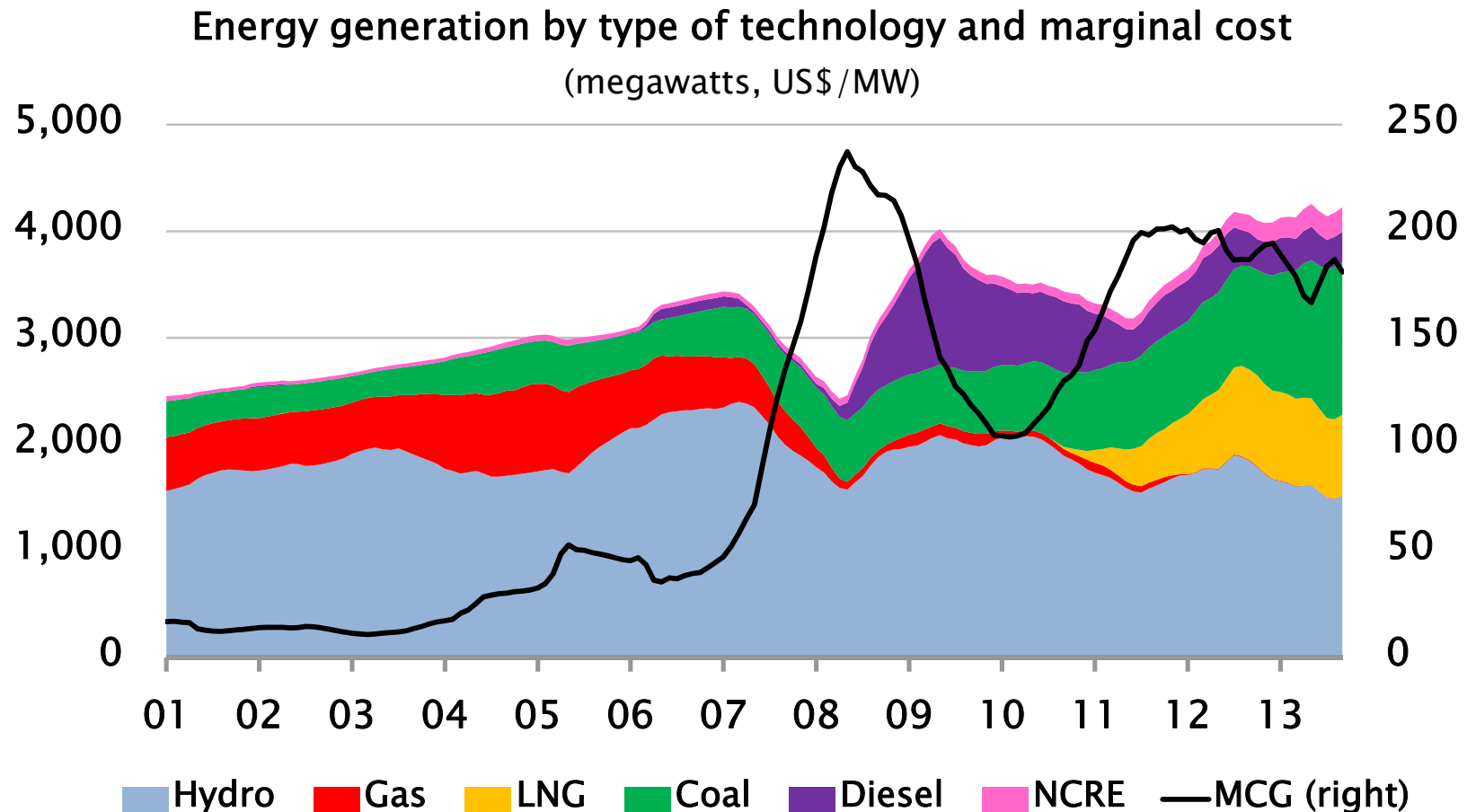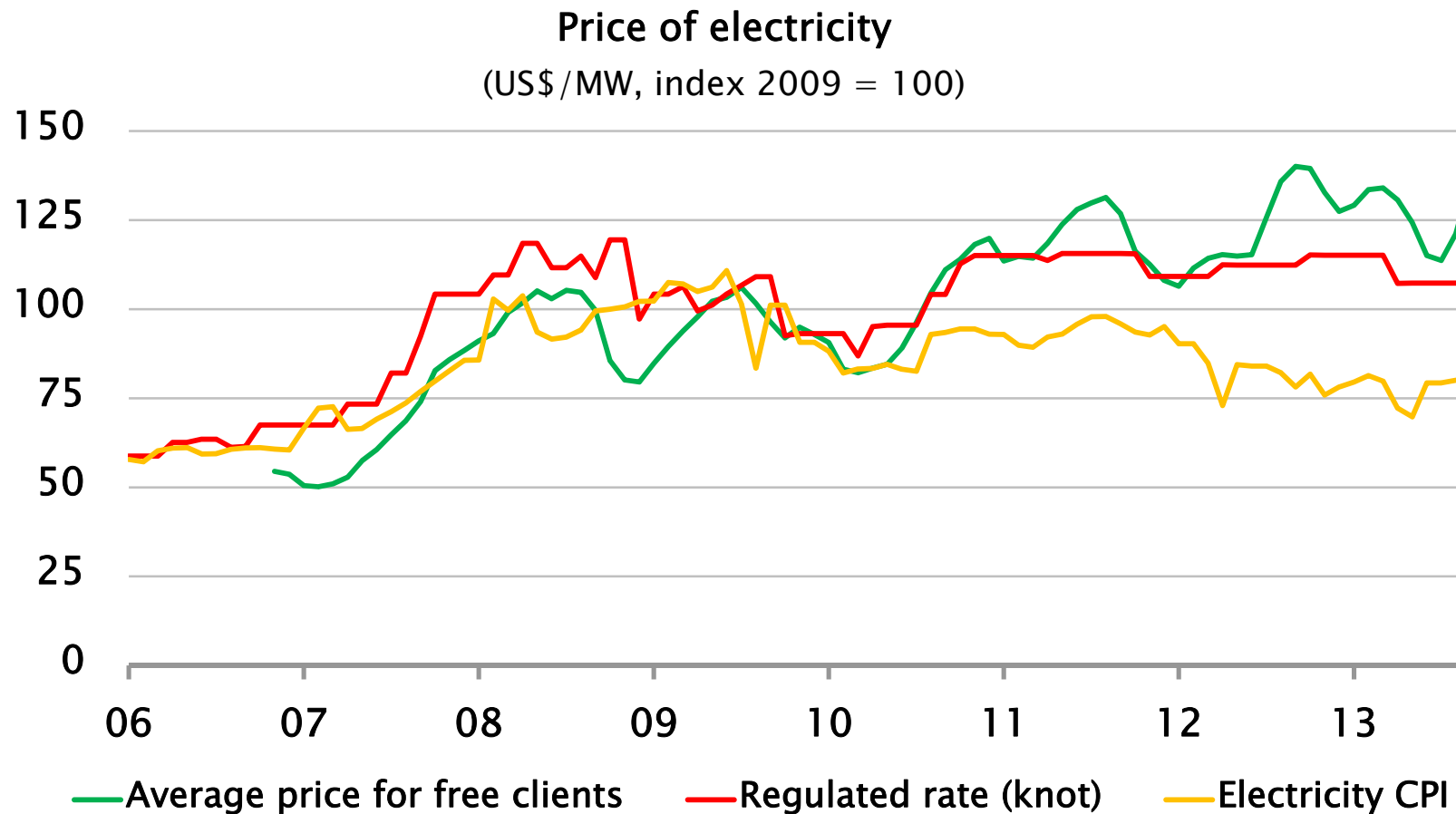
Sources: National Energy Commission (CNE) and National Statistics Institute (INE).

3) This has been translated into final prices for households and firms.

Electricity tariffs for firms
(US dollars per Mega Watt)

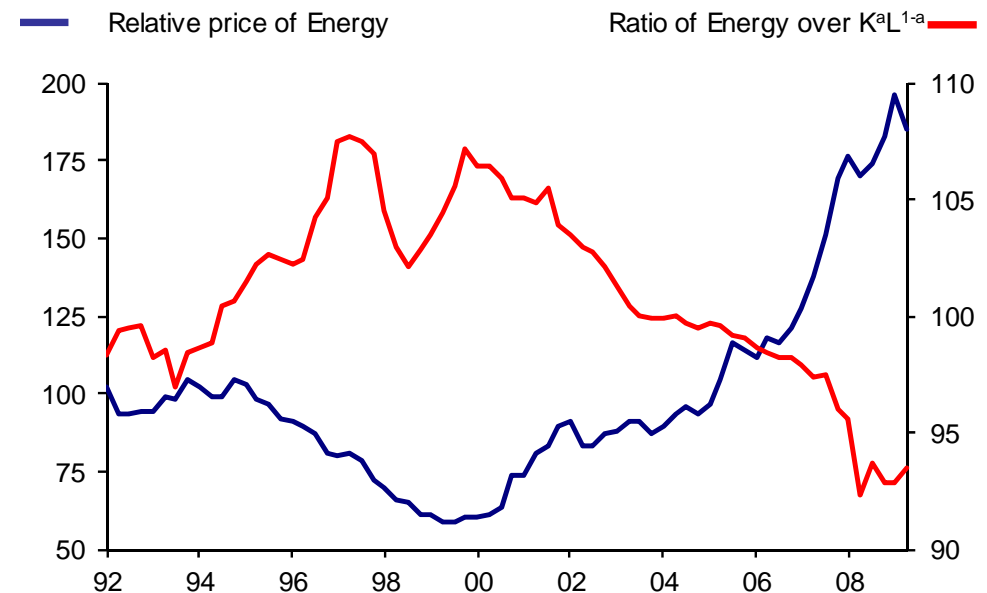
Source: International Energy Agency.

3) Over the medium term, higher energy prices have affected measured productivity.

$$Y_t^b = A_t \left[\gamma^{\frac{1}{\theta}} \left(K_t^\alpha L_t^{1-\alpha} \right)^{\frac{\theta-1}{\theta}} + (1-\gamma)^{\frac{1}{\theta}} \left(ENER_t \right)^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

$$\frac{ENER_t}{K_t^\alpha L_t^{1-\alpha}} = \frac{\gamma}{1-\gamma} \left(\frac{P_{E,t}}{P_t} \right)^{-\theta}$$

— Relative price of Energy   Ratio of Energy over $K^a L^{1-a}$ —

Source: Echavarría et al. (2009).

Conclusions

- Optimal monetary policy response to commodity price fluctuations is not straightforward.

- It depends on, among other issues:
    - Credibility of monetary policymaking,
    - Expected transience and persistence of shocks,
    - Fiscal policy response,
    - Cost and income effects.

- Thus, for small open economies such as Chile, understanding and monitoring commodity price fluctuations is key for successful Inflation Targeting management.

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