

Commodity Price Cycles and Policy Responses in Small, Open, Resource Rich Economies

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Paper prepared for the Fall Meeting of Project LINK, October 2017

Preliminary draft

Abstract

In this paper we study the response of resource rich countries to the last commodity price cycle. We use the experience of Chile to find explanations for why, in the last few years, economic performance has generally deteriorated in most of these countries. In particular, we review the connection between this poor performance and the macro policy in place. In doing so, we revisit the main aspects of the last commodity price cycle (2005 – 2016) and describe the economic cycle in some Latin-American countries that are highly exposed to changes in commodity prices. We focus in the case of Chile and its policy response. We conclude with some preliminary recommendations.

1. Introduction

The recent commodity price cycle has attracted renewed attention on the most effective policies and institutions to deal with their macroeconomic effects, especially in small open economies that rely heavily on these commodities for exports and fiscal revenues². The general notion is that both the government and the private sector are somewhat myopic and tend to amplify the effect of commodity price fluctuations. Policy prescriptions tend to promote the creation of Sovereign Funds to save part of the fiscal windfall in the good years to finance deficits when prices fall, or to pursue a Budget Rule based on long-term estimates of key variables (commodity prices, GDP growth). In fact, the experience of a few countries with well-established rules and institutions of such kind, like Chile, Colombia and Peru, has been usually cited as evidence in support of these prescriptions³.

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² See for instance IMF (2015a). Céspedes and Velasco (2013), IMF (2015b), IADB (2006)

³ IMF (2015), Vegh et al (2016), Talvi and Izquierdo (2008)

However, economic performance has generally deteriorated in most of these countries in the last few years with similar symptoms among them: lower GDP growth, major declines in private investment, downward revisions in potential GDP growth, rising fiscal deficits and fiscal adjustments attempts that severely limited countercyclical fiscal response⁴.

In this paper we examine the experience of Chile to try to find explanations for this phenomenon, and their relation with the policy rules in place, that merited so much praise in the past. During the discussion we will frequently refer to other commodity dependent countries with similar policy frameworks, particularly those of Colombia and Peru in Latin America.

The paper is structured as follows. In the next section we look at the last commodity price cycle (2005 – 2016) in order to find some distinguishing features that might have made it different from previous ones. The third section describes the economic cycle in some Latin-American countries that are highly exposed to changes in commodity prices, and their policy responses. Finally we review Chilean experience during this period with special focus on fiscal and monetary policies. We run simulations using Central Bank of Chile's DSGE model to explore the importance of how copper price evolution is understood by agents. In particular, we explore the importance of how persistent the changes are perceived by agents. We conclude with some preliminary recommendations.

2. The Recent Commodity Price Cycle: Was it really different this time?

When we look at the evolution of aggregate commodity prices since 2000, we find several important features:

- Starting around 2003, the prices of all categories began rising. This trend ended and reversed abruptly at the end of 2008.
- All of them recovered quite fast, and by the 3rd quarter of 2010 they were close to the previous peak. Energy prices recovered but did not reach their pre-crisis peak.
- Later on, with different timing and intensity, all price groups began a sustained decline.
- Prices seemed to have bottomed out in 2016, at levels significantly above those of the early 2000s.

The above price performance is consistent with significant shifts in aggregate demand for commodities, and has been generally attributed to the combination of rising demand from China, followed by the Great Recession of 2008-09 and its aftermath. The remarkable

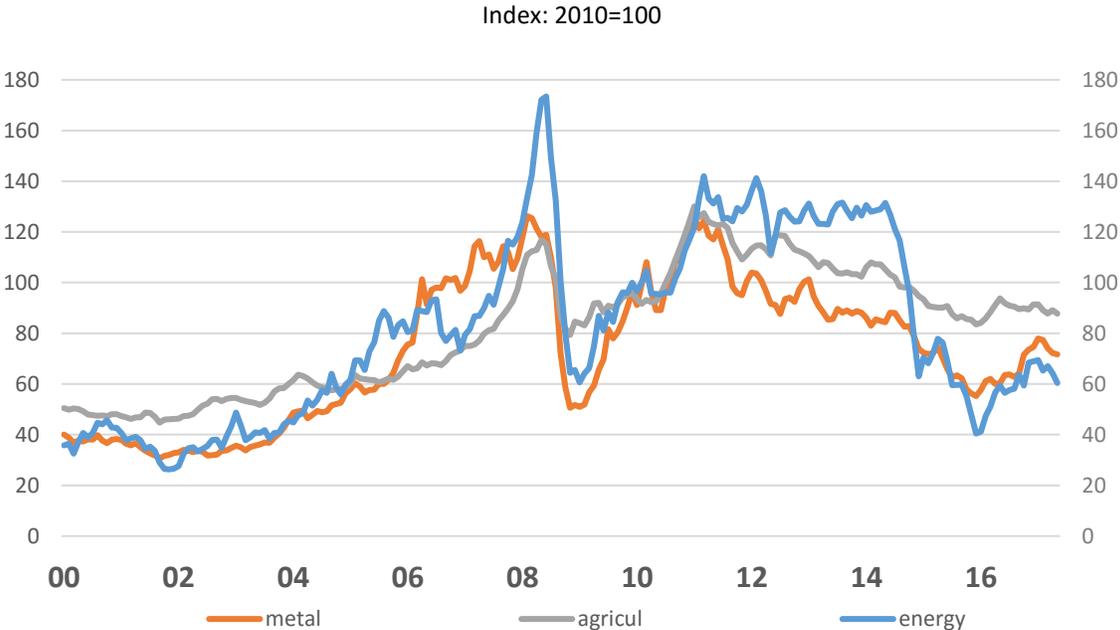
⁴ In the case of Chile, these events also translated in a reduction of the credit rating, albeit from a very high level, and with a neutral outlook into the future.

price recovery that began in mid-2009 can be explained by the extraordinary investment stimulus applied by China that year.

Of course, developments on the supply side also played a role. In particular, its response to the increase in demand was slow due to the long time required to increase capacity, and the fact that the initial price rebound was seen as a transitory phenomenon. As we discuss in the rest of the paper, these two elements are central to understand the economic and policy response to the commodity price cycle.

During the boom years, energy prices doubled by 2005, tripled with respect to their initial level early in 2008 and then briefly quadrupled those prices in mid-2008. Metal prices followed a similar pattern (without the quadrupling), and agricultural commodity prices followed a similar, but slightly subdued rise: at their peak they just doubled their 2000 levels for a few months. The coincidence and magnitude of these changes led to the general view that the global economy was experiencing a Super Cycle of commodity prices, and most of the doubters were eventually convinced by the unprecedented fast recovery that followed the Great Recession.

Figure 1: Commodity Groups Monthly Price Indices (2000-2017)

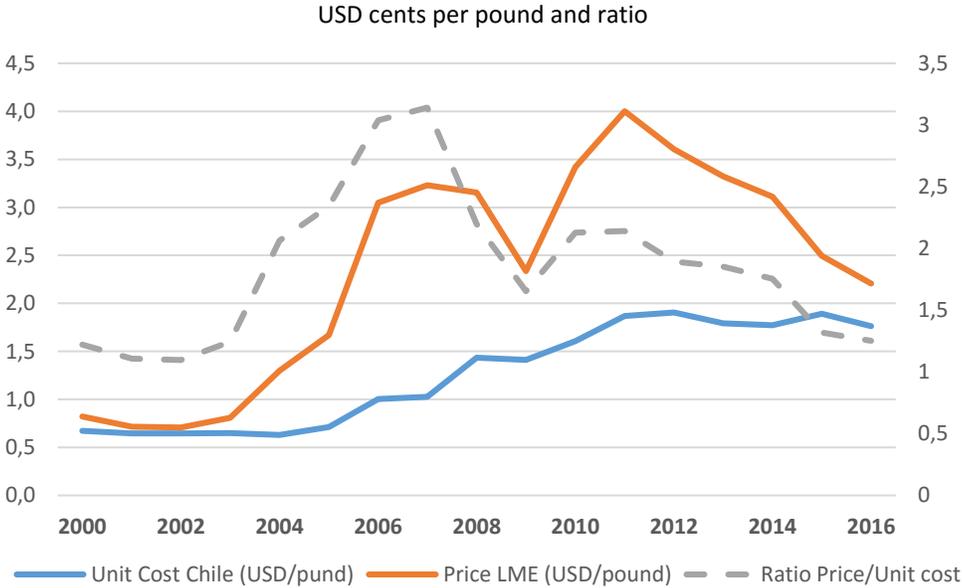


Source: World Bank Group.

The gradual decline in metal and agricultural commodity prices that began in 2011 was not seen initially as the end of the cycle (prices remained about twice their levels at the beginning of the decade). Perceptions changed slowly, especially when firms began

realizing that production costs had risen so much that even at those high historical levels, they were not making enough profits. Investment expenditures were cut significantly and by 2013 there was a sense of crisis, especially in the metals sector. The coincidence of increasingly worrisome news about the Chinese economy, the beginning of the normalization of monetary policy in the US and the sudden collapse in oil prices that year convinced almost everybody that the Super Cycle had come to an end.

Figure 2: Evolution of Copper Prices and Unit Costs (2000-2016)



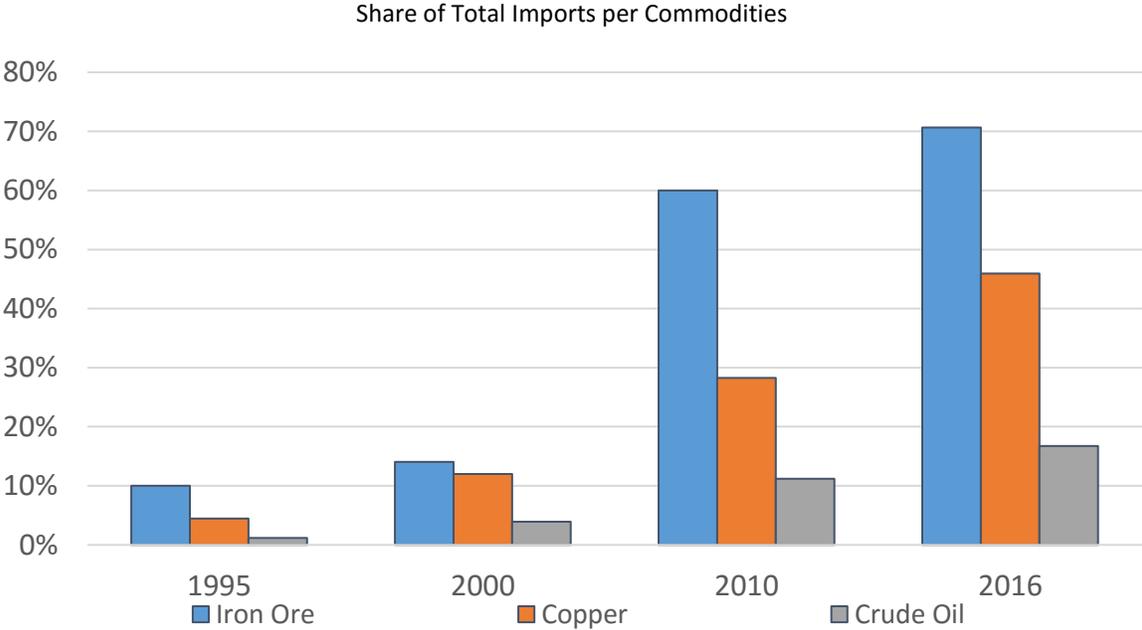
Source: Cochilco (2016).

What we see in the aggregate commodity prices is well reflected also for copper, a metal which plays a key role in our analysis since it is Chile’s main export. Figure 2 above also includes the estimate for the average unit cash cost to produce copper in the largest mines in Chile. One distinct feature of this prolonged cycle is the significant increase in production costs, a normal feature of mining resources. The dotted line depicts the ratio of the market price to the unit costs, and by the end of the period, it came back to the initial levels, suggesting that the period of extraordinary rents from copper mining had come to an end. Does these data reflect one or two cycles? From a purely statistical point of view, it depends on the minimum parameters used to identify a cycle. In Annex I we present two alternatives. If we choose a “short window” (9 months for the shortest phase and 18 months as the minimum length for the cycle as a whole, we find two clear cycles for each category. If we take a “longer window” we find just one cycle for energy and agricultural products and two for metals. In both cases, and in all three categories, we find that the initial build up phase lasted about double than average. The decline phase in the

2008-09 period was much shorter than average (in the “short window”) for energy prices and about average for the other two categories. The 2009-10 recovery was about average, but the downturn was significantly longer for metals and agriculture, and average for energy. Of course, when we take the “longer window” the length of the phases for energy and agricultural products become much longer than average. However, from an economic point of view it can be argued that the unusually short negative cycle of 2009 is more a reflection of a temporary “scare” more than a change in fundamentals, and once that passed, the previous cycle persisted. The fact that unit costs kept rising over the whole period also suggest that this period could be considered as just one event

As mentioned before, one of the main reasons behind the idea of a super cycle of commodities was the surge of imports from China, for all types of industrial raw materials and energy. This is illustrated in Figure 3, for the cases of Iron Ore, Copper and Crude Oil. As it can be seen there in little more than a decade China went from an insignificant participant in these markets to a major player, if not the dominant one.

Figure 3: Share of Chinese Imports in Global Trade of Selected Commodities

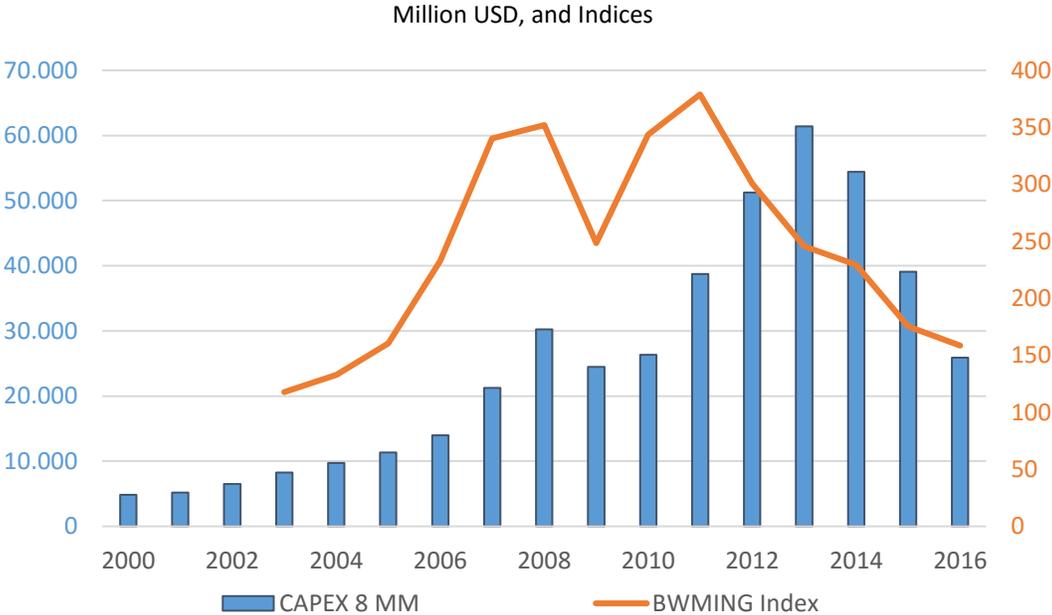


Source: UNCTAD

Commodity price cycle affect producer countries through its impact on terms of trade and public finances, as well as through its spillovers on exchange rates and financial activities. It also had a direct impact on investment in natural resource sectors (IMF, 2015). In the case of metals this might be delayed due to the relatively long amount of time involved in the development of greenfield projects. One remarkable feature of the latest commodity

price cycle is the impact it had in investment decisions in natural resource sectors. Figure 4 shows aggregate nominal capital expenditures of some of the largest (listed) mining multinationals in this period⁵. Starting at slightly below USD 10 billion per year at the onset of the price boom, it tripled in a few years before the Great Recession. But, most telling is the fact that after a short retrenchment in 2009-10, it quickly recovered and surpassed USD 60 billion in 2013.

Figure 4: CAPEX and Stock Prices of 8 Large Mining Multinationals



Source: Bloomberg

These large expenditures are in part a consequence of rising cost of equipment, labor and energy in the mining sector globally, something widely recognized in industry reports at the time⁶, but the fact remains that in spite of that, and even after some metals prices had already begun to fall, the boards of directors of those multinationals felt confident enough to be willing to invest those amounts, even after sizeable losses in market capitalization. Information about capital expenditures in the mining sector at the global level are not available for previous cycles, so we cannot say for sure that this cycle is unique in this respect, but we could not find evidence of a global cycle like this in the last quarter of a century. There have been local mining investment booms when economic and political changes opened up known mining districts (Chile in the late 1980s and 1990s, Mongolia

⁵ They are BHP, Glencore, Rio Tinto, Southern Copper, GMexico, GMKN, Anglo American and Freeport McMoran. Source: Bloomberg.

⁶ See Barclays (2012), Bank of America Merrill Lynch (2012), McQuaire’s Commodities Research (2012)

and Peru in the last decade, for instance) but they were mostly independent of the resources price cycles. The last cycle had real impacts on resource rich countries that were similar to previous local mining booms, but since the origin was a change in perception about long-term demand trends, it became widespread across resource-rich countries.

3. The impact of the commodity price cycle on commodity exporters

Looking back at the history of commodity price cycles and their effects on the performance of resource rich countries in Latin America, it is easy to find large evidence of amplification of those shocks by pro-cyclical policies. Typically, fiscal windfall gains were used to expand public expenditures and fixed exchange rate generated huge currency appreciation that allowed for outburst of domestic demand and a fall in savings. When commodities prices turned down, external imbalances became unmanageable and currency crisis followed and inflation soared, while the economy went into recession, propelled in part by severe fiscal adjustments⁷. Starting in the late 1980s things started to change. In Chile and later in Peru, Colombia and other countries, resource-rich economies in Latin America performed critical economic policies changes and adopted better institutions. The last commodity price boom and bust was the first severe test of those changes. The main areas of reform were the following⁸:

- International trade liberalization: from large and pervasive exchange and trade controls, that reached a peak in the 1970s, foreign trade was liberalized quite significantly, with the removal of tariff and non-tariff barriers first, and extensive bi-lateral and multilateral Trade Liberalization treaties. Later on, access to foreign exchange markets was gradually liberalized and intervention in these markets was significantly reduced.
- Fiscal institutions and fiscal rules: Also starting with Chile in the 1980s, countries began adopting explicit fiscal rules (such as Stabilization Funds) to save at least part of the windfall of commodity price booms. By the early to mid-2000s, most countries had adopted Fiscal Responsibility Laws to enhance the ability of fiscal authorities to enforce macro discipline, and some countries adopted Structural Budget Rules, geared toward the reduction of the pro-cyclical bias of fiscal policies during commodity price cycles.
- Monetary institutions and monetary policies: After generalized inflation crises in the 1970s, countries in the region reinforced technical capabilities at Central Banks, granting them more autonomy in the management of monetary policy. In the early 2000s Central Banks in most of the countries in the region were

⁷ See Dornbusch and Edwards (1991), Edwards (1995) and IADB (1997) for a description of previous economic performance and early reforms in the region.

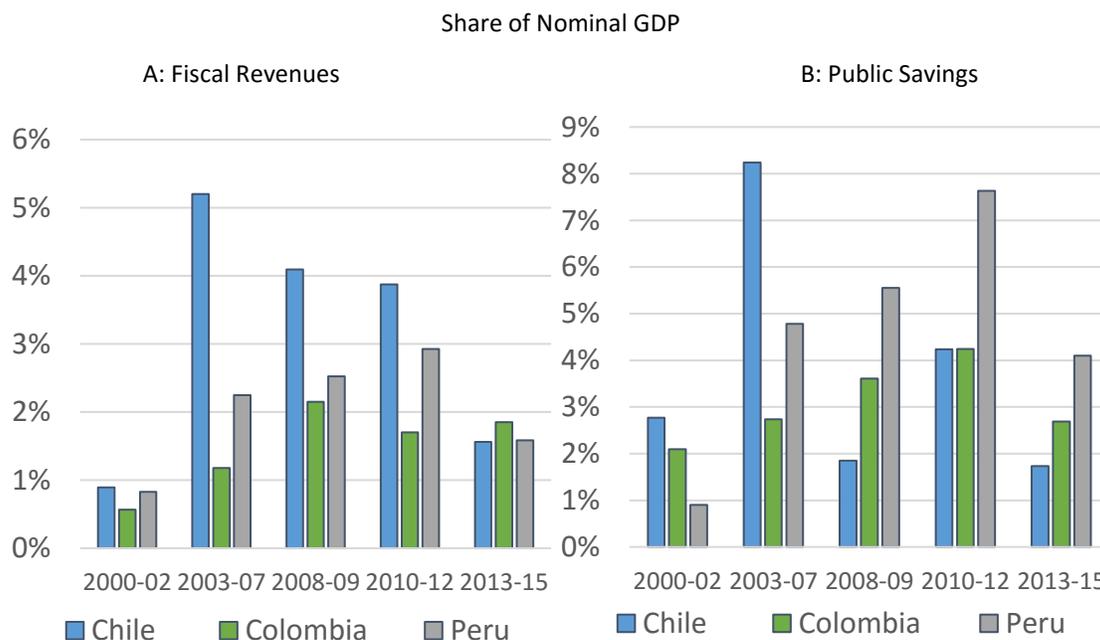
⁸ See IADB (1997) for one of many reviews of these reforms.

successfully pursuing inflation targets, with almost total autonomy from governments and within flexible exchange rate regimes, although with different degrees of intervention in currency markets.

- Financial modernization and capital markets deepening: following the severe financial crisis of the 1980s, there was a major reorganization of financial markets that included the liberalization of interest rates and international capital flows, and the modernization of financial market regulations and supervision. All these contributed to a significant development of markets and institutions, which were reinforced by the increasing importance of domestic institutional investors after pension reforms that replaced pay as you go systems for individual capitalization schemes in many of these countries.

The initial phase of the commodity price boom (2003-2008 approximately) saw significant improvements in fiscal and current accounts and some increase in domestic savings, especially from governments, leading many people to think that “this time was truly different” (See Figures 5 and 6 below).

Figure 5: Fiscal Revenues & Public Savings from Commodities Throughout the Cycle



Source: Ministries of Finance of each Economy.

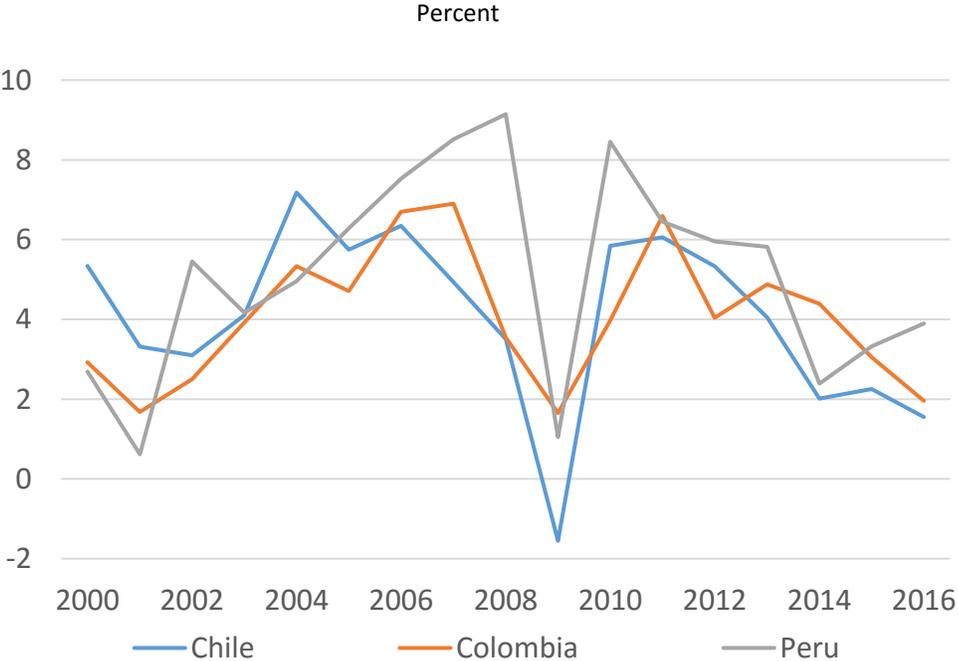
Even though some economists held a positive, but more nuanced view⁹, the real test came at the end of 2008, when the Global Financial Crisis struck. In fact, Chile and the Pacific

⁹ See Talvi and Izquierdo (2008).

Alliance countries were able to apply significant fiscal and monetary stimulus during those years, without loss of access to international financial markets and foreign exchange or fiscal crisis. Actually there was very limited turmoil in domestic financial markets in these countries, after some initial problems caused by the retraction of some US banks that played a central role in foreign trade financing operations. Central banks intervened temporarily providing liquidity in US dollars and after a few months the situation normalized. Even though most countries experienced severe private demand contractions in the initial months after September 2008, leading to major economic slowdowns or even recessions, they were temporary, and most economies had resumed strong growth by the end of 2009 (See Figure 7 below). Of course these recoveries were greatly helped by a very sharp recovery of commodity prices, supported mainly by strong Chinese stimulus programs.

However, as it is shown below (Figure 6), the latter part of the commodity cycle has not been as benign as the previous one. After significant investment boom, production capacity was much larger, and so, when the initial impulse from China began to fade, commodity prices began to slide, and these economies suffered a significant slowdown.

Figure 6: Annual GDP Growth in Select Latin American Economies

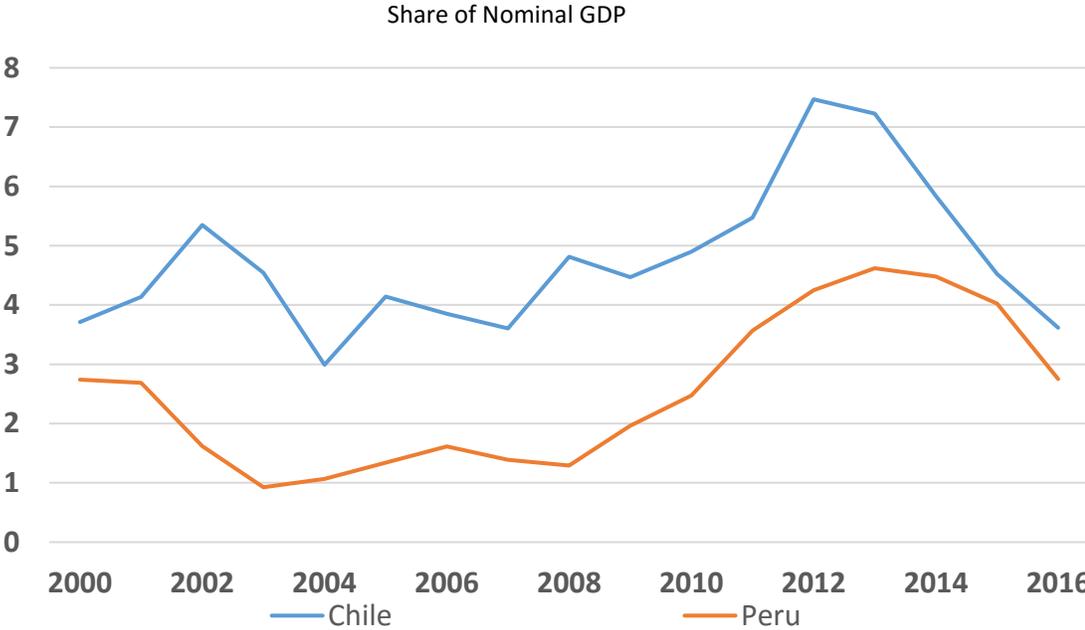


Source: IMF.

This time the slowdown was not driven by the traditional fiscal and foreign exchange problems, but was primarily due to a major cutback of mining investment, led by

multinational mining companies as reflected in Figure 3. This is fully reflected in the figures for Fixed Capital Investment in Chile and Peru (unfortunately we could not find equivalent figures for Colombia), as shown in Figure 7. In addition to the negative shock to domestic demand coming from the mining sector, there was also a negative impact on fiscal revenues and savings due to the fall in commodity prices. However, government authorities were in a better position to neutralize this shock using the assets accumulated in previous years: funds in Sovereign Funds and other assets, as well as access to financial markets due to the well-deserved credibility gains in previous phases of the cycle. Monetary policy also helped and policy rates were cut to help accommodate the negative impacts on domestic demand.

Figure 7: Fixed Capital Investment in Mining over the Cycle



Source: Central Banks of Chile and Peru.

However, fiscal rules are not designed to shield the economy against permanent shocks, and therefore when it was clear that the reduction in the price of copper would be more persistent, as the economic slowdown proved to be lasting and potential growth was revised downwards, authorities realized that fiscal space was limited. On top of that, doubts amongst Rating Agencies began to arise.

4. Economic Policy during the last commodity cycle: The Chilean experience

But, was the impact of commodity cycle really different this time? In order to answer this question it is key to review the policy reactions during the whole cycle, which goes from

the mid-2000s up to the most recent years. We will concentrate in the Chilean experience mostly for three reasons. First, it has usually been referred to as the best case of institutions and macroeconomic management of resources cycles in the region¹⁰, especially in the initial phase of the cycle. Second, the economic performance in terms of economic growth has been somewhat weaker than in the other Pacific Alliance countries in the last phase of the cycle, revealing how exposed to the commodity cycle the economy was. Third, we have significantly better access to information and policy decisions.

We consider the question from two perspectives. First, we describe the evolution of the Chilean economy and the response of its economic authorities through the cycle. Second, using the general equilibrium model of the Central Bank of Chile, we further investigate the importance of how the change in the price of copper is understood, as a permanent or a transitory one.

To set the stage, it is useful to briefly review some aspects of Chile's economic institutions and how they have evolved during the last decades.

4.1 The Chilean economy: some relevant characteristics

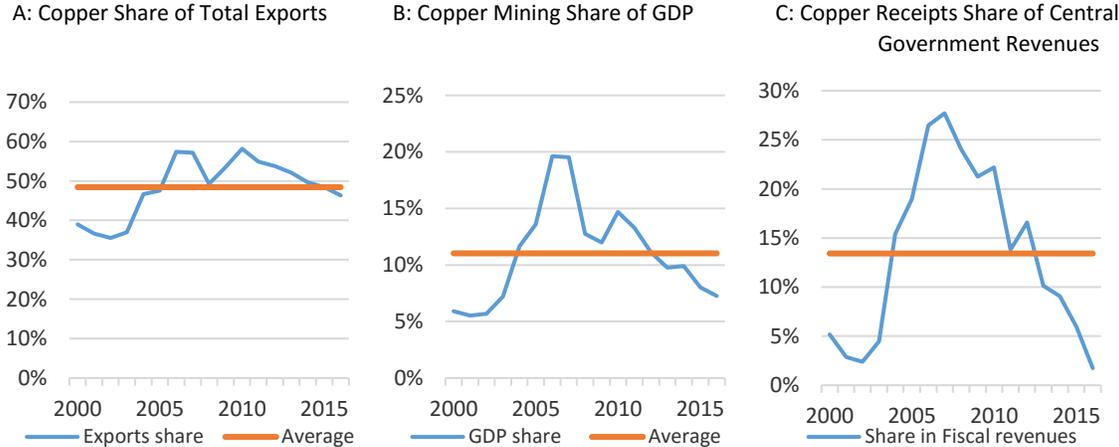
The role of copper in the Chilean economy. Copper is by far the most relevant commodity for Chile. It accounts for a large (although fluctuating) share of exports, fiscal revenues and economic activity in general. The evolution of the relative importance of copper in Chile in these three dimensions is summarized in the three charts below. Clearly, copper is very relevant in all of them, averaging 48% of exports, 11% of GDP and 13,4% of fiscal revenues. In all cases there is significant volatility, mostly associated to changes in copper prices. The area most exposed to copper price fluctuations is fiscal revenue, something that should not be a surprise, given the importance of profits in this sector, both from the state owned firm (CODELCO) and from the largest private mining companies, for fiscal revenues. But the latter is not the only channel through which fluctuations in copper prices affect the economy. Indeed, the foreign exchange markets (and monetary policy in periods of fixed exchange rates), as well as different wealth effects and the impact on investment in the mining sector are also relevant transmission channels. The relative relevance of each of these channels changes from time to time, depending on the institutional setting, the structure of the economy, and the persistence of the movement in the price of copper.

Financial development and integration. After a deep process of economic reform in the late seventies and eighties, it is adequate to describe the Chilean economy as highly integrated to the rest of the world through trade, financial services and FDI. Nowadays, Chile has free trade agreements with more than 60 countries and there are basically no

¹⁰ See for instance, Talvi and Izquierdo (2008), De Gregorio (2014), IMF (2015), Vegh, Lederman, and Bennet (2017)

trade restrictions, including having one of the world’s lowest average tariffs. There are also no relevant restrictions to the movement of capital, and the economy is one of the largest recipients and supplier of FDI relative to its GDP. By the time of the beginning of the commodity cycle, the exchange rate regime had already moved from a peg to a floating exchange rate with limited interventions by the Central Bank¹¹. In addition, Domestic Pension Funds (holding more than 60% of GDP in assets under management) were active participants in international financial markets. Therefore, the relative importance of copper as a source of foreign currency had diminished quite significantly. At the same time, flexible exchange rates allowed for some degree of independence of monetary policy from copper price fluctuations. However, given the high degree of exchange rate pass-through that characterizes the economy, it comes at the price of additional volatility of inflation.¹²

Figure 8: Relative Importance of Copper in the Chilean Economy, 2000-2016 (Percent)



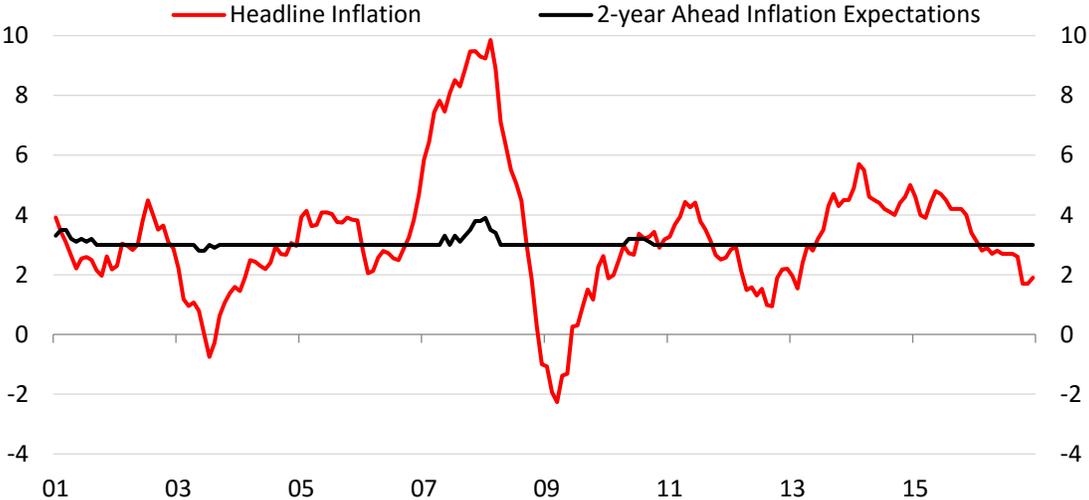
Source: Central Bank of Chile, Budget Office.

Monetary policy. Until the mid-1990s, and despite many attempts to control it, inflation had been a problem with no solution for the Chilean economy. A relevant part of the problem was fiscal dominance, since for all practical purposes, the Central Bank operated as a department of the Ministry of Finance. Several stabilization programs were put in place, but more often than not, they ended up in crises of different kinds, many times because a reduction of the price of copper produced unsustainable fiscal deficits. The solution came in the early 1990s, when the Central Bank was granted independence, with a clear mandate of stabilizing inflation at a low level. The 1980 constitution also forbid any

¹¹ In fact they were occasional, with an initial announcement of the total amount of purchases over a limited period of time and at a preset sequence.
¹² More on this in Naudon and Vial (2017).

form of Central Bank lending to the government. From the very beginning, the new independent Central Bank began targeting inflation, but in a context of underdeveloped financial markets, growing financial integration with the rest of the world, and an economy that had gradually recovered from the 1983 financial crisis, it also intervened heavily in foreign exchange markets. The Asian Crisis proved the high cost of trying to follow multiple targets with fewer instruments. At the beginning of the 2000s a fully-fledged inflation targeting framework, including a free floating exchange rate regime, was put in place. Since then, monetary policy has been guided by a medium term target for inflation set at 3%, with a tolerance of deviations of +/- 1%. That implies that inflation is allowed to move in the short run within the band, provided inflation expectations at the two-year policy horizon are anchored at the target. The idea is that in an economy where inflation in the short run varies so much, fighting short-term inflation would introduce too much volatility to output. Free floating exchange rate has been a key component of monetary policy during the last 17 years, giving more independence to the Central Bank to pursue counter cyclical policies. As shown in the next Figure, interventions in the FX market have been limited, and always based on a preannounced a schedule.

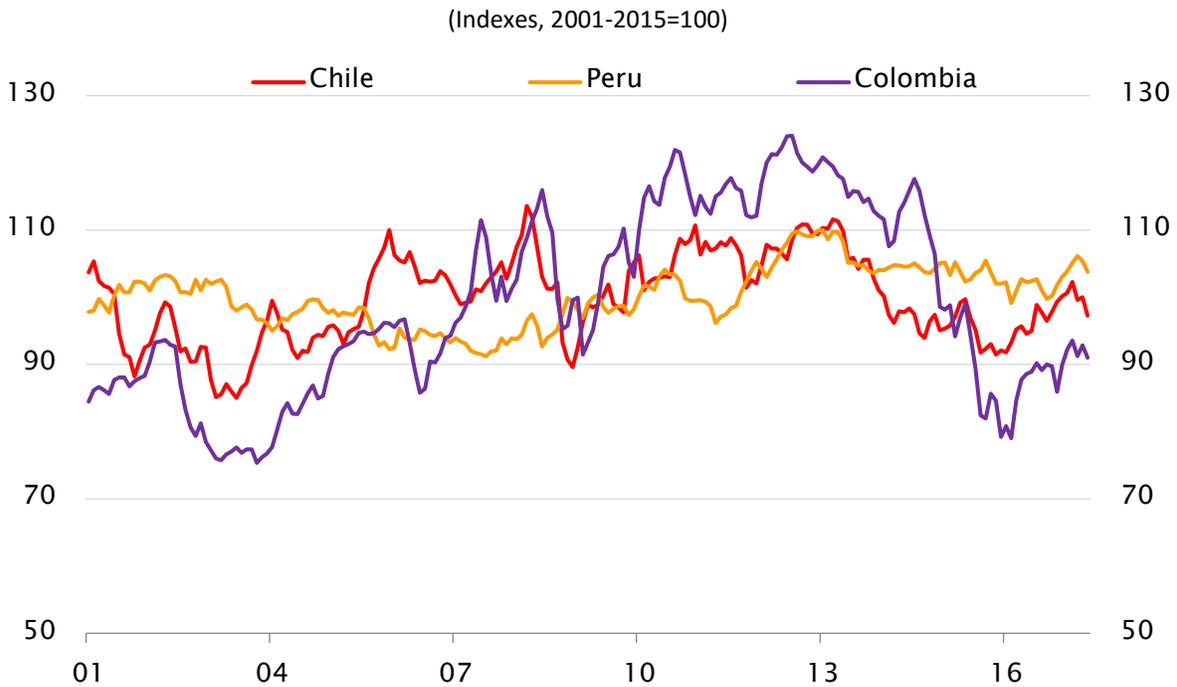
Figure 9: Actual and Expected Inflation (2 years ahead) in Chile



Source: Central Bank of Chile. 2-year ahead inflation expectations from the Central Bank’s EEE survey.

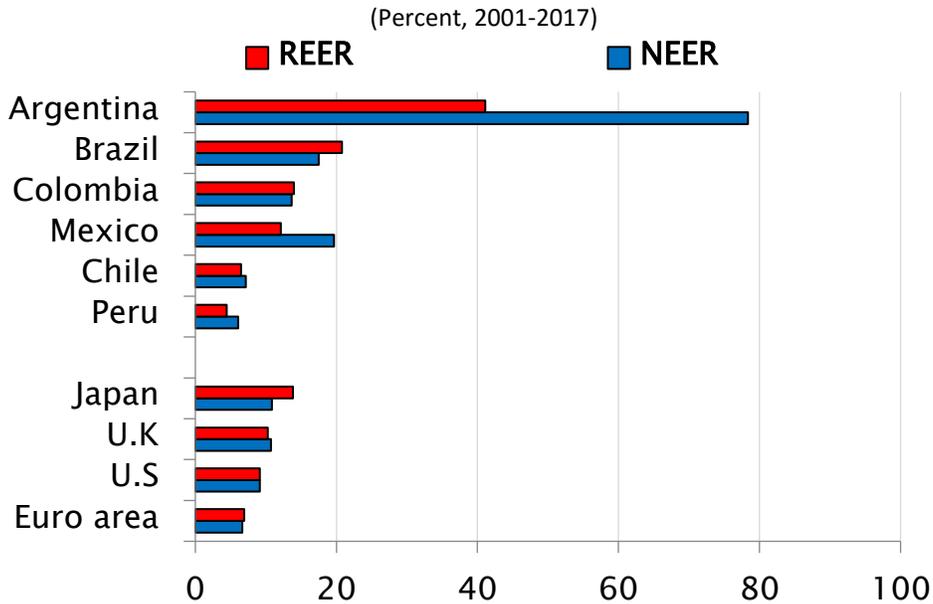
One interesting lesson of this period is that free-floating of the exchange rate, does not necessarily results in more appreciated real effective exchange rates in periods of high commodity prices and vice versa, neither in higher volatility of these rates, as shown below.

Figure 10. Real Effective Exchange rates selected countries in Latin America



Source: BIS Broad REER Index. Monthly data between January-01 and May-17.

Figure 11. Exchange Rate Coefficients of Variation for Selected Countries



Source: BIS Broad REER Index. Monthly data between January-01 and May-17.

Fiscal Policy: In the 1970s and 1980s a set of institutions and policies designed to gain better control of public finances and detach fiscal expenditures from movements in the price of copper were put in place. In the late 1970s the governance of public finances was strengthened and clearly in the hands of the Ministry of Finance, an arrangement that was

further reinforced in the 1980 Constitution¹³. In the late 1980s a Copper Stabilization (Sovereign) Fund (CSF) was enacted, with an accumulation/use of funds based on deviations of copper revenues from “normal” ones, estimated on the basis of a reference price of copper set by the Budget Office. In the 1990s this Fund was activated and the resources were used primarily to reduce the government’s external debt, and still, enough funds were saved to be able to fund a significant – and transitory - fiscal stimulus in 1999, in response to the Asian Crisis and its aftermath. In the early 2000s a new fiscal rule was introduced with the explicit goal of isolating the budget from cyclical fluctuations of all sources of revenues. In practice the rule adjusted expenditure in order to achieve an explicit (ex-ante) target for the so-called Structural Balance, i.e. the actual balance adjusted by the effect of cyclical deviations of the copper price from its expected trend, as well as for the impact of the cyclical deviations of GDP from its potential. The target was preset at a 1% surplus, and the key parameters for the estimation of the long term price of copper and potential output were defined by independent panels of experts¹⁴. The initial years of the new rule were uneventful and since both copper and domestic tax revenues were below their structural levels, this rule even allowed for some modest fiscal expansion. Once copper prices began to rise in 2004 the real test began, and it was passed quite successfully, but not without a significant effort on the part of the ministers of Finance.

4.2 Fiscal and monetary policies during the commodity cycle

Policy response to the initial phase of the commodity cycle (2004 – 2008). In 2004, when the price of copper began to increase, Chile was still recovering from the aftermath of the Asian crisis. The economy was growing below potential¹⁵, even though the unemployment rate was about 6% (low for historical standards); inflation (headline and core) was below target¹⁶; and the real effective exchange rate was depreciated by about 8% relative to its long term average.

In this context, the increase in the price of copper generated significant pressures to use the extra fiscal revenues to boost domestic demand, activity, and employment. However, despite the increase in fiscal revenues that went from 22.8% of GDP in 2004 to a peak of 27.1% in 2007, expenditures remained relatively stable as a share of GDP, at about 20% of GDP. This reflected the fact that, at the beginning, the increase in the price of copper was viewed as transitory, and therefore was saved.

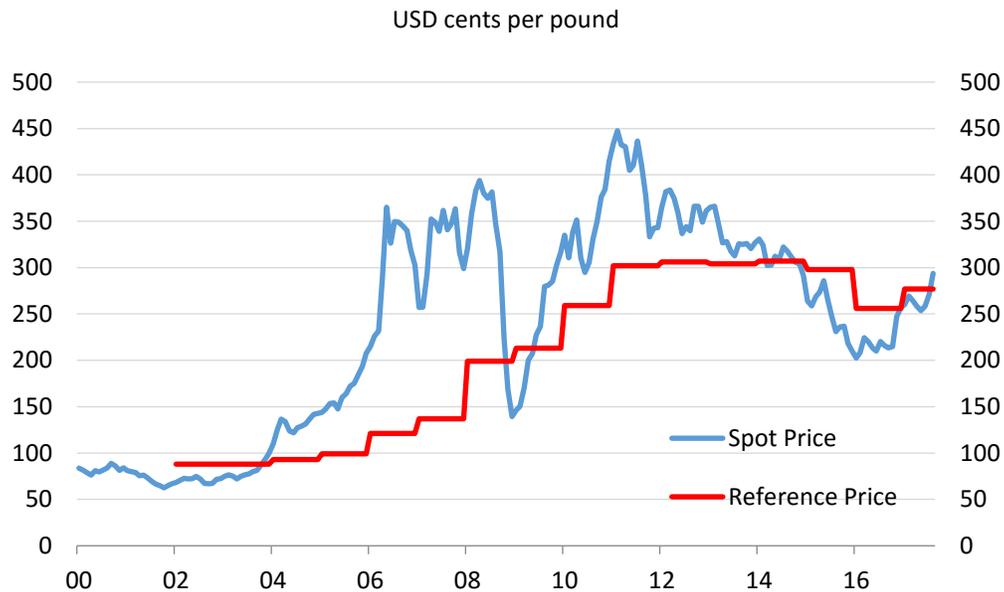
¹³ See Arellano (2016), Aninat et al. (2010)

¹⁴ More on this rule in Marcel et al. (2001).

¹⁵ The output gap was estimated at 3.5% of trend GDP for the 2004 budget, a figure later revised downwards to about 2%.

¹⁶ Average headline CPI was 2.4%, while core inflation was 2.0%. The inflation target was 3%.

Figure 12: Spot and Reference Price of Copper



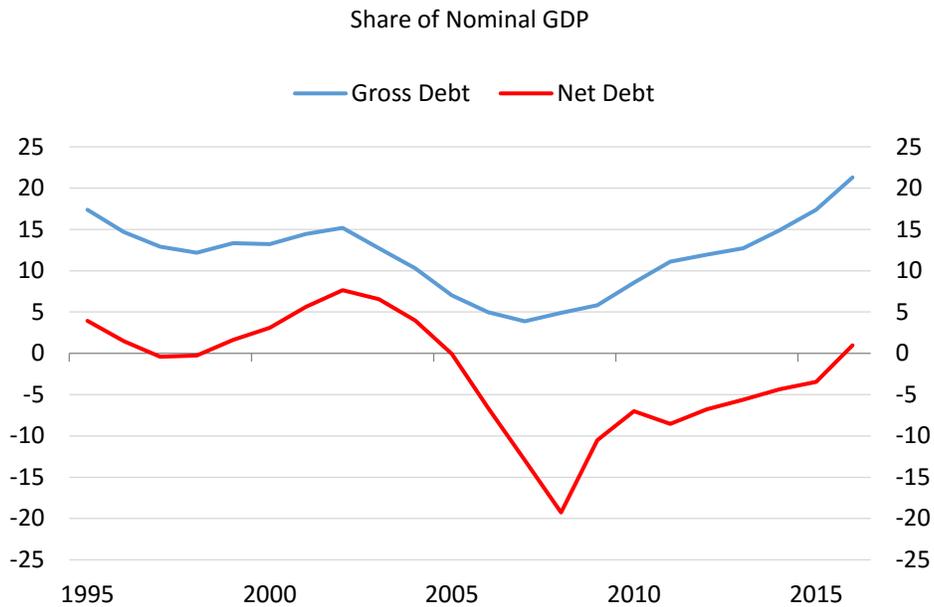
Source: Central Bank of Chile and Chilean Budget Office

However, despite the rise in government savings (from an average 3.5% of GDP in the period 2000-03, to 8.9% of GDP in 2004-2007) during this period government expenditures also accelerated (from a real average growth of 3.8% between 2000 and 2003, to 8.9% real average in 2003-2007). This was an unusual combination that reflects the gradual upward revision of the “structural parameters” governing the Fiscal Rule: as copper prices kept rising the independent experts began adjusting upwards their estimate of the reference price of copper, especially after 2006 (for the 2017 Budget). Something similar happened to potential growth estimates, as the economy sustained a significant acceleration, especially in Fixed Capital Investment¹⁷.

In general terms, the fiscal sector provided a positive impulse to aggregate demand in this phase of the commodity price cycle, in spite of the increase in savings and the overall surplus. This was so because part of the increase in copper revenues was deemed “structural”. However, the counterfactual of not having the Fiscal Rule would most likely have been far more pro cyclical. Additionally, there was also a significant accumulation of net assets on the hand of the government, as it is shown in the following figure.

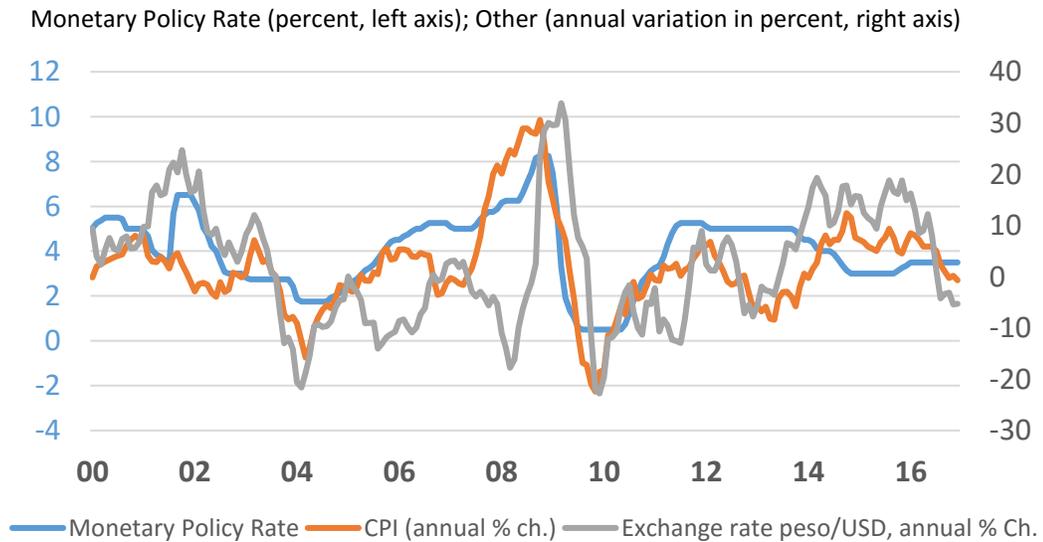
¹⁷ We now know that this was due to the investment boom in copper mining, but was not known precisely at the time, since investment by sectors of activity was estimated with a significant lag at the time.

Figure 13: Chile's Government Net & Gross Debt



Source: Central Bank of Chile and Budget Office.

Figure 14: Monetary Policy Rate, Exchange Rate Fluctuations and Inflation, 2000-2016



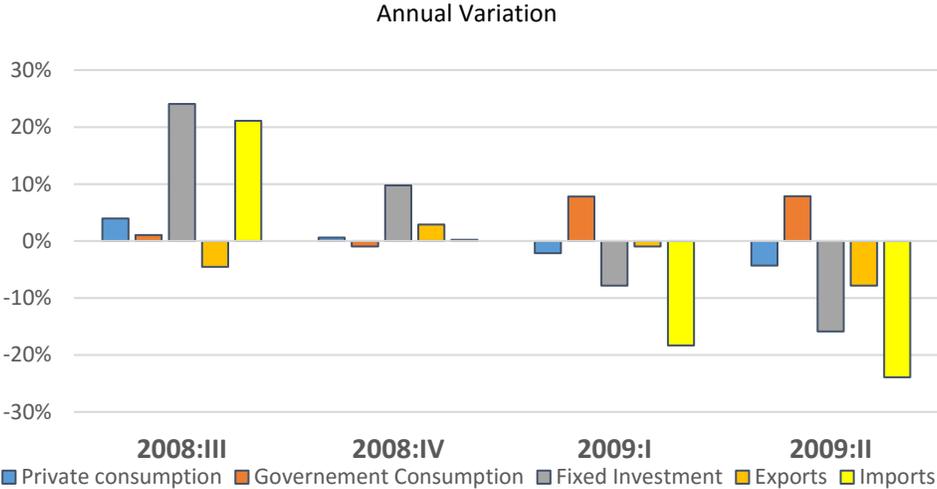
Source: Central Bank of Chile

Over the same period, monetary policy had a moderately expansionary tone, with the Monetary Policy Rate (MPR) remaining below neutral levels, in tune with a perception of a persistent slack in the economy, as inflation began to creep up in 2005, the MPR moved first to neutral territory (estimated at that time to be about 5.5 – 6%) and then higher up as evidence of increasing tightness in capacity emerged. The quick surge in inflation

starting in mid-2007, induced additional increases in the MPR, but it was playing catch up with past inflation. All in all, and with the exception of a short – but very relevant period in 2006 – monetary policy moved from a clearly expansionary tone, to a neutral one over this phase of the cycle. Inflation remained close the Central Bank target most of the time, with the exception of the quick acceleration in 2008, resulting from the depreciation of the peso at a time when the economy was running above capacity and international prices of energy and food were rising fast.

The global crisis and the Economic policy reaction (2008 – 09). Leading up to September 2008 the economy was experiencing fast growth, mostly as a result of a significant increase in investment. Since Chile is not a producer of equipment, part of this addition to aggregate demand was transferred abroad through imports of capital goods. Private consumption and domestic investment were also rising but at a more moderate pace. The events of September caused a wave of fear among households and firms, leading to a collapse in consumption, investment and imports. Even though the price of copper and other commodity exports collapsed in 2008, the volume of exports felt the global shock only by the second quarter of 2009. Part of the global shock came through the “financial channel” after the collapse of several U.S. banks with a significant presence in international trade financing (Citibank, Wachovia), but after some delay, the financing gap narrowed and financing for trade operation was restarted by the end of 2008.

Figure 15. Main Components of Aggregate Demand during the Global Financial Crisis



Source: Central Bank of Chile

The only item in domestic aggregate demand that moved against the trend was government consumption. In fact, the government reacted quite promptly, with a significant increase in expenditures beginning in the last quarter of 2008 and extending over 2009. The government plan tried to focus most of the fiscal impulse through

transitory measures that could – eventually – be reversed. Key among them was a transitory reduction in income taxes, targeted one-time transfers of income to the lower incomes households and fixed investments, both by the Central Government and also by CODELCO. The overall size of the package was about 3.5% of GDP. All in all, government expenditures rose by 21.6% in 2009 in real terms, with current expenditures (consumption plus transfers) increasing by 20.5% and capital expenditures by 28.2%. In order to finance these extraordinary increases as well as the temporary tax cuts, the structural balance rule target had to be revised and almost USD 9 billion were withdrawn from the Stabilization Fund (FEES in Spanish) in order to compensate the cyclical tax collection reduction, as well as to fund the stimulus package. This was about 44% of the balance of the FEES at the end of 2008. As Figure 5 shows, Chile is the country in the Pacific Alliance that experienced the most significant reduction in government savings during the crisis (about 6% of GDP).

Monetary policy had to wait a little before reacting, given the high levels of inflation at the end of 2008, and the fear of persistence, given the extent of indexation in wage setting and financial contracts. This concern on inflation was exacerbated by the severe depreciation of the peso after the Lehmann collapse. The drop in domestic demand that began by the end of 2008, and the quick reversal of the depreciation were enough to eliminate any inflation pressures and after a few months, annual inflation rates were in negative territory. The Central Bank quickly took advantage of this reversal, cutting the MPR from 8.25% in December 2008, to 0.5% in July 2009.

For the first time in many decades Chile was able to pursue counter-cyclical monetary and fiscal policies in the event of a severe external shock and a collapse in consumer and business confidence, without a collapse in the currency or a financial crisis.

In spite of this strong reaction of fiscal and monetary policies, the Chilean economy went into recession in 2009, albeit a short-lived one: the recovery started in the third quarter of 2009, and by the end of the year, the level of output was back to the previous peak in early 2008.

Economic policies during the recovery phase. In early 2010 the economy was in an early recovery when a major earthquake struck the central part of the country, with significant damage to housing and infrastructure¹⁸. This came a few days before the inauguration of a new government in early March and caused a major shift in economic policy priorities. Reconstruction of public infrastructure (schools and hospitals, mostly) as well as low income housing used up a significant amount of investment resources of the government, especially after 2011.

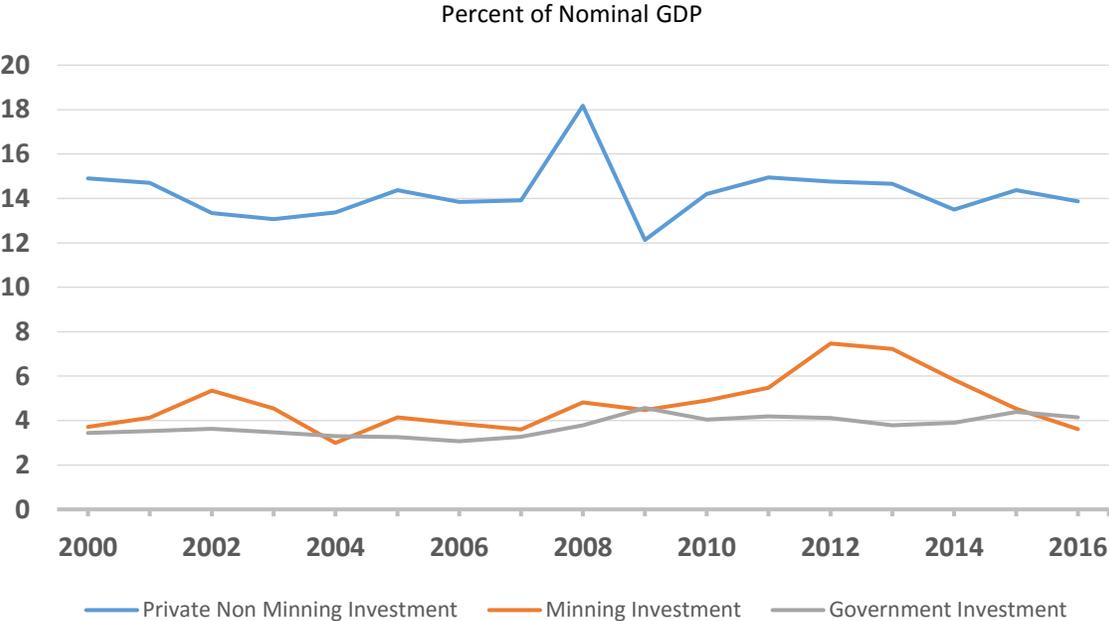
The government reacted by reallocating resources within the budget and increasing the size of the budget for 2010 by about 4% of total expenditures. In order to pay for this

¹⁸Since all major highways, airports and ports were under privately managed concessions, they were privately insured and their reconstruction was not financed by the government Budget.

effort it increased some taxes temporarily. The cyclical recovery provided significant support to increase revenues, so that at the end of 2010, government revenues rose by 28% in real terms, while expenses increased by 7% in real terms. These changes allowed for a reduction in the structural and nominal government balance with respect to 2009¹⁹.

However, a worrisome trend on government expenditures began to emerge, as current and total expenditures by the end of 2010 were about 35% higher than in 2007, while potential GDP rose by 11% in the same period. The original idea of having a short-lived fiscal stimulus became very difficult to put into practice, partially because of the earthquake, but also because a large fraction of the increase in expenditures was in the form of transfers and other current expenditures. The fiscal problem became evident a few years later, once temporary tax increases reversed to previous levels and copper revenues fell as a consequence of lower prices and higher costs (Figure 2).

Figure 16. Composition of Fixed Capital Investment in Chile during the Cycle



Source: Central Bank of Chile, Budget Office.

As mentioned earlier, at the same time of this fiscal expansion, private investment was rising fast due also to the demand for reconstruction of housing and infrastructure, but also due to the mining investment boom. In fact, in 2012, at the peak of the mining

¹⁹ The actual balance went from -4.5% of GDP to -0.4% and the structural balance was reduced from 3% of GDP to 2%. The methodology to compute the structural balance was adjusted that year to reverse previous changes. Both moves were hotly debated at the time (Velasco et al. (), Larraín et al. ()).

investment boom, both private non-mining and government investment were higher as a fraction of (nominal) GDP than in 2007²⁰.

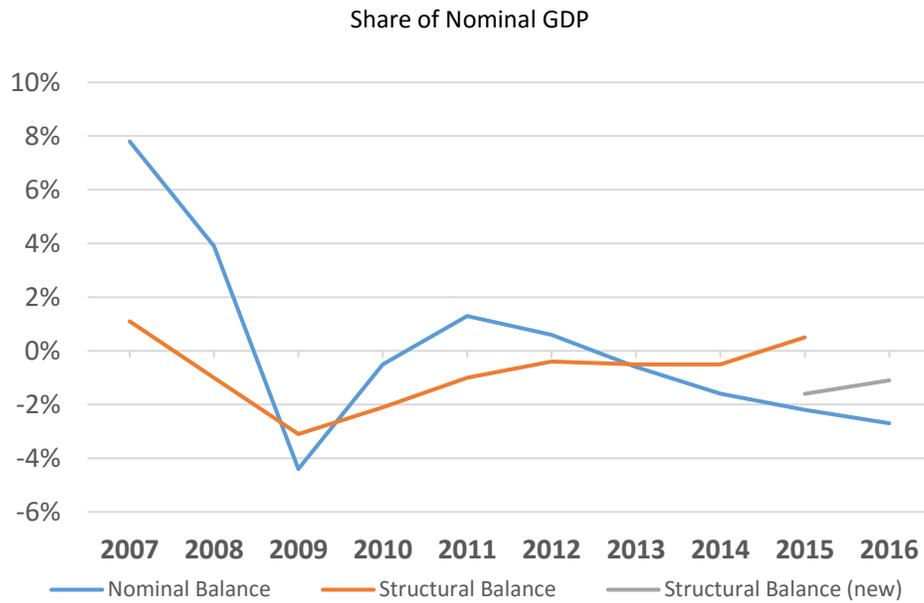
On the monetary policy side there was a faster reaction, and beginning in June 2010, just after inflation came back into positive territory, the Central Bank began to increase the MPR until reaching a peak at 5.25% one year later. It did not go beyond that level which was about neutral, because inflation remained subdued. By 2012, the fast and early recovery of copper prices was putting significant pressure on the exchange rate to appreciate, a common trend in emerging markets at the time. Even though copper prices peaked in 2011, the ensuing slide was very gradual and mining investment peaked in 2012 and remained very strong in 2013.

2013r marked the end of the positive cycle for the Chilean economy, as mining as well as government investment began to fall. Almost at the same time, the so-called Taper Tantrum had a significant impact on global risk appetite, affecting commodity prices and EME currencies. On the domestic side, the new government inaugurated in March 2014 came into power with a very ambitious reform focused in reducing inequality, including major increases in transfers. In order to pay for them, it began by introducing a tax reform aimed to gradually increase the Corporate Income Tax (base and rates). The aim was to collect up to an additional 3% of GDP once the reform was fully enacted, but as the economy slowed and both the structural and effective balances deteriorated and to (gross) public debt began to rise, the initial ambitions had to be scaled down. Interestingly, as it is shown in Figure XX, the Central Bank of Chile acted with total independence of the Fed, which highlights the benefit of the free floating exchange rate system for situations where local and global cycles are not synchronized.

In this context, fiscal policy was not available for counter cyclical policy and the Central Bank took the lead with gradual reductions in the MPR starting in 2014, moving in the opposite direction from the Fed. Not surprisingly, the combination of lower copper prices, a slowing economy and monetary easing at the time of tightening international financial conditions resulted in a significant depreciation of the peso. Inflation increased by more than initially expected and remained above the upper bound of the target zone of 4% for almost two years, but this deviation was deemed transitory and two-year ahead inflation expectations remained close to the Central Bank's target. By mid-2016, after the economic slowdown proved more lasting than expected, and ongoing mining investment contraction, inflation fell back into the target zone.

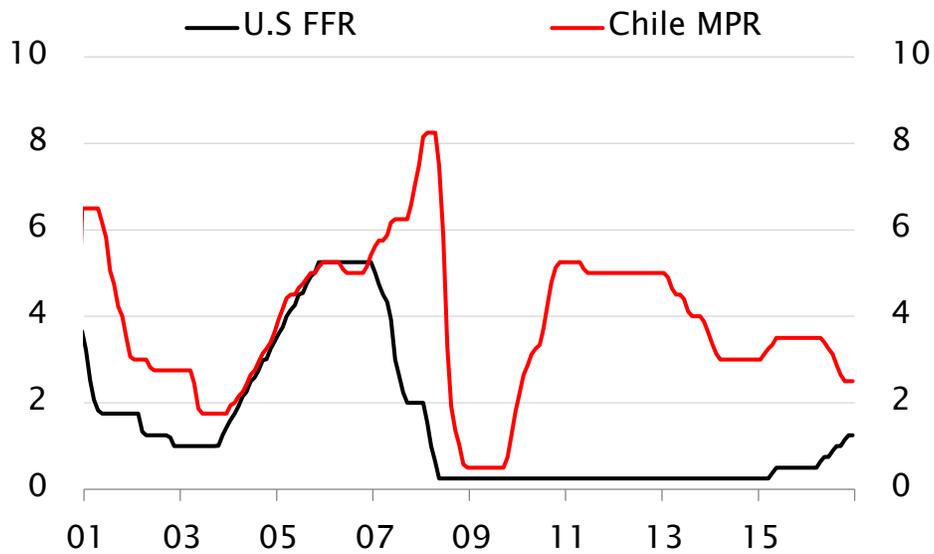
²⁰ Nominal GDP can be strongly influenced by copper prices, given the importance of this sector in the Chilean Economy.

Figure 17. Fiscal Balance over the cycle; nominal and Structural²¹



Source: DIPRES 2016, 2017

Figure 18: Monetary Policy Rates in Chile & the U.S.



Source: Central Bank of Chile

²¹ A new methodology to estimate the Structural Balance was introduced in 2016, in order to correct systematic errors in the cyclical correction to the Non Copper Revenues as well as updated estimates of the key parameters.

Some hypotheses to explain the loss of power to enact counter cyclical policies. From the previous discussion we can see the economic policy reactions differed quite significantly in the lower parts of the cycle in 2008-09 and 2013-16. During the first cycle fiscal policy enjoyed widespread credibility and had ample savings at its disposal, while monetary policy was severely restricted by the high inflation levels at the time of the crisis in 2008. On the contrary, by 2013 the government faced a combination of structural and nominal deficits and gradually falling trends in copper prices and GDP growth, but monetary policy had credibility and probably more room for maneuver than the Chilean authorities expected. The selection of tools was more a question of availability than optimality. This is a big improvement over the more traditional situation, in which financial restrictions and low credibility were at the root of pro-cyclical reactions to negative external shocks. However, it fell short of what policy makers, multilateral organizations and rating agencies expected. There are several hypotheses to explain this underperformance, and they fall under three categories:

1. The nature of the shock was different from previous ones
2. Methodological shortcomings in the measurement of the cyclical position of the economy in real time
3. The complexity of the politics of fiscal counter cyclical policy

Starting with the first one (the nature of the shock), the main difference of this cycle with respect to previous ones was the duration and the story behind the rise of commodity prices. The “super cycle” derived from the convergence of China, accompanied by growing demand for materials, energy and food produced not only commodities price increases, but also a major investment boom in all resources globally, and general change in perspectives about the value of natural resources. For small resources-rich countries this meant first a major and prolonged investment boom, led by FDI. Then a gradual change of perceptions ensued: the rising incomes as well as the surge in the ranks of the middle classes, gradually changed the perception about countries and societies: after about 10 years of sustained progress (more in the case of Chile) in which emerging middle classes gained access to better housing, cars, private health and even higher education for their kids, social demands to secure better and more affordable services began to displace the urgency to improve efficiency in order to sustain fast economic growth. With plentiful demand for labor and growing shortages in many areas, voluntary labor mobility increased and wages rose. On the other hand, investment costs rose, not only because of higher wages, but also due to higher environmental requirements and growing pressures coming from local communities. The end of the investment boom was sharper and more prolonged, and both fiscal authorities and the political elites were slow to react to the new reality.

During the prolonged investment boom, fiscal rules based on cyclical corrections of government revenues, like the one used in Chile, worked well at the beginning because

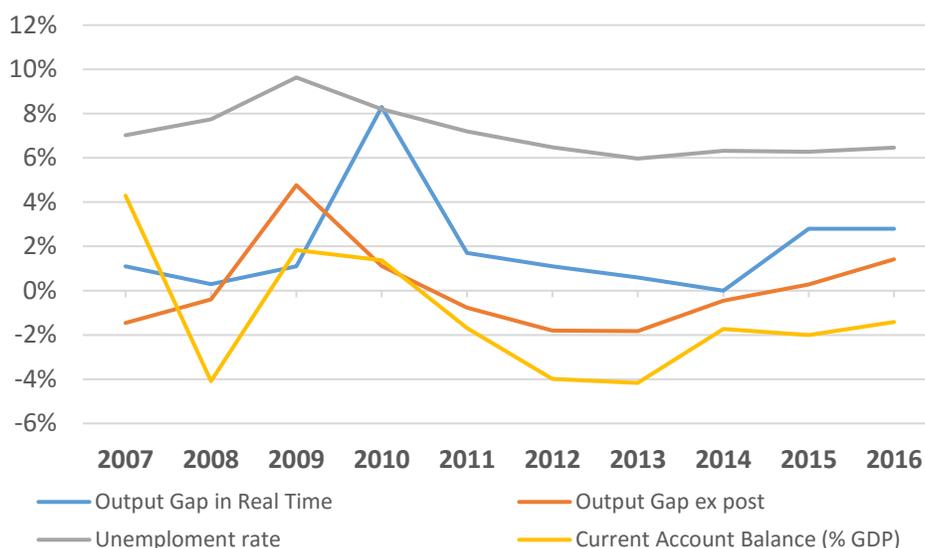
the shock was perceived a transitory. However, as it lasted longer than usual and carried alongside an investment boom, both the long-term price of copper and the estimated growth of potential output were revised up and fiscal expenses and future commitments increased. When copper prices came down, both key parameters of the fiscal rule were revised downwards, but with a significant delay and very gradually. The new government that came into power in 2014 raised taxes to pay for the ambitious pledges it made during the campaign, but in fact the additional resources had to be devoted mostly to cover the shortfall in revenues, leaving very little to pay for the additional expenses being legislated. In May 2015 a new team at the Ministry of Finance began a fiscal consolidation process in order to restore the credibility of the Fiscal Institutions and policies, but this also meant that there was no room for additional fiscal stimulus to compensate for the fall in private investment. This consolidation will take a sustained effort over the coming years, leaving very little room for the kind of government expenditure increases seen in the previous decade.

The second one is more technical, but it is based on a well-known fact²²: real-time estimates of the cyclical position of the economy are not very reliable, especially at points where trends shift. Therefore, it is important to use different estimates and apply informed judgement to evaluate this critical situation; this is in fact what most central banks do when implementing monetary policy. However, this is not the case with fiscal rules like the Chilean one that rely heavily on a fixed number (the predicted value of the output gap for the next fiscal year). The problem is illustrated in Figure 19, where we show different indicators of slack in the Chilean economy for the 2007-2016 period. The most striking feature of the Figure is the large difference between the ex-ante estimates of the Output Gap calculated by independent experts and the ex-post calculation based on the same methodology but with the observed GDP and the cyclical deviations estimated with ex post information. 2010 is the most extreme case, but note also that between 2011 and 2014 the ex-post estimates were always negative (actual GDP was above potential) while the ex-ante calculations showed the opposite, with the effect of having more room for expenditure than what the actual situation allowed²³. Part of the deterioration of public finances would have resulted from an application in good faith of a fiscal rule based on a flawed estimation of the cyclical position of the economy.

²² See for instance, Orphanides (2002) and Borio et al. (2014)

²³ This was one of the reasons for the methodological correction in 2016.

Figure 19. Measures of Economic Slack for the Chilean economy, 2007-16



Source: Central Bank of Chile, DIPRES 2016 and 2017.

Something similar happens with the estimation of the reference price of copper. The current procedure is based on a poll of about 20 national experts that are asked to provide projections of the price of copper for the next 10 years. This is almost an impossible task and it probably misses the mark on one key aspect: mining production is a decreasing returns to scale operation for a given technology, so sustained increases in prices will translate in large initial profits at the beginning, but they will decrease as costs begin to mount as miners try to increase production. So for a given (high) copper price, the level of profits (and fiscal revenues from copper) will decline over time.

The third hypothesis is a familiar one: blame the politicians for the bad outcomes of a well-designed economic policy. However, the reality of economic policy-making is well known and there has been a lot of research about this issue. In fact, Chilean institutions were often presented as a model to follow.²⁴ In this case, part of the problem as we just mentioned above, was that politicians were led to believe that there was more room for fiscal expenditure. But this is not all. In fact, the figures show that the expansion in fiscal expenses in 2009 – a year without a structural fiscal target in practice - went beyond the limits of prudence, especially for current expenditures. The problem was compounded in ensuing years when one-time transfers became customary and some of them were enshrined in permanent laws. One big benefit of a fiscal rule is the budget discipline imposed by an objective limit to expenses. The Chilean experience in 2009 shows how much harder it becomes to impose fiscal discipline at times of crisis when the fiscal target is relaxed on one hand, and also how difficult it is to avoid medium and long term fiscal

²⁴ See for instance, IADB 2006, 2010.

commitments based on overly optimistic projections of revenues after a sustained commodity boom.

4.3 Simulations

Setup. As was mentioned above, a key element for understanding the impact of copper price changes on the economy is whether agents interpret these adjustments as transitory or as a permanent. To complete the analysis, in this section we use the general equilibrium model of the Central Bank of Chile to analyze this issue. The model is a standard small-open economy neo-keynesian model, similar to those used by central banks in this type of economies. Its specification includes imported and locally produced tradable goods, price and wages rigidities, partial indexation to past inflation, incomplete exchange pass through, habits formation, adjustment costs, non-Ricardian households, among other common features (see Medina and Soto 2007 for details).

As was also highlighted earlier, one particularity of the Chilean economy is its fiscal rule. The model captures the fiscal problem with the following two equation. First, the government budget constraint,

$$P_{G,t}G_t + \frac{\varepsilon_t B_{G,t}^*}{r_t^* \Theta_t} = \varepsilon_t B_{G,t-1}^* + \tau_t P_{Y,t} Y_t + \chi C F_{S,t} + \tau_S (1 - \chi) \Pi_{S,t}^\delta,$$

where $P_{G,t}G_t$ and $P_{Y,t}Y_t$ are nominal government consumption and nominal GDP respectively, $B_{G,t}^*$ is the government net foreign asset position, ε_t is the nominal exchange, r_t^* is the risk free dollar interest rate, Θ_t is the risk premium paid by the government, τ_t is the tax rate, $C F_{S,t}$ is the cash flow of mining firms of which a share χ belongs to the government (the rest is assumed to be owned by foreigners), τ_S is the corporate tax in the mining sector, and $\Pi_{S,t-1}^\delta$ is profit of mining firms net of depreciation.,

Second, the government expenditure is determined by the following structural balance fiscal rule:

$$\frac{P_{G,t}G_t}{P_{Y,t}Y_t} = \left[\left(1 - \frac{1}{r_{t-1}^* \Theta_{t-1}} \right) \frac{\varepsilon_t B_{G,t-1}^*}{r_t^* \Theta_t} + \tau_t \frac{P_{Y,t} \bar{Y}_t}{P_{Y,t} Y_t} + \chi \frac{C F_{S,t}}{P_{Y,t} Y_t} \right] \frac{P_{G,t} \zeta_{G,t} T_t}{P_{Y,t} Y_t},$$

$$\tau_S (1 - \chi) \frac{\Pi_{S,t}^\delta}{P_{Y,t} Y_t} - \frac{V C_t}{P_{Y,t} Y_t} - \bar{s}_B$$

Where $\zeta_{G,t}$ is a shock capturing deviations of government expenditure from the rule, $VC_t = [\chi + \tau_S(1 - \chi)]\varepsilon_t(P_t^* - \bar{P}_t^*)Y_{S,t}$ is the cyclical adjustment rule depending on the difference between the effective and reference copper price, P_t^* and \bar{P}_t^* respectively. The rule also adjusts for the difference between actual and potential GDP, \bar{Y}_t .

Given the importance of mining investment for our argument, we use Fornero and Kirchner’s (2014) extension of the model that endogenizes the production of copper (in the original model it is an endowment), adding time-to-build, and adjustment costs to capital accumulation in that sector.

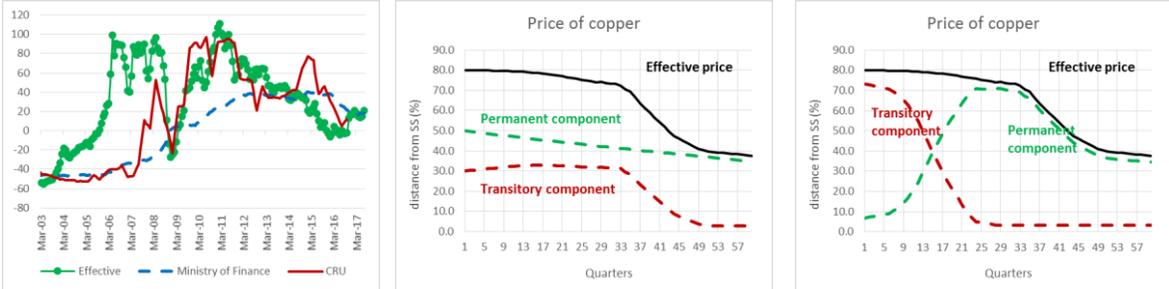
Using this model, we simulate the effects of an increase in the price of copper of the order of 80% above its long-term level, an increase that partially reverses after 8 years. This is somewhat similar to what happened in Chile, where the price of copper increased during 2006 beyond \$4 /pound (in 2016 dollars), well above its 1960 – 2016 average of \$2 / pound, to start falling by mid-2013 towards a level still above its average (see figure 20, panel A).

Figure 20: Copper Prices

A: Effective and Medium Term Estimates
Term Estimates
(deviation from the mean)

B: Baseline: Dev. from Steady State.

C: Low-Learning: Dev. from Steady State



Note: Panel A shows deviation from historical mean of copper effective price, the reference price used by the Ministry of Finance for fiscal rule calculations, and 5 year ahead estimation by CRU, a consulting firm. Panel B and C show simulation of baseline and low-learning scenarios. In both cases the effective price of copper is the same, but the portion that is perceived as transitory and persistent is different.

Source: Central Bank of Chile, Ministry of Finance, CRU.

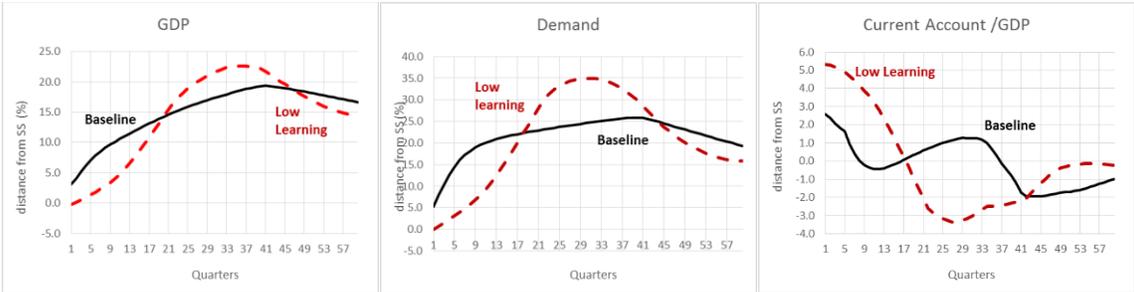
To capture the differences between the impacts of a change in price that is anticipated from one that is not, we carry out two simulations. In the first case half of the increase in the price of copper is perceived as permanent and half as transitory. In this scenario, when after some years the price of copper begins to decline, it is understood that it is reaching its long-term level (Figure 18, panel B). We call this the baseline case, since agents learn from the beginning the correct proportion of the persistent and transitory component of the change. The second simulation tries to replicate what actually

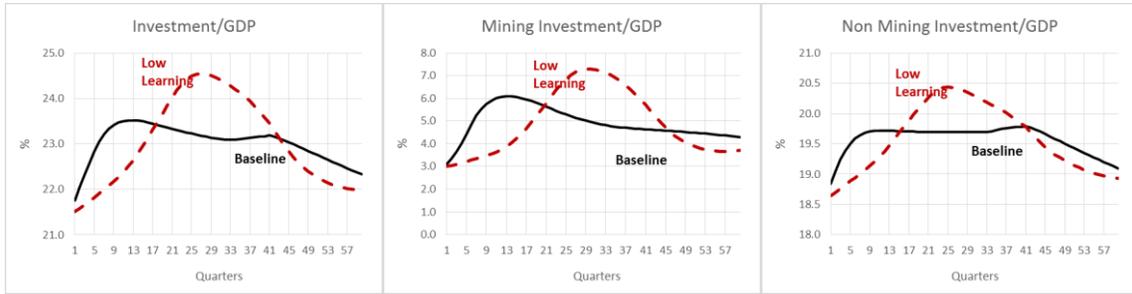
happened in Chile during those years. At the beginning, and for several quarters, the whole increase in the price of copper was seen as transitory, and only after around four years it was understood that we were facing a more persistent change. But, probably, there was a little bit of overshooting, a situation that was reversed along with the price adjustment of copper from 2013 (Figure 20, panel C).

The division between persistent and transitory changes is somewhat extreme in this model, since the permanent component is assumed to have a mid-life of about 25 years and the transitory lasts for only one quarter. However, Fornero and Kirchner (2014) show that these two shocks do a good job explaining the evolution of the price of copper in a context where the agents are learning the nature of shock’s persistence.

Results. Figure 21 presents the main results. Starting with activity it is evident from the movement in GDP and demand that, even though the total effect is similar in both the baseline and the low-learning scenarios, the timing is quite different. In particular, under low-learning the economy take more time to take off, and suffer a more drastic adjustment afterwards. This behavior is related to investment decisions. Since building a mining project takes time (remember the time to build assumption), firms will start this projects only if they believed that price will be high for a sufficiently long period of time. In the same vein, when the projects are underway, they will keep investing in them even if the prospects for future prices has deteriorated. The spillovers to the rest of the economy are clear from the behavior of the current account and non-mining investment. In the low-learning case, savings increases initially because the extra income is seeing as transitory. This, combined with stable investment, generates a current account surplus. As time pass, savings decrease and investment rise, and not only in the mining sector but also in the rest of the economy. Therefore, there is a significant reversal of the current account.

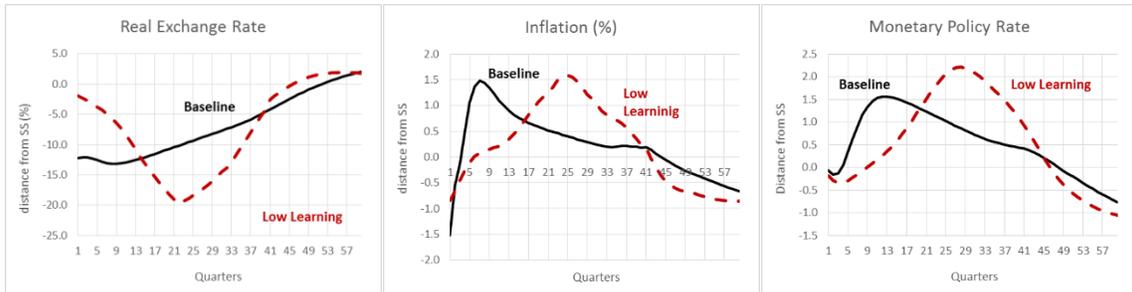
Figure 21: Simulation Results For Baseline & Low-Learning Scenarios I





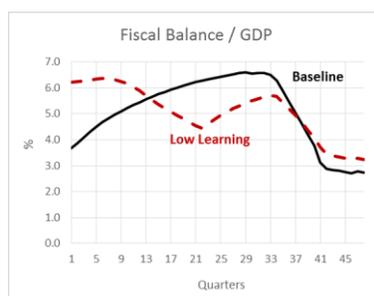
The behavior of the real exchange rate, inflation, and the monetary policy rate is depicted in Figure 22. In the baseline scenario since the movement in the price of copper is seen a persistent movement from the beginning, the real appreciation of the peso is instantaneous, while in the low-learning case it took a long time to react. Because of appreciation of the peso, inflation abruptly decline, but afterwards it starts rising because of the relative stability of the RER and the acceleration of demand. Monetary policy responds accordingly, but it is a little bit more aggressive in the low-learning case, since the misunderstanding of the nature of the shock generates a delayed response.

Figure 22: Simulation Results for Baseline & Low-Learning Scenarios II



Finally, fiscal policy response is shown in Figure 23 showing fiscal balances relative to GDP. In both scenarios there is an improvement in the fiscal situation, since a relevant part of the change in the price of copper is seeing as transitory. However, in the low-learning case, the improvement is larger. These extra savings are used afterwards when the government realizes that the increase in the price of copper will last longer (part is used to finance mining investment of state own firms, this type of expenditures is annotated above the line in the model, but below the line in practice). When the price of copper drops by the end of simulation period the improvement in the fiscal balance is reversed.

Figure 23: Simulation Results for Baseline & Low-Learning Scenarios III



Source: Central Bank of Chile.

1. The perception about how persistent are the shocks to the price of commodities is critical. The impact on private investment decisions as well as on fiscal expenditures is determined by a structural balance fiscal rule dependent on this perception.
2. Monetary policy by itself is not enough to compensate for the private investment shock, and the way it is implemented also depends on how persistent the shock is understood
3. In general, the government surplus must increase when the price of copper rise, if the latter is seen as transitory. Of course, the greater is the perception that the change is transitory, the larger will be the increase in government savings.
4. The permanent increase in the price of copper is associated with a deterioration of the external position of the economy, as reflected in the Current Account. That is consequence of two forces. On the one hand, the fiscal rule do not ask for increase in public saving when the change in the price of copper is seen as permanent. Second, investment, especially in the mining sector, increases when firms think the price of copper will remain high for a long time. On the contrary, when the improvement in the price of copper is seen as transitory, current account surplus increases, since there is no major change in investment and a big part of the income windfall must be saved according with the fiscal rule.

5. Final comments

Probably the first and most important lesson from this commodity price cycle is that a Fiscal Rule designed to compensate short-term volatility of fiscal revenues due to short-term cyclical fluctuations in the price of a key commodity can work well during a short-term cycle. However is not necessarily useful to deal with a long-term cycle that at some point is perceived as a change in the trend of that price.

A change in the perceived trend will be accompanied by a real shock in private investment that will generate a domestic cycle by itself. Given the perception of a permanent increase in fiscal (and private) incomes this will translate in permanent

commitments in expenditures for the government. When the cycle comes to an end, the government will face a permanent deterioration in the budget and the private sector would have built excess capacity.

The effectiveness of conventional monetary policy to smooth short-term cycles seems quite significant over the short-term. Longer (real) cycles are a different matter, and the ability of Central Banks to deal with them is limited by the global stance of monetary policy in the international financial centers.

In the event of a prolonged resources-linked investment boom there is a potential for asset prices bubbles, especially in the construction sector, given the location specificities of these investments. This is particularly true if long-term interest rates are low, as happened in the last cycle. Therefore, these type of cycles call for close monitoring of housing prices and credit into this sector, both by central banks and financial supervisors.

The previous analysis also suggests that the Chilean Fiscal Rule can benefit from technical and institutional adjustments. In the aftermath of the global recession there was a very active debate about the nature of the fiscal rule: Should it be designed to limit cyclical fluctuations of government expenses, or should it aim to link expenses to permanent incomes?²⁵ At first glance this question seems absurd, but it is not. A cyclical adjustment does not correct for transitory revenues that are not linked to the cycle. The issue was settled in favor of the first hypothesis, mostly due to the technical difficulties to assess permanent revenues from rents of natural resources. However, the evidence shows that the cyclical correction also faces major challenges to assess the cyclical position of the economy in real time. Given that potential GDP growth changes gradually and in more predictable ways than the Output Gap, it seems reasonable to reconsider this issue, at least with respect to the correction of Non-Mining revenues of the government.

With respect to the copper price adjustment, it is almost impossible to project long-term prices. The independent committee is a very good instrument to provide transparency to the fiscal rule, but it does not do much good in terms of reliability of the predictions. One possible improvement could be to focus the attention on cash costs of the mining companies, corrected by a “long-term margin rate”. They tend to be more stable and put the attention in what really matters for public finances and investment decisions by mining firms: profits in this sector. There is far more information about them and they should be easier to predict over a medium-term horizon.

²⁵ See (Parrado et al. (2012), Larraín et al. (2011), Corbo et al. (2011)

One additional improvement should be the creation of an autonomous committee to watch over the sustainability of public finances and was proposed by the so-called Corbo Committee in 2011²⁶. This would provide more transparency and credibility to methodological changes and assumptions, as well as a much needed independent revision of public expenditure commitments over the long term.

²⁶ Corbo et al, (2011)

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ANNEX I: Comparison of Commodity Price Cycles

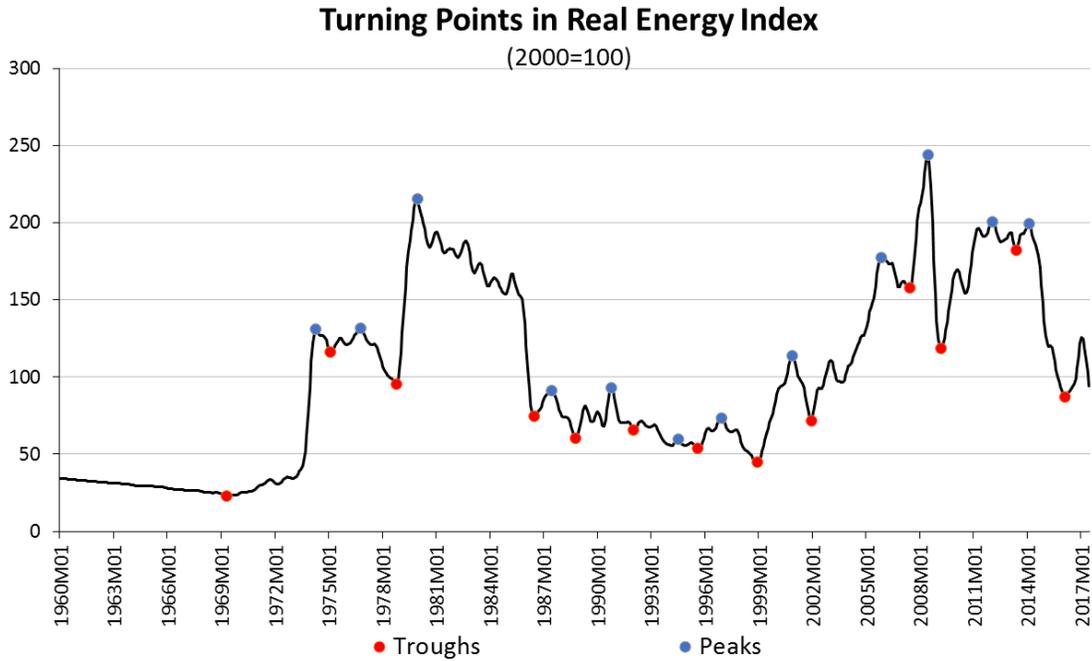
Option A: Minimum phase 9 months, Minimum length 18 months

Figure 1a. Cycles, troughs and peaks of real commodities prices and indices
(1960M1 - 2017M6)

	Cycles		Troughs		Peaks	
	Numbers	Average Duration (months)	Numbers	Average Duration (months)	Numbers	Average Duration (months)
Cooper price	12	55	12	31	12	24
Crude oil price	10	55	10	29	10	26
Crude oil Brent price	9	61	9	33	9	28
Coal price	8	55	9	34	8	22
Energy index	12	47	12	22	12	25
Non energy index	10	65	10	36	10	29
Agriculture index	12	48	12	29	13	18
Food index	13	51	13	29	13	22
Metals and minerals index	12	53	12	30	12	23

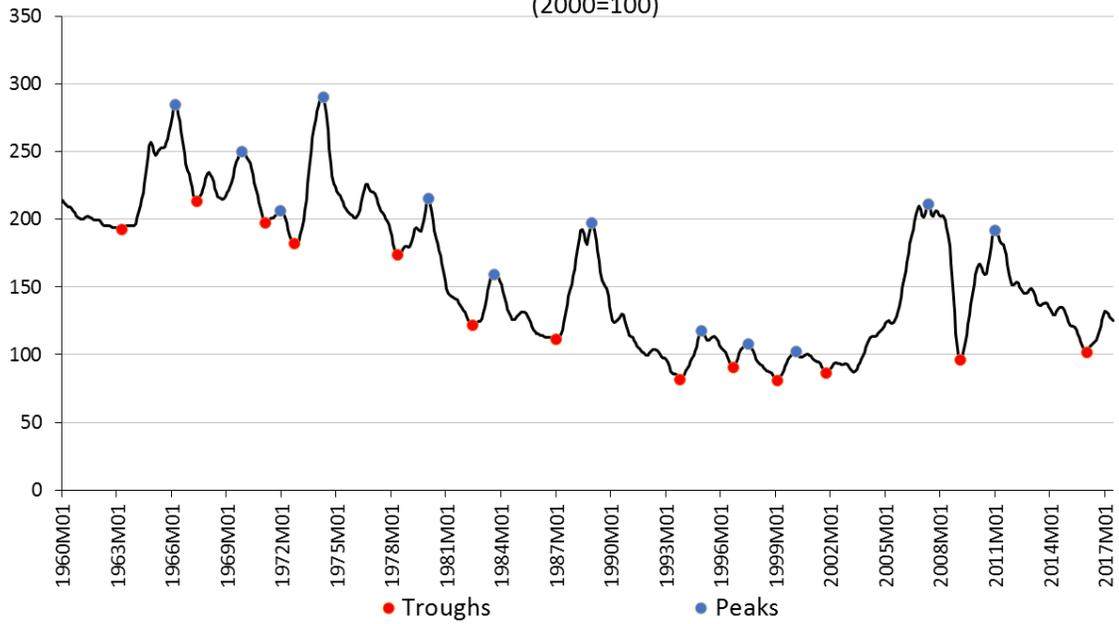
Source: World Bank Commodity Price Data (The Pink Sheet), and authors' calculations.

Note: Following Bello, Cantú and Heresi (2011), we define a windows as a period of at least 9 months, phases with a minimum of 9 months and cycles of at least 18 months.



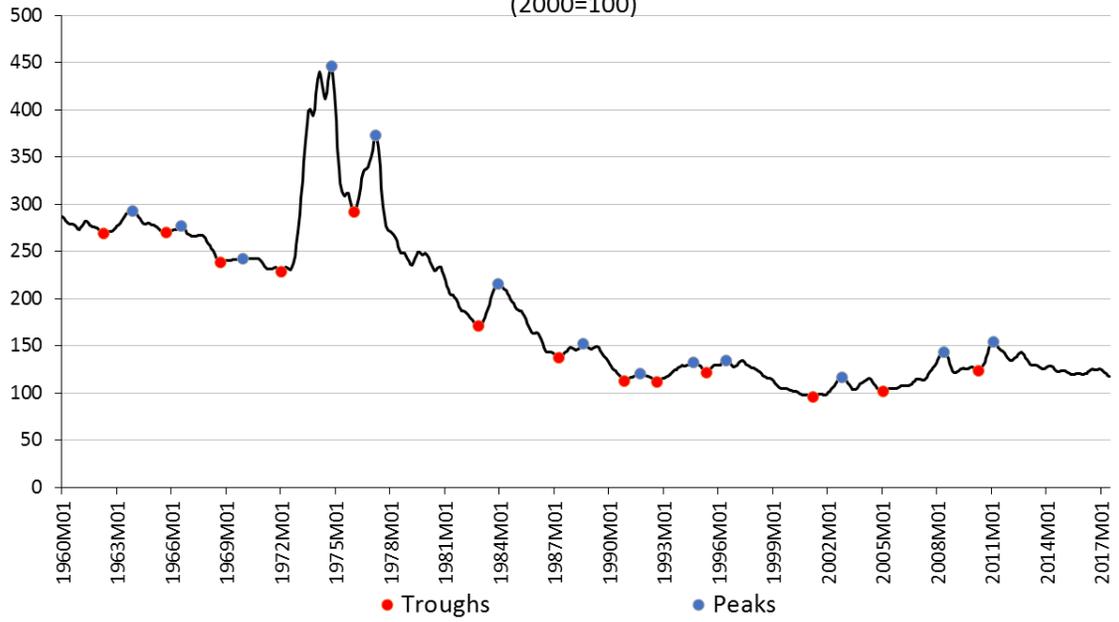
Turning Points in Real Metals and Minerals Index

(2000=100)



Turning Points in Real Agriculture Index

(2000=100)



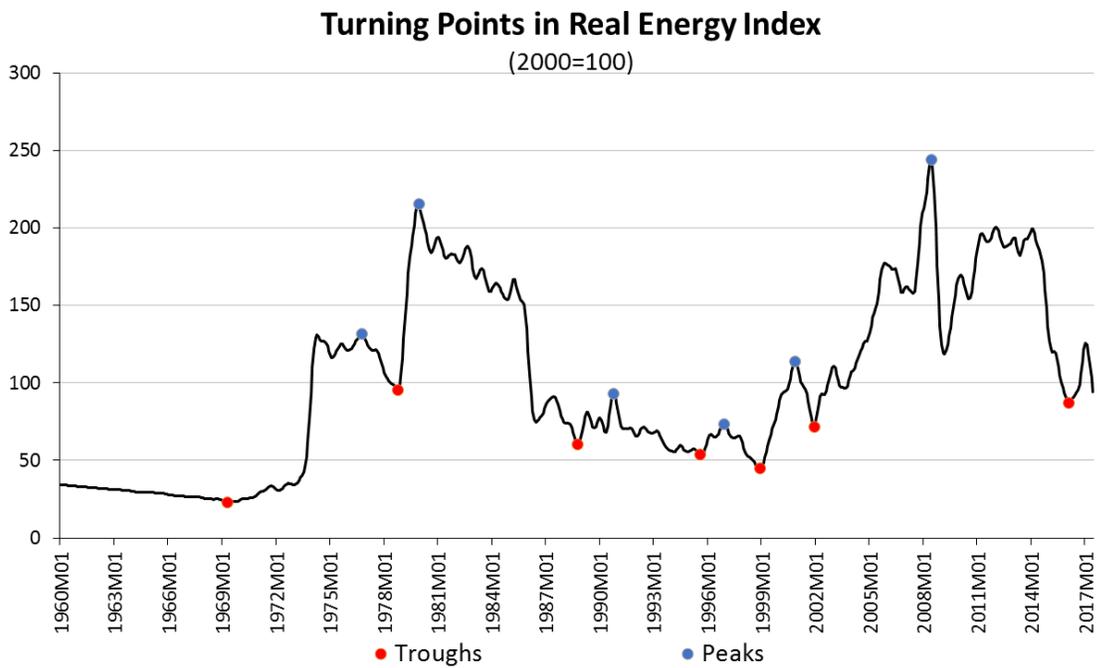
Option B: Minimum phase 12 months, Minimum length 36 months

Figure 1b. Cycles, troughs and peaks of real commodities prices and indices
(1960M1 - 2017M6)

	Cycles		Troughs		Peaks	
	Numbers	Average Duration (months)	Numbers	Average Duration (months)	Numbers	Average Duration (months)
Cooper price	9	73	9	44	9	29
Crude oil price	5	110	5	63	5	47
Crude oil Brent price	3	183	3	99	3	85
Coal price	5	79	6	54	5	31
Energy index	6	94	6	53	6	41
Non energy index	8	81	8	45	8	36
Agriculture index	7	73	7	46	8	33
Food index	8	70	9	31	8	42
Metals and minerals index	10	63	10	39	10	24

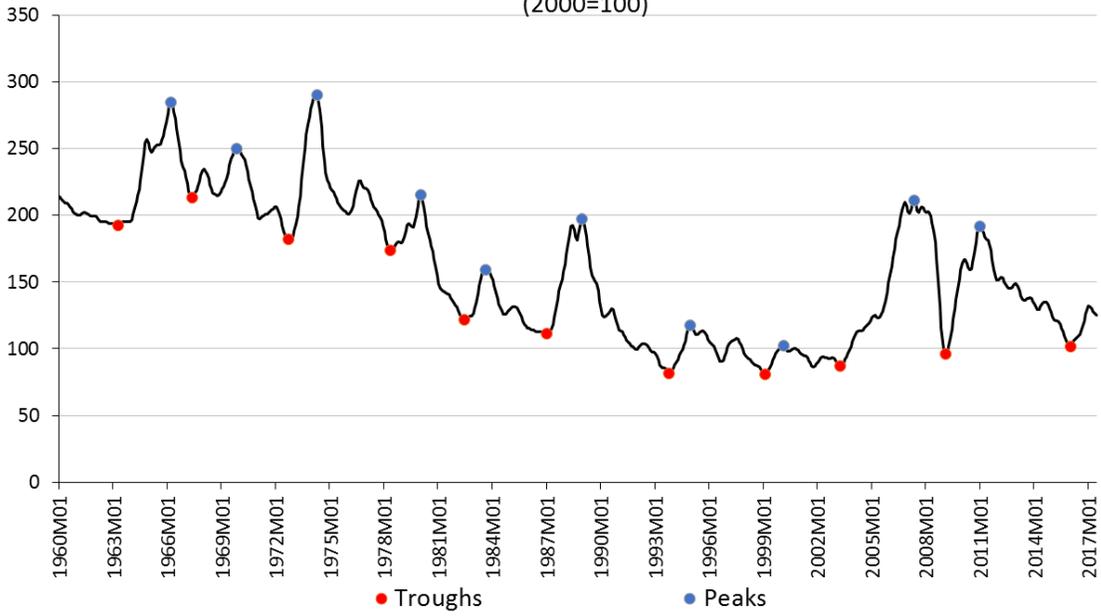
Source: World Bank Commodity Price Data (The Pink Sheet), and authors' calculations.

Note: We define a windows as a period of at least 12 months, phases with a minimum of 12 months and cycles of at least 36 months.



Turning Points in Real Metals and Minerals Index

(2000=100)



Turning Points in Real Agriculture Index

(2000=100)

