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COMMODITY PRICE CYCLES AND FINANCIAL STABILITY*

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Abstract

Commodity exporter economies usually suffer when a boom in commodity prices ends, especially if the cycle ends abruptly. Furthermore, recent literature has highlighted the role of financial instability as either causing or aggravating financial and real crises. In this paper we look at these two aspects, and study the relationship between commodity prices, output growth and financial stability, the latter proxied by domestic credit growth. Given the asymmetry we observe in boom and bust cycles, we estimate the output cost of commodity price shocks on separate samples, with a special emphasis in emerging economies. In particular, we focus on the output cost of a commodity price reversal given the credit increase observed during a boom event. We find that, in line with previous literature, the correlation between commodity shocks and output growth decreases as economies are more open to financial markets. The novelty is that we also find that this correlation is higher when countries experience very rapid credit growth during the Upturn phase of a boom. That is, rapid credit growth –regardless of its initial level—exacerbates the cost of a commodity price reversal.

Resumen

Las economías exportadoras de materias primas por lo general sufren cuando un ciclo de boom del precio de éstas termina, especialmente si termina abruptamente. Por otra parte, la literatura reciente ha puesto de relieve el papel de la inestabilidad financiera, ya sea como una causa o como un agravante de las crisis financieras y reales. En este artículo nos fijamos en estos dos aspectos, y estudiamos la relación entre los ciclos de precios de las materias primas, el crecimiento del producto y la estabilidad financiera, esta última aproximada por una medida de crecimiento del crédito doméstico. Específicamente, estimamos el costo en términos de puntos porcentuales de PIB a partir de una reversión de precios de los productos básicos luego de que éstos alcanzaron un máximo durante un evento de boom, controlando por apertura financiera, régimen cambiario y profundidad del mercado de crédito doméstico. Encontramos que, en línea con la literatura, la correlación entre los shocks de las materias primas y el crecimiento real es mayor en economías que están más integradas a los mercados financieros. La novedad es que esta correlación se estima más alta cuando los países experimentan un crecimiento muy rápido del crédito privado en la fase de alza del boom. Es decir, el crecimiento acelerado del crédito, independientemente de su nivel inicial, agrava el costo de una reversión de los precios de materias primas. Se presenta el caso de una economía emergente

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representativa, cuantificando el costo de una reversión de precios dadas las características promedio de los países en el ciclo actual de boom.

1 Introduction

Economies whose exports are more concentrated in commodity products are more exposed to commodity price cycles (Mendoza, 1995; Kose, 2002; IMF, 2012; Eyzaguirre, Kaufman, Phillips, and Valdés, 2011). In particular, major economic crises suffered by commodity exporting economies often coincide with terms of trade shocks. Nevertheless, not all economies are equally affected, and the literature has found evidence that exchange rate flexibility and financial openness act as mitigating factors (Broda, 2004; Céspedes and Velasco, 2012). On the same line, Spatafora and Tytell (2009) document that different responses to commodity terms of trade shocks – although not always significant – depend on the initial fiscal condition of the economy.[1] However, little has been studied about the role of domestic financial stability as a mitigating factor to commodity price shocks. Even thought financial stability should be addressed using a combination of variables and conditions, the role that credit growth had on the latest financial crisis motivates its use as a proxy of financial stability.

In fact, the current cycle of commodity boom has coexisted with an environment of high liquidity and rapid credit growth in most emerging economies. This, compounded by the duration and intensity of the cycles, has implications for the economic performance, and particularly the current cycle has affected a wider range of commodities – and has presented more volatility in prices than previously identified boom cycles (IMF, 2008). In this paper, we find evidence that those countries with moderate domestic credit growth while commodity prices are growing above trend suffer significantly lower output losses once the commodity price boom ends, compared to those that show credit acceleration.

Some recent empirical studies find that domestic financial vulnerabilities, such as rapid domestic credit growth, would be a factor that could make external shocks more costly in terms of economic performance. For example, in a study for the U.S. and the crisis of agricultural commodities of the 1920s, Ramcharan and Rajan (2012) conclude that increased availability of credit during the commodity price boom was associated with a greater number of bank failures when this was reversed, and greater depression of the price of the land, even decades later. The study suggests that the cost of commodity price reversal would have been temporary and not durable, absent the excessive indebtedness.

Recent literature that identifies determinants of financial crises and their economic cost, grants a marginally significant role for domestic credit growth, measured as a fraction of GDP. Dell'Ariccia, Igan, Laeven, Tong, Bakker, and Vandenbussche (2012) find that the likelihood of financial crises is greater when economies experience credit booms, showing a high correlation with the real cycle. Rancière, Tornell, and Westermann (2008) add that there could even be a trade-off between macroeconomic performance and financial stability. Even a classic determinant of financial crisis such as

[1] Although in this paper we emphasize the initial situation, macroeconomic policy response during the events are also relevant. For example, Céspedes and Velasco (2011) find that the cost is higher in economies whose fiscal policy is procyclical, as in those where tax revenues represent a significant portion of total revenues.

the current account deficit turns out to be marginally less relevant once domestic credit growth is accounted for (Jordà, Schularick, and Taylor, 2010; Borio, McCauley, and McGuire, 2011; Dell'Ariccia *et al.*, 2012; Gourinchas and Obstfeld, 2012).

To understand the connection between commodity price shocks and macro-financial conditions in commodity exporting economies, this paper provides a characterization of boom and bust cycles in commodity prices, for a group of emerging and developed, net commodity exporters. Our work is closer to Spatafora and Tytell (2009) and Céspedes and Velasco (2011, 2012) in that we are interested in the relevance of commodity price cycles from the economic performance perspective. We test the hypothesis that the output loss may be higher for an economy whose domestic credit is accelerating as the event unfolds. By using credit to GDP ratio as an indicator of financial stability, we aim to provide a simple but contingent view of what currently affects emerging market economies.

We choose not to employ other financial stability indicators – such as those included in the large list of Financial Soundness Indicators (FSIs) by the IMF, or the ECB's Macro-Prudential Indicators (MPIs) (see, e.g., Gadanecz and Jayaram, 2009) – so to keep our analysis simple. Moreover, acceleration of credit does seem to have predictive power for financial crises (Dell'Ariccia *et al.*, 2012). In fact, even for external crises, some variables which were commonly recognized as good predictors – current account deficit, for instance – become less significant as determinants of financial crisis when domestic credit growth is accounted for (Jordà *et al.*, 2010). We interacted this measure with a commodity price index, in a regression where we also control for the degree of financial openness and the exchange rate regime, in order to take care of the aforementioned literature. In addition, we control for the share of government spending in total output. Our work does not elaborate on the transmission channels through which slow domestic credit growth acts as a mitigating factor, but simply provides evidence about it. We control for endogeneity between credit growth and GDP, by considering the ratio of domestic credit on a measure of trend output instead of current output.

This paper is organized as follows: section 2 presents the description of the data and methodology used for identifying commodity price cycles. Section 3 is dedicated to characterize these cycles, in particular, the average financial and economic performance in the different phases within booms and busts. In section 4 we estimate the economic consequences of commodity price shocks, and the role of credit acceleration. Special emphasis is given to the asymmetry of boom and bust events, and even within the initial and final phase of a boom. Given the importance of the latter, we quantify the economic cost of the current boom reversion for a representative emerging economy. The findings and conclusions are summarized in section 5.

2 Data and methodology used for cycle identification

In order to study commodity price cycles, we use a commodity price index constructed by Céspedes and Velasco (2012).[2] This index takes into account the production intensity of a country on each commodity and thus allows to identify different cycles for each economy. It is a weighted average of the prices of commodities exported by each economy, where the weighting factor is calculated according to the output share of those goods.[3] Specifically, the index is calculated as the price of each commodity i produced by country j weighted by the share of this commodity in total country's j production.

There is no single methodology in the literature to define the boom and bust cycles in commodity prices. One alternative is to identify a boom or bust event when the index is 1.5 or 2 standard deviations away from a long-term trend, obtained using a Hodrick-Prescott filter (technique used in the literature of credit boom; see, e.g., Dell'Ariccia *et al.*, 2012; Mendoza and Terrones, 2012). Another alternative is to consider the turning points where the greatest distance between local maximum and minimum prices is generated using an algorithm that is common in the real business cycle literature, modified to take into account the differences between commodity price series and the evolution of real variables (Cashin, McDermott, and Scott, 2002; Spatafora and Tytell, 2009). In this paper, we follow the methodology proposed by Céspedes and Velasco (2012), which is closer to the first alternative, but takes into account a long-term trend defined at each year as the moving average on 50 observations – previous 40 years and 10 years after each point in time, for each country. A boom (bust) begins when the commodity price index of a country is 25% above (below) this trend. In turn, this boom (bust) ends when the index returns to a level below (above) 10% its trend.

The sample of countries comes from Céspedes and Velasco (2011), whom construct the index of commodity prices for 48 countries (emerging and developed). Not all these countries were commodity exporters, so we further narrowed down the sample so as to exclude countries, such as for instance Belgium, whose commodity output share was as low as 0.51%. Considering data availability constraints, mostly regarding the credit series, the final sample includes 29 countries, out of which 23 are emerging economies. In this sample we identify 66 booms and 32 busts.[4] Within each cycle we distinguish two phases, in addition to the *Previous*, and *Posterior* two-year periods. The first phase of a boom, *Upturn*, begins once the commodity price index of the country exceeds by 25% the long-term trend at that point, and lasts until it reaches the maximum level. From then on the *Reversion* phase

[2] We thank the authors for sharing their database to perform this work.

[3] The reason to consider the production function to calculate the weight is that, prior to 1970, there was no information on the exports structure of the countries. Therefore, a production function based model would allow for a longer time series as the price index series dates back to 1930 for almost all countries considered in the sample.

[4] The countries considered in our sample are Argentina, Australia, Bolivia, Brazil, Canada, Chile, Cameroon, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Ghana, Guatemala, Honduras, Indonesia, India, Mexico, Malaysia, Nigeria, Norway, New Zealand, Peru, Paraguay, Saudi Arabia, Trinidad and Tobago, Uruguay, Venezuela, and South Africa. The sub sample of emerging countries excludes: Australia, Canada, Denmark, Norway, New Zealand, and Saudi Arabia.

begins, until the index is deviated at most by 10% above the long-term trend. Likewise, the phases of the bust cycle are defined as *Downturn*, from the point when the commodity price index decreases by more than 25% from its long-term trend until it reaches a minimum level, and *Reversion* which begins at this minimum level and ends, analogously to the case of the boom cycle, once the index is deviated at most 10% below the long-term trend. Figure 1 shows the commodity price index for a set of countries, and the boom and bust events detected for each of them. Tables 1 and 2 present a list of the most important features of each of the boom and bust events identified.

The rest of the variables used in the paper were obtained from various sources, at annual frequency, for the period 1970-2010. Economic performance is given by real GDP growth (World Bank, and Penn World Table version 8.0 – PWT hereafter); Government spending share of GDP (PWT); Domestic private credit as a percent of GDP (International Financial Statistics and World Bank). To identify the exchange rate regime we use the classification of Reinhart and Rogoff (2004), which is available until 2007.[5] Finally, the degree of financial openness is given by the index of Chinn and Ito (2008), available at their website until 2010.

3 Characterization of the commodity price index cycles

The frequency of booms and busts, as well as the duration of the cycles, varies if these are analyzed in different decades, by income groups, depending on whether the economies are open to financial transactions, or have a more flexible exchange rate regime (see Tables 3 and 4, that will be referred to throughout this whole section). Most importantly, they differ depending on how deep and dynamic the domestic credit market is.

By definition, during a boom, the commodity price index accelerates, while during a bust it slows down. Figure 2 shows the average annual percent change of the commodity price index during the *Upturn* and *Downturn* periods of booms and busts, respectively. In the case of booms, the annual percent change during the *Upturn* phase is calculated as the difference of the level of the index observed at the peak of the event with respect to the level observed at the beginning of the event, divided by the number of years passed between the beginning and the peak of the event. As a result, the annual rate of change is obtained, so that events of different length are comparable. In the case of busts, the difference is calculated between the level observed at the through of the event and, instead of comparing with the initial level, we compare it with the average observed during the *Previous* period. The only reason for this is that bust events are usually shorter and, in many cases, reaching the through in the beginning of the event.

It is interesting to note the asymmetry throughout the commodity price cycles. On average, the

[5]This is not a problem as will become clearer later, because we only need to identify the exchange rate regime at the beginning of the cycle. The data was obtained from http://www.carmenreinhart.com/research/publications-by-topic/exchange-rates-and-dollarization/, which is the official IMF classification.

increase during the *Upturn* of a boom is slightly smaller than the decrease during its *Reversion*: 12.3% from the first year of the boom until its peak, versus 14.1% from the peak until the end of the boom. In contrast, the decrease during the *Downturn* of a bust (21.7% between its through and the two year prior the ignition of the bust) is relatively much higher than the increase during its *Reversion* (15.1% from through to end of the bust).

As shown in Figure 3, the boom events identified in the sample are concentrated in the 1970s and 1980s (specifically mid 1970s to mid 1980s) and 2000s (mid 2000s onwards), with average commodity price index increase of 13.4% and 10.6%, respectively. On the one hand, during the 1970s, there is a larger dispersion in commodity price variation during the cycle (reaching 50% in some cases), while during the 2000s, the intensity of the booms is at most 20%. On the other hand, more than half of the bust events are concentrated in the late 1990s. In the 1970s only 7 bust events are identified (out of 32 in total), which are characterized by much larger price variations within the cycle than those of the 1990s. Note that, as mentioned above, not only boom events are more frequent than bust events but they also last longer. In the sample, the minimum duration is 2 years but some events last as long as 20 years. On average, duration is 7.3 years (median duration is 6 years). In turn, bust events last on average 4.7 years (median duration is 3 years), being 5 years in the sub-sample of emerging countries.

The economic policy background of the countries, given by their decision on how to manage the exchange rate and financial accounts, have implications in terms of how exposed the economies are to external shocks, and how they respond to them. Commodity shocks are no exception.

As shown in Figure 4, it turns out that during the 1970s more than 40% of the countries in the sample had fixed exchange rate regimes, while very few (less than 20%) had flexible regimes. By mid 1970s, when commodity booms became more frequent, that proportion was sharply decreasing to 30% with more countries adopting flexible exchange rate regimes. Since the end of the 1990s, this trend reversed and the proportion of flexible exchange rate countries decreased again to less than 20%. That period coincided with a higher frequency of bust events. During the 2000s, the share of mixed exchange rate regime countries grew to approximately 70%. As discussed above, this was again a period when boom events were frequent. As a result, we observe that, on average, boom episodes occur more frequently in countries with mixed exchange rate regime, followed by a significant number of events with a fixed exchange rate regime. In terms of duration, there is no significant difference among exchange rate regimes in boom events.

The degree of financial openness is also changing across the sample period analyzed. The proportion of countries with high financial openness has increased from less than 20% in the 1970s, to almost 40% in the 2000s. The proportion of those with low and moderate financial openness fluctuates a lot. During the mid 1980s, half of the countries in the sample had low financial openness compared to less than 20% at present. But it was almost 20% also during the second half of the 1970s. As a result, on average, booms appear to be more frequent in countries with moderate and low financial openness

as the years in which they are more frequent coincide with periods in which the share of low financial openness is lowest. Regarding bust events, they are more frequent at a time in which the share of countries with high openness was at its maximum (almost 40 %).

The duration of booms is longer and rather similar in countries with moderate to high degree of financial openness (7.6 years on average), while among low financial openness countries, booms last 5.7 years on average. Regarding bust events, the opposite holds, i.e. they last significantly less in countries whose financial markets are more open: 2.3 versus approximately 6.4 years in countries with moderate financial openness degree. The differences are less dramatic when considering the median: 2 versus 3.5 years.

It is also interesting to look at the characterization of the cycles by income group (World Bank classification). The sample is biased towards emerging economies as most commodity exporter countries turn out to fall into this group.[6] Therefore, it is no surprise that the events are more frequent among emerging economies: 50 out of 66 booms, and 28 out of 32 busts.

In terms of duration, boom events last longer in high-income countries: 8.4 versus 6.9 years. Nevertheless, on average busts are significantly longer lasting in emerging economies: 5 versus 2.5 years in high-income countries. The difference is less so when the median duration is compared: busts last 3 years in emerging economies and 2 years in high-income countries.

Commodity price index cycles and domestic credit

Domestic credit is defined as total credit to the private sector as percent of GDP. In order to isolate endogeneity between credit and the economic cycle, we replace GDP by a measure of its trend for each economy. Such trend is calculated with a Hodrick-Prescott filter. Based on this ratio, we formulate different measures of credit conditions for each economy.

The first measure is given by the average annual change of the credit ratio during the *Upturn* (*Downturn*) phase of a boom (bust). During commodity price *Upturns*, developed countries show a lower credit ratio variation than emerging countries, especially during the 1970s and 1980s (0.6 versus 2.6 percent points of GDP, high income versus emerging countries). More evidently, during the 1990s the credit acceleration among high income economies was on average around 4.2 percent points of GDP, while emerging economies actually decelerated in 3.7 percent points (see Figure 5).

A second measure identifies whether a country was experimenting a credit boom (or not) at the moment in which a commodity event begins. It is defined according to the credit history of each economy in a way that is similar to that of commodity prices described above: a credit boom (bust) is defined at time t when the credit-to-GDP ratio is 25% above (below) its average in the previous

[6] Emerging economies in the sample are mostly exporters of agricultural and food commodities, only a few are classified as metal exporters, while high income countries are mostly fuel exporters. The estimations considering the export intensity of the country do not show significant differences among categories, and therefore are not reported. They are available upon request.

5-years. If the country does not face a credit boom or bust event, we say credit is *moderate*. This measure is considered a *relative* criterion for defining domestic financial conditions, as it is constructed relative to the individual distribution of credit ratio for each economy.

The coincidence of number of countries experiencing credit booms and commodity booms each year is worth noting (see Figure 6). The correlation is particularly high during the 2000s, when the number of countries with credit booms per year increases and then so does the number of countries with boom events. Although we cannot conclude causality, this feature further motivates the main question of the paper, justifying the inclusion of a financial acceleration measure in our estimation of the effect of commodity price shocks on real activity in Section 4.

Finally, we also consider an *absolute* criterion, that defines credit as *high*, *moderate* or *low* depending on whether it is over, within, or under a range of absolute credit ratio levels of 30-70% of GDP.[7] This measure can be a proxy for financial development.

The motivation to consider the credit ratio level as well as its deviations according to absolute or relative criteria as relevant factors for measuring the economic costs of commodity price shocks is the theoretical model developed by Céspedes and Velasco (2012). In their model, the sensitivity of real activity to commodity price shocks increases as financial development increases in countries with a very low credit ratio until a certain threshold. From that point on, the correlation of the volatility of output and commodity prices decreases, and so in countries with high financial development commodity price shocks matter less. In this sense, we observe that on average high income countries have a much higher credit ratio than emerging economies. As shown in Figure 5, this difference was not as significant during the boom events of the 1970s and 1980s (23% versus 18%) as in the recent cycle (121.1% versus 39.5%).

According to Figure 7, the average GDP growth in the different phases of the events differs significantly, as expected. For instance, during the *Upturn* phase of a boom the average GDP growth fluctuates around 5% versus 2% during *Reversion*. Interestingly, the average growth differs also depending on whether the economy experienced a credit boom at the peak of a boom cycle. For those countries whose credit levels were moderate (i.e. when they did not experience credit boom or bust) by the time the boom reached its peak, the average GDP growth fluctuates just below 3%, while those experiencing credit boom (probably because of an accelerated credit ratio during the *Upturn* phase) showed output growth around 1.7% on average.[8]

[7] These levels correspond to those observed in the 20^{th} and 80^{th} percentiles of the distribution of this variable in our sample.

[8] It is worth noting at this point that the average duration of the *Reversion* phase is of 4 years throughout the sample.

4 Economic cost of commodity price cycles and its relationship to financial stability

To evaluate the cost that boom and bust events have on economic activity under different financial conditions, we estimate the following empirical model:

$$\Delta y_i = \alpha + X'\beta + Z'\delta + \varepsilon_i \tag{1}$$

where $X = \{1, err_i, kao_i, gov_i, cred_i\}$, Z are interactions between X and Δpc_i, and β and δ vectors of parameters to be estimated. Specifically:

- Δy_i and Δpc_i are the average annual percent change of real GDP and the commodity price index respectively, during either the *Upturn* (*Downturn*) of a boom (bust), or the *Reversion* of a boom;[9]
- err_i is the Reinhart and Rogoff (2004) exchange rate regime index;
- kao_i is the Chinn and Ito (2008) financial openness index;
- gov_i is the PWT government spending share in real GDP;
- $cred_i$ represents one of the three alternative measures of domestic credit conditions, as defined in Section 3.

Our work differs from Céspedes and Velasco (2012) in two main respects. First, while theirs focus on testing the general hypothesis that macroeconomic structure of the countries (exchange rate regime and financial openness) have a significant effect on the impact of changes in commodity prices on domestic activity during boom and bust events, ours controls for these factors and also evaluates the role of financial conditions to mitigating or aggravating the impact of commodity prices on GDP growth. The second difference is that, while their study considered all events within a single sample, in this study we emphasize the fact that not only there is an asymmetry between the different phases of an event, but also an asymmetry between event types. Furthermore, the response of GDP to different events and throughout each event type is also varying. Thus, we estimate the cost of boom and bust events on output separately. Additionally, and as discussed in the next section, we also differentiate between the phases within such events, particularly focusing on the boom *Reversion* phase given that many emerging commodity exporters are currently facing (or might be about to face) such an event.

[9] For instance, suppose that a boom is identified between 1977 and 1983. If the commodity price index reached a local maximum in year 1980, then Δpc_i during the *Upturn* phase will be the percent change between pc_i^{1980} and pc_i^{1977}, the latter being the commodity price index in the beginning of the event. For bust events, instead of considering pc_i^{1977} we use the average of pc_i in the *Previous* phase of the bust, as discussed in Section 3. Similarly, Δpc_i during the *Reversion* phase of boom that goes from 1977 to 1983 will be the percent change between pc_i^{1977} and pc_i^{1983}, the latter being the commodity price index in the end of the event. This calculations are analogous for the bust case. The dates used to calculate Δy_i are those defined by the behavior of the commodity price index, summarized in Tables 1 and 2.

As mentioned earlier, the unit of observation is a country-event, which is expanded according to the duration of such event. As a result, the number of observations in each regression is larger than the number of country-events, and allows for longer events to be more representative.

The results of our estimations are summarized in Tables 5 and 6, the latter being the same specifications but restricted to emerging economies only. In each table, the first set of estimated equations allows us to compare with Céspedes and Velasco (2012) as we estimate the above specification for the total number of events, regardless whether these are booms or busts. In particular, considering the results in Table 5 we find that a shock to commodity prices is related to economic activity but only through the interaction with the exchange rate regime index. In addition, the financial openness variable, when interacted with the commodity price variable, is also significant when the sub-sample of emerging economies is considered. Nevertheless, we argue that boom and bust events should be analyzed separately given the strong asymmetry in their behavior, so we now turn to these results.

Figure 8 shows the marginal effect of commodity prices on output, once the rest of the variables are held constant at their sample averages, for the case of the boom-only and bust-only regressions. We find that the direct relationship is significant, being stronger during bust events. Both exchange rate regime and financial openness help mitigate the impact of the shock on domestic activity, although the latter is significant during bust events only. These results hold as well in the sub-sample of emerging markets. Interestingly, government spending is no longer significant in bust-only regressions.

Considering the recently discussed results as the base scenario, we now turn to the specifications (2) and (3) that consider credit acceleration, on which we would like to highlight three main aspects, beginning with the boom events. First, and most importantly, domestic private credit acceleration during the boom *Upturn* phase results in real activity being more sensitive to commodity price shocks. This result holds in emerging markets as well. Second, the result is robust to the inclusion of the level of credit-to-GDP ratio at the beginning of the event. That is, the acceleration of credit increases the sensitivity of countries to commodity price shocks regardless of the initial level of credit. Third, a more flexible exchange rate regime mitigates the impact of commodity price shocks as was the case in the base scenario. Fourth, the interaction of commodity price changes and financial openness coefficient is now significant, and negative: that is, financial openness helps mitigate the impact of these shocks on the economy.

When only bust events are considered, the credit acceleration is significant also and with a much larger estimated coefficient. The result holds, and is even stronger, in the sub-sample of emerging markets. Nevertheless, there are a few reasons why we think it would be more appropriate to analyze the boom *Reversion* phase rather than the bust event. First, as it was mentioned earlier, the fact that many bust events do not have a *Downturn* phase because the minimum commodity price level is achieved immediately in the year where the event is identified, implied that a slightly different calculation had to be done to calculate price and output variations. Second, the current cycle is one in

which prices are reverting from a maximum level, rather than from a near-trend level. Third, all the estimated effects are more relevant for the emerging market sample. Then, for this group of countries, we estimate the same specification but observing the boom *Reversion* phase only.

When this is the case, credit acceleration is measured during the *Upturn* phase and the commodity price and output variations during the *Reversion* phase.[10] This again seems more relevant as a policy question, because we can learn what the sensitivity of an economy to commodity price shocks is when financial vulnerabilities build up during the booming phase. As Table 7 shows, for the case of emerging markets, it turns out that GDP growth is much more sensitive to changes in commodity prices during a boom *Reversion*. Interestingly, the exchange rate regime loses significance while financial openness still mitigates the impact of commodity price shocks.

To have an order of magnitude of the estimated results in the *Reversion* phase, Figure 9 compares the total impact of a fall of 13% in commodity prices for the total sample as well as for a representative emerging economy.[11] The latter has a a mixed exchange rate system (*rcc=2.6*), moderately-to-highly integrated to international financial markets (*kao=0.1*). We assume a zero acceleration of credit to be the baseline scenario, and compare it with the situation where prior to *Reversion*, credit acceleration was between 2 and 22% (annual average).[12] The effect of credit acceleration is significant in the emerging countries sample, as mentioned before: credit acceleration as large as 22% while running the boom in commodity prices, results in 4 percent points less of GDP growth.

The latter result is very interesting and has important policy implications. Considering the same representative emerging economy, we quantify the effects under two price shock scenarios, as shown in 10. One in which the economy faces a 5% drop in the commodity price index – which brings the index back to its long term average – and a second one in which the price decline not only ends the boom cycle but actually turns it into a bust cycle (8.5% drop). The milder shock results in an estimated reduction of GDP growth by 1.5 percent points. For the same representative emerging economy, a stronger decline in prices, would result in as much as 3 percent points less of growth. This loss is equivalent to the one that this economy would face in the milder commodity shock scenario had this economy experienced a 16 percent point acceleration in credit instead. In this case, of course, the stronger commodity shock also implies a larger output loss, of as much as 4 percent points of growth.

[10] More specifically, in this case Δy_i and Δpc_i for the average percentage change observed between the last year of the boom and the year when commodity prices peaked within the boom cycle. The initial credit conditions are thus evaluated at the peak of the cycle, as this is the beginning of the *Reversion* phase.

[11] This shock corresponds to the average annual decline observed in the sample during the boom *Reversion* of specification (2) of Table 7.

[12] These min-max range is the one observed in the highest 25^{th} percentile of our sample.

5 Conclusions

The objective of this paper is to test the hypothesis that the output loss due to a reversion in commodity prices may be higher for an economy that is already vulnerable because of domestic financial instability, measured by high domestic credit growth. We find that countries that experience a moderate increase in credit-to-GDP ratio during the *Upturn* of a boom cycle, experience a less costly *Reversion* in terms of GDP. This result holds regardless of the initial level of credit-to-GDP ratios. Analyzing the case of a representative emerging economy, we quantify that output loss can be between 1.5 percent points less of GDP growth if credit increase were moderate, versus 3 percent points if credit acceleration were high (for instance, 16 percent points of GDP). We conclude that credit booms may breed financial vulnerabilities that may in turn increase the output cost that results from the end of a commodity boom cycle.

The motivation for considering private credit growth has to do, first, with the fact that the current cycle of commodity boom has coexisted with an environment of high liquidity and rapid credit growth in most emerging economies, many of which have also shown signs of acceleration in prices of assets such as real estate. Recent empirical studies find that domestic financial vulnerabilities, such as rapid domestic credit growth would be a factor that could make external shocks more costly. Our work does not elaborate on the transmission channels through which domestic credit acts as a mitigating factor, but simply provides evidence about it. We control for endogeneity between credit growth and GDP, by considering the ratio of domestic credit on a measure of trend GDP instead of current GDP.

Our work differs from previous studies (Spatafora and Tytell, 2009; Céspedes and Velasco, 2012) in two main respects. First, we take into account the asymmetry between boom and bust events, both in length and intensity, and also within a each cycle. Thus, we estimate the correlation between output and commodity price dynamics during booms and busts as in separate samples. Second, we acknowledge the credit boom literature and the role played by financial stability as mitigating factors to the effect of external shocks on output dynamics. Therefore, while previous research focus on testing the general hypothesis that macroeconomic structure of the countries (exchange rate regime and financial openness) have a significant effect on the impact of changes in commodity prices during boom and bust events on domestic activity, ours not only controls for these factors, but also explicitly evaluates the role of credit acceleration.

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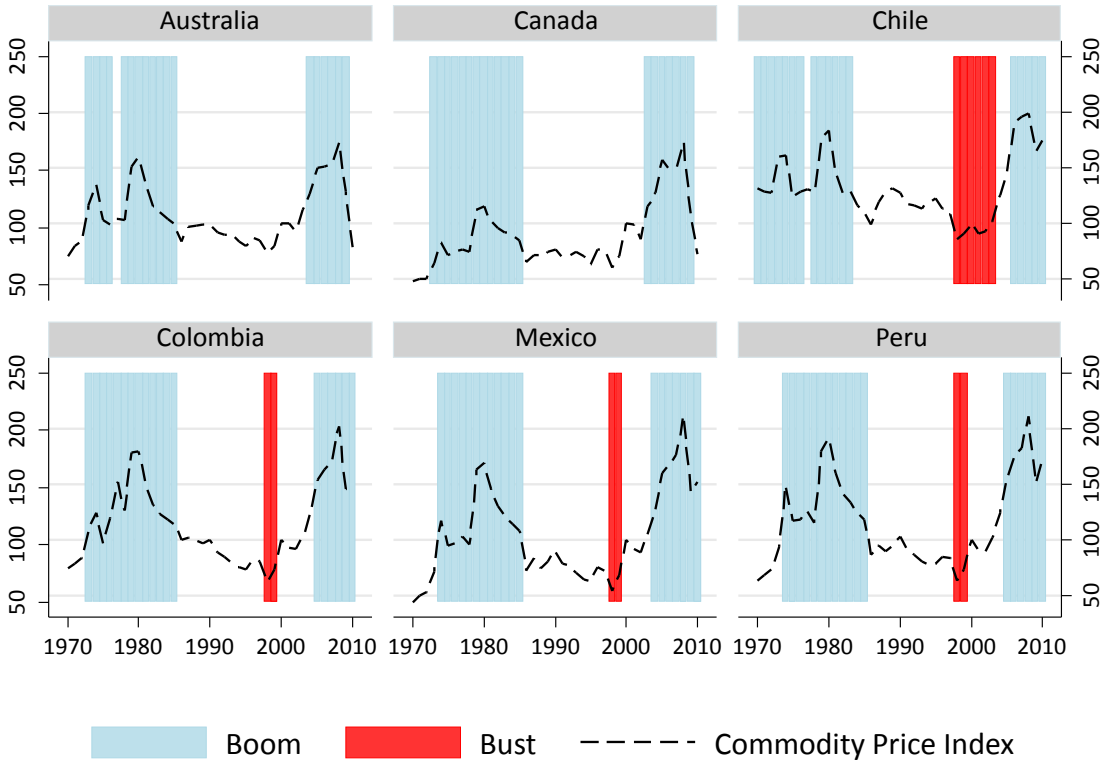
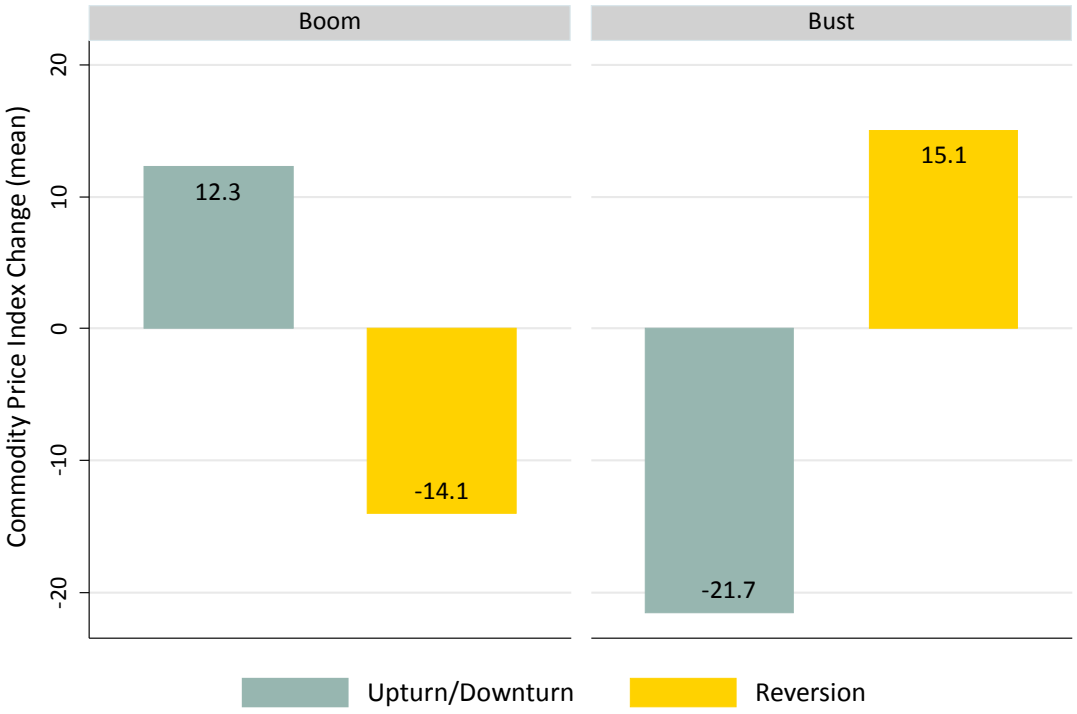
Figure 1: Commodity Price Index and Identified Events



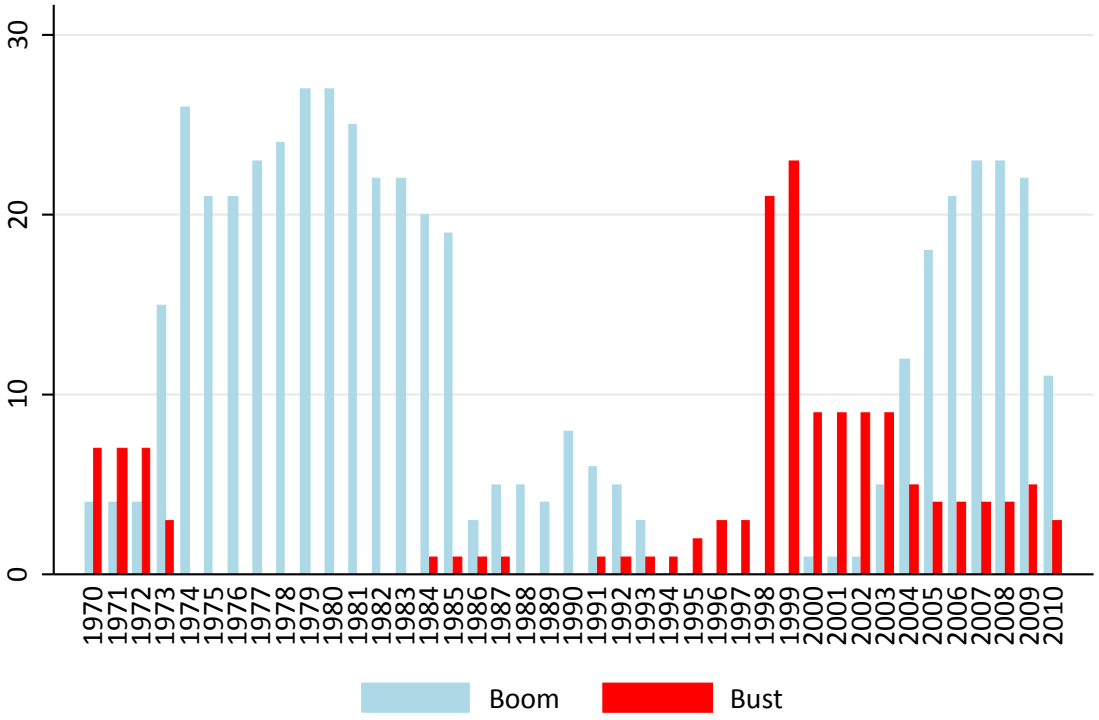
The figure shows the evolution of the commodity price indexes provided by Céspedes and Velasco (2011) for a subsample of countries chosen from our data. Boom and bust events are the ones identified by the authors according to the methodology explained in Section 2.

Figure 2: Commodity Price Index During Boom and Bust Events



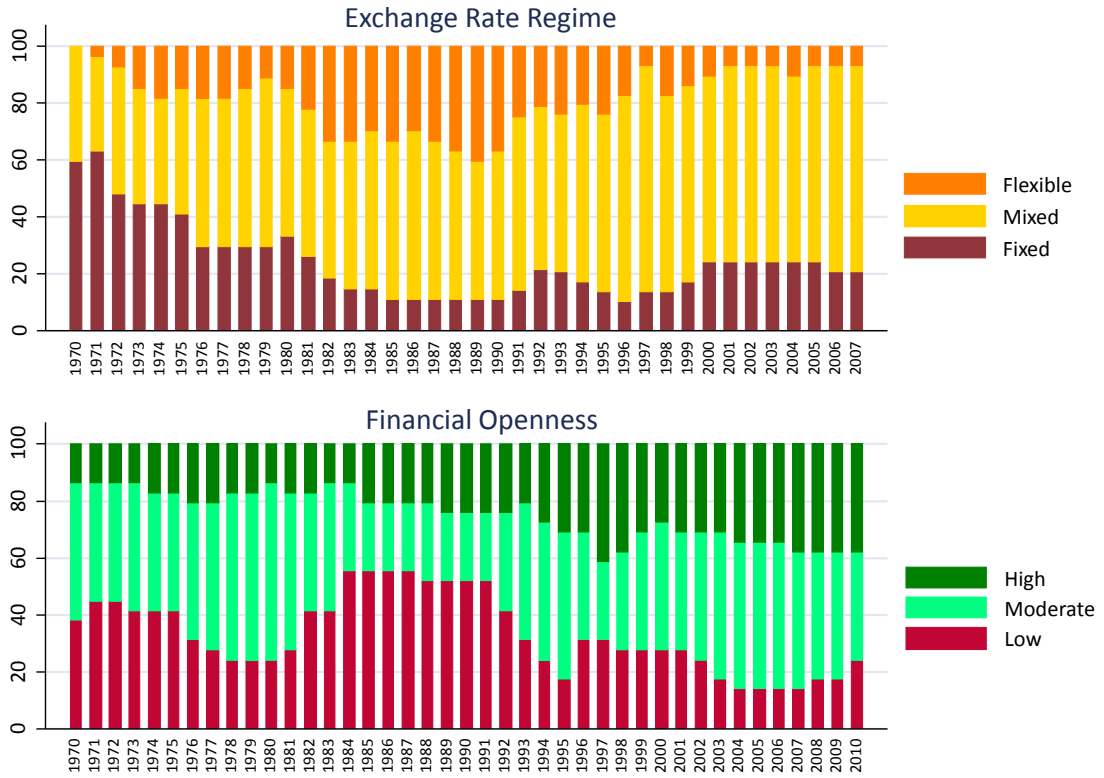
The figure shows the mean across the sample of the average annual percentage change of commodity price indexes provided by Céspedes and Velasco (2011), calculated over the duration of each phase.

Figure 3: Number of Countries Experiencing Commodity Price Boom and Bust Events



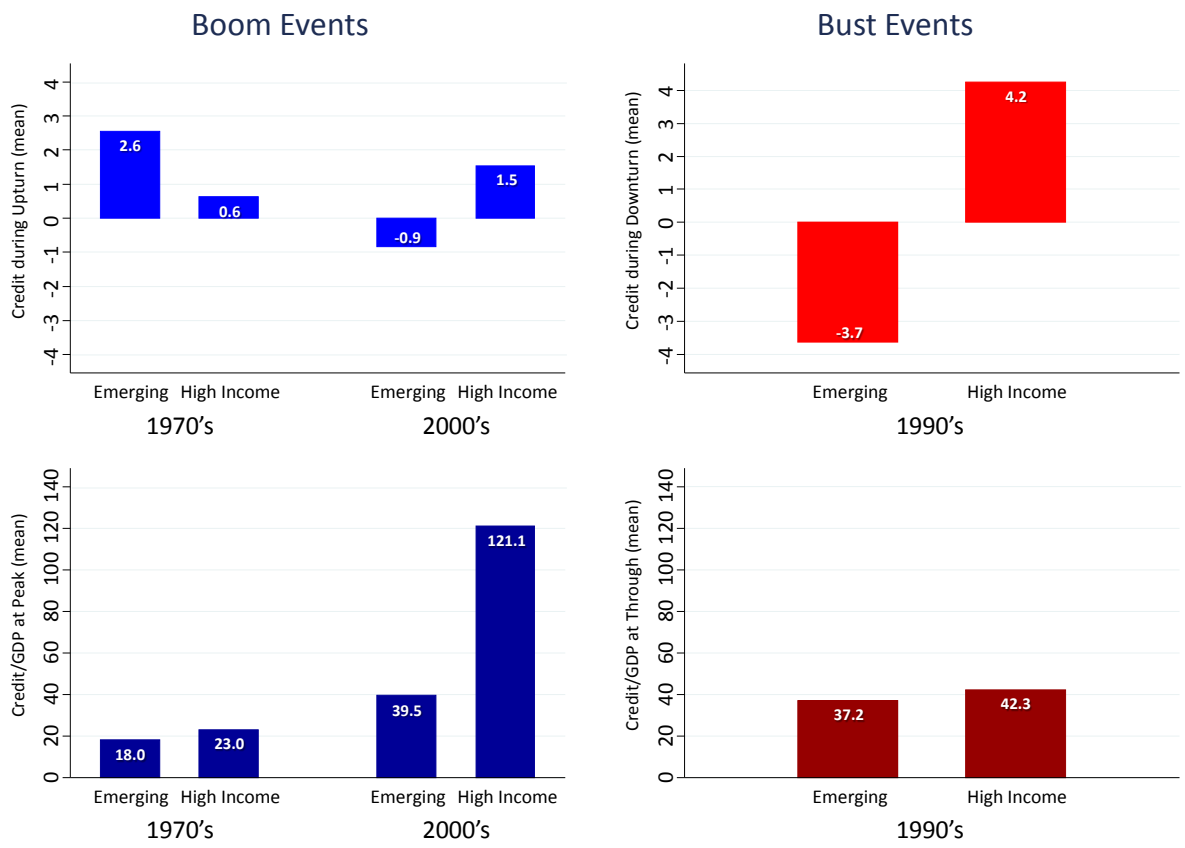
The figure shows the sum of all countries experiencing boom or bust events at each year. Given that events last longer than a year, countries are counted repeatedly during consecutive years since the beginning until the end of each event that it experiences.

Figure 4: Number of Countries with Different Exchange Rate Regimes and Financial Openness Degrees



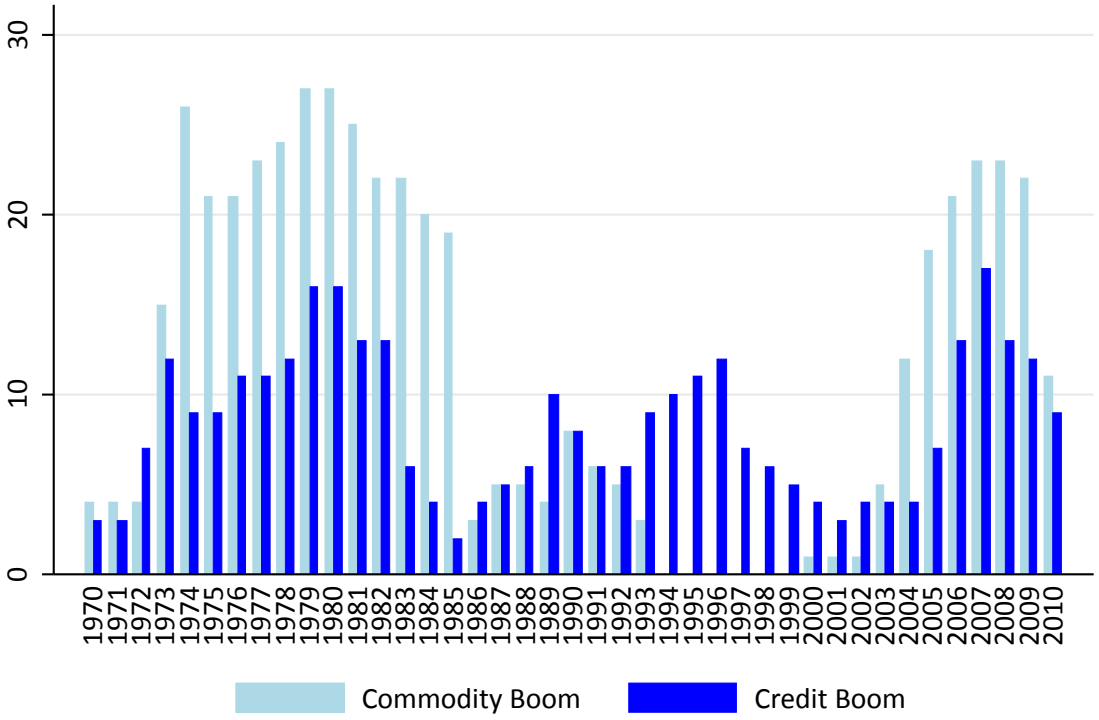
The figure shows the number of countries as a percentage of the total, under different exchange rate regimes and financial openness degrees at each year according to Reinhart and Rogoff (2004) and Chinn and Ito (2008), respectively. In particular, the exchange rate regime classification of Reinhart and Rogoff (2004) – which is the IMF official coarse classification – is aggregated in order to make it easier for the reader to interpret. In our aggregation, ***Fixed*** corresponds to regimes reported as no separate legal tender, pre announced peg or currency board arrangement, pre announced horizontal band that is narrower than or equal to +/-2, *De facto* peg, or dual market to which parallel market data is missing. ***Mixed*** consists of regimes reported as pre announced crawling peg, pre announced crawling band that is narrower than or equal to +/-2, *De facto* crawling peg, *De facto* crawling band that is narrower than or equal to +/-2, pre announced crawling band that is wider than or equal to +/-2, *De facto* crawling band that is narrower than or equal to +/-5, moving band that is narrower than or equal to +/-2 (i.e., allows for both appreciation and depreciation over time), and managed floating. ***Flexible*** are those regimes that allow for free floating or free falling. Financial openness classification according to and aggregated as in Chinn and Ito (2008). Particularly, when the Chinn-Ito index of a country in a year is above the 75^{th} percentile of the full sample, i.e. cross-section and time-series, it is considered to have ***High*** financial openness; whereas when it is bellow the 25^{th} percentile of the full sample it is considered to have ***Low*** financial openness; otherwise, it is shown as ***Moderate***.

Figure 5: Financial Conditions During Events



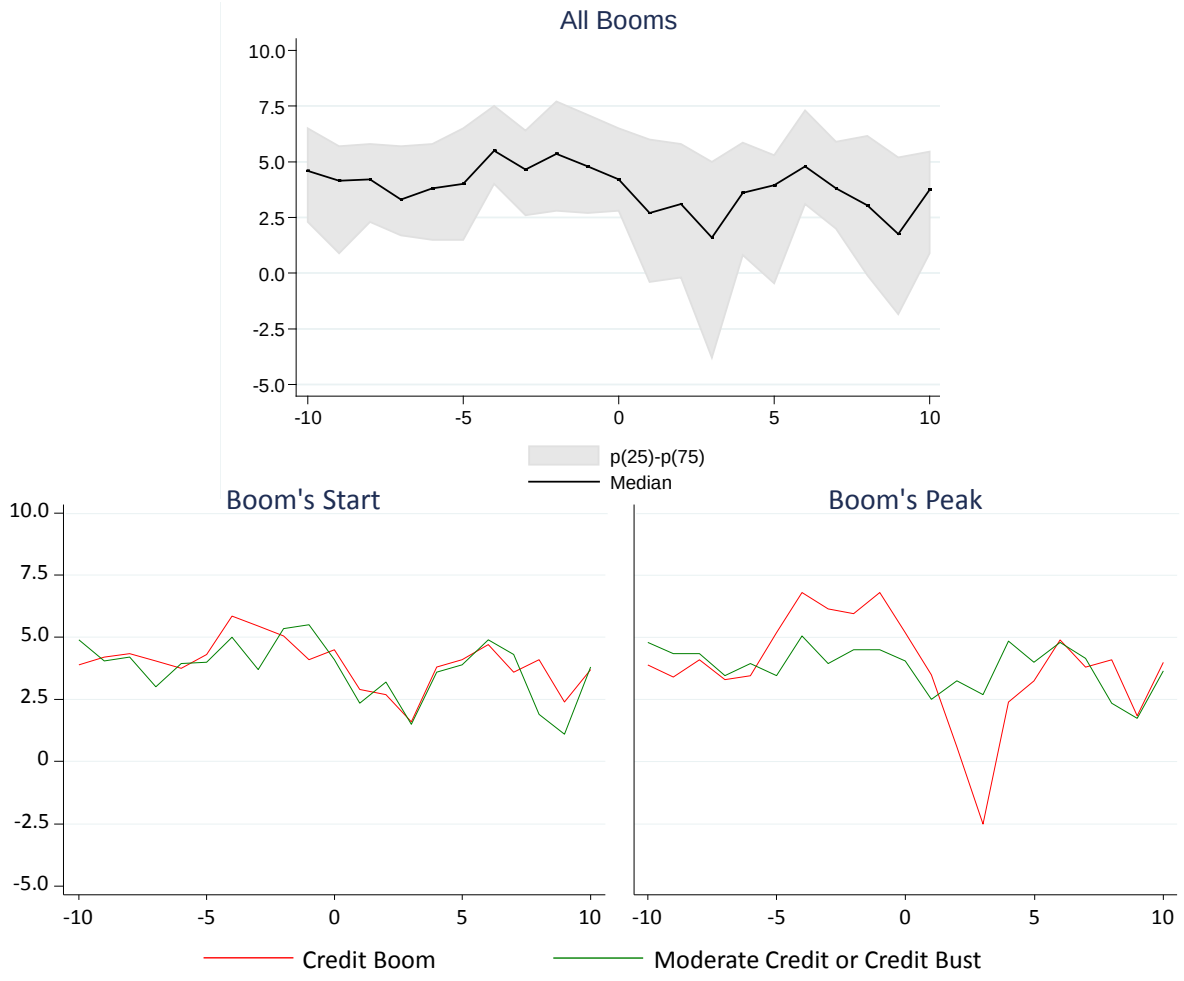
The figure shows basic descriptive statistics of credit-to-GDP ratio across the sample during the periods that concentrated boom and bust events (1970s and 2000s for booms, and 1990s for busts). Top panels indicate the sample mean of the average annual change on credit-to-GDP ratio over different economic classification, in percent points of GDP. Bottom panels indicate the sample mean of credit-to-GDP ratios at the turning points of the events (boom's peak and bust's through) over different economic classification, in percentage.

Figure 6: Number of Countries Experiencing Commodity Price and Credit Boom Events



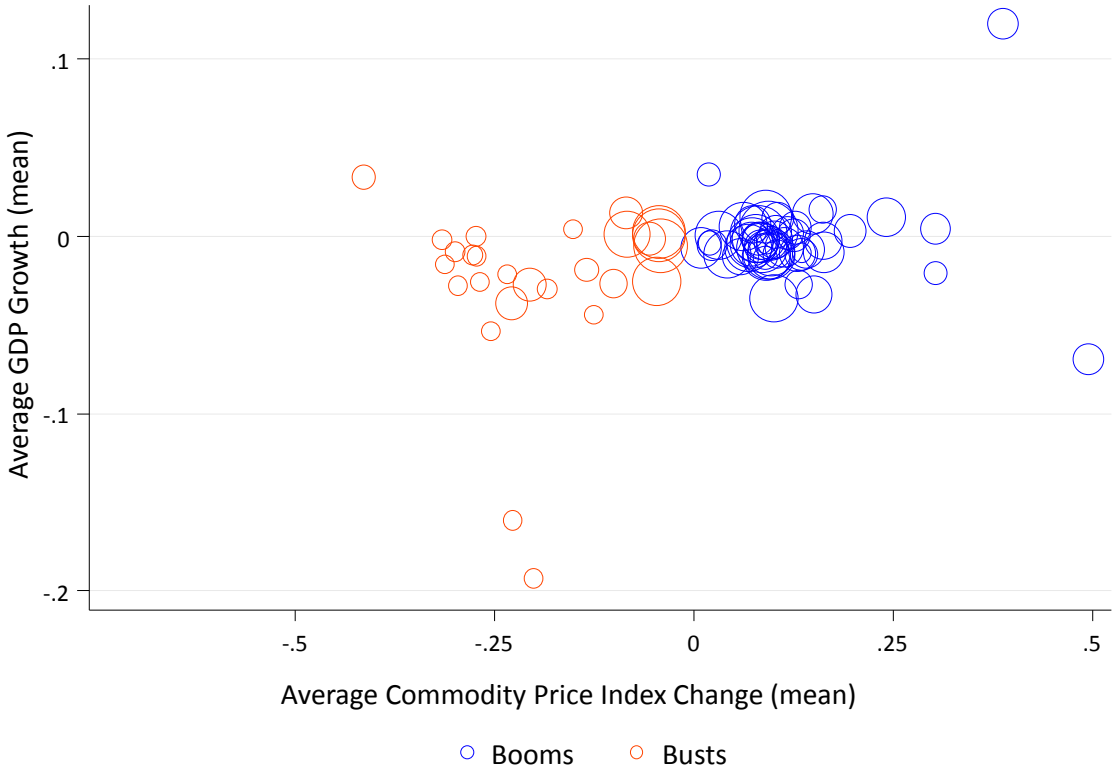
The figure shows the sum of all countries under boom events at each year. Given that events last longer than a year, countries are counted repeatedly during consecutive years since the beginning until the end of each event that it experiences.

Figure 7: GDP Growth Dynamics Around Event's Turning Points



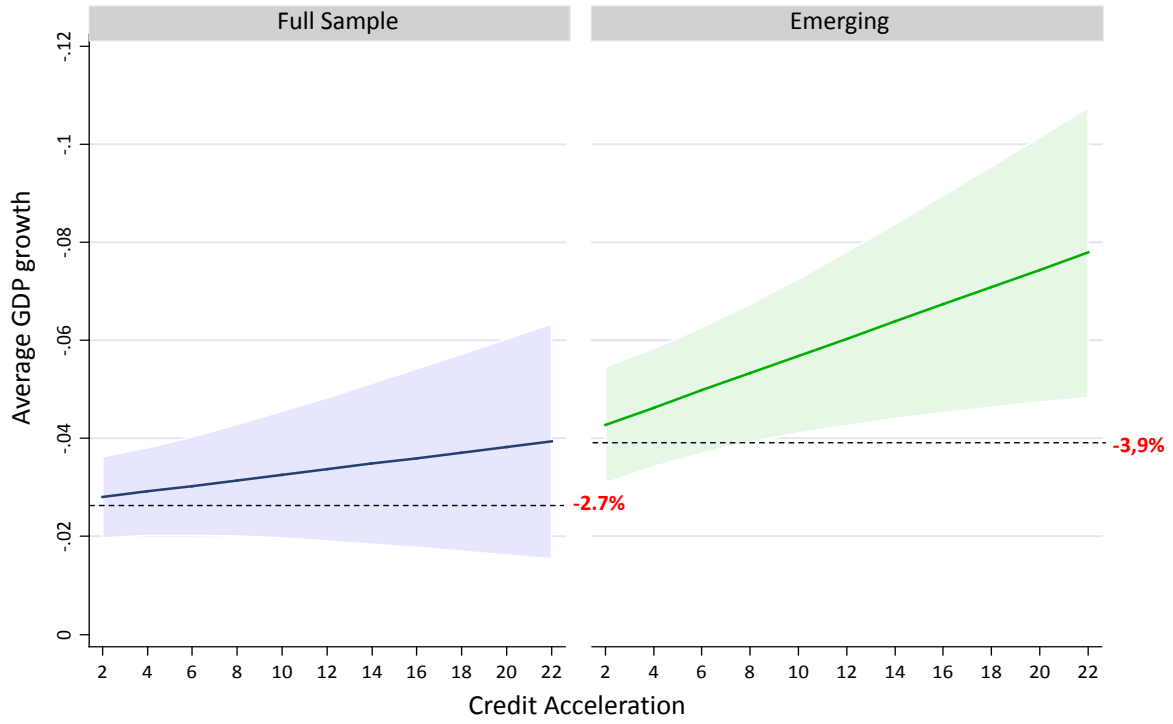
The figure shows the median of growth the GDP trend in percentages around the peak of boom events ± 10 years. In the case of the top panel, the range between the 25^{th} and 75^{th} percentiles is shown as shaded area area. The bottom panels show the median of the GDP growth of those countries experiencing a credit boom (or not) at the beginning of the event (left hand side chart) and at the peak of the event (right hand side chart).

Figure 8: GDP Growth and Commodity Price Index Basic Relationship, by Event Types



The figure shows the association between the average GDP growth (vertical axis) and the average annual change of commodity price index (horizontal axis) during the *Upturn* and *Downturn* phases of boom (blue markers) and busts (orange markers), respectively. The size of the Markers indicates the duration of each event.

Figure 9: Average Marginal Effect of Commodity Price Index during *Reversion* Under Different Credit Acceleration Scenarios

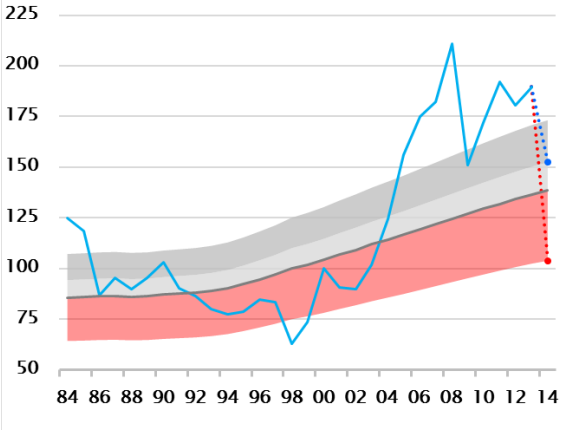


The figure shows the effect of commodity prices on output under different credit scenarios, ceteris paribus the other variables considered in Equation 1. That is, it evaluates $\frac{\partial(\Delta y_i)}{\partial(\Delta pc_i)} = \beta_1 + \beta_2\overline{err_i} + \beta_3\overline{kao_i} + \beta_4 cred_i$ (vertical axis) for different levels of $cred_i$ (horizontal axis). The dashed horizontal line represents the baseline scenario, i.e. where $cred_i = 0$. More specifically, the sample averages of levels of the variables different from $cred_i$ in Equation 1 are as follows:

	err_i	kao_i
Full Sample	2.5	0.3
Only Emerging	2.6	0.1

Left hand side panel evaluates scenarios for the entire sample. Right hand side panel shows evaluation for sub sample of emerging economies.

Figure 10: Commodity Price Marginal Change Scenarios for a Representative Emerging Country



The figure shows the evolution and projection of the commodity price index for a representative emerging economy based on the actual case of Chile, Colombia, Peru and Mexico. Light gray area corresponds to the long term trend plus 10%. Dark gray corresponds to the long term trend plus 25%. These gray areas represent the tolerance ranges to avoid the ignition of a boom. Red area corresponds to the long term trend minus 25% and indicates the tolerance range to avoid the ignition of a bust.

Table 1: List of Identified Boom Events

	Country	Start	Peak	End	Duration		Country	Start	Peak	End	Duration
1	Argentina	1973	1973	1974	1	34	India	1987	1987	1988	1
2	Argentina	1977	1980	1985	8	35	India	2006	2008	2009	3
3	Argentina	2004	2008	2009	5	36	Mexico	1974	1980	1985	11
4	Australia	1973	1974	1976	3	37	Mexico	2004	2008	2010	6
5	Australia	1978	1980	1985	7	38	Malaysia	1974	1980	1985	11
6	Australia	2004	2008	2009	5	39	Malaysia	2003	2008	2009	6
7	Bolivia	1973	1980	1985	12	40	Nigeria	1974	1980	1985	11
8	Bolivia	2003	2008	2009	6	41	Nigeria	1990	1990	1991	1
9	Brazil	1973	1980	1981	8	42	Nigeria	2005	2008	2010	5
10	Brazil	2007	2008	2008	1	43	Norway	1974	1980	1990	16
11	Canada	1973	1980	1985	12	44	Norway	2004	2008	2010	6
12	Canada	2003	2008	2009	6	45	New Zealand	1970	1973	1974	4
13	Chile	1970	1974	1976	6	46	New Zealand	1977	1980	1985	8
14	Chile	1978	1980	1983	5	47	New Zealand	1987	1987	1993	6
15	Chile	2006	2008	2010	4	48	New Zealand	2003	2008	2009	6
16	Cameroon	1974	1979	1985	11	49	Peru	1974	1980	1985	11
17	Cameroon	2005	2008	2010	5	50	Peru	2005	2008	2010	5
18	Colombia	1973	1980	1985	12	51	Paraguay	1973	1973	1974	1
19	Colombia	2005	2008	2010	5	52	Paraguay	1979	1980	1981	2
20	Costa Rica	1977	1977	1980	3	53	Saudi Arabia	1974	1980	1985	11
21	Denmark	1970	1980	1985	15	54	Saudi Arabia	1990	1990	1992	2
22	Denmark	2005	2008	2010	5	55	Saudi Arabia	2004	2008	2010	6
23	Dominican Republic	1973	1974	1977	4	56	Trinidad & Tobago	1974	1980	1987	13
24	Ecuador	1974	1980	1985	11	57	Trinidad & Tobago	1990	1990	1993	3
25	Ecuador	2005	2008	2010	5	58	Trinidad & Tobago	2000	2008	2009	9
26	Ghana	1977	1980	1984	7	59	Uruguay	1970	1973	1974	4
27	Ghana	2007	2009	2009	2	60	Uruguay	1979	1980	1981	2
28	Guatemala	1973	1974	1974	1	61	Uruguay	1988	1988	1993	5
29	Guatemala	1976	1977	1980	4	62	Venezuela	1974	1980	1985	11
30	Indonesia	1974	1980	1985	11	63	Venezuela	1990	1990	1992	2
31	Indonesia	2004	2008	2009	5	64	Venezuela	2004	2008	2010	6
32	India	1973	1974	1975	2	65	South Africa	1973	1980	1990	17
33	India	1979	1980	1983	4	66	South Africa	2006	2008	2009	3

Table 2: List of Identified Bust Events

	Country	Start	Through	End	Duration
1	Argentina	1998	1998	1999	1
2	Bolivia	1998	1998	1999	1
3	Brazil	1998	1998	2003	5
4	Chile	1998	1998	2003	5
5	Cameroon	1998	1998	1999	1
6	Colombia	1998	1998	1999	1
7	Costa Rica	1996	2003	2009	13
8	Denmark	1998	1998	1999	1
9	Dominican Republic	1984	1985	1987	3
10	Dominican Republic	1995	2003	2010	15
11	Ecuador	1998	1998	1999	1
12	Ghana	1970	1970	1972	2
13	Ghana	1998	2001	2003	5
14	Guatemala	1991	1999	2004	13
15	Honduras	1999	2003	2009	10
16	Indonesia	1970	1971	1972	2
17	Indonesia	1998	1998	1999	1
18	India	1970	1971	1972	2
19	India	1998	1999	2003	5
20	Mexico	1998	1998	1999	1
21	Malaysia	1998	1998	1999	1
22	Nigeria	1970	1970	1972	2
23	Nigeria	1998	1998	1999	1
24	Norway	1998	1998	1999	1
25	Peru	1998	1998	1999	1
26	Paraguay	1999	2000	2010	11
27	Saudi Arabia	1970	1970	1973	3
28	Saudi Arabia	1998	1998	1999	1
29	Trinidad & Tobago	1970	1970	1973	3
30	Uruguay	2009	2009	2010	1
31	Venezuela	1970	1970	1973	3
32	Venezuela	1998	1998	1999	1

Table 3: Descriptive Statistics: Boom Events

	y_i		Δy_i		Duration			Number of
	Upturn	*Reversion*	*Upturn*	*Reversion*	*Total*	*Upturn*	*Reversion*	Events
Exchange Rate Regime								
Peg	5.71 (6.16)	2.31 (2.2)	-0.49 (-0.26)	-1.16 (-1.04)	7.68 (6)	3.68 (3)	3 (2)	19
	[1.66, 9.71]	[-4.41, 9.15]	[-3.5, 1.46]	[-12.25, 7.96]	[2, 16]	[0, 10]	[0, 6]	
Bands	5.61 (6.74)	3.71 (3.36)	0.32 (-0.04)	-0.57 (0.01)	6.14 (6)	2.86 (2)	2.29 (1.5)	14
	[-0.02, 9.45]	[-3.3, 9.63]	[-6.89, 11.97]	[-6, 5.66]	[2, 13]	[0, 8]	[0, 5]	
Managed	4.88 (4.5)	1.72 (1.89)	-0.19 (-0.39)	-1.17 (0.01)	7.58 (7)	3.63 (4)	2.95 (2)	19
	[1.44, 13.09]	[-4.39, 8.54]	[-1.18, 3.46]	[-13.5, 2.17]	[2, 18]	[0, 7]	[0, 10]	
Free Float	4.25 (4.25)	-0.09 (-0.09)	-0.54 (-0.54)	-3.78 (-3.78)	5 (5)	3 (3)	1 (1)	2
	[3.59, 4.92]	[-1.54, 1.37]	[-0.99, -0.09]	[-5.16, -2.41]	[4, 6]	[2, 4]	[1, 1]	
Free Fall	4.04 (3.3)	1.05 (-1.59)	-0.62 (-0.76)	0.26 (-0.06)	8.8 (9)	3.8 (3)	4 (5)	5
	[2.18, 7.73]	[-2.43, 5.67]	[-1.02, 0.08]	[-2.35, 2.72]	[2, 13]	[0, 7]	[1, 5]	
Other	6.98 (6.98)	-0.89 (-0.89)	-2.14 (-2.14)	-1.72 (-1.72)	9.5 (9.5)	5 (5)	3.5 (3.5)	2
	[3.45, 10.5]	[-2.35, 0.56]	[-3.25, -1.03]	[-3.38, -0.06]	[7, 12]	[4, 6]	[2, 5]	
Economic Classification								
High Income	3.76 (3.04)	0.96 (1.65)	-0.34 (-0.25)	-1.11 (0.11)	8.38 (7)	3.94 (4)	3.44 (2)	16
	[-0.02, 9.69]	[-4.41, 6.87]	[-3.5, 1.46]	[-12.25, 1.18]	[3, 17]	[0, 10]	[1, 10]	
Emerging	5.55 (5.74)	2.41 (2.45)	-0.23 (-0.42)	-0.98 (-0.34)	6.94 (6)	3.22 (3)	2.72 (2)	50
	[-0.43, 13.09]	[-4.39, 9.63]	[-6.89, 11.97]	[-13.5, 7.96]	[2, 18]	[0, 8]	[0, 10]	
Credit over GDP								
Boom	4.92 (4.04)	1.72 (1.48)	-0.12 (-0.69)	-1.22 (-0.32)	6.52 (6)	3.04 (2)	3.1 (2.5)	23
	[0.75, 13.09]	[-4.41, 8.54]	[-6.89, 11.97]	[-12.25, 4.35]	[2, 13]	[0, 7]	[0, 7]	{30}
Bust	6.41 (6.47)	-0.75 (-2.77)	-0.93 (-0.58)	-1.43 (-0.2)	6.2 (7)	3.2 (4)	2 (2)	5
	[2.18, 10.5]	[-3.98, 7.9]	[-3.25, 0.69]	[-6, 2.04]	[3, 8]	[0, 5]	[1, 4]	{5}
Moderate	5.07 (5.33)	2.81 (2.63)	-0.27 (-0.19)	-0.74 (-0.23)	7.89 (7)	3.63 (3.5)	2.84 (2)	38
	[-0.43, 9.71]	[-4.39, 9.63]	[-3.5, 1.23]	[-13.5, 7.96]	[2, 18]	[0, 10]	[0, 10]	{31}
Financial Openness								
High	5.09 (4.61)	0.94 (1.54)	-0.5 (-0.45)	-0.96 (-0.92)	7.57 (7)	3.79 (3.5)	2.79 (2)	14
	[1.52, 9.69]	[-4.41, 6.87]	[-3.5, 0.99]	[-6, 1.22]	[3, 13]	[0, 8]	[1, 6]	
Low	4.7 (3.97)	2.55 (2.35)	-0.48 (-1.01)	-0.57 (0.18)	5.68 (5)	2.53 (2)	2.16 (1)	19
	[0.75, 9.45]	[-4.39, 9.63]	[-6.89, 11.97]	[-13.5, 7.96]	[2, 13]	[0, 7]	[0, 5]	
Moderate	5.36 (5.63)	2.25 (2.54)	-0.06 (-0.17)	-1.29 (-0.69)	8.09 (7)	3.73 (4)	3.36 (2)	33
	[-0.43, 13.09]	[-3.12, 8.54]	[-3.25, 3.46]	[-6.35, 2.62]	[2, 18]	[0, 10]	[0, 10]	
TOTAL	5.11 (4.93)	2.05 (2.25)	-0.26 (-0.4)	-1.01 (-0.26)	7.29 (6)	3.39 (3)	2.89 (2)	
	[-0.43, 13.09]	[-4.41, 9.63]	[-6.89, 11.97]	[-13.5, 7.96]	[2, 18]	[0, 10]	[0, 10]	

The table shows the basic statistics for GDP growth at different phases of booms, according to country classifications and financial conditions. Main statistic is the mean across the sample. In parenthesis, the median. Within brakes, the min-max range. For the particular case of financial conditions, the last column of the table indicates the number of commodity boom events that coincide with a credit boom or bust at the beginning and the peak of each commodity boom; the latter, indicated within { }. Exchange rate regime aggregated in this table according to Reinhart and Rogoff (2004) and the IMF official coarse classification. *Peg* considers no separate legal tender, pre announced peg or currency board arrangement, pre announced horizontal band that is narrower than or equal to +/-2, and *De facto* peg. *Bands* considers pre announced crawling peg, pre announced crawling band that is narrower than or equal to +/-2, *De facto* crawling peg, and *De facto* crawling band that is narrower than or equal to +/-2. *Managed* considers pre announced crawling band that is wider than or equal to +/-2, *De facto* crawling band that is narrower than or equal to +/-5, moving band that is narrower than or equal to +/-2 (i.e., allows for both appreciation and depreciation over time), and managed floating. Other considers those dual markets in which parallel market data is missing. Financial openness classification according to and aggregated as in Chinn and Ito (2008). Particularly, when the Chinn-Ito index of a country in a year is above the 75^{th} percentile of the full sample, i.e. cross-section and time-series, it is considered to have *High* financial openness; whereas when it is bellow the 25^{th} percentile of the full sample it is considered to have *Low* financial openness; otherwise, it is shown as *Moderate*.

Table 4: Descriptive Statistics: Bust Events

	y_i		Δy_i		Duration			Nbr of
	Downturn	*Reversion*	*Downturn*	*Reversion*	*Total*	*Downturn*	*Reversion*	Events
Exchange Rate Regime								
Peg	3.34 (3.34)	4.52 (2.33)	-1.25 (-1.02)	-3.42 (-2.89)	2.88 (3)	0.13 (0)	1.75 (1.5)	8
	[1.64, 5.04]	[-3.39, 23.02]	[-2.97, -0.01]	[-7.24, -0.65]	[2, 4]	[0, 1]	[1, 3]	
Bands	2.6 (2.98)	2.54 (3.1)	-1.16 (-0.56)	-0.76 (-0.13)	7.91 (6)	2.64 (1)	4.27 (5)	11
	[-2.41, 7.32]	[-5.97, 6.6]	[-5.35, 1.33]	[-6.26, 1.76]	[2, 16]	[0, 8]	[1, 10]	
Managed	3 (2.96)	3.26 (3.8)	-1.32 (-1.9)	0.06 (-0.26)	3.38 (2.5)	0.63 (0)	1.75 (1)	8
	[-0.43, 7]	[-4.2, 7.88]	[-3.78, 3.34]	[-4.77, 6.12]	[2, 6]	[0, 3]	[1, 5]	
Free Float	-7.36 (-7.36)	6.14 (6.14)	-16.02 (-16.02)	13.5 (13.5)	2 (2)		1 (1)	1
	[-7.36, -7.36]	[6.14, 6.14]	[-16.02, -16.02]	[13.5, 13.5]	[2, 2]		[1, 1]	
Free Fall	-5.51 (-5.51)	-2.75 (-2.75)	-10.21 (-10.21)	2.75 (2.75)	2 (2)		1 (1)	2
	[-13.13, 2.11]	[-6.3, 0.79]	[-19.3, -1.11]	[-8.41, 13.92]	[2, 2]		[1, 1]	
Other								0
Economic Classification								
High Income	2.56 (2.68)	6.71 (2.29)	-1.19 (-0.86)	-1.28 (-0.66)	2.5 (2)		1.5 (1)	4
	[2.16, 2.83]	[-0.75, 23.02]	[-2.56, -0.15]	[-3.58, 0.4]	[2, 4]		[1, 3]	
Emerging	1.77 (2.7)	2.7 (3.51)	-2.73 (-1.75)	0.32 (-0.13)	4.96 (3)		2.71 (1.5)	28
	[-13.13, 7.32]	[-6.3, 8.89]	[-19.3, 3.34]	[-8.41, 13.92]	[2, 16]		[1, 10]	
Credit over GDP								
Boom	2.89 (3.59)	2.03 (0.91)	-1.24 (0.01)	-1.42 (-1.24)	5.25 (4)	1.75 (1.5)	2.67 (1)	4
	[-0.66, 5.03]	[0.43, 4.76]	[-5.35, 0.37]	[-4.6, 1.57]	[2, 11]	[0, 4]	[1, 6]	{3}
Bust	-1.3 (0.04)	5.56 (3.87)	-5.37 (-2.64)	2.16 (0.22)	3.29 (3)	0.14 (0)	2.14 (2)	7
	[-13.13, 4.91]	[-6.3, 23.02]	[-19.3, -1.05]	[-8.41, 13.92]	[2, 6]	[0, 1]	[1, 5]	{7}
Moderate	2.5 (2.76)	2.61 (3.19)	-2.08 (-1.75)	-0.14 (-0.14)	5 (3)	1.29 (0)	2.68 (1)	21
	[-7.36, 7.32]	[-5.97, 8.89]	[-16.02, 3.34]	[-7.24, 13.5]	[2, 16]	[0, 8]	[1, 10]	{22}
Financial Openness								
High	1.94 (2.42)	3.41 (1.47)	-2.73 (-2.79)	-1.33 (-0.66)	2.25 (2)		1.25 (1)	8
	[-0.66, 3.85]	[-5.97, 23.02]	[-5.35, -0.15]	[-7.24, 6.48]	[2, 4]		[1, 3]	
Low	2.7 (2.44)	3.23 (4.06)	-1.5 (-2.03)	-0.08 (0.01)	4.1 (3.5)	0.6 (0)	2.5 (2)	10
	[-0.43, 7.32]	[-4.2, 8.8]	[-3.78, 1.33]	[-4.77, 6.12]	[2, 6]	[0, 3]	[1, 5]	
Moderate	1.24 (3.58)	3.06 (3.57)	-3.17 (-0.8)	1.16 (-0.46)	6.43 (3.5)	2.07 (0)	3.36 (2)	14
	[-13.13, 7]	[-6.3, 7.88]	[-19.3, 3.34]	[-8.41, 13.92]	[2, 16]	[0, 8]	[1, 10]	
TOTAL	1.85 (2.68)	3.2 (3.19)	-2.56 (-1.62)	0.15 (-0.14)	4.66 (3)	1.09 (0)	2.56 (1)	
	[-13.13, 7.32]	[-6.3, 23.02]	[-19.3, 3.34]	[-8.41, 13.92]	[2, 16]	[0, 8]	[1, 10]	

The table shows the basic statistics for GDP growth at different phases of busts, according to country classifications and financial conditions. Main statistic is the mean across the sample. In parenthesis, the median. Within brakes, the min-max range. For the particular case of financial conditions, the last column of the table indicates the number of commodity bust events that coincide with a credit boom or bust at the beginning and the through of each commodity bust; the latter, indicated within { }. Exchange rate regime aggregated in this table according to Reinhart and Rogoff (2004) and the IMF official coarse classification. *Peg* considers no separate legal tender, pre announced peg or currency board arrangement, pre announced horizontal band that is narrower than or equal to +/-2, and *De facto* peg. *Bands* considers pre announced crawling peg, pre announced crawling band that is narrower than or equal to +/-2, *De facto* crawling peg, and *De facto* crawling band that is narrower than or equal to +/-2. *Managed* considers pre announced crawling band that is wider than or equal to +/-2, *De facto* crawling band that is narrower than or equal to +/-5, moving band that is narrower than or equal to +/-2 (i.e., allows for both appreciation and depreciation over time), and managed floating. Other considers those dual markets in which parallel market data is missing. Financial openness classification according to and aggregated as in Chinn and Ito (2008). Particularly, when the Chinn-Ito index of a country in a year is above the 75^{th} percentile of the full sample, i.e. cross-section and time-series, it is considered to have *High* financial openness; whereas when it is bellow the 25^{th} percentile of the full sample it is considered to have *Low* financial openness; otherwise, it is shown as *Moderate*.

Table 5: OLS Estimation Results: Commodity Price Index Effect on GDP During the First Stage of the Events, Full Sample

	All events					*Only booms*					*Only busts*				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Δpc_i	-0.050	-0.008	-0.001	-0.044	-0.046	0.060	0.230	0.232	0.048	0.059	0.399	0.470	0.318	0.649	0.378
	(1.01)	(0.15)	(0.02)	(0.98)	(0.95)	(1.04)	(3.48)***	(3.49)***	(1.13)	(1.03)	(2.17)**	(2.86)***	(2.07)**	(2.93)***	(2.13)**
err_i	-0.008	-0.008	-0.007	-0.008	-0.007	0.000	0.004	0.005	0.001	0.000	-0.055	-0.070	-0.051	-0.088	-0.053
	(3.14)***	(2.93)***	(2.73)***	(3.13)***	(2.83)***	(0.08)	(2.14)**	(2.24)**	(0.56)	(0.08)	(2.49)**	(3.56)***	(2.39)**	(3.22)***	(2.33)**
$\Delta pc_i * err_i$	0.046	0.040	0.035	0.046	0.041	-0.024	-0.059	-0.060	-0.032	-0.024	-0.139	-0.189	-0.144	-0.272	-0.144
	(2.05)**	(1.69)*	(1.56)°	(2.02)**	(1.80)*	(1.74)*	(2.70)***	(2.75)***	(2.40)**	(1.75)*	(1.58)°	(2.38)**	(2.00)**	(2.55)**	(1.72)*
kao_i	-0.002	-0.001	-0.001	-0.002	-0.002	0.001	0.007	0.008	0.000	0.001	-0.025	-0.033	-0.022	-0.029	-0.024
	(2.04)**	(1.67)*	(0.70)	(2.09)**	(2.43)**	(0.49)	(3.80)***	(4.02)***	(0.27)	(0.54)	(3.43)***	(4.87)***	(2.63)***	(3.61)***	(3.11)***
$\Delta pc_i * kao_i$	0.010	-0.009	-0.005	0.006	0.013	-0.010	-0.081	-0.082	-0.002	-0.011	-0.094	-0.113	-0.058	-0.109	-0.075
	(0.90)	(0.86)	(0.43)	(0.99)	(1.13)	(0.46)	(3.69)***	(3.74)***	(0.17)	(0.47)	(3.55)***	(4.63)***	(1.92)*	(3.83)***	(2.41)**
gov_i	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.04)	(0.02)	(0.03)	(0.00)
	(4.56)***	(4.88)***	(4.95)***	(4.15)***	(4.36)***	(4.41)***	(2.99)***	(3.05)***	(4.50)***	(4.31)***	(0.37)	(4.09)***	(1.34)	(2.68)***	(0.74)
$cred_i$		0.000	0.000				-0.001	-0.001				0.012	0.008		
		(0.02)	(1.68)*				(4.75)***	(3.85)***				(5.37)***	(3.62)***		
$\Delta pc_i * cred_i$		0.005	0.004				0.009	0.009				0.047	0.032		
		(4.70)***	(3.82)***				(6.63)***	(6.36)***				(4.45)***	(3.64)***		
$Previous\ \frac{C}{Y}$			0.000					0.000					-0.001		
			(3.63)***					(1.94)*					(4.15)***		
D_i^{CB}				0.005					-0.007					0.057	
				(0.87)					(1.22)					(5.24)***	
$\Delta pc_i * D_i^{CB}$				-0.033					0.047					0.282	
				(0.52)					(0.71)					(4.68)***	
D_i^{C70}					-0.007					0.000					0.165
					(1.50)°					(0.11)					(4.43)***
$\Delta pc_i * D_i^{C70}$					0.084					-0.002					0.882
					(1.74)*					(0.08)					(3.61)***
Constant	0.011	0.009	0.012	0.011	0.010	-0.002	-0.022	-0.022	-0.001	-0.002	0.114	0.141	0.114	0.175	0.109
	(1.99)**	(1.69)*	(2.18)**	(2.04)**	(1.87)*	(0.43)	(3.50)***	(3.39)***	(0.18)	(0.40)	(2.48)**	(3.46)***	(2.67)***	(3.14)***	(2.26)**
adj.R^2	0.22	0.36	0.38	0.22	0.23	0.05	0.54	0.54	0.05	0.04	0.45	0.55	0.68	0.53	0.51
Obs	498	498	498	498	498	372	372	372	372	372	126	126	126	126	126

The table reports OLS estimates of annualized changes in GDP on the annualized changes in commodity and a set of monthly macroeconomic and financial variables through alternative specifications, for all event types. *Obs* indicates the number of events considered, which is expanded according to the duration of each event. Thus, the number of observations in each regression is larger than the number of country-events, and allows for longer events to be more representative. The regressions include events identified along the full sample, which consists of the following 29 high income and emerging market countries: Argentina, Australia, Bolivia, Brazil, Canada, Chile, Cameroon, Colombia, Costa Rica, Denmark, Dominican Republic, Ecuador, Ghana, Guatemala, Honduras, Indonesia, India, Mexico, Malaysia, Nigeria, Norway, New Zealand, Peru, Paraguay, Saudi Arabia, Trinidad and Tobago, Uruguay, Venezuela, and South Africa. Newey-West (1987) standard errors are reported in parentheses. *** indicates statistical significance at 1% level, ** at 5% and * at 10%. The sample ranges from 1970 to 2010.

Table 6: OLS Estimation Results: Commodity Price Index Effect on GDP During the First Stage of the Events, Only Emerging Economies

	All events					*Only booms*					*Only busts*				
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Δpc_i	-0.047	0.003	0.011	-0.051	-0.041	0.062	0.250	0.250	-0.011	0.063	0.449	0.546	0.352	0.819	0.456
	(0.89)	(0.06)	(0.20)	(1.07)	(0.79)	(1.03)	(3.41)***	(3.42)***	(0.45)	(1.05)	(2.14)**	(2.98)***	(2.22)**	(3.28)***	(2.45)**
err_i	-0.008	-0.008	-0.007	-0.009	-0.007	0.001	0.005	0.005	0.002	0.001	-0.056	-0.073	-0.049	-0.098	-0.055
	(3.00)***	(2.78)***	(2.75)***	(3.02)***	(2.66)***	(0.41)	(2.49)**	(2.43)**	(1.36)	(0.74)	(2.48)**	(3.65)***	(2.40)**	(3.48)***	(2.45)**
$\Delta pc_i * err_i$	0.047	0.038	0.032	0.048	0.040	-0.028	-0.065	-0.064	-0.037	-0.031	-0.152	-0.211	-0.148	-0.331	-0.167
	(1.95)*	(1.52)°	(1.36)	(2.00)**	(1.65)*	(2.04)**	(2.82)***	(2.76)***	(2.94)***	(2.34)**	(1.55)°	(2.43)**	(2.00)**	(2.85)***	(1.91)*
kao_i	-0.002	-0.002	-0.002	-0.002	-0.003	0.002	0.008	0.008	0.000	0.002	-0.022	-0.031	-0.017	-0.028	-0.021
	(1.95)*	(1.52)°	(1.41)	(2.00)**	(2.20)**	(1.16)	(4.49)***	(4.32)***	(0.50)	(1.64)°	(3.14)***	(4.68)***	(2.24)**	(3.56)***	(2.81)***
$\Delta pc_i * kao_i$	0.019	0.001	0.002	0.018	0.023	-0.011	-0.079	-0.078	0.020	-0.014	-0.070	-0.089	-0.015	-0.080	-0.041
	(1.51)°	(0.04)	(0.18)	(2.25)**	(1.75)*	(0.51)	(3.57)***	(3.50)***	(2.55)**	(0.69)	(2.51)**	(3.48)***	(0.58)	(2.55)**	(1.26)
gov_i	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.04)	(0.01)	(0.04)	(0.00)
	(3.69)***	(4.52)***	(4.25)***	(3.19)***	(3.72)***	(3.39)***	(2.46)**	(2.45)**	(3.89)***	(3.50)***	(0.22)	(4.11)***	(1.17)	(3.11)***	(0.65)
$cred_i$		0.000	0.000				-0.001	-0.001				0.013	0.009		
		(0.53)	(1.46)°				(3.18)***	(3.45)***				(5.49)***	(3.82)***		
$\Delta pc_i * cred_i$		0.005	0.004				0.009	0.009				0.051	0.035		
		(3.82)***	(3.47)***				(5.68)***	(5.76)***				(4.63)***	(3.95)***		
Previous $\frac{C}{Y}$			0.000					0.000					-0.001		
			(3.14)***					(0.76)					(5.35)***		
D_i^{CB}				0.006					-0.016					0.054	
				(1.03)					(2.53)**					(4.90)***	
$\Delta pc_i * D_i^{CB}$				-0.017					0.150					0.167	
				(0.25)					(2.14)**					(2.22)**	
D_i^{C70}					-0.009					-0.006					0.193
					(1.84)*					(2.20)**					(5.20)***
$\Delta pc_i * D_i^{C70}$					0.094					0.063					1.022
					(1.85)*					(1.96)*					(4.30)***
Constant	0.010	0.009	0.013	0.010	0.009	-0.004	-0.024	-0.025	0.002	-0.004	0.118	0.148	0.113	0.198	0.115
	(1.80)*	(1.57)°	(2.27)**	(1.81)*	(1.62)°	(0.74)	(3.76)***	(3.91)***	(0.87)	(0.86)	(2.49)**	(3.58)***	(2.73)***	(3.41)***	(2.42)**
adj.R^2	0.21	0.36	0.39	0.22	0.24	0.04	0.55	0.54	0.06	0.03	0.47	0.57	0.72	0.57	0.54
Obs	401	401	401	401	401	281	281	281	281	281	120	120	120	120	120

The table reports OLS estimates of annualized changes in GDP on the annualized changes in commodity and a set of monthly macroeconomic and financial variables through alternative specifications, for all event types. *Obs* indicates the number of events considered, which is expanded according to the duration of each event. Thus, the number of observations in each regression is larger than the number of country-events, and allows for longer events to be more representative. The regressions include events identified along the sample that includes only emerging market countries, that are: Argentina, Bolivia, Brazil, Chile, Cameroon, Colombia, Costa Rica, Dominican Republic, Ecuador, Ghana, Guatemala, Honduras, Indonesia, India, Mexico, Malaysia, Nigeria, Peru, Paraguay, Trinidad and Tobago, Uruguay, Venezuela, and South Africa. Newey-West (1987) standard errors are reported in parentheses. *** indicates statistical significance at 1% level, ** at 5% and * at 10%. The sample ranges from 1970 to 2010.

Table 7: OLS Estimation Results: Commodity Price Index Effect on GDP during *Reversion*

	Full Sample		*Only Emerging*	
	(1)	(2)	(1)	(2)
Δpc_i	0.173	0.166	0.109	0.228
	(3.79)***	(3.74)***	(1.60)°	(2.80)***
err_i	0.001	0.001	0.004	0.001
	(0.23)	(0.51)	(1.17)	(0.25)
$\Delta pc_i * err_i$	0.019	0.023	0.051	0.008
	(0.80)	(0.98)	(1.37)	(0.20)
kao_i	-0.004	-0.004	-0.005	-0.005
	(2.66)***	(2.89)***	(2.55)**	(3.00)***
$\Delta pc_i * kao_i$	-0.060	-0.062	-0.056	-0.055
	(3.08)***	(2.99)***	(2.54)**	(2.44)**
gov_i	(1.30)	(1.34)	(1.30)	(1.43)
	(3.55)***	(3.52)***	(3.17)***	(3.41)***
$cred_i$		0.001		0.003
		(0.82)		(3.25)***
$\Delta pc_i * cred_i$		0.003		0.030
		(0.64)		(4.19)***
Constant	0.014	0.012	0.005	0.015
	(3.36)***	(2.65)***	(0.86)	(2.04)**
adj.R^2	0.31	0.31	0.3	0.33
Obs	374	374	281	281

The table reports OLS estimates of annualized changes in GDP on the annualized changes in commodity prices and a set of monthly macroeconomic and financial variables through alternative specifications, for boom events. *Obs* indicates the number of events considered, which is expanded according to the duration of each event. Thus, the number of observations in each regression is larger than the number of country-events, and allows for longer events to be more representative. The regressions include events identified along the full sample and the sub-sample that includes only emerging market countries (see footnotes of Tables 5 and 6 for the corresponding lists of countries of each sample). Newey-West (1987) standard errors are reported in parentheses. *** indicates statistical significance at 1% level, ** at 5% and * at 10%. The sample ranges from 1970 to 2010.

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