

# Macroprudential policies in a commodity exporting economy<sup>1</sup>

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Colombia, like other Emerging Market economies, is a small open and commodity exporter economy. The predominant type of the commodity exported has varied, from coffee in the past century to oil in the current one. Nonetheless the importance of the commodity exporting sectors for the Colombian business cycle is prominent. In the last 40 years, empirical evidence shows a strong and positive association between the cyclical component of the real price of Colombian exports and the cyclical component of real GDP. Periods of high export prices coincide with economic booms, while periods of lower than usual prices are associated with recessions. In addition, besides contributing significantly to the GDP cycle volatility, the effects of these shocks are widespread as they affect real variables, such as consumption and investment, as well as other financial variables, such as credit.

In this study we perform an oil price shock identification analysis in which we analyse how a key set of macroeconomic variables behave around oil price shocks. We are interested in studying large increases in international oil prices. Once we identify the shocks, we observe how country risk, output, private consumption, domestic credit, trade balance and the real exchange rate evolve during the commodity price surge as well as during its collapse.

Our sample runs from 1988 to 2012. The event analysis is carried out at quarterly frequency. However, neither all variables are available for the full sample nor observed at the same frequency. In particular, we take monthly data for the oil price and the country risk measured by JPMorgan EMBI-Colombia index. Our measure of oil prices is the Europe Brent Spot Price FOB (in US dollars per barrel) adjusted by using the United States' CPI. This series is available from January 1988 to December 2012. The remaining variables are at quarterly frequency, and taken from the national accounts and the balance of payments statistics. The data for these last variables are available from 1999Q2 to 2012Q4.

We follow Hamilton (2003) to find the quarters during which there were oil price shocks. Hamilton defines an oil shock as a large increase in the oil price. Specifically, an oil shock is the maximum value of the oil price during the last 36 months. An oil shock event occurs when the oil shock is larger than two standard deviations. At quarterly frequency, there is an event if at least one monthly shock event occurs.

Our main findings are that before the peak of a large and steady oil price hikes, country risk falls, output rises, private consumption increases, domestic credit increases, trade balance improves and the real exchange rate appreciates. In general,

<sup>1</sup> This article was completed while Andres Gonzalez was at the Central Bank of Colombia. The views expressed in this paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy.

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after the sudden oil price reversal all these patterns shift back in the opposite direction.

These findings are consistent with the intuition shared by many economists, who study small open economies in which resource sectors are important. As the oil price grows, income from the resource sector increases and risk premium falls with the improved overall creditworthiness, creating a surge in demand for tradable and nontradable goods, inducing a real exchange rate appreciation and a shift of economic resources from the tradable sector to the nontradable sector. Credit expands, especially in those sectors that benefit from the real exchange rate appreciation. Overall economic activity and demand rise in tandem with asset prices. However, sharp oil price reversals truncate this process and a rapid reallocation of resources occurs together with a collapse in asset prices and the currency.

To explain these facts, we develop a New-Keynesian DSGE model for financial policy analysis that takes into account these key empirically relevant features of the Colombian economy. Our baseline model is a three-sector economy (commodity, tradable and nontradable sectors) populated by households, entrepreneurs, retailers, capital producers, private banks, the government and the central bank. Households receive the revenues from the resource sector, supply labour to firms, consume final goods and save in the form of bank deposits. Output is produced in several stages, including a monopolistically competitive nontradable sector with nominal rigidities. Entrepreneurs, both in the tradable and nontradable sectors, face financial frictions and their external financing cost is decreasing in their net worth, as in Bernanke, Gertler and Gilchrist (1996).

In the baseline specification of the model, the central bank sets the nominal interest rate using a monetary policy rule. We also enhanced further the model to consider exchange rate and credit policies. We model the first as the sales/purchases of international reserves, which adjust in response to real exchange rate misalignment, and the second as any financial regulation instrument, which responds to aggregate credit dynamics by enlarging or compressing the external financing premium in the economy.<sup>5</sup>

In sum, we construct a setup with a commodity-driven transfer problem, in which high oil prices increase export revenues and cause higher demand for tradable and nontradable goods. The model includes three productive sectors: commodity, nontradable and tradable sectors and uses the Bernanke-Gertler-Gilchrist setup to introduce an external financing premium relating net worth of entrepreneurs in the tradable and nontradable sectors to their financing costs. It also models separately the central bank and commercial banks.

The economy's long-run net foreign assets is pinned down by assuming that the external interest rate is an exogenous, increasing function of the ratio of external debt to the stock of oil. We interpret this as representing a form of collateral for credit provided by foreign lenders. The model allows us to show that the dynamics of the proposed transfer problem can be the efficient response of the economy to exogenous terms-of-trade shocks.

However, the adjustment is inefficient because the equilibrium is distorted by financial frictions. In the commodity boom phase, credit growth and real appreciation transfer net worth from the tradable to the nontradable sector, which enhances

<sup>5</sup> The complete set of equations are available upon request.

borrowing capacity in the latter, and then a sudden reversal in commodity prices causes a reallocation back to the tradable sector and causes the nontradable sector to experience a credit crunch.

Moreover, a pecuniary externality is also at work in this process, because in the Bernanke-Gertler-Girlichrist financing premium the value of net worth depends on equilibrium sectoral relative price movements that individual agents do not internalise when they make borrowing decisions.

We enhance the model to account for the role of macroprudential policy. Our model introduces policy rules governing central bank foreign exchange intervention and a regulatory premium incorporated as a multiplicative factor of the external financing premium banks charge to entrepreneurs. These rules are ad-hoc, but they make an interesting contribution because they are formulated as functions of the deviations of the real exchange rate from its long-run target (for the foreign exchange intervention rule) or the private sector credit from its steady state value (for the regulatory premium). Hence, these rules try to approximate the prudential nature of the policy because by construction they induce larger adjustments in the policy instruments in boom times (ie when the real exchange rate and/or credit exceed their long-run levels), and converge to turning off both instruments in the long run, when their driving variables settle at their steady state values.

We use the estimated model (by Bayesian techniques) to perform several quantitative exercises. First, we perform a shock decomposition analysis. We quantify the historical importance of external and domestic shocks in the Colombian data. Although our focus is commodity export shocks, we also study the relative importance of the remaining ones. Second, we compute the Bayesian impulse-response functions. The objective is to visualise in more detail the macroeconomic impact of one-off commodity shocks and the policy response of the central bank. The third exercise is a counterfactual experiment to assess the effects of an unexpected reversal of a commodity shock. There, agents take decisions based on the idea that the value of commodity production will increase persistently for several quarters. However, they do not anticipate the possibility of a sudden reversal. Our interest is to use the model to analyse the role of conventional monetary policy and macroprudential policies when the sudden commodity collapse takes agents by surprise.

Our first quantitative experiment is a shock decomposition analysis. The model considers 12 shocks. We label four of them as external and the rest as domestic. The external shocks are: one to the foreign interest rate spread that the economy faces when borrowing abroad, another is a foreign inflation shock and the third is a shock to commodity exports. It can be either commodity prices or quantities. The domestic ones are shocks to productivity, investment and interest rate spreads all to both sectors (tradable and nontradable), markup as well as a monetary policy shock. Our aim is to gauge the estimated contribution of the considered shocks on the observed movements of tradable and nontradable output and credit, aggregate consumption, inflation, the real exchange rate and nominal interest rates.

The shock decomposition of these time series confirms a conventional finding in many of the models used in the international macro literature. The role of foreign interest rate spread shocks appear to be small. Also the role of foreign inflation shocks is negligible. Most of the importance of foreign shocks in the Colombian macro series stems from commodity export movements, as we suspected from the documented evidence in the first part of the paper.

Despite these large real effects on sectoral output and relative prices, commodity export shocks have a smaller contribution to tradable and nontradable credit and consumption. Credit fluctuations are mostly dominated by investment specific shocks, especially in the case of nontradable credit. The inter-sectoral effects of specific shocks go from nontradable credit to tradable credit, but not the other way around. More precisely, tradable investment shocks have no impact on nontradable credit, while nontradable investment shocks spillover to tradable credit. This type of credit is much more responsive to interest rate credit spread shocks than nontradable credit. Thus, based on these findings, we are inclined to conclude that the importance of commodity export shocks appears to lie more on its sectoral effects than on its impact on aggregate activity. GDP fluctuations may mask the reallocation effects that commodity export shocks entail. Preference shocks appear to be an important source of macroeconomic fluctuations, as they affect GDP through nontradable output, consumption, inflation and the policy rate. However, they do not affect both types of credit. Their contribution to real exchange rate and tradable output fluctuations has also been small. Put together, these results suggest that credit cycles in Colombia does not appear to be driven by aggregate domestic shocks nor by foreign shocks, but mostly by sectoral specific shocks and their interaction.

The mechanism that we have in mind to explain the response of the economy to commodity booms, approximated by the model's impulse responses, is as follows: besides the standard channels in the tradable and nontradable small open economy models, a key mechanism works through the external interest rate risk premium. This premium has an endogenous component, which depends not only on net external debt but also on the stock of the real commodity resource. A commodity price shock raises the value of this real asset lowering the risk premium that the economy faces in international financial markets. Thus, the income effect on the households' budget constraint may be small but the wealth effect may be large, especially since overall the economy has a negative net foreign asset position. Without this mechanism, the effects of a commodity boom on the real exchange rate in a three sector model would be smaller.

There is an additional channel in our model induced by the presence of the sectoral financial accelerator. The appreciation of the exchange rate also leads to a fall in the value of the assets of the tradable sector, lowering the value of its collateral and consequently, rising the external financing premium that tradable firms pay to commercial banks. This increase in financing costs coupled with the lower demand of domestically produced tradable goods drives further down employment in this sector. In contrast, the nontradable sectors benefit from an exchange rate appreciation. This channel is present in the model but it is quantitatively small in the Colombian data, as the shock decomposition also reveals.

Finally, the effectiveness of the macroprudential policy is evaluated by studying how the response of the economy to an oil price hike lasting six quarters, followed by an unexpected reversal, differs with and without the macroprudential policy rules. In the case without the rules, the only policy rule at play is the standard Taylor rule in New-Keynesian DGSE models.

The results show only small differences with or without the policy rules governing currency intervention and the regulatory premium. These results could be interpreted as indicating that the model's financial frictions are not the empirically relevant ones, but they may also suggest again that the perturbation approach to smooth the convex borrowing costs implied by the financial frictions is weakening their real

effects. The results also suggest that it would be useful to explore the implications of varying the values of the parameters that characterise the elasticities of the macroprudential policy instruments to their corresponding determinants. Intuitively, it seems that in the limit if the elasticities were very high, the financial sector should have strong real effects because of large changes in financing costs via the regulatory premium, and large adjustments in the central bank's balance sheet via the foreign exchange interventions.

## References

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