Box 1
IMPACT OF THE DROP IN TERMS OF TRADE ON REAL GROSS NATIONAL DISPOSABLE INCOME: THE EXPERIENCE OF CHILE, COLOMBIA AND PERU

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For a small open economy that receives external funding and is obliged to adapt to international credit and liquidity conditions, besides being an intensive producer and exporter of commodities (as is the case of Colombia and many other countries in the region), it is very important to analyze the momentum in terms of trade (TT) and how it affects gross national disposable income (GNDI). Doing so is important to ensuring good economic policy in terms of how it is planned, designed and implemented. The significance of this relationship lies with the fact that changes in terms of trade have a real impact on the economy, particularly on national income. For instance, agents will have more spending power when the ratio of export prices to import prices for goods and services is favorable. The opposite also applies: if that ratio is unfavorable, the economy will have to adjust its spending levels, which would imply a decline in the collective welfare of the country. Moreover, depending on the nature of the TT shock, which might be temporary or persistent, an economy can be temporarily or permanently richer or poorer.

The past decade saw historically high prices for the commodities exported by most economies in the region. Coupled with an international environment marked by a relative abundance of liquidity, this allowed national disposable income in countries such as Chile, Colombia and Peru to grow at a good pace. It also led to significantly higher rates of investment and public and private consumption.

However, raw material prices follow a cyclical pattern. It is possible that high-price phase, which would have lasted about ten years, is being followed by a prolonged period of low prices. In the case of Chile and Peru, countries where prices for their exports began to fall as of late 2011 (well before the drop in oil prices), there were real changes of considerable magnitude in the growth of output and its components.[1] Annual GDP growth in these countries during 2015 was only 1.9% and 2.4%, respectively. In both cases, these figures are explained by a sharp decline in investment and private and public consumption. In Colombia, the adverse effects of the drop in oil prices are already evident: a moderate slowdown in consumption and investment, relatively less so in the case of the latter, was observed in the fourth quarter of 2014 and the first three months of 2015. However, the extent to which this shock will affect economic performance in the coming quarters is still unclear, partly because the level at which the price of oil and other commodities will stabilize is not yet known.

Although the economies of Chile, Colombia and Peru have distinguishing characteristics that set them apart from one another, this section offers a comparative calculation of the contribution of TT to real GNDI growth in each of these countries in recent years. The results suggest the negative TT shocks had a considerable impact on the purchasing power of real GNDI in all three cases. Additionally, we show different metrics proposed in the literature to calculate the real effect a drop in TT has on GNDI, as there is no consensus on what deflator should be used to measure the extent of that shock. Finally, we present an econometric exercise that reveals the differences between countries in terms of how the GNDI and domestic demand (DD) respond to a shock to TT quarterly growth.

1. Calculating the Impact of Terms of Trade on Real Gross National Disposable Income

To estimate the impact of TT on real GNDI, it is best to start with the identities of GDP and gross domestic income (GDI). In current terms and market prices, they are equivalent:[2]

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1 It is important to point out that this slowdown occurred in a less favorable external context and was not due solely to the decline in raw material prices.

2 See Lora (2008) for a more detailed explanation.

$$GDP = C + G + I + X - M = GDI$$

GNDI is obtained once the nominal values of net factor payments (NFP) and net current transfers (NCT) are incorporated. The sum of the last two components is known as net income from abroad (NIA). As such:

$$GNDI = GDI + NFP + NCT = GDI + NIA$$

To convert the expressions of GDP and GDI to constant prices, each of the components is deflated by its respective price index. For private consumption, public consumption, investment and imports (C, G, I and M, in that order), the deflators used are the same in both identities. In the case of exports, the deflator is different for each identity. When calculating real GDP, exports are valued at their own prices. For real GDI, the import price index is used. This assumes the real value of exports is measured in terms of the goods and services they can acquire abroad; so, the deflator used is the import price index. However, in this section, we introduce other metrics with different underlying assumptions related to the purchasing power of exports.

Different alternatives are found for the NIA deflator as well. In this exercise, we deflate the nominal NFP and NCT series with the domestic demand price index, which implicitly assumes their purchasing power is valued at the prices of goods and services (both consumer and investment) in the domestic market.

With the foregoing, the constant value of the amounts stated (in italics and lower case) is given by the following expressions:

$$gdp = \frac{C}{P_C} + \frac{G}{P_G} + \frac{I}{P_I} + \frac{X}{P_X} - \frac{M}{P_M} = c + g + i + x - m$$

$$gdi = \frac{C}{P_C} + \frac{G}{P_G} + \frac{I}{P_I} + \frac{X}{P_M} - \frac{M}{P_M} = c + g + i + \frac{X}{P_M} - m$$

$$gndi = gdi + \frac{NFP}{P_{NFP}} + \frac{NCT}{P_{NCT}} = gdi + nfp + ntc$$

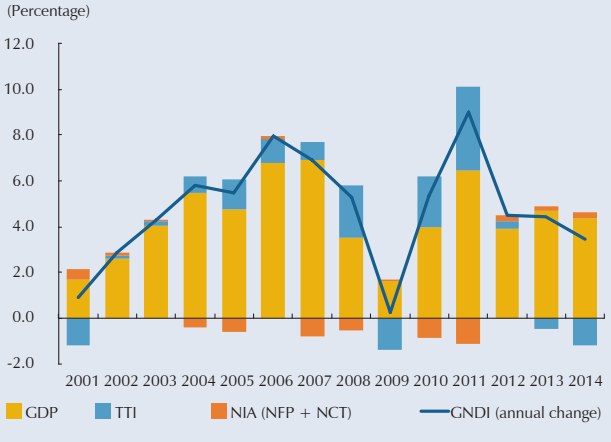
Discounting the real GDP on both sides of the last equation, gives us:

$$gndi = gdp + nfp + ntc + x\left(\frac{P_X}{P_M} - 1\right)$$

The term at the end of the equation represents the real impact of terms of trade (TTI) on real GNDI; that is, the perceived gain or loss in the purchasing power of income due to the change in the terms-of-trade ratio.

Graph B1.1 shows the contribution of each component to the change in GNDI in Colombia. One sees a favorable TT ratio (the blue bar) contributed to the expansion in GNDI throughout much of the last decade. The contribution was negative in 2013 and 2014, albeit in relatively small amounts. For the economies of Chile and Peru, the real impact of the drop in the TT was greater (Graph B1.2, panels A and B).

Graph B1.1
Annual Change in Gross National Disposable Income (GNDI) in Colombia – Contribution by components



TTI: real effect of the terms of trade.
NFP: net factor payments.
NIA: net income from abroad.
NCT: net current transfers. Sources:
DANE and Banco de la República; authors' calculations.

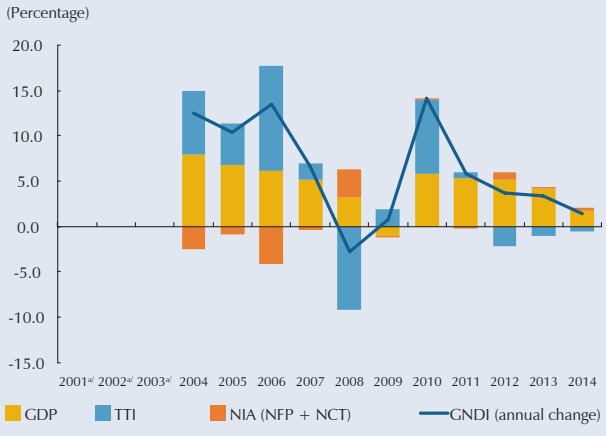
2. Alternative Metrics to Measure TTI against Real GNDI

There is broad debate about the appropriate deflator to measure the impact of TT shocks, and a consensus has yet to be reached on which one is best. However, alternative deflators generally calculated as follows are suggested in the literature to measure the TTI.

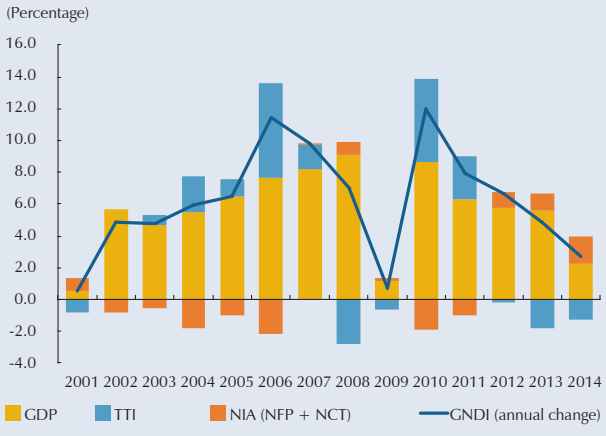
$$TTI = x\left(\frac{P_X}{P^*} - 1\right) + m\left(1 - \frac{P_M}{P^*}\right)$$

Graph V1.2
Contribution, by Components, to the Annual Change in Gross National Disposable Income (GNDI)

A. Chile



B. Peru



a/ No available data
TTI: real effect of the terms of trade.
NFP: net factor payments.
NIA: net income from abroad.
NCT: net current transfers .
Sources: Central banks and statistics bureaus; authors' calculations

where Px and PM are the export and import price indices, respectively; x and m are the real quantities of exports and imports; and P * is one of the deflators shown in Table B1.1, as compiled in Gutierrez (1987).

With the Geary-Nicholson formula (Alternative 1), the real gains or losses in TTI, due to changes in relative prices, affect the country's capacity to acquire imports, since it assumes the additional income from exports is used to purchase goods and services the country normally acquires abroad. In other words, the TTI is equivalent to the purchasing power of exports in terms of imports for a given period, which is why P M is the deflator used.

Geary and Burge (Alternative 2) adopt the foregoing criteria, but differentiate a trade deficit from a trade surplus. In the event of a trade surplus (nominal), the TTI represents the fraction of exports not used to purchase imports, in which case the export price index is the deflator used. In the case of a trade deficit, they opt for the import price index.

Geary (1959) proposes using a simple average of the export and import price indexes as a deflator (Alternative 3). Courbis and Kurabayashi (Alternative 4) recommend a measure that considers the relative importance of each of these items, formulating a linear combination of Px and PM weighted by the share of real exports and imports in the trade balance as a deflator.

Another measure for P * that was presented in Stuvel (1959) (Alternative 5) suggests the GDP deflator be used to ensure that all components of the identity

Table B1.1

Alternative	Authors	Deflator (P^*)
1.	Geary (1961), Nicholson (1960); Stuvel (OECD); SCN-1 (commonly used)	P_M
2.	Geary and Burge (1957)	P_X, si $X - M > 0$ P_M, si $X - M < 0$
3.	Geary-2 (1959)	$\frac{(P_X + P_M)}{2}$
4.	Courbis (1964), Kurabayashi (1971)	$\frac{(X + M)}{(x + m)}$
5.	Stuvel (1959)	$\frac{PIB}{pib}$
6.	SCN-2	$\frac{DI}{di}$

Source: Gutiérrez (1987).

reflect changes in purchasing power in terms of the output of the economy. Similarly, the United Nations System of National Accounts suggests the domestic demand price index be used as a deflator (Alternative 6).

Graph B1.3 shows the annual values of TTI (as a percentage of GNDI) for Chile, Colombia and Peru, using the described metrics. In all cases, the results are conclusive and point in the same direction. To make the results comparable among countries, we take all the price indexes to the same base year (2005). According to our calculations, the TTI impact represented between 6.5% and 7.0% of GNDI in the three countries, for the average 2012-2014.

3. An Econometric Approach

In the previous section, we calculated the contributions of TTI to national income in Chile, Colombia and Peru. Now, we want to quantify the impact of a TT-index shock on the momentum of several macroeconomic aggregates in these economies. To do so, we estimate vector autoregressive models (VAR) in each case, with three endogenous variables: the terms-of-trade index (TT), gross national disposable income (GNDI) and domestic demand (DD). Using the results, we calculated the relevant impulse-response functions (IRF).

The series used are constructed with information from the national accounts and the balance of payments of each of the countries, on a quarterly basis and for the following periods: I Qtr. 2000 to I Qtr. 2015 for Colombia and Peru, and I Qtr. 2003 to I Qtr. 2015 for Chile. They are expressed in real terms and the seasonal component is removed, as required.

In the case of GNDI, we use six different series calculated from an equal number of measures for the component involving the real TTI on income. These were described in the first part of this section. This makes it possible to estimate at least six models per country, by varying the GNDI and maintaining the TT and DD series.

For correct specification, the unit root tests suggest that all the series in log differences are stationary in level and variance. In addition, and after estimating the VAR by ordinary least squares (OLS), the optimal number of lags is determined based on a set of criteria; namely, information, model stability and normality of residuals. After assessing these criteria, we calculate the GNDI and DD response to an impulse in TT.

The results (Graph B1.4) are similar for each of the six measures, which is why only the first one is presented. In addition, the estimated IRF are scaled to comparable magnitudes between the countries: in all cases, the results are interpreted as the impact of a shock of 1% per quarter in TT on GNDI and DD.

As shown in Graph B1.4, all GNDI and DD responses to (positive) shocks in TT go in the expected direction, are statistically significant in one of the first four periods following the shock, and are less than proportional in magnitude. Also, convergence of all the IRF before the ninth post-shock period is shown, which is related to the stability of the model.

So, with to a quarterly variation of 1% in TT for one single period, the response of GNDI and DD in the first period after the shock is 0.27% and 0.025%, respectively, in the case of Chile; and 0.58% and 0.5% for Peru. The results for Colombia suggest this impulse translates into quarterly changes on the order of 0.17% and 0.04% in the first period after the shock for GNDI and DD, respectively.

Conclusions

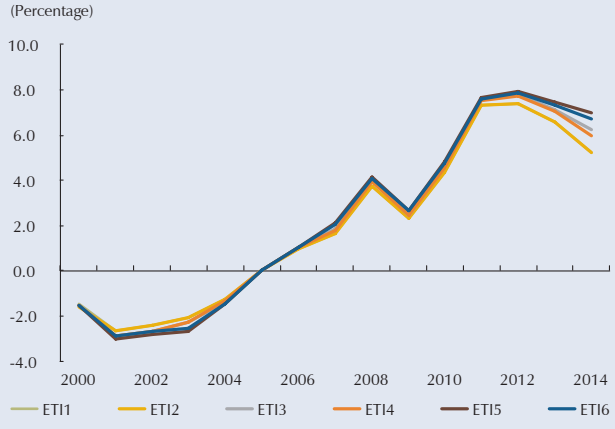
We explore the real impact of the drop in the TT on gross national disposable income and domestic demand for different countries in the region. Quantitative results for the impact of the described shock on the relevant variables are presented by using different metrics and estimating an econometric exercise. The empirical results support the hypothesis that movements in TT have a real impact on GNDI and, therefore, on DD in Chile, Colombia and Peru, countries with small, open and commodity-exporting economies.

The differences between the metrics suggested in the literature depend on the deflator used to assess the nominal figures. However, these are not significant for the countries in question.

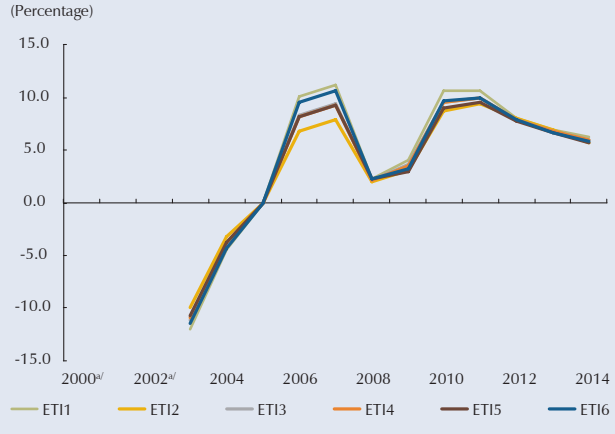
The results of the IRF highlight several aspects; namely, i) the shock observed in the Chilean economy was more persistent; ii) the GNDI and DD responses in Peru were more pronounced, and iii) the impact of the TT shock (from only one period) on GNDI and DD in Colombia is significantly very different from zero only in the first period after the shock, does not persist in time and is limited in size. This last point suggests that a shock of this kind does not pass through entirely to the

Graph B1.3
Measurements of the Real Impact of Terms of Trade (TTI) as a Percentage of Gross Disposable National Income (GNDI)

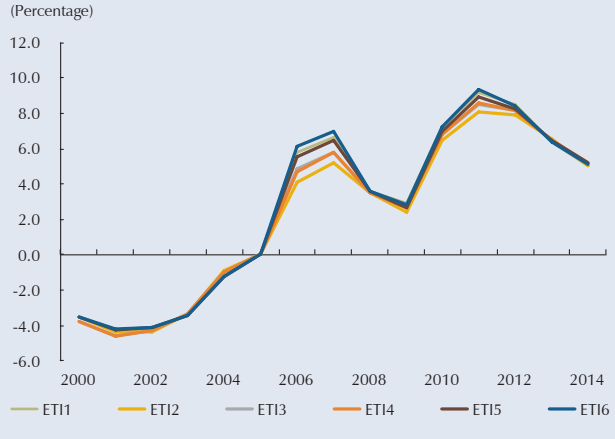
A. Colombia, 2005 base year



B. Chile, 2005 base year



C. Peru, 2005 base year



a/ Not available
Source: Central banks and statistics bureaus; authors' calculations

performance of the country's main macroeconomic aggregates. The differences in the results for the countries may be due to a variety of factors (such as the ownership structure of firms producing raw materials or the degree of trade openness in each country),[3] but that explanation is beyond the scope of this study.

This conclusion might not be valid if the nature of the shock is permanent, as seems to be the case in the current situation. We recommend further and more in-depth study concerning the impact of permanent declines in TT on GNDI and DD, considering how important this variable is to the country's welfare and wealth.

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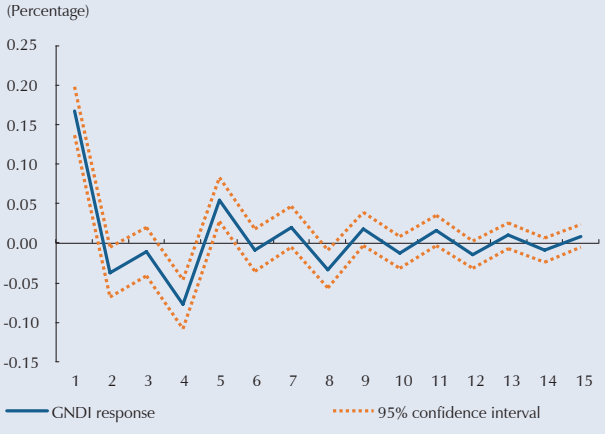
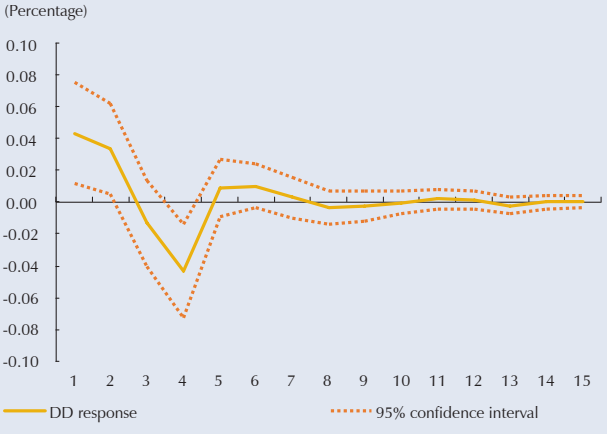
3 In 2014, real exports accounted for 16.0% of GDP in Colombia, as opposed to 35.9% in Chile and 24.9% in Peru.

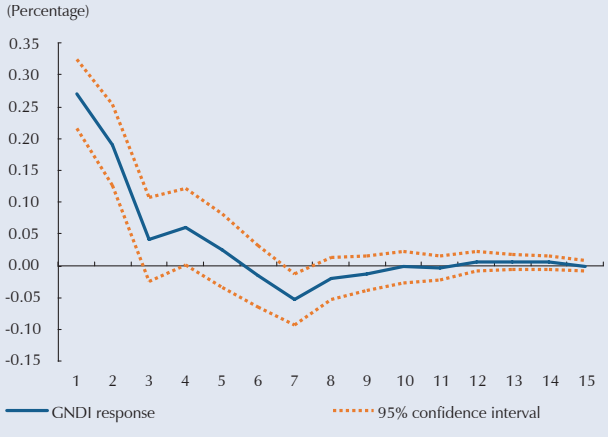
Graph B1.4
Gross Disposable National Income (YNBC) and Domestic Demand (DI) response to a 1% Shock to Quarterly Growth in Terms of Trade

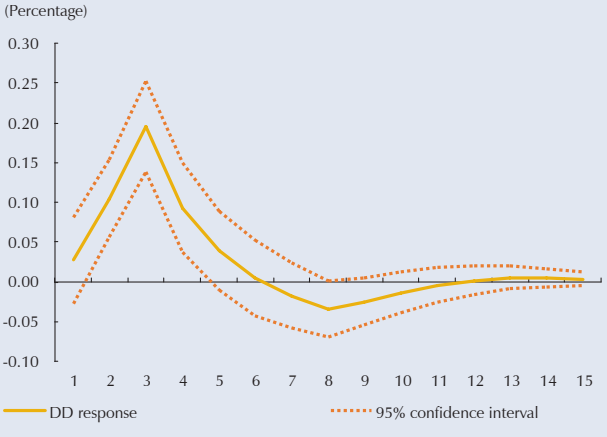
A. Colombia



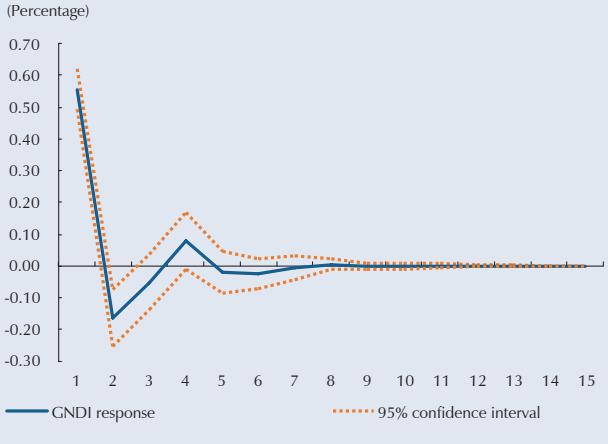


B. Chile





C. Peru



Source: Authors' calculations