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Policy responses to terms of trade shocks

Pierre Jacquet, Alexis Atlani, Marwan Lisser

Pierre Jacquet, Global Development Network

Alexis Atlani, Paris School of Economics

Marwan Lisser, Sciences-Po Paris

Abstract

Terms-of-trade shocks are important determinants of long-term growth in commodity-rich developing countries. Transforming commodity assets into engines of development requires confronting two interrelated challenges: a long-term one of moving from commodity dependency to a diversified productive economy, a short-term one of managing commodity price volatility. Both challenges call for appropriate policies. The complexity of the channels of transmission reviewed in the existing literature vouches for these policies to be country and commodity specific and for implementation to receive at least as much attention as recommendations – especially in view of the historically documented incentives to deviate from recommendations and conduct poor policies. Our paper suggests that the best general advice is to highlight a few robust principles, to reflect on the conditions for their implementation, and to empower local institutions while strengthening research capacities so that the understanding of policy challenges and principles is locally owned and may better inspire policies and institutional building.

The study was first presented at the conference "What responses to terms of trade shocks in poor and vulnerable countries?" held by the Banque de France and FERDI on January, 24 in Paris.The views expressed are those of the authors and do not necessarily reflect the position of the Banque de France or the Eurosystem.

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Outline

1. Introduction

Dependence on commodities is an important feature of development. Wealth in natural resources has been seen both as a chance for development and as a malediction or a "curse" (as proposed by Sachs and Warner (2001))[1]. The underlying reason for such contradiction is that resources can be, and may even tend to be, poorly used. The response to terms-of-trade shocks is central to addressing that dilemma. Terms-of-trade are the relative prices of exports in import units, one of the most crucial relative prices for development outcomes. For most poor developing countries, they are mainly driven by commodity prices. Their evolution determines that of commodity income, and responses to terms-of-trade shocks are an important feature in the collection and utilization of these resources.

An abundant literature has been devoted to studying terms-of-trade movements and their implications for macroeconomic indicators and for policy. Our ambition here is much more modest and consists of reviewing basic facts, discussing how that literature may inform policy and in drawing some policy conclusions from the existing work. We first review commodity dependence and its known implications, before turning to the policy prescriptions that emerge from the literature, and concluding with a discussion on how these prescriptions might be operationalized in the political economy context of developing countries.

As emphasized by Collier (2012), commodity dependence is intimately linked to the importance of government in low income countries. Furthermore, commodity resources are a rent, thus the questions of rent ownership, of contracts with foreign firms, of rent utilization (in saving and spending on consumption and investment) are more than likely to involve governments. Consequently, the question that occupies us here is not primarily technical. Of course, the nature of desirable policy responses has a strong technical component. But a major challenge is to understand the kind of incentives that may lead low-capacity governments to implement policies that may run against their own perception of their short-term interests. To the extent that technical issues can be understood and proper information is available, this political economy question remains the major stumbling block: the question that occupies us here is not primarily technical.

[1] For a synthesis of the development issues linked to commodities, see e.g. (Venables, 2016).

2. Natural resources and development

Few certainties emerge from an otherwise profuse literature on natural resources and development. We choose here to highlight three stylized facts:

1. Poor developing countries are typically vulnerable through their dependence on (a few) commodities.
2. The temporary or permanent nature of terms-of-trade shocks – understood here as commodity price shocks – is often hard to characterize from price series. Potential long-term movements are hidden by high short-term volatility.
3. Terms-of-trade shocks are important determinants of long-term growth performance in commodity-rich developing countries.

2.1. Poor countries are dependent on a few commodities

Exports and government revenues of many developing countries depend strongly on a few commodities, especially compared to high-income countries[2]. The share of natural resource rents in GDP is greater than 10% for 39 countries in 2015 (World Bank World Development Indicators). Moreover, this dependency comes out as a striking characteristic of groupings of Low Income Countries (on average 12.7%), Heavily Indebted Poor Countries (HIPC, on average 11.5%) and Fragile and Conflict affected Countries (14.7%). Céspedes and Velasco (2012) document the role of commodities as drivers of fiscal policy outcomes.

Since we are interested in terms-of-trade shocks, we look at the share of commodities in exports. Figure 1 and Figure 2 respectively represent the distribution of developing (lower and lower middle-income) and developed (high income) countries respect to the share of commodities in exports. While nearly half of high-income countries are almost not dependent at all on natural resources (which represent less than 20% of their total exports), developing countries' situations are much more diverse. Sub-Saharan countries' exports, notably, are predominantly based on commodities (while their imports are essentially manufactured goods).

[2] The denominations "low income", "lower middle-income", "higher middle-income" and "high income" countries refer to the World Bank classification (March, 2017) which uses GNI per capita and is available at : http://databank.worldbank.org/data/download/site-content/CLASS.xls.

Figure 1: Distribution of low income and lower-middle income countries with respect to the share of commodities in total exports in 2014, World Bank WITS data (accessed January 2017). There are 57 represented countries.

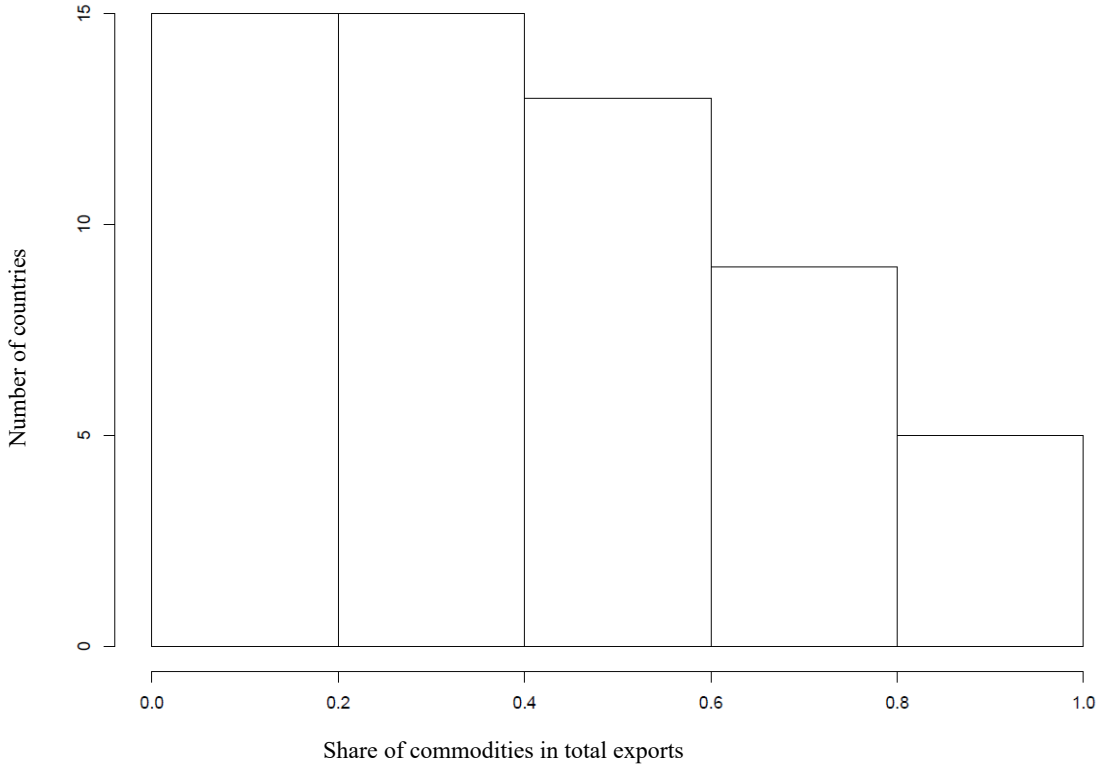
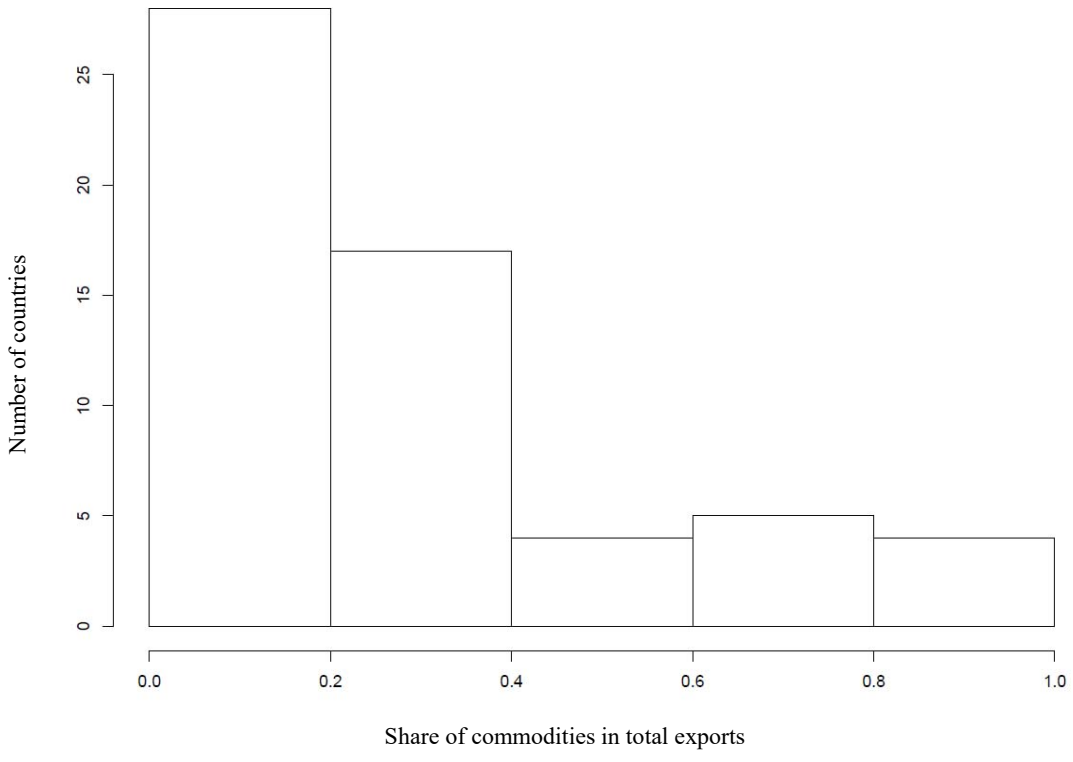


Figure 2: Distribution of high-income countries with respect to the share of commodities in total exports in 2014, World Bank WITS data (accessed January 2017). There are 58 represented countries.



Furthermore, developing-country commodity exports not only typically represent a large share of exports but are also very concentrated among a few commodities, as presented for a selected number of developing countries in Table 1 below. The Table shows the 2011-2015 average ratio of commodity exports over total exports, and shows only commodities that account for 10% or more of total exports. For reference and comparison, the third column provides the 1990 data taken from (Deaton, 1999). Over the 2011-2015 period, for example, oil was basically the only meaningful export from Angola (97% of export receipts) while gold and cotton accounted for two-thirds of Burkina Faso exports.

A possible caveat in interpreting the data in Table 1 is that we do not control for imports. It would especially be a concern when looking at countries which transform and sell commodities they import, since the commodity data we use do not distinguish between raw and transformed materials. For example, in developed countries such as Singapore and Greece, oil represents a large share of exports because petroleum is also refined in these countries. But this is not an issue for our analysis: commodities from developing countries are transformed either locally or in developed countries, and very rarely in another developing country. Furthermore, developing countries are usually not important trading poles, they do not import for re-exporting like, for example, the Netherlands. These two reasons explain why the shares of exports represented in Table 1 do represent actual dependencies on the commodities for developing countries.

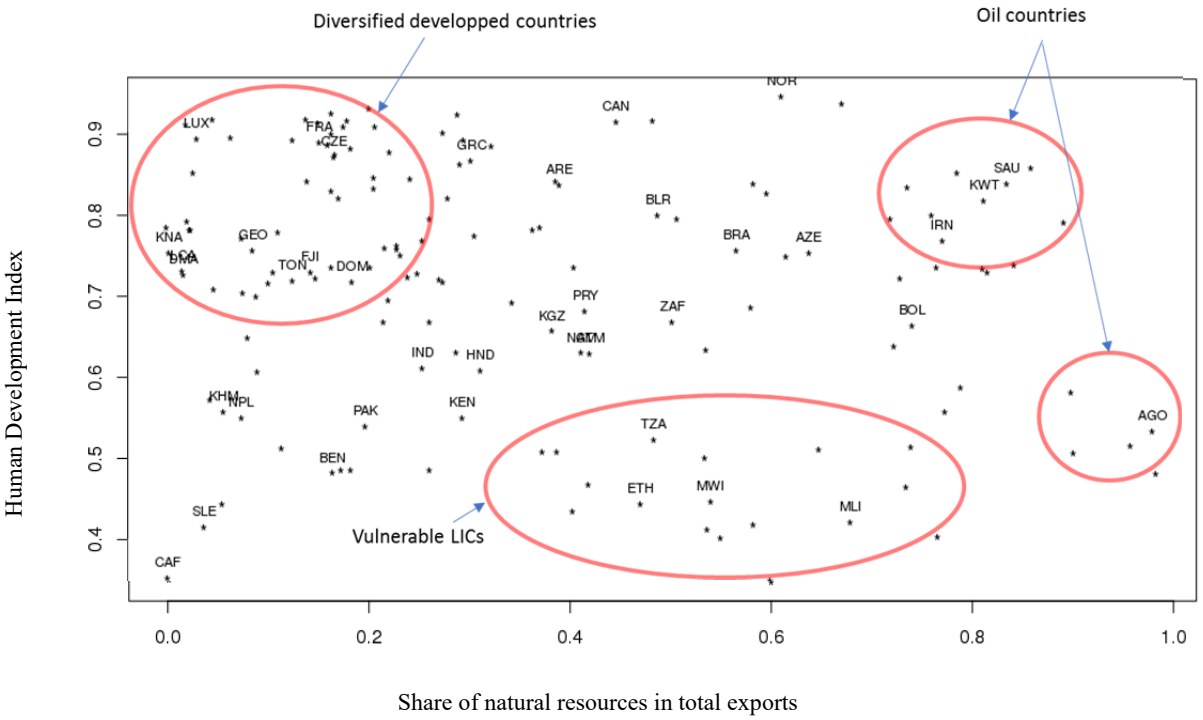
Sharing a high dependency on a few commodities, however, does not make commodity-dependent countries similar, and Table 1 hides a very strong diversity of situations. Figure 3 below correlates the Human Development Index (HDI) of year 2014 to the share of natural resources among total exports (average of years 2011 to 2015). No pattern emerges, although some consistent groupings may appear: Some resource-based economies have reached a high human development level (it is the case of most oil exporting countries, at the top-right corner) while some have not (Malawi, Ethiopia, at the bottom center). On the other side, among diversified economies (on the left) one can find most developed countries (top left corner) but also very fragile ones (Central Africa, Benin, at the bottom left corner).

Table 1: Share of specific commodities in some dependent developing countries. Percentages are averages of yearly ratios of specified commodity exports on total exports, over the 2011-2015 period.

Country	*Commodities' share of total exports*	
	2011-2015 average ratio above a 10% threshold (WITS data)	*As it appears in* **(Deaton, 1999)**[3] *(1990 data)*
Angola	Oil, 98%	Oil, 93%
Bolivia	Gas, 41%	
Botswana	Diamonds, 74%	Diamonds, 90%; Nickel 10%
Burkina Faso	Gold, 53%; Cotton, 12%	Gold, 20%; Cotton, 57%
Burundi	Gold, 25%; Coffee, 19%	Coffee, 75%; Tea, 10%
Cameroon	Oil, 43%; Cocoa, 12%	Oil, 50%
Chile	Copper, 45%	
Congo, Rep.	Oil, 39%	Oil, 85%
Côte d'Ivoire	Oil, 10%; Cocoa 30%	Cocoa, 26%; Wood, 11%
Ethiopia	Coffee, 15%, Vegetables and fruit, 12%	
Ghana	Gold, 36%; Oil, 21%; Gas, 10%; Cocoa, 12%	
Guinea	Gold, 48%	Aluminium, 76%; Diamonds, 13%
Kenya	Tea, 12%	
Malawi	Tobacco, 31%	Tobacco, 68%; Tea, 11%
Malaysia	Oil, 11%	
Mali	Gold, 54%	Cotton, 62%
Mozambique	Aluminium, 24%	Fish, 36%
Namibia	Fish, 13%; Diamonds 23%	
Niger	Oil, 14%; Uranium 38%	Uranium, 83%
Nigeria	Oil, 81%	Oil, 96%
São Tomé and Principe	Cocoa, 75%	
Sudan	Oil, 82%	Cotton, 42%
Tanzania	Gold, 19%	Coffee, 19%; Cotton, 18%; Sugar, 13%
Ukraine	Iron, 28%	
Uruguay	Meat, 12%; Oil-seed and oleaginous fruits, 11%	
Zambia	Copper, 66%	Copper, 88%
Zimbabwe	Gold, 13%; Tobacco, 21%, Nickel 15%	Tobacco, 24%

[3] Deaton's paper (1999) provides data only for Sub-Saharan countries. These are mostly 1990 data. Some of the countries that it covers do not exceed the 10% threshold today and are not listed here, either because they are less dependent on natural resources or have diversified their economy: Benin, Central African Republic, Chad, Democratic Republic of the Congo, Equatorial Guinea, Kenya, Liberia, Madagascar, Mauritius, Rwanda, Senegal, Sierra Leone, Swaziland, Togo, Uganda.

Figure 3: Is human development correlated to share of commodities in exports?



Note : All countries in the world, mean over 2011-2015, World Bank WITS and UN data. Percentages are averages of yearly ratios of commodity exports on total exports, over the 2011-2015 period. HDI is that of year 2014.

Export dependency is compounded by price variations, and both feed into terms-of-trade vulnerability. We now turn to briefly discussing the behavior of commodity prices.

2.2. Commodity prices: volatility matters more than trend

With the notable exception of agricultural products, land and natural resources are usually in finite (and certainly at any point in time inelastic) supply. A Malthusian approach would suggest that the price of these commodities should increase as time goes. The Hotelling rule (1931) specified this point: for non-renewable, exhaustible commodities whose stock is known and which have no alternative, the trade-off between selling the commodity now or later (i.e. the trade-off between investing in the commodity or in other assets) would make the commodity price grow over time at the world interest rate.

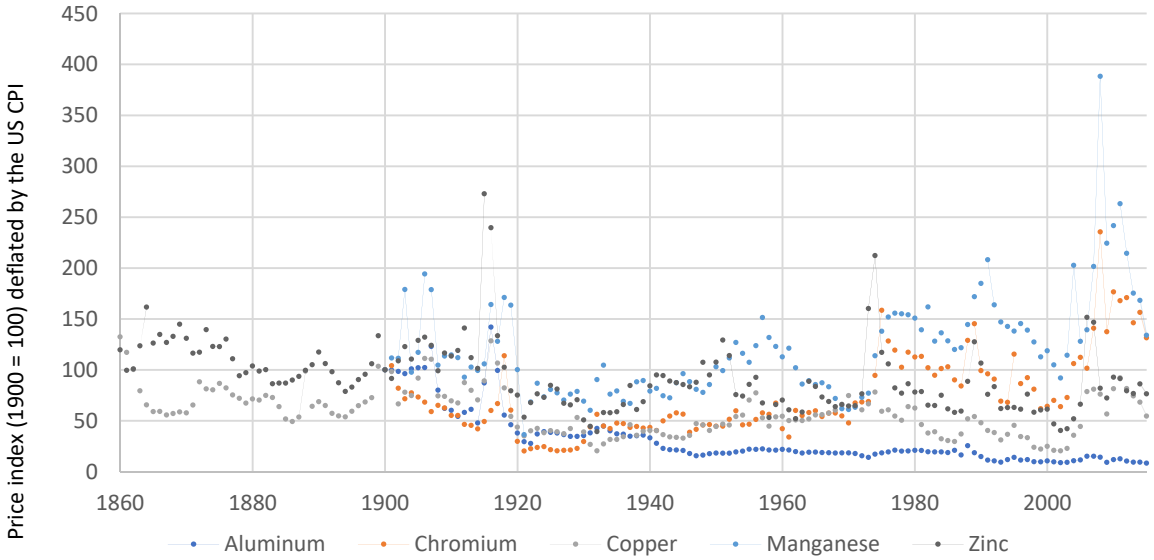
As illustrated in the price figures presented below, it is hard to discern any Hotelling-like tendency for commodity prices. One reason is that the current knowledge of stocks is dependent on past exploration, current estimates and current economic conditions which determine the nature and location of stocks whose exploitation might be profitable given extraction costs. Another reason is that demand patterns adjust over time (notably in reaction to relative prices). The fact that the ratio of proven oil reserves to production has increased from about 25 years to more than 50 years in the 2010s illustrates these two factors at work. Furthermore, alternatives to the use of specific commodities depend on the movement of real prices, on the structural evolution of demand, and

also on technical progress, which many see as the best check on exhaustion. Cheikh Yamani, a former Saudi Oil minister (The Telegraph, 2000) suggested as much with his comment that: "*The Stone Age came to an end, not because we had a lack of stones, and the oil age will come to an end not because we have a lack of oil.*" Another way to discuss the limits of the Hotelling approach is thus to argue that any given current equilibrium (i.e. real price) equating supply and demand for a given commodity generates forces that will lead to a move of both demand and supply curves over time.

In sharp contrast with the implications of Hotelling's rule, Prebisch (1950) and Singer (1950) famously derived the so-called Prebish-Singer hypothesis: real prices of commodities (relative to manufactures) are bound to decrease over time. Their main rationale was that the income elasticity of the demand for manufactures was higher than that of commodities: when income rises, the demand for manufactures increases relative to that for commodities, leading to a decline in the real price of commodities. The Prebish-Singer hypothesis was very influential and inspired pro-active diversification and industrialization policies based on policies of import substitution, notably in Latin America.

Tests using wide datasets and advanced econometric methods, have neither confirmed nor invalidated the Prebish-Singer hypothesis and have led to no consensus. While Hadass and Williamson (2003) found a slight increase in price (thus contradicting Prebish's finding, notably for the 1870-1914 period), Grilli and Yang (1988), Reinhart and Wickham (1994) and Harvey et al. (2010) found a slight decrease and Cuddington and Urzúa (1989), Cuddington (1992), Pindyck (1999), Kellard and Wohar (2006), Cuddington et al. (2006) and Balagtas & Holt (2009) did not find any straightforward trend. Arezki et al. (2014) find a negative trend in most of the price series they look at. Figure 4 below shows the price indexes of metals since 1860, deflated by the US Consumer Price Index (CPI), with the normalization 1900=100, as computed by Jacks (2013). No obvious trend emerges: prices of aluminium and chromium have increased over time, the price of manganese strongly decreased and the prices of zinc and copper slightly decreased. Similar figures (not presented here) on cereal prices, animal products or energy support similar conclusions.

Figure 4: Commodity prices (metals) deflated by the US CPI over 1860-2015 (1900=100), data from (Jacks, 2013)



If anything, Figure 4 suggests that much more is needed to uncover trends than sole price curves, and it is likely that any derived trend will be dependent on the time period and on the technique used. Apart from the problem of time window choice, the main econometric issue is to get rid of short-term volatility. Jacks (2013) studies the price movements of 30 commodities over 160 years and distinguishes long-run trends, medium-run cycles and short-run volatility (booms and busts episodes). He notes that the perceptions of their trajectory is highly dependent on the period that is considered (and on the weights used when using price indices). He cautions against deriving general facts from events in the past and differentiates between "commodities to be grown", for which he sees evidence of a secular real price decline, and "commodities in the ground", which have seen their price increase.

What comes out of Figure 4, and is confirmed by Figure 5 and Figure 6, is the salience of short-term price volatility. It should not come as a surprise: both demand and supply of commodities are relatively price-inelastic in the short term. Production of commodities is determined by existing capacity and knowledge of exploitable reserves, and can often not adapt within months. On the demand side, the use or consumption of commodities depends on techniques or habits that cannot change rapidly. High short-term price volatility comes as a result.

Figure 5 reports the evolution of some of the IMF commodity price indexes for 15 years (from November 2001 to November 2016). Well apart from the 2007-2008 financial crisis, monthly variations of +100% or -50% occur quite frequently. It is a very tangible issue: according to our calculations, there was between 1992 and 2016 a 60% probability of a 10% or more variation of the price half a year later. The dispersion in Figure 6 illustrates the huge uncertainty responsible for the unreliability of short-term predictions.

Figure 5: Diffusion of prices over time (authors' calculations, 1990-2016 IMF all commodity price indices)

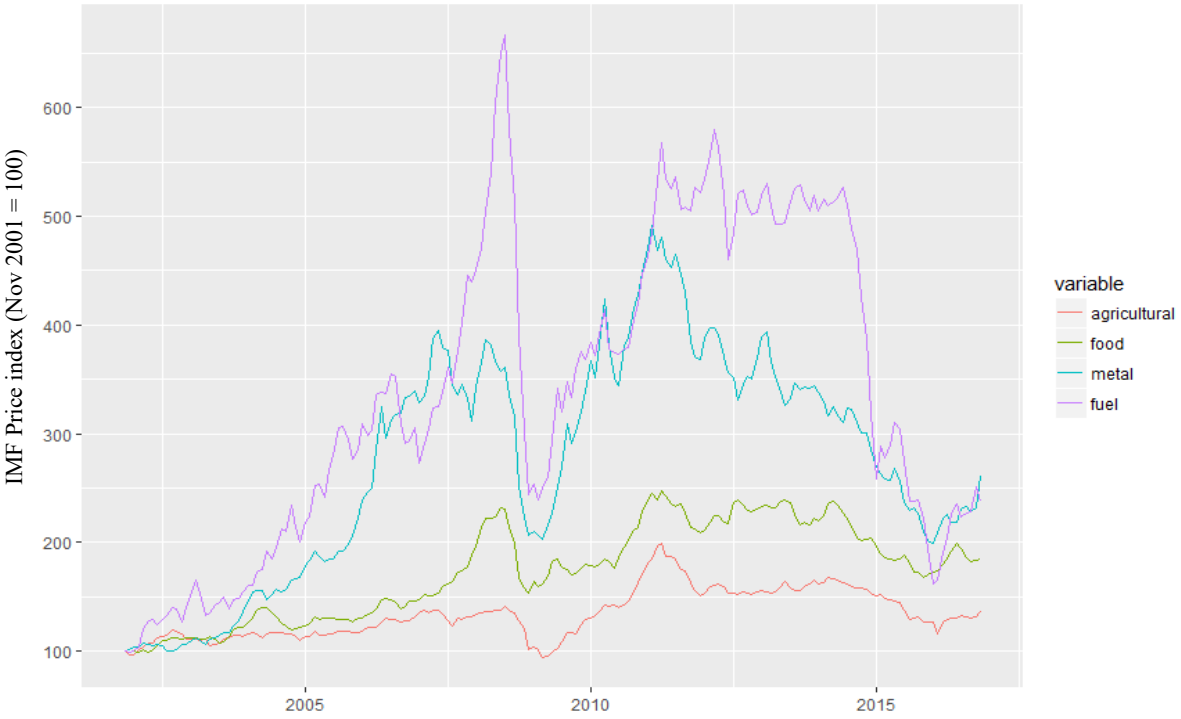
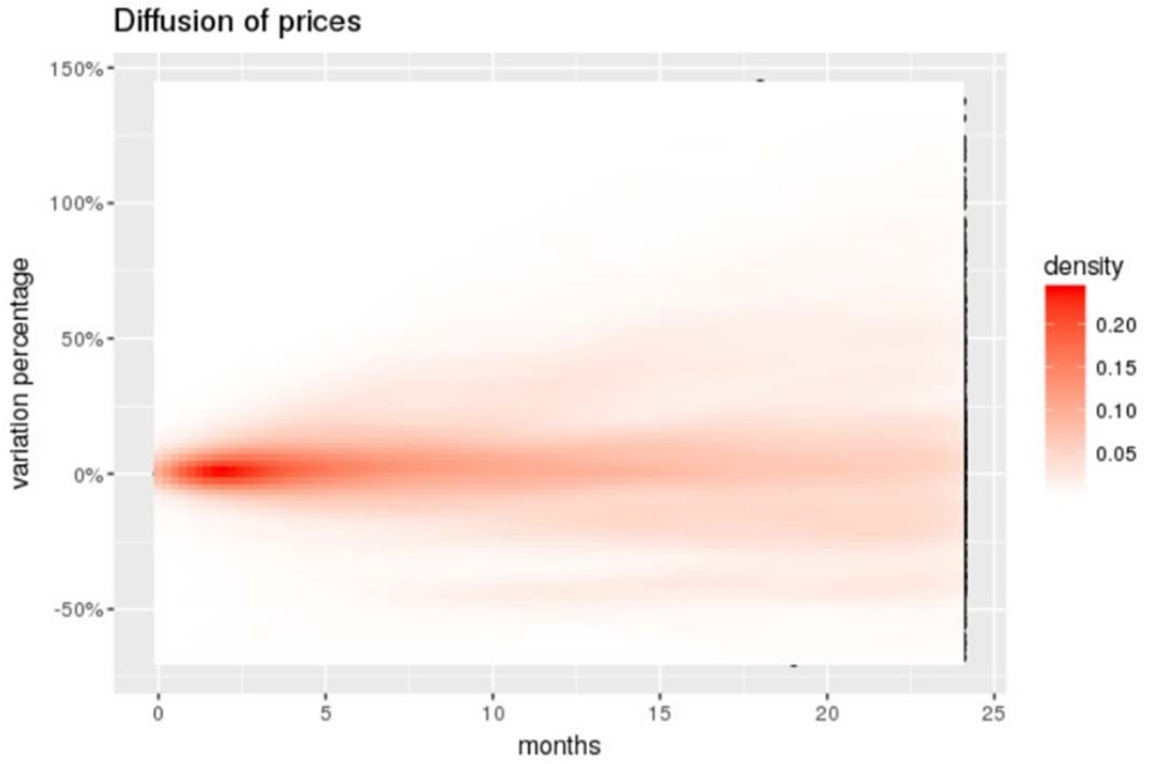


Figure 6: The volatility of commodity prices, November 2001 to November 2016 (IMF aggregated indices, 100=Nov. 2001)



As Deaton (1999) pointed out, short-term volatility hides any long-term trend. The major policy issue is therefore volatility rather than trend. Van der Ploeg and Poelhekke (2009) indeed see volatility as "*the quintessential feature of the resource curse*". We now turn to a broader discussion of the impact of terms-of-trade shocks.

2.3. Impact of terms-of-trade shocks: a primer

A good starting point for this reflection is the observation from Easterly et al. (1993), further discussed by Blattman et al. (2003) that growth rates are much more variable than their alleged fundamental determinants, namely institutions, geography, and culture. Blattman et al. infer that terms-of-trade shocks might account for the excess variance around these persistent fundamentals. Yet, the terms-of-trade literature focused more on scrutinizing price movements and unearthing trends, qualifying the Prebish-Singer hypothesis, than on discussing the impact of terms-of-trade shocks on long-term economic growth (Hadass & Williamson, 2003).

The importance of terms-of-trade shocks for developing countries is related to their dependency on commodities. A first explanation of the "resource curse", linked to long-term terms-of-trade movements, is the Dutch disease (Corden & Neary, 1982), named after the discovery of gas in Holland in the 60s, which led to a considerable increase in revenues and simultaneously to the weakening of the competitiveness of Dutch exports. The migration of production factors to the resource extraction sector raises factor costs in other industries and the non-traded goods sector. In short, booming commodities generate real exchange rate appreciation in countries that export them, penalizing other export sectors and economic diversification. Badeeb et al. (2017) review the evidence for Dutch disease as well as claims of misspecification from critiques of existing empirical work. They conclude in favor of the plausibility of a Dutch disease effect for commodity-rich countries. Arthur Lewis, quoted in (Williamson, 2008), also argued that the movement of terms of trade underlay greater specialization in primary products and resulted in de-industrialization in the poor periphery (notably by making imports of manufactures relatively cheaper), a finding also highlighted in (Hadass & Williamson, 2003). Zafar (2004) observes a similar effect in Gabon, where oil abundance created wealth but also led the industrial and agricultural sectors to shrink due to the real exchange rate appreciation. De la Huerta and Garcia-Cicco (2016) also report that total factor productivity in the Chilean industry was negatively affected by both temporary and permanent commodity price shocks.

The Dutch disease effect is compounded by additional, non-economic, factors (also discussed in (Badeeb, Lean, & Clark, 2017) , (Hadass & Williamson, 2003) and (Van der Ploeg, 2011)): excess confidence linked to the abundance of resources may support excessive spending and mismanagement; rent-seeking behavior can feed into conflict, corruption, governance issues, and weakening of institutions. Bannon and Collier (2003) review how the presence of abundant natural resources may increase the risks of conflict. This conclusion is also relevant to the policy discussion: to make policy recommendations based on good governance and solid institutions to manage

commodity dependency, for example, is not relevant since commodity dependency itself may lead to poor governance and weak institutions.

Let us now turn to short-term reactions to terms-of-trade changes. This is the second side of the coin of commodity dependency. The seminal approach to studying the impact of terms of trade shocks was developed by Harberger (1950) and Laursen and Metzler (1950). Their focus, however, was not on economic growth and was mainly concerned by the potential conflict between internal (full employment and price stability) and external (current account) balance. Laursen and Metzler wanted to address the question of the extent to which flexible exchange rates could be expected to isolate countries from external shocks, a vivid debate at the time. Harberger introduced real income effects in the discussion of the impact of a devaluation on the balance of trade. This consideration of real income effects of a terms-of-trade shock provides the link between the two papers and led to what came to be known as the Harberger-Laursen-Metzler (HLM) effect. The HLM effect is derived from a static approach (including consumption smoothing), with constant investment and no government: a negative terms-of-trade shock (a decline of export prices relative to import prices) implies a decrease in real income; the smoothing of consumption over time implies a decrease in the level of savings at any given level of income, and thus in the savings rate; the current account therefore deteriorates. Laursen and Meltzer qualify this discussion when output movements are considered: an improvement in terms-of-trade negatively affects domestic output (since it makes imports relatively cheaper and exports relatively more expensive) thus negatively affecting real income. Hence the direct effects of a change in terms-of-trade on real income are of an opposite sign to the effects of the induced change in output: the overall impact on real income is indeterminate.

Failing to get unanimous empirical validation (see e.g. (Arezki, Ramey, & Sheng, 2016), (Bouakez & Kano, 2008), (Cashin & McDermott, 2002), (Otto, 2003)), the HLM approach has been extended and qualified by an abundant literature, notably calling on dynamic intertemporal models in which savings behavior is forward-looking, and introducing both investment behavior and public policy responses ((Obstfeld, 1982), (Svensson & Razin, 1983) and (Persson & Svensson, 1985)). A key modifier of the HLM result is the introduction of an intertemporal substitution effect between savings and consumption (for example when agents follow a savings target), driven by the real interest rate, i.e. the relative price of consumption across periods. A temporary terms-of-trade deterioration leads to a temporary fall in real income: consumption smoothing implies that consumption falls by less, and the corresponding decline in savings leads to a deterioration of the current account. If the terms-of-trade shock is permanent, both income and consumption are cut similarly and the effect on savings is ambiguous. The original HLM effect is no longer systematic and can be reversed. A key determinant is the nature of the shock: temporary or permanent, expected or not. These theoretical insights give justice to the complexity of events but can hardly be transformed into policy blueprints, given the difficulty to predict the nature of a shock when it happens. The record of prediction errors is telling (see for example (Deaton, 1999), figure 4).

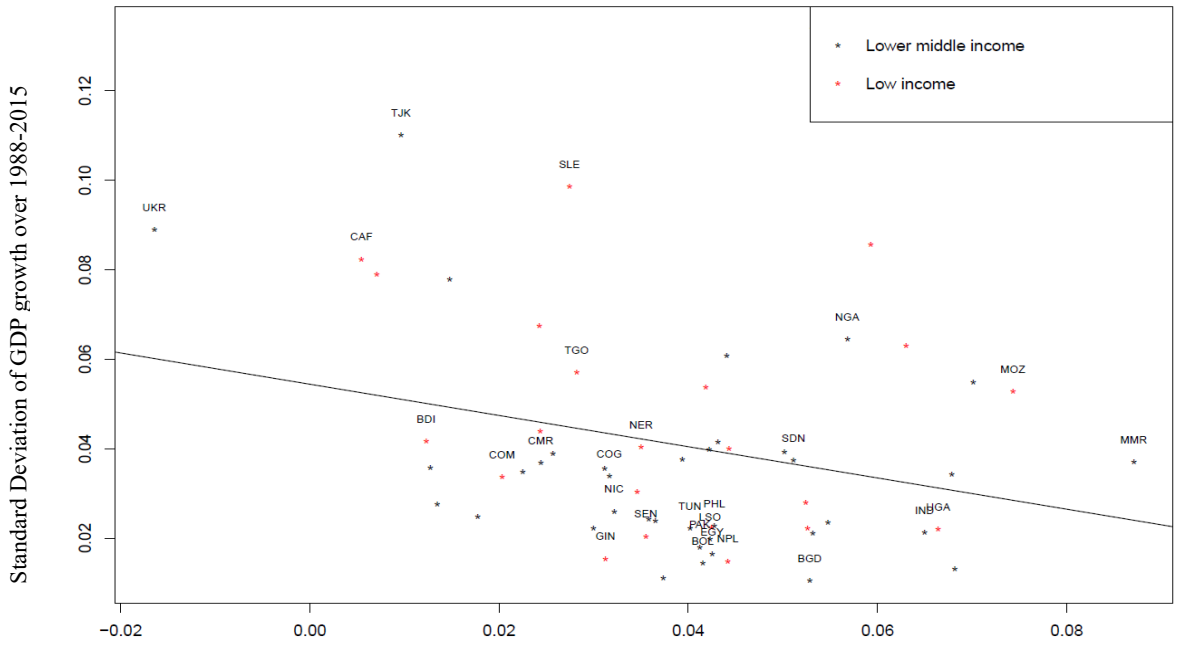
It is accordingly hazardous for any producer, consumer, government, financial institution, etc. to predict future price trends based on any ex-ante pretense to understand the determinants of short-term variations. Agents cannot form reliable expectations and cannot infer whether the price shock they observe is likely to be temporary or permanent, a crucial issue for any policy response. A practical lesson is that implementing policies solely based on forecasts may lead to costly mistakes. For instance, a temporary positive shock perceived as permanent (the most common prediction failure) will lead to a credit expansion and a rise in debt-financed investments. But when it is reversed, the resulting sudden credit tightening stops ongoing investments, feeds into a debt crisis and leads to macroeconomic instability. The intuition would suggest that this inability to forecast should increase macroeconomic volatility, but Rees (2013) observes that it may encourage households to respond cautiously to terms-of-trade changes, leading to less volatility. Nonetheless, the uncertainty attached to high terms-of-trade volatility is not costless. Williamson (2008) argues that the high induced risk may lead risk-averse agents to under-invest and may shorten their time horizon, thus deteriorating investment quality. Van der Ploeg and Poelhekke (2009) discuss causal links between price volatility and growth, and find the standard deviation of output growth is of 7.37% in countries where commodity exports represent more than 19% of GDP, against only 2.83% in countries where that ratio is less than 5%. Cashin and Pattillo (2000) have attempted to document the duration of shocks to derive more insights for policy. They study 42 Sub-Saharan African countries over the 1960-1996 period and show that for about half of them, terms-of-trade shocks tended to be temporary (with half of the effect disappearing within four years) and for another third, permanent. This approach has the advantage of accounting for the specific dependence of given countries to a basket of commodities that behave differently. Yet, it is a leap of faith to assume that future shocks will resemble past ones, and uncertainty remains.

The vulnerability to shocks is broadly confirmed by the empirical literature: terms-of-trade shocks do have an important impact on GDP and growth. Terms-of-trade volatility also increases the volatility of growth ((Deaton, 1999), figure 6*)*, and this is itself detrimental to growth ((Ramey & Ramey, 1995), Figure 7)[4]. This negative effect of volatility on growth is likely to be stronger for developing countries where financial markets are less developed (Aghion, Angeletos, Banerjee, & Manova, 2010). Hausmann et al. (2006) find that terms-of-trade volatility in emerging countries is 3 times higher than in industrial countries, and real income shocks are 3.5 times as volatile there. Williamson (2008) concludes from his literature review that modern econometric evidence over the 1970-2000 period confirms that terms-of-trade volatility has a strong negative impact on long run growth in poor countries. Mendoza (1995), for example, found that shocks account for half of GDP

[4] The negative effects of growth volatility on growth have then be shown by other authors, see among others : (Bourguignon, 2012), (Easterly, Islam, & Stiglitz, 2000), (Hnatkovska & Loayza, 2010), (Kroft & Lloyd-Ellis, 2002), (Martin & Rogers, 2000) and (Mobarak, 2005). Mendoza (1997) also shows a direct negative link of term of trades volatility on consumption growth.

variations in developed countries and 40% in developing countries[5]. Kose (2002) also found that shocks account for almost the totality of the GDP variance in small open developing economies. Schmitt-Grohé and Uribe (2015), however, point to the variability of results. They show that while calibrated business-cycle models show that term-of-trade shocks explain 30 percent of the variance of key macroeconomic variables, results from empirical (SVAR) models lead to a much smaller impact, of the order of 10% and call for further work to reconcile these divergent results.

Figure 7: An apparent correlation between growth and volatility of growth (World Bank data).



Finally, beyond the economic impact briefly discussed here, terms of trade shocks have a substantial social impact. They can quickly plunge millions of people into poverty or starvation (Bredenkamp & Bersch, 2012) and have numerous social consequences (Guillaumont & Puech, 2005). On the whole, Nkurunziza et al. (2017) find that commodity dependence does affect negatively human development for highly commodity-dependent countries. Effects of terms-of-trade shocks are also unequally spread within a country: a negative shock on export prices would affect more the producers of the natural resource, to the benefit of urban inhabitants, for example. In addition, the size of firms matters for their survival: small businesses are much more sensitive to credit shutdowns than bigger ones.

[5] The analysis has not been made for every developed and developing countries but included very different countries to be representative. The analysis was made for years 1955-1990 in developed countries and for years 1960-1990 in developing countries.

3. What role for economic policies?

What kind of normative policy agenda could emerge from the previous discussion? Ultimately, the social objective is to convert exhaustible natural capital into other forms of productive capital, if that does not happen spontaneously. It involves attention to the two main issues addressed above, short-term issues linked to volatility, and long-term issues linked to diversification in the presence of commodities. While the two sets of issues are related, they may sometimes be at odds due to time inconsistent behaviors or to the political economy issues of the arbitrage between the present and the future. As we discussed in the introduction, governments are yet bound to be involved in the management of natural resources, so that the question is not whether they should intervene, but to do what and how.

However, it is useful to build the case for policy progressively, to try to address the various market failures that are tied to commodities. In line with Collier (2012) and Van der Ploeg (2016), we start from the (purely hypothetical) benchmark of a small resource-rich economy with full access to capital markets, producing a freely traded homogeneous good and receiving an exogenous commodity income (pure windfall). There is a domestic physical asset (capital used in production) and foreign assets. Given full access to capital markets, the level of capital used in production is fully determined by profit maximization (here, arbitrage between the net return from production and the international real rate of interest) and does not depend on the exogenous commodity income. Savings and consumption are determined under permanent income, intertemporal utility maximization. Commodity windfalls should therefore not be invested in the domestic economy but used to acquire foreign assets. The effects of temporary negative windfall shocks on consumption are smoothed out by drawing on foreign asset savings (or foreign borrowing), permanent negative shocks are met by spending cuts.

3.1. The "what" and "why" of policies

No developing country, of course, can be described by this benchmark, but distance from the benchmark (including market failures) can inspire policy. This documents the question of what policy should do and why. We briefly review in a literary style a few departures from the benchmark that are relevant for developing countries (see (Van der Ploeg, 2016) for a full model-based discussion).

A first departure from the benchmark is the poor access to financial markets that developing countries often have. With limited access, domestic investment can be financially constrained and suboptimal. Resource exploitation revenues have a crucial role to play in relaxing the financial constraint. This is also intuitively why commodity resources should be seen as a potential blessing for developing countries: by relaxing the financial constraint, they can, in principle, allow proper and productive investment to take place that without them might not. Of course, this possibility immediately faces the challenge of the quality of investment, while the investment climate is seldom propitious in developing countries. Developing domestic financial markets is also

important. Financial markets play a very important role, although it may depend on their level of development. Intuitively, financial markets should help mitigate the impact of shock by notably facilitating risk management and the temporal reallocation of resources. It is likely, however, that these effects depend on their maturity. With very little-developed financial markets, terms-of-trade shocks are simply not transmitted to the rest of the economy, and their impact is consequently subdued. As they develop, however, they also contribute to disseminating shocks, so that they first amplify their impact (whether positive or negative). It is only at a later stage of their development that they provide more sophisticated instruments to mitigate risk, allow longer-term visibility and help dampen the impact of a shock (see (Lautier & Simon, 2004) for a detailed list of useful financial instruments). As analyzed by Céspedes and Velasco (2012), the overall impact of financial markets on dealing with shocks is likely to be hump-shaped, with moderately developed financial markets amplifying shocks.

A second departure is volatility, which introduces uncertainty and the risk of unstable or mistaken expectations. Prevention (building flexibility a priori) is more advisable than prediction, and this calls for risk management approaches and instruments. These can include additional savings (smoothing fund) or specific insurance instruments (hedging on financial markets when available[6], long-term contracts). Frankel (2012) has also offered to denominate debt in terms of the commodity world prices and/or to index local contracts to the commodity world prices. However, both the capacity to generate and manage additional savings, and that to use proper insurance instruments and get them accepted, call for mature institutions and good governance, both in short supply in developing countries. For example, a major issue with the implementation of a smoothing fund is that it requires an accumulation period: the fund must be constituted during a windfall (which is hard to identify and not to enjoy immediately). The size of such a fund can also be a limit when facing very low prices on a long period. Contracts and insurances also require respect of ex-ante commitments, understanding of risks, and willingness to pay ex-ante for risk mitigation (i.e. demand for insurance), three characteristics that are also in short supply in developing countries.

The third departure is the Dutch Disease: there are non-traded goods, and as discussed earlier, the commodity boom (and any boom) means real exchange rate appreciation that crowds out exports and prevents further diversification of the economy. The standard response is to try to dampen that appreciation through appropriate fiscal and monetary policies (Brahmbhatt et al. (2010) provide a summary of various responses). The exchange rate regime also matters. Most of the literature finds that flexible exchange rate regimes dampen the effects of terms-of-trade shocks on economic performance, while these tend to be amplified under fixed exchange rates (see for example (Edwards & Yeyati, 2005), (Jääskelä & Smith, 2013) and (Broda & Tille, 2003)). Attention

[6] For a model-based analysis of the welfare gains induced by financial derivatives, see (Lopez-Martin, Leal, & Fritscher, 2016).

needs also to be given to building the productivity of the non-traded sector, so that increased consumption there is met by increased production rather than a higher relative price and real exchange rate appreciation. This requires time.

Fourth, there is a case for "prospecting on growth" (as described in (Collier, 2012)). Successful development implies faster growth and convergence with richer countries. This also implies that smoothing of consumption over time vouches for higher consumption rates in the early developing years, and therefore lower saving rates – gauged on future growth. However attractive, this argument should be used with caution. Promoting growth is itself a gamble that should not be taken for granted. Although sub-optimal, it is likely that under-consumption is a better bet than future revenues, which is not easy to get, but above all growth expectations are depending on early choices. One should probably not look too hard for the subtle optimum here, because sacrificing growth to early consumption may be worse than under-consuming to guarantee growth.

Finally, the government is not the only agent that matters, and presenting the issues only in terms of shaping centralized policy decisions would be misleading. Even if the government plays a crucial role in the collection and utilization of the natural resource rent, it may not have an advantage over households and firms when it comes to the allocation of spending. Public investment in infrastructures, in research, and in education, are indeed valuable, but private investment also needs to be promoted, lest there could be an excess of public goods over private goods (Collier, 2012).

A few normative conclusions come out of this discussion in terms of policy recommendations. First, fiscal policy is bound to play a huge role in generating and shaping savings and their use. It should be prudent and conservative, countercyclical and smoothing, i.e. strike a balance between two equally wasteful and inequitable scenarios: one of consuming out all resource revenue, and the other one of saving the totality (i.e. postponing consumption into the far-distant future). There are two main objectives there: one is to substitute exhaustible natural capital for other forms of productive capital, and appropriate long-term saving and investment is the conduit to do so. This points to the creation of a sovereign wealth fund, supplied by the revenues of the resource extraction and which should be the motor of long-term development through thoughtful foreign and domestic investments. The second objective is to smooth terms-of-trade shocks, with savings taking place during windfalls and dissaving during slumps. This in turns points to the creation of a smoothing fund, managed independently of the sovereign wealth fund. The frontier between these two should be hermetic, in no way should the sovereign wealth fund be used to serve short-term issues, such as supplying the smoothing fund: it should pursue its only goal of long-term development. The first one oversees the building of productive capital, the second gives continuity to the government's activity. Money should flow out of the smoothing fund *only* when being in a low phase of the cycle. The sovereign fund should not be used for consumption, it should be the key element in the public investing process.

Second, monetary policy can dampen real exchange rate variability. Its credibility and attention to long-term price stability are important determinants. There is ongoing debate about the role of inflation targeting and the choice of an inflation target: headline or core inflation (Anand, Prasad, & Zhang, 2015); product price targeting (Frankel, 2003)[7]. The role of monetary policy also includes management of the real exchange rate through proper reserve accumulation and decumulation. Aizenman et al. (2012), for example, show that active management of international reserves contributed to the adjustment of Latin American countries to the terms-of-trade shocks that they faced between 1970 and 2007. Capital account openness should also be managed carefully, given the destabilizing nature of short-term capital movements linked to commodity price variations and their impact on the exchange rate (for a study of the impact of openness on stability of growth rate see (Combes, Guillaumont, Guillaumont Jeanneney, & Motel Combes, 2000)). Finally, central banks should also be given a role in bank regulation and supervision, in order to monitor the risk of booms leading to excess credit creation, to be followed by debt crises when the slumps occur – something that even mature financial markets do not provide spontaneously.

Collier's (2012) usefully summarizes the policy challenge along three clocks:

- A long-term clock, consisting in successfully managing resource exhaustion, which implies using savings and investment to convert natural capital into other forms of productive capital;
- A short-term clock of managing volatility, which amounts to using savings and insurance and hedging instruments to build risk mitigation during booms and smooth spending during negative shocks;
- Finally, a medium-term clock, which consists in building internal capacity and internal absorption, to create the conditions for proper allocation of resources and profitable investment out of existing resources.

3.2. From the "what" to the "how"

Unfortunately, but unsurprisingly, these largely consensual recommendations have proven hard to implement (see (Venables, 2016), (Bhattacharyya & Collier, 2011)) beyond a couple of successful countries (Botswana, Chile). As already mentioned, it is usually technically difficult to properly read "the cycle", to start accumulating at the right rate at the right moment. Moreover, public sector spending and taxation affect private sector behavior and distort signals and incentives (see notably the critique of Collier and Gunning (1996)): governments do not necessarily have a better knowledge than households and firms about the optimal savings rate. And the investment climate

[7] Headline inflation consists in total inflation, while core inflation is computed excluding volatile prices (usually food and energy, i.e. commodities). Product Price Targeting (PPT), as proposed in (Frankel, 2003), focus on the output instead of consumption, it consists in computing the average inflation of domestically produced goods.

is often hardly conducive to an efficient allocation of resources. Another aspect of these recommendations is that they are quite general and need to be contextualized: their implementation is bound to be highly dependent on the country economic, social, political and institutional characteristics (as illustrated in (Ezema, 2012)). Yet, there is not enough empirical knowledge to transform them into detailed blueprints.

Mostly, political economy considerations provide powerful explanations. Decision makers exhibit a high preference for the present and are tempted to extract the rent too fast (Robinson, Torvik, & Verdier, 2006). Contracyclical policies cannot be sustained if a drop in prices lasts for too long, and booms conversely generate high pressure to spend. Instead of taking on a countercyclical role, fiscal policy often turns out to be pro-cyclical (Alesina, Campante, & Tabellini, 2008). The existence of a rent, by itself, supports strong, authoritarian states which base their power on the rent ((Engerman & Sokoloff, 1997), (Frankel, 2012)) and can be sustained through rent sharing with strategic allies (McGuirk & Burke, 2017). The fight for the rent may increase the incentive for potential competitors to seize power (possibly by force) and thus that of the government to buy social peace through tactical (rather than economically optimal) rent spending and distribution (Tornell & Lane, 1999). Moreover, temptations to misuse the rent may be more powerful in autocratic states than in democracies, leading to higher debt increases in the former (Arezki & Brückner, 2012).

Moving from the "what" to the "how" thus points to a number of principles – rather than detailed policies. First, there is the idea of separation of powers: when funds are created, they need to be managed independently and protected from political interference. This is also one way to contribute to institutional creation and to identify and address capacity issues in a very pragmatic way. Development aid and technical assistance institutions can then offer their help in providing the necessary training. However, a useful first step might be to rely on the central bank, because it has generally built some credibility and some virtue, together with the technical competence that is required, and often with some degree of independence (Collier, 2012). Indeed, as Anand et al. (2015) point out, the central bank is often one of the best managed public institutions in developing countries. It can provide guidance and tutelage for the funds, all the more so that new institutions may tend to be weak in the face of political power.

Second, in countries with weak institutions and governance, rules are often a better option than discretion (as reviewed by Fornero et al. (2016)). They anchor credibility and predictability. There are multiple possibilities: there can be rules on the proportion of resource income that automatically goes into the funds, on the investments to be made from the sovereign wealth funds, on the utilization of resources from the smoothing fund, on how to treat a shock (temporary or permanent), on the evolution of public spending between possible limits, etc. These rules should be protected by the legal system, to provide permanence and the capacity to resist pressures, and to give them a legitimacy that goes beyond fluctuating and fragile political will. Some might even be enshrined in the constitution. Of course, laws or even the constitution can be changed, but it comes at a cost that acts as a restraint on political interference. The main guiding

idea is to combine public action with de-politicization of the collection and use of natural resource income. Some authors (Ross, Mazaheri, & Kaiser, 2012) go as far as recommending barter contracts that delegate the exploitation of the resource to a foreign company in exchange for infrastructure building and investment. This idea has been tested with mixed results between Nigeria and China (Wong, 2009). It may provide an interesting way to shed decisions from political interference, but it lacks basic ownership virtues.

Third, resources need to be properly invested, but this requires capacity that is often lacking. We fully follow Collier (2012) in his recommendation to "invest in investing" – as hinted in the third "clock" mentioned above. This covers many dimensions, from basic infrastructure (without which private investment is less profitable), human capital formation, but also proficiency in project design, evaluation, and implementation.

Fourth, information of the public is a crucial element of ownership of proper rules and policies and of shaping political demand for wise management of natural resources. It is also a crucial determinant of the effectiveness of public policies (see for example (Collier & Gunning, 1996)) by allowing agents to make optimal decisions and by providing the incentives individuals need to understand why taxes are increasing and decreasing and how long is it going to last. Governments should also publish financial information like the current price level, the volatility, and the expected price level. The public is usually quite aware of short-term issues around resource exploitation, but may not be sensitized to longer term issues. The central bank can also be an actor here, as it often already has a role in informing about monetary policy (Collier, 2012).

Fifth, local empowerment also rests on local research capacities. We cannot expect good policies to be shaped only by the influence of foreign advice, even when it comes from the most seasoned academics. The issues identified above need to be debated locally and to be a subject of lively academic debate. Local research is the best way to contextualize the analysis and the recommendations. Research provides much more than an academic product (the research paper): it is the key to establishing a process of on-going, critical and analytical assessment of ideas, issues, and policies. This is what ultimately creates ownership and a better culture of understanding the complex issues related to natural resource management.

Finally, this naturally points to the role of foreign aid. It is still dominated by a sense of superior knowledge of what needs to be done in developing countries. This feeling may actually be legitimate and accurate, but this is not the point. Much more focus should be given to the "how" than to the "what". What is the value of recommending a course of action that cannot be owned locally – or whose local ownership will be only artificially based on the promise of funding? It is ample time to pay more than lip service to the Paris Declaration aid effectiveness principle on ownership. More resources for training, technical assistance, "investment in investing" and research capacity building are urgently needed. More attention to risk management issues would also be welcome, with aid instruments that promote risk management and that offer facilities of risk mitigation, such as loans with insurance components, countercyclical financing instruments, etc.

Instead of trying to come up with development solutions, aid institutions should focus on how to help local actors devise their own solutions and address their own problems.

4. Conclusion

Our goal in this paper has been to draw some policy conclusions from the abundant existing literature on reactions to terms-of-trade shocks. Our first conclusion is that the technical content may have been overemphasized in relation to the policy management aspects: the "how" deserves much more attention if the "what" is ever to become operational. This points to devising approaches that are fully contextualized and shaped in reference to the local political economy environment: poor governance, corruption, unchecked preference for the present, lack of checks and balances in taxing and spending decisions, etc. Our second conclusion is that policies to deal with both short-term and long-term terms of trade movements need to be devised and owned locally, on the basis of a body of empirical knowledge produced and analyzed locally. This does not mean that foreign studies and advice are not useful: on the contrary, their effectiveness is directly linked to the capacity of local academic communities to intermediate it through the domestic policy debate. To that end, much more efforts in local research capacity building are needed. Our third conclusion is in line with Collier's (2012) "Invest in investing" recommendation. The quality of spending and investment requires capacity and complementary investments. Providing them is a priority.

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"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

Pascal

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