Commodity dependence, structural reforms, and commodity trap: South America 1970-2017*

Dependência de commodities, reformas estruturais e armadilha de commodities: América do Sul 1970-2017

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RESUMO: A dependência de *commodities* é uma característica duradoura das economias sul-americanas, com efeitos de longo alcance no desempenho econômico e social. Este artigo centra-se na interacção entre os preços das matérias-primas e a taxa de câmbio real e nos seus efeitos sobre as capacidades produtivas. A abordagem Novo-Desenvolvimentista rotulou essa situação como uma "Doença Holandesa". Proponho um modelo de Crescimento com Restrições da Balança de Pagamentos especialmente concebido para abordar algumas especificidades da dependência de *commodities* que permitem analisar teoricamente esta questão. Os testes empíricos são realizados para o período 1970-2017. Verifica-se que os aumentos de preços são prejudiciais para as capacidades produtivas apenas no contexto do desmantelamento da intervenção estatal.
PALAVRAS-CHAVE: Taxa de câmbio real; modelo de crescimento de restrições da balança de pagamentos; dependência de *commodities*; reformas estruturais.

ABSTRACT: Commodity dependence is a long-lasting feature of South American economies, with far reaching effects in economic and social performance. This paper focuses in the interaction between commodity prices and real exchange rate and in its effects on productive capabilities. New-Developmentalist approach has labeled that situation as a "Dutch-Disease". I propose a Balance of Payment Constraint Growth model especially designed to address some specificities of commodity dependence that allow to theoretically analyze this issue. Empirical tests are conducted for the period 1970-2017. It is found that price surges are damaging for productive capabilities only in the context of the dismantling of state intervention.
KEYWORDS: Real exchange rate; balance of payments constraint growth model; commodity-dependence; structural reforms.
JEL Classification: C23; E12; 011.

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INTRODUCTION

All South American countries are categorized as commodity-dependent (UNCTAD, 2019). Commodity dependence has historical roots, dating back to colonial times. Latin American economic thought has historically identified that dependence as a source of economic and social backwardness and instability. However, during the last century, following a prolonged period of state-led industrialization, which despite mistakes and imbalances, allowed the region to reduce its commodity dependence and to accumulate significant productive capabilities, the region embraced the Washington Consensus, dismantling the regulatory mechanisms, leading to deindustrialization, and to a deepening in commodity dependence (Prebisch, 1949; Bértola & Ocampo, 2013; CEPAL, 2005, 2007; 2014; Ocampo, 2017).

Commodity dependence poses multiple challenges to development, encompassing both, Keynesian (demand-side) and Schumpeterian (supply-side) obstacles. From one side, an unstable and undynamic demand that is expressed in highly volatile relative prices with a long-term downward trend. On the other, very specific productive capabilities, far from most dynamic technological innovations (Ocampo & Parra-Lancourt, 2010; Bértola & Ocampo, 2013; CEPAL, 2014; Dosi et al., 2022).

However, this paper focuses on an additional obstacle, associated to the effects of commodity price-instability on real exchange rates (RER), and consequently, on the competitiveness of non-commodity sectors. This relationship, labeled as a case of Dutch Disease in the literature (Bresser-Pereira, 2008, 2019), has far reaching consequences, since productive and technological capabilities needed to compete in industrial sectors are cumulative, what means that even short or medium term events of currency appreciation can erode long term accumulations, generating hysteresis situations with progressive impoverishment of productive structure (Cimoli & Porcile, 2015).

The objective of this paper is to present and adapt a Balance of Payment Constraint Growth (BPCG) model, especially designed to address some productive and commercial specificities of commodity dependent countries. The aim is to analyze the effects of a surge in commodity prices on the productive structure. Additionally, some empirical tests are conducted for South American countries for the period 1970-2017 to test the relationship between commodity price hikes and accumulation of capabilities in the productive fabric, interacted by public policies. It is found that price surges are damaging for productive capabilities only in the context of the dismantling of state intervention instruments.

THE COMMODITY EXCHANGE TRAP

Most South American economies exhibit a strong negative correlation between commodity prices and RER. Table 1 shows the relationship for most South American countries for different time-windows:

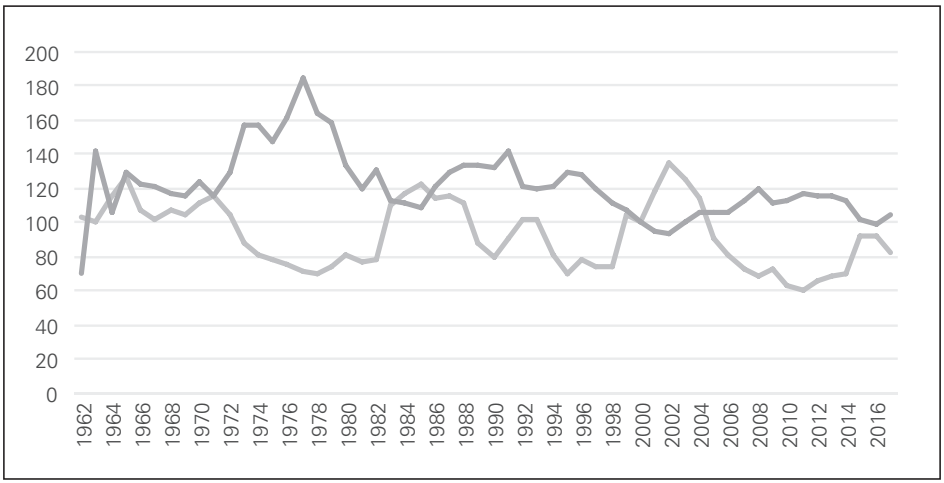
Table 1: South American countries: correlation between export prices and real exchange rate

	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela
since 1962	-0,53	0,58	-0,36	-0,44	0,05	-0,02	0,02	-0,35	0,22	-0,15
since 1970	-0,47	0,39	-0,38	-0,45	0,03	-0,02	-0,01	-0,32	0,04	0,03
since 1980	-0,34	0,04	-0,33	-0,26	0,08	-0,06	-0,12	-0,37	-0,27	-0,03
since 1990	-0,56	-0,28	-0,51	-0,10	0,11	-0,05	-0,53	-0,72	-0,16	0,22
since 2000	-0,35	0,30	-0,87	-0,87	-0,87	-0,54	-0,54	-0,52	-0,34	-0,26

Note: All time-windows end in 2017
Source: Own elaboration based on PWT 9.1[1]

Figure 1 shows this relationship for Brazil, the biggest country in the region and the one that reached the most advanced industrial development during the industrialization period:

Figure 1: Real exchange rate and export prices indexes in Brazil. Year 2000=100



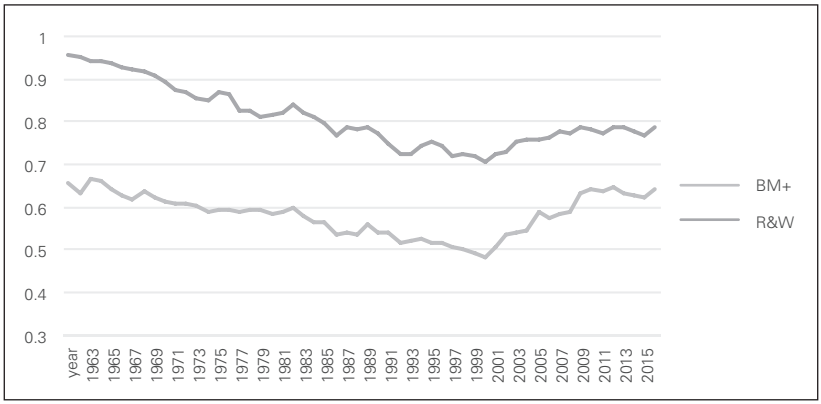
Source: Own elaboration based on PWT 9.1

The consequence of that relationship is that during commodity-booms the currency appreciation erodes the competitiveness of sectors non favored by the price upswing, creating a scenario akin to the Dutch Disease and further deepening commodity dependence (Bresser-Pereira, 2008; Bresser-Pereira et al., 2015; Bresser-

[1] Feenstra et al. (2015)

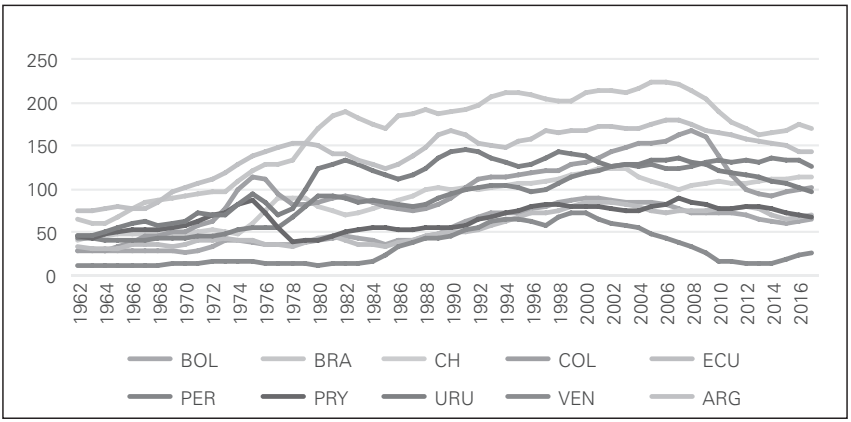
Pereira, 2019). Specially, during the last commodity – boom (2002-2012) it can be observed throughout the region that the share of commodity exports increased hand in hand with a loss in diversification from what a loss of capabilities can be inferred (Figures 2 and 3).

Figure 2: Commodity share in South American exports applying two alternative definitions of *commodities*



Source: Own elaboration based on Atlas Database (Hausmann et al., 2014) and two alternative commodity definitions (World Bank and Radetsky & Warrell, 2021)

Figure 3: Export diversification by country. Number of products exported with Revealed Comparative Advantage (three-year moving average)



Source: Own elaboration based on Atlas Database

But the situation described is more challenging than what conventional Dutch-Disease's model (Corden and Neary, 1982) suggests, since while that model refers to a transition to a new equilibrium, this is a recurrent situation, potentially unleashed by each commodity price-cycle. Furthermore, that recurrence generates a

hysteresis situation. Productive and technological capabilities are cumulative and path dependent, meaning that learning processes require time and practical experience, obtained through production history inside firms and regions (Nelson & Winter, 1982; Katz, 2000). But that accumulation may be rapidly eroded during price-boom phases, given that firms shutdown and productive sectors dismantling implies the loss of accumulated capabilities, which cannot be fully regained during downturns, resulting in progressive productive impoverishment (Cimoli & Porcile, 2015). This is what we call "commodity exchange trap".

Specialization in *commodities* poses multiple challenges to development. On one hand, demand, in long run, shows low dynamism. The idea of income-elasticity of demand of products classified as *commodities* captures the degree of responsiveness of international demand to the growth patterns. Most *commodities* show an income demand elasticity lower than one, meaning that countries specialized in their production will face a slow demand growth affecting their economic dynamism. This is usually referred as Keynesian (in)efficiency (CEPAL, 2014, Dosi et al., 2022). On the other hand, the production of *commodities*, demands and allows the development of less complex capabilities, which are less suitable for a further diversification in comparison to several manufactures and services branches where learning opportunities are bigger. This is known as Schumpeterian (in)efficiency. In this sense, the Economic Complexity approach, has developed a set of innovative indicators to assess this feature, from which de Economic Complexity Index (ECI) is the most popular one. This index assesses the diversification and exclusivity of the export basket of countries or regions, from where it is possible to infer the complexity and diversification of productive capabilities. There is also a mirror indicator to ECI, but which applies to products, the Product Complexity Index (PCI) which shows that while most sophisticated products are pharmaceuticals and industrial machines, most *commodities* rank very low (Hidalgo & Hausmann, 2009; Hausmann et al., 2014; Hidalgo, 2021). In this way, a commodity – trap as outlined previously, not only implies an important threat to productive diversification, but also a condemn to economic backwardness.

THE MODEL

The relationships outlined previously can be explained within the framework of a Balance of Payment Constrained-Growth (BPCG) model, especially designed for developing commodity-dependent countries (Isabella, 2023). It includes two export sectors, *commodities* and manufactures, and does not explicitly consider capital movements, assuming that capital account has to balance in medium to long run.

The three basic equations of the model are as follows:

$$X = g\left(\frac{P}{P*E}\right)^{-\gamma} Y^{*\varepsilon} + d\left(\frac{PcomE}{P}\right)^{\alpha} \qquad (1)$$

$$M = a\left(\frac{P^{*}E}{P}\right)^{-\Psi} Y^{\pi} \qquad (2)$$

$$P = (P^{*}E)^{\beta} C^{1-\beta} \qquad (3)$$

Equation (1) is the exports equation (expressed in real or physical terms), where exports are constituted by two different sectors. First, a traditional industrial export sector (first term on the right side of the equation) which, just as in Thirlwall's (1979) model, depends negatively on relative price to a foreign good, with price P* and where E is the nominal exchange rate, and where $-\gamma$ (γ>0) is the price elasticity of demand. Industrial exports also depend, but positively, on commercial partners income level (Y*), where ε (>0) is the income-elasticity of demand. So, that sector is only demand-restricted in the sense that there are no explicit supply constraints.

Secondly, a commodity export sector, which depends positively on the "commodity export margin", the expression between parenthesis in the second term of the right side (Bianchi et al., 2023, 2024). Commodity export margin relates exporter's unitary income expressed in local currency (in the numerator), with local production costs, approximated by "P", local price-level, in the denominator. Parameter is the "commodity export margin"-elasticity of the commodity supply (and exports, assumed as equivalents), where $\alpha > 0$. This means that commodity supply reacts to variations in its profitability, but that reaction is limited by α, reflecting supply-constraints. This expression for the commodity export sector is the result of assuming some specificities of commodity production and export, like the strong reliance on limited and heterogeneous natural resources, what determines diminishing returns; the highly competitive that most commodity-markets are, and the price exogeneity that most exporters face (Reinert, 1996, 2007; Rodriguez, 2006; Massot & Merga, 2021).

Equation (2) is the import equation, just the same as in Thirlwall (1979), in which imports depend negatively on their relative prices to local products and positively on local income, where is the price elasticity of the demand for imports ($\psi > 0$, which can be understood as the import-substitution coefficient). Finally, equation (3) is a local price-formation-equation, where local prices depend on external prices expressed in local currency (with a weight β) and on local non-tradable costs (C; e.g., salaries).

The standard procedure with that equation-system is to solve for y_B which is the external equilibrium growth rate, as a function of exogenous variables p_{com}, (e-c), p* and y*, where lower-case letters represent the rate of variation of the respective variables in upper-case letters and are the result of time–differentiation of the system.

But our focus now is to understand the effects of a commodity-boom on RER. A commodity-boom strongly increases currency inflows, relaxing the external constraint and paving the way for fast growth. However, if production cannot respond rapidly enough to accelerate growth, increasing imports to fill the external positive gap, the abundance of foreign currency will exert downwards pressures on the exchange rate. In this way, a quite heterodox assumption for this literature is assumed.

That is, given any balance of payments relaxation, it not only income growth but also RER can react to adjust (Razmi, 2016). The local currency appreciation will hurt the competitiveness of industrial exports, unlike commodity exports, which initiated the process with their price hikes.

That can be shown analytically, solving equation system (1) (2) (3) for (e-c) instead of y_B. This expression is the difference between two rates of variations. On one hand, nominal exchange rate, and, assuming arbitrage, tradable prices. On the other, local, non-tradable costs. The difference is the "internal RER" variation (Blecker, 2022):

$$(e\text{-}c) = \frac{yB\,\pi - \theta(1+\alpha)pcom + [1-\beta(1-\theta)+\beta\theta\alpha-(1-\beta)[(\psi)-\Upsilon(1-\theta)]p* -(1-\theta)\varepsilon y*}{[\theta\alpha+\psi+(1-\theta)(\Upsilon-1)](1-\beta)} \quad (4)$$

Where Θ is the share of *commodities* in total exports. From where:

$$\frac{\partial(e-c)}{\partial pcom} = - \frac{\theta(1+\alpha)}{[\theta\ \alpha +\Psi +(1-\theta)(\Upsilon-1)\ ](1-\beta)} \quad (5)$$

Theoretically this expression can take any sign. However, it can be shown that for plausible values of parameters, it will be negative. The condition it must satisfy to be negative is the following:

$$\theta\alpha + \Psi + (1-\theta)\Upsilon > (1-\theta) \quad (6)$$

Conceptually this last inequation states that, given an acceleration in commodity prices, and assuming that all the adjustment is exclusively given through RER, this variable will adjust downwards to keep external equilibrium if the sum of the three positive effects of the RER acceleration on current account surpass its only negative effect. The three positive effects in the sum are, in order, the effect on current account of real growth in commodity exports consequence of its profitability increase ($\Theta\alpha$); the fall in imports given their relative price increase (Ψ) and the effect in foreign currency inflows of the growth (in real terms) of industrial exports given their relative price reduction, when prices are expressed in foreign currency $(1-\theta)\Upsilon$. The only negative effect on current account as a consequence of RER acceleration is the flip side of the last one, and it is the reduction in currency inflows for each unit of industrial product exported, given the price reduction when they are expressed in foreign currency $(1-\theta)$. In this way, if the positive effects surpass the negative one, given a commodity price acceleration, RER must fall so as to avoid external surplus and keep equilibrium.

Given the historical evidence in the sense that a real devaluation normally generates an improvement in current account (and vice versa), and the fact that with any of the three positive effects mentioned being close or bigger to 0.5 it would suffice to assure the fulfilment of expression (6) ($(1-\theta)$ in a commodity-dependent country will be lower than 0.5), it is assumed that this is the general situation, and so, an acceleration in commodity prices will tend to cause a fall in RER variation.

Now our interest is to state the effect of a currency appreciation on the productive structure of the economy. For that purpose, our focus is on the export special-

ization of the country, which can be thought as the productive structure. It can be expressed as follows:

$$\Theta = \frac{\left(\frac{\text{PcomE}}{P}\right)^{\alpha}}{\left(\frac{\text{PcomE}}{P}\right)^{\alpha} + \left(\frac{P}{P*E}\right)^{-\gamma} Y^{*\varepsilon}} \quad (7)$$

As previously mentioned, Θ is the share of *commodities* (numerator) in total exports of the country (denominator). Now, the commodity-boom impact on productive structure can be analyzed, by obtaining the time-variation-rate of Θ:

$$\frac{\partial \theta}{\partial t} = \theta = \alpha\ (p_{com}+e-p) - \{\ \Theta\alpha\ (p_{com}+e-p)+(1-\Theta)[-\gamma(p-p^*-e)+y^*\varepsilon] = \alpha\ (p_{com}+e-p)(1-\Theta)+(1-\Theta)[\gamma(p-p^*-e)-y^*\ \varepsilon]$$

Given: $P = (P^*E)^{\beta}\ C^{1-\beta}$ (equation 3), from where: $p = \beta(p^*+e) + (1-\beta)c$;

$$\theta = (1-\Theta)\{\alpha\ (p_{com}+e-(\ \beta(p^*+e) + (1-\beta)c) + \gamma(\beta(p^*+e) + (1-\beta)c -p^*-e)-y^*\ \varepsilon\}$$

Operating we can get to:

$$\theta = (1-\Theta)\{\alpha\ p_{com}+(1-\beta)(\ \alpha\cdot\gamma)(e-c) - [\ \alpha\ \beta+\gamma(1-\beta)]p^* - y^*\ \varepsilon\} \quad (8)$$

From where:

$$\frac{\partial \theta}{\partial pcom} = (1-\Theta) \quad (9)$$

$$\frac{\partial \theta}{\partial (e-c)} = (1-\Theta)\ (1-\beta)\ (\alpha\cdot\gamma) \quad (10)$$

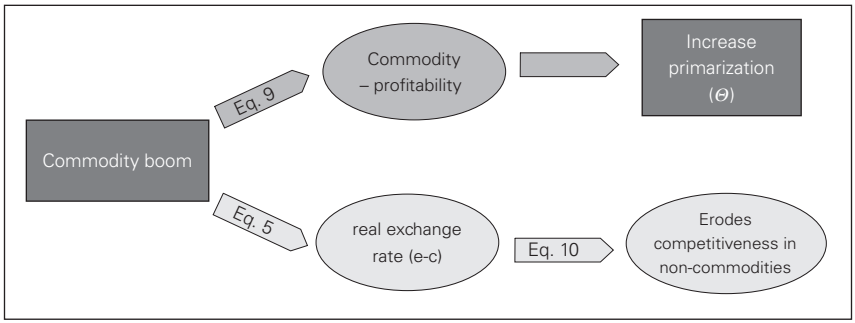
Equation (9) means that, a commodity-price acceleration (commodity-boom), will generate, ceteris paribus, an increase in the commodity-share of exports, that is, a tendency to reprimarization of the economy, because the expression on the right is necessarily positive. That will happen just because *commodities* will become more profitable and producers will increase production either through the extensive margin (expanding the agricultural or mining frontier, exploiting incremental and less productive natural resources) or the intensive one (more capital or innovation over the same natural resources). That process would indeed affect the industrial production as commodity sectors will absorb more investment and other resources. That will happen without assuming yet any change in real exchange rates.

Equation (10) states that, the impact on productive structure of a RER acceleration depends on the relative size of α (the supply elasticity of *commodities* to an increase in export margin), and (the price elasticity of demand of industrial export). Assuming that the later will tend to be relatively high in developing countries given that their export are low-sophisticated and low-differentiated (Oreiro et al., 2015) and the former will tend to be relatively low given commodity production reliance on limited and heterogeneous natural resources eq. (10) will be negative.

These results mean that a price hike in *commodities*, will tend to increase by two different channels: through a direct effect associated to the increase in profitability of commodity exports (eq. 9), and through an indirect effect through a de-

celeration in RER (eq. 5) which tends to increase the commodity-share in exports (eq. 10). This last effect is consequence of the erosion in competitive conditions in non-commodity activities because of the exchange rate reaction to the commodity price increase and would constitute the core of the commodity exchange trap. Figure 4 shows these two different channels.

Figure 4: The two channels through which a commodity – price hike affects productive structure



Source: Own elaboration

The model also implies the opposite, that is, that given a downturn in commodity prices, the effect in productive structure will tend to be an increase in the share of industrial sectors. But this conclusion has to be discussed. As was explained in the last section, competitiveness in industrial exports depends on productivity and innovation, which in turn, depends on productive capabilities. Those capabilities are the consequence of long run processes of learning and accumulation in which path dependency is critical. In that sense, long run processes of accumulation can be rapidly eroded with the shutdown of industries and the dismantling of productive fabric. But the opposite does not hold, and the recreation of those productive assets would take long time. That is why the erosive effect of price cycles are accumulative.

THE STRUCTURAL REFORMS

However, the narrative till this point presupposes an absence of state intervention, which sustaining exchange rate and/or supporting affected sectors, could alter the outcome. Effectively, during the industrialization period in Latin America (1930-1980), the national states developed a wide variety of instruments to intervene in economy so as to sustain and deepens the industrialization. Those instruments included several interventions in currency exchange markets and even the exchange rates administrative determination, industrial policies to support targeted industries, direct intervention in production through state-owned companies, and very high tariffs in strategic sectors to promote import substitution and protect new industries (Bértola & Ocampo, 2013).

But these instruments where dismantled since the 1970s and, especially during the 1990s, as part of the "structural reforms". This expression denominates the policies emanated from a deep reorientation of economic (and beyond) conceptions, that took place in most Latin American countries, and all South American ones, during the last quarter of last century, in the framework of the Washington Consensus. The Developmentalist ideas of industrialization, market protection and administrative allocation of resources were replaced by the neoclassical conception of openness, liberalization and deregulation, as means to get efficient allocation of resources, lower production costs and growth. In this framework, international specialization was conceived as the natural result of incentives deriving from international price system and free trade, with the result of aligning specialization with static comparative advantages. Free international capital movements were conceived as the best way to access to international investment financing (Lora, 2001; Stalling & Peres, 2010).

Despite having covered all the countries in the region, these reforms showed different speeds across countries. In the 70's the South Cone countries (Argentina, Chile and Uruguay) were the leaders in implementing those policies, while during the 90's the rest of the countries caught-up. Additionally, in some countries the reforms advanced more in one dimension (like capital account liberalization or tariff reduction), while in others the priority dimensions were different (like privatization or domestic capital market deregulation) (Morley et al., 1999; Lora, 2001). In this way, Stalling & Peres (2000) state that despite Chile was a leader implementing an aggressive financial and commercial opening in the 70's, those reforms seemed moderate later, in the light of the depth of the reforms in the same direction in other countries during the 90's.

To summarize these processes, several authors proposed summary indexes for the different reform areas covering a period spanning from de 1970's till the end of the century. In this paper, Morley at al. (1999) indexes are used, as explained in next section.

HYPOTHESIS AND METHODOLOGY

The hypothesis states a negative relation between commodity prices and the complexity of productive structure of the countries in South America, specially, but not only, through their effect on RER. A strong acceleration on commodity prices, besides making the production and export of *commodities* more profitable, increasing the allocation of resources to their production (and partially subtracting them from other activities), increases the foreign currency influxes, tending to appreciate local currency, and then, affecting the competitiveness of other tradable sectors not benefitted from the price upswing. In this way the commodity-share in exports and in value added will tend to increase, and the share of more complex activities to

reduce. But this process is mediated by public policies, which could diminish or even block those effects, through exchange market regulation and productive policies supporting affected activities. But those policies require the decision and the instruments needed to intervene, which are negatively associated to the advance in the structural reforms. So, the sketched process will be stronger, the more advanced the structural reform.

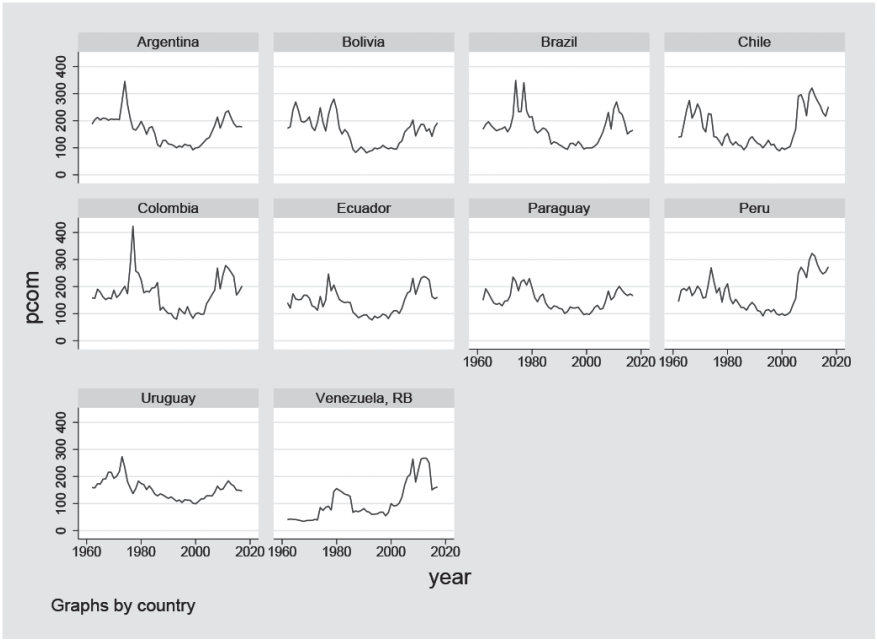
To test the hypothesis, econometric panel data methods are used, for all South American countries along the period 1970-2017. As dependent variable the ECI is used to measure economic complexity, as a proxy of productive capabilities accumulation. This decision softens a possible endogeneity problem that would arise if the dependent variable would be the commodity share in exports. In that case, a price increase would generate, just through a nominal effect, an increase in the share of *commodities*, even without any real effect. The use of ECI, even if not completely isolated from that risk, limits it. The sign that the commodity price variable takes in most results show that the risk did not materialize.

To capture the varying evolution of commodity prices faced by each country, a commodity-price index for each country is used. This index was specifically built in the framework of this research. For that task, World Bank Commodity Price Data (The Pink Sheet)[2] (WB database henceforth) was used, from where annual prices for 47 *commodities*; including food, metals and minerals, raw materials, and fuels; are taken for the whole period. Additionally, the price of paper pulp was added from Federal Reserve Economic Data. In the third place, information of trade flows was taken from the Atlas of Economic Complexity Database (Hausmann et al., 2014)[3], using Standard International Trade Classification (SITC) at 4-digit disaggregation. This provides annual information of exports and imports for more than 100 countries in more than 700 goods. Each commodity from WB database was associated to the corresponding good in SITC classification, to create a database where not only exports values are considered, but also individual commodity prices. With that information a country specific commodity price index was created, in which each commodity ponderation is given by the share of that commodity in total commodity exports of the country in any specific year. Figure 5 shows country indexes for South American countries, for the period 1962-2017, where the different impact of recent commodity boom can be observed.

[2] https://www.worldbank.org/en/research/commodity-markets

[3] https://atlas.cid.harvard.edu/

Figure 5: Country specific commodity price indexes for South American countries



Source: Own elaboration, based on World Bank Commodity Price Data and The Atlas of Economic Complexity Database

As anticipated, to consider the advance degree of structural reforms, Morley et al. (1999) indexes are used. These authors propose indexes covering 5 different areas for the period 1970-1995, the most intense reform period, in all cases ranging from 0 to 1, where the higher the index, the more advanced the liberalization process. The reform areas covered by the indexes are: commercial reforms (measuring the level and dispersion of tariffs), domestic financial reform (measuring controls and requirements on loans and debts and reserve requirements of banks), international financial liberalization (controls on foreign investment, limits to capital repatriation and capital outflows and controls on external credits to local agents), tax reform (maximum rate on taxes to firms and individuals, VAT rate and efficiency) and privatizations (added value on state-owned companies as a share of non-agricultural GDP). Additionally, they provide a summary index averaging these five categories. From these set of indexes, and according to the objective of the paper, there are only used some of them. Firstly, and more intensively, the summary index, which gives an overview of the general reform process, and is the one that is going to be interacted with the commodity prices as will be explained later. This decision seeks to capture in only one variable most of the information about the structural reform process. Additionally, the international financial liberalization index and the domestic financial reform index are also included. The first of these indexes is the most specific to the objectives we are interested on, since it focuses on the cap-

ital inflows and outflows, which may affect the real exchange rate. The second one, since it may capture an additional effect of reform processes on the economy, beyond the real exchange rate, as is the efficiency of the capital allocation. Despite the commercial reform index could also provide important information in relation to the interest of this research, the authors warn about some problems with it, what may affect its performance (Morley et al., 1999, page 8). Additionally, the correlation among the different indexes is quite high, from which the additional information that an extra index can provide is not determinant. As can be seen in Table 2, the correlation coefficient between the general reform index and the commercial index is greater than 0.72.

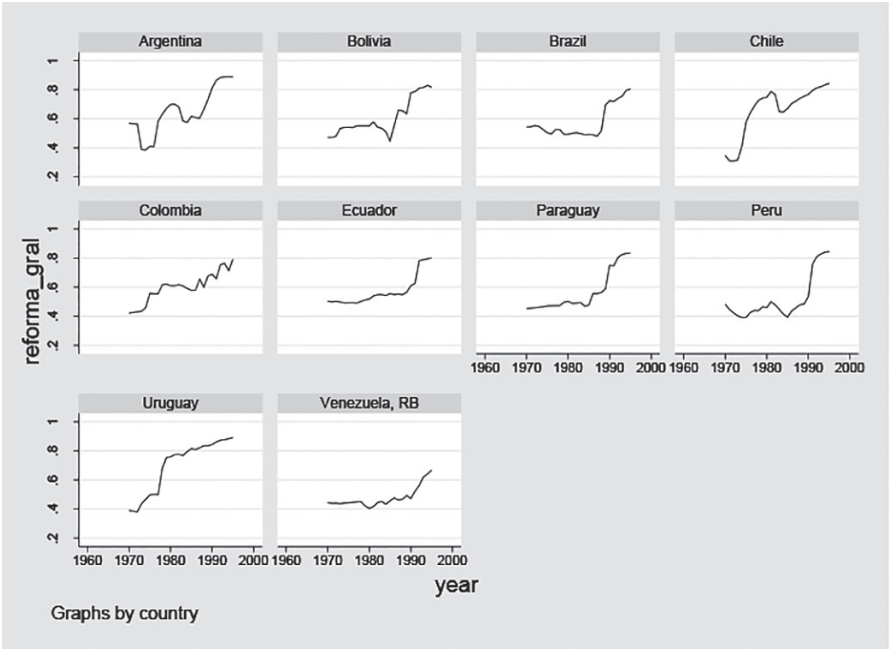
Table 2: Correlation coefficients between reform indexes 1970-1995

Correlations	Commercial	Int.financial	Dom.financial	General ind.
Comercial	1			
Int.financial	0.3524	1		
Dom.financial	0.5853	0.2146	1	
General ind.	0.7218	0.4498	0.8637	1

Source: Own elaboration based on Morley et al. (1999).
Note: Int.financial means International financial liberalization and Dom. financial refers to domestic financial liberalization

As mentioned, Morley et al. (1999) indexes cover the period 1970-1995, while we want to test the hypothesis for a much longer period. To that end, a first set of regressions for the period 1970-2002 is made, assuming that after 1995, up until 2002, the reform indexes take the value of 1 for every country. In this way, the indexes just stop operating in the regressions after 1995. This is clearly a limitation of the analysis, but acceptable given the fact that, firstly, South American countries tended to converge to very high levels in the reform process during the nineties, and the period in which the value of indexes is arbitrarily assigned is short. In that way, Morley et al. (1999) state that a characteristic of the reform process was convergence, in the sense that the countries that embraced the process later, like Paraguay or Peru, were those that advanced faster once started. Figure 6 shows the value of the average index for each country.

Figure 6: Structural reform general index evolution by country.



Source: Morley et al., 1999

Additionally, although later some of these reforms were retraced in some countries, we aim to assess the permanent impact on productive structure of a historical process like the structural reforms in South American countries that took place from 1970s to 1990s.

On a second set of regressions, the same assumption is made, but the analysis will cover a longer period, 1970-2017, what means that we are taking greater risks given that the information of structural reform process spans just till 1995, so these last set of regressions will be less reliable.

The specification tested is as follows:

$$ECI_{it} = \beta 0 + \beta 1\ Pcom_{it-1} + \beta 2\ Reforms_{it-1} + \beta 3\ Pcom*Reforms_{it-1} + X_{it} + \delta i + u_{it} \qquad (11)$$

In this specification $\mathbf{Pcom}_{\mathbf{it-1}}$ refers to the specific commodity-price index; $\mathbf{Reforms}_{\mathbf{it-1}}$ refers to the structural reforms indexes from Morley et al. (1999) and $\mathbf{Pcom*Reforms}_{\mathbf{it-1}}$ refers to the interaction of both indicators, using the general reform index. All variables mentioned are specific for each country "i" and refer to period "t-1", that is, they are lagged one period to avoid endogeneity problems. **δi** represents the fix effects by country and X_{it} refers to control variables.

Even when a negative sign is expected for β1 and β2, reflecting the currency inflows and the dismantling of intervention instruments effects on economic complexity, the main interest in this specification is to test whether $\beta 3 < 0$, meaning that there is an additional effect stemming from the mutual reinforcement of both fac-

tors, that is, price hikes are specially damaging for the countries that have renounced to intervene trying to block or diminish those impacts.

We are looking for a medium-term relationship, in the sense that, facing competitiveness challenges of the kind previously explained, firms and productive sectors probably do not shut down immediately, but they can manage to resist for some time and so the effects on complexity are only observable sometime later. That is why data is grouped in triennials, where each data is the average of the three years involved.

In this way we are assessing the relationship between the two extreme variables of the process sketched in Figure 4, that is, between commodity prices and productive complexity. In that figure we showed that there are two different channels through which that relationship can occur, the relative profitability of commodity production/exports and the real exchange rate and its effects on non-commodity competitiveness, what we called, "the commodity exchange trap". With this specification we cannot evaluate which of those channels is operating and in equation (11) the role of real exchange rate is left unnoticed. So, just as an auxiliary regression, to show that real exchange rate matters, and in addition to information showed in Table 1, equation 12 is also tested:

$$RER_{it} = \beta 0 + \beta 1\ Pcom_{it-1} + \beta 2\ Reforms_{it-1} + \beta 3\ Pcom*Reforms_{it-1} + X_{it} + \delta i + u_{it} \qquad (12)$$

In eq. 12, RER_{it} refers to the real exchange rate (in relation to United States) of country "i" in year "t", while the rest of variables are the same of eq. 11. With this specification the only objective is to test the first step of the second channel depicted in Figure 4, also stated by equation 5, that is, that a price hike will tend to appreciate RER ($\beta 1<0$) and, also, that the interaction with reforms matter, that is, that a price variation will have a differential effect on RER depending on the degree of reforms advance of the country ($\beta 3 \neq 0$). In this case, as the dependent variable is very volatile, our focus is on short run relations, because of what the panel is run with annual data.

RESULTS

In this section the empirical results are exposed. Firstly, the results for the specification (11); in the first place for the period 1970-2002, and then for the period 1970-2017. Then, the results for the auxiliary specification (12). Table 3 shows the results for the period 1970-2002:

Table 3: Regression results for ECI for the period 1970-2002

Dependent Variable ECIit	FE simple	FE interaction	FE robust	Random EF
Pcom t-1	0.001**	0.005***	0.005*	0.005***
Reform_gral t-1	0.229	0.849	0.849	0.887*
Reform_fin t-1	0.269	0.389*	0.389	0.381*
Reform_CapAcc t-1	-0.473**	-0.399*	-0.399	-0.425**
Reforma*Pcom t-1	-	-0.008**	-0.008*	-0.007**
Openess	-	0.003	0.003	-0.092
Constant	-0.373**	-0.795***	-0.795*	-0.788***
N	100	100	100	100
N_g	10	10	10	10
chi2			21138	
F	3.664	3.231	3675	
r2	0.146	0.188	0.188	
Legend:	* p<.1;	** p<.05;	*** p<.01	

Source: Own elaboration

Four different models are tested. In the first column, a simple fixed effect regression without interaction term, just to observe the sign of regressors. The second column is the complete model with interaction term and the commercial openness of the country (export plus imports as a share of GDP) as a control variable. Third column includes standard error adjustment to cope with possible heteroscedasticity problems and the fourth is a random effect regression, only as a robustness check. It can be seen that, perhaps quite surprisingly, commodity price sign is always positive and significant, meaning that, isolating other effects (as will be explained next) the relationship with complexity is positive, what could be related to its internal-markets reinforcing effects, where firms can make learning processes and scale economies to face external competition. Although reform variables on their own are generally not significant, the consistently negative interaction term confirms the hypothesis that a surge in commodity prices negatively impacts capabilities accumulation, but only within the context of the dismantling of intervention instruments through the advancement of the structural reform process. Additionally, the only individual reform variable generally significant is the international financial reform variable ("Reform_CapAcc", for capital account liberalization), whose negative sign means that the more financially open the country, the more rapidly it loses capabilities, reinforcing the idea that the dismantling of capital controls negatively affects the capabilities, probably through a more intense RER volatility. The domestic financial reform (reform_fin) is weakly positive, suggesting possible positive effects, perhaps improving the access to financing to new firms. Table 4 shows the results for the period 1970-2017:

Table 4: Regression results for ECI for the period 1970-2017

Dependent Variable ECIit	FE simple	FE interaction	FE robust	Random EF
Pcom t-1	-0.001**	0.003***	0.003	0.003***
Reform_gral t-1	-0.719**	-0.395	-0.395	-0.313
Reform_fin t-1	0.267	0.491**	0.491	0.482**
Reform_CapAcc t-1	0.060	0.130	0.130	0.095
Reforma*Pcom t-1	-	-0.005***	-0.005*	-0.005***
Openess	-	0.756***	0.756**	0.666***
Constant	0.190**	-0.506**	-0.506	-0.517**
N	150	150	150	150
N_g	10000	10000	10000	10000
chi2	46251			
F	6320	8476	4724	
r2	0.157	0.275	0.275	
Legend:	* p<.1;	**p<.05;	***p<.01	

Source: Own elaboration

In the first place, again the interaction term is negative and significant, confirming, once more, the hypothesis. Interestingly, now, in the regression without interaction term, the commodity price variable shows a negative sign, what is certainly capturing the commodity-boom in a period in which capabilities loss deepened, but once the interaction term is added, the sign reverses and get positive again, what reinforces the idea that de damaging effect on capabilities accumulation of commodity price-hikes, only operates when the state has renounced to its intervention tools, paving the way for a full operation of the commodity exchange trap. Now the international financial reform variable lost its significance.

Finally, the set of regressions where the RER is the dependent variable is shown in Table 5. Again, four different specifications are tested; a simple relation between RER and prices (with constant and fixed effects by countries, as in all specifications); a second specification including the reform variables and two specifications with the complete model, including interactions, the last one robust to heteroscedasticity. It can be seen that commodity prices (lagged one year) shows, in all the specifications, a negative and significant effect on the RER, reinforcing the idea that an important channel through which the erosion in productive capabilities confirmed in previous regressions occurs is the RER-appreciation facing commodity price increases.

Table 5: Regression results for RER for the period 1970-2017

Variable	FE simple	FE reforms	FE interaction	FE robust
Pcom t-1	-0.003***	-0.003***	-0.004***	-0.004**
Reform_gral t-1		0.600*	-0.207	-0.207
Reform_fin t-1		0.098	-0.074	-0.074
Reform_CapAcc t-1		-0.554***	0.373	0.373
Reform*Pcom t-1			0.008***	0.008**
ReformCA*Pcom t-1			-0.006***	-0.006*
Openess			-0.873***	-0.873
Constant	2.207***	2.115***	2.305***	2.305***
N	550	470	470	470
N_g	10	10	10	10
F	69.538	22.742	16.807	18.470
r2	0.114	0.166	0.206	0.206
Legend:			*p<.1; ** p<.05; *** p<.01	

Only the international financial reform variable shows a robust significance when no interactions are considered (negative sign as expected) but it is lost with the interactions. In this case two different interactions were tested; using the general reform index, as in previous regressions, and interacting the international financial reform variable with the commodity-prices. The reason for this is that in this case we are studying just the effects on RER, a much specific variable than productive capabilities, and which would show a much looser relation with other variables like the rules to assign credits or the privatization process, all considered in the general reform index. As expected, the interaction variables are significant, and despite the positive sign of the interaction with the general reform process is intriguing and would require further research, the negative sign in the case of the international financial liberalization, confirms the idea that prices hikes press to currency revaluation in these countries, and specifically, that relation is reinforced with the opening and deregulation of the capital account. That is, the commodity exchange trap exists, and it was consolidated with the international financial liberalization.

CONCLUSIONS

In this paper, it was proposed a BPCG model, especially designed to cope with the specificities of commodity exports and their interactions with other export sectors in the face of commodity-price instability, inspired by current situation in South

American countries. It is shown that, within this framework, a surge in commodity prices may intensify commodity dependence and have a negative impact on productive capabilities in other export sectors. That may happen through the increase in commodity export profitability and through its effect on RER, leading to overvaluation of local currency.

But that succession of events presupposes the absence of state intervention. In fact, during the state-led industrialization period (1930-1980), a wide set of intervention instruments were developed in the region so as to regulate or control the exchange rate, support strategic industrial sectors and protect local markets from external competition. But within the framework of the Washington Consensus in the subsequent decades, the 'Structural Reforms' carried out across the entire region, albeit at different paces, dismantled those instruments.

The hypothesis proposed, states a negative relation between commodity prices and the complexity of productive structure of the countries in South America mediated by the public policies, which could diminish or even block those effects, through exchange market regulation and productive policies supporting affected activities. So, the expected relation would be stronger, the more advanced the structural reforms.

Empirical tests, for two different time-periods confirm the negative impact on productive capabilities (observed through economic complexity) of the interaction between commodity prices and structural-reform advances. That is interpreted in the sense that faced with a surge in commodity-prices, countries that had dismantled more deeply their intervention instruments, experience deeper loss of capabilities. In fact, once removed this interaction effect, the impact of commodity prices in complexity turns positive, possibly related to their dynamic effects on internal markets, what allow firms to expand their operations leading to learning processes and scale economies which can then be exploited in external markets. Also, it was shown that the RER channel operates, confirming the idea of a commodity exchange trap for South American commodity dependent countries.

These results give insights about the importance of state intervention through exchange market regulation and industrial policies, especially for commodity dependent developing countries. Technological learning, international competition and development, at the face of international demand patterns, commodity-price volatility, and short-term capital flows implies enormous challenges for South American countries that cannot be met without strategic state intervention. In the name of efficiency, institutional tools for economic policy were dismantled in the last quarter of last century, affecting the productive fabric and making the countries more and more dependent on *commodities*. However, high price-cycles can be exploited in the sense of productive transformation, given that they may have a positive effect reinforcing internal markets. But it will demand an institutional recreation of state tools for economic intervention.

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