UNIVERSIDAD SAN FRANCISCO DE QUITO USFQ

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How does commodity dependence on exports affect long-term economic growth?

Emilio José Cevallos Donoso
George Sebastian Apolo Campoverde
Stephany Carolina Mantilla Salgado

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Nombre del profesor, Título académico **Carlos Uribe, Ph. D.**

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Nombres y apellidos: Stephany Carolina Mantilla Salgado

Código: 00138483

Cédula de identidad: 1717723009

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Emilio, George y Stephany

RESUMEN

Para entender si los recursos naturales son una limitación para la prosperidad económica, estudiamos cómo la dependencia de las exportaciones de commodities afecta al crecimiento económico a largo plazo según el nivel de ingresos de los países. Utilizamos modelos de regresión lineal evaluando un conjunto de datos panel del Banco Mundial para el período 1960-2019 para 228 territorios reconocidos, donde elaboramos un estimador de efectos fijos modelados para encontrar efectos tanto al corto como al largo plazo sobre el crecimiento del PIB per cápita a largo plazo. Debido a la relevancia del fenómeno del mal holandés, concentrarse en los recursos naturales como principal determinante de la renta podría provocar estragos en el crecimiento económico. Encontramos que una dependencia a corto y largo plazo de las exportaciones de commodities conlleva un impacto negativo en el PIB per cápita a largo plazo, y que esto es especialmente grave para los países de renta baja y media, donde la dependencia de los commodities tiende a ser mayor, y por tanto son más vulnerables a la volatilidad de los precios de los mismos.

Palabras clave: commodities, crecimiento económico, exportaciones, largo plazo, mal holandés, PIB per capita, modelo de data panel, nivel de ingresos

ABSTRACT

To understand if natural resources are a limitation for economic prosperity, we study how commodity dependence on exports affects long-term economic growth according to income categorization. We use linear regression models by evaluating a World Bank panel dataset for the period of 1960-2019 for 228 recognized territories, where we elaborate a modeled fixed-effects estimator in order to find short and long-run effects on long-term GDP per capita growth. Due to the relevance of the Dutch disease phenomenon, concentrating on natural resources as a main determinant of income could provoke strains on long-term economic growth. We find that a short and long-term dependence on commodity exports lead to a negative impact in long-run GDP per capita, and that this is especially severe for low and middle-income countries, where commodity dependence tends to be higher, and therefore are more vulnerable to commodity price volatility.

Key words: commodities, economic growth, long-run, Dutch disease, exports, GDP per capita, panel data model, income level, income level

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INTRODUCTION

Commodity goods such as fuels, agricultural raw materials, metals and ores, and food comprise a notable share of total merchandise exports as well as GDP amongst developing countries and emerging markets. According to a study conducted by the Food and Agriculture Organization of the United Nations, it has been considered that a country that depends heavily on commodity exports could possibly see their economic performance affected, since this dependence can incite negative and unstable trade terms, macroeconomic volatility, political instability, and even empirical evidence of the Dutch Disease (2017).

Figure 1 provides a graphical illustration of this negative relationship between commodity dependence and long-term economic growth. To recognize this, we focus our attention on South Korea, which has a 12% participation of commodity exports and a long-term economic growth of 1470%, whereas opposite to this, we have Ecuador, which with a 93% participation it presents a 105% long-term economic growth. This can also be seen on Figure 2, where we construct commodity dependence per commodity category, showing that for each of the four, there is a negative relationship between participation and long-term economic growth.

In this paper, we analyze the effect that commodity dependence[1] on exports has on long-term economic growth, while focusing on countries' income level[2]. To do so, we exploit a worldwide data set which contains information from 228 recognized territories for the 1960 – 2019 period, resulting in an unbalanced panel with 13.427 observations. Our strategy focuses on different linear regressions. First, we estimate an OLS regression and proceed with random and fixed-effects estimations. We conduct a parametric approximation for the fixed effects, by giving said effect a

[1] Based on total commodity participation as a percentage of total merchandise exports.
[2] Defined by the World Bank's threshold of income levels in which countries are categorized by GNI per capita.

functional form after retrieving the averages of each variable, which allows us to recover measurements and fit the model to the panel data. To obtain more robust standard errors, we cluster our data by country, and follow with bootstrap simulations to increase precision.

We find that there is a significant correlation between short and long-term dependence of commodity exports on long-term economic growth, in which the greater the dependence, the lower the long-term rate of growth. The model implies that an increase of one standard deviation in short term commodity dependence on exports reduces long-term economic growth by 0.201 standard deviations, whereas long-term dependence reduces growth by 0.166 standard deviations. Regarding the effects of dependence in compliance to income levels, when there is an increase of one standard deviation on short-term commodity export participation, long-term economic growth is reduced by 0.06 standard deviations on low-income countries and 0.1347 standard deviations on middle-income ones.

The mentioned relationship and its effects have been accounted for across time in the economic field. Evidence has been found when focusing the study of how commodity prices affect GDP growth. As Ge and Tang state, since commodity markets differ from traditional economic markets by combining properties of 'the goods market and the financial market' (2020, p.1), commodity prices can be good predictors of the economic cycle. For instance, Fama and French (1988), as cited in Commodity prices and GDP growth, find that 'a rapid increase in metal prices occurs before the economy reaches its peak and a quick decline occurs after the peak', and therefore, since for many countries commodities represent a major proportion of their national income, 'a secular decline in commodity prices would lead to long-run economic stagnation' (p.1). Rabah Arezki (2011) uses a panel dataset of 158 countries from 1970-2007, proving a positive impact of commodity price volatility on economic growth sorted by political system. Despite the

influence of prices on economic growth for third world countries, there are other channels of impact such as total factor productivity, human capital acquisition and physical capital accumulation (de v Cavalcanti, 2011) that can create inequality in exporting countries if there is an existent commodity price boom (Engerman,1997).

In this paper we aim to contribute to this area of literature by giving empirical evidence on theories that prove the negative effect of the Dutch disease. We do this by focusing on providing evidence based on commodity concentration on exports and not on the price of said commodities.

The remainder of this paper unfolds as follows. Section 2 provides the empirical strategy used in our investigation, while Section 3 describes the data recollected. Section 4 discusses the results of our study and Section 5 concludes.

METHODOLOGY

The empirical strategy we use in our study compiles a comparison of several linear regresion models, with the objective of analyzing the dependent variable of long-term economic growth. The structural form this model adopts is:

$$G_{it} = \phi + \delta y_{it} + \xi I_{it} y_{it} + \mathbf{X}_{it}\lambda + \alpha_i + \varepsilon_{it} \quad (1)$$

Where G_{it} is long-term economic growth, $\mathbf{X}_{it}$ is a matrix that contains structural[3] economic controls that vary across time and countries, α_i indicates the fixed effects, and ε_{it} is the error term. We model marginal effects as $y_{it} + I_{it} y_{it}$ where y_{it} is short-term commodity dependence on exports and $I_{it} y_{it}$ is an interaction heterogenous effect with I_{it} being a time variant categorical variable that denotes income level per country.

We start by conducting an OLS regression model. We recognize that using this model can be ineffective, since it does not account for either fixed or random effects that come with a panel data set. This could lead to biased estimations. We find this assumption to be valid in our study and we discuss it in the results section.

Our model is based on recovering a random effects estimator that is combined with a modeled fixed-effects estimator. This is done by obtaining averages of each explanatory variable across time, therefore applying a between transformation (Wooldridge, 2002). We have:

$$\alpha_i = \overline{\mathbf{X}}_{it}\widetilde{\lambda} + \widetilde{\delta}\overline{y}_{it} + \mu_i \quad (2)$$

with μ_i being an uncorrelated error term. Combining both (1) and (2), we obtain

$$G_{it} = \phi + \delta y_{it} + \xi I_{it} y_{it} + \mathbf{X}_{it}\lambda + \widetilde{\delta}\overline{y}_i + \overline{\mathbf{X}}_i\widetilde{\lambda} + \varepsilon_{it} + \mu_i$$

[3] We recognize that a variable is considered structured if it is expected to have small variations in the short run (Uribe-Teran & Mosquera, 2018).

Where $\overline{y}_i$ and $\overline{\mathbf{X}}_i$ are the demeaned versions of each set of variables, allowing $\widetilde{\lambda}$ and $\widetilde{\delta}$ to represent the long-term effects. This is due to a within transformation that includes the demeaning of the variables in the total effect, given by $\widetilde{\omega} = \omega + \overline{\omega}\, for\, \omega \epsilon \{\lambda, \delta\}$.

We apply clusters by country since we recognize that grouping our data accounts for serial correlation in panel data errors.[4] By clustering, we are correcting the standard error bias that would otherwise be triggered and affect our inference. Similarly, we have applied nonparametric bootstrap[5] simulations to our regression across our models. This method performs nonparametric estimation of specified expressions by carrying out several re-samples of our regressions, consisting in repeating the estimations in order to stabilize the standard errors and approximate them to the most empirical distribution possible. This avoids the assumption of normally distributed standard errors.

[4] Serial correlation in the errors in a panel data model occurs when the error for each time period contains a time-constant omitted factor. (Woolridge, 2002)

[5] After running several simulations, we notice a stabilization of the standard errors when reaching 10.000 bootstrap simulations.

DATA

Our sample is gathered from the World Development Indicators data set of the World Bank. Our data constitutes a panel from 1960 to 2019, distributed among 228 countries and territories recognized by the institution. Considering the World Bank is a recognized organization, the Data Bank offers a wide variety of time-series data along various topics needed in economic research, which presents an accurate global representation on national, regional, and global indicators.

To analyze long-term economic growth, we estimate a percentage variation of the logarithm of per capita GDP, relative to the first available observation for each country.

We find that for some countries, there are time periods that are missing for some units, and vice-versa, which leaves us with an unbalanced panel (Wooldridge, 2002). In our study, this arises more often in developing or low-income countries since earlier data recollection is harder to retrieve. In total, this compiles 13,426 observations on our database. The descriptive statistics of these variables can be found in Table 1 and further details in Appendix B.

Main regressors.

We measure commodity dependence on exports as a sum of the participation (in %) of four commodity categories on total merchandise exports. These categories are as follows: agricultural raw materials, food, fuel, and metals and ores. It should be emphasized, that the World Bank considers manufacture exports along merchandise exports. However, we have excluded this category in our analysis considering it is not grouped as a commodity. Regarding this regressor,

we expect to obtain a negative sign for the estimated coefficient given that the higher the dependence on these exports' categories, the lower the long-term economic growth should be.

Variable	Units	Obs	Mean	Std. Dev.	Min	Max
country	category	13.426	114,744	66,172	1	228
year	years	13.427	1990,266	17,64	1960	2020
long-term growth	%	9.264	0,511	0,603	-1,325	3,761
commodity exports	%	7.049	58,666	36,225	0,172	821,853
mean commodity	%	11.880	61,147	31,273	4,645	270,177
low income	category	13.427	0,702	0,458	0	1
middle income	category	13.427	0,107	0,31	0	1
high income	category	13.427	0,191	0,393	0	1
total commodity imports	%	7.071	0,327	0,12	0,015	0,957
merchandise trade as a % of GDP	%	9.315	0,906	14,22	0	435,219
total population	billions	12911	24335531	1,021E+08	3893	1,40E+09
inflation	%	7.840	23	335,65	-30,243	23773,132
GDP per capita	Log	9.470	8	1,525	4,883	12,186
initial GDP per capita	US$ K	12.360	8	1,457	5,033	11,858

Table 1: Descriptive statistics

We use the mean of commodity exports, built as an average of total commodity dependence per country. We should also observe a negative sign for this variable since this average provides the effect of a long-term commodity dependence. Furthermore, our data is compiled in categories of income levels following the World Bank's guidelines[6]. This allows us to divide the countries and territories between three thresholds that are qualified according to the respective GNI per capita, with data from 1989 to 2018: 'low income', 'middle income' and 'high income'. For this,

[6] The income classification is based on a measure of national income per person, or GNI per capita, calculated using the Atlas method. (Wadhwa & Prydz, 2019)

we use a dummy variable to identify the income level per country, taking a value of one when the countries in question are considered a low or middle-income country accordingly, and a value of zero if the country is considered a high-income country. Relative to this, we compute interactions between commodity dependence on exports and income level. We foresee that economies with low and middle-income categorizations are in a worse position relative to high-income ones, which are often more industrialized. Countries in the former are more susceptible to a volatile income caused by commodity dependence than the latter, therefore we should observe negative signs for these variables: as the income level worsens, the long-term economic growth rate should decline.

Control variables.

In terms of economic growth, the first value recorded for GDP per capita is important since it gives us an expectation of what the long-term growth rate for each country would be. We should observe a negative sign coefficient since this variable gives us an initial convergence result. This occurs since the higher the initial GDP, the lower the growth rate ends up being given that it converges to a steady state, and in doing so it converges to a lower growth rate overall.

We consider total commodity imports exactly as we did for commodity exports, but, in this case it is as a sum of the participation (in %) of the same four commodity categories on total merchandise imports. To measure how trade balance affects economic growth specifically through exports, it is important to consider the effect that imports, as well as a separate variable of total merchandise trade as a percentage of GDP, could weigh on said impact. We expect a negative and positive sign for these coefficients, respectively, both in the short and in the long run.

Additionally, we monitor inflation and total population since they both affect GDP per capita in the long run. We aim to observe a negative sign in the short and long-term, because higher

inflation will lead to a reduction in purchasing power parity also provoking in turn a lower economic growth.

We consider that in the short-run, total population will provoke a positive change in the economy since it betters the probability of output, but in the long-run, if the economic system is not managed correctly, income inequality could arise, provoking a lower economic growth. It is important to recognize that this could vary between countries and how rapid their population growth occurs. Many countries that experience a rapid population growth could show negative changes in real per capita GDP, but others in the same position could also have a rapid increase in per capita GDP. Knowing this, we foresee uncertainty[7] regarding total population in our results.

It is important to emphasize that all long-run effects are time-invariant variables, which are obtained by demeaning all controls considered in our regression which allows to eliminate variation over time and obtain long-term effects of each variable, respectively, on long-term economic growth. Lastly, we include temporal effects, by denoting a dummy variable that identifies each year in our panel dataset.

We find a negative correlation between long-term economic growth and both total commodity exports as well as per commodity exports, as seen in Figure 1 and Figure 2. We establish that countries with higher commodity dependence on exports have lower economic growth over time, while countries with lower dependence tend to have a higher long-term economic growth. This paves us a path of where our study will take us.

[7] Studies have shown that there is no systematic relationship between the rates of population and income growth. (UNDP, 2007). See Appendix C for further details.

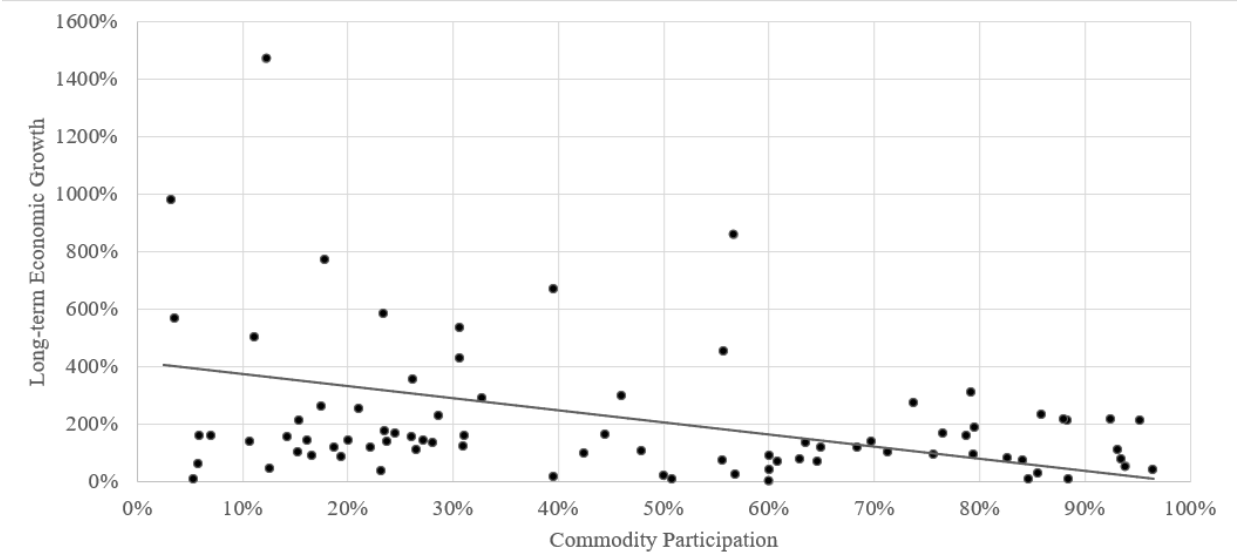
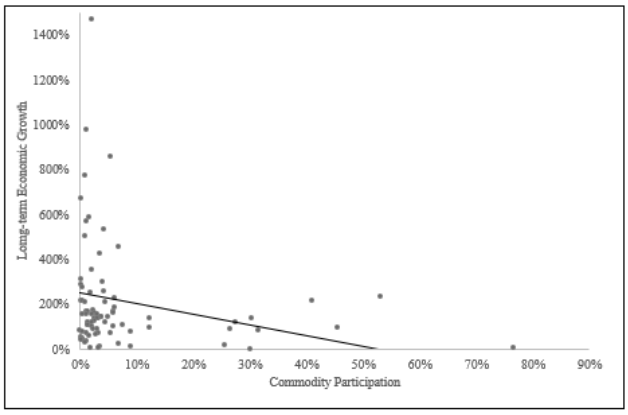
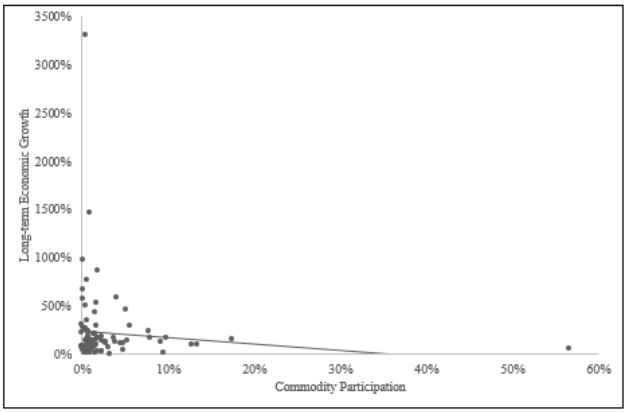


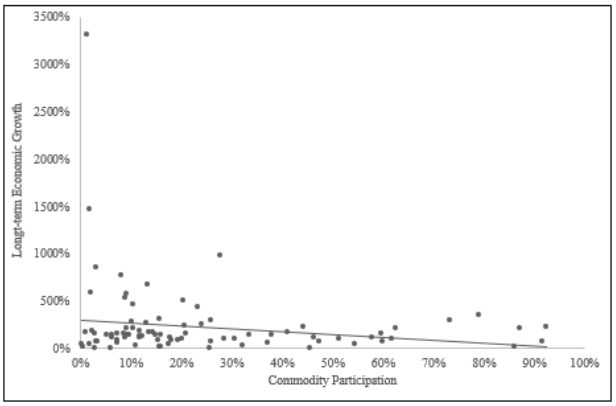
Figure 1: Relationship between long-term economic growth and total commodity exports. This figure shows the long-term economic growth measured by the percentual variation per country of the GDP per capita (in constant 2010 US$) between 1970 and 2018, and total commodity exports as a sum of four commodity categories: fuels, metals and ores, agricultural raw materials, and food.

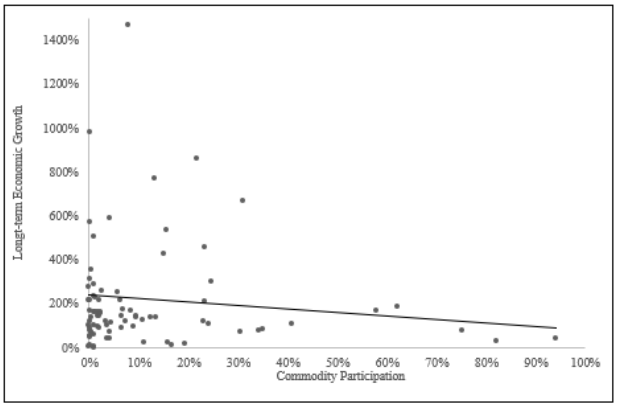


a) Food exports



b) Fuel exports





c) Metals and ores

d) Agricultural Raw Materials

Figure 2: Relationship between the commodity dependence on exports sorted by commodity category and long-term economic growth. This figure shows the long-term economic growth and total commodity exports, determined by each commodity category. All categories represent a percentage of total merchandise exports.

RESULTS

Table 2 compiles the effects of commodity dependence on exports on long-term economic growth, under three different scenarios. Column (1) corresponds to the OLS model, column (2) to the fixed-effects model, column (3) to the modeled fixed-effect model and columns (4) and (5) to the last two regressions with applied bootstrap, respectively. Given that our database has considerable variety in the units between variables, which could cause a scale problem, we apply standardization all of our variables in order to avoid the risk of obtaining misleading results. The rest of the variables studied can be found in Appendix D.

Regarding the first scenario, column (1) reveals a significant relationship between short-term total commodity dependence on exports and long-term economic growth. Nevertheless, the impact long-term commodity dependence on exports has on growth proves to be insignificant, which counteracts theoretical evidence. Jaffee (1985) presents the general idea that various forms of 'economic dependence will have negative effects on the economic growth of nations', which included export dependence. Despite the fact that there is evidence that proves a positive effect of export dependence on economic growth, the same effect is 'either reduced or reversed' under conditions of 'commodity concentration' (p.102).

After proving that the OLS model is a biased estimation of our regression and of our expected results, we conduct a modeled fixed-effects estimation. This choice is justified by a Hausman test that leads to the conclusion that the null hypothesis, which establishes that the random effects model is appropriate, is rejected at any level of significance, proving that the use of the modeled fixed-effects estimator is preferred which is why we focus our attention on the results provided by said regression.

This model illustrates the expected signs, since we find that the effect on long-term economic growth is of -0.201 and -0.166 standard deviations from a one standard deviation change in short-term and long-term commodity dependence on exports, respectively. Additionally, the p-value associated with the independent variables in question proves them to be significant at a 1% level, demonstrating its strong correlation with long-term growth.

This last effect is upheld by long tradition of economic research, showing that commodity dependence on exports can provoke strains on long-term economic growth, especially when it is proceeded by the Dutch-Disease phenomenon. As Rudd accounts for in his paper An Empirical Analysis of Dutch Disease: Developing and Developed Countries in 1996, the Netherlands discovered the Slochteren gas fields in the late 1950's which led to a rapid exploitation of the natural resource. Because of this, the country quickly became 'a net exporter of natural gas' which led to a 'huge increase in revenues' (p.1). The country started depending their income on this sector, which led to an exponential increase in government revenues, but instead declined inflow from other non-resource exports sectors.

The reason for this, as Brahmbhatt et.al in 2010 determine, is that there are two types of effects that lead to this disease. First, the spending effect, which occurs 'when increased domestic income from the booming natural resource sector leads to higher aggregate demand and spending by the public and private sectors' (p.2) which contributes to higher prices and output in the non-tradable sector. Second, the resource movement effect, which occurs 'when a boom in the natural resource sector attracts capital and labor from other parts of the economy' (p.2) which in turn prompts to a reduction in output in the rest of the economy. Thus, depending economically on commodity exports, and therefore overlooking other economic sectors, would provoke some growth-enhancing economic qualities to be disregarded, such as 'positive technological spillovers,

learning by doing effects' and 'increasing returns to scale in production', as well as 'resource depletion and employment' (p.3), marked by 'a decline of the non-resource exports sector' (Collier & Goderis, 2012).

When it comes to evaluating the impact of total commodity participation by the income-level threshold that a country is categorized into, we also find the expected signs for the respective coefficients. The total effect of a one standard deviation change in commodity participation on long-term economic growth in low-income countries is -0.06 standard deviations lower than high-income countries, whereas the effect for middle-income countries is -0.1347 lower.

The thesis that argues this last negative effect is based on different perspectives. First, the country's vulnerability is contingent to their 'commodities price fluctuation, the pattern of export commodity specialization, the level of commodity concentration' or 'the economic state of the world economy' (Jaffee, 1985, p.106). Second, the 'export enclave theses' stated by Cardoso and Faletto cited in Jaffee, determines that the export enterprises in the less developed world are largely foreign owned, meaning that the largest proportion of the profits are exported by these multinational firms. Similarly, other studies have emphasized how price volatility affects rich and poor countries, especially in third world economies, which usually have a higher export concentration, are the most vulnerable in their terms of trade (Williamson, 2012) and in turn see their long-run growth diminished (Acemoglu et al., 2003). Therefore, natural resource abundance is considered as having a negative impact on growth, making a reliance on export trade a 'developmental dead-end' according to dependency theorists. (Jaffee, 1985, p.103).

For the structural controls included in our model, inflation, and merchandise trade as a percentage of GDP exhibit the expected signs both in the short and the long run but come out as insignificant when accounted for their short-term effect. This could be explained because both of

these variables will not suffer significant change in the short-run and therefore will not affect long-term growth. Nonetheless, by providing the long-term effects of said variables, they both turn out to be significant.[8] Inflation then proves to have a negative effect and merchandise trade a positive one. On the contrary, total commodity imports and total population prove to be significant only in the short run.

	(1) OLS	(2) FE	(3) MFE	(4) BTFE	(5) BTMFE
Commodity exports	-0.298***	-0.195***	-0.201***	-0.202***	-0.201***
	(0.0920)	(0.0745)	(0.0171)	(0.0745)	(0.0212)
Mean of Commodity exports	-0,0266		-0.166***		-0.166***
	(0.0682)		(0.0463)		(0.0124)
Low income	-1.785***	-0.539***	-0.572***	-0.544***	-0.572***
	(0.184)	(0.103)	(0.0254)	(0.102)	(0.0293)
Middle income	-0.870***	-0.272***	-0.285***	-0.274***	-0.285***
	(0.129)	(0.0674)	(0.0199)	(0.0678)	(0.0200)
Low income x commodity exports	-0.00281	0.144*	0.141***	0.146*	0.141***
	(0.0899)	(0.0747)	(0.0152)	(0.0757)	(0.0184)
Middle income x commodity exports	0.110	0.0651	0.0663***	0.0672	0.0663***
	(0.124)	(0.0733)	(0.0218)	(0.0755)	(0.0226)
Inflation	-0,00651	-0.00810**	-0,00809	-0,00821	-0,00809
	(0.00756)	(0.0037)	(0.0089)	(0.0729)	(0.0102)
Total Population	0.442***	0.212***	0.216***	0,212	0.216***
	(0.0935)	(0.0489)	(0.0154)	(0.132)	(0.017)
Merchandise trade as a percentage of GDP	-0.00669*	0.00547*	0,00504	0,00522	0,00504
	(0.00343)	(0.00329)	(0.00829)	(10801.9)	(0.00494)

[8] See Appendix D.

Merchandise trade as a percentage of GDP	-0.00669*	0.00547*	0,00504	0,00522	0,00504
	(0.00343)	(0.00329)	(0.00829)	(10801.9)	(0.00494)
Total imports	-0,0212	-0.105***	-0.103***	-0.104***	-0.103***
	(0.036)	(0.0306)	(0.00784)	(0.0293)	(0.00949)
Constant	1.302***	-0.480***	-0.556***	-0.593	-0.556***
	(0.208)	(0.156)	(0.0794)	(687.8)	(0.106)
N	5553	5553	5553	5553	5553
R^2	0.552	0.694			

Notes: Standard errors are in parenthesis. MFE refers to our modeled fixed effects regression. BTFE and BTME are based on 10.000 bootstrap replications and refer to our fixed-effects estimator regression and our modeled fixed-effects estimator regression, respectively. All variables are standardized.

Table 2: Commodity dependence in exports and long-term-economic growth

CONCLUSION

In this paper we argued that long-term economic growth can be strongly affected when a country depends on commodity exports as a main source of income, and this effect can be more accentuated when the country in question is considered to be either a low or middle-income country. For this, we based our study on a panel dataset of 228 territories recognized by the World Bank for the 1960-2019 period, which contained long-term economic growth defined by GDP per capita values, resulting in a sample of 13.427 observations. We used the classification of income group thresholds that the World Bank developed based on the Atlas method, established since 1989.

The main objective of our study was understanding the effect a country can observe on its long-term economy when their trade balance's exports depends mainly in commodities. We used several linear regression models that consisted in a random and fixed effects estimator. After running these regressions, we recognized that the best alternative was introducing a modeled fixed-effect regression, in which we obtained its approximation by demeaning all of the regressors present in our structural model. This parametric transformation allowed us to recover the long-term effects of each variable in the long-term economic growth. Furthermore, we used both clustered standard errors and bootstrap resampling at a country level, granting more empirical distributions of said errors and therefore, more accurate coefficients in our regressions.

We found that commodity dependence on exports has both short and long-term negative effects over long-term economic growth, and that this effect is adequately stronger for low and middle-income countries. Our contribution in this area consisted in evaluating the effect as the

proportion they englobed in total merchandise exports, and by categorizing said proportion depending on the income level each country fell into.

The limitations of our strategy rely mainly on the dismissed variables that could show a more broad and accurate understanding of how the commodity dependence phenomenon affects countries on the long term. These variables could be focused on governance indexes, such as corruption, rule of law and openness to trade, since we consider these variables could give a more authentic representation of low and middle-income countries' vulnerability to this dependence. We also recognize the importance of studying how and why countries react differently to price volatility, and also how countries' geographical location could set them up for long-term failure by depending on natural resources as their first source of income.

We believe that diving further in this area of study could open diverse approaches as to how commodity dependence affects not only economic growth, but also socio-economic areas of development. Taking into consideration the negative effects that basing the economy of a country in non-renewable resources for a long period of time could be crucial to understanding why other sectors of the economy should be developed in order to mantain a proper and sustainable economic growth. This could also be portrayed by evaluating the outcomes of commodity dependence on relevant areas of development, such as education and health.

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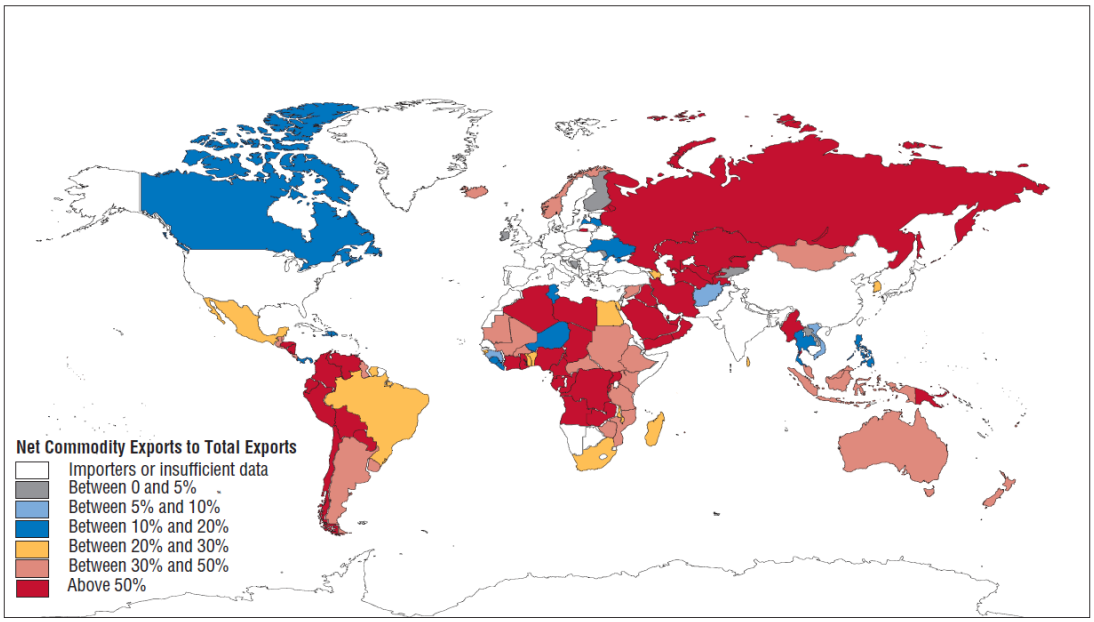
APPENDIX A: SHARE OF NET COMMODITY EXPORTS IN TOTAL EXPORTS AND GDP (PERCENT)

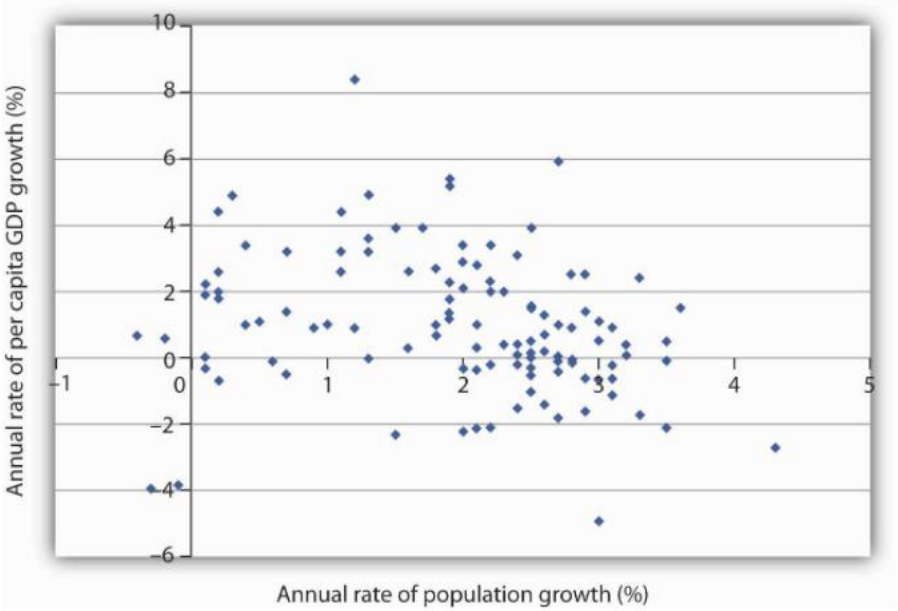


Note: IMF staff calculations. This map shows the economy average using the available yearly data for 1962-2010.

APPENDIX B: SUMMARY OF VARIABLES

Variable Name	Variable Label
country	Country Name
year	Time
commodity exports	Sum of all four commodity categories as a % of merchandise exports
mean commodity exports	Mean of total commodity exports as a % of merchandise exports, per country
long-term growth	Difference between log_gdp and initial_gdp, in constant 2010 US$
merchandise trade as a % of gdp	Merchandise trade (% of GDP)
total population	Population, total (in billions)
inflation	Inflation, consumer prices (annual %)
GDP per capita	GDP per capita (constant 2010 US$)
logarithm of GDP per capita	Logarithm of GDP per capita (in constant 2010 US$)
logarithm of GNI per capita	Logarithm of GNI per capita, per country
initial GDP per capita	Repeats value of gdpmin per country, per year
mean of GDP per capita	Mean of gdp per capita(in constant 2010$), per country
mean of inflation	Mean of inflation (from consumer prices annual%), per country
mean of total population	Mean of total population (in billions), per country
mean of agricultural exports	Mean of raw agricultural material exports
mean of merchandise trade	Mean of merchandise trade (% of GDP), per country
total imports	Sum of all four commodity categories within imports (excluding manufacture)
low income	Low income country
middle income	Middle income country
high income	High income country
food exports	Food exports (% of merchandise exports)
metal and ores exports	Ores and metals exports (% of merchandise exports)
fuel exports	Fuel exports (% of merchandise exports)
agricultural exports	Agricultural raw materials exports (% of merchandise exports)
agricultural imports	Agricultural raw materials exports (% of merchandise exports)
fuel imports	Fuel imports (% of merchandise imports)
food imports	Food imports (% of merchandise imports)
metal and ores imports	Ores and metals imports (% of merchandise imports)

APPENDIX C: POPULATION AND INCOME GROWTH, 1975-2005.



Note: This scatter plot, developed by the United Nations Development Program on the Human Development Report of 2007/2008, shows that population growth rates versus GNP per capita growth rates for various developing countries in the 1975-2005 period do not prove to have a systematic relationship.

APPENDIX D : REGRESSION RESULTS (CONTINUED)

	(1) OLS	(2) FE	(3) RE	(4) BTFE	(5) BTRE
initial GDP per capita	-0.965***		-0.716***		-0.716***
	(0.127)		(0.0829)		(0.0126)
mean of GDP per capita	0.700***		0.599***		0.599***
	(0.149)		(0.109)		(0.0118)
mean of inflation	-0,0359		-0,0429		-0.0429***
	(0.037)		(0.0422)		(0.0058)
mean of total population	-0.428***		-0.127***		-0.127***
	(0.0607)		(0.043)		(0.0206)
mean of merchandise trade	0.128***		0,03		0.0300***
	(0.0186)		(0.0466)		(0.00703)
mean of total imports	0,00523		-0,00456		-0,00456
	(0.0494)		(0.0464)		(0.00882)
1962	0	0	0	0	0
	(.)	(.)	(.)	0	0
1963	0,0516	0.102**	0,1	0.101**	0,1
	(0.0486)	(0.042)	(0.0793)	(0.0429)	(0.13)
1964	0.0841*	0.154***	0.152*	0.153***	0,152
	(0.0493)	(0.0521)	(0.0779)	(0.0523)	(0.134)
1965	0.106**	0.251***	0.248***	0.249***	0.248*
	(0.051)	(0.0631)	(0.0751)	(0.0634)	(0.127)
1966	0.129**	0.289***	0.286***	0.288***	0.286**
	(0.0591)	(0.0656)	(0.0752)	(0.0659)	(0.126)
1967	0.136**	0.313***	0.309***	0.311***	0.309**
	(0.0651)	(0.0729)	(0.0743)	(0.073)	(0.124)
1968	0.187***	0.385***	0.381***	0.383***	0.381***
	(0.0712)	(0.0772)	(0.0744)	(0.0776)	(0.122)
1969	0.226***	0.449***	0.444***	0.447***	0.444***
	(0.077)	(0.0812)	(0.0737)	(0.0811)	(0.119)
1970	0.261***	0.520***	0.515***	0.518***	0.515***
	(0.0768)	(0.082)	(0.0726)	(0.0822)	(0.115)
1971	0.266***	0.534***	0.529***	0.532***	0.529***

	(0.0822)	(0.0873)	(0.0715)	(0.0876)	(0.114)
1972	0.291***	0.586***	0.580***	0.583***	0.580***
	(0.0844)	(0.0907)	(0.0711)	(0.091)	(0.114)
1973	0.360***	0.661***	0.655***	0.658***	0.655***
	(0.0848)	(0.0922)	(0.0713)	(0.0925)	(0.112)
1974	0.403***	0.790***	0.783***	0.786***	0.783***
	(0.0923)	(0.0938)	(0.0699)	(0.0941)	(0.113)
1975	0.414***	0.776***	0.769***	0.772***	0.769***
	(0.0946)	(0.0945)	(0.0698)	(0.095)	(0.111)
1976	0.462***	0.803***	0.796***	0.799***	0.796***
	(0.0974)	(0.0978)	(0.0696)	(0.0979)	(0.111)
1977	0.516***	0.831***	0.825***	0.828***	0.825***
	(0.0962)	(0.0971)	(0.0699)	(0.0972)	(0.11)
1978	0.506***	0.843***	0.837***	0.839***	0.837***
	(0.0934)	(0.0985)	(0.0697)	(0.0983)	(0.108)
1979	0.568***	0.919***	0.912***	0.916***	0.912***
	(0.0975)	(0.1)	(0.0702)	(0.1)	(0.107)
1980	0.616***	0.947***	0.940***	0.943***	0.940***
	(0.0988)	(0.105)	(0.0701)	(0.104)	(0.108)
1981	0.582***	0.986***	0.978***	0.982***	0.978***
	(0.103)	(0.105)	(0.0693)	(0.105)	(0.107)
1982	0.636***	0.964***	0.957***	0.959***	0.957***
	(0.0987)	(0.106)	(0.0697)	(0.106)	(0.106)
1983	0.578***	0.923***	0.916***	0.919***	0.916***
	(0.1)	(0.109)	(0.0694)	(0.109)	(0.105)
1984	0.610***	0.958***	0.951***	0.954***	0.951***
	(0.108)	(0.112)	(0.0703)	(0.111)	(0.105)
1985	0.635***	0.954***	0.947***	0.950***	0.947***
	(0.108)	(0.114)	(0.0702)	(0.113)	(0.105)
1986	0.659***	0.940***	0.934***	0.936***	0.934***
	(0.11)	(0.122)	(0.0706)	(0.121)	(0.105)
1987	0.632***	0.935***	0.928***	0.931***	0.928***
	(0.113)	(0.129)	(0.0705)	(0.126)	(0.107)

1988	0.922***	1.075***	1.071***	1.072***	1.071***
	(0.153)	(0.143)	(0.0885)	(0.141)	(0.11)
1989	-0.457**	0.597***	0.567***	0.588***	0.567***
	(0.193)	(0.134)	(0.0822)	(0.132)	(0.109)
1990	-0.437**	0.649***	0.619***	0.641***	0.619***
	(0.181)	(0.133)	(0.0785)	(0.13)	(0.106)
1991	-0.505***	0.632***	0.601***	0.623***	0.601***
	(0.18)	(0.138)	(0.0767)	(0.135)	(0.108)
1992	-0.520***	0.629***	0.598***	0.620***	0.598***
	(0.171)	(0.143)	(0.0746)	(0.139)	(0.108)
1993	-0.535***	0.642***	0.611***	0.633***	0.611***
	(0.172)	(0.145)	(0.0732)	(0.141)	(0.108)
1994	-0.487***	0.685***	0.654***	0.676***	0.654***
	(0.163)	(0.143)	(0.0721)	(0.139)	(0.107)
1995	-0.522***	0.708***	0.675***	0.698***	0.675***
	(0.164)	(0.141)	(0.0713)	(0.138)	(0.106)
1996	-0.516***	0.720***	0.688***	0.710***	0.688***
	(0.157)	(0.139)	(0.07)	(0.136)	(0.106)
1997	-0.541***	0.709***	0.676***	0.699***	0.676***
	(0.16)	(0.142)	(0.0698)	(0.138)	(0.106)
1998	-0.561***	0.699***	0.666***	0.689***	0.666***
	(0.157)	(0.143)	(0.0698)	(0.139)	(0.106)
1999	-0.552***	0.725***	0.691***	0.715***	0.691***
	(0.158)	(0.145)	(0.0697)	(0.141)	(0.106)
2000	-0.525***	0.792***	0.757***	0.781***	0.757***
	(0.157)	(0.144)	(0.0693)	(0.14)	(0.105)
2001	-0.468***	0.830***	0.796***	0.819***	0.796***
	(0.153)	(0.144)	(0.069)	(0.14)	(0.105)
2002	-0.476***	0.846***	0.810***	0.834***	0.810***
	(0.156)	(0.147)	(0.0692)	(0.143)	(0.105)
2003	-0.438***	0.898***	0.862***	0.887***	0.862***
	(0.156)	(0.147)	(0.069)	(0.143)	(0.105)

2004	-0.421***	0.946***	0.908***	0.934***	0.908***
	(0.16)	(0.149)	(0.0692)	(0.145)	(0.105)
2005	-0.384**	1.011***	0.973***	1.000***	0.973***
	(0.164)	(0.15)	(0.0693)	(0.146)	(0.105)
2006	-0.336**	1.085***	1.046***	1.073***	1.046***
	(0.165)	(0.15)	(0.0693)	(0.146)	(0.105)
2007	-0.312*	1.153***	1.113***	1.140***	1.113***
	(0.168)	(0.151)	(0.0693)	(0.147)	(0.106)
2008	-0.375**	1.184***	1.142***	1.171***	1.142***
	(0.176)	(0.154)	(0.0697)	(0.15)	(0.106)
2009	-0.415**	1.132***	1.090***	1.119***	1.090***
	(0.176)	(0.155)	(0.0697)	(0.15)	(0.106)
2010	-0.368**	1.185***	1.143***	1.172***	1.143***
	(0.174)	(0.155)	(0.0695)	(0.151)	(0.106)
2011	-0.312*	1.247***	1.206***	1.235***	1.206***
	(-0.177)	(0.154)	(0.0696)	(0.15)	(0.106)
2012	-0.322*	1.278***	1.235***	1.265***	1.235***
	(0.182)	(0.156)	(0.0699)	(0.152)	(0.107)
2013	-0.330*	1.288***	1.244***	1.275***	1.244***
	(0.181)	(0.157)	(0.07)	(0.152)	(0.107)
2014	-0,287	1.323***	1.280***	1.310***	1.280***
	(0.18)	(0.157)	(0.07)	(0.153)	(0.108)
2015	-0,288	1.305***	1.262***	1.292***	1.262***
	(0.18)	(0.158)	-0,0701	(0.153)	(0.108)
2016	-0,259	1.314***	1.271***	1.301***	1.271***
	(0.179)	(0.158)	(0.0702)	(0.153)	(0.108)
2017	-0,237	1.358***	1.315***	1.345***	1.315***
	(-0.182)	(0.158)	(0.0703)	(0.153)	(0.108)
2018	-0,164	1.412***	1.370***	1.400***	1.370***
	(0.185)	(0.157)	(0.0706)	(0.153)	(0.11)
2019	1.273***	1.899***	1.884***	1.892***	1.884***
	(0.14)	(0.152)	(0.0686)	(0.15)	(0.11)
Constant	1.302***	-0.480***	-0.556***	-0,593	-0.556***

	(0.208)	(0.156)	(0.0794)	(687.8)	(0.106)
N	5553	5553	5553	5553	5553
R^2	0,552	0,694			

Notes: Standard errors are in parenthesis. MFE refers to our modeled fixed effects regression. BTFE and BTME are based on 10.000 bootstrap replications and refer to our fixed-effects estimator regression and our modeled fixed-effects estimator regression, respectively. All variables are standardized.