DOCUMENTOS DE TRABAJO

The Resource Curse: Does Fiscal Policy Make a Difference?

Álvaro Aguirre
Mario Giarda

N.º 761 Julio 2015

BANCO CENTRAL DE CHILE

DOCUMENTOS DE TRABAJO

The Resource Curse: Does Fiscal Policy Make a Difference?

Álvaro Aguirre
Mario Giarda

N.º 761 Julio 2015

BANCO CENTRAL DE CHILE

BANCO CENTRAL DE CHILE

CENTRAL BANK OF CHILE

Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
Agustinas 1180, Santiago, Chile
Teléfono: (56-2) 3882475; Fax: (56-2) 3882231

Documento de Trabajo
N° 761

Working Paper
N° 761

THE RESOURCE CURSE: DOES FISCAL POLICY MAKE A DIFFERENCE?*

Álvaro Aguirre
Banco Central de Chile

Mario Giarda
Barcelona GSE

Abstract

This paper explores empirically the relationship between commodity prices, fiscal policy, and income per capita. First we construct time-varying indicators of fiscal cyclicality for 121 countries since 1970. Then we estimate panel data cointegrating vectors between income per capita, an index of commodity prices, and an interaction between commodity prices and our fiscal cyclicality indicators. We do this for different groups of commodities and different groups of countries. The results confirm the existence of a resource curse, which is contingent on the quality of institutions and varies with the type of commodities. The new findings are related to fiscal policy. The cyclical conduct of fiscal policy explains a large fraction of the long-run effects of commodity prices on GDP per capita. The systematic response of fiscal spending to changes in commodity prices beyond the cyclical stance of the economy is relevant for obtaining this result. In general, if fiscal policy is conducted in a procyclical way, the long-run effect of an increase in commodity prices becomes more negative. But this is not always the case.For certain commodities and group of countries the effect is the opposite. All of these results are driven by the time variation in fiscal policy and obtained after controlling for institutional quality.

Resumen

Este trabajo explota empíricamente la relación entre precios de commodities, política fiscal e ingreso per-cápita. Primero construimos indicadores de ciclicidad fiscal móviles para 121 países desde el año 1970. Luego estimamos vectores de cointegración con datos de panel entre ingreso per-cápita, un índice de precios de commodities y una interacción entre precios de commodities y nuestros indicadores de ciclicidad fiscal. Esto lo hacemos para diferentes grupos de commodities y grupos de países. Los resultados confirman la existencia de la maldición de los recursos naturales, que es contingente a la calidad de las instituciones y varía con el tipo de recurso natural. Los nuevos resultados están relacionados a la política fiscal. La conducta cíclica del gasto público explica una fracción alta de los efectos de largo plazo de los precios de commodities en el PIB per-cápita. La respuesta sistemática del gasto fiscal a cambios en precios de commodities, más allá de lo que ocurre con la respuesta a variaciones de la actividad agregada, es relevante para la obtención de este resultado. En general, si la política fiscal es conducida procíclicamente, el efecto de largo plazo de un aumento de los precios de commodities es negativo. Pero para ciertos commodities y grupos de países el efecto es el opuesto. Todos estos resultados están generados por la variación temporal de la política fiscal y se obtienen luego de controlar por calidad de las instituciones.

*We thank Diego Huerta, who provided excellent research assistance. All errors are ours. Emails: aaguirre@bcentral.cl y mario.giarda@barcelonagse.eu.

1 Introduction

The Resource Curse, i.e. the fact that resource-rich countries are poorer that non-resource rich countries, has been one of the most important puzzles in economics. Many explanations have been proposed to explain it. The Dutch disease, i.e. the lost of competitiveness of nonresource sectors driven by a real exchange rate appreciation is the most common explanation that ignores the political dimension of the problem. But when this dimension is considered many potential mechanisms exist, including raising expropriation risks, rent-seeking and clientelism, corruption, voracity effects, violent conflict, and low state capacity to raise taxes.

When considering all of these possible mechanisms it becomes clear that the single relationship between natural resources and income per capita should be heterogenous across countries. This heterogeneity could come from specific features of natural resources the country possesses, particularly depending on how easy is to capture them by the state, or from structural characteristics that help shape the exposure and response to variations in commodity revenues, particularly institutional quality (Mehlum et al., 2006; Collier and Goderis, 2012).

In this context fiscal policy, as a key piece of the macroeconomic management toolkit and a manifestation of the institutional framework, may play an important role when studying the resource curse. But at least theoretically it is not clear what should be the fiscal policy response to variations in revenues coming from natural resources. Smoothing spending in the case of transitory shocks, limited absorptive capacity, and other possible benefits from a precautionary fiscal behavior, calls for a response in public savings. However, and particularly in low and middle income countries, the need for investments, both in productive assets and nonresource sectors, as well as social spending, may imply a larger response of spending (See Collier, 2010, ch. 6 and 7 for a discussion on these issues). But notice that in order to be growth enhancing this type of expenditure needs to be sustained over time, particularly in the presence of limited absorptive capacity. Otherwise social returns would be lower and social conflict would increase. Hence, from this perspective, a windfall coming from changes in commodity prices more likely will increase growth the lower is fiscal procyclicality.[1]

This paper pursues an empirical exploration of the link between the resource curse and the conduct of fiscal policy. In particular, in a panel data context using changes in commodity prices as an explanatory variable, it tries to answer the following question: Does fiscal policy influence the link between commodity price changes and growth?

The empirical framework in this paper combines the empirical literature on the resource curse and fiscal cyclicality. On the first of these Collier and Goderis (2012) is the closest to our paper. They estimate cointegration relationships between commodity prices and income per capita. They

[1]However, it may be the case that political elites need to signal that they won't steal the resources coming from a raise in commodity prices, and procyclicality is a way of doing this (e.g. Alesina et al., 2008), reducing the likelihood of social conflict and improving the response of output per capita in the long run.

find a negative long-run effect of commodity price changes on GDP, contingent on institutions, and only for non-agricultural commodities. On fiscal procyclicality we base our analysis on the empirical work by Aghion and Marinescu (2007), who estimate time-varying measures of cyclicality for OECD countries and explore their effect on growth. They find a negative and significant effect of procyclicality, which is contingent on the level of financial development.[2]

In this paper we estimate time-varying indicators of fiscal cyclicality for a sample of 121 countries since 1970. In addition to the usual measure that links GDP and public spending, we consider the response of fiscal policy to changes in commodity prices while keeping constant GDP. Then we use these indicators as explanatory variables in cointegration vectors which include GDP per capita and commodity prices . The focus is on the interaction between our fiscal indicators and changes in commodity prices, differentiating by type of commodities and group of countries.

We confirm the heterogeneous nature of the resource curse. Our results show that it is very contingent on institutional quality, and more evident for oil and in emerging economies. When considering the effect of fiscal policy, the focus of our paper, results are more homogeneous: in most of the specifications fiscal procyclicality has a negative effect, meaning either that the curse is more severe, or the blessing less intense, when fiscal policy is conducted in a procyclical way. On average cyclicality explains about 40% of the long-run effect of commodity prices on GDP per capita, and even a higher fraction in certain cases, particularly when considering non agricultural commodities. A large part of the effect is explained by the response of fiscal spending to a raise in commodity prices, beyond the cyclical stance of the economy. Although in most of the specifications cyclicality has a negative effect, we find certain cases where its effect is positive, particularly for emerging countries and agricultural goods, depending on whether the procyclical response is with respect to total GDP or to commodity prices.

2 Data

In this section we describe the construction of the two main explanatory variables in the cointegration regressions, the commodity price index and the fiscal cyclicality indicators.

Commodity Export Price Index

We construct a commodity price index for a large sample of countries following the methodology proposed by Collier and Goderis (2012), based in Deaton and Miller (1995) and Dehn (2000). We collect yearly commodity price indices, and 1990 export and import values, for 50 different

[2]The growth effect of fiscal, or more general, macroeconomic procyclicality is commonly explained by the effect on volatility, and the consequent effects on uncertainty and the tightening of investment constraints (Loayza et al., 2007; Aghion et al., 2010). This channel is not driving our results though, because we analyze the effect of commodity price shock realizations.

commodities, which is as many as data availability allows.[3] For each country we first construct a weighted average of commodity prices, considering only commodities in which the country is a net exporter, and where the weight for each commodity c and country i, $\tau_{c,i}$, is

$$\tau_{c,i} = \frac{(x-m)_{c,i}}{\sum_{c=1}^{50} \max(0,(x-m)_{c,i})} \quad \text{for all } i \text{ st. } (x-m)_{c,i} > 0,$$

where x and m are exports and imports for commodity c and country i in 1990, respectively. Using these weights, the weighted average of commodity export prices, $P_{i,t}$, is defined as:

$$P_{i,t} = \log \frac{\prod_{c=1}^{l} p_{c,t}^{\tau_{c,i}}}{e_t},$$

where $p_{c,t}$ is the price of commodity c in year t, and, as in Collier and Goderis (2012), prices are deflated by an annual world average of export unit values, e_t. Finally we use the share of commodity net exports to GDP, w_i, defined by

$$w_i = \frac{\sum_{c=1}^{l}(x-m)_{c,i}}{GDP_{1990}} \text{ for all } (x-m)_{c,i} > 0.$$

to obtain the commodity price index, $w_i P_{i,t}$, which is used in the regression analysis.[4]

In Table 1 we present summary statistics of the commodity price index for our sample of 121 countries from 1971 to 2013.[5] In the first column we present statistics for the entire sample, using all commodities in panel A, and discomposing them between minerals, agricultural commodities,

[3]These are aluminium, natural gas, phosphatrock, uranium, urea, coal, ironore, nickel, silver, copper, lead, tin, and zinc, which we classify as minerals; bananas, cotton, oliveoil, pulp, sugar, barley, fish, oranges, rice, sunfloweroil, butter, groundnutoil, palmkerneloil, rubber, swinemeat, cocoabeans, groundnuts, palmoil, sisal, tea, coconutoil, hides, pepper, sorghum, tobacco, coffee, jutes, plywood, soybeanoil, wheat, copra, maize, poultry, soybeans, and wool, classified as agricultural commodities; and gasoline and oil, which we classify as oil.

[4]We followed the adjustments proposed by Collier and Goderis (2012) to treat gaps and missing values. See their paper for details.

[5]Countries, and their classification by tercile of average GDP per capita (H: High Income; M: Middle; L: Low), and by IMF classification (D: Developed; E: Emerging; O: Others), are Albania (M,O), Argentina (H,E), Australia (H,D), Austria (H,D), Burundi (L,O), Belgium (H,D), Benin (L,O), Burkina Faso (L,O), Bangladesh (L,O), Bulgaria (M,E), Bahrain (H,O), Bolivia (M,O), Brazil (M,E), Botswana (M,O), Central African Republic (L,O), Canada (H,D), Switzerland (H,D), Chile (M,E), China (L,E), Cote d'Ivoire (M,O), Cameroon (M,O), Congo, Rep. (M,O), Colombia (M,O), Costa Rica (M,O), Cuba (M,O), Cyprus (H,D), Czech Republic (H,D), Germany (H,D), Denmark (H,D), Dominican Republic (M,O), Algeria (M,O), Ecuador (M,O), Egypt, Arab Rep. (M,O), Spain (H,D), Ethiopia (L,O), Finland (H,D), Fiji (M,O), France (H,D), Gabon (H,O), United Kingdom (H,D), Ghana (L,O), Guinea (L,O), Gambia, The (L,O), Guinea-Bissau (L,O), Equatorial Guinea (M,O), Greece (H,D), Guatemala (M,O), Guyana (L,O), Honduras (M,O), Hungary (H,E), Indonesia (L,E), India (L,E), Ireland (H,D), Iran, Islamic Rep. (M,O), Israel (H,D), Italy (H,D), Jordan (M,O), Japan (H,D), Kenya (L,O), Korea, Rep. (H,D), Kuwait (H,O), Lebanon (H,O), Liberia (L,O), Sri Lanka (L,O), Lesotho (L,O), Morocco (M,O), Madagascar (L,O), Mexico (H,E), Mali (L,O), Mongolia (M,O), Mozambique (L,O), Mauritania (L,O), Mauritius (M,O), Malawi (L,O), Malaysia (M,E), Namibia (M,O), Niger (L,O), Nigeria (L,O), Nicaragua (M,O), Netherlands (H,D), Norway (H,D), Nepal (L,O), New Zealand (H,D), Oman (H,O), Pakistan (L,E), Panama (M,O), Peru (M,E), Philippines (M,E), Papua New Guinea (L,O),

and oil in panels B, C, and D, respectively (see footnote 3). We present the average weight, w_i, the number of countries with positive weights, $w_i > 0$, the average of the standard deviation of the unweighted index (when $w_i > 0$), $sd(P_{i,t})$, and the average of the estimated autoregressive coefficient from a regression of the HP cyclical component of the index, $AR(1)$ $coef$.

In the entire sample net exports of the commodities we consider represent around 8% of GDP on average. Almost half of this is explained by agricultural commodities, exported by almost all the countries, a 40% by oil, exported by a third of the countries, and the remaining fraction by minerals, which are exported by half of the countries.[6] Oil and minerals show the highest volatility, and oil the highest persistence of transitory shocks. Agricultural commodities show a relatively low volatility and persistence.

In the next 3 columns of Table 1 we split the sample in terms of average GDP per capita for the years considered in the estimations. The main difference across income groups is related to the share of commodity exports in GDP. Middle income countries show the highest share, close to 9.6%, followed by low income countries with 7.6%. This difference is due to agricultural exports, the only category for which the share is larger for middle income countries. High income countries export a smaller, although similar, fraction of their GDP, but it is almost exclusively explained by oil exports. The second difference between groups of countries is that volatility and persistence of transitory shocks are lower in most of the categories in richer countries. This pattern may be explained by price volatilities at a higher level of disaggregation, or by different degrees of diversification inside each category, with richer countries showing more diversification.

In the last three columns of Table 1 we split countries into groups as defined by the IMF, i.e. developed, emerging, and others. We do this in order to explore features that may be relevant for emerging economies in particular, as these have been identified as countries with the most procyclical fiscal policies. Additionally, when doing this classification, many oil exporters are removed from the high income group. The share of oil exports in GDP falls to 2.7% in the group of developed countries. This, and a relatively lower share of minerals, lowers the share of exports of commodities in GDP, which is now one third and one fifth relative to emerging and other countries respectively, and lowers the volatility and persistence of the general index in this group of countries. Emerging countries export less commodities as a fraction of GDP (close to 3% less) than other middle income countries, with the fall explained almost exclusively by a lower participation of agricultural goods. This does not have major effects on volatility, but it does raise the persistence

Poland (H,E), Portugal (H,D), Paraguay (M,O), Romania (M,E), Russian Federation (H,E), Rwanda (L,O), Saudi Arabia (H,O), Sudan (L,O), Senegal (L,O), Singapore (H,D), Sierra Leone (L,O), El Salvador (M,O), Suriname (M,O), Sweden (H,D), Swaziland (M,O), Syrian Arab Republic (M,O), Chad (L,O), Togo (L,O), Thailand (M,E), Trinidad and Tobago (H,O), Tunisia (M,O), Turkey (H,E), Tanzania (L,O), Uganda (L,O), Uruguay (M,O), United States (H,D), Venezuela, RB (H,E), Vietnam (L,O), South Africa (H,E), Congo, Dem. Rep. (L,O), Zambia (L,O), Zimbabwe (L,O).

[6] Considering all the commodities the median and maximum weights (not shown in table 1) are close to 4.5% and more than 40% of GDP, implying a skewed distribution. A similar pattern is observed in each of the categories.

of the transitory component of the price index.

Fiscal Cyclicality

As noted in the introduction our aim is to study the interaction between changes in commodity prices and the cyclical pattern of fiscal policy. The empirical literature on cross-section differences in fiscal procyclicality is large (See e.g. Gavin and Perotti, 1997; Kaminsky et al., 2004; Alesina et al., 2008). To exploit temporal changes in fiscal behavior, and therefore lowering the probability of capturing more general factors associated with fiscal policy, we compute time-varying, country-specific indicators of fiscal procyclicality following the study for OECD countries by Aghion and Marinescu (2007). In addition to the response of fiscal spending to movements in GDP we measure the fiscal response to changes in our commodity price index, similarly than Céspedes and Velasco (2014).[7] We do this to assess any differential effect on the resource curse.

These indicators are computed as elasticities using the following specification,

$$d\log g_{i,t} = \alpha^c_{i,t} + \alpha^y_{i,t} d\log y_{i,t} + \alpha^p_{i,t} dP_{i,t} + \epsilon_{i,t},$$
$$\alpha^x_{i,t} = \alpha^x_{i,t-1} + \upsilon^x_{i,t}, \quad \upsilon^x_{i,t} \sim N(0, \sigma^2_x), \qquad x = c, y, p,$$

where dz denotes the change in variable z, g is public expenditure, and y is GDP, both in constant local currency units. The estimated series $\alpha^y_{i,t}$ and $\alpha^P_{i,t}$ are the fiscal indicators we use in our regressions.[8] Notice that $\alpha^P_{i,t}$ captures the response of fiscal policy to changes in commodity prices that don't have a significant effect in GDP. Our interpretation is that these coefficients capture mainly two features. First, responses to commodity price changes that generate public revenues beyond those coming from taxing aggregate income, perhaps due to specific taxes or public production. This may be the case of minerals and oil. Second those that generate income effects for some political powerful groups that call for a fiscal response. This may be the case of agricultural commodities. Notice also that, unlike in our panel regressions, we are not controlling here for the effect of common shocks. Hence these parameters can also be capturing the effects of global conditions and their implications on fiscal external financing; e.g. oil crises. In the regressions below we do control for global factors.

We use first differences instead of the cyclical component of spending and output. This is because we want to analyze the response of fiscal policy to both transitory and permanent shocks,

[7] Céspedes and Velasco (2014) do this to characterize the behaviour of fiscal policy over the commodity price cycle. They explore if this has changed, as rules and institutions governing fiscal policy have improved. However, they don't compute time-varying indicators of cyclicality as we do. They compare OLS estimations of cyclicality between different periods. A similar approach is pursued by Frankel et al. (2013).

[8] Due to data constraints we use central government expenditure for g, excluding public transfers and investment. We estimate α^x using the Kalman Filter. We use as a starting point of α^x for the Kalman Filter an OLS estimate using the first 10 years of data. Hence we estimate parameters α^x from 1971 to 2013.

under the assumption that it is difficult for policymakers to distinguish between the two types of shocks, particularly in the case of commodity prices, and because permanent shocks will be generating the effects on our cointegration vectors.

Summary statistics for our measures of fiscal cyclicality are depicted in Table 2. We present the average country means for the same groups of countries shown in Table 1. This cross-section variability is not behind the results related to the resource curse below, but we analyze them anyways to have an idea of the size of the indicators. In the first row we show the average $\alpha_{i,t}^{y}$. As expected we find a positive coefficient, which is decreasing in the level of income, and the highest in emerging markets when considering the IMF classification. In the case of $\alpha_{i,t}^{p}$ (second row) we observe a negative value for the entire sample and every group of countries. This may be capturing the different effects of different groups of commodities. We show estimations of $\alpha_{i,t}^{P}$ for each of the commodity groups. Minerals (third row) show the largest coefficient, with levels above 0.75 in middle income countries and other countries as defined by the IMF. This may be explained by a procyclical behavior together with a disproportionate share of this type of commodities in public revenues. When considering agricultural goods we observe negative coefficients in general. As we show below agricultural prices seems to be stationary. The permanent income hypothesis would imply that changes in these prices should affect savings much more that minerals and oil, which are not stationary. Notice finally that the $\alpha_{i,t}^{P}$ are relatively small in absolute terms since we don't adjust by the weight, w_i.

3 Results

Since we are interested in the long-run effects of commodity prices on income per capita we estimate in this section cointegration vectors among the variables of interest. Hence we first test for the presence of unit roots and cointegration vectors in the data. Table 3 presents the results. In the upper panel we observe that we can't reject the null hypothesis of unit root for income per capita, implementing the Im, Pesaran & Shin test for heterogenous panels, both with and without a trend. Unlike GDP per capita, in the case of the commodity index the hypothesis is rejected. When decomposing the index we can see that this is due to agricultural commodities, since in the case of minerals and oil we can't reject unit roots, without and with trend. This may explain the result by Collier and Goderis (2012) of a non-significant effect of changes in prices of this type of commodities on income per capita in the long-run. Notice that since our focus is on fiscal policy, and our cyclicality indicators have unit roots by construction, we still may find a relevant role of agricultural commodities in explaining the resource curse. In the lower panel we report the results from the Fisher cointegration test, which rejects the hypothesis of no cointegration relationship among the variables of interests.

To explore the long-run relationship between commodity prices and income per capita we begin

with the following specification

$$y_{i,t} = \beta w_i P_{i,t} + \delta_1 \alpha^y_{i,t} + \delta_2 \alpha^p_{i,t} + \gamma_1 \alpha^y_{i,t} w_i P_{i,t} + \gamma_2 \alpha^p_{i,t} w_i P_{i,t} + \theta x_{i,t} + \mu_i + \eta t + \epsilon_{i,t}$$

where $y_{i,t}$ is the log of GDP per capita in constant US dollars, $x_{i,t}$ is a set of controls, μ_i is a country fixed effect, t is a common trend, $\epsilon_{i,t}$ is the residual, and β, δ_1, δ_2, γ_1, γ_2, θ, and η are the parameters to be estimated. To account for common factors beyond a trend the principal component of $P_{i,t}$ is included as a control in all of our estimations. Besides other controls usually included in growth regressions we include a time-invariant measure of institutional quality, denoted by Iq_i. Hence our results regarding the effect of cyclicality is not driven by a more general cross-country variation in institutional quality.

Since the commodity index includes the size of commodity exports in GDP the elasticity of GDP per capita to prices is

$$\frac{dy_{i,t}}{dP_{i,t}} = w_i(\beta + \gamma_1 \alpha^y_{i,t} + \gamma_2 \alpha^p_{i,t} + \theta_{Iq} Iq_i),$$

The parameters of interest are γ_1 and γ_2. They capture the interaction between commodity prices and fiscal policy. Positive values mean that income per capita is more sensitive, in the long-run, to permanent variations in commodity prices. Since the elasticity depends on w_i in the rest of the paper we refer as the unweighted elasticity the term inside the parentheses.

Because we work with two-stage estimations we need to control by the measurement error of the cyclicality measures in the cointegration vector. To do this we bootstrap the first stage and generate 1000 series of the cyclicality indicators for each country. To assess the significance of the second-stage estimations we run the same number of cointegration regressions, one for each of the cyclicality series, and with that we construct confidence intervals. When we present the results the significance levels for the coefficients of the cyclicality variables are computed with respect to these intervals.

Baseline Estimations

Table 4 presents regression results. In column (1) we can see that commodity prices are positively correlated with income per capita when no interaction terms are included, but the coefficient is not significant. In column (2) we include the cyclicality indicators. Both are significant but their sign differ. The one on output is negative and the one on commodity prices is positive. The first is consistent with Aghion and Marinescu (2007), although they don't estimate long-run relationships. If these correlations were explained by causality from policy to GDP per capita then the implication for growth differs when analyzing the fiscal response to output and to commodity prices. In column (3) the coefficients of interest are estimated: the interactions between the cyclicality indicators and the commodity price index are added. Both of them are negative and significant, suggesting that procyclical fiscal policies are associated to the resource curse.

In column (4) we explore if these effects are driven by differences in institutional quality across countries. We control for the quality of political institutions (Iq_i), for which we use the average Polity index normalized in the interval [-1,1], where a higher value means better institutions.[9] As in Collier and Goderis (2012), the coefficient on this last variable is positive and significant, illustrating the conditional nature of the resource curse as first shown by Mehlum et al. (2006) using a cross-section of countries. Results imply a negative elasticity in countries with the lowest institutional quality, and a positive and significant unweighted elasticity of 0.19 for the median country.[10] The interaction of fiscal policy and commodity prices becomes not significant in the case of the fiscal response to output, although the size of the coefficient is unchanged. The one capturing the response to commodity prices remains significant. Overall the inclusion of institutional quality doesn't change the results importantly. This suggests that the fiscal indicators are capturing additional effects that are either independent of institutional quality or not captured by the time invariant institutional index. To ensure that this is the case in all of our specifications we maintain institutional quality as a control for the rest of the paper.

To have an idea of the size of the effects we compare the elasticity between countries with different levels of cyclicality. We consider as a highly countercyclical country the one with an average for the cyclicality coefficients equal to the cut-off for the 95 percentile. These correspond to an α^y of -0.21 and an α^p of -0.43. The average country in terms of spending cyclicality has an α^y of 0.8 and an α^p of -0.08. And we consider as a highly procyclical country the one with the cyclicality coefficients corresponding to the cut-off for the 10 percentile, meaning an α^y of 2.1 and an α^p of 0.29.[11] Based on the coefficients in column (4), going from a highly countercyclical country to the average one lowers the unweighted elasticity from 0.24 to 0.19, while going to a highly procyclical does so to 0.13. Roughly 60% of this difference is explained by the response of fiscal policy to commodity prices. Using the average weight, which is 8%, weighted elasticities are 0.019, 0.015, and 0.011, respectively, while using the maximum weight, which is 41%, these rise to 0.1, 0.08, and 0.06. Therefore cyclicality explains about 40% of the long-run effect of commodity prices on output per capita.

The exchange rate system may also condition the resource curse. We explore this possibility using the index of exchange rate flexibility ($erf_{i,t}$) constructed by Ilzetzki et al. (2008). Results are shown in column (5). Neither the index nor its interaction with commodity prices are significant. On the other hand the magnitude and significance of fiscal interactions rise. But this may be due to the change in sample size. Since erf doesn't seem to be important for the results, and

[9] Other institutional measures have less coverage than Polity. We tried with alternative measures and results didn't change much.

[10] In the regressions fiscal variables are adjusted by their sample means so the first row shows the unweighted elasticity for the average country.

[11] This classification may underestimate the effects because the variability within countries is higher than the variability of cross-section averages.

because many observations are lost when it is included in the regressions, we keep the specification in column (4) as the baseline for the rest of the paper.

In columns (6) and (7) we further explore the source of variation behind the results regarding fiscal policy. First we adjust the cyclicality indicators by their country means, to consider only the time variation in the interactions. In column (6) we can see that results are mostly unchanged when this adjustment is made (compared to column 4), so the effects are not coming from differences across countries. Then we additionally adjust these variables by the average across countries by year, to isolate global factors behind the way fiscal policy is conducted. Results are similar as shown in column (7). Hence the results are driven by changes over time in the conduct of fiscal policy, and very likely by its idiosyncratic component.

Additional variables included in the set of controls $x_{i,t}$, not shown to save space, are population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP.[12] The source for all of these variables is the World Bank's WDI. Some of these may be transmission channels for the resource curse. But their inclusion does not affect the results, as shown in Table A.8 in Appendix A. There we estimate the same baseline specifications but without these controls. The estimated coefficients for the interactions are mostly unchanged, although the unconditional effect is larger when not including them. But this is mainly due to the change in sample size. We also estimate the regressions without controls but restricting the sample to the one we use in our baseline exercise in the right panel of Table A.8. Results are very similar to our baseline results.

Heterogeneous Effects

Not all commodities may have the same effect on income per capita. In Table 5 we explore heterogeneity across different commodity types. For comparisons, in column (1) we present the baseline results, which correspond to those in column (4) of Table 4. In the middle panel (columns 2-4), we split the commodity index in minerals, agricultural, and oil subindexes, and show the results including them in a single regression (see footnote 3 for the classification). The rest of the regressors are the same than in column (4) of Table 4, except that now the principal component for each subindex is added separately. The unconditional effect differs across these subindexes. The first row shows that, in a country with acyclical fiscal policy and median institutional quality, the positive effect is only present in the case of minerals and agricultural commodities. In the case of oil the results show that even in the average country, income per capita falls in the long-run with a raise in prices. The unweighted elasticities are larger in absolute terms than in the baseline estimations, particularly for minerals and agricultural goods (0.85 and 2.69, respectively). Also, since the average participation in net exports differs, the weighted elasticities are closer between each other compared with what is observed from unweighted elasticities. Taking the average weight, these

[12] We don't show the coefficients on the principal component and the common trend either. The first one is always positive and very significant, while the second one is not.

elasticities are 0.02, 0.11, and -0.03, for minerals, agricultural commodities, and oil, respectively, all of them larger in absolute terms than the 0.015 found when not decomposing the commodity index.

In the case of fiscal cyclicality the estimated effects are heterogenous as well. When considering the response of spending to output, i.e. α^y, the effect is significant in the case of oil, and its negative value implies that procyclicality makes even larger the negative response of output per capita in the long run. As in the baseline estimation, this interaction is not significant for minerals and agricultural goods. When considering α^p the coefficient is always negative, and it is significant in the case of minerals and oil. The unweighted elasticities with respect to mineral prices for a highly procyclical and a highly countercyclical country are 1 and 0.67, respectively, while the weighted elasticities, using the average weight for minerals which is 2.75%, are 0.028 and 0.019, respectively. Cyclicality explains about 30% of the long-run effect of minerals prices, with most of this effect explained by the response of spending to these prices. In the case of oil the unweighted and weighted elasticities are -0.26 and -0.025 for a highly countercyclical country, and -0.39 and -0.037 for a highly procyclical country, respectively. Hence in this case cyclicality also explains a third of the long-run response of output, although this is explained in similar proportions by the response of spending to output and prices.[13]

But heterogeneity in the effects of commodity prices may be generated by the heterogeneous response of fiscal policy to them reported in Table 2. To explore this possibility in the right-hand panel of Table 5 (columns 5-7) we also vary the cyclicality indicators for each of the commodity groups. Results related to fiscal policy become stronger in terms of size and significance. Indeed both interactions are significant for each of the subindexes. Now cyclicality explains 80% and 50% of the total effect of commodity prices in minerals and oil on long-run output, respectively[14]. In the case of agricultural commodities procyclicality with respect to GDP improves the long-run response of output per capita to price changes. The effects are small for the country with average institutional quality, but they are increasingly relevant as institutions improve.

In Table 6 we explore heterogeneity across different groups of countries. In column (1) we present the baseline estimations for comparisons. In the middle panel (columns 2-4) we divide the sample in terciles with respect to average income per capita. Fiscal variables are adjusted by the group mean, and the institutional quality is normalized in the interval [-1,1] inside each group. We can see that the unconditional elasticity is decreasing on the level of income. It is negative in the case of high-income countries, and positive in the rest of the countries.[15] Regarding

[13]Note that the interaction between institutional quality and prices is negative and significant in the case of agricultural commodities. Similarly Collier and Goderis (2012), who don't separate oil from minerals, find that institutional quality raises the elasticity in minerals and lowers it in agricultural commodities.

[14]The increase in the case of minerals is due in part to a lower unconditional elasticity. But without considering this the fraction still increases to a 55%.

[15]Recall from the discussion of Table 1 that in the group of high income countries there are many oil exporters not classified as developed by the IMF. Hence the negative coefficient is consistent with the negative one for oil in Table

fiscal cyclicality we observe heterogeneous effects as well. Interactions are negative and significant for high-income countries, but they are not significant in middle-income countries. In the case of low-income countries only the interaction with cyclicality with respect to commodity prices is significant.

In the right-hand side panel (columns 5-7) we divide the sample of countries according to the IMF classification. This allows us to explore the effects within the much homogeneous group of industrial countries and emerging economies. Now the unconditional effect is negative only in the case of emerging countries. The resource curse is evident in this group, independently from institutional quality. Cyclicality with respect to GDP is negative and significant in both developed and emerging countries, while that with respect to commodity prices is not significant in the second group. And indeed the coefficient is positive. The first type of cyclicality explains about 15% of the negative long-run effects of commodity prices on output per capita in emerging economies.

In Table 7 we decompose for every group of countries the commodity price index and the cyclicality indicators into the categories of minerals, agricultural, and oil. Hence these results need to be compared with those for the entire sample presented in columns (5-7) of Table 5. Since the size of the sample for developed and emerging countries is small, estimations may lose accuracy as we add more explanatory variables. In the case of developed countries minerals drive the results found in Table 6. Both interactions are negative and significant for this subindex, while they are not significant in the other subindexes. Considering emerging countries we can see that oil is behind the unconditional negative effect. The negative effect of cyclicality with respect to GDP found in Table 6 for this type of countries is also found in oil. Indeed, in the case of minerals, procyclicality with respect to GDP has a positive and significant effect on GDP per capita. The same happens with cyclicality with respect to prices in the case of agricultural goods, while the same interaction is negative and significant for minerals. Hence, the weak effects found in Table 6 for emerging countries is the outcome of heterogeneous results for different commodities. Finally, when analyzing the group of countries that are not classified as developed or emerging by the IMF (columns 7-8), which is more heterogeneous than the other two, cyclicality seems to be relevant only when it is measured with respect to total GDP, and only for minerals and agriculture. And in the case of agriculture the effect is positive, which would explain the positive effect in Table 5.

Conclusions

This paper explores empirically the relationship between commodity prices, fiscal policy, and income per capita. We find that the cyclical conduct of fiscal policy explains a large fraction of the long-run effects of commodity prices on GDP per capita. The effect is very heterogenous depending on the type of commodity and the type of countries, which may give some light in understanding the main

5. There are many emerging countries as well (see footnote 5). Note that countries with good institutions inside this group have an unconditional elasticity close to zero.

mechanisms behind the resource curse. Future work should focus on exploring the cause of the influence of this stabilization policy, which influences the economy mostly in the short run, on the long-run effect of commodity prices on GDP per capita.

References

Aghion, P., G.-M. Angeletos, A. Banerjee, and K. Manova (2010): "Volatility And Growth: Credit Constraints And The Composition Of Investment," *Journal of Monetary Economics*, 57(3), 246–265.

Aghion, P., and I. Marinescu (2007): "Cyclical budgetary policy and economic growth: What do we learn from OECD panel data?," *NBER Macroeconomics Annual*, 22, 251–278.

Alesina, A., F. R. Campante, and G. Tabellini (2008): "Why Is Fiscal Policy Often Procyclical?," *Journal of the European Economic Association*, 6(5), 1006–1036.

Céspedes, L. F., and A. Velasco (2014): "Was This Time Different?: Fiscal Policy In Commodity Republics," *Journal of Development Economics*, 106, 92–106.

Collier, P. (2010): *The Plundered Planet*. Oxford University Press.

Collier, P., and B. Goderis (2012): "Commodity prices and growth: An empirical investigation," *European Economic Review*, 56(6), 1241–1260.

Deaton, A., and R. I. Miller (1995): *International Commodity Prices, Macroeconomic Performance, And Politics In Sub-Saharan Africa*. International Finance Section, Department of Economics, Princeton University.

Dehn, J. (2000): "Commodity Price Uncertainty In Developing Countries," World Bank Policy Research Working Paper N.2426.

Frankel, J. A., C. A. Vegh, and G. Vuletin (2013): "On Graduation From Fiscal Procyclicality," *Journal of Development Economics*, 100(1), 32–47.

Gavin, M., and R. Perotti (1997): "Fiscal Policy in Latin America," *NBER Macroeconomics Annual*, 12, 11–72.

Ilzetzki, E. O., C. M. Reinhart, and K. Rogoff (2008): "Exchange Rate Arrangements Into The 21St Century: Will The Anchor Currency Hold?," *Quarterly Journal of Economics*, 119(1), 1–48.

Kaminsky, G. L., C. M. Reinhart, and C. A. Végh (2004): "When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies," *NBER Macroeconomics Annual*, 19, 11–82.

Loayza, N. V., R. Rancière, L. Servén, and J. Ventura (2007): "Macroeconomic Volatility and Welfare in Developing Countries: An Introduction," *The World Bank Economic Review*, 21(3), 343–357.

Mehlum, H., K. Moene, and R. Torvik (2006): "Institutions And The Resource Curse," *The Economic Journal*, 116(508), 1–20.

		By GDP per capita			*By IMF classification*		
	All	*High*	*Middle*	*Low*	*Developed*	*Eme*	*Others*
A. All commodities							
$w_i > 0$	121	41	40	40	26	20	75
w_i	7.98	6.81	9.59	7.57	2.18	6.52	10.38
$sd(P_{i,t})$	0.27	0.27	0.26	0.28	0.24	0.27	0.28
$AR(1)$ $coef$	0.44	0.43	0.47	0.43	0.36	0.52	0.45
B. Minerals							
$w_i > 0$	54	22	19	13	10	18	26
w_i	2.75	1.80	2.63	4.54	1.21	2.12	3.77
$sd(P_{i,t})$	0.39	0.36	0.37	0.49	0.34	0.37	0.43
$AR(1)$ $coef$	0.59	0.61	0.58	0.59	0.60	0.61	0.58
C. Agricultural							
$w_i > 0$	109	35	35	39	22	19	68
w_i	4.21	0.90	6.64	5.02	0.99	2.06	5.86
$sd(P_{i,t})$	0.23	0.19	0.23	0.26	0.20	0.22	0.24
$AR(1)$ $coef$	0.36	0.30	0.37	0.40	0.24	0.37	0.40
D. Oil							
$w_i > 0$	37	18	14	5	8	8	21
w_i	9.62	11.51	7.22	9.57	2.73	6.60	13.41
$sd(P_{i,t})$	0.41	0.40	0.42	0.43	0.37	0.43	0.42
$AR(1)$ $coef$	0.63	0.64	0.62	0.62	0.67	0.61	0.62

Notes: See footnotes 3 and 5 for commodity and country classification respectively. $w_i > 0$ is the number of countries with positive weights, w_i is average weight considering countries for which $w_i > 0$, $sd(P_{i,t})$ is the average standard deviation, and $AR(1)$ $coef$ is the average autoregressive coefficient of the HP cyclical component of the index.

Table 1: Commodity Price Index: Summary Statistics

		By GDP per capita			*By IMF classification*		
	All	*High*	*Middle*	*Low*	*Developed*	*Eme*	*Others*
α_i^y	0.79	0.53	0.80	1.05	0.36	0.96	0.89
α_i^p, *All commodities*	-0.08	-0.08	-0.07	-0.08	-0.04	-0.08	-0.09
α_i^p, *Minerals*	0.29	0.01	0.95	-0.05	0.01	-0.02	0.77
α_i^p, *Agricultural*	-0.10	0.00	-0.35	0.07	-0.06	0.00	-0.17
α_i^p, *Oil*	-0.10	-0.14	-0.08	-0.01	0.00	-0.05	-0.16

Notes: Group averages of country averages. In the commodity classification only countries producing the commodities are included. See footnotes 3 and 5 for commodity and country classification respectively.

Table 2: Fiscal Cyclicality: Summary Statistics

A. Im, Pesaran & Shin test for unit roots in heterogenous panels, and ADF test (†)			
		Without trend	With trend
y		5.66	2.72
wp	*All*	- 5.01***	- 3.03***
wp	*Minerals*	- 0.79	0.69
wp	*Agricultural*	- 9.96***	- 6.15*
wp	*Oil*	3.26	0.82
wp	*Factor* †	- 1.87	- 2.35
B. Fisher cointegration test			
		Trace test	Max-eigen test
y, wp		842***	617***
y, wp, *Factor*		1050***	961***
y, wp, *Factor*, α^y, α^p		1690***	1259***

Notes: y is income per capita in constant US dollars, wp the commodity price index, and *Factor* the principal component of commodity prices. The null hypothesis in test B is no cointegration equations, and a linear trend is included. See footnote 3 for commodity classification.

Table 3: Unit Root and Cointegration Tests

	(1)	(2)	(3)	(4)	(5)	(6)†	(7)‡
$wiP_{i,t}$	0.13	0.17^{**}	0.12	0.19^{**}	0.21^{***}	0.19^{**}	0.22^{***}
	0.08	*0.09*	*0.09*	*0.08*	*0.07*	*0.08*	*0.08*
$\alpha^{y}_{i,t}$		-0.01^{***}	-0.01^{***}	-0.01^{***}	-0.01^{***}	-0.01^{***}	-0.01^{***}
		0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$\alpha^{p}_{i,t}$		0.09^{***}	0.09^{***}	0.09^{***}	0.14^{***}	0.09^{***}	0.09^{***}
		0.01	*0.01*	*0.01*	*0.02*	*0.01*	*0.01*
$wiP_{i,t} \times \alpha^{y}_{i,t}$			-0.02^{*}	-0.02	-0.02^{**}	-0.02	-0.02^{*}
			0.01	*0.01*	*0.01*	*0.01*	*0.01*
$wiP_{i,t} \times \alpha^{p}_{i,t}$			-0.07^{**}	-0.08^{**}	-0.12^{***}	-0.09^{***}	-0.10^{***}
			0.03	*0.03*	*0.04*	*0.03*	*0.03*
$wiP_{i,t} \times Iq_i$				0.45^{**}	0.34	0.44^{**}	0.43^{**}
				0.18	*0.25*	*0.18*	*0.18*
$erf_{i,t}$					0.01		
					0.01		
$wiP_{i,t} \times erf_{i,t}$					0.00		
					0.03		
R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Observations	4087	4087	4087	3806	3134	3806	3806

Notes: The dependent variable is log GDP per capita in constant US dollars. Fixed effects, a common trend, the principal component of commodity prices, population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP are included in all the equations as additional regressors. The cyclicality parameters are adjusted by sample means. $erf_{i,t}$ and Iq_i are normalized in the interval $[-1, 1]$. † : in (6) the ciclicality parameters are adjusted by country means. ‡ : in (7) these are additionally adjusted by the cross-section means by year. Standard errors are clustered by year. * means significant at 10%, ** significant at 5%, and *** significant at 1%. Significance levels for cyclicality variables based on bootstrapped confidence intervals (see the text).

Table 4: Long-run Estimations, Baseline Specifications

		Eq. 1, varying $w_i P_{i,t}$			*Eq. 2, varying $w_i P_{i,t}$ and $\alpha^p_{i,t}$*		
	All **(1)**	*Minerals* **(2)**	*Agricultural* **(3)**	*Oil* **(4)**	*Minerals* **(5)**	*Agricultural* **(6)**	*Oil* **(7)**
$w_i P_{i,t}$	0.19^{**}	0.85^{***}	2.69^{***}	-0.32^{***}	0.42^{**}	2.72^{***}	-0.25^{***}
	0.08	*0.18*	*0.26*	*0.09*	*0.20*	*0.26*	*0.08*
$w_i P_{i,t} \times \alpha^y_{i,t}$	-0.02	-0.01	0.00	-0.03^{**}	-0.04^{*}	0.02^{*}	-0.07^{***}
	0.01	*0.03*	*0.01*	*0.01*	*0.02*	*0.02*	*0.01*
$w_i P_{i,t} \times \alpha^p_{i,t}$	-0.08^{**}	-0.44^{***}	-0.06	-0.08^{**}	-0.66^{***}	-0.11^{**}	-0.04^{***}
	0.03	*0.06*	*0.04*	*0.03*	*0.22*	*0.03*	*0.02*
$w_i P_{i,t} \times Iq_i$	0.45^{**}	1.09^{***}	-4.02^{***}	0.48^{*}	1.02^{**}	-3.93^{***}	0.59^{**}
	0.18	*0.40*	*0.50*	*0.26*	*0.42*	*0.47*	*0.28*
R^2	0.99	0.99			0.99		
Observations	3806	3806			3806		

Notes: Columns under the headings $Eq.1$ and $Eq.2$ show results for a single regression, with each column showing the results for the regressors associated with each commodity type. See footnote 3 for commodity classification. The dependent variable is log GDP per capita in constant US dollars. Fixed effects, a common trend, the principal component of the commodity price index (in Eq. 1 and Eq. 2 the principal component of each of the subindexes), the cyclicality indicators, population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP are included in all the equations as additional regressors. The cyclicality parameters are adjusted by sample means (and for each commodity in Eq. 2). Iq_i is normalized in the interval $[-1, 1]$. Standard errors are clustered by year. * means significant at 10%, ** significant at 5%, and *** significant at 1%. Significance levels for cyclicality variables based on bootstrapped confidence intervals (see the text).

Table 5: Long-run Estimations, By Type of Commodities

		By GDP pc			*by IMF class*		
	All **(1)**	*High* **(2)**	*Middle* **(3)**	*Low* **(4)**	*Dev* **(5)**	*Eme* **(6)**	*Others* **(7)**
$w_i P_{i,t}$	0.19^{**}	-0.40^{**}	0.80^{***}	1.59^{***}	2.33^{***}	-0.34^{*}	0.50^{***}
	0.08	*0.16*	*0.15*	*0.15*	*0.29*	*0.18*	*0.07*
$w_i P_{i,t} \times \alpha^y_{i,t}$	-0.02	-0.06^{***}	0.00	0.02	-0.21^{***}	-0.02^{**}	0.00
	0.01	*0.01*	*0.02*	*0.01*	*0.03*	*0.01*	*0.01*
$w_i P_{i,t} \times \alpha^p_{i,t}$	-0.08^{**}	-0.15^{*}	-0.09	-0.12^{**}	-0.32^{*}	0.09	-0.10^{***}
	0.03	*0.05*	*0.06*	*0.05*	*0.08*	*0.06*	*0.03*
$w_i P_{i,t} \times Iq_i$	0.45^{**}	0.47^{***}	0.28	2.08^{***}	-1.63^{***}	-0.34	0.78^{***}
	0.18	*0.18*	*0.29*	*0.27*	*0.18*	*0.46*	*0.23*
R^2	0.99	0.96	0.86	0.91	0.97	0.97	0.97
Observations	3806	1281	1248	1277	977	653	2176

Notes: See footnote 5 for country classification. The dependent variable is log GDP per capita in constant US dollars. Fixed effects, a common trend, the principal component of the commodity price index, the cyclicality indicators, population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP are included in all the equations as additional regressors. The cyclicality parameters are adjusted by sample means. Iq_i is normalized in the interval $[-1, 1]$ for each group of countries. Standard errors are clustered by year. * means significant at 10%, ** significant at 5%, and *** significant at 1%. Significance levels for cyclicality variables based on bootstrapped confidence intervals (see the text).

Table 6: Long-run Estimations, By Country Groups

	Dev			*Eme*			*Others*		
	Min **(1)**	*Agric* **(2)**	*Oil* **(3)**	*Min* **(4)**	*Agric* **(5)**	*Oil* **(6)**	*Min* **(7)**	*Agric* **(8)**	*Oil* **(9)**
$w_i P_{i,t}$	-12.51^{***}	-1.00	4.16^{***}	0.81^{*}	0.54	-0.76^{***}	-0.34	2.01^{***}	0.24^{***}
	4.13	*3.14*	*0.38*	*0.45*	*0.85*	*0.18*	*0.25*	*0.32*	*0.08*
$w_i P_{i,t} \times \alpha^{y}_{i,t}$	-1.40^{***}	0.17	-0.02	0.06^{*}	0.00	-0.08^{***}	-0.05^{***}	0.05^{***}	-0.03
	0.29	*0.24*	*0.08*	*0.07*	*0.06*	*0.02*	*0.03*	*0.01*	*0.01*
$w_i P_{i,t} \times \alpha^{p}_{i,t}$	-1.52^{**}	-0.03	-0.11	-0.74^{***}	1.01^{***}	0.00^{*}	-0.25	-0.05	-0.04
	0.48	*0.51*	*0.07*	*0.27*	*0.19*	*0.04*	*0.31*	*0.04*	*0.02*
$w_i P_{i,t} \times Iq_i$	8.32^{**}	6.83^{**}	-1.09^{***}	-1.22	-3.21^{*}	0.18	-0.83	-3.83^{***}	1.13^{***}
	4.16	*3.05*	*0.30*	*1.71*	*1.84*	*0.69*	*0.52*	*0.58*	*0.29*
R^2	0.97			0.97			0.97		
Observations	977			653			2176		

Notes: Columns under the headings *Dev*, *Eme*, and *Others*, show results for a single regression, with each column showing the results for the regressors associated with each commodity type. See footnotes 3 and 5 for commodity and country classification respectively. The dependent variable is log GDP per capita in constant US dollars. Fixed effects, a common trend, the principal component of each of the commodity subindexes, the cyclicality indicators, population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP are included in all the equations as additional regressors. The cyclicality parameters are adjusted by the sample mean of each commodity subindex. $erf_{i,t}$ is normalized in the interval $[-1, 1]$. Standard errors are clustered by year. * means significant at 10%, ** significant at 5%, and *** significant at 1%. Significance levels for cyclicality variables based on bootstrapped confidence intervals (see the text).

Table 7: Long-run Estimations, By Country Groups and Commodity Types

Appendix A

	Without controls							*Without controls: restricted sample*						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)†**	**(7)‡**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)†**	**(14)‡**
$w_i P_{i,t}$	0.33^{***}	0.34^{***}	0.28^{***}	0.43^{***}	0.46^{***}	0.44^{***}	0.48^{***}	0.21^{**}	0.25^{***}	0.18^{*}	0.31^{***}	0.37^{***}	0.32^{***}	0.36^{***}
	0.10	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.10*	*0.09*	*0.09*	*0.09*	*0.09*	*0.08*	*0.09*	*0.09*
$\alpha^y_{i,t}$		-0.03^{***}	-0.03^{***}	-0.03^{***}	-0.02^{***}	-0.03^{***}	-0.02^{***}		-0.02^{***}	-0.02^{***}	-0.02^{***}	-0.01^{***}	-0.02^{***}	-0.01^{***}
		0.00	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*		*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
$\alpha^p_{i,t}$		0.09^{***}	0.10^{***}	0.10^{***}	0.14^{***}	0.10^{***}	0.10^{***}		0.10^{***}	0.11^{***}	0.11^{***}	0.16^{***}	0.11^{***}	0.11^{***}
		0.01	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*		*0.01*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*
$w_i P_{i,t} \times \alpha^y_{i,t}$			-0.02	-0.02	-0.02^{*}	-0.02	-0.02			-0.02	-0.02	-0.03	-0.02	-0.03
			0.01	*0.01*	*0.01*	*0.01*	*0.01*			*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
$w_i P_{i,t} \times \alpha^p_{i,t}$			-0.09^{***}	-0.09^{***}	-0.13^{***}	-0.10^{***}	-0.11^{***}			-0.10^{***}	-0.11^{***}	-0.13^{***}	-0.12^{***}	-0.13^{***}
			0.02	*0.02*	*0.03*	*0.03*	*0.03*			*0.03*	*0.03*	*0.04*	*0.03*	*0.03*
$w_i P_{i,t} \times Iq_i$				0.41^{***}	0.28	0.40^{***}	0.40^{***}				0.51^{***}	0.41^{*}	0.50^{***}	0.49^{***}
				0.09	*0.21*	*0.09*	*0.09*				*0.15*	*0.23*	*0.15*	*0.15*
$erf_{i,t}$					-0.02^{**}							-0.01^{*}		
					0.01							*0.01*		
$w_i P_{i,t} \times erf_{i,t}$					0.03							0.06^{**}		
					0.03							*0.03*		
R^2	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Observations	4571	4571	4571	4237	3417	4237	4237	4087	4087	4087	3806	3134	3806	3806

Notes: Notes: The dependent variable is log GDP per capita in constant US dollars. Fixed effects, a common trend, the principal component of commodity prices, population ages 0-14, domestic credit to GDP, trade to GDP, inflation, and government expenditures to GDP are included in all the equations as additional regressors. The cyclicality parameters are adjusted by sample means. $erf_{i,t}$ and Iq_i are normalized in the interval $[-1, 1]$. † : in (6) the ciclicality parameters are adjusted by country means. ‡ : in (7) these are additionally adjusted by the cross-section means by year. Standard errors are clustered by year. * means significant at 10%, ** significant at 5%, and *** significant at 1%. Significance levels for cyclicality variables based on bootstrapped confidence intervals (see the text).

Table A.8: Long-run Estimations, Baseline Specifications with and without Additional Controls

Documentos de Trabajo Banco Central de Chile	Working Papers Central Bank of Chile
NÚMEROS ANTERIORES	PAST ISSUES
La serie de Documentos de Trabajo en versión PDF puede obtenerse gratis en la dirección electrónica: www.bcentral.cl/esp/estpub/estudios/dtbc. Existe la posibilidad de solicitar una copia impresa con un costo de Ch$500 si es dentro de Chile y US$12 si es fuera de Chile. Las solicitudes se pueden hacer por fax: +56 2 26702231 o a través del correo electrónico: bcch@bcentral.cl.	Working Papers in PDF format can be downloaded free of charge from: www.bcentral.cl/eng/stdpub/studies/workingpaper. Printed versions can be ordered individually for US$12 per copy (for order inside Chile the charge is Ch$500.) Orders can be placed by fax: +56 2 26702231 or by email: bcch@bcentral.cl.

DTBC – 760
A Microestructure Approach to Gross Portfolio Inflows: The Case of Chile
Bárbara Ulloa, Carlos Saavedra y Carola Moreno

DTBC – 759
Efectos Reales de Cambios en el Precio de la Energía Eléctrica
Lucas Bertinato, Javier García-Cicco, Santiago Justel y Diego Saravia

DTBC – 758
The Labor Wedge and Business Cycles in Chile
David Coble y Sebastián Faúndez

DTBC – 757
Accounting for Labor Gaps
François Langot y Alessandra Pizzo

DTBC – 756
Can a Non-Binding Minimum Wage Reduce Wages and Employment?
Sofia Bauducco y Alexandre Janiak

DTBC – 755
The Impact of the Minimum Wage on Capital Accumulation and Employment in a Large-Firm Framework
Sofia Bauducco y Alexandre Janiak

DTBC – 754

Identification of Earnings Dynamics using Rotating Samples over Short Periods: The Case of Chile

Carlos Madeira

DTBC – 753

The Impact of Commodity Price Shocks in a Major Producing Economy. The Case of Copper and Chile

Michael Pedersen

DTBC – 752

Nominal Term Structure and Term Premia: Evidence from Chile

Luis Ceballos, Alberto Naudon y Damián Romero

DTBC – 751

The Labor Wedge: New Facts Based on US Microdata

David Coble

DTBC – 750

El Rol de las Asimetrías en el Pass-Through: Evidencia para Chile

Lucas Bertinatto y Diego Saravia

DTBC – 749

Dissent in FOMC Meetings and the Announcement Drift

Carlos Madeira y Joao Madeira

DTBC – 748

Post-crisis Financiera y Expansión de las Exportaciones: Micro-Evidencia para Chile

Roberto Álvarez y Camila Sáez

DTBC – 747

Exchange Rate Pass-Through to Prices: VAR Evidence for Chile

Santiago Justel y Andrés Sansone

DTBC – 746

A New Liquidity Risk Measure for the Chilean Banking Sector

Sebastián Becerra, Gregory Claeys y Juan Francisco Martínez

BANCO CENTRAL
DE CHILE

DOCUMENTOS DE TRABAJO • Julio 2015