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ORIGINAL ARTICLE

Shock del precio del cobre sobre la pobreza en el Perú: un análisis a nivel provincial

Shock in the price of copper on poverty in Peru: An analysis at the provincial level

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Abstract

IIn the context of high copper prices in recent years, which quadrupled its value since the beginning of the 2000s, this research proposes to analyze the effects of variations in the copper price, which is the main mineral exported by Peru, on the poverty ratio. For this reason, a DIF & DIF model is proposed. The results indicate that for every rise of 1% in the copper price, from the super cycle of commodities price, in the long-term, declines of 0.061 percentage points in poverty rates were generated in provinces where copper is extracted in contrast to provinces where copper is not extracted. In conclusion, copper is a very important commodity for the development of Peru

Keywords: DIF & DIF, Shock, Copper Price, Poverty Rate.

JEL Classification Codes: I30, F43, Q33

Resumen

En el contexto de altos precios del cobre en los últimos años, que cuadriplicaron su valor desde inicios de la década de 2000, esta investigación se propone analizar los efectos de las variaciones del precio del cobre, principal mineral exportado por el Perú, sobre el índice de pobreza. Por este motivo se propone un modelo DIF & DIF. Los resultados indican que por cada aumento del 1% en el precio del cobre, a partir del superciclo de los precios de las materias primas, en el largo plazo, se generaron caídas de 0,061 puntos porcentuales en las tasas de pobreza en las provincias donde se extrae cobre, en contraste con las provincias donde el cobre no se extrae. En conclusión, el cobre es un mineral muy importante para el desarrollo del Perú.

Palabras claves: DIF & DIF, Shock, Precio del cobre, Ratio de pobreza.

Clasificación JEL: I30, F43, Q33

1. Introducción

The Economic Commission for Latin America and the Caribbean (ECLAC) states that Peru is the second largest copper producer in the world, basically due to three factors: high endowment of geological resources, as Peru ranks third in the world copper reserves; investment promotion policies sustained since the 1990s and thereafter, combined with macroeconomic stability; and favorable international prices, since the "commodity price boom" started in the 2000s, coupled with the low production costs of this mineral in the country (De Echave, 2020).

In the last decade, the mining industry's share of national exports was above 50%, and in the last five years, it has exceeded 60%. In 2021, according to the Ministry of Energy and Mines (2022), mining exports represented 63.69% of total exports. Moreover, copper represented 52.5% of the metallic mining GNP, and this represents 12.1% of the total GNP.

On the other hand, commodities quotations, especially copper, show high and frequent variability, which could have repercussions on the main macroeconomic variables and subsequently on Peru's social indicators, given that it is an economy whose exports depend on this mineral (Rodríguez et al., 2019).

Therefore, the purpose of this paper is to determine the effects of copper price shock on the main social indicator, the poverty rate, to evaluate its incidence on economic development in provinces where copper mining activities will be developed, compared to provinces where such activities are not developed. Previous studies such as Naranpanawa & Bandara (2012) who analyzed the impacts of high oil prices on poverty, Loayza &

Rigolini (2016) who studied the impacts of mining on poverty and inequality, Marivil (2017) who analyzed the commodity supercycle and its impact on the labor market, and Daher et al. (2017) who analyze the territorial effects of the commodity price super-cycle on some social indicators, show how commodities can impact on various social indicators.

This research used a DIF & DIF model, whose findings showed that with each 1% increase in the copper price, from the super cycle commodity price, in the long run, declines of 0.061 percentage points in poverty rates were generated in provinces where copper is mined, in contrast to provinces where copper is not mined.

2. Methodology

2.1. DIF & DIF frameworks

Following the proposal of Álvarez et al (2021), who suggest that the provinces exposed to copper extractive activities benefited relatively more from the boom in commodity prices, this may have contributed to poverty reduction, in contrast to municipalities not exposed to copper extractive activities. Thus, the following model is specified for this purpose:

$$Y_{ct} = \alpha_c + \alpha_t + \varphi X_{ct} + \beta Log P_t * \theta_c + \varepsilon_{ct} \qquad (1)$$

Where Y_{ct} is the poverty rate of province c at time t; α_c y α_t are the provincial and annual fixed effects that account for all province-specific variables that may affect poverty and also for shocks that over time affect all provinces. X_{ct} is a vector representing other variables that previous literature indicates are important in explaining changes in poverty across provinces[1], P_t is the copper price, θ_c is the province

[1] This is intended to control the unobservable heterogeneity that may exist to meet the assumption of the DIF & DIF Model.

to changes in P; being β, the differential impact of the copper price on poverty across provinces.

In the model proposed, the treatment group would be reflected in the provinces where the copper mining activity takes place, and the control group, which estimates the counterfactual, i.e., how our variable of interest (poverty rate) would have developed in the provinces, without the effect that the copper mining activity would bring with it. Both groups were analyzed in the period of the commodity price boom, where the treatment group would be the one to benefit the most from this external factor, since a revenue shock to the national revenue is directed to a greater extent to the provincial governments where copper is mined, due to the mining royalty law[2], which would mean that the royalty income would be used to develop projects that benefit the welfare of the population.

Figure 1 shows a very similar trend between the poverty rate of the provinces where copper mining activity is developed and the provinces where no mining activity is developed, until the period where the commodity price boom begins (2003), from which the poverty rate of the provinces in the treatment group are much lower than those of the control group, evidencing the assumption of parallel trends before the onset of the exogenous shock that makes such differences.

This would reflect that the mining royalties received by the provincial municipalities for works within these provinces The mining royalty is the participation of local governments in the national income obtained from the exploitation of economic resources. could accelerate their development compared to provinces where copper is not mined. Parallel trends

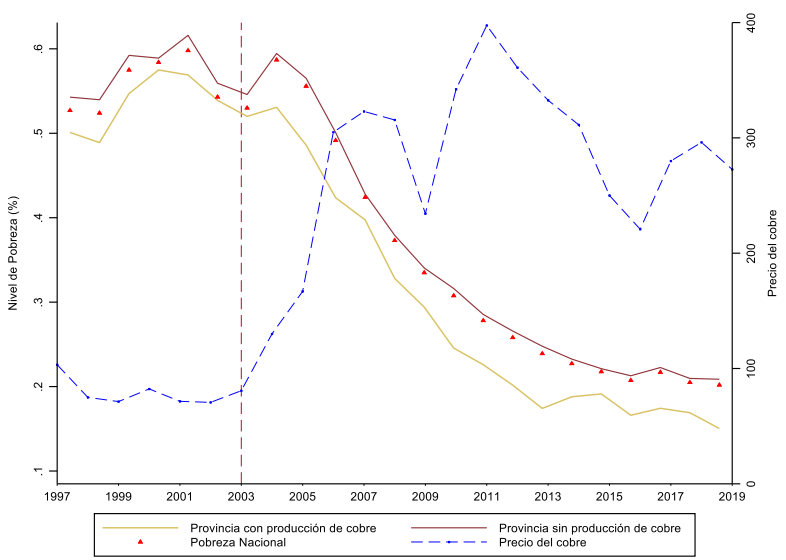
2 The mining royalty is the participation of local governments in the national income obtained from the exploitation of economic resources.

are observed at the provincial level, and the unobservable heterogeneity is not relevant over time.

On the other hand, the study period was divided into two periods, the break of which was determined at the beginning of the commodity price boom (2004). The first period was determined as before the commodity price super-cycle (1997 - 2004) and the second period was determined as after the beginning of the commodity price supercycle (2004 - 2019).

Figure 1.

Poverty Rate throughout all the provinces



Note. The poverty rate is measured as the percentage of households below the monetary poverty line. The copper price is measured in USD per pound. The measure in provinces was calculated as the average poverty level per total province where Copper is produced and the average poverty level per total provinces where Copper is not produced. Source: INEI, BRCP.

3. Data

The data of the social indicator, Monetary Poverty Rate in quarterly frequency in the period between 1Q1997 - 4Q2019, were obtained from the National Household Survey (ENAHO) provided by the National Institute of Statistics and Information of Peru nationwide. The indicators throughout all the provinces were estimated according to the same methodology provided by INEI. The analysis was carried out throughout all the provinces, for which the provinces where copper mining works are carried out were determined. The provincial poverty rate was obtained as the average of the percentage of households not exceeding the monetary poverty line[3].

4. Empirical results

Table 1 shows that there are differences in poverty rates between the two periods of analysis. The reduction in the poverty rate would be 1.67 percentage points in the provinces with copper production compared to the provinces without copper production.

Table 1. Poverty Ratio by Provinces

Provinces	Before the commodity price boom (1997 – 2004)	After the commodity price boom begins (2004 – 2019)	Differences
With copper production	0.5338	0.2716	**-0.2622**
	(0.0302)	(0.1244)	
Without copper production	0.5724	0.3269	**-0.2455**
	(0.0289)	(0.1304)	
Differences	**-0.0386**	**-0.0553**	**-0.0167**

Note. Poverty rates are measured as a simple average for each period of analysis.

3 It is defined as the insufficiency of monetary resources to acquire a minimum socially acceptable consumption basket. In 2002 the monetary poverty line in Peru was PEN 415.00.

In response to this, the DIF and DIF model was proposed, assessing poverty as the model's dependent variable. The control variables introduced to the model[4] would be: X_{it} = Scholarship, population, geographic area, departmental GNP. Scholarship at the provincial level is measured as the illiteracy rate of the population aged 15 years and older; the population rate is measured by thousands of people in each province analyzed; the geographic area is measured as a dichotomous variable, where 1 means rural area and 0 means urban area; and the GNP is measured as the gross national product per capita of each department. Likewise, fixed effects by year and by province were incorporated into the model.

Table 2 shows the results of the difference-in-differences model, where we observe consistent and robust evidence that increases in copper prices are associated with a reduction in the poverty rate. In all regressions, the sign of the interaction effect of the copper price and the variable that identifies in which province copper extraction takes place is negative and statistically significant.

Table 2.
Impact on Poverty Ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LogP_t	-.079***	-.058**	-.061***	-.061***	-.086**	.003	-.090**
	(.028)	(.023)	(.021)	(.021)	(.010)	(.029)	(.039)
Copper producing province	.348**	.249*	.275**	.274**	.229**	-.058	.478**
	.156	.129	(.115)	(.115)	(.116)	(.161)	(.226)

4 The variables inserted into the model follow those proposed by Álvarez et al (2021).

Copper price boom period	-.274***	-.197***	-.196	-.197***	-.086***	--	--
	(.007)	(.007)	(.006)	(.006)	(.010)		
Scholarship	--	.021***	.019	.019***	.016 ***	.016***	.017***
		(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
Geographic Area	--	--	.207	.206***	.206***	.239***	.191***
			(.005)	(.005)	(.005)	(.009)	(.006)
Population	--	--	--	-.001**	-.001**	-.001**	-.001**
				(.000)	(.000)	(.000)	(.000)
Departmental GNP	--	--	--	--	-.001***	-.001***	-.001***
				.	(.000)	(.000)	(.000)
Constant	.637***	.374***	.062***	068***	.179***	.159***	21.07***
	(.006)	(.010)	(.012)	(.012)	(.014)	(.024)	(2.01)
Remarks	5,676	5,676	5,676	5,676	5,676	1,907	3,769
Sample	1997 -2019	1997 -2019	1997 -2019	1997 - 2019	1997 -2019	1997 -2004	2004 -2019
Fixed Effect by Year	SI	SI	SI	SI	SI	SI	SI
Fixed Effect by province	SI	SI	SI	SI	SI	SI	SI
R2	.2428	.3615	.4984	.5990	.5173	.4503	.3834

Note. *** significance level at 99% ** significance level at 95%, * significance level at 90%.

This would prove that changes in copper prices would generate changes in the poverty rate, especially in the provinces where this type of extractive activity is developed. A 1% increase in the copper price would generate over time, on average, decreases of 0.061 percentage points in poverty rates in provinces where copper is mined, compared to provinces where copper is not mined. This would show that in the long

term, the copper price would also have an impact on the poverty rate, especially in sectors where copper is produced.

Concerning the control variables, scholarship, and geographic area are consistent with expectations. The poverty ratio in provinces increases where the percentage of scholarship is lower, i.e., with a one percentage point increase in the illiteracy rate in said province, the poverty ratio increases by 0.016 percentage points. Likewise, the poverty ratio is higher in provinces where the geographic area is mostly rural compared to provinces where it is urban. On average, the poverty rate in rural areas is 0.206 percentage points higher than the poverty rate in urban areas. On the other hand, the variables GNP per capita by department and provincial population density are statistically significant, but the impacts on poverty rates are very low. GNP per capita would not reflect an immediate impact on social variables since the transmission mechanisms would take much longer to be reflected in social variables.

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Subsequently, as a robustness analysis, the sample was split in two, with the breakpoint being the beginning of the commodity price super cycle. In the analysis period 2004 – 2019, a period where great commodity speculation was evidenced, which led to new significant increases in the copper price, an increase of 1% in the copper price would generate over time, on average, decreases of 0.09 percentage points in poverty rates in districts where copper is mined, compared to provinces where copper is not mined. No statistically significant results were obtained for the period of analysis before the commodity price super-cycle (1997 - 2004).

5. Conclusions

The objective of this study was to determine the effects of copper price shocks on the main social indicator, the poverty rate. The results indicated that a copper price shock has positive impacts on the decrease in the monetary poverty rate, a 1% increase in the copper price would generate over time, on average, decreases of 0.061 percentage points in poverty rates in districts where copper is mined, compared to provinces where copper is not mined. This would show that in the long term, the copper price would not only generate an increase in GNP but would also have an impact on the poverty rate, especially in sectors where copper is produced.

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