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The Economic Effect of Peruvian Mining Investment Between 2013-2024

Abstract

The Peruvian government has announced a program of mining investment to be carried out between 2013 and 2021. This research paper quantifies the effect of this investment on the mining sector specifically, and on the Peruvian economy more generally by estimating the evolution of mine production, and the growth in employment and gross domestic product (GDP). This research is based on a macroeconomic model that represents the relationships between the mining industry and other industries in the Peruvian economy using annualized announced investment schedules to predict annual mine production. The results indicate that mining output will increase by 27.9% per year from 2014 to 2024 due to an expansion in copper production. This increased mine output and investment will benefit 10 million workers in the Peruvian economy, with agriculture (26.2%) and trade (18.8%) showing the largest growth in demand. Finally, tax collections will increase by 143.6% between 2013-2024.

1. Introduction

The mining industry has played a preeminent role in the Peruvian economy since the 17th century and is one of the major generators of tax for the government. At its peak in 2007, mining contributed a quarter of all direct tax revenues, and half of all income tax revenues in Peru (Table 1.). Fluctuations in the vitality of the mining industry therefore weight heavily on the general economy.
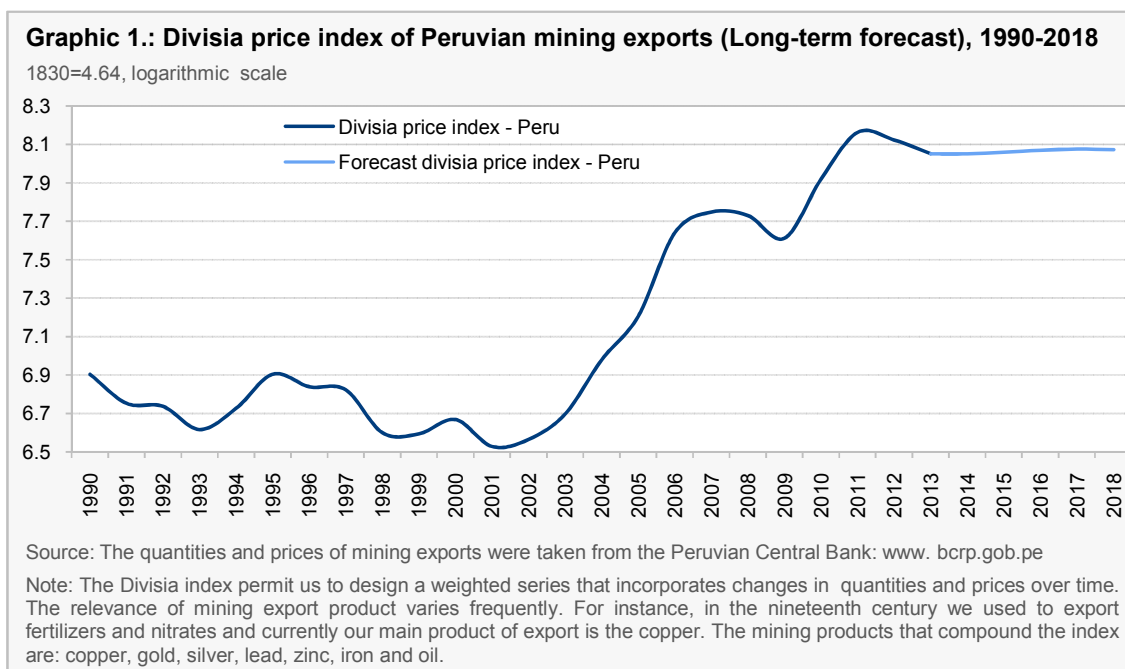
Table 1.: Composition of Peruvian tax revenues, 2000-2013 (percentage)														
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tax revenues														
Fishery products	0.5	0.4	0.6	0.6	0.8	0.9	0.7	0.8	0.4	0.5	0.7	0.6	0.5	0.4
Agricultural products	0.4	0.5	0.6	0.7	0.7	0.5	0.4	0.4	0.5	0.4	0.4	0.4	0.5	0.5
Mining products	4.2	3.4	3.7	5.1	7.2	11.2	20.9	24.7	19.1	10.7	15.2	17.5	14.7	9.4
Oil products	9.5	3.2	1.7	3.1	4.1	4.9	5.0	4.6	4.9	4.3	5.0	6.1	6.1	5.7
Other	85.4	92.4	93.4	90.4	87.1	82.5	72.9	69.5	75.0	84.1	78.7	75.3	78.2	84.0
Income tax[1]														
Fishery products	0.4	0.5	0.5	0.9	0.8	0.9	0.5	0.5	0.3	0.4	0.5	0.5	0.4	0.3
Agricultural products	0.4	0.2	0.2	0.4	0.5	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Mining products	8.0	5.7	9.2	8.8	13.0	24.2	43.5	48.6	40.6	24.4	33.0	32.6	26.0	14.9
Oil products	3.9	5.2	1.1	4.2	6.1	6.9	6.7	6.0	6.2	4.3	5.9	7.6	8.6	9.7
Other	87.4	88.4	88.9	85.7	79.7	67.8	49.2	44.8	52.9	70.8	60.5	59.2	64.9	75.0

Source: http://www.sunat.gob.pe/estadisticasestudios/busqueda_actividad_economica.html.

1/ The income tax of Third Category: taxes income earned by the performance of business activities carried out by natural and legal persons.

The correlation coefficient between mining-based taxes and Peruvian GDP has been calculated at 76%. Fluctuations in the Divisia price index for exports of mineral products (Graphic 1.) also correspond to changes in the annual growth rates for revenues and income tax in Peru. Between 2003 and 2011 revenue grew by 15% and taxes by 28.4%, while mining grew by 26%, but in 2012, and 2013 these rates fell to 9.3% and 1.0%, respectively, while annualized mining growth fell to 8.2%.

Graphic 1.: Divisia price index of Peruvian mining exports (Long-term forecast), 1990-2018

1830=4.64, logarithmic scale

Source: The quantities and prices of mining exports were taken from the Peruvian Central Bank: www. bcrp.gob.pe

Note: The Divisia index permit us to design a weighted series that incorporates changes in quantities and prices over time. The relevance of mining export product varies frequently. For instance, in the nineteenth century we used to export fertilizers and nitrates and currently our main product of export is the copper. The mining products that compound the index are: copper, gold, silver, lead, zinc, iron and oil.

Mining products represent about half of all Peruvian exports; a trend that started back in 1960. Indeed, since then, the ratio of exports to GDP has ranged between 42% and 62% (Table 2.).

Table 2.: Composition of Peruvian exports, 1950-2012 (percentage)

	1950	1960	1970	1980	1990	2000	2007	2008	2009	2010	2011	2012
Fishery products	2.9	9.5	33.0	5.0	10.6	13.9	5.2	5.8	6.3	5.3	4.6	5.1
Agricultural products	53.7	34.4	15.5	5.9	5.4	3.6	1.6	2.2	2.4	2.8	3.6	2.4
Mining products	20.6	42.8	45.0	47.6	45.6	47.0	62.3	58.7	61.1	61.5	59.5	57.3
Oil products	12.7	4.0	0.7	19.9	8.0	5.6	8.2	8.7	7.2	8.7	10.2	10.9
Non-traditional products	10.1	9.2	5.9	21.7	30.4	29.8	22.6	24.5	23.1	21.6	22.0	24.3

Source: http://www.bcrp.gob.pe/estadisticas/cuadros-anuales-historicos.html

Extraction of minerals and mineral refining corresponds to 15.7% of the national amount of Gross Value Added (GVA) - a significant proportion for just one sector in the economy. The sum of mining GVA and intermediate consumption is 13.2% of national gross production.

Two of the most impressive statistics are the contribution of mining to total profits and to total employment. According to Table 3., utilities from mining companies was one third of total profits generated in Peru, while mining employed only 1.4% of the economically active population.

Table 3.: Principal national statistics of mining activity in Peru, 2007 (millions US$)					
	Extraction of minerals	Mineral refining	Total mining	National gross value added	%
Gross value added	12,397	2,308	14,705	93,701	15.7
Utilities	9,531	1,945	11,476	40,936	28
Gross production	17,827	5,919	23,746	180,290	13.2
Employment	198,519	8,760	207,279	15,330,461	1.4
Dependent	168,699	8,760	177,459	7,130,783	2.5
Independent	29,820	0	29,820	8,199,678	0.4

Source: National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.

While it can be inferred on the basis of these statistics that mining does have a positive effect on the Peruvian economy, some sectors of the population believe otherwise.

There is also a tension between the desires of the communities in the vicinity of potential mining projects (who are reluctant to accept the development of mining projects), and the government (which is worried about the sustainability of fiscal accounts, as it tries to create policies that will stimulate investment and growth).

Moreover, the bureaucratic procedures involved in settling the opposing viewpoints can also create a considerable barrier to the timely realization of many mining investments and projects. The consequences can be catastrophic, with delays rendering the projects uneconomic. In these cases, the government loses the future income related to these investments, and society loses too because the output and the ancillary benefits never crystallize.

One of the major factors behind opposition to mining is the perception of the weak links between mining investment and growth in other economic sectors. For instance, the intense use of capital and high labour productivity in mining are widely known, but this doesn't mean the sector is an *enclave*.

This section has briefly summarized the main statistics that capture the contribution of mining to the Peruvian economy. However, this information is not enough to understand the wider importance of the sector within Peruvian economic development plan as a whole. The following sections therefore present findings that support a more holistic, longer-term perspective of the impact of mining on the economic performance of Peru.

The aim of this research is to inform the academic discussion regarding the positive macroeconomic effects of mining activity on gross domestic product (GDP), employment, balance of trade and fiscal accounts of Peru.

2. The mining multiplier in Peru

To estimate the full macroeconomic effects of mining exports in the short term, the input-output matrix of 101 sectors and products of the Peruvian economy in 2007 was used. This model correlates the supply and demand of different activities, and so permits the identification of both direct and indirect effects of an increase in any of the listed sectors in the rest of the economy. By simulating an increase in mining exports it is possible to study how this affects the GVA of the rest of the activities that produce the inputs of the mining process, the consumption and reinvestment of the new final demand and the increment in government revenues. The assumptions in this model are as follows: (i) all sectors have responsiveness, and (ii) imports do not compete with national production, they are complementary.

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Table 4 summarizes the disaggregated mining multiplier of an increase in exports of US$1B. The first row describes the initial macroeconomic impact of this investment due to an increment in mining-exports. Exporting US$1B of mining product is divided into three components: the gross value added (88.1%), imports (9.8%) and taxes (2.1%). In this scenario the created or fortified employment could reach 26,516 workers, of which 56.2% is directly related to mining activity, and 43.8% is indirectly related to mining activity. The second row of Table 4 aggregates the initial impact and the round of consumption generated by the first row. At this point, the percentage of new or fortified employment indirectly related to mining activity exceeds the percentage that is directly related to mining activity. Finally, the third row describes the round of reinvestment plus the secondary impact. On the GVA side, the final economic impact on the Peruvian economy can be observed, and is described by equation (1):

$$\Delta GVA_N = \Delta X_m \varphi_m \dots (1)$$

Where ΔGVA_N denotes the change in national gross value added; ΔX_m, change in mining exports: and φ_m, the mining multiplier.

Table 4.: The impact of a US$1B increase in mining exports (millions US$)

	Gross value added	Imports	Taxes	Employment[1]	Direct	Indirect
I. Initial impact	882.85	97.97	21.46	26,516	14,900	11,616
II. Secondary impact	1,202.12	178.36	60.27	95,765	43,195	52,570
III. Tertiary impact	1,557.69	312.28	98.79	158,446	72,109	86,337

Source: National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.
1/ Employment are in units.

Hence, the mining multiplier will be the ratio between ΔGVA_N and ΔX_m. The multiplier for a US$1B increase in mining exports is 1.56 – which indicates that other sectors of the economy will also benefit from such an investment in the mining industry.

The multiplier effect of an increase in mining exports on 10 national activities can be observed in Table 5. Each column presents the incremental change in GVA, imports, taxes and employment for a given sector of the Peruvian economy. The major contributors to GVA are sectors related to mining, but contributions to employment in agriculture, hunting, forestry and related sectors represent 26.5% of the overall figure, followed by trade, maintenance, motor vehicle repairs etc. with 25.24%, and manufactured products with 10.65%.

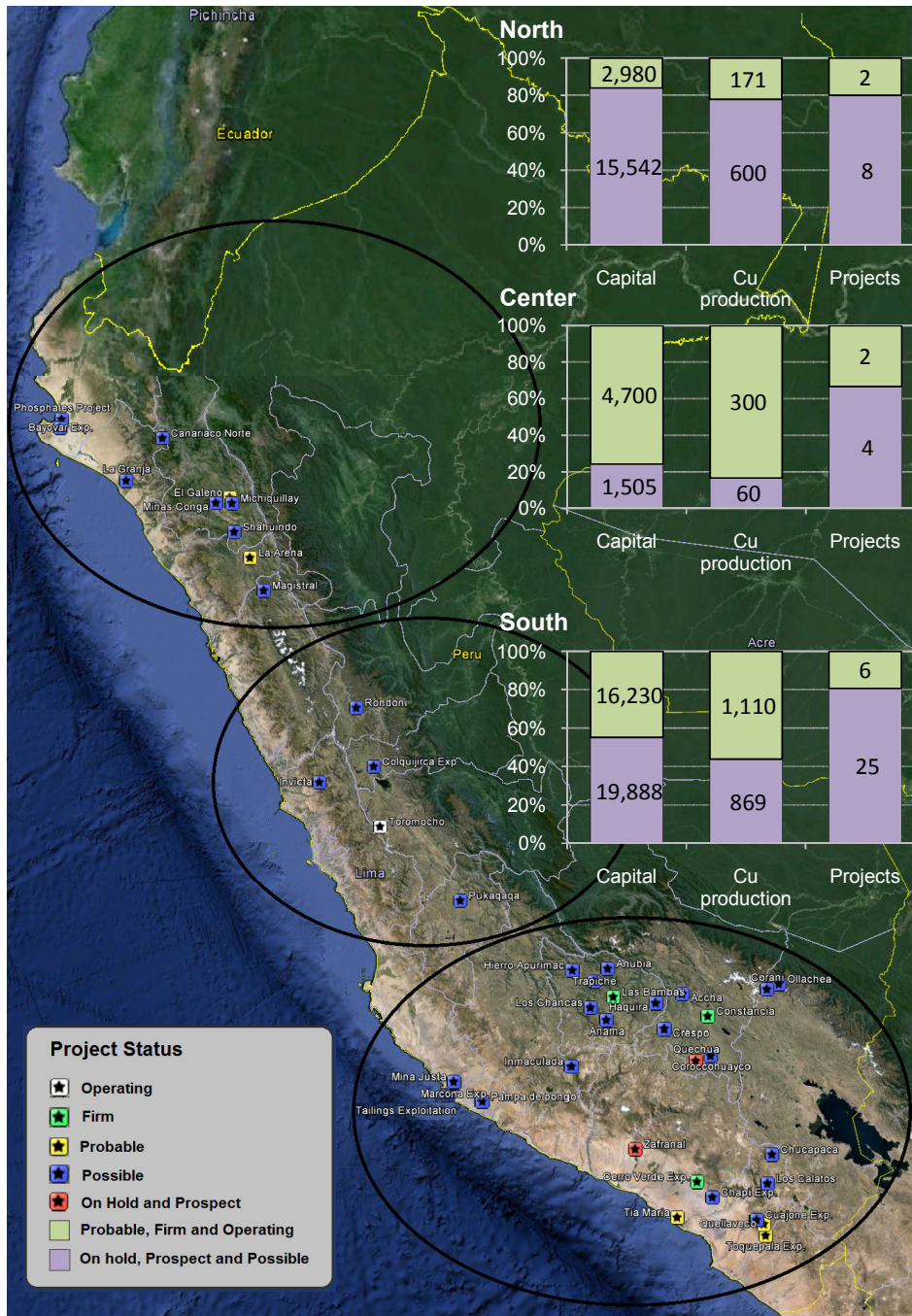**Table 5.: Multiplier effect of mining exports by sector (millions US$, prices of 2007)**

	GVA	Imports	Taxes	Employment[1]	Direct	Indirect
Agricultural	60	9	2	42,046	9,276	32,770
Fuels, minerals and metals	780	65	14	8,992	7,531	1,461
Manufactured products	137	205	54	16,881	10,300	6,581
Electricity and water	30	0	6	694	542	152
Construction	77	2	4	10,096	6,866	3,230
Trade	144	4	4	39,995	13,300	26,696
Transport and communications	90	8	8	13,752	4,490	9,262
Intermediate services	162	18	4	8,942	6,337	2,605
Unspecified services	67	2	5	15,735	12,156	3,579
Government and social services	10	-	-	1,312	1,312	-
Total	**1,558**	**312**	**99**	**158,446**	**72,109**	**86,337**

Source: National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.
1/ Employment are in units.

Graphic 2: Mining investment portfolio, 2009-2021
Capital in millions of US$ (2009-2021) and copper production in '000t (2024)

North

	Capital	Cu production	Projects
(green)	2,980	171	2
(purple)	15,542	600	8

Center

	Capital	Cu production	Projects
(green)	4,700	300	2
(purple)	1,505	60	4

South

	Capital	Cu production	Projects
(green)	16,230	1,110	6
(purple)	19,888	869	25

Project Status

- ☆ Operating
- ★ Firm
- ★ Probable
- ★ Possible
- ★ On Hold and Prospect
- ☐ Probable, Firm and Operating
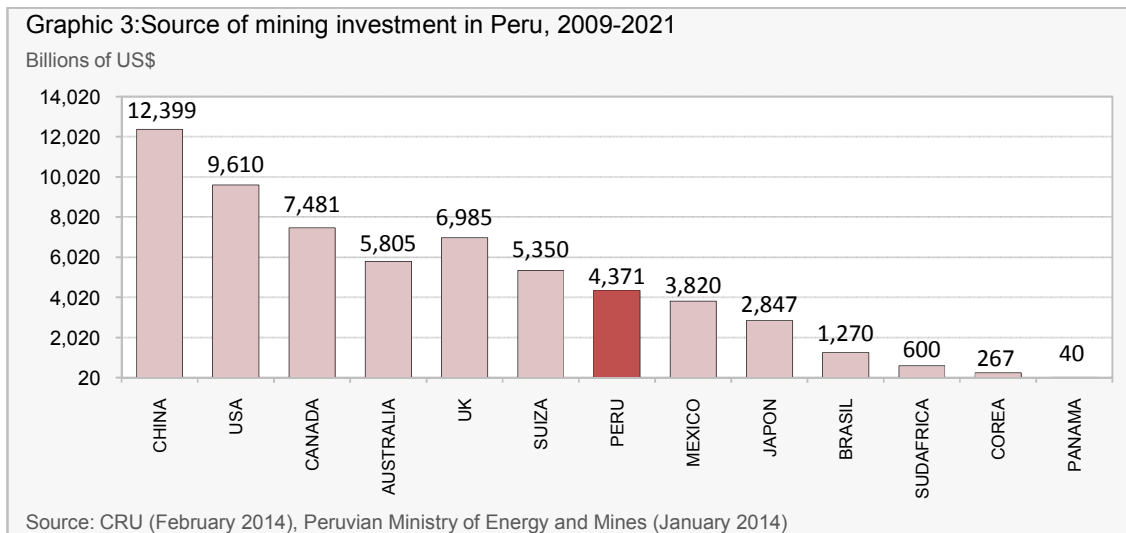- ☐ On hold, Prospect and Possible

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014)

3. Mining investment and production in Peru, 2009-2024

The mining industry views Peru as a growth opportunity with the potential to increase copper production by 139.5% from 2012 to 2024 if all of the scheduled products come on stream. The investment portfolio covers 47 projects that are scheduled to start operating in the next eight years and which would require a total investment of more than US$60B.

The location and status of the 47 mining projects in Peru is described in Graphic 2. The Southern region of Peru accounts for 66% of projects, which represents the 63.6% and 59.4% of the scheduled copper production and investment respectively. The remaining 34% of projects are in the Northern and Central regions of Peru, where approximately one third of the copper production and 40.6% of the investment will occur.

The source of these investments can be seen in Graphic 3. China, with 20.4% of the national portfolio, is the major source of investment, followed by United States, with 15.8%, and Canada, with 12.3%. Peruvian investment represents 7.2% and occupies the seventh place in the ranking.

Graphic 3:Source of mining investment in Peru, 2009-2021

Billions of US$

Country	Value
CHINA	12,399
USA	9,610
CANADA	7,481
AUSTRALIA	5,805
UK	6,985
SUIZA	5,350
PERU	4,371
MEXICO	3,820
JAPON	2,847
BRASIL	1,270
SUDAFRICA	600
COREA	267
PANAMA	40

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014)
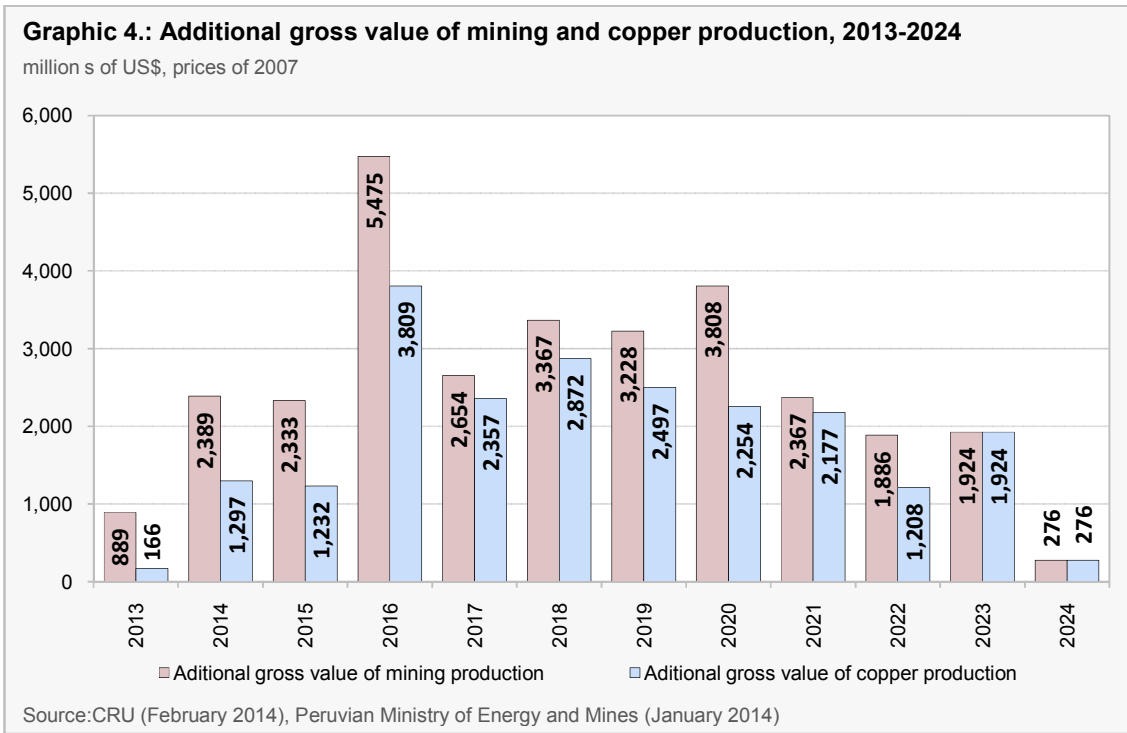
Simulating the distribution of mining investment through the period 2009-2021, its participation could reach 3.52% and 2.83% of Peruvian nominal GDP, calibrated to consider the construction and production phase of mines, in 2014 and 2015, assuming the opening of two of the most important mine projects in Peru: Las Bambas and the Cerro Verde Expansion.

Graphic 4. illustrates the average percentage of the gross value of copper production in the additional mining production for the following ten years is 71.8%. Graphic 5 illustrates the start-up year of new copper mines and mine expansions in Peru between 2013 and 2022. This figure provides an optimistic scenario in which the 32 listed copper projects go forward. In 2016 there is an increase of 141.3% of additional copper production.

It seems that the Peruvian economy is, and will be, primarily supported by mining activity.

How will these projects affect the national accounts? How will employment respond to the projected growth in mining investment and production? How much tax will the government collect as a result of this investment in mining? The next section presents the main results of applying the mining multiplier
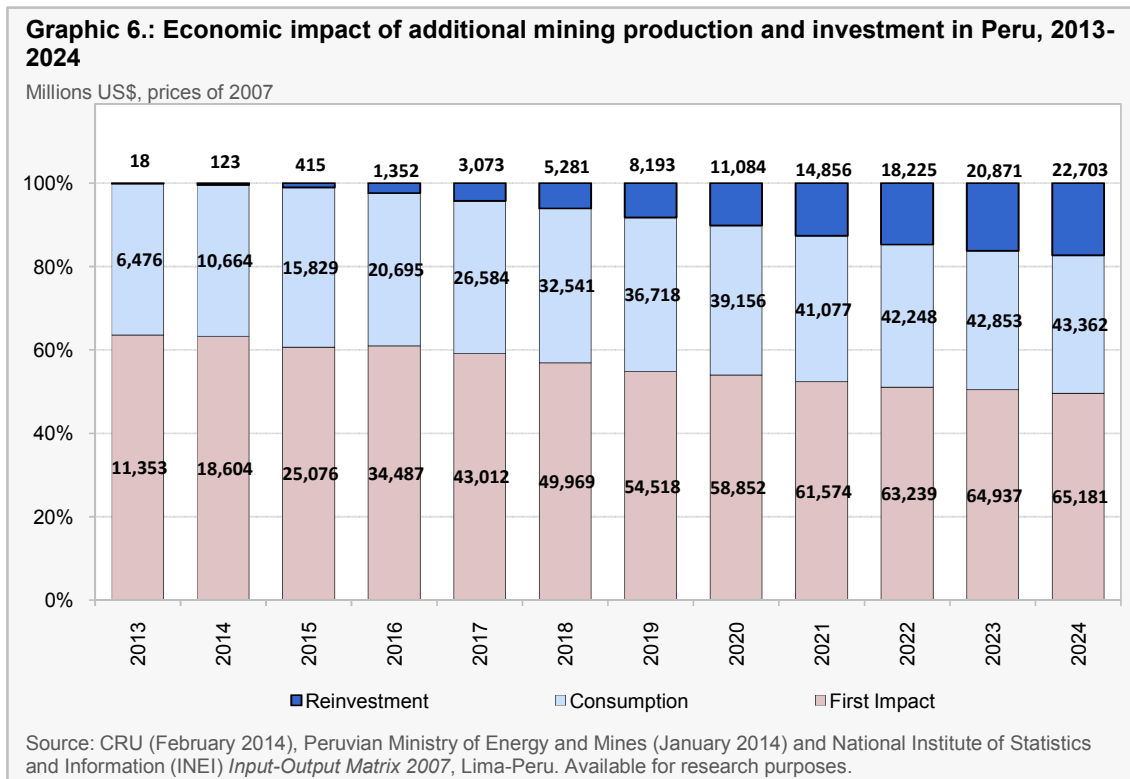
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described earlier in this report to the increase in mining exports that would follow investment in new mines and expansions of the mining industry outlined above.

Graphic 4.: Additional gross value of mining and copper production, 2013-2024

million s of US$, prices of 2007

Legend:
■ Aditional gross value of mining production   ■ Aditional gross value of copper production

Source:CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014)

Graphic 5.: Start-up year of new copper mines and mine expansions in Peru, 2013-2022

Production in '000t

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014).

Note: Group 2015 (Constancia, Anubia and Tailings Exploitation), Group 2016 (Toquepala Exp., Toromocho Exo., La Arena and Rondoni), Group 2017 (Tia Maria), Group 2018 (Mina Justa SXEW, Coroccohuayco, Pukaqaqa and Magistral), Group 2019 (Minas Conga, Zafranal Concs, Cuajone Exp. and Zafranal SXEW), Group 2020 (Canariaco Norte, Los Chancas, Quechua, Mina Justa Concs and Trapiche) and Group 2021 (Haquira SXEW).

4. The macroeconomic effect of an increase in mining investment and exports

There are many ways in which Peruvian mine production could evolve over the next few years. In this paper the focus is on an optimistic scenario where all 47 mining projects previously identified come on stream.

Using the information contained in Table 4. we can estimate the proportion of three different impacts in the GVA: first impact weight of 0.88, new consumption, 0.32, and reinvestment, 0.36. In order to obtain the impact of investments, I will use the construction multiplier of the Peruvian economy, which is distributed as follow: first impact weight of 0.63, new consumption, 0.55, and reinvestment, 0.26. Graphic 6. illustrates the impact in the Peruvian GVA after multiplying these shares with the additional annual gross value of mining.

Graphic 6.: Economic impact of additional mining production and investment in Peru, 2013-2024

Millions US$, prices of 2007

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014) and National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.

Assuming that the average growth rate of real GDP is 5.35% for the period 2014-2024, the multiplier effect of mining exports on other sectors may reach 31.6%.

The same procedure can be applied to employment. Graphic 7. shows the evolution of employment in Peru as a result of the operation and investment phases of the projected new mines. These calculations predict that by 2024 the direct and indirect employment demand could be as high as 10 million new jobs. Using information compiled in Table 3. it does not seem consistent to have this demand for new workers, but what this result suggests is the possible relationship between the current jobs and future demand supported by mining activity as well as by the creation of new employment.

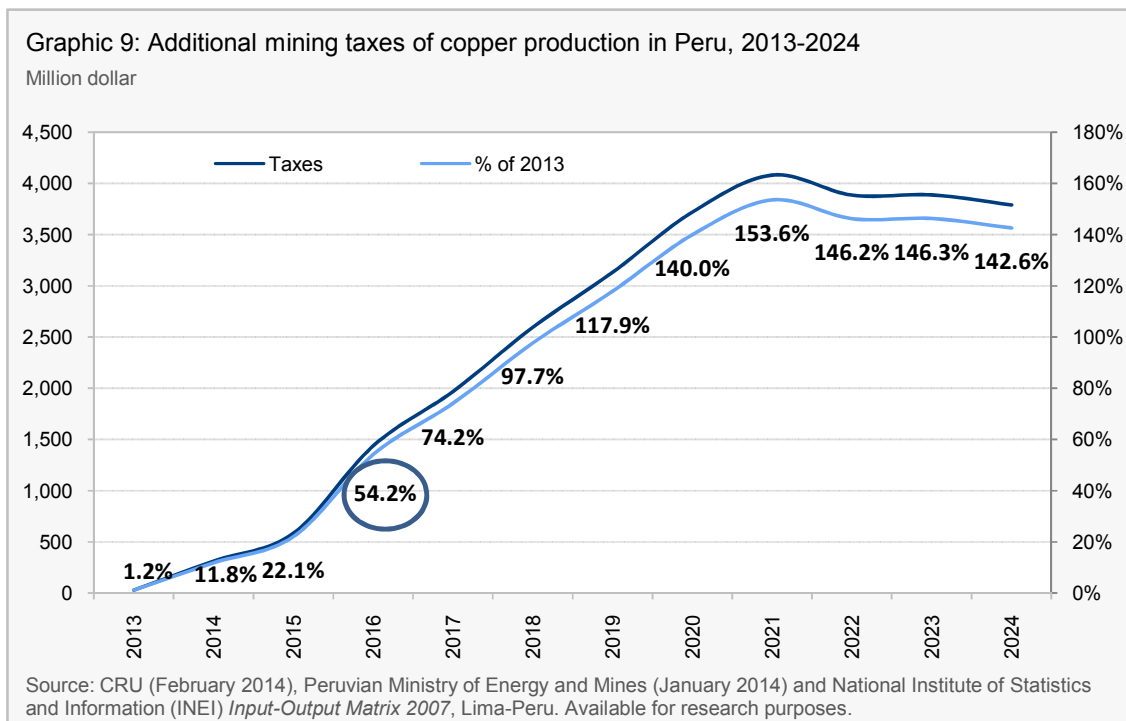## Graphic 7.: Future employment demand in Peru, 2013-2024

Employment in thousands of units
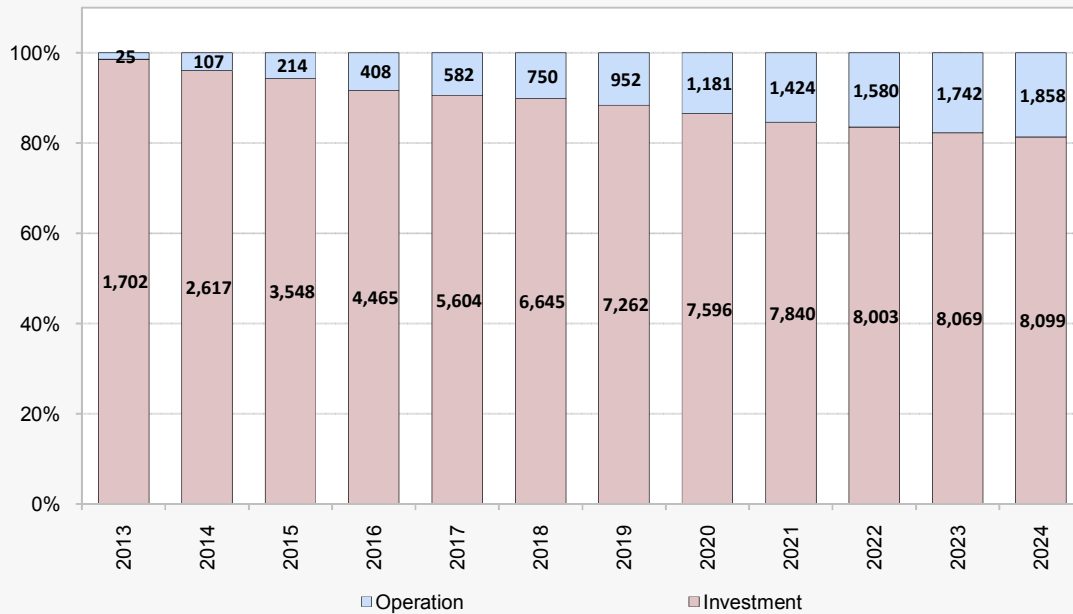
Year	Operation	Investment
2013	25	1,702
2014	107	2,617
2015	214	3,548
2016	408	4,465
2017	582	5,604
2018	750	6,645
2019	952	7,262
2020	1,181	7,596
2021	1,424	7,840
2022	1,580	8,003
2023	1,742	8,069
2024	1,858	8,099

□ Operation   ▨ Investment

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014) and National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.

Graphic 8.: Balance of trade of additional mineral production, 2013-2024
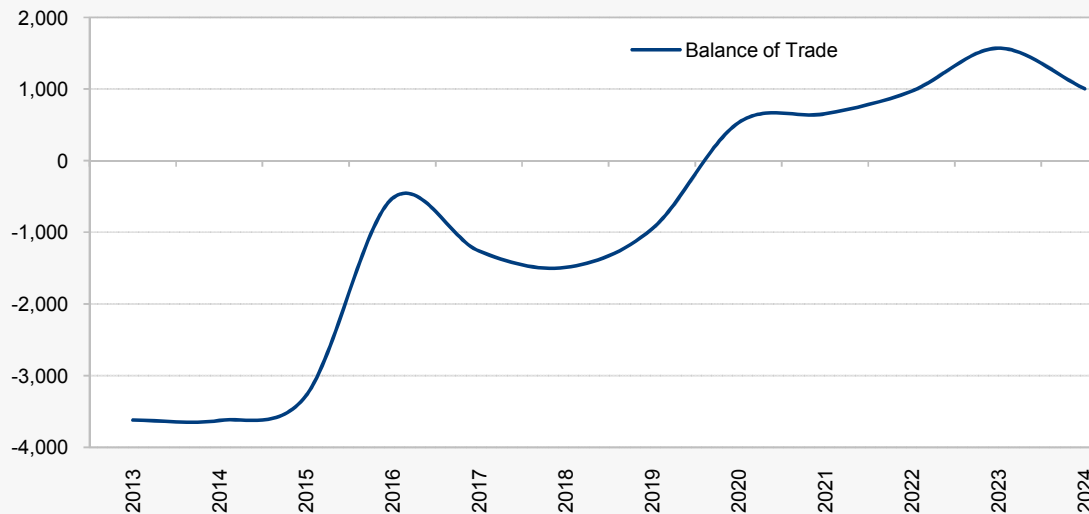
Million s of US$, prices of 2007

——— Balance of Trade

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014) and National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.

balance of trade will be positive, until that year the balance of trade of additional mining production will be negative.

It is possible to estimate the additional mining tax derived from copper production in Peru over the following 10 years by using the forecasted cost curves of the possible new mines in Peru and the Divisia price index illustrated in Graphic 1. In Graphic 9. the sky blue line shows the percentage of the additional mining production tax with the total mining taxes contribution in 2013. By 2016 this could represent 54.2% of 2013 tax take, increasing to 153.6% by 2021. The smooth decline that precedes 2021 is based on an increase of 56.4% of the average cost per tonne of copper produced from 2021 to 2024. Advances in technology could reverse this trend, but still keeping this path, in 2024 the additional mining production tax could represent the 13.36% of total collected revenues in Peru in 2013.

Graphic 9: Additional mining taxes of copper production in Peru, 2013-2024

Million dollar

Source: CRU (February 2014), Peruvian Ministry of Energy and Mines (January 2014) and National Institute of Statistics and Information (INEI) *Input-Output Matrix 2007*, Lima-Peru. Available for research purposes.

Conclusions

Is mining really contributing to the development of Peru or is it just an isolated sector of the economy? Is the private domestic sector boosted by mining activity? Is the Peruvian government taking advantage of the mining revenues? These important questions have been resonating in Peru as a consequence of the exponential growth of the mining sector since the beginning of the 21st century. In this paper I have provided some preliminary quantitative answers to these questions. In particular, this investigation attempted to assess the macroeconomic effects of investment and production of new mining projects in Peru for the period between 2013 and 2024. For this purpose, I estimated the probable evolution of mining activity in Peru in the next 10 years using the mining investment schedule from the Peruvian Ministry of Energy and Mines validated by CRU, and the mining multiplier

with Peruvian Input-Output Matrix in 2007 constructed by the National Institute of Statistics and Information.

The results suggest that for every dollar of mining exports, the Gross Domestic Production (GDP) of Peru increases by an additional 0.56 dollars. The additional mining production could represent in 2015 3.32% of real GDP and with the multiplier effect of the construction and operating phases, 24.4% of GDP. The effects on employment are different during construction than in the operating phase. In 2015, during the construction phase, 23.1% of the economically-active population will have a certain relationship, either direct or indirect, with mining activity, while during the operating phase only 1.4% will. The balance of trade of additional mining production will probably be negative until 2020, the final year of mining investment. The additional government revenues due to copper production in 2015 will represent 22.1% of total mining tax in 2013 and will be 100% higher by 2019.

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