

MINING DEVELOPMENT AND OPPORTUNITIES FOR POVERTY REDUCTION AND HUMAN DEVELOPMENT IN LATIN AMERICA

Case analysis based on Chilean experience

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ABSTRACT

Large-scale mining development has a potential to contribute to human development and poverty reduction in Latin America, particularly in the area of influence of mining activities. Given efficient resources management with a core objective towards sustainable development, large-scale mines are sources of long-term impacts at local and national levels.

This paper of AFD Group analyses the effects of large-scale mining development on poverty reduction in the Antofagasta Region, Chile. By employing a simple econometric model, this research demonstrates that large-scale mining development can be an important economic engine for poverty reduction and social progress.

The regression results show high correlation between the independent and dependent variables and indicate that poverty levels have decreased with every increase in mining production over the period 1990-2010.

Based on these results, it is possible to conclude that: 1) there is strong evidence of causality between mining activity (represented by copper production) and poverty reduction (percentage of poverty) in Antofagasta during that period and 2) Mining activity is the most important source of poverty reduction in Antofagasta.

The analysis recommends that efforts need to be coordinated among policy makers, interested groups, civil society and mining companies to develop complementary policies, strategies and actions focused on specific social aspects to transform mining opportunities into effective results.

INTRODUCTION

Mining development is a prominent feature of Latin American economies; however, poverty reduction and human development continue to be significant challenges. Despite progress in the last 20 years, around 45-50 million people (31% of the population) are still living in poverty and have no access to basic conditions of health, education and sanitation ([ECLAC 2012](#)). For this reason it is important to generate an objective analysis of the capacity of mining development (as an economic driver) to have real positive effects on poverty reduction and human development in mining areas of Latin America.

Research Objectives

The objectives of this research are:

- 1) To analyse the effects of large-scale mining development on poverty reduction in Antofagasta-Chile by employing an econometric analysis.
- 2) To provide recommendations about extending benefits of mining development to the poorest and most vulnerable groups in different mining zones in Latin America.

This paper evaluates the role that economic growth based on large-scale mining development has played in terms of poverty reduction and human development improvement in Antofagasta, northern Chile (which is one of the most important mining regions in Latin America). The paper analyses the case of socioeconomic progress in the region between 1990 and 2010. Based on the results of the analysis, it will provide recommendations for decision makers and stakeholders in Chile and by extension in other mining regions across Latin America and worldwide.

The paper forms its argument by addressing the following research questions:

Q1. The lack of coherence between mining investment and social expectations in Latin America: The mining sector in Latin America has significant economic opportunities in areas of employment, economic linkages at local and national level, fiscal incomes, and better macroeconomic scenarios. These opportunities raise social expectations in terms of poverty reduction and human development.

If these social expectations are not addressed, then the economic inputs/outputs could become missed opportunities like other past mining developments in Latin America or worldwide, generating a negative boomerang effect on ongoing mining projects and its activities.

Currently, it is possible to observe across different mining regions in Latin America how the lack of connection between mining effects and the perceptions of social progress are a permanent source of social conflicts. Specific discussions around how to distribute fiscal benefits, and concerns about the level of taxation are part of this context.

Q2. The socioeconomic performance of mining activity has traditionally been informed using different measures of 'inputs and outputs' (1). However, these inputs and outputs alone are insufficient to demonstrate effects on poverty reduction and improvements of basic social conditions. It is necessary to generate a comprehensive analysis about the effects on social development goals and understand the correlation and causality between mining activity and social progress.

Q3. Overcome Poverty and Social Progress Expectative. Mining regions/zones are expected to overcome poverty and realise positive final effects for the most vulnerable groups and groups that experience higher level of social exclusion. To understand how this objective can be achieved, **it is important and necessary to have a broad analysis about the limits and capacity of the mining activity as an social and economic progress driver.** It is a necessary step to coordinate and generate a common agenda of policies and actions focused on these kinds of specific social aspects and goals for a mining region.

1) GDP, exports, investment, employment, fiscal effects.

ANTOFAGASTA & CHILEAN MINING ZONES

Chile and Antofagasta are very interesting cases of analysis to understand the potential effect of mining activities on poverty reduction and human development. At national level, Chile is one of the best examples in terms of positive socioeconomic progress and human development in Latin America during the last three decades. For example, and using 1990 as baseline, Chile is the only country in Latin America that has already achieved and accomplished most of the Millennium Development Goals and the target of halving extreme poverty (Gobierno de Chile/ PNUD 2010). At regional level which is the focus of this paper, Antofagasta region (as one of the fifteen administrative regions in Chile) can show the best socioeconomic performance in Chile.

In recent decades, Chile has made significant progress in socioeconomic terms making it stand out among the economies of Latin America and developing countries. In 2010, the country's GDP was over US\$ 200 billion, with a GDP per capita around US\$ 12,000 (current dollars; (Banco Central de Chile 2010). In the same year, Chile was admitted into the OECD as a result of its strong economic progress and continued strengthening of its democratic institutions.

The significant player in the Chilean economic progress is its mining sector which (based on current dollars) represented around 20% of the Chilean GDP in the last five years

Chile is the principal supplier of copper worldwide with 5.4 million metric tonnes per year (equivalents to 34%) of world copper production (COCHILCO 2010). Chilean copper reserves account for 28% of worldwide copper reserves (USGS 2013). This is in addition to abundant reserves in other natural resources the country possesses.

The most important mining region in Chile is Antofagasta. Antofagasta represents 75% of the Chilean mining GDP and 25% of world copper production (Banco Central de Chile 2010). In the last two decades, the region grew in terms of production, foreign investment and new world class projects (Consejo Minero de Chile 2011).

Antofagasta has also experienced very significant economic and social transformations, particularly in comparison to non-mining regions in Chile and other zones in Latin America.

Poverty (Figures 1 & 2) declined from 35% to less than 8% of the population between 1990 and 2010 (National Poverty Line; (CASEN 2010). During that period, GDP per capita grew to over US\$30 thousand per year.

Given these figures, Antofagasta offers an interesting scenario and case for analysis.

Figure 1
Poverty (%): Antofagasta, Chile and Latin America (1)

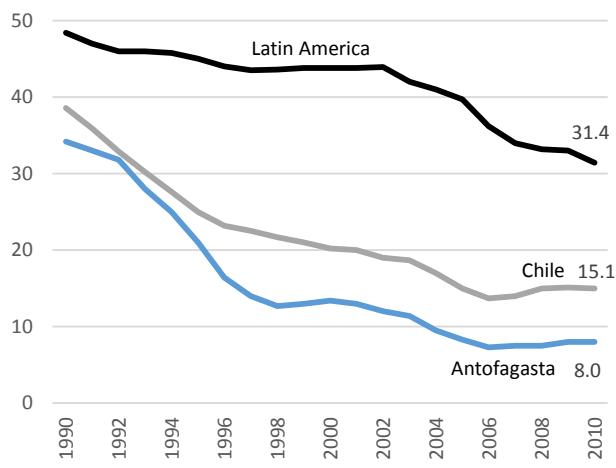
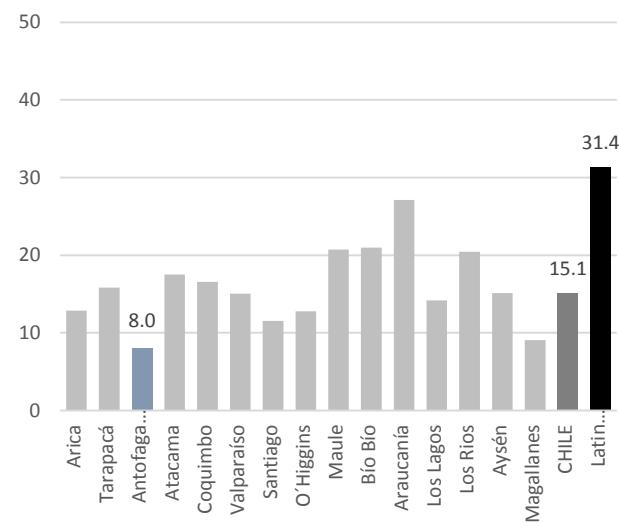


Figure 2
Poverty in Chile by regions 2010 (%) (1)



1) Prepared by AFD Group ● Analysis based on information of MIDEPLAN, ECLAC, CASEN – CHILE. Indicators of poverty based on national poverty line measures.

Antofagasta is the second largest region located in the northern Chile. It is characterised by extremely dry climate with almost no agricultural activity. Mining is the dominant sector representing over 90% of the regional GDP (considering direct and indirect GDP) during the period 1990-2010 based on a high level economic linkages ([\(AIA 2008; Parra 2009\)](#)). From the 2002 Census, it has a population of around half a million predominantly (around 97.7%) occupying the major cities of the region.

To date the mining assets invested represent around US\$25 billion; in the last two decades foreign investment materialized was over US\$15 billion; and the contribution to state income topped 25% (considering direct and indirect effects; data based on current dollar). Resource development is undertaken by a mix of both Chilean state owned companies such as CODELCO, and international mineral houses, including BHP Billiton, Anglo-American, Xstrata, Freeport-McMoRan and Barrick Gold.

METHODOLOGICAL CONSIDERATIONS

This paper employs regression model to analyse mining effect on poverty reduction in the region for the period 1990-2010. However, it is important to recognise the complexity of measuring human wellbeing and the importance of avoiding simplistic arguments. For this reason, the analysis considers the following two key aspects:

1. The effect on only monetary poverty (national poverty line) is analysed.
2. Antofagasta has a unique geographic position, and social and economic structure that supports the statistical analysis employed in this research. As noted earlier in this paper, Antofagasta is predominantly a mining region representing around 90% of regional economic activity (based on direct and indirect GDP) with 97.7% urban population. With an isolated geographic setting, the region's wellbeing is thus highly reliant on the mining sector as the driving force behind its economic change.

Therefore, the regression analysis employed in this paper treats mining production as a major independent variable to influence the change in regional wellbeing (measured in terms of a change in poverty level). Given Antofagasta's dependence on the mining income, the potential of a change in mining production affecting the change in regional wellbeing is significant. The level of confidence in the analytical model applied is reasonably high given the unique aspects of the context.

REGRESSION ANALYSIS OF POVERTY REDUCTION

Regression Model

The regression analysis utilized to explain the relationship between poverty reduction and mining activity in Antofagasta uses the rate of poverty as dependent variable (percentage of total population in Antofagasta: P=Y) and copper production as independent variable (Q=X) for the period 1990-2010. The hypothesized relationship between poverty (P) and copper production (Q) can be written as:

$$\text{Poverty} = f(\text{Production}, e)$$
$$P = a + b Q + e$$

Where:

P = Percentage of Poverty (%)

Q = Copper production (Thousands of Tonnes)

a = A constant amount (poverty level when Q = 0 = Zero)

b = The effect in the percentage of poverty of additional production of copper

e = the "noise" or error of the model. It reflects other factors that influence poverty.

In this paper, investigators have tested different models and combinations of independent variables to avoid specification error and bias. These tests have included modelling using other independent variables such as: social public expenditure, mining investment, mining exports, private copper production and public copper production. Results show that $(P = a + b Q + e)$ is the model that better represents the relationship between mining activity and poverty reduction.

Statistical Results of Regression Analysis

The regression analysis shows that the model presented ($P = a + b Q + e$) has statistically significant (F test) and high degree of confidence (Significant F). At the same time, the statistical analysis shows that parameters (a, b) are significant (as indicated by the Standard Error, t Stat and P-Value).

Based on this information, and the high correlation (determined by regression statistics: multiple R, R Square and Adjusted R Square) it is possible to ascertain the relationship between Production (Q) and Poverty. This result is in conformity with the findings in other previous research (Larde, Chaparro et al. 2008; Parra 2008; Lagos and Blanco 2010).

Table 1
Summary of Data and Output of Regression Analysis (1)

DATA						
	Poverty (%) P = Y	Production (Thousand of Metric Tons) Q = X	SUMMARY OUTPUT			
			Regression Statistics			
1990	34.2	1,063	Multiple R	0.964		
1991	33.0	1,297	R Square	0.929		
1992	31.8	1,348	Adjusted R Square	0.925		
1993	28.0	1,385	Standard Error	2.479		
1994	25.0	1,503	Observations	21		
1995	21.0	1,555				
1996	16.4	2,132				
1997	14.0	2,416				
1998	12.7	2,572				
1999	13.0	2,752				
2000	13.4	2,698	ANOVA			
2001	13.0	2,716	Regression	df	SS	MS
2002	12.0	2,708		1	1,529.8	1,529.8
2003	11.4	2,971		Residual	19	6.1
2004	9.5	3,344	Total	20	1,646.5	
2005	8.3	3,365				
2006	7.3	3,341				
2007	7.5	3,573				
2008	7.5	3,269	Intercept	Coefficients	Standard Error	t Stat
2009	8.0	3,349	X Variable Q	-0.011	0.001	-15.781
2010	8.0	3,327				P-value
						Lower 95%
						Upper 95%

1) Analysis by AFD Group ● Analysis based on information of MIDEPLAN,
COCHILCO.

DISCUSSION:

SOCIOECONOMIC ANALYSIS OF RESULTS

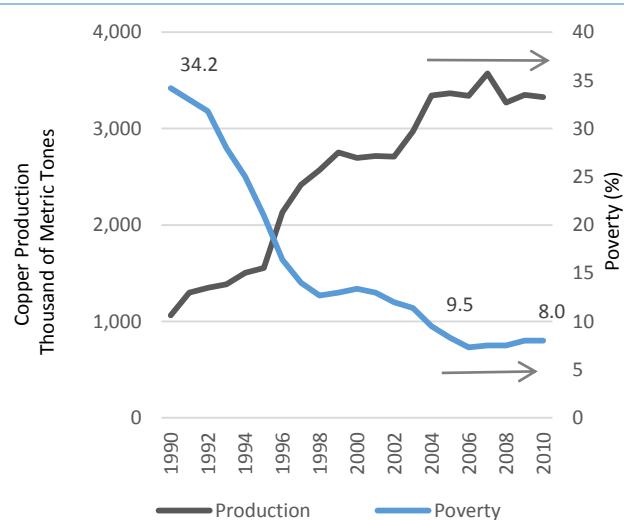
The high correlation between the independent and dependent variables indicates that poverty level decreased with every increase in mining production over the period 1990-2010. In this period, poverty declined from 34% to 8% of the total population in Antofagasta, following the increment of copper production from 1 million to 3.3 million of metric tons.

The analysis also shows strong evidence of causality between mining activity (represented by copper production) and poverty reduction (percentage of poverty) in Antofagasta during that period. This is evident from Figure 3 and Table 2 below which demonstrate the consistency of the relationship in that as production increases, or remains steady poverty decreases or remains steady.

Table 2
Poverty Reduction and Copper Production (1)

	Poverty (%)	Population Living in Poverty (Thousands)	Copper Production (Thousands of Metric Tons)
1990	34.2	136	1,062
2004	9.5	50	3,343
2010	8.0	46	3,326

Figure 3
Poverty (%) and Copper Production (2) in Antofagasta-Chile (1)



Given the case analysis and robust regression outcomes, the following conclusions and deductions can be made:

Conclusions

Copper production (or mining activity) could be understood as the main cause of poverty reduction in Antofagasta during the period 1990-2010.

If copper production were at the same level as 1990 (no increment), then poverty level in Antofagasta would have persisted around 25%-30% (*Ceteris Paribus*).

Deductions

The strong causal relationship between poverty and mining production entails that other variables have had minimal effects on poverty reduction in Antofagasta. Copper production as representation of mining activity (investment, local expenditure, employment, taxes) is not only the main cause of poverty reduction in Antofagasta, it also appears as the only important source of effective social progress.

Other socioeconomic drivers (or independent variables) such as public social policies and expenditure and other non-mining economic activities do not have statistical significance on poverty reduction in Antofagasta. This is clearly observed in the period 2004-2010, when copper production remained at the same level (around 3.3 million of metric tons) and the poverty level in Antofagasta did not show significant improvements (Poverty 2004= 9.5 and Poverty 2010=8% or around 50-45 thousand people).

When mining activity is growing significantly, it has a positive effect on poverty reduction. However, the model also shows that if mining does not grow significantly for an extended period, then most vulnerable groups are not able to take advantage of economic opportunities and their socio-economic status remains unchanged with continued poverty. This situation can occur when mining activities have low expectations in terms of growth and they are forced to adjust their cost structure thereby reducing the economic impacts in the mining region.

1) Analysis by AFD Group ● Analysis based on information of MIDEPLAN, COCHILCO.

Limitations

Despite the strong evidence of relationship between copper production and poverty reduction, it is important to recognise the following limitations of the study.

- i. Factor not considered. Other factors are considered as having minimal effect; however, factors such as the return to a normal republican system in Chile (1989) and a stable democratic period (1990-2012) which coincided with the period under study may have played a role in favour of poverty reduction.
- ii. This research only accounts for the period 1990-2010.
- iii. The research also does not compare the relationship between economic activity and poverty reduction in other regions (in particular non mining regions) during the same period (1990-2010).

CONCLUDING REMARKS AND RECOMMENDATIONS

In the last twenty years, Latin America has experienced positive socioeconomic progresses with overall positive trend on basic parameters such as poverty, year of schooling, life expectancy at birth, mortality rates, as well as basic social services such as education, health, water and sanitation. Despite these positive tendencies, there is a consensus that the final objective of building a Latin America free of poverty with equitable and abundant opportunities where everyone has a real access to a decent standard of living is far away.

Examples of mining regions where the social progress in terms of poverty reduction is evident but not sufficient to eradicate poverty include San Juan (Argentina), Huaraz and Jangas (Peru) or a nearby region Tarapacá (Chile). There is, however, a potential to change this notion and realise comprehensive human wellbeing in Latin America, because the region can demonstrate a real capacity to create wealth and wellbeing with sustainable utilisation of resources.

Using Antofagasta Region in Chile, this research demonstrated that mining development at large-scale can be an important economic engine and driver for poverty reduction and social progress. This is realised when mining production generates a positive socioeconomic scenario in the area of influence of mining activities.

At the same time, however, it is highly important to note that large-scale mining activity (especially if the activity is not growing) **does not have the capacity to reduce to zero or eradicate poverty.**

In a context of large-scale mining activities, evidence suggests that traditional social policies/ programs should be complemented for an effective poverty reduction strategy. Hence, it is necessary to implement specific or complementary social/programs to face bigger challenges in terms of poverty reduction and work with vulnerable groups and using mining development as a real opportunity for social progress.

By way of recommendation, social programs and policies in Latin America should focus on the following objectives and criteria:

1. In order to facilitate the process of eradicating poverty, policies should identify vulnerable groups in specific areas of influence connecting them with large-scale mining activities.
2. Analyse in depth the patterns and dynamics of how people can move out of poverty in the context of large-scale mining by identifying what are the activities that can better strengthen social capital and personal skills of more vulnerable groups.
3. Generate programs/policies aimed at preventing possible return to poverty.
4. Generate program/policies to support people who are still living in poverty without connections to opportunities that arise.

Final disclaimer

It is important to highlight that this paper represents a particular analysis about a specific mining region by using indicators of poverty to understand social progress. However, the researchers understand that social progress is about people and it is very important to have a comprehensive analysis about this social issue based on a multidimensional perspective of poverty, human development and progress. Further research is required to address the following questions:

What other factors may have contributed to the reduction of poverty during the period under consideration? How would the relationship and causality between copper production and poverty reduction be affected if the sample size was stretched further back in time? What happened in other regions (in particular non-mining regions) during the same period and how can this be compared to the situation in Antofagasta?

REFERENCES

1. AIA (2008). "Asociación de Industriales de Antofagasta @www.aia.cl." Retrieved 13 June, 2013.
2. Banco Central de Chile (2010). "Compendio de Estadísticas Económicas, Santiago, Chile."
3. CASEN (2010). Ministerio de Planificación de Chile. Resultados Encuesta CASEN.
4. COCHILCO (2010). Reporte Anual, Santiago, Chile.
5. Consejo Minero de Chile (2011). Reporte Anual. Santiago, Chile.
6. ECLAC (2012). "Statistical Yearbook for Latin America and the Caribbean."
7. Gobierno de Chile (2013). "DESCRIPCIÓN/CARACTERÍSTICAS DE LA REGIÓN @<http://www.goreantofagasta.cl/index.php/historia-region>." Retrieved 01 August, 2013.
8. Gobierno de Chile/ PNUD (2010). Tercer Informe sobre los Objetivos de Desarrollo del Milenio.
9. Lagos, G. and E. Blanco (2010). "Mining and development in the region of Antofagasta." Resources Policy **35**(4): 265-275.
10. Larde, J., E. Chaparro, et al. (2008). El aporte del sector minero al desarrollo humano, El Caso de la Región de Antofagasta, División de Recursos Naturales de la CEPAL, UN.
11. Parra, C. (2008). Desarrollo Humano y Socioeconómico en la Región de Tarapacá 1990-2007, Tarapacá, Chile.
12. Parra, C. (2009). El caso de la Provincia de San Juan y Mina Veladero, San Juan, Argentina.
13. Parra, C. and D. Franks (2011). Monitoring social progress in mining zones - the case of Antofagasta and Tarapacá, Chile. SRMining Santiago, Chile.
14. USGS (2013). Mineral commodity survey.