ARTÍCULO

MINING INVESTMENT AND A FISCAL REGIME THAT PROMOTES THE INVESTMENT: AN INTER-TEMPORAL MODEL

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ABSTRACT

This paper aims to show how both mining company and government will improve financially by promoting the reinvestment of profits. It will start with a theoretical framework about the mining investing sustainability. Then, an inter-temporal model will be proposed to formalize, theoretically, how the reinvestment will improve, in present value, profits and revenues for both firm and government, respectively. Also, empirical evidence will be shown, particularly, for Peru and Chile. Then, an approach to strong sustainability in Peru will be set by explaining the main variables of sustainability in the Peruvian mining sector as well as its main sustainability items. Finally, some conclusions will be presented.[1]

JEL: C6, E23

KEYWORDS: Cluster, Expenditure, Fiscal Regime, Government, Inter-temporal, Investment, Mining, Peru, Profit, Reinvestment, Revenue, Sustainability, Taxes

RESUMEN

El objetivo del documento es mostrar cómo la compañía minera y el gobierno mejorarán financieramente tras la promoción de la reinversión de beneficios. El documento comenzará con una base teórica acerca de la sostenibilidad de la inversión minera. Luego, un modelo intertemporal será propuesto para formalizar, teóricamente, cómo la reinversión mejorará, en valor presente, los beneficios e ingresos tanto para la firma como para el gobierno. También se mostrará una evidencia empírica, particularmente para Perú y Chile. Por último, se establecerá un enfoque de la fuerte sostenibilidad en el Perú, explicándose las principales variables de sostenibilidad en el sector minero peruano así como también sus particularidades. Finalmente, se mostrarán algunas conclusiones.

JEL: C6, E23

PALABRAS CLAVES: Clúster, Gastos, Régimen fiscal, Gobierno, Intertemporal, Inversión, Minería, Perú, Utilidades, Reinversión, Ingresos, Sostenibilidad, Impuestos

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INTRODUCTION

Natural resources are important factors of wealth for many economies around the world, particularly for countries endowed with oil, gas, and minerals. Some countries in Latin America and Caribbean (LAC) are not exceptions to this characteristic. Countries like Mexico (oil, gas, and mineral), Venezuela (oil and gas), Colombia (oil and gas), Chile (minerals), and Peru (oil, gas and minerals) are endowed with important reserves of natural resources.

A substantial element of natural resources endowed countries is related to how these resources contribute with their economic development. In fact, there are many examples in the developed world of natural resource-rich countries that have improved considerable their levels of GDP, income and wealth using natural resources (Australia, Canada, the United State, and Scandinavian countries). In this context, natural resource wealth is positive for development; but, more importantly, various studies show that natural resource wealth becomes a real development asset when investments in skill, technological capacities, and good macroeconomic institutions and management[2] are present.

This paper will start with a theoretical framework about the mining investing sustainability where institutionality and fiscal stability issues are addressed for Peru and Chile. Then, an inter-temporal model will be proposed to formalize, theoretically, how the reinvestment will improve, in present value, profits and revenues for both firm and government, respectively. Also, empirical evidence will be shown for Peru and Chile, particularly, levels of explorations and productions for both countries will be exposed. Then, an approach to strong sustainability in Peru will be set by explaining its main variables such as tax regime, social agreement with communities, government´s revenues, regulatory regime, among others in the Peruvian mining sector as well as its main sustainability items such as people's solidarity mining program, work for taxes, paperwork waiting time. Finally, some conclusions will be presented.

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[2] Perry, G., "Natural Resources, Neither Curse nor Destiny", The World Bank (2007).

THEORETICAL FRAMEWORK

The exploitation activity of mineral resources transforms the resource rent of the natural capital into financial capital. To government, mineral resources (government´s property) are transformed in taxes, principally. For this reason, if the assumption of weak sustainability is accepted, then financial capital gained from the exploitation of mineral resources is more relevant to the people's welfare than the unexploited mineral resources. In this process, usually, the financial capitals can generate returns through business activities and will grow over time if parts or all of these capitals are reinvested properly. Consequently, under these assumptions, the mineral resources should be optimally exploited in such a way that renders maximum economic rents, through time (Arnonkitpanich, 2009).

Moreover, according to Brekke (1997), "a development is … said to be weakly sustainable if the development is non-diminishing from generation to generation. This is by now the dominant interpretation of sustainability." In addition, according to this author, the strong sustainability sees sustainability as non-diminishing life opportunities, in other words, the sustainability should be achieved by conserving the stock of human capital, technological capability, natural resources and environmental quality.

On the other hands, from an economic perspective, the idea to maximize the present value through time of the economic rents obtained from the extraction of mineral resources was firstly introduced in a renowned article named "The Economics of Exhaustible Resources", which was written by Harold Hotelling in 1931. This Hotelling's article did not talk about sustainability, but his model has become the basic of many later works that involve the optimal natural resources exploitation. Under some assumptions, the Hotelling's Rule say: if the level of production is always positive for all time periods and such production does not generate the extinction of the resource in a period of time equivalent, an optimal production path of non-renewable natural resources is achieved by the natural resources owner. In other words, the Hotelling's Rule finds the best or optimal moment to extract the reserves of the natural resource and, the same time, finds the process of maximizing of the benefits of the owner of the resource (Gómez, 1994).

With this conceptual framework, an economic model to obtain the optimal depletion path of mineral resources of two countries will be developed in this section. These countries will be Chile and Peru. Specifically, we will evaluate the relationship between mining investment and a fiscal regime that promotes this investment, taking into account an inter-temporal model. To analyze this relationship, first at all it is important to mention that the Hotelling´s model will be complemented incorporating a factor that works to promote the mining investment over the time, mainly exploration investment to increase the reserve. In other words, we will assume that a mining company can invest in the future part of its profit generated in the current period because the mining fiscal regime promotes this behavior, for instance mining companies can re-invest part of their profit and pay less taxes as Chilean case.

In fact, until 2012, in Chile the income tax rate was 20% and the withholding tax on dividends rate was 35% on dividends, less income tax or corporate tax credit. In this case, Chilean mining fiscal regimen promoted significantly the mining investment because if a mining company did not distribute dividends and re-invests its profits it paid 20% only, but if the company distributed dividends and did not re-invest it paid 35%. In contrast, in Peru, the income tax rate was 30% under the general tax regime and the withholding tax on dividends rate was 4.1% on dividends of profits to non-domiciled and individuals by domiciled companies and by branches, permanent establishments and agencies of foreign companies. The difference was clear, Chilean mining fiscal regime was more promoting of the mining re-investment than Peruvian mining fiscal regime.

Another fundamental issue that needs to be considered in this section is the stability and credibility of the mining fiscal regime and the time inconsistency problem, principally in countries where the institutionality of the fiscal regime is weak or is in progress. Generally, the mining agreements between the company and the state are from 10 to 30 years. One of the principal reasons that explain why the exploitation of mineral resources is carried out with long-term agreements is referred to the following issue: the balance of power changes during the life of the mining project. Before the production starts, the power is in the hands of mining companies because countries around the world compete to attract investors to their respective jurisdictions.

Then, once the project begins to develop and produce, this power shifts from the mining company to the State, consequently, in countries with institutions that often change the mining tax regime, the political pressures towards contract renegotiation can be almost irresistible to change original contract or establish a new mining taxes if the company does not have stability agreements. In the final stage of the project, when the mining reserve or deposit is almost exhausted, this balance of power change again. The mining company may abandon the project if it concludes that the state requires too much.

In this context, according to Philip and Sunley (2010), fiscal stability clauses in mining agreements or stability contracts are generally justified by the following reasons: i) the large size and the sunken nature of the initial investment, ii) often a long period required to recover investment and earn a reasonable return, and iii) a lack of credibility on behalf of the host country to abstain from changing the fiscal rules once the investment is sunk, the time inconsistency problem. This is the reason why mining enterprises sings stability contract with the government to reduce the sovereign risk.

Taking into account these issues, we will describe a math model which assumes that the mining companies can re-invest part of its profit in the next periods to discover (exploration activities), develop and exploitation new mining reserves. This re-investing profit generates new reserve, new production and new profit and this new profit is re-invested by the mining company in the future. In other words, in the time, the re-investing profit generates new mines, and consequently the mining reserves change in the time. Moreover, to treating a mineral resource as an infinite stock because the re-investing profit generates new mines, the Hotelling model is simplified by making the following assumptions:

i.   The goal of mining is to maximize the present value of net benefits from extraction.

ii. The resource stock of mine is homogeneous.

iii. The mining industry is perfectly competitive.

iv. The current and future costs of extraction and market price of the mineral are known.

v.   The quantity of mineral stock changes in the time, explaining by re-investment of profit to discover new mines.

vi. The mine has unlimited production capacity and there is no technological advance.

An inter-temporal model

To build a math expression of this idea, we begin with a basic specification of profit (Π_{t+s}), which includes taxes paid by the mining companies. In this model we assume that there are two tax rates, one of them is the tax rate paid by the mining company according to a general fiscal regime (τ_1), but if the company re-invests part of its profit in exploration activities it pays a less tax rat(τ_2). The mining company's revenue and total cost are pq_{t+s} and q_{t+s}^2, respectively. We assume that the total cost depends positively of the production. Additionally, in the following equation, the percentage of profit that the mining company re-invests in the next period is represented as γ and the parameter φ is a factor that transforms the mining company's re-investing profit in new profit in the next period. Consequently, the basic specification of profit will be the following expression:

Equation 1

$$\Pi_{t+s} = (1-\alpha)\left(pq_{t+s} - q_{t+s}^2 + \theta_{t+s}(1-\alpha)\left(pq_{t+s-1} - q_{t+s-1}^2\right)\right)$$

In the last expression, we will assumes that $\theta_{t+s} = (\gamma\varphi)_{t+s}$, where φ represents the percentage of profit that is re-invested in the next period and $\gamma\varphi$ represents the percentage of re-investment that becomes profit[3]. Furthermore, the restriction of the mining company is defined by $x_{t+s+1} - x_{t+s} = -q_{t+s}$ and $\alpha = \tau_1 - \psi(\tau_1 - \tau_2)$. Also, the stock and control variables are represented by the reserves, x_{t+1}, and the production, q_t, respectively.

The solutions for stock and control variables are:

Equation 2
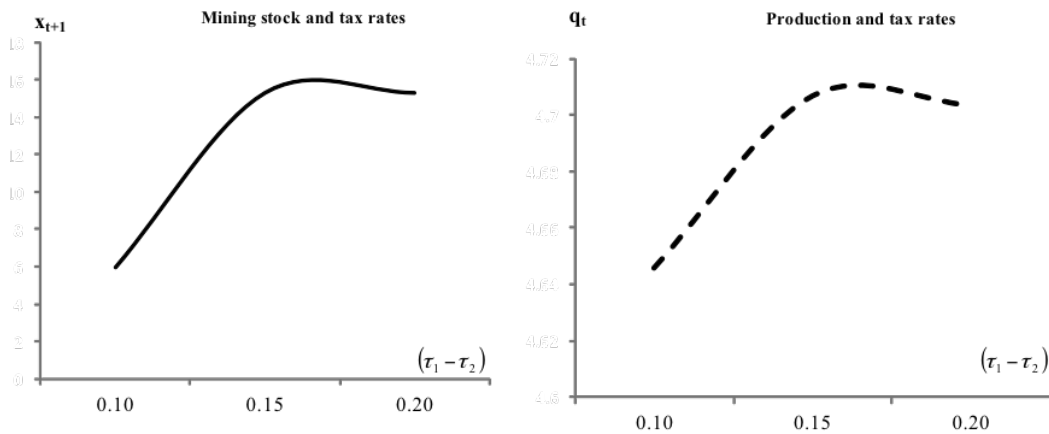
$$x_{t+1} = \frac{1}{1+A}\left[Ax_t + \frac{1-A}{2}p\right]$$

$$q_t = \frac{1}{(1+A)}\left[x_t - \frac{1-A}{2}p\right]$$

According to the last two equations, there are positive relationships between the deviation of tax rates $(\tau_1 - \tau_2)$ and the mining stock and production, as it is showed in the following figure.

Figure 1

Mining stock, production and tax rates
(Theoretical)

Source: Own elaboration

The objective of this model is to show that the future mining stock (x_{t+1}) changes in the time and it depends negatively of the tax rate. Specifically, if the difference between τ_1 and τ_2 increases, the mining company's re-investment in exploration activities and the mining stock rise in the future. In other words, if a mining fiscal regime promotes mining re-investment in exploration activities, this regime will permit to discover new mines and, consequently, new

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3   See Appendix 1 to see how we obtain the optimal expressions for control and stock variables throughout a Lagrangian as well as the parameters value.

reserves in the future. In this context, there will not be conflict between the mining company and the government to obtain profits and fiscal revenues, respectively. Both company´s benefit and government´s revenue will increase as result of exploitation old and new mines. Only if there are not discovered new mines, the benefits of the unique mine in operation will be disputed by the mining company and the government. The gain of one of them will be the lost of the other participant.

This issue is showed by the solution for x_{t+1} which indicates how both company´s present value of profit and government´s present value of revenue will rise when new mines are discovered and exploited as a result of a fiscal legal framework that promotes the re-investment. This equation shows that the present values of company´s profit and government´s revenue with discovered new mines are more significant than present values of company´s profit and government´s revenue without discovered new mines and the mining company operates one mine only. Using the solution for x_{t+1} showed before and the parameters selected, the following figure presents this theoretical comparison.

Figure 2

Comparison of present values: simulated with 60 years
(Theoretical)
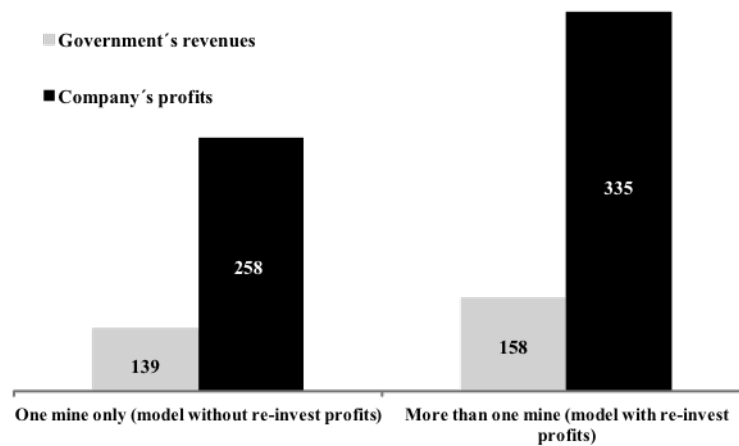
Source: Own elaboration

Empirical evidence: Chile and Peru

The theoretical framework just outlined provides a potential basis for analysis of changes in the main variables mentioned before. Taking into account the available information, in the present section we will describe the behavior of theses main variables for Chile and Peru cases. Firstly, we start describing how the total mining investment and exploration mining investment have changed in both countries in the last twenty two years. Specifically, it is important to show that Chilean mining investment has been major than Peruvian mining investment, both in total and exploration investment. As a result, the Chilean copper reserves have increased highly until 2016.

In Peruvian case, the following figure shows that its copper reserves has been around to 80 millions of tons in the last ten years, there was not an important change in this variable in that period. Another aspect that the following figure shows is the Peruvian mining investment in explorations activities is less productive than Chilean case. Two things that explain this problem are difficult regulatory regime and social agreement with the communities, definitely.

Figure 3

Mining Investment
(Millions of dollar)
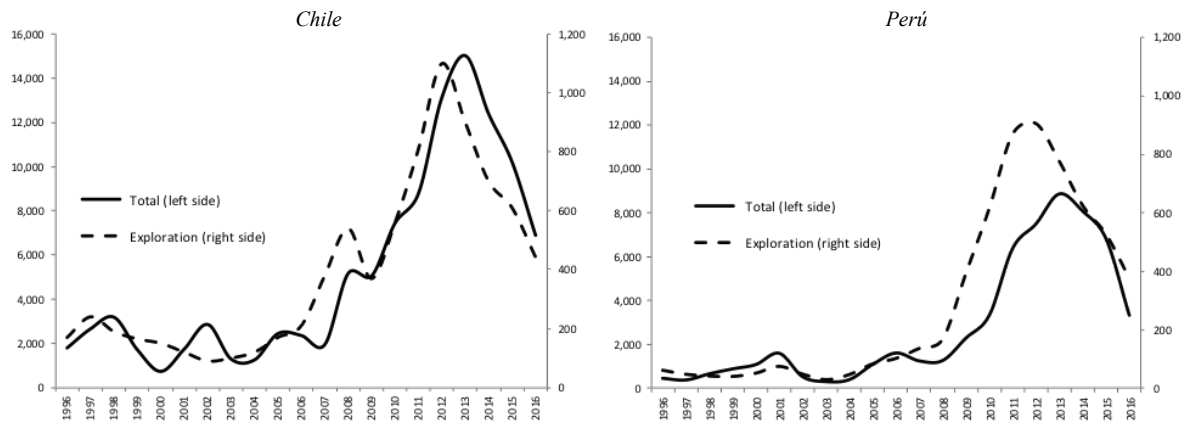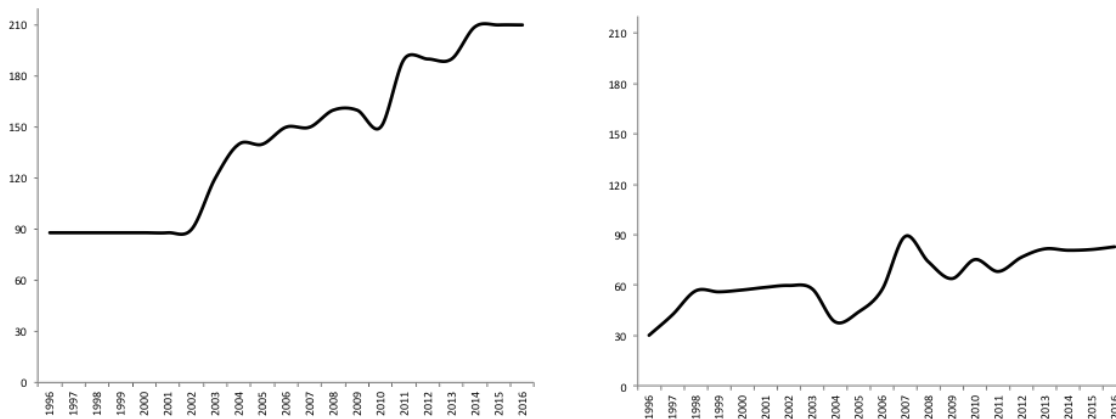
Source: US Geological Survey, Ministry of Mining and Energy (Peru) and Ministry of Mining (Chile)

More mining investment and reserves produce more tons of minerals, and new mines start operation. The following figures show how many new mines have started their operations in these countries, promoting by a mining fiscal regime which promotes mining investments. In Chilean case, it is considered the private production only because this sector has been more dynamic than public sector. In 1992, 60% and 40% of the Chilean copper production were produced by public company (Codelco) and private companies, respectively. This structure has changed in the last years. In 2016, only 31% of the Chilean copper production was produced by public company and 69% was produced by private companies. In contrasts, in Peruvian case, all mines have been privates in the last twenty five years.

We can see that the production of new mines in Chile has been more significant than Peruvian`s new mines. In other words, in Chile the mining company´s re-investment and the number of new mines in operations have risen more significant than Peru, encouraging by a mining fiscal regime that promotes mining re-investment which permits to discover new mines and, consequently, the production. In this Figure, mines that have started its operations since 1993 are considered as new mines.

In addition, compared with Peru, Chile not only has increased its copper production but also has increased the number of operating mines and the level of mining reserves and stocks. In Chile, the new main mines that have started their operations since 1993 were Collahuasi,

Los pelambres, Spence, El Abra, Zaldivar, and Candelaria, all mines with levels of production upper than one hundred and thousand tons by year. In contrast, since this year, in Peru the Antamina mine, and recently Toromocho and Las Bambas, have been the unique new mines that started operations with a level of production upper than one hundred and thousand tons by year. Moreover, since 1992, the Chile´s copper reserve has improved compared whit Peru´s copper reserve.

Another important element that we need to consider in this analysis is how the government`s revenues generating by the mining sectors have increased in the twenty last years. The following figure shows that in Chile the mining fiscal revenues have increased faster than Peru, as result of the attractive mining tax regime that has Chile. This is contrasted when the mining sector´s accumulated private taxes of Chile and Peru are compared. The accumulated private tax ratio, which is defined as the accumulated private taxes of Chile divides by the accumulated private taxes of Peru, has increased steadily in the last years.

In part, these rise on Chilean tax revenues reflected a generous fiscal regime designed to attract new investment through re-investment system of profits. Chilean mining fiscal regimen promotes significantly the mining investment because if a mining company did not distribute dividends and re-invested its profits the mining company paid 20% only, but if the company distributed dividends and did not re-invest it paid 35%.

Figure 4

Production and government´s revenues
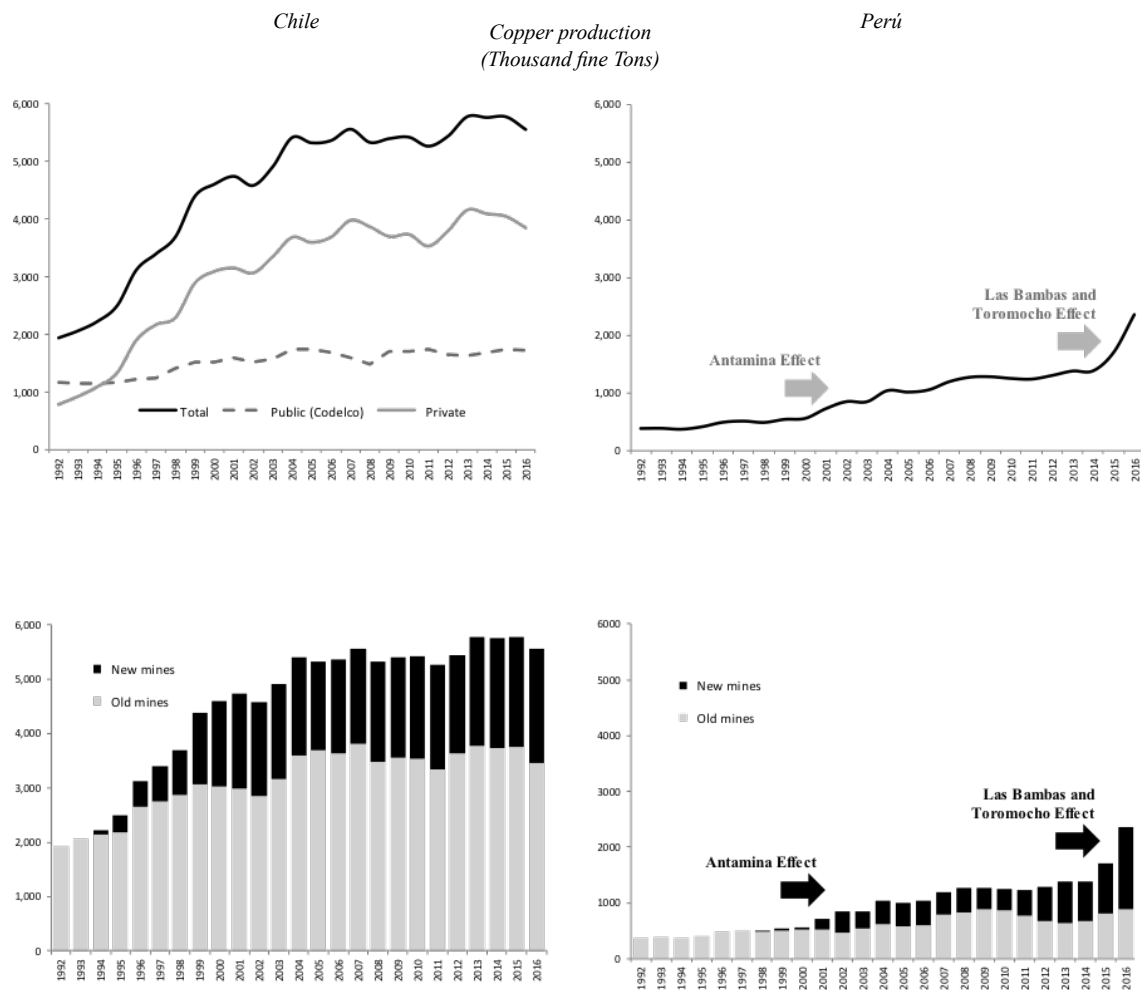
Total fiscal of government´s revenues mines
(Millions of dollars)
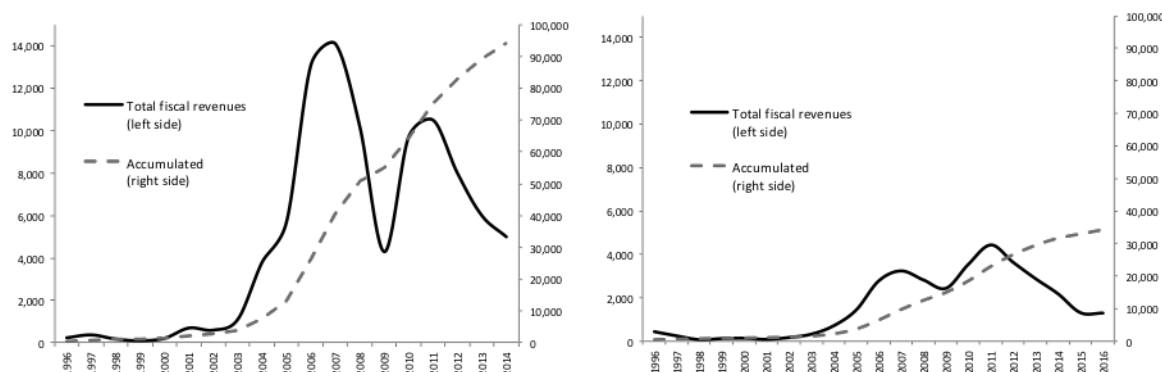
Source: Ministry of Mining and Energy (Peru) and Ministry of Mining (Chile)

An important issue of Chile and Peru´s fiscal regimes is related to the stability contracts and income tax (corporate tax). In Chile, if the taxpayer has elected to enter into a Stabilization Agreement or Mining Contract, the rate is up to 2 percentage points over the income tax rate; however, in Peru, if the taxpayer has elected to enter into a Stabilization Agreement or Mining Contract, the rate is up to 2 percentage points over the income tax rate (Law 27343). Mining companies that invest in Peru usually sing a Stabilization Agreement, which guarantees the holders of mining activities, the current tax regime, including the income tax, on the date of approval of the investment program.

In a re-invest scope, a proposal could be investing what the country earns by granting stability in activities that contribute with its sustained growth towards prosperity, that is, stability with sustainability. In this way, stability is achieved with "win-win". Indeed, for the country to achieve first world standards of living requires greater investment to increase its reserves and at the same time to invest more resources in innovation, mainly to gain productivity through innovation in any of its modalities; innovating in processes, products or technology.

To obtain this goal, a fiscal framework that promotes the reinvestment of profits tends to increase reserves and consequently the levels of production: virtuous circle of taxation that allows the investor and the State to earn at the same time; and greater productivity in the sectors with the greatest potential. In this context, under an investment for sustainability scope, it is essential

that the Income Tax of stability contracts (up to 2 percentage points) be allocated to promote investment in mining exploration and innovation, in general, to promote a developed sector of Mining Equipment, Technology and Services (METS) or mining cluster. This proposal includes companies with stability contracts; they would not pay 2 percentage points for Income Tax for stability as long as it is destined to expenses in exploration and innovation in productive processes (transversal) and the generation of competitive competitors. Also, the condition of stability would not be lost.

AN APPROACH TO STRONG SUSTAINABILITY IN PERU

Following to Brekke (1997) a strong sustainable is sustainability as non-diminishing life opportunities, as conserving the stock of human capital, technological capability, natural resources and environmental quality. In fact, taking into account a large scope, we consider that the strong sustainable not only will consider conserving the stock of human capital, technological capability, natural resources and environmental quality, buy also increasing or better theses aspects.

Consequently, in this step is very important that we will answer the following question. What must the rate t_2 include? How we can include others items which explain the strong sustainable? For this reason, not only this rate must include taxes or all items that mining companies pay to government (tax approach), but also how these government´s revenues are

used (public expense approach). In this context, we consider all direct and indirect issues that impact the sustainability. The following figure shows how these variables are related with this concept.

Figure 5

Main variables of sustainability in the mining sector
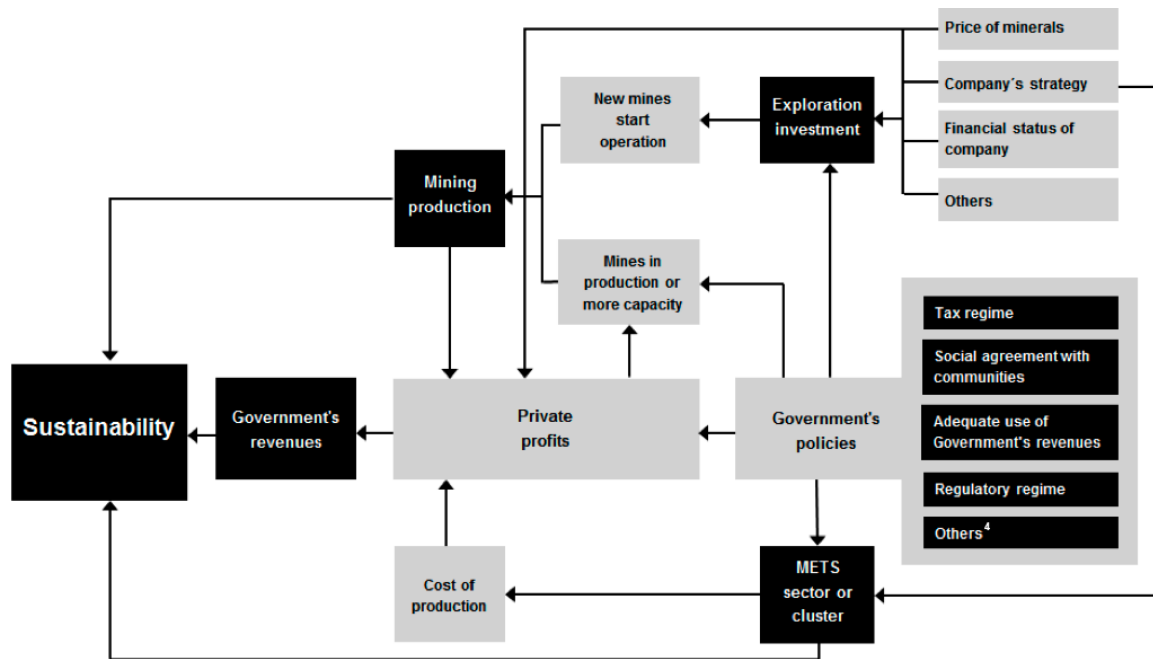
Source: own elaboration

In the last figure we can observe the relationship between tax regime and sustainability, through exploration investment and mining production. An important issue related to exploitation of mining resources is to determine whether the objective is to maximize the fiscal revenue in the short or in the long term. If the goal is short-term maximization, the mining fiscal system needs to impose a high effective tax rate, but it is too high, burden on individual mines will be too heavy, and consequently in the long run there will be fewer mines, thus fewer taxpayers, a narrower tax base, and a smaller contribution to the government. A good mining fiscal system will strive to set the optimal effective tax rate where an optimal balance is found. In this case, if a mining fiscal regime promotes mining re-investment, this regime will permit to discover new mines and, consequently, new reserves in the future. For this reason, there will not be conflict between the mining company and the government to obtain profits and fiscal revenues respectively. Both company´s benefit and government´s revenue will increase as result of exploitation old and new mines. Only if there are not discovered new mines, the benefits of the unique mine in operation will be disputed by the mining company and the government.

This idea is analyzed with our inter-temporal model which assumes that the mining companies can re-invest part of its profit in the next periods to discover, develop and exploit new mining reserves. This re-investing profit generates new reserve, new production and new profit and this new profit is re-invested by the mining company in the future. In other words, in the time, the re-investing profit generates new mines, and consequently the mining reserves change in the time. The objective of this model is to show that the future stock of minerals changes in the time and it depends negatively of the tax rate. With a mining fiscal regime that promotes the mining investment, principally in exploration

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[4] The appendix section show a complete numbers of factors that influences over company decisions to invest in various jurisdictions, according to Fraser Institute.

stage, the present values of company´s profit and government´s revenue with discovered new mines are more significant than present values of company´s profit and government´s revenue without discovered new mines and the mining company operates one mine only.

Tackling particular issues

On the other hand, the social agreement with communities and an adequate use of government's revenues encompass two aspects that we need to analyze in this section to a better compression of the sustainability. During the first stages of private mining, 90´s years, the State was practically inexistent regarding the relationship between local communities and mining investors. A poor environmental regulation and inexistent financial resources to communities were part of these years. In the following the decade of 2000´s, mining sector has grown significantly regarding its importance in the Peruvian economy. It has probably been the engine behind the successful economic growth, especially during when international mineral prices skyrocketed. At the same time, social conflicts began to rise in the country, especially in the mining areas.

So, we are able to mention three common problems in local governments directly related to mining project.

Changes done in the 2000´s decade related to Mining Canon did not showed the expected results. It is true that local governments' revenues increased because of canon and royalties but there have not been an adequate expenditure capacity; that is, the level of expenditure as percentage of revenue has been decreasing and most of the money is just gaining interests on a bank account. Furthermore, this lack of capacity is highly related to lack of technical expertise among public workers who cannot fulfill public investment requirements stated by Peruvian laws. The nearly inexistent expenditure capacity is also due to corruption issues which is present not only in local governments but also in the central government.

Likewise the lack of expenditure quality is another crucial problem present on local governments whose investments are a little bit unproductive. That is most of the expenditure is concentrated on increasing public workers salary due to local governments´ high revenues. Also, unproductive infrastructure is also common. That is, other projects are prioritized

instead of electricity or sewers connections and the governor is also agree because it not only allows him to be more popular among local people but also gaining votes if reelection is the main concern. Then, the low quality of capital expenditure is characterized unproductive public infrastructure because it has no impact on local potential gross domestic product.

Another problem deals with poor targeting expenditure. This problem is similar to lack of expenditure quality mentioned above; that is, local government usually does not spend in favor of communities directly related to the mining project. It is because of they are not high population communities where the governor cannot get votes for future elections. Then, it is only infrastructure that will have no long term impact on those communities. In contrast, the governor would rather to spend most of those revenues on zones which have more population and gain more votes in the future. Then, the local government indirectly promotes that the mining deals with the development of those communities.

Those three problems mentioned are present in spite of there is bill which states that the municipality directly related to the mining project gets the 3% and 10% of the total cannon and royalties, respectively.

As a solution, the government implemented several measures to ease the political pressure. Perhaps the most significant one was distributing mining fiscal income among the region, the provinces and the districts where the mine operated and from where the natural resource was extracted. At the same time, mining firms began spending more on corporate social responsibility and became more involved in social development activities in their influence areas. Of course, this is not exclusive to the Peruvian case; it is part of an attempt of International Financial Institutions and transnational mining companies to build an image of a more responsible and more development oriented mining industry.

In this context, the Peruvian government created the People's Solidarity Mining Program (PMSP – Programa Minero de Solidaridad con el Pueblo) created in 2006. It was a context of mineral international prices sky rocketing, and some politicians claimed for contracts with stability tax agreements with mining companies to be revised and for mining enterprises to pay over profit tax.

The first proposal was not viable as it would imply the Peruvian government could be involved in judiciary problems for not fulfilling a contract signed earlier. And as an answer to the second claim, the Peruvian government offered a solution in agreement with mining companies where the latter ones would not pay over profit tax, but in exchange they committed to invest during the next five years a predetermined amount in social development projects in their operations' influence areas.

Once these elements have been described, there are currently few concrete, efficient and promising tools for the development of the population related to the Socio-Environmental Economic Influence Area of the mining projects. The non-renewal of the Mining Program of Solidarity with the Community (MPSC), the most important tool available to allocate resources from the MC and MR for local and regional governments (either by WfT, subcontract or public direct investment) added to the lack of incentives mentioned above, there is little room for effective intervention.
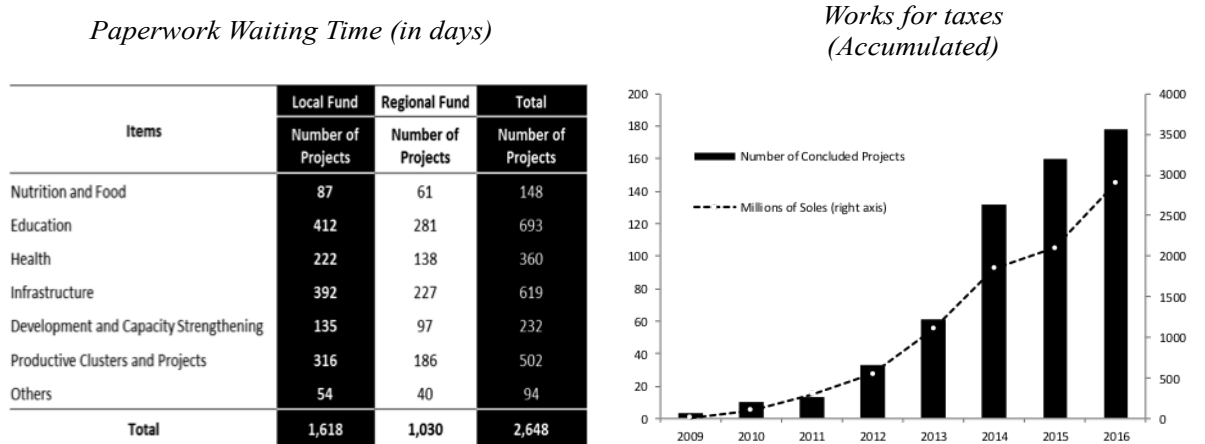
In 2007 another program was created by the Ministry of Economy and Finances to help the mining industry gain support from the population without having to disburse additional money, it was called "Works for Taxes". The Law 29230 and rules were issued in 2008, and the scheme is now used not only by mining companies, but also by banks, telephone companies, cement and even beer companies, among others, to reinforce their social responsibility programs. "Works for Taxes" is a scheme under which any company can pay up to 50% of their profit tax through building public infrastructure chosen by a regional or local government, and in exchange the company receives Certificates for a total amount equivalent to the value of the infrastructure work which they can use during the next ten years to pay taxes to the Central Government.
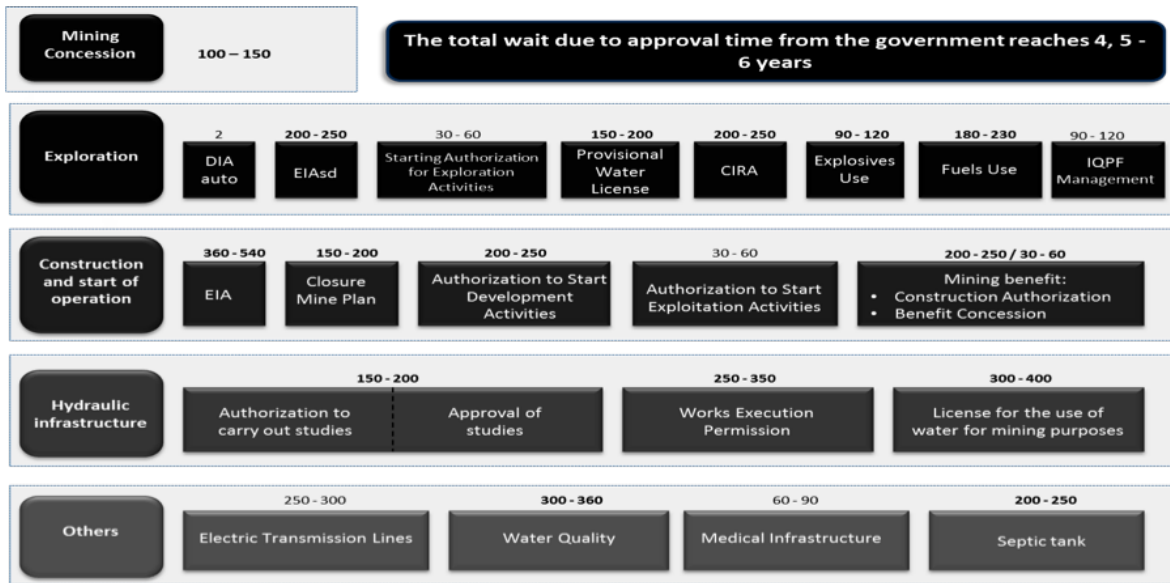
The regional or local government receiving the infrastructure must pay to the Central Government during the next years the total amount of the infrastructure work with their determined resources transfers (which include canon, royalties and other transfers as customs). This scheme brings ahead benefits from public infrastructure projects, as usually traditional procurement take much longer. In this case, the Regional or Local Government does not have to worry about the execution of the infrastructure, they just hire a Supervisor and give the conformity when the job is done. For the private enterprises, it is beneficial as their recover the whole amount of the investment (plus a 2% annual rate for inflation) and they associate the company image with high impact infrastructure projects. Plus, during the building process, local employment can be generated, and after the work is finished, operation and maintenance presents opportunities for local providers. The limit for building infrastructure under the scheme Works for Taxes is determined by the "determined resources transfers" each Regional or Local Government receives. The Ministry of Economy and Finances set the limit according to the transfers received during the last three years.

Figure 6

Main sustainability items

Paperwork Waiting Time (in days)

| Items	Local Fund Number of Projects	Regional Fund Number of Projects	Total Number of Projects
Nutrition and Food	87	61	148
Education	412	281	693
Health	222	138	360
Infrastructure	392	227	619
Development and Capacity Strengthening	135	97	232
Productive Clusters and Projects	316	186	502
Others	54	40	94
Total	**1,618**	**1,030**	**2,648**

Works for taxes (Accumulated)

Paperwork Waiting Time (in days)

Southern Main Projects Map
(Mining projects , ports and logistics corridors)

Annual Cooper Production
Southern Zone -2016
(Thousands of MT)
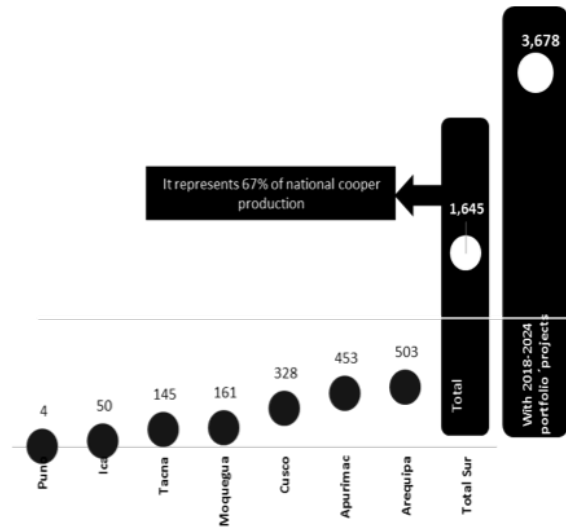
In addition, the Peruvian mining sector has a complex regulatory regime. It is necessary to organize and reduce the permits required for mining, which have grown exponentially in recent years along with the creation of new institutions that have been dismembered from others. While only ten years ago, the Ministry of Energy and Mines (MINEM) was the only in

charged of granting almost all permits, almost completely reviewed environmental studies and supervised matters of safety and environment.

Currently, an Environmental Impact Study (EIS) is being reviewed by more than seven institutions, led by the General Directorate of Environmental Mining Affairs (GDEMA) of MINEM, which has

just transferred its faculties to the newly created SENACE, but only for detailed Environmental Impact Studies (EIS-d), which will cause a "bottleneck" because MINEM is the only specialist and has the experience to do so, the other seven institutions do not count on defined criteria, nor guidelines or clear procedures for reviewing an EIS. Therefore, the company will not have "one single window" in SENACE, because it will have to seek authorization in each institution that should review its study, so the promised period of 150 days for revision will not comply.

In terms of mining safety issues, ten years ago the General Directorate of Mining (GDM)) of the MINEM dictated the policies, took the statistics and supervised. Currently, the Ministry of Labor and Employment Promotion (MTPE) is responsible for supervising the safety of "the worker", the Supervisory Organization for Investment in Energy and Mining (SOIEM) for the safety of "the facilities", and the National Center of Occupational Health and Protection of the Environment for health at work (NCOHPE). The GDM and the first two require reports for their statistics, yet none has any responsibility for the coordination between the institutions, the updating of the regulations, or the simultaneous fines for the same event, which have been increased and with the argument of "cost avoided" discretionalities have been introduced.

Regarding the control of environmental obligations, the Agency for Environmental Evaluation and Control (AEEC) has taken responsibility, however that has not had any technical-reference effect. The current administration has excelled to obtain resources with a "Contribution for Regulation", increase the discretion and the amount of the fines, and make any appeal difficult. What is more, the AEEC aims to have its own laboratory that can make its decisions more arbitrary.

In this context, the permit procedures regarding authorizations, permits, licenses and in general any type of administrative documentation required to the mining industry in any stages are very complex and remark capacity institutional as insufficient and inefficient. Consequently, 4 to 6 years are the total needed for the approval.

Finally, a cluster is defined as a geographical concentration of interconnected companies, specialized suppliers, service providers, companies in related industries and associative entities. That geographical site can be a city, a region, a country, etc. In the last 15 years the Peruvian mining sector has contributed significantly to the development of the country. Important projects, mainly copper's have started operating, which, together with the expansion of production, have allowed the generation of employment and fiscal resources for 100 billion soles nationwide. This dynamic has made possible important levels of copper production in the country; about 2.5 million tons per year, being 70% in southern Peru. In labor terms, currently in the south mining directly generates 76,500 jobs, which, added to the indirect ones exceeds half a million jobs. Why are these magnitudes and volumes of production important? Because following experiences such as the Australian or Canadian, our country has the natural resources to raise its production through the development of an advanced mining cluster located initially in the south. That is, promote an industrial agglomeration with interconnected companies, highly specialized suppliers, companies in related industries and associative entities, all with the aligned view of producing goods and services on a global scale. This vision of development would allow the Peruvian south to raise one and a half million direct and indirect highly specialized jobs associated with the cluster in the coming years.

CONCLUSIONS

Natural resources constitute a great advantage for countries to improve their development and ensure its sustainability. The sustainable development is not only a non-diminishing issue but also an issue which deals with conserving the stock of human capital, technological capability, natural resources and environmental quality.

The incentive for reinvestment profits (in exploration activities and innovation, mainly) by reducing the income tax is great alternative to keep the sustainable development in a country which is highly dependent on natural resources, in this case mining; moreover, there is evidence (Chile) which supports empirically this incentive is a good alternative. The inter-temporal model helps us to show formally this fact where both mining company and the government improve their profits and revenues, respectively.

During the first stages of private mining in Peru, 90´s years, the State was practically inexistent: a poor environmental regulation and inexistent

financial resources to local communities. In the 2000´s decade Peruvian mining sector has grown significantly regarding its importance in the economy. In fact, the mining sector dynamism has been one of the main engines behind the successful economic growth, especially during when international mineral prices were so high.

In spite of some improvements, some other problems came about. Those problems are related to inefficiency in terms on quantity and quality on the expenditure from local governments' side. That is given the increasing revenues as consequence of mining activity the capital expenditure which has a positive repercussion on local communities' potential gross domestic product has been small. In addition, if take into account corruption problems among governors, things turn worse.

Finally, Peruvian central government adopted some measures or main items to improve the environment such that firms and households get a sustainable development. They are Social-Mining program, Works for taxes, and Paperwork Waiting time. Although those items help to improve the mining activity and the economic sustainability, they are susceptible to be improved. Also it is important to promote the mining cluster and/or METS through the Income Tax of stability contracts to keep a virtuous circle of investment sustainability.

REFERENCES

A. Arnonkitpanich (2009), *"Strategies for Maximizing the Social Benefit from the Exploitation of Gypsum Mineral Resource of Thailand"*, Department of Economics, University of Stirling.

B. Dolbear (2010), *"2010 Ranking of Countries for Mining Investment – Where not to Invest"*, retriebed from: www.dolbear.com.

K. Brekke (1997), *"Economic Growth and the Environment: On the Measurement of Income and Welfare"*. Edward Elgar, Cheltenham.

R. Christopher & P. Lattanzi (2010), "Discounted Cash Flow Analysis Imput Parameters and Sensitivity", retriebed from: http://web.cim.org/mes/pdf/valdaychrislattanzi.pdf.

Daniel, Philip; Michael Keen and Charles McPherson (Editors). 2010. The Taxation of Petroleum and Minerals: Principles, Problems and Practice, Routledge Explorations in Environmental Economics.

A. Dammert & F. Molinelli (2007), *"Panorama de la Minería en el Perú"*, OSINERGIM.

H. Ergas, M. Harrison & J. Pincus (2010), *"Some Economics of Mining Taxation"*, Economic Papers, Vol. 29, No. 4, Australia.

C. Gómez (1994): *"Desarrollo sostenible y gestión eficiente de los recursos naturales"* in: Azqueta, D. y Ferreriro, A. (eds.), Análisis económico y gestión de recursos naturales, Alianza editorial, Madrid, pp. 73-100.

Gonzales, Clara (2015). La Regla de Hotelling para la Gestión Óptima de Recursos Naturales No Renovables. Facultad de Ciencias Económicas y Empresariales. Grado en Administración y Dirección de Empresas. Universidad de Valladolid.

Hogan, Lindsay and Goldsworthy, Brenton. 2010. "International minerals taxation: experience and issues" in Daniel, Philip; Michael Keen and Charles McPherson (Editors), The Taxation of Petroleum and Minerals: Principles, Problems and Practice, pp.127.

L .Hogan & B. Goldsworthy (2010), "International mineral taxation". The Taxation of Petroleum and Minerals: Principles, Problems and Practice, Routledge Explorations in Environmental Economics.

Hotelling, H. (1931): "The Economics of Exhaustible Resources", Journal of Political Economy, 39(2), pp. 137-175.

Mendiola A., Dávila O., Herrera M., Luján N., Muñoz R., "Marco "Normativo y Generación de Valor en empresas mineras Análisis comparativo entre el Perú y Chile", Universidad ESAN (2010).

Muro Ruiz, Eliseo. 2000. La Minería Mexicana, su evolución, retos y perspectivas. Instituto de Investigaciones Jurídicas. Universidad Nacional de México (UNAM).

Nellor, D, 1995, "Manual de Política Tributaria". División de Política Tributaría, Departamento de Finanzas Públicas, Fondo Monetario Internacional.

Otto, J., "Position of the Peruvian Taxation System as Compared to Mining Taxation Systems in Other Nations" (2002), and Tilton, J., "Determining the optimal tax on mining" (2004).

Otto, James et al, (2006), Mining Royalties: A Global Study of their Impact on Investors, Government, and Civil Society, Washington DC: World Bank Press (available in English and Spanish).

Perry, G. 2007. "Natural Resources, Neither Curse nor Destiny", the World Bank.

U.S. Geological Survey. 2011. MineralCommoditySummaries 2011.

U.S. Geological Survey. 2009a.The Mineral Industry of Chile. 2009 Minerals Yearbook.

U.S. Geological Survey. 2009b. The Mineral Industry of Mexico. 2009 Minerals Yearbook.

U.S. Geological Survey. 2009c. The Mineral Industry of Peru. 2009 Minerals Yearbook.

Villafuerte, M., Lopez-Murphy, P, and Rolando Ossowski. 2010. " Riding the Roller Coaster: Fiscal Policies of Nonrenewable Resource Exporters in Latin America and the Caribbean", IMF Working Paper, International Monetary Fund.

APPENDIX 1

Then the Lagrangian, with the discount rate r (where $\beta = \dfrac{1}{1+r}$), is defined by the following expression:

$$L = \sum_{s=0}^{\infty} \left\{ \beta^s (1-\alpha) \left[pq_{t+s} - q_{t+s}^2 + \theta_{t+s}(1-\alpha)\left[pq_{t+s-1} - q_{t+s-1}^2 \right] \right] + \lambda_{t+s}\left[x_{t+s} - x_{t+s+1} - q_{t+s} \right] \right\}$$

$$L = \sum_{s=0}^{\infty} \left\{ \beta^s (1-\alpha) \left[pq_{t+s} - q_{t+s}^2 \right] + \beta^s \theta_{t+s}(1-\alpha)^2 \left[pq_{t+s-1} - q_{t+s-1}^2 \right] + \lambda_{t+s}\left[x_{t+s} - x_{t+s+1} - q_{t+s} \right] \right\}$$

$$\left[q_{t+s} \right] : \beta^s (1-\alpha)\left[p - 2q_{t+s} \right] - \lambda_{t+s} + \beta^{s+1} \theta_{t+s+1}(1-\tau)^2 \left[p - 2q_{t+s} \right] = 0 \quad ...(1)$$

$$\left[x_{t+s} \right] : \lambda_{t+s} - \lambda_{t+s-1} = 0 \quad ...(2)$$

$$(1-\alpha)\left[p - 2q_{t+s} \right]\left[1 + \beta(1-\alpha)\theta_{t+s+1} \right] = \lambda_{t+s}$$

Doing $s = 1$ (two periods), $x_{t+2} = 0$, and considering (1) and (2), we obtain:

$$(1-\alpha)\left[p - 2q_{t+1} \right]\left[1 + \beta(1-\alpha)\theta_{t+2} \right] - (1-\alpha)\left[p - 2q_t \right]\left[1 + \beta(1-\alpha)\theta_{t+1} \right] = 0$$

$$\frac{\left[p - 2q_{t+1} \right]}{\left[p - 2q_t \right]} = \frac{\left[1 + \beta\theta_{t+1}(1-\alpha) \right]}{\left[1 + \beta\theta_{t+2}(1-\alpha) \right]}$$

$$2Aq_t - 2q_{t+1} = Ap - p \,...(3) \quad ; \quad where: \quad A = \frac{\left[1 + \beta\theta_{t+1}(1-\alpha) \right]}{\left[1 + \beta\theta_{t+2}(1-\alpha) \right]}$$

Then, linking the restriction and the equation number 3, we have:

$$2A\left(x_t - x_{t+1} \right) - 2\left(x_{t+1} \right) = -p(1-A)$$

$$\Rightarrow x_{t+1} = \frac{1}{1+A}\left[Ax_t + \frac{1-A}{2}p \right] \,.......... \,(4)$$

$$\Rightarrow q_t = \frac{1}{(1+A)}\left[x_t - \frac{1-A}{2}p \right] \,.......... \,(5)$$

Parameters:

	Parameters	
τ_1	0.35	0.35
τ_2	0.20	0.30
θ_1	0.50	0.50
θ_2	0.25	0.25
β	0.95	0.95
ψ	0.20	0.20
x_t	20.00	20.00
p	10.00	10.00

APPENDIX 2

1. Uncertainty concerning the administration, interpretation, or enforcement of existing regulations.

2. Uncertainty concerning environmental regulations (stability of regulations, consistency and timeliness of regulatory process, regulations not based on science).

3. Regulatory duplication and inconsistencies (includes federal/provincial, federal/state, inter-departmental overlap, etc.).

4. Legal system (legal processes that are fair, transparent, non-corrupt, timely, efficiently administered, etc.).

5. Taxation regime (includes personal, corporate, payroll, capital, and other taxes, and complexity of tax compliance).

6. Uncertainty concerning disputed land claims.

7. Uncertainty concerning what areas will be protected as wilderness, parks, or archeological sites, etc.

8. Infrastructure (includes access to roads, power availability, etc.).

9. Socioeconomic agreements/community development conditions (includes local purchasing or processing requirements, or supplying social infrastructure such as schools or hospitals, etc.).

10. Trade barriers (tariff and non-tariff barriers, restrictions on profit repatriation, currency restrictions, etc.).

11. Political stability.

12. Labor regulations/employment agreements and labor militancy/work disruptions.

13. Quality of the geological database (includes quality and scale of maps, ease of access to information, etc.).

14. Level of security (includes physical security due to the threat of attack by terrorists, criminals, guerrilla groups, etc.).

15. Availability of labor/skills.