

ORGANIZATIONAL STRUCTURE FOR COAL MINE IN BOYACÁ*

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Abstract

This is a review article that analyze previous research results and contrasts them with the firm theory in order to propose an economic organization structure for Boyacá's mining sector. Results indicate that the present scheme of contracts between producers and intermediaries is inefficient and promotes inequality. The highest benefits proportion is in the intermediation side, despite the risk and effort falls mainly on the producer. Three different forms of sector's organization are presented, as well as pros and cons aspects from each side are analyzed, in the light of the theoretical framework proposed. Most region farmers are smallholders and they are characterized by a high heterogeneity, it is conclude that alliance scheme is more economic and socially efficient in the relationship between producer and market.

Keywords: *Coal Production, Organizational design, Contract, Alliances.*

ESTRUCTURA ORGANIZACIONAL PARA UNA MINA DE CARBÓN EN BOYACÁ

Resumen

Este es un artículo de revisión que analiza los resultados de investigaciones previas y los contrasta con la teoría de la firma con el propósito de proponer una forma de organización económica para el sector minero de Boyacá. Los resultados señalan que el esquema actual de contratos entre productores e intermediarios es ineficiente y promueve la desigualdad. La mayor proporción de los beneficios queda en manos de los intermediarios, a pesar de que el riesgo y el esfuerzo recaen sobre el productor, principalmente. Se presentan tres diferentes formas de organización para el sector y se analizan los aspectos positivos y negativos de cada una de ellas a la luz del marco teórico propuesto. Como en su mayoría los productores de la región son pequeños y se caracterizan por una alta heterogeneidad, se concluye que el esquema de alianzas es más eficiente económica y socialmente en la relación entre productor y mercado.

Palabras clave: *Producción de carbón, Diseño organizacional, Contratos, Alianzas.*

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ESTRUTURA ORGANIZACIONAL PARA UMA MINA DE CARVÃO EM BOYACÁ

Resumo

Este é um artigo de revisão que analisa os resultados de pesquisas prévias e os contrasta com a teoria da empresa com o propósito de propor uma forma de organização econômica para o setor mineiro de Boyacá. Os resultados assinalam que o esquema atual de contratos entre produtores e intermediários é ineficiente e promove a desigualdade. A maior proporção dos benefícios fica nas mãos dos intermediários, apesar de que o risco e o esforço recaem sobre o produtor, principalmente. Apresentam-se três diferentes formas de organização para o setor e se analisam os aspectos positivos e negativos de cada uma delas à luz do marco teórico proposto. Como em sua maioria os produtores da região são pequenos e se caracterizam por uma alta heterogeneidade, conclui-se que o esquema de alianças é mais eficiente econômica e socialmente na relação entre produtor e mercado.

Palavras chave: *Produção de carvão, Desenho organizacional, Contratos, Alianças.*

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JEL: D24, D02, D86, D74.

1. Introduction

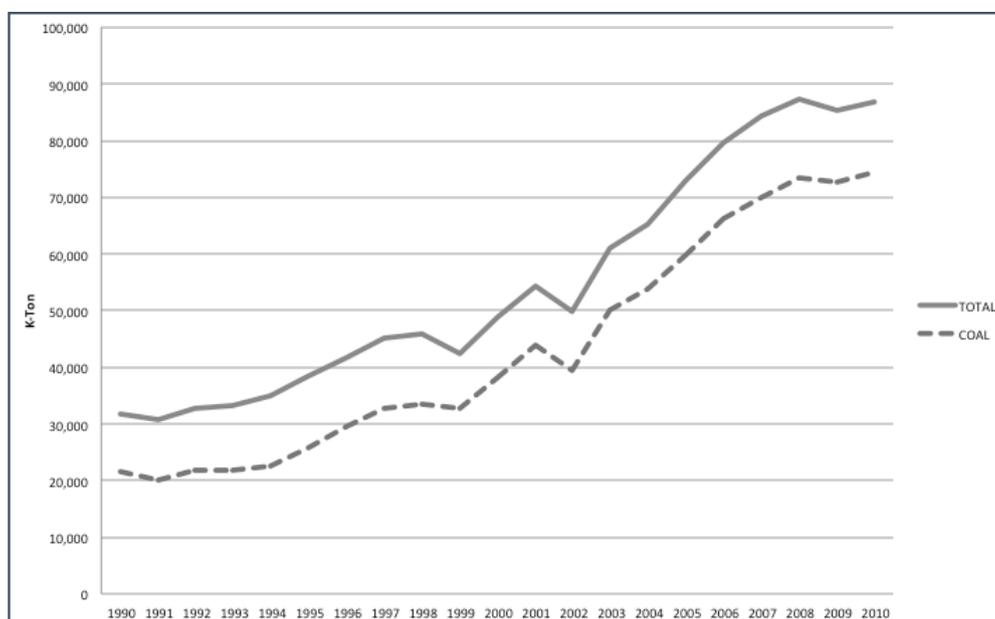
According to Warner & Sullivan (2004), extractive industries have raised importance in the worldwide economy, and especially, in developing and emerging economies, when measured by the flow of foreign direct investment (FDI). Due to the rapid growth of the industry, there are many challenges in managing, environmental, and particularly, in social issues to be faced by institutions in these countries. This article reflects on an economic and social problem of one of the coal producing regions in Colombia, as is Boyaca. The main objective is to analyze the secondary data from field-based research that were collected in year 2011 by Benavides et al. (2011), and to propose an efficient form of organization for the coal mining sector in this region. First, I propose three different alternatives of organization; second, I analyze the pros and cons of each organizational form; and third, I present the best organizational alternative under the paradigm of the theory of the firm.

Empirical evidence shows that the average producer in the region is small, lacks of technological development and her financial capacity is minimum. These features make the producer subject of high infor-

mation asymmetry when engaged in an agreement (mostly informal) with the commercial intermediary. In this way, the current scheme of contracts between producers and commercial intermediaries is inefficient and promotes inequity. These results are in line with the findings of Krug & Mehta (2001), whose statement claims that “high transaction costs associated with uncertainty, together with resource constraints, are responsible for pushing entrepreneurs into these agreements” (Krug & Mehta, 2001, 3). In addition, cultural features of local producers like individualism, has made to fall the negotiation capacity of the producers, since they manage the intermediary in different ways, and this isolation is economically ineffective (Franks, Brereton, & Moran, 2010).

There is no doubt that as in the rest of developing economies and emerging markets, the extractive industry has become economically important, in Colombia it also has been as well. In Colombia, mining has increasing its total production during last 20 years (Figure 1). Total production, without emeralds, has become almost threefold; it was 31.750 K-ton in early 90’s and has increased up to 86.750 K-ton in 2010. From such production, coal represented near 67% at the beginning of this period, and has reached

Figure 1. Colombia's total mineral production¹



85% nowadays, approximately. Other minerals like Cooper or precious metals like Silver or Gold, have not significant weight over the total production.

Since coal mining has reached an important role in the economy, it is important to see where the coal resources and the production are. In Colombia, La Guajira and Cesar departments have the biggest proportion (84%) of coal reserves (Figure 2).

Boyaca is considered one of the regions with smaller coal deposits (Jähnig, 2007). As it is observed, Boyaca just have 2% of total coal reserves. However, as stated before, in the region this activity has a remarkable importance in the economy. Mining generates from 4.000 to 8.000 jobs (Benavides et al., 2011).

The role of the mining in the regional economy is important because in spite of representing just 2%

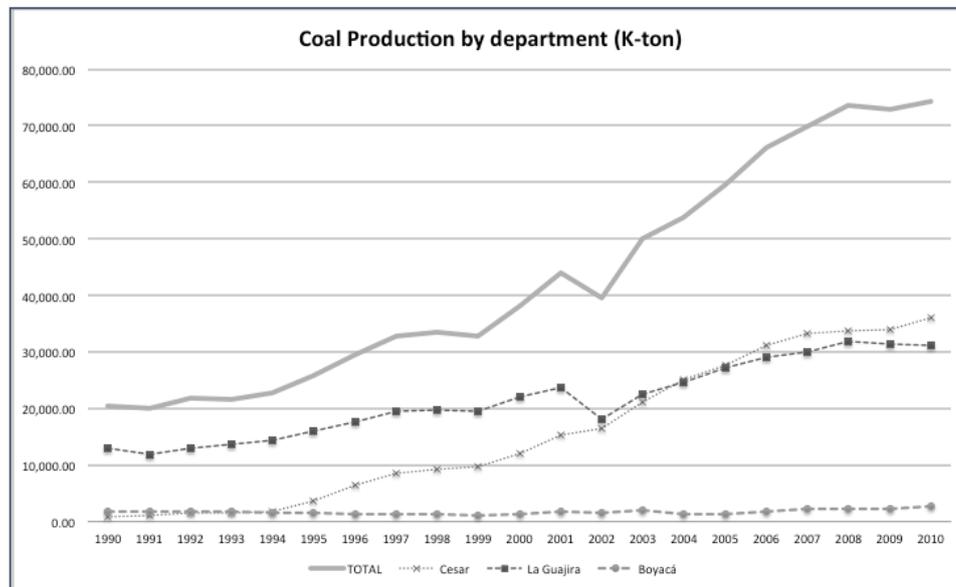
of the regional GDP, its growth has rounded 20% in the last years² (DANE, 2011). Production does not have grown as in the Caribbean region (See Figure 3), but its importance is due to the characteristics of regional economy. Moreover, the transferences from National Government corresponding to royalties for coal extraction were equivalent to the 0,82% of the total regional income budget in 2010³. Therefore, it is necessary to have an optimal organizational structure to get better economically and socially efficient results.

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¹ Source: Own elaboration. Data: INGEOMINAS.

² Further information and detailed statistical information at www.dane.gov.co

³ Own calculation based on the information reported by UPME (2011) and Gobernación de Boyacá: <http://www.boyaca.gov.co/gobernacion/presupuesto/25-gobernacion/presupuesto/265-presupuestos-2006-2007-2008-y-2010>

Figure 2. Colombia's total coal reserves⁴

The role of the mining in the regional economy is important because in spite of representing just 2% of the regional GDP, its growth has rounded 20% in the last years⁶ (DANE, 2011). Production does not have grown as in the Caribbean region (Figure 3), but its importance is due to the characteristics of regional economy. Moreover, the transferences from National Government corresponding to royalties for coal extraction were equivalent to the 0,82% of the total regional income budget in 2010⁷. Therefore, it is necessary to have an optimal organizational structure to get better economically and socially efficient results.

In Colombia, coal mining has not been planning as an institutional policy. Great deals of coal resources are mined in illegal way (it is known as 'fact mining'). The Government has promoted some laws (Law 141/1994, Law 685/2001 and Law 1382/2010), but they have not rendered the expected results mining coal (Güiza, 2010, 83).

1.1 Method

Data collection procedures: This study used secondary data from field-based research that were collected in year 2011 by Benavides et al. (2011). They were presented to the sponsor institution⁸ in 2011 to study the current characterization of the small-scale coal mining in the central region of Colombia. The list of sources includes 11 meetings between small-scale producers, 2 with regional associations and established firms, and 16 detailed interviews in 4 departments.

Authors apply a cluster analysis to classify the producers. All the clusters are characterized by using different variables. I review this information and define three different forms of organization. I compare each alternative under the theory of the firm (Spulber, 2009) paradigm. Then, analyze the pros and cons and recommend the best form of organization for coal mining sector in Boyacá.

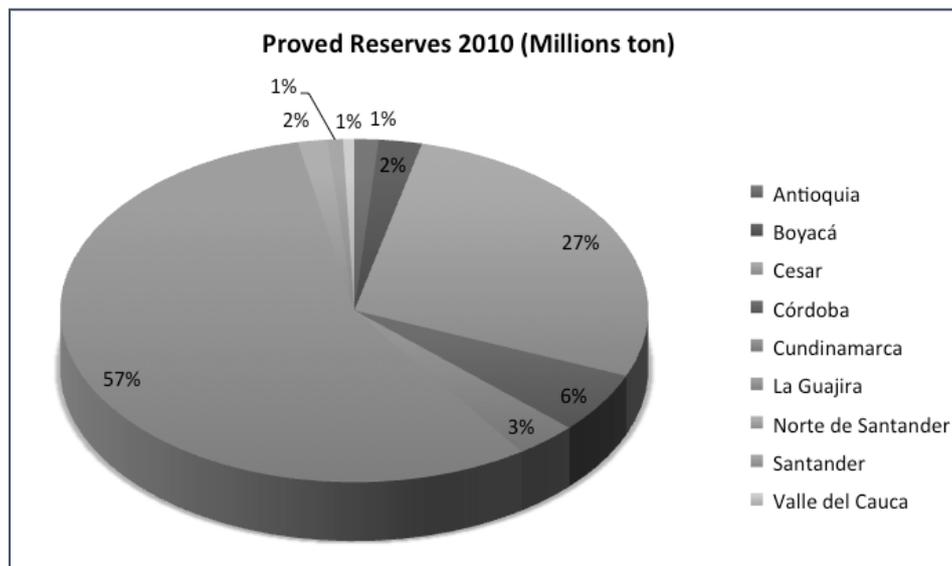
⁴ Source: Own elaboration. Data: INGEOMINAS.

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⁶ Own calculation based on the information reported by UPME (2011) and Gobernación de Boyacá: <http://www.boyaca.gov.co/gobernacion/presupuesto/25-gobernacion/presupuesto/265-presupuestos-2006-2007-2008-y-2010>

⁷ Centro de Investigación Económica y Social –FEDESARROLLO: <http://www.fedesarrollo.org.co/>

Figure 3. Colombia's coal production⁸



2. Characterization of the mining sector in Colombia and Boyaca

The coal reserve areas of Boyacá go from the municipality of Jericó, in the north, to the border with the department of Cundinamarca; the main mining area is located between the municipalities of Sogamoso and Jericó, which has bituminous type coals (Mejía, 2005, 29).

Boyaca has established mining districts⁹ to improve the conditions of the miners and to control this activity. One of the most important of them, for coal mining, is the North Boyaca District, which includes 23 municipalities from 3 provinces¹⁰. There are 210 mining titles operating (Güiza, 2010, 176). By the Act 354/2009 from Ministerio de Minas y Energia (Energy and Mining Ministry), it was declared a spe-

cial reserve of coal in Jerico municipality, given the poor conditions of the exploitation in that zone.

In Boyaca metallurgic coal is around 58% of the total coal production, while thermal coal is the complementary 42% over the total. The extraction of this mineral is characterized for being, between 70% or 80%, an illegal activity. In general, illegal mining is present in the 44% of the total municipalities in the country and it represents near 30% of the total mining exports (Güiza, 2010).

For example, in the mining district of North Boyaca, there are identified 55 units of illegal mining (Table 1), according with the Güiza (2010, 13) report¹¹. This is in line with the findings of Lahiri-Dutt (2007) who points out that illegal mining prevails in the developing world. According to the author, immediate

⁸ Source: Own elaboration. Data: INGEOMINAS.

⁹ This is a kind of administrative entity defined on a specific territory by the National Government (Mining Ministry), in association with the local Government. Its main characteristic is that the principal economic activity is mining. It is created with the purpose is to develop policies towards management and economic efficiency of mining activity (Fundacion para el Desarrollo del Quindío, 2008).

¹⁰ Boyaca has a sub-regional division called 'Provincias' (in English: provinces). This kind of territory is bigger than a municipality but smaller than a department. Each province has a number of municipalities and one recognized province's capital. There are 15 sub-regional divisions in total.

¹¹ The report "Mineria de hecho en Colombia" (Fact mining in Colombia), by Güiza (2010) is part of a series of reports presented by the Defensor del Pueblo, in the developing of his functions in citizen rights defense.

consequences of this kind of activity are greater inequality and poverty, and environmental problems. Nevertheless, it is important to notice that, in general, producers interviewed recognize the importance of being right with the authorities.

According to Benavides et al. (2011), mining activity is replacing the primary activities of the region: agriculture and livestock. However, it is estimated that 48% of the mining is artisanal, 38% small scale mining, and just 14% is medium or great scale mining. It implies a poor development of technology and a high dependence on human labor. Some characteristics of this type of mining are described as following (Table 1).

The information collected directly from Tasco municipality, indicates that there are 32 illegal mining units in that zone. The consequences of the illegality are deeply considered in section three of this paper.

As observed in Benavides et al. (2011), other cultural and personal characteristics of the miners in this region involve that miner is strong and resilient, and dedicated to her work, but in most cases they represent the first generation of miners with little experience compared with miners from other regions. Because the proportion of small scale and artisanal mining, their start in the business is very rudimentary; the level of professionalism is very low, and most of them do not perceive growing as needed since they assume mining just as a livelihood not as a business. It is a region that prefers to work with miners from the region, living in their homes near the mine; only 20% to 30% come from other regions of the country (Benavides et al., 2011).

Related to the personality, they are people difficult to organize. The miners do not like to commit a schedule work; they just work according to the individual capacity. Additionally, they use to spent part of their money on consumption of liquor (mainly beer). These people are with little loyalty to the employer, move

Table 1. Fact mining units in North Boyacá District of Mining^{12,13}

Municipio	Autoridad Ambiental	No. de UEM de hecho
Jericó	Corantioquia	0
Betéitiva	Corpoboyacá*	ND*
Boavita	Corpoboyacá	ND
Chiscas	Corpoboyacá	2
Chita	Corpoboyacá	ND
Covarachía	Corpoboyacá	0
El Cocuy	Corpoboyacá	ND
El Espino	Corpoboyacá	2*
Güicán	Corpoboyacá	ND
La Uvita	Corpoboyacá	36*
Panqueba	Corpoboyacá	ND
Paya	Corporinoquia	0 según Corporinoquia
Paz del Río*	Corpoboyacá	0
Pisba	Corporinoquia	0 según Corporinoquia
San Mateo	Corpoboyacá	ND
Sativanorte	Corpoboyacá	2*
Sativasur	Corpoboyacá	ND
Soatá	Corpoboyacá	ND
Socotá	Corpoboyacá	10
Socha	Corpoboyacá	2
Susacón	Corpoboyacá	1*
Tasco	Corpoboyacá	ND
Tipacoque	Corpoboyacá	0

from the mines in the region looking for the highest payment. The owner of the mine feels very frustrated by the lack of miner's commitment (Table 2).

2.1 Production

In the region there are problems related to climate, since the winter affects the productivity of the mines for several months. Furthermore, after the rainy

¹² Ardila (2010, 176). ND means Not Available.

¹³ Note for correction: When author of this table refers to Jericó, it is a municipality in Boyacá with the same name of another municipality in Antioquia, where environmental Authority is Corpoantioquia. However, concerning to Jericó (Boyacá) the environmental Authority is Corpoboyacá.

Table 2. Characteristics of mining activity¹⁴

Artisanal	Average production from 50 to 200tons/ month Provides maximum 5 to 10 employees Generally is not legal Carry out a rudimentary extraction process ("pick and shovel")
Small	A miner who has 1 or 3 mines, with a single production of near 500tons, for a total of 1000 to 1500tons approx. Between 10 and 25 employees approx. (95% are blue collar workers) They are legal or are in the legalizing process They have invested in infrastructure (has a compressor, electric winch, ventilation system, etc.) Offers casino and camp for foreign miners
Medium	They produce between 3,000 to 8,000 tons approx Manage more than one mine, with an average of 25 to 45 employees per mine They not consider highly technical, but important improvements have been made: mechanization (tunnels with transportation system by rail or wood roads and locomotive power, more than one compressor, ventilation systems, pneumatic hammers, lamps, etc.) Offers casino and camp for foreign miners

season miners should carry out repairs which are costly. Additionally, environmental authority is not perceived as support but as prosecutor, so the miner perceives herself alone (Benavides et al., 2011).

Small-scale mining is generally characterized by production units with a minimum degree of organization, small-scale production and low level of technology. On the other hand the subsistence mining is comprised mostly of independent workers who combine this activity with other productive activities, especially agricultural, reason why mining becomes cyclical (Mesa Sectorial de Minería, 2003; UPME, 2004).

In her study, Betancurt (2002) found that the technology used for extraction of the mineral, at the small mining, is mainly underground of cavern. There are used two methods: extraction by room and pillars and the method of long wall; being the former the most used in Colombia. In spite of its popularity, this

method causes that the amount of coal extracted be relatively low.

Artisanal miners do not have any mechanization process. Small miners sometimes use compressed air for the perforation and coal starting operations. They have electrical power and it allows for ventilation underground. Most of the mines have a low mechanization and are based on an intensive manual labor; this has as a consequence a little cost of capital but a little amount of clean coal (Betancurt, 2002, 216).

Studies have demonstrated that mining sector in Boyacá has a very low degree of R&D; it is possibly due to the poor education level of the miners (Benavides et al., 2011; Betancurt, 2002; Mesa Sectorial de Minería, 2003). Artisanal miner is an individual who only reaches a primary level of education. Still, Benavides et al. (2011) found that the bigger is the size of the activity, the greater is the level of education of the miners (or their staff, when apply).

2.2 Market and commercialization

Regarding the marketing activities, Boyacá has a high level of organizational complexity (Benavides et al., 2011). From the market perspective, the region is characterized by high industrial demand of coal, e.g. thermal industries, cement, paper and brick, the needs of power generation and exports of metallurgical coal. Additionally, this demand is highly stationary.

In another perspective are the distribution and marketing channels. According to Benavides et al. (2011) there is a high presence of arbitrageurs, which characterizes the market as one with multiple buyers and sellers, with a dominant position of the formers in price setting. The very small producers sell almost all their product to traders, excepting occasional sales to large consumers (due to some cases of very high quality). Small producers sell to medium and large regional customers (supply contracts) and some retailers. On the other hand, the medium producers buy from other producers; they have storage facilities and add value classifying the product and preparing

¹⁴ Source: translated from Benavides et al. (2011, 44).

mixtures adapted to the characteristics of consumers with quality control. Their customers are usually large consumers and sometimes they directly export.

In general, for the miners of the region, the sales abroad are of little interest given the characteristics of regional demand. For the small mining exports is too costly, because it requires a client, or customer pull, with a clear negotiation covenants. Additionally, it implies high requirements in terms of volume, transportation costs, taxes, permits; and low flexibility in payment, as well as fluctuations in international prices (Benavides et al., 2011). Betancurt (2002, 212) considers that the reason why the Boyaca's coal does not arrive at international markets is, mainly, due to the high transport costs from the center of the country to the coast, where ports are located. Actually, there is a road and rail infrastructure to supply the regional demand, only (Ponce, 2005).

3. Illegal mining consequences

There is evidence of the negative impact of illegal mining on the economic, social and environmental dimensions of any region (Aspinall, 2001; Dreschler, 2001; Hilson, 2009; Kitula, 2006). According to Barry (1995, 1): "although it provides an important source of income, artisanal mining engenders a host of problems: environmental, health, and safety concerns; labor and gender issues; and technical, financial, regulatory, and legal issues". The fact that illegal mining in Boyaca rounded the 80% over the total, have negative impacts as well.

In the World Bank conference (Barry, 1995) pointed out that from the financial and technical perspectives, there are some serious problems in this kind of mining. Firstly, this miner does not have enough financial resources to invest in technology (sometimes is not interested), and is not subject to any loan from the financial system. They have higher transaction cost related to de post exploitation activities (like production gathering and commercialization).

Related to the commercialization, there are problems in the relationship of illegal miners with established mining enterprises or traders, because the illegal status of the formers. It is evident the existence of constrains in establishing legal contracts between the parts. Benavides et al. (2011) found that most of the contracts are not signed but there is a personal compromise (gentlemen's agreement) between the parts. This imposes uncertainty over the long-term relationship and limits the investment decisions. This is in line with Das & Noushis's contention related with the propensity to opportunistic behavior between the parties when the length of the relationship is perceived just for a short-term (Das & Noushi, 2002).

That is the reason why small or artisanal miners have a real disadvantage in any contractual relationship, sometimes affecting their income and maintaining (or promoting) the illegal *status quo*. For Amaratunga & Kumar (1994, 15), under such scheme, the beneficiaries are the traders, buying below market price to make quick profits.

According to Hansmann & Kraakman (2000, 808), there are two ways of coordinate the economic activity of two parties: (i) by having direct contracts between each other, and (ii) Entering in a contract with a third party who coordinates the contractual relationship. In sum, an ex-ante mechanism for deterring opportunistic behavior is to write formal contracts, and an ex-post mechanism is monitoring (Das & Noushi, 2002, 97).

3.1 Constrains to legalization process

In an environment where legalization implies a big effort, there are not incentives to legalization. As a matter fact, legalization process in Colombia implies a legal process¹⁵, plenty of prerequisites and activities by who is interested in established that a great number of illegal miners have not interest in legalization (Benavides et al., 2011). Actually, most of them have decided to be illegal and assume the risk of their decision.

¹⁵ This site is an official web site for a legalization process of any exploitation contract with the State: <http://www.gobiernoenlinea.gov.co/web/guest/home/-/government-services/4367/maximized>

One of the biggest barriers related to this subject is the scanty capacity of small-scale miners to accomplish the technical and economical requirements imposed by laws, to operate a legal mine. Sometimes, this is due to the shortage of knowledge about these matters. On the other hand, the capacity of monitoring and control by government is not enough to cover all the illegal activities. In fact, one can find that public policy considers this level of control as good enough. The national Government judges that given the structure of the sector, where biggest enterprises own the 97% of the sector's assets and they generate the 98% of the profits, it is not necessary to have any small size detailed analysis (Ruiz, 2007, 9).

This is a fact that has been found in different studies around the world. For example, Chakravorty (2001) showed a difficulty to gather information about this type of mining; Dreschler (2001) found that the sector is extremely mobile and flexible, mining activities can appear and disappear overnight, which makes it very difficult to control, even for local authorities and NGOs working many years in the sector. In the case of sub Saharan Africa, for example, the approach taken to formalize and support this mining has resulted in the implementation of bureaucratic licensing schemes, and in the designing of ineffective and/or incompatible regulations (Hilson, 2009, 4).

Gathering producers would incentive the legalization; the group shares the process, not only in expenses, but also in the effort engaged. It should facilitate the relationship between authorities and miners for regulation and monitoring activities. On the other hand, the intervention of an intermediary could alleviate the costs of legalization by individuals. An intermediary provides economies of scale and minimizes the informational costs (Gehrig, 1993).

Though, financial matters are other kind of constraints because of the characteristics of the regional mining sector. Benavides et al. (2011) have found that traders are one of the most common financing resources. Traders have enough capital to provide

the miner with cash flow resources in order to attend their daily operations. It could be considered a form of strategic loan, by means of which trader engage an underlying contract for buying coal.

3.1.1 Market failure

It is worth to evaluate this type of activity and to consider more detailed aspects, because it generates asymmetries and delivers the bargaining power to the buyer. This aspect is treated on Spulber (1996a), by using a model of the market with endogenous price setting by intermediaries. The author found that depending on the discount rate¹⁶, this could lead to an intermediary acting as a monopoly. Apreda (2001) considers the intermediary as a “broker of asymmetric information”.

It is assumed that the loan has no interest rate charges; however, it is clear that the bargaining power of the lender allows her to set, in turn, the purchase price once the coal has been extracted. Murry & Zhu (2008) mention that this bargain power creates asymmetries favoring intermediaries. This is termed in the literature of transaction costs as “lock-in situation”, which transform a bilateral exchange in to a command structure (Wathne & Heide, 2000).

On the other hand, since mining is a stationary and income variable activity, as was pointed out above, miner is not subject to credit for commercial banks. In fact, they do not have much interest in to access bank financing due to the existence of the alternative source from intermediaries.

It is clear that the common trader activity is an imperfect substitute for financial markets and leads to asymmetries between producers and consumers. In despite of being an apparent agreement without warranty, lender can take possession of the miner's assets, but borrower does not perceive the situation due to a lack of an explicit interest rate. In this situation, besides, producer reaches a comfort zone that let her to get daily operating resources and inhibits improvements in technology, knowledge and legal practices.

¹⁶ In his model, Spulber consider the time as a transaction cost (Spulber, 1996a, 560)

From these two conditions in the relationship between producers and commercial traders, it is clear that there is a problem of control rights allocation. These control rights are defined as “the right from one party to affect the course of action of the business in certain circumstances” (Tirole, 2010, 387). Since the intermediary have enough power on this relationship, the allocation of the control rights are not based on the willingness of the producer to transfer them to the counterparty, but in the impossibility to exert them.

3.2 Illegality and property rights

As was described before, asymmetries between producers and consumers make the parts to face problems regarding property rights. In spite of the miner being the owner of the resources, bargain structure imposes restrictions to her as a residual claimant. When buyers give financial resources to the producers, or provide services as transport of the final product, they gain a power on the contractual relationship that poses her as residual claimant. It causes a fall in private benefits for the producer (Hart & Holmstrom, 2010, 3).

While it could be thought that one solution to this problem is to write complete contracts, it is not a final solution¹⁷, especially when writing complete contracts at no cost is impossible (Hart, 1988). On the other hand, most of the contracts between illegal miners and buyers are just gentlemen’s agreements. So, contracts enforcement is a constraint for symmetric relationships in this market because buyers face a moral hazard problem. Benavides et al. (2011) have identified that miners do not respect this kind of agreements and, sometimes, decide to sell the product to any consumer that is paying the better price.

This kind of behavior is correlated as much with the size of the trader. Traders as intermediaries have been identified in the market, mainly being of three types (Benavides et al., 2011):

- Intermediary traders: they benefit from producer’s necessities of financing and other resources. Their payments are 30 to 90 days in average. As well, generate distortions on the market since they set the buying and selling price.
- Permanent traders: they pay in a short term, 8 days in average. The prices are ruled by the size of the producer (first degree price discrimination). They have storage facilities and add value by classifying coal.
- Temporary traders: they appear sporadically paying higher prices than the market. They do not require specific quantity or quality. Usually rent a space, but are not established in the area. They use to pay cash.

In this perspective, illegality promotes unfair competition between legal producers and generates price wars, which leads to price volatility. Due to this situation, producers need to engage in vertical integration with the trading activity (Hart & Holmstrom, 2010). As consequence medium scale producers are the biggest beneficiaries of prices throughout the chain. This appetite for high prices, lack of compliance with industry standards, the reluctance to submit to state control and disregard for processing and marketing the final product, promote operating practices without environmental control, quality of mining health and safety and a fall in the reputation of the business.

4. Organizational structure for the sector

The regional mining environment described shows that due to illegality, mainly, most of the transactions between producers and buyers are directly performed. Nevertheless, it is not necessarily the best form of organization to be more economically and socially efficient. In their study, Pooe & Mathu (2011) claim for a more collaborative supply chain to make the coal mining more competitive, in the South Africa’s case.

¹⁷ Tirole (2010) highlights that in spite of the existence of contracts, the final results could be different as written due to the role of Control Rights.

On the other hand, for direct interchange, Spulber (2009, 4) highlights that the firm act as contracting hub and that they achieve more than would a complete set of contracts between the parties. In general, an intermediation function clears the market and facilitates the matching between sellers and buyers (Spulber, 1996b).

From this point of view I present three different alternatives to organize the mining sector in Boyacá in order to improve efficiency and benefits for all the actors of the chain. First of all, the firm as the corporation concept from the Spulber's perspective; second, an alliances structure; and finally, a cooperative scheme of organization.

4.1 A firm vs. individual interchange

Until here it is clear that small scale and artisanal miners have a very short vision of the mining business and they do not have any interest in association activities. However, a firm is an economic vehicle that enhances exchange, doing it more efficient than the direct exchange (Spulber, 2009, 11). Its role improves the information gathering and the matching process, decreasing transaction costs. Firms also alleviate financial constraints, and board monitoring by corporate owners (Allen & Phillips, 2000).

In this way, one of the more evident advantages of firm gathering producers of coal is the bargaining power. Given the opportunity to improve information systems and to subscribe multiple contracts, allows the firm to standardize the selling process. By offering standard contracts, producers can go to the market for generalized bid-ask prices, free of traders bargain power. In Spulber (2009) this bargain power is considered as an externality from which, in this case, buyers extract benefits. Moreover, when this market power is big enough, these firms can set the bid-ask prices and the market equilibrium is compared with a monopoly intermediation (Spulber, 1996a).

One argument against firm could be the fixed transaction costs. According with the theory, the benefit derived from the firm intermediation vs. direct interchange must be greater than the transaction costs (Spulber, 2009). But under the current scheme it has been noticed that the gap between market price and buyer price offered is great enough to cover those fixed costs and to give benefits to the firm. According with the costs analysis of Benavides et al. (2011), this activity has a utility margin different for each type of coal. For thermal coal, the utility margin is around 27% and for metallurgic coal is 76% in average. In Boyacá the thermal coal is around 42% of the total production and the metallurgic coal is 58% (Benavides et al, 2011, 41).

On the other hand the analysis of fixed cost must not be separated from the investments analysis. As was highlighted in former sections, one of the problems of the small-scale mining is the insignificant level of investment and a lack of interest for technology development. Since the firm realizes economies from specialization, it provides a better capacity to invest in equipment as in education for miners.

Added value is a consequence of this new investment capacity. A firm could engage projects for adding value to coal, as storage facilities, cleaning processes and transportation to consumer place. Current situation do not facilitates that the small producer controls any value added, since storage or transportation services are in charge of traders.

Because of the characteristics of labor market in mining sector in Boyacá hiring employees by verbal contracts and, sometimes, under illegal schemes¹⁸, there is a problem that could be solved. Firm has the capacity of hire employees under legal schemes and design incentive systems that promotes an adequate effort when compared to the compensation. Firm has to train the personnel with necessary skills to develop the work. This is a way to improve the education level of artisanal and small-scale mining,

¹⁸ This type of contract is present in the Artisanal scale mining. The Small and Medium mining is more organized in this sense and have understand the importance to have formal contracts. However, contracts are subscribed just for short terms of three months to avoid continuity (Benavides et al. 2011, 43).

in which currently almost 40% of miners do not have any education and 30% just have reached the elementary education level (Benavides et al. 2011, 53). On the other hand, firm provides all the required elements of protection to ensure that the work done avoid any type of risk.

Reputation and construction of a brand name encourage firms to improve commercial relationships. By the way, it allows the contracts enforcement given that the firm operates under the institutional framework. It leads to benefits for partners, but most important, to consumers that will have a counterpart for claims and warranties.

It is evident that by this way, firm can overdue financial constrains like capital access from traditional financial sector. Benavides et al. (2011) have found that banks use to lend money to persons by their reputation and a long-term relationship. The financial sector in Boyaca does not consider the small-scale producer as a subject of credit. It is due to that this sector perceives the producers as persons with a minimum technical capacity, an absence of accountability, a lack of accomplishment of contracts, a little association capacity and a scarce entrepreneurial capacity (Benavides et al., 2011, 129).

One possible barrier to this form of organization is related to the property rights. Not always there is a coincidence between the property of land, the mining official permission owner and, the person who is exploiting the resources. As Spulber (1989) point out, particularly, property rights may not be clearly defined for natural resources. Here achieving completeness and exclusivity is often incompatible with a system of private ownership (Spulber, 1989, 49). This situation generates social tensions and it is an evident obstacle for a firm scheme. It is not quite clear who must join the firm as partner because the problem needs to be solved before.

In this sense, it is absolutely necessary to have the State intervention through the public policy. Regulations, norms, monitoring activities, promotion and prevention, are some of the activities the Government is called to implement, far away from the merely energy consumption policy. There are many

examples of successful public policy around the world; though, most of them refer to developed countries (Gordon, 1987).

However, as Benavides et al. (2011) remark in their work, that idiosyncratic aspects of the producers in Boyacá are clear barriers to implement a corporation scheme. One of the main problems is the separation of the property and control. Well-defined property rights are essential to the establishment of firms (Spulber, 2009, 66). By definition, "a firm is an organization whose objectives differ from those of its owners" (Spulber, 2009, 63). It has been identified a resilience and a lack of interest for associability.

Here one can find a barrier to establish a firm where producers are the partners. A firm is a scheme in which the benefits are perceived as shared. Given the regional miner's behavior, as individualists, it is very difficult for this producer to assume the partner condition. An incentive problem emerges when it is not possible to show a clear positive benefit-cost balance to the coal producers. Incentives for artisanal and small scale miners are just the subsistence Benavides et al. (2011), while a firm has to guarantee longevity.

Clear rules between partners would be a prerequisite for this organizational form. Then corporate governance is an alternative to introduce these rules, which implies a previous education process and an individual approaching to generate confidence between the partners. It has to be clear for them that profits are maximized when firm acts independent of the consumption objectives of its owners (Spulber, 2009, 147).

Nevertheless, what is proposed here does not imply the necessity of integration between producing and trading activities. Improvements in technical, marketing and financial aspects, allow the firm to subscribe contracts with intermediaries, as legally organized trader, or even with final consumers, in a more efficient way.

At the end, one of the key success factors is the willingness of the agents involved to make the firm a profitable business. Here one can find the major constraint to this proposal. First, as mentioned be-

fore, illiteracy plus the lack of interest for association are determinants for a low entrepreneurial capacity. This argument has been developed by Molefe & Ashworth (2004) in the development of Small Mining Enterprises in South Africa. Second, given the success rate between new firms in the region, which is 68% within the first five years (Wengel, Ferreira, Restrepo & Suárez, 2008), there is an important barrier to be solved before implementing a firm scheme model.

Moreover, it is important to notice that one of the key points of the Science and Technology prospective plan for Boyaca, is the education. Particularly, for mining and energy sectors, it appears as imperative to provide more entrepreneurial education to the population of these sectors in order to improve competitiveness and economic efficiency (Ruiz et al., 2012).

4.2 Alliances

An alliance is a flexible organization that allows firms to experiment with new technological, organizational, and marketing strategies. The principle goal of the alliance is to learn more about technical and market parameters. According to Ashoka (1993) a few successful alliances can trigger more widespread alliance formation. Then, it could be a middle term scheme of solution for illegality problem of mining in Boyacá.

Alliances have different dimensions to be considered. Some of them refers to the geographical origin of the partners, the intra or inter sector of them, for example (Vyas, Shelburn, & Rogers, 1995). However, the most important dimension to be considered in this case is the relationship to be established, this is, the motivation behind such alliance. The objective of any proposed alliance should be to improve the economical and social conditions of the mining sector in the region.

Artisanal and small-scale miners in Boyacá, given the characterization done before, could be considered behaving as early entrepreneurs. It is, they could be located in the first stage of entrepreneurial process, according to (Spulber, 2009, 153). As a matter of fact, in this stage the startup's objectives are not

separated from the owners'. Although they do not accomplish the firm definition, their role in regional economy has been recognized before. Alliances between them could be a first step to find the financial resources to become firms. It could encourage the coal miners to legality.

In their book, Contractor & Lorange (2002) have established that one of the key factors for the success of a strategic alliance is if the parties are legally able to join the contractual terms of the alliance. Other authors highlight the importance of cultural aspects and behavioral norms between the parts (Artz & Brush, 2000, 338). In fact, it is considered very difficult to establish alliances between regions (or even micro-regions) where cultural differences are quite remarkable (Fothergill, 1994). Nevertheless, evidence of cross-country alliances shows important successes (Gillingham, 1995).

Cultural barriers are clearly defined in Benavides et al (2011). Mining activity for small-scale and artisanal miners is a short-term vision business. Illegality and power imbalances promote isolation between producers. Their propensity to opportunistic behavior makes the producer as a subject not willing to cooperate. While the vision of the business is just the short term, the alliance strategy will be not viewed as a beneficial alternative.

According with Kandemir et. al (2006), the alliance orientation will depend on the capabilities of participants for looking opportunities, coordinate the activities and managing effectively. However, it is not easy to start an alliance under the features described above. Alliances are the arena for multiple opportunistic behavior situations (Das & Noushi, 2002). Moreover, Buckling & Sengupta (1993) point out that the success will depend mainly on the resources that each participant provides to the alliance. Other authors consider that it depends on the voluntarily alignment of capabilities and contractual structure (Haeussler & Higgins, 2013, 28).

It is recognized that institutional framework plays an important role in alliances strategy (Das & Noushi, 2002; Tirole, 1994; Vyas et al., 1995). Benavides et al. (2011) found that institutional framework is

perceived in a negative way in Boyaca. The Authorities in the field are perceived as prosecutors; legalization process as extremely complex, and other supporting and promoting governmental offices as unknown.

Provided that alliances have basically two basic factors as determinants, market and technology (Vyas et al., 1995, 49), it is important to have a clear vision of the benefits expected in the regional sector. Once alliances are established, they can encourage projects for assessing markets in a more efficient way. Value drivers for coal commercialization are the more important prospects. Technologies of better exploitation under the health and environment perspectives have to be in the agenda.

There are many risks that miners face in the underground mining. Coal bed methane could be mentioned as one of them. Mechanization and learning on the mining know how would offer an attractiveness to coal producers in the region. On the other hand, in spite of the lack of concern for their health, prevention and security program will improve the mining conditions in the region. In general, alliances moderate the knowledge flow along the coal cluster (Contractor & Lorange, 2002, 164).

Whit this organization, partners do not need to allocate common property. All the projects can be started under the shared risk model. In this way, transaction costs related to the projects are treated as shared and assumed by a third party. The role of the Government as facilitator ensures a more adequate allocation of rights. However, Krug & Metha (2001) consider that an effective alliance should overcome this role by an adequate set of sanctions and social punishment .

Market exploration and finding of new customers is one of the biggest tasks of the alliance. When a great number of producers engage in a wide bargain process there are many economic advantages and benefits (Pierson, 1950). In this form, producers achieve a bargain power derived from greater quantities to negotiate, prices standardization to customers, and possibility to sell abroad. This strategy breaks the current circle depicted by intermediaries due to its

market power in price setting (Benavides et al. 2011, 205).

One of the problems identified when alliances operate is the weak incentive to avoid cheating or opportunistic behavior (Ashoka, 1993, p. 152). Thus they may be thought of as experimental organizations that trade off the acquisition of knowledge against potential losses due to cheating and opportunism. Compared with the current framework, cheating is not a new practice. Due to illegality the hold-up is very common between producers and buyers in verbal contracts (gentlemen's agreements). As was mentioned before, it is impossible to appeal to complete contracts. As is said by Artz & Brush (2000, 338), "while relational contracts may mitigate some opportunistic behavior, significant residual opportunism may remain".

Another circumstance derived from this kind of association is the free riding problem. As Spulber (2009, 329) points out, members of the alliance could engage non-cooperative behavior. In this sense, alliance can experience a great transaction costs derived from this conduct. So, again, the incentives design to make attractive the tradeoff between joint projects against transaction costs, have to play an important role.

Assuming that it is a real risk to face by the alliance; parties have to make investments that permit them to develop competences in distinguishing high-risk partners from (preferred) low risk partners and reduce problems of adverse selection (Contractor & Lorange, 2002, 154). The definition of promotion strategies from Government institutions must be the key of the alliances.

4.3 Cooperatives

It is important to notice that a cooperative is not a firm. A cooperative seeks an increasing of the social welfare, while a firm seeks to increase the stockholders' welfare. In such way, the subjective interests of the members (owners) influence the cooperative's production decisions, provided that its interests are mainly social. Then, there is not separation of ownership and control (Spulber, 2009).

Koljatic & Silva (2011) find that cooperatives are a kind of organization in low-income sectors in Latin America. These authors point out that self-organized groups share risks and benefits and take advantage of some tax exemptions. According to Bonus (1986), one of the main advantages of this organization is that the members gain the benefits of collective organization and, on the other hand, they keep their independent operation. Undoubtedly, this is the center of the analysis in this case, and is how to reach the equilibrium between independency and social benefits for coal producers.

Multcher (1980) has studied coal cooperatives in US as a means of providing services and to improve their economic position in coal markets, and has demonstrated the potential benefit-cost for the participants. On the other hand, Rieber & Soo (1975) analyzed the feasibility of marketing/transportation cooperatives composed of small coalmines producers, primarily located in Alabama, Kentucky, Ohio, Western Pennsylvania, Tennessee, Virginia, and West Virginia.

There is no doubt that the cooperative form of organization has received attention and has supported many productive units. By this form, it is possible to undertake projects that can serve as support units for established producers. This has mainly been the spirit of producer cooperatives in different areas.

In Boyaca potato cluster has implement strategies of association, some like cooperatives, in order to provide benefits to the associates. For example, storage facilities have been one of those benefits. In the case of coffee grain industry in Colombia, cooperatives not just have supported the storage, but the marketing activity has been remarkable. Then, one of the alternatives for the cooperative is to improve the storage and classification conditions of the coal in the region.

There are experiences in this kind of organization of producers in Boyacá. Actually, Benavides et al.

(2011) have identified at least seven experiences of cooperative organizations in Boyaca¹⁹. Nonetheless they pointed out that the experiences from miners have been not always positive and they perceive the costs of association but not the same way the benefits. In most of the cases, there are no major motivations to maintain the cooperative by members, beyond the right of exploitation (Benavides et al. 2011, 74).

Cooperatives, however, have received a hard criticism from different perspectives. According to Spulber (2009, 331) cooperatives experience several types of transaction costs that affect their efficiency in allocating resources. Given that the cooperative has an organization framework that is based in the democratic participation of the associates; participants face high cost of operating and monitoring. On the other hand, as was mentioned before, perceptions of the coal producers about their cooperative experiences indicate that they find the costs of operating quite expensive against the benefits derived from the organization. As well Spulber (2009) warns that the transaction costs for a cooperative increases with the number of participants (diseconomies of scale). As a matter of fact, Bonus (1986) affirms that the argument of having economies of scale is not strong enough to justify a cooperative.

The experiences identified by Benavides et al. (2001) show that there has been different projects developed that has not received the expected attention by the members of the cooperative. For example, in the case of CARBOPAZ, facilities for storage and classification are not employed by most of the members (Benavides et al. 2011, 74). It could be due to a poor managerial ability of the cooperative; or even, the lack of interest of the users.

On the other hand, results show that under the current operation scheme, the interest to be associated to the cooperative is minimum. Producers have to sale the entire production to the cooperative; at the same time, they must pay a fee directly related to

¹⁹ Some cooperatives are well recognized; as CARBOPAZ, which has been working for 19 years as producer cooperative. It has its own exploitation title in Socotá and gathers more than 32 partners, and other partners working in other titles.

Table 3. Analysis of the results under the proposed organization alternatives²⁰

Dimension	Current Situation	Firm	Alliance	Cooperative
Business Term Vision	A short-term vision. In most of the cases it is just a subsistence way of life	A firm has a long-term vision by definition and the key is the separation between its objectives and those of the owners (Spulber, 2009)	Will depend on the results and, mainly, on the ability to measure its performance; but in general, alliances are persistent (Inkpen & Ross, 2001)	As the cooperative has social objectives, it transcends the merely immediate profit goal
Associativity	Multiple attempts, most of them failed by the primacy of personal interests over those of the group	As stockholders of a firm, producers are committed with their own welfare. Perhaps, it exacerbates the detected individualism	A key factor for associativity will be the attention of the local necessities. Here, the role of the Government as facilitator is imperative	A cooperative by definition is a voluntary association of persons in order to achieve social common benefits (Koljatic & Silva, 2011)
Legality	Illegal producers, mainly in small-scale and artisanal mining	In order to accomplish with the separation criterion, the firm requires a legal scheme of operation	Negotiation under a formal scheme with written contracts. Nonetheless, alliances will recognize limitations and constrains of producers; then, alliances will provide technical and legal support	Members shall be encouraged to legality in order to get benefits from tax exemptions and other legal advantages for cooperatives
Commercialization	High uncertainty due to the price volatility. A minimum ability of producers to negotiate	The firm reduces the transaction cost of marketing. It matches the buyers and sellers and improves efficiency from trade (Spulber, 2009)	Prices will be defined by contracts. As the intermediaries will be partners of the alliance, they will not have a dominant position	Cooperative agreements give to the relationship stability in the long term and reduce the transaction costs
Financing	Dependency of the intermediaries. The latter fill the financial sector absence and establish the conditions of the payments	The assets are the main collateral to have access to the formal financial sector and to obtain credit at fair interest rates	Producers could have access to the formal financial sector through the alliance. A financial operator (trust) should play the role of managing financial resources	Given the more intimate knowledge of the members, Cooperatives can act as a money lender like credit unions (Bonus, 1986, 318)
Information	Producers do not have access to the market, or even to the final clients	It gathers information on demand and supply in order to match them in an efficient way	The largest and most experienced partners will afford artisanal and small-scale producers with more market knowledge and access to final customers	Acting as a hub for producers, high volumes and value added give the cooperative more bargain power and access to the market
Contracts	Difficulty of the producers to accomplish the covenants	It can write contracts subject to the institutional and legal enforcement	Commercial agreements establish economical sanctions and legal punishments in case of non-compliance of contracts	Members involved in this kind of organization are threatened by the opportunistic behavior, but they act as a coalition in which cooperation is the key. Then they define inner rules to achieve the members commitment (Bonus, 1986, 327)
Producer autonomy	Most of the producers are afraid of losing their autonomy	According to Spulber (2009) well-defined property rights are essential for firms. These property rights must be complete, exclusive and transferable	Alliances are respective of the producer autonomy	Members have to keep the cooperative agreement and are granted to intervene just by means of the established democratic instances

²⁰ Source: own adaptation from Benavides et al. (2011, 203-207)

their production level. However, the cooperative is not able to support the individual producer in financing with the financial sector (Benavides et al. 2011, 74).

The results obtained by Benavides et al. (2011) from the field, are important inputs in the analysis of the different alternatives drawn here. Each of them would have diverse impacts on the social and economical situation for mining in the region. Those impacts need to be considered in defining the future this sector in Boyacá. The following are the most important results under each alternative (Table 3).

5. Conclusions and remarks

Davidson (1993) sustains that the small-scale and artisanal mining cannot be ignored or eliminated; he argues the necessity of Governments and private sectors intervention in legalizing it. The purpose of to evaluate three different alternatives of organization for this sector is to maximize its social and economical benefits.

It is necessary to encourage the artisanal and small-scale miners to find any organizational form that promotes the legalization and avoid asymmetries in their contractual relationships. At the same time, it is necessary to improve the social, economic, environmental and personal conditions, under those miners work. It is clear that they need formation in techniques of coal exploitation, as well in entrepreneurial abilities and knowledge. Some extent of collaboration between them also is necessary.

It has been depicted the idiosyncratic feature that could restrict the cooperation due to the remarkable individualism of the local miners. Allocation of rights, moral hazard, free riding and contracts enforcement are the main barriers to organize the producers, particularly, small-scale and artisanal miners.

From this point of view, and given the analysis of proposed alternatives, alliances are a well mechanism for organization of the mining sector in Boyaca. In the current situation, the legal processes for legalization are perceived as extremely complex (Benavides et al. 2011). Other organizative forms as firms or

cooperatives that requires legal partners should fail in the middle term.

Opportunistic behavior is a real menace for the model. Nonetheless, more complete contracts and enforcement should reduce the negative impact of this menace. A third party monitoring is perceived as guarantor of efficiency in a long-term relationship. However, some authors consider that it is necessary to tolerate some level of opportunism (Wathne & Heide, 2000).

In the first steps, it is clear that the alliance strategy could be hard to implement, according with Inkpen & Ross (2001). Nonetheless, with the time social and political mechanisms of enforcement guarantee the persistence of the alliance. Moreover, the informal contracts are a significant support for formal contracts since they are based on trustiness and loyalty (Frankel, Whipple & Frayer, 1996)

The main contention is that changes are benefic not only for producers, but for the actors in the coal supply chain, as pointed out in previous studies (Pooe & Mathu, 2011). Small-scale miners could beneficiate more in cooperating with bigger firms; they can access more easily to financing, as proposed by Tirole (2010). Intermediaries involved will decrease their market power and this cleans the market and facilitates competence. Clients could obtain more quality and fair prices.

From the point of view of institutions, Government has a key role as facilitator. Allocation of rights and contract enforcement are main activities to develop. However, the extent of its participation overcomes the merely legal role. Promoting activities and education are part of a long-term strategy.

The scope of this work is not to propone a complete and definitively organizational form, but to put on the table the discussion from the point of view of the theory of the firm. It is necessary further research in fields like organizational behavior to guarantee the persistence of any organizational model.

There is no doubt that the theory of the firm indicates that actually there is an opportunity to make the

Boyaca's coal industry more competitive and economically better efficient. Communities and society will be the beneficiaries. However, it is necessary the Government intervention through the public policy to reach the objective.

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