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ARTÍCULO

# Addressing misperceptions about land conflicts and quinoa: the case of Bolivia

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**Abstract:** The increasing popularity of quinoa for its culinary and nutritional value has unintended consequences in the main producer countries. While it could provide communities with revenues, it can also trigger desires to control the land which produces it. We analyse whether the increase of quinoa's price increases land conflicts in Bolivia, one of the leading quinoa producer countries. We compare the fluctuation of this staple price to the price of other primary export goods in Bolivia: minerals. We do not find an increase in the quinoa's international price changes conflicts in the producer areas. However, we find that the relationship between price changes and conflicts in the case of minerals is consistent with the rapacity and opportunity cost effect described in the literature. While the prices of labour-intensive minerals like silver and copper are associated with a decrease in conflicts, consistent with an opportunity cost effect, fluctuations do not affect tin and other income-intensive exports.

**CÓDIGOS JEL:**
Q17; F16; J30; O13; D74

**PALABRAS CLAVE:**
Conflictos de tierra; Precios de materias primas; Quinoa; Bolivia; Exportaciones; Precios minerales

**Resumen:** El incremento de la popularidad de la quinua por sus características culinarias y nutricionales puede tener consecuencias inesperadas en los principales países productores. Mientras las comunidades productoras se podrían beneficiar del incremento de la demanda, también puede ocasionar deseos de controlar la tierra productiva, como indican numerosos artículos de prensa. Este estudio analiza si el incremento del precio de la quinua aumenta los conflictos de tierra en Bolivia, uno de los mayores productores de quinua del mundo. Comparamos la fluctuación del precio de este producto con el precio de otros productos exportados por el país: los minerales. No encontramos una relación significativa entre los precios de la quinua y los conflictos por la tierra. Sin embargo, sí encontramos una asociación entre los precios de los minerales y los conflictos, consistente con los efectos rapacidad y de coste de oportunidad descritos en la literatura. Mientras los precios de los minerales intensivos en mano de obra como la plata y el cobre están asociados con una reducción en los conflictos, las fluctuaciones no afectan al estaño y otras exportaciones intensivas en capital.

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*"Today we are here to recruit a new ally in the fight against world hunger and food insecurity: quinoa"*

*FAO Director-General José Graziano da Silva at the official launch of the International Year of Quinoa at UN Headquarters. Feb. 2013*

In February 2013, the United Nations officially launched the International Year of Quinoa. With support from several member countries, the UN announced that this initiative's objective is "to focus world attention on the role that quinoa's biodiversity and nutritional value play in food security, nutrition, and poverty eradication, and support of the achievement of the Millennium Development Goals." Despite the sudden spotlight, the quinoa plant is relatively unknown outside its major producer countries and certain culinary circles. However, the task of increasing global awareness about quinoa's potential to help fight hunger and alleviate poverty is undoubtedly facilitated by the unique characteristics of this plant, including its nutritional properties and versatile growth. While the UN just begins pushing forward with the program, there has already been a wave of impressive growth in the quinoa market in recent years.

Moreover, the media has already been reporting some of the consequences associated with this market growth. Some have argued that the dramatic rise in quinoa's price is causing decreased affordability for low native consumers. The press also reports higher prices as a source of conflict at the local level as communities clash over access to land.

This paper will examine the quinoa market boom and take a close look at the quinoa-related land disputes in Bolivia, including an unprecedented quantitative evaluation of the conflict issue. Our goal is to use quantitative data to understand the actual effect and counteract this issue's massive media coverage. As far as we know, a quantitative study of this kind has never been conducted in Bolivia. We believe this paper contributes to the literature of conflicts and natural resources by providing a new context not studied before and using evidence to address media misperceptions that can significantly impact social unrest. According to the literature, the increase in the price of a commodity could increase conflict if the value of the productive land increases and the incentive to fight for it is higher (rapacity effect). On the other hand, if the price boom increases individuals' incomes, we might find a decrease in the area's conflicts because time will be better spent working for the production of the commodity than working (opportunity cost effect). This paper analyzes which effect prevails using quinoa and minerals using the most important productive commodities in the country.

Cultivated as far back as 3000 BC by the Incas, quinoa is typically incorrectly labeled as a grain or cereal because of its edible seeds. Quinoa is a member of the chenopod family of plants and is closely related to spinach. One of the most relevant features of quinoa is its high nutrient content. Quinoa is the only plant food that contains all ten amino acids that are essential for the human diet. Given that it is a complete protein source, quinoa is considered by some as an incomparable substitute for animal proteins. Quinoa is also a good source of fiber, iron, potassium, calcium, and magnesium. Moreover, given that quinoa is a seed and not a grain, it is gluten-free and appropriate for many different diets. A technical paper from NASA researching the potential uses of quinoa in space determined that "while no single food can supply all the essential life-sustaining nutrients, quinoa comes as close as any other in the plant or animal kingdom[1].

In addition to its nutritional value, quinoa is highly regarded for its adaptability to harsh ecological conditions. Quinoa is only produced in some environmentally hostile regions of the high Andean plateaus in South America. It can grow in saline soil and at a high altitude above sea level (3,500m), where there are thin oxygen and limited water supply, making it virtually the only crop able to grow under such conditions. A few specific regions in Bolivia, Peru, and Ecuador exhibit this type of environment. The core characteristics of quinoa make it a valuable crop that also produces very high yields, which means that it takes minimal inputs and resources to produce a large harvest. Currently, it is a commodity in an expanding market, and its production is delivering high revenues.

The rest of the paper is organized as follows; in section 1, we present the background and context of this topic. We study the market situation for quinoa and its evolution, the mass media coverage and attention in Bolivia and international press, the problem on property rights and land conflicts, and some of the efforts that have been done regarding organization around quinoa production. In section 2, the literature related to conflicts and the price of commodities is presented, together with our argument's theory. Section 3 explains how we have worked with the data and the methodology used for the empirical analysis. In the next section, section 4, we present and interpret our results. In section 5, we provide a brief overview of the study and principal conclusions.

## 1. Background and context

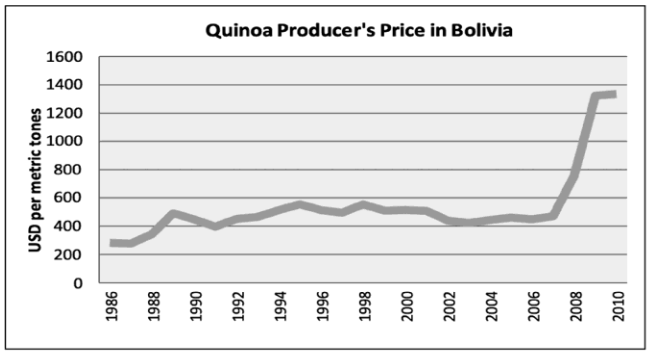
### 1.1 The quinoa market

The market for quinoa has grown significantly in recent years. According to the Food & Agriculture Organization, world production of quinoa in 2019 was 161,415 tons (FAOSTAT, 2019), an increase of more than 100% from 2011, when the last year of the data for this work was collected. In 2011 it was 80,241 tons on 101,527 hectares. These two figures represent a 28% and 38% increase from 2006 respectively. Bolivia and Peru alone represent more than 90% of global quinoa production and exports. In 2011, Bolivia produced 38,257 tons, 42% more than in 2006. Similarly, Peru produced 41,168 tons in 2011, an increase of 35% compared to 2006. Bolivia is the world's number one exporter of quinoa. The value of Bolivian quinoa exports has risen from a total of US$2 million in 1999 to more than US$46 million in 2010 or about 15,400 tons. (See Appendix A1, A2)

The booming quinoa export market has been pushed by international customers and importers predominantly throughout Europe, Canada, and the US, willing to buy the crop at higher prices. (See Appendix A3, A4) Primarily driven by the growing popularity and consumer demand, the crop prices had risen from 1.399$ per ton in 1989 to 9.300$ per ton in 2010. Climbing prices are understood to be leading to higher income revenues for rural farmers that were before isolated from the international markets. However, an associated implication is that poor local consumers cannot afford quinoa as part of their basic consumption basket. Today, quinoa's value is about five times that of soybeans and about four times that of wheat, both similar staples but of lower nutritional quality.

[1] Greg Schlick and David L. Bubenheim. 1993. Quinoa: An Emerging "New" Crop with Potential for CELSS. NASA Technical Paper 3422

**Image 1:** Quinoa's production Price in Bolivia




Source: Self-made using data from FAOSTATS 2011

Even in light of the increasing demand in the international market, the gross value of quinoa production barely reaches 1% of Bolivian GDP, and its contribution to the agriculture sector is 5.2% (INE 2011). FAO estimated that for 2011 there were 70,000 quinoa producers in Bolivia, with roughly 15,000 of them dedicated to its commercialization in the internal and foreign market. The remaining producers are mainly families who produce for household consumption and household exchange.

## 1.2 The Broader Productive Landscape

Bolivia is a landlocked country located in the heart of South America and divided into nine different regions. Oruro and Potosi, in the Andean territory at more than 3.500 meters high, are the world's central quinoa-producing regions. However, as mentioned above, quinoa represents only a small fraction of production in the country. These two regions were born and have thrived around mineral extraction, mainly silver, zinc, lead, and tin (See Appendix A5), which are also the country's main exports and natural gas and crude petroleum. The country is highly vulnerable to international market fluctuations produced by the large economies in Europe, Asia, and North America that establish international prices. Bolivia is mainly an exporter of raw materials and cheap manufactures, subject to boomand-bust economic cycles.

During the presidency of Evo Morales, Bolivia increased government control and investment in the mining sector. At the Huanuni mines in Oruro, violent clashes among cooperative miners led to the facility's nationalization in the year 2007. The government also nationalized the Vinto smelter,

citing corruption by private owner Glencore in February 2007. The still- unopened Karachipampa metallurgy complex was nationalized in 2011 following the regional protest in Potosí's demand for its operation and foreign investors' failure to accomplish this. The last nationalization by Mr. Morales' government took place in June 2012 as a window to end a violent dispute at the Colquiri tin mine, Bolivia's second largest, that agitated the country for months.

Throughout the history of Bolivia, conflicts have marked the country's social and economic pulse. These facts represent the existing tensions between the different social groups and the discordances between the state and society and are also an expression of unwellness and despair among Bolivians.

## 1.3 Mass Media Coverage and Attention

The growing quinoa market described above has not come without accompanying scrutiny from third-party observers. Increased attention has been brought to different consequences of market growth. Specifically, higher prices have socioeconomic effects, such as decreased affordability for poor consumers in quinoa-producing countries who have relied on this as a staple food for centuries. Reports in top international newspapers argue that quinoa's skyrocketing price is making it too costly for consumers in producer countries to purchase, forcing them to substitute quinoa for cheaper and less nutritional processed foods. Some of the most polemic headlines regarding this topic are as follows:

"Can vegans stomach the unpalatable truth about quinoa?" Ethical consumers should be aware poor Bolivians can no longer afford their staple grain due to western demand raising prices.

- The Guardian (Jan. 2013)

"Quinoa: The Dark Side of an Andean Superfood"

Quinoa was always food for Indians. Today it's food for the world's richest.

- Time World (Apr. 2012)

"The Quinoa Boom Is a Lesson in the Global Economy" The speed of quinoa uptake has not been without problems, highlighting the interconnections that exist in a global economy.

- ABC News (Jan.2013)

"Quinoa's Global Success Creates Quandary at Home" Fewer Bolivians can now afford it, hastening their embrace of cheaper, processed foods and raising fears of malnutrition in a country that has long struggled with it.

- The New York Times (Mar. 2011)

Moreover, with the increase in prices, many of the vast unattended fields of the southern Bolivian Andes have become much more valuable, worsening land conflicts and transforming the social links among communities in close vicinity to each other. According to many international NGOs and the local press, there has been an increase in property rights conflicts in a few particular regions in Bolivia between native communities that lived in relative harmony before the quinoa price boom.

There was a series of notably violent territorial disputes between Oruro and Potosi in February and March of 2012, and quinoa-producing land is at the center of this issue. Many Bolivian newspapers reported that these conflicts left dozens of people seriously injured, hostage-taking, and damaged machinery. Residents in Potosi have reported land invasions by natives from Oruro and vice-versa. "La Prensa" (Villca Jimenez, 2012) reported that local leaders had organized their communities during these incidents to defend plots of land from further incursions. It was also reported that government authorities have attempted to facilitate dialogue between the parties involved. However, a solution has been hard to come by. International advisors were invited to help revise land decrees that had initially been written in the 16th century, but negotiations have stalled. Some government leaders have suggested that perhaps the army may need to be called in to control confrontation and minimize further escalation.

The problem of conflict over quinoa land has not gone unnoticed in the international press. In June 2012, a Canadian currents affairs magazine (Pedromo, 2012) reported that this "popular superfood had spurred violence between producers" in Bolivia. The article explains that land used for growing quinoa is scarce, and soaring prices have led to increased tensions in Bolivia over agricultural lands' control. The article states: "Warring quinoa producers on

the borders of the Potosí and Oruro departments recently attacked one another with dynamite, grenades, and sticks. An informal truce was reached by dividing 250 sq. km of quinoa plantations in half, with each side taking control of one half. But it's harvest season, and new fights could soon erupt."

News about conflicts over quinoa lands continues to be published. Most recently, in April 2013, the publication from a significant Bolivian NGO (Fundación TIERRA, 2013) reported how clashes between communities in Oruro and Potosi have been reignited. This article emphasizes property rights as a core issue. Each of the opposing parties claims the land to be theirs, but the articles emphasize that there is no clear legal structure behind the disputed parcels of land and that interest in controlling the area has only arisen with the rise in quinoa prices.

## 1.4 Property Rights and Land Conflicts

Bolivian property rights legislation and its enforcement are relatively weak, and government authorities have not reconciled the increasing disputes over quinoa-producing lands between local communities. Moreover, "Bolivia has one of the most inequitable distributions of land in South America, represented by both inter-regional and intra-regional inequality" (USAID, 2016). In the east of the country, 60–70% of cultivable land is held by a few thousand large landowners. In contrast, 5–10% of the agricultural land in the same region is held by hundreds of thousands of indigenous smallholders" (World Bank 2006b). Over 90% of Bolivian regions currently experience territorial conflicts due to various political and land interests throughout the country, not to mention conflicts in smaller quinoa-growing communities such as Oruro and Potosi.

One prominent researcher whose work focuses on quinoa comments that "land disputes have unfortunately been in the fabric of the Andes and Bolivia since before colonial times" (Laguna and Rollet, 2012). Following Bolivia's independence from Spain in the nineteenth century, existing communities were already fighting each other to access agricultural land and natural resources. Several times during the twentieth century, the government tried to implement geographical limits by appointing the army to settle the dispute but had no luck. Conflicts resurfaced in the 1990s with the more current expansion of quinoa production.

In 1996, Bolivia adopted its primary land reform law: The Law of Agrarian Reform (el Acto Nacional para la Reforma Agraria, INRA Act). The INRA Act was designed to address chronic issues of limitations on land tenure access and insecurity through regularization of land rights, issuance of titles, resolution of land disputes, and distribution of land. Unfortunately, the law's implementation was uneven and ineffective (World Bank 2006a).

When Bolivia gained its independence, the government neglected to declare geographically detailed and firm territorial or political boundaries of communities, municipalities, provinces, and departments (regions). In her article, Jean Friedman-Rudovsky (2012), mentions conflicts between communities within the Potosí and Oruro regions of Bolivia, "The Dark Side of Quinoa," in Time Magazine. She claims that these conflicts are a result of commoditized quinoa expansion.

To overcome these disputes, indigenous Bolivian president Evo Morales imposed a grassroots solution agreed to by regional governors and small community civic leaders living in the various regions' urban centers, giving these community leaders the responsibility to negotiate territorial conflicts directly. At the beginning of March 2012, uprisings of this new system began and pushed the Bolivian State to the limits of its political resources; this approach to solving territorial boundaries is continuing to solve these conflicts all over Bolivia. Although conflicts over land possession, land reform, and regional autonomy have decreased since the advent of the Morales administration's efforts, the continuing inequalities in land distribution and the sluggish land reform progress have led to conflicts. Allocation of Original Community Lands (Tierras Comunitarias de Origen-TCOs), concessions, titling, INRA processes, and local land administration operations have supplied fodder for disputes, and the imposition of TCOs as the only tenure model for indigenous communities has created conflicts (World Bank 2006b).

## 1.5 Organizational Efforts

As a result of market expansion and the economic opportunities perceived to be contained within, there has been an attempt to improve the quinoa value chain organization (i.e., producers, intermediaries, and exporters) in Bolivia. Given quinoa's tremendous productive and profit potential, the Bolivian Government has established different organizations at the regional and national levels, such as the State Chamber of producers of Quinoa Real of Potosi (CADEQUIR), the State Chamber of producers of Quinoa Real of Oruro (CADEPQUI-OR), the National Chamber of Quinoa Producers, National Committee of Competitiveness and Productivity of Quinoa (CONACOPROQ), and the Bolivian Chamber of Exporters of Quinoa (CABOLQUI). The coordination among these institutional actors of the quinoa chain has allowed the formulation of the National Policy and Strategy of Quinoa (2009). The document's main objective is to "foster the sustainable cultivation of quinoa as a base for productive development in the Andean area within the frame of food security and sovereignty policy in Bolivia"[2]. It encourages the process towards a model of development that includes all rural actors, improving their production system in a more diversified and participative rural economy.

Despite its importance, these organizational efforts still lack policy-based reinforcement and need further revision. Furthermore, as mentioned above, there are continued reports of conflict over quinoa land in Bolivia. Upon first looking at the data, we can see that there is no clear correlation between quinoa prices and conflicts. However, since the middle 2000s, when quinoa gained world relevance, there has been an eruption of conflicts in the region.

Although there has been little international attention to past local conflicts in Bolivia, there is an increasing coverage on the fringes of the quinoa price boom that has placed the country's current conflicts in the spotlight. Simultaneously, both local and international publications have focused on the socio-economic importance of quinoa to fight hunger and boost development in one of the poorest regions in the southern hemisphere. However, no systematic quantitative study has been done yet relating the increasing prices and the current conflicts. Before proceeding with our quantitative analysis, we first look at what the literature says about the relationship between commodity price changes and conflict.

[2] AGROBOLIVIA: http://vdra.agrobolivia.gob.bo/contenidos/informacion/publicaciones/VDRA_COM_SCT-4929993-25062012-2.pdf

## 2. Literature Review

There is a vast literature on how commodities prices can affect conflicts. In economic theory, there might be two different effects from an increase in prices. One suggests that higher local income results in a more efficient allocation of resources, improving welfare and diminishing conflicts. In this case, higher potential income implies an opportunity cost such that time spent embroiled in conflict could be better spent in the profitable production of quinoa. Thus, a rise in income may reduce conflict by increasing wages and reducing labor supplied to criminal or conflict activity (Becker, 1968; Grossman, 1991). In this line, Brückner and Ciccone (2010) show that the probability of a civil war outbreak is higher following periods of decreased international prices of a country's commodity exports rather than increased prices.

The second argument, which captures what is known as the rapacity effect, is that under certain circumstances, increasing prices of natural resources raises the land value and might lead to an increase in conflicts by gains from attempted appropriation, as far as there is more to fight over (Hirshleifer, 1991; Grossman, 1999). This argument could explain why oil and other natural resource exporters face a higher probability of experiencing civil war (Fearon, 2005). Angrist and Kugler (2008) study the consequences of an exogenous surge in coca prices and cultivation in Colombia, where most coca leaf is now harvested. They find that rural areas that saw accelerated coca production subsequently became considerably more violent, while urban areas were affected little. These findings are consistent with the view that the Colombian civil conflict is fueled by the financial opportunities that coca provides. Also, rent-seeking by combatants limits the economic gains from coca, where a rise in income may increase conflict by raising the return to predation and promoting rapacity over these resources.

Moreover, some studies show a higher rapacity effect when the commodities involved are capital intensive. One of the most insightful contributions is made by Dube and Vargas (2012). They find that the price of agricultural commodities (which are labor-intensive) is negatively related to conflict: when the price rises, conflict falls differentially in municipalities that produce more of these goods. In contrast, the price of natural resources (which use labor less intensively) is positively related to conflict: when the price rises, conflict rises differently in municipalities that produce more of these resources. In their paper, the authors examine Colombia's two largest exports, coffee, and oil. They conclude that a sharp fall in coffee prices during the 1990s lowered wages and increased violence in municipalities cultivating more coffee, consistent with the coffee inducing an opportunity cost effect. In contrast, a rise in oil prices increased both municipal revenue and violence differentially in the oil region, consistent with the oil shock inducing a rapacity effect.

The existence of these two opposing effects suggests that some income shocks may mitigate conflict, while other shocks exacerbate it, depending on the relative strength of the two effects. Thus, we would like to examine the case of quinoa to understand which of these two effects best represents the Bolivian situation and identify the conditions under which these regions have, presumably, experienced an increase in the number of conflicts.
This framework generates two sets of alternative predictions. First, a rise in agricultural goods' price should increase work hours in the productive sector and increase wages relative to contestable municipal revenue, thus reducing conflict differentially in regions that produce these goods more intensively. Second, an increase in the price of natural resources should increase municipal resource revenue but not offset wage increases, thus increasing conflict differentially in the natural resource region.

This paper aims to examine the relationship between the quinoa price boom and the existing conflicts in Bolivia. Our goal is to use real data to understand the real effect and counteract the massive media coverage of this issue. As far as we know, a quantitative study of this kind has never been conducted in Bolivia.

## 3. Data and methodology

We use a database of conflicts in Bolivia that Roberto Laserna and Miguel Villarroel provide to measure conflicts. They have tracked conflicts from January 1970 to December 2012 and created a private database that compiles conflicts and is organized according to region, type of conflict, leader group, and even the presidential round under which that conflict took place. The information about the conflicts has been collected from different local newspapers and magazines that reported these incidents in their database. Their paper "38 años de conflictos sociales en Bolivia," (2008) describe in detail how to do it. We got in touch with Roberto Laserna, who kindly provided us with an updated 2012 version of the database.

In their paper, the term conflict is defined as any mobilization of social agents that go after a specific and imminent objective and usually use violence. Thus, some conflicts are left out because of no use of violence like legal complaints letters, accusations, or threats. Laserna and Villarroel (2008) point two main problems regarding data collections. Firstly, the rural areas' conflicts are underestimated since they receive less attention from the media, so we are only going to find the more important ones. This will affect our study as we are mostly interested in the small conflicts in the quinoa production areas, mostly rural. Secondly, during high conflict periods, media coverage is more likely to underestimate small conflicts as they become more habitual. This would also be the case of quinoa conflict.

We are interested in those conflicts organized by regions. Oruro and Potosí are two different regions, but we are aggregating them to have a picture of the quinoa production area. The other regions in Bolivia do not produce quinoa, so they will be considered "other regions."

We use annual international prices of tin, copper, lead, zinc, and silver regarding prices. These products are listed in the stock market, so we took data from 1970 to 2010 in US dollars per metric ton[3]. We include them as controls in the regressions. We do this because they are the most crucial production activities of the quinoa production region. Bolivia is the 4th world producer of tin and the 11th of silver and zinc, and the regions where these metals are extracted are Oruro, Potosí, and La Paz. So, we want to account for the movement of these prices on the effect on conflicts, interacting with the dummy of Oruro.

For quinoa prices, we construct a variable called *QuinoaPrice* that tries to solve problems with the multiple

[3] http://www.indexmundi.com/es/
http://www.lme.com/

hyperinflation episodes and changes in currencies in the region. For this purpose, we use the price of quinoa in local currency units (LCU) of the only three producers worldwide: Perú, Bolivia, and Ecuador. We converted these prices into US dollars using official data of the average exchange rate from each country central bank[4], and for trend smoothing purposes, some influential observations were removed in years. Considering that quinoa is more of a commodity and its price should be similar among the three producers, we have considered outliers those quinoa prices in USD due to political circumstances (i.e., coups, hyperinflation periods, and new currencies introduced). Thus, QuinoaPrice is the mean of those prices that we keep each year, and we believe this smoothes the variations in the prices due to hyperinflation and changes in currencies.

We present the descriptive statistics in Table 1 in the Appendix.

We also constructed a moving average (MA) that will consider the long-term effect of quinoa prices. Understanding that farmers may take time to adjusts to prices, we are taking three-period prices intervals in the following way:

$$\text{MA. QuinoaPrice} = \frac{1}{3}\sum_{t=1}^{3} \text{World AveragedPrice}_{\ t} \qquad (1)$$

All the prices are expressed in logarithms because we want to interpret the results as growth rates. Also, since our coefficients are small, it is easier to explain them.

This study's central question is to see how the price increase of a commodity such as quinoa affects the number of conflicts in the region where it is produced. We also keep in mind the context of a country with property rights that are not very well defined and with a commodity only produced in a particular area.

The method used to analyze this effect is a regression of the number of conflicts in the region j in time t explained by an interaction term composed by the quinoa price times a dummy for producer regions. This latter dummy variable will be equal to 1 if it is the quinoa producer region and 0 otherwise. Thus, we can account for the effect of the producing quinoa in the producer region.

Besides that, we include a set of control interaction terms of mineral prices times their local production in each region to account for how much of the conflicts in each region are explained by the amount and price of the minerals produced.

In equation (3), includes the three-year lagged average price of quinoa price instead of the current year price. We want to account for the effect of quinoa price increase in conflicts but with a lapse of time of 3 periods. We are trying to account for the fact that there might be delays in the effects of variation in quinoa prices over the conflicts.

We include region and time fixed effects in all specifications. The reason to include time-fixed effects is that we want to control those aspects that vary over time, constant across regions, and are correlated with our regressor (quinoa price), such as inflation. With region-fixed effects, we control those aspects that vary across regions, constant over time, and potentially correlated with quinoa's price.

We cluster by region regarding the standard errors since we believe it might be some within-group correlation in regions.

The regressions will be as follows:

$$Conflicts_{\ j,t} = Q[log(\ QuinoaPrice_{\ t)} * QuinoaProducer'_{j,t}] + \alpha + R_j + r_t + \theta[log(\ MineralPrices_{\ t}) * MineralProduction'_{j,t}] + s_{i,t} \qquad (2)$$

$$Conflicts_{\ j,t} = \rho[log(\ MA.QuinoaPrice_{\ t})^{*}\ QuinoaProducer_{\ j,t}'] + \alpha + R_j + r_t + \theta[log(\ MineralPrices_{\ t})^{*}\ MineralProduction_{\ j,t}'] + u_{j,t} \qquad (3)$$

Where:

$$MineralPrices_{\ t} = \begin{bmatrix} TinPrice_{\ t} \\ CooperPrice_{\ t} \\ LeadPrice_{\ t} \\ SilverPrice_{\ t} \\ ZincPrice_{\ t} \end{bmatrix}$$

$$MineralProduction_{\ t} = \begin{bmatrix} TinProduction_{\ j,t} \\ CooperProduction_{\ j,t} \\ LeadProduction_{\ j,t} \\ SilverProduction_{\ j,t} \\ ZincProduction_{\ j,t} \end{bmatrix}$$

We have to be aware of possible endogeneity problems. There is the possibility that conflicts may drive quinoa prices if we consider that the quinoa region is the biggest producer with approximately 46% of world production. If there is this kind of endogeneity, our results will be biased and inconsistent. One possible solution would be to take the weather as an instrumental variable for quinoa prices. However, weather in the quinoa region may not be exogenous as it also can affect conflicts. For example, droughts or floods may, on the one hand, affect quinoa production and price but also can exacerbate possible conflicts in the region due to natural catastrophes. Hence, we could use the weather in the Peruvian quinoa production region, the other biggest world producer. Thus, it would be exogenous and relevant. This is a very interesting avenue of research for future studies.

## 4. Results

Our main results (Table 1) show that quinoa does not have a significant association with conflicts in the quinoa production region compared to the non-producer regions. However, we do find a significant association between the price of minerals and conflicts in the country. Like copper and silver, some minerals are associated with a decrease of conflicts in the regions where they are produced, while others, like tin, are associated with a significant increase.

Even though quinoa is not significant, we can see in Table 1 of results that, when we run the regression substituting the price of quinoa in year t (specification 1) with an average of prices three periods before t (specification 2), our coefficient changes sign. It becomes negative and suggests that an increase in quinoa price is associated with a decrease of conflicts in the region that quinoa is produced compared to the other ones but three periods ahead. This is consistent with sticky prices theory since quinoa producers in Bolivia,

[4] Banco Central de Ecuador. Cotizaciones del tipo de cambio interbancario 1960-2013.

Banco central de Reserva del Perú. Tipo de Cambio interbancario, cotizacion 1970-2013.

Banco Central de Bolivia. Tabla de cotizaciones de monedas-Estadística histórica. 1970-2012

which work in small and medium cooperatives, sell their harvest to intermediaries. These middlemen are the ones that sell the quinoa at the international price, so the producers are going to see their incomes affected due to the price boom some years afterward. However, this effect is still not significant and minimal, so we cannot say that the association between quinoa price boom and conflicts exists, as the media suggest.

**Table 1:** Main Results

| **Dependent variable:** | Share of conflicts | |
|---|---|---|
| | (1) | (2) |
| Copper | -0.426*** | -0.382*** |
| | (-2.693) | (-2.218) |
| Zinc | 0.003 | -0.005 |
| | (0.005) | (-0.025) |
| Tin | 0.006*** | 0.006*** |
| | (3.148) | (3.090) |
| Lead | 0.001 | 0.001 |
| | (0.878) | (0.814) |
| Silver | -0.156*** | -0.163*** |
| | (-3.563) | (-3.216) |
| Quinoa | 0.618 | |
| | (0.192) | |
| MA Quinoa | -2.976 | |
| | (-0.485) | |
| Constant | 437.6*** | 395.1*** |
| | (4.553) | (2.847) |
| Observations | 245 | 233 |
| R-squared | 0.734 | 0.732 |
| Mean dependent variable | 0.152 | |

*Standard errors clustered at the region level. In parenthesis t-statistics. All regressions include region and time fixed effects. The dependent variable is the share of conflicts in the region per year. The independent variables are the logPrice*logProduction. *** 1\%, ** 5\%, * 10\%.*

There are other exciting results apart from those related to quinoa. Oruro and Potosí are also the leading extractor region of minerals in the country. As we have explained in our specification, we observe an association between conflicts and fluctuation in minerals' prices. An increase in copper and silver price suggests a significant reduction of conflicts in the quinoa region compared to a region that does not produce these minerals. However, for another mineral produced in the region, tin, we expect it to have the opposite effect on conflicts. An increase in the price of tin would cause an increase in conflicts.

The opposite suggested effects on conflicts of the fluctuation of prices in different minerals could be explained by the number of expected reserves of each of them and their extraction process. Tin is a mineral with one of the country's highest reserves, together with zinc and lead (the two nonsignificant ones) and one of the most difficult ones to reach, with high technical requirements. Since the reserves are not accessible and the process requires high technology, the extraction of tin is mostly only implemented by a private company, COMIBOL, with a lower labor force rate. This can explain the positive effect on conflicts of an increase in their price, consistent with a rapacity effect dominating the opportunity cost effect (Dube and Vargas, 2012, Humphreys, 2005). It is also consistent with findings on the null association between natural resources and conflict in Africa (Bhattacharyya and Mamo, 2021). If there is a price boom of tin, workers would not see an increase in their incomes, but they will see how the land's value increases, a reason to fight over it. On the other hand, silver and copper (minerals that suggest a decrease of conflicts caused by an increase in their price) are mostly extracted by small and medium cooperatives, which are labor-intensive. In this case, the opportunity cost effect would dominate, and the workers would perceive an increase in their wealth that decreases conflicts.

In order to quantify this effect, we will account for the production of minerals in Bolivia. As we can see in Table 2, Oruro and Potosí (quinoa region) are the leading producer of minerals in the country. It accounts for 95% of the silver production. Multiplying the average production for each mineral's average price, we compute the value of the production of that mineral. The extraction of tin and silver accounts for more than 98% of the country's total value of the country's mineral production. These figures reflect the importance of mineral production in the country's economy, but especially of the quinoa production region (Oruro and Potosí) compared to other regions like Beni-Pando or Sucre-Tarija that do not produce minerals.

Multiplying the minerals' average production by the coefficients of our specification, we get the absolute number of conflicts per region (Table 3). If we double the price of silver, copper, and tin (the significant ones) are associated with a significant average reduction of 32 conflicts per year in Oruro-Potosí compared to the non-producer region. The average number of conflicts in Oruro and Potosí per year is 41, with a standard deviation of 23. Thus, it is a significant increase because the average number of conflicts by region and year is bigger than two standard deviations over the mean. However, an increase of 100% in the price in a year is not very common. The effect of a decrease in conflicts might be because as the price increases, the workers in that industry see how their income increases, which makes them reduce conflicts, as is suggested in theory with a dominating opportunity cost effect.

**Table 2:** Average production of minerals (metric tons) and value (million US$)

| **Average Mineral Production** | | | | | |
|---|---|---|---|---|---|
| Region | Copper | Silver | Tin | Lead | Zinc |
| Oruro-Potosí | 76.86 | 379.36 | 10,239.62 | 8,608.69 | 114,619.50 |
| La Paz | 78.29 | 6.19 | 4,430.51 | 420.91 | 14,028.82 |
| Cochabamba | 0.00 | 13.77 | 220.01 | 6,213.87 | 9,519.65 |
| Santa ruz | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| Sucre-Tarija (Chuquisaca) | 0.00 | 0.00 | 0.00 | 0.00 | 846.49 |
| Beni-Pando | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Average Value Mineral Production** | | | | | |
| Value | 2,489.84 | 247,476.71 | 8,643.52 | 744.11 | 1,281.58 |
| Share country´s value | 0.96 | 94.95 | 3.32 | 0.29 | 0.49 |

**Table 3:** Average change of conflicts due to a doubling in the price of the mineral compared to non-producer region

| **Conflicts Change** | | | | | | |
|---|---|---|---|---|---|---|
| Region | Copper | Silver | Tin | Lead | Zinc | Quinoa |
| Oruro-Potosí | -29.36 | -61.84 | 59.29 | 11.02 | -0.23 | -2.976 |
| La Paz | -29.91 | -1.01 | 25.65 | 0.54 | -0.03 | .. |
| Cochabamba | 0.00 | -2.24 | 1.27 | 7.95 | -0.02 | .. |
| Santa ruz | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .. |
| Sucre-Tarija (Chuquisaca) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .. |
| Beni-Pando | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .. |

Regarding endogeneity, we are worried if it would affect the magnitude and sign of our results. As presented before, the

simplest endogeneity framework would be that when the region's conflicts increase, the supply of these goods would decrease and the international price increase. This would only be possible if Bolivia is determining the good's international price because of accounts for an essential share of the world's production. Tin is the mineral for which Bolivia contributes most to the total world production, around 8%. In addition to this, tin is the only mineral that has a significant positive effect on conflicts, meaning that it goes in the direction of the reverse causality framework.

In order to solve this problem, future research in this topic aims to use an instrumental variable. The rest of the mineral's extraction is less than 5%, and the sign is negative, so in case of a reverse causality situation, it would make our effect more negative. Thus, we will not worry about them both because of being price takers and because of the sign. In the case of quinoa, even though it is not significant, Bolivia is the primary world producer, so that Bolivian prices would set the international price. For future research, we would include an instrument, as is described in the section of the specification, the weather in Peru quinoa production areas.

## 5. Conclusions

Our study uses data to explore the relationship between the fluctuations on the prices of quinoa and other exports of Bolivia, on land conflicts. Our results show no significant correlation between the quinoa price boom and the wave of recent conflicts in the quinoa region in Bolivia. Our data suggest a big and significant association of the price of certain minerals (copper, silver, and tin) on several conflicts in the regions where they are extracted. We can attribute these results to 1) The primary source of wealth for the region is not quinoa, but mineral extraction; and 2) the price boom is a recent phenomenon, and the real effects may become present later in the medium and long run. The main contribution to this work is to give a quantitative overview on a relevant issue: quinoa market growth and local conflicts.

These results also have policy implications for quinoa and mineral producers in the area, as well as for the government of Bolivia. There is a strong perception in the country that the price boom of quinoa is causing land conflicts. According to our results that is not the case. Thus, the government should address this misinformation by launching campaigns in which they correct this view, since it is causing unrest and social alarm. Regarding quinoa and mineral producers, strong property rights will be important for them to secure the land and decrease the probability of grabbing. However, the opportunity cost that we found to dominate on average in the results, suggests that the increase in the mineral prices is beneficial for the region, and is probably creating jobs that prevent uprisings in the area. Monitoring the situation, strengthening the property rights and giving access to jobs created by the industry, could have a beneficial decrease of conflicts in the area.

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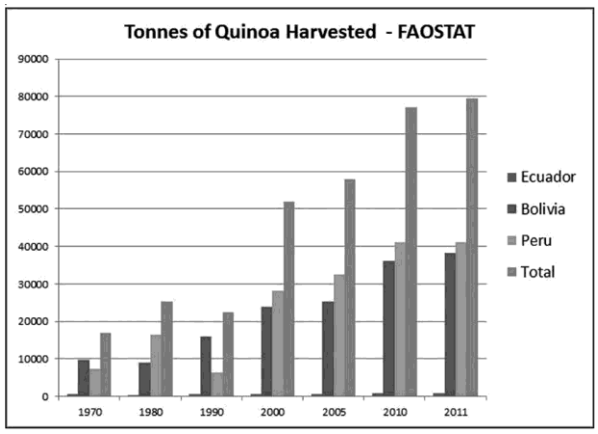
**Appendix**

**Table 1:** Summary statistics

| Variable | MeanStd. | Dev. | Min. | Max. |
|---|---|---|---|---|
| Total Conflicts | 336.24 | 189.69 | 59 | 783 |
| **Prices** | | | | |
| World Quinoa | 396.15 | 232.33 | 99.48 | 1266.38 |
| World Zinc | 1281.58 | 1251.41 | 295.8 | 8045.3 |
| World copper | 2489.84 | 1707.37 | 1057.67 | 7534.78 |
| World tin | 8643.52 | 4400.74 | 3512 | 20405.6 |
| World lead | 744.11 | 521.04 | 253.6 | 2579.9 |
| World silver | 247476.71 | 158435.28 | 54519.49 | 733850.88 |
| **Beni-Pando** | | | | |
| Production Zinc | 0 | 0 | 0 | 0 |
| Production Copper | 0 | 0 | 0 | 0 |
| Production Tin | 0 | 0 | 0 | 0 |
| Production Lead | 0 | 0 | 0 | 0 |
| Production Silver | 0 | 0 | 0 | 0 |
| **Cochabamba** | | | | |
| Production Zinc | 9519.65 | 0 | 9519.65 | 9519.65 |
| Production Copper | 0 | 0 | 0 | 0 |
| Production Tin | 220.01 | 0 | 220.01 | 220.01 |
| Production Lead | 6213.87 | 0 | 6213.87 | 6213.87 |
| Production Silver | 13.77 | 0 | 13.77 | 13.77 |
| **La Paz** | | | | |
| Production Zinc | 14028.82 | 0 | 14028.82 | 14028.82 |
| Production Copper | 78.29 | 0 | 78.29 | 78.29 |
| Production Tin | 4430.51 | 0 | 4430.51 | 4430.51 |
| Production Lead | 420.91 | 0 | 420.91 | 420.91 |
| Production Silver | 6.19 | 0 | 6.19 | 6.19 |
| **Oruro-Potosi** | | | | |
| Production Zinc | 114619.5 | 0 | 114619.5 | 114619.5 |
| Production Copper | 76.86 | 0 | 76.86 | 76.86 |
| Production Tin | 10239.62 | 0 | 10239.62 | 10239.62 |
| Production Lead | 8608.69 | 0 | 8608.69 | 8608.69 |
| Production Silver | 379.36 | 0 | 379.36 | 379.36 |
| **Santa Cruz** | | | | |
| Production Zinc | 0 | 0 | 0 | 0 |
| Production Copper | 0 | 0 | 0 | 0 |
| Production Tin | 0 | 0 | 0 | 0 |
| Production Lead | 0 | 0 | 0 | 0 |
| Production Silver | 0.02 | 0 | 0.02 | 0.02 |
| **Sucre-Tarija** | | | | |
| Production Zinc | 846.49 | 0 | 846.49 | 846.49 |
| Production Copper | 0 | 0 | 0 | 0 |
| Production Tin | 0 | 0 | 0 | 0 |
| Production Lead | 0 | 0 | 0 | 0 |
| Production Silver | 0 | 0 | 0 | 0 |

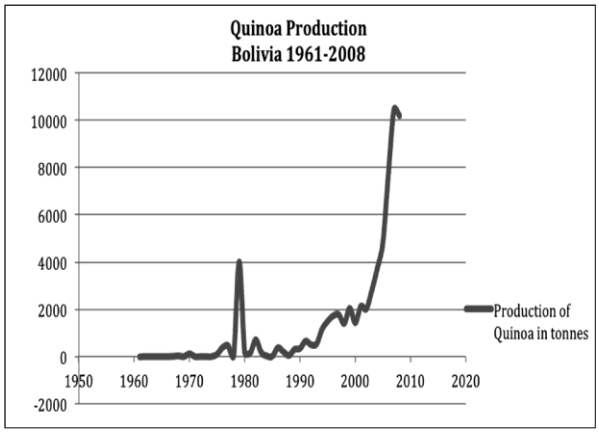
*The production data is from year 2010*

**A1:** Tones of Quinoa Harvested



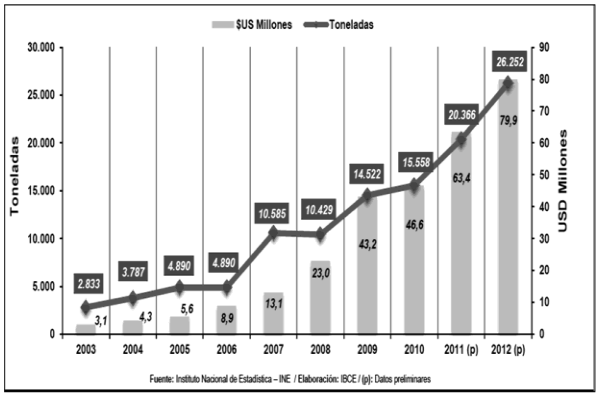

*Source: FAOSTAT 2011*

**A2:** Quinoa Production in Bolivia (1961-2008)



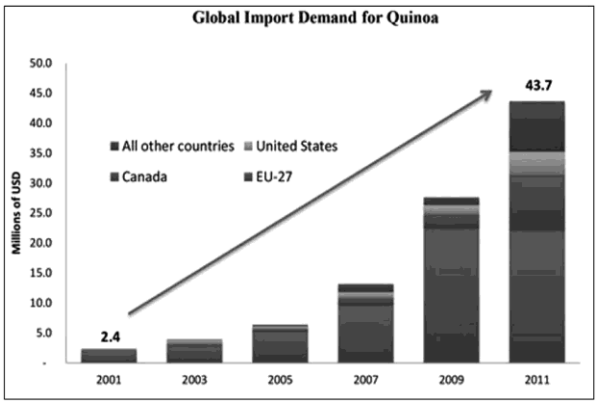

*Source: FAOSTAT 2011*

**A3:** Quinoa Value and Volume of Exports in Bolivia



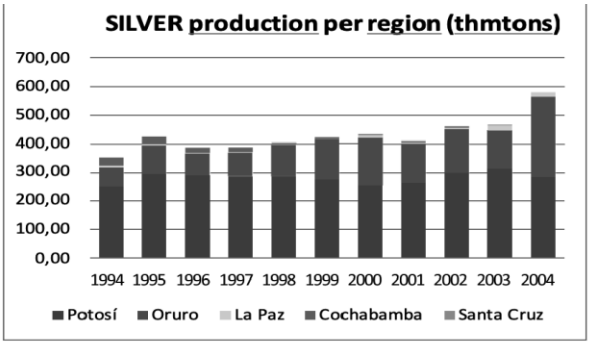

*Source: Instituto Nacional de Estadística*

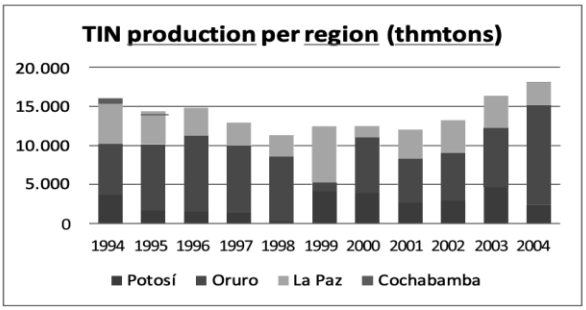
**A4:** Global Import Demand for Quinoa

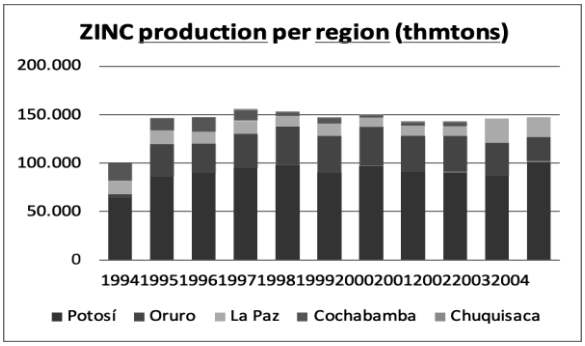



*Source: FAOSTAT 2011*

**A5:** Selected Minerals Production in Bolivia




*Source: Self-made using INE data*