

Extractive Colonial Institutions: An Explanation for the Emergence and Persistence of Informality

Daphne Alvarez Villa[§]

August 16, 2014

Abstract

This paper argues that extractive colonial activities can explain the emergence and persistence of informality. Therefore, it argues that these activities not only caused underdevelopment through persistent bad institutions (that deny property rights to the common people), but through persistent incentives to enforce property rights out of the law. I develop a theoretical model, which predicts the emergence and persistence of informality due to a colonizer extractive strategy and the possibility to access resources in an illegal way. I show how the model and its predictions are supported by historical evidence, considering the case of Antioquia, large gold producer under Spanish colonial rule, now a Colombian department. Finally, I provide empirical evidence for a persistent link between colonial informal mining and current informality in the labor market; for this, I use variation in the number and type of colonial gold mines across municipalities in Antioquia.

-very preliminary version-

Keywords: Informal Sector, Extractive Industries, Institutions and Growth, Colombia.

JEL Classification: N36, N56, O17, O43.

[§]Ph.D. candidate, University of Munich, Germany.

Email: daphne.alvarez@econ.lmu.de. I would like to thank Davide Cantoni for very helpful comments. I also thank Juan Pablo Salavarieta at the Luis Ángel Arango Library - Banco de la República - for facilitating the access to colonial mining information.

1 Introduction

The literature has extensively claimed a negative effect of extractive colonial activities on development, through the establishment of institutions that deny property rights to the majority of the population, and that are persistent over time. This study aims to provide an additional explanation for underdevelopment path dependence through the persistence of informality or illegality among former colonies affected by extractive colonial activities. The hypothesis of this paper argues that extractive colonial activities not only left detrimental institutions for property rights, but also created long-lasting incentives to secure property rights out of the law. In other words, extractive colonial activities might have not only caused underdevelopment through persistent bad institutions, but through a persistent gap between *de jure* and *de facto* institutions, as well.

I proceed in three main steps in order to formalize and test my hypothesis, close in spirit to an analytic narrative: I develop a theoretical model for the emergence and persistence of informality due to a colonizer extractive strategy and the availability of resources to be owned. I then show how the model assumptions and predictions are supported by historical qualitative evidence, considering the case of Antioquia, one of the main gold producer regions among Spanish colonies, now a Colombian department. Finally, I provide empirical evidence for a persistent link between colonial informal mining and current informality levels within Antioquia.

The model shows the influence of two colonization types on the relative profitability between formal and informal sector. In particular, extractive colonization, characterized by a high extraction rate and a low provision of public goods, makes the outside option of being illegal or informal relatively more profitable in places where resources are also accessible for illegal individuals. Unlike the papers by Baumol (1990), Acemoglu (1995) or Nunn (2007), the model considers the case where illegal/informal individuals perform productive activities for the economy, do not steal from the formal sector, but are not identified in this sector; that is, illegal/informal individuals are not taxed, and they are not users of public and legal services. The consideration of this case can explain two simultaneous facts: Extractive colonial activities did not lead to the same low production equilibria in all areas; and even areas with relatively high production levels still show very poor social outcomes today.

The model has two stages following the model fashion in Nunn(2007). In the first stage, the colonizer chooses an expropriation rate and a level of public goods investment. Any strategy chosen by the colonizer only affects the formal sector of the economy. In the second stage, individuals decide every period whether to be formal or informal, and the share of informal individuals affects relative payoffs in the next period. Even though payoffs in both sectors may differ at a given point in time, not all individuals will go

to the most profitable sector, since there is persistent behavior along overlapping generations to some extent, and the share of individuals in a given sector that will follow their former peers is increasing over time. Payoff functions reflect different returns to scale in labor between colonial extractive activities (formal activities) and informal ones. Colonial extractive activities were characterized by large-scale operations, with high demand of labor force, whereas informal/illegal activities were performed in an almost individual (therefore imperceptible) way.

The following outcomes are predicted by the model: 1) An extractive strategy by the colonizer causes the appearance of an informal sector where the portion of resources that could be accessed in an illegal way is sufficiently high; 2) given the persistence of such strategy, the share of individuals in the informal sector is increasing over time until a stable high informality equilibrium; 3) little changes towards a less extractive strategy will not reverse the path of a growing informality, if the informal sector is already big enough; 4) if this change in the colonizer's strategy happens at a sufficiently low level of the informal sector, the size of this sector could only be partially reduced depending on the strength of the network effect.

Historical evidence for Antioquia-Colombia points out the existence of informality in the colonial period, as well as its striking growth at the end of the 18th century. Informality was present in gold mining (the economic activity subject to colonial extraction) and illegal miners were characterized by their independence and mobility, which allowed them to look for easy gold sources, escape colonial control and evade colonial gold taxes. One question follows: In a region with a dominant extractive activity in the past, can this experience still have an impact on informality/illegality outcomes today? In other words, has this activity left a persistent gap between the order of law and reality? I present suggestive empirical evidence for this persistence in a within-department setting. I use variation in the number and type of colonial gold mines across municipalities in Antioquia and seek to explain current informality outcomes, namely, child labor, not being affiliated to a health system if employed and not having a formal contract if employed. Following qualitative evidence, informal or illegal miners in the colonial period worked in alluvial mines¹, rather than vein mines², given these mines' characteristics; thus, the availability of alluvial mines in an area can be considered a necessary condition for the emergence of informality in the past. I take the number of alluvial mines during 1739-1810 (72 years before independence) as intention-to-treat, which allows variation in the intensity assignment of the colonial informality treatment.

After controlling for the overall number of colonial gold mines in the same period (which should capture the effect of the size of colonial settlements)

¹Gold found in rivers or that has been transported by water

²Gold found in mountains

and several observables at the individual and municipality level (including the share of individuals in the mining sector in 2005), estimates indicate that a larger number of colonial alluvial mines is significantly related to a lower probability of having a formal contract if employed, and to a higher probability that a child works. I further control for alluvial and total mines after independence (1811-1900). Results show that it is not a general effect of alluvial mines the one driving current informality outcomes; it is the effect of colonial alluvial mines. This supports the idea that the possibility to become informal in the past under an extractive strategy is an important determinant of current informality levels.

Results for having a formal contract are robust to the exclusion of children from the sample and to the inclusion of a ‘colonial’ fixed effect; that is, a fixed effect for municipalities that had once colonial gold mining. On the other hand, after including this fixed effect, a larger treatment is significantly associated with a lower probability of being affiliated to a health system if employed, whereas it is no longer significant to explain child labor. Interestingly, a higher overall number of colonial gold mines is associated with less informality in terms of the different measures.

The colonization experience has served as a good experiment in history for identifying institutions as a main cause of economic growth. According to the literature³, extractive colonial activities have set institutions that deny property rights to the majority of the population, which can then explain very low saving and investment rates, and thus the lag-behind after the Industrial Revolution.

The institutions hypothesis has been a cogent explanation for the resource curse paradox in former colonies, which has pointed out evidence that countries with most abundant natural endowments are the ones with worst economic outcomes or weakest democracies. Extractive colonial activities were precisely placed where plenty of resources could be extracted, and if these activities left bad institutions, economic underdevelopment can be explained.

Development differences can be also found within developing countries, where some regions are clearly much richer than others, or production and population are concentrated in certain areas. There are also different dimensions of development that need to be considered. For instance, high levels of informality are often observed among developing countries regardless of relative prosperity in an area. In other words, GDP per capita may be relatively high, but social and economic welfare can be low for a significant share of the population.

Also large literature⁴ observes that same formal institutions can perform

³Among others, Acemoglu et al. (2002)

⁴Among others, Putnam et al. (1993), Fukuyama (1996), Knack (2002), Tabellini (2010).

differently in different cultural environments. Despite formal institutions have gradually changed in former colonies, or have replicated those in western industrialized countries, most former colonies with extractive activities in the past still seem trapped in underdevelopment equilibria.

The Colombian region of Antioquia gives evidence for a relatively high production equilibrium in the context of a developing country, with high levels of informality. The territory of Colombia (within the Nueva Granada in the colonial period) was one of the main gold producers among the American colonies⁵ and within this territory, the Antioquia region was considered 'gold lands' by colonizers (Restrepo, 1888). However, registered gold production in Antioquia was not always consistent with the abundance of gold in this region. The literature suggests that this was not a sign of an actual decline in production, but the consequence of a "legality crisis in the tax base" (Alvarez and Uribe, 1985, p. 92).

Gold mining was already present in the pre-colonial period along the Colombian territory, but this activity did not likely induced informality or illegality for several reasons: Precious metals were demanded for artistic and religious purposes and they were conceived as any other good to be exchanged (Alvarez and Uribe, 1985); the indigenous social structure was accepted by its members and social status could not be gained with the possession of gold.⁶

Why should extractive colonization have led to informality/illegality? The intuition behind the hypothesis in this paper would provide the following explanation. First, colonization brought a change in the conception and use of gold; gold was demanded as the almost single mean of exchange and it became the equivalent of wealth. Second, given an extractive strategy by the colonizer, a new hierarchical structure was forcibly imposed and it established a highly unequal society. It is then logical to think that this colonial society rewarded gold accumulation, as economic status could be bought with gold and this was very much desired due to large economic and welfare inequality. On the other hand, colonial gold taxes were most likely understood as an expropriation rate, given that they did not benefit the population, and the colonial unfair social structure was not chosen by the society. Finally, minerals were abundant and mines were not easy to exclude, so that tax payment could not be perfectly enforced. For these reasons, gold was very likely exploited in an illegal way.

The literature gives the phenomenon of illegal mining an important role in the conformation of the independence movement in Antioquia. Illegal

⁵Its cumulative production until 1875 was the largest among former Spanish colonies (Alvarez, 1900).

⁶Although indigenous people had very rudimentary techniques to access minerals, they were able to accumulate a lot of them over time. These minerals were basically salt, coal, emeralds and gold, where gold was often found in rivers. Provided access to these minerals, mining was an activity shared by the tribe members.

miners gave gold mining the character of an egalitarian and popular activity (Poveda, 1981; Alvarez and Uribe, 1985), thereby mitigating the negative effects of extractive institutions on growth and perhaps giving common people more power to demand their rights. Accordingly, Antioquia has been attributed the leading role in the Colombian industrialization process, with a notably high economic growth between the second half of the 19th century and the first part of the 20th century (Mejía, 2012). Antioquia is still one of the richest regions in Colombia; however, it has been also characterized by high informality levels, violent conflicts and criminal activities. Although these adverse features may respond to many influences, this paper argues that the initial idea of perceiving a benefit when operating out of the law makes societies prone to these later negative outcomes. In this sense, the emergence of informality due to colonial extractive activities and its persistence should be relevant to explain present underdevelopment.

The model in the following section uses the case of extractive colonial mining in order to provide an explanation for the emergence of informality, and the persistence of informality after independence. Section 3 analyzes historical evidence for the Antioquia region in terms of the model; section 4 presents empirical evidence for the persistence of informality in this region. Finally, section 5 concludes.

2 The Model

The colonizer and a continuum of individuals living in the colony are the players of the game. They are placed in an area with plenty of mineral resources. These resources can be present in different forms or types in nature, according to which mineral resources can be more easily accessed in an illegal way. Let γ ($0 \leq \gamma \leq 1$) be the extent to which resources are the type accessible for illegal individuals.

The colonizer and individuals in society play in two stages. In the first stage the colonizer chooses an expropriation rate, τ , and a level of public good investment, g . Any strategy chosen by the colonizer only affects the formal sector of the economy: The colonizer can only expropriate individuals in the formal sector and the public good only has an effect in the production of that sector. The public good may comprise subsistence means, such as agricultural goods and housing, and services or infrastructure like education, roads, technology, etc. In general, g improves living and working conditions and determines the degree of equality/inequality in the society.

I assume that only individuals identified in the formal sector can access these goods, either because this access depends on paying τ directly, or because only formal individuals work in places, where these goods are available (it is not possible to avoid τ working there). Under this assumption, a higher public good level translates into a higher productivity of the formal sector.

In the second stage, individuals decide every period whether to be formal or informal, and the share of informal individuals affects relative payoffs in the next period. I will assume that the colonizer sticks to his initial strategy throughout the game.

Even though payoffs in both sectors may differ at a given point in time, not all individuals will go to the most profitable sector, since there is persistent behavior along overlapping generations to some extent. Individuals live two periods; in the first period they are born and exposed to their network behavior (legal or illegal); in the second period they decide in which sector to be. A share $q(t)$ of all adult individuals will follow their former peers' behavior regardless of relative payoffs in both sectors, whereas the share $1 - q(t)$ will compare payoffs and follow economic incentives regardless of their peers.

$q(t)$ can be understood as the network effect on individuals' behavior. This network effect will be stronger the longer is the period in which the two sectors in society have built habits. That means that the share of individuals in a given sector that follow their peers is increasing over time ($q'(t) > 0$), whereas the share $1 - q(t)$ is decreasing over time.

2.1 Second stage

Individuals decide whether to be in the formal sector and pay τ , or to avoid τ and work on his own (be informal). Only a portion η of individuals is able to foresee the individual payoff in the informal sector in $t = 0$, when this sector does not exist and there are no established habits. After period $t = 1$, the portion of individuals that compare payoffs and behave according to economic incentives is given by $1 - q(t)$. Therefore, $q(t)$ and payoffs in both sectors determine the share of informal individuals in total population at a certain point in time. Denote it by Z .

Informal individuals can move their place of work so that they can find new mineral sources to exploit. Therefore, they always secure an individual profit as long as there are resources to be accessed in an illegal way ($\gamma > 0$).

Total output produced by the informal sector is given by:

$$I(Z) = \alpha\gamma \left[1 + (1 - Z)^{1-\gamma} \right] Z \quad (1)$$

where

$$\Pi_I = \frac{I(Z)}{Z} = \alpha\gamma \left[1 + (1 - Z)^{1-\gamma} \right] \quad (2)$$

is the individual payoff for an informal miner.

Note that increasing the number of informal individuals does not decrease their individual payoff if $\gamma = 1$, as there are unlimited resources for the informal sector; thus, Π_I is constant (independent from Z) and equal to 2α . For γ between zero and one, informal individuals compete among each

other for these resources and so the maximum individual profit ($\Pi_I = 2\alpha\gamma$) is given at the time $Z = 0$.

Informal individuals work on their own in an undetectable way and, therefore, there are no positive synergies among them. On the contrary, positive synergies exist in the formal sector. Formal workers are tied to a given mine and work together with other formal miners. Their productivity increases with their number, given a big size of mines and the need of division of labor.

Total output produced by the formal sector is given by:

$$F(g, Z) = \beta(g)[1 - Z]^\theta \quad (3)$$

where $\theta > 1$ and $\beta(g) (> 0)$ denotes the productivity in the formal sector that is derived from the public good; in particular, $\beta'(g) > 0$ and $\beta''(g) < 0$. Note that the extent to which resources are accessible for informal individuals (γ) does not affect production in the formal sector, except for the fact that individuals can move to the informal sector.

Individual payoff in the formal sector is thus:

$$\Pi_F = \frac{[1 - \tau]F(g, Z)}{1 - Z} = \frac{[1 - \tau]\beta(g)[1 - Z]^\theta}{1 - Z} = [1 - \tau]\beta(g)[1 - Z]^{\theta-1} \quad (4)$$

Π_F is increasing in g and decreasing in τ and Z .

The change in Z over time is then given by:

$$Z_{t+1} - Z_t = \begin{cases} \eta & \text{if } \Pi_I > \Pi_F \text{ and } t = 0 \\ (1 - q(t))(1 - Z_t) & \text{if } \Pi_I > \Pi_F \text{ and } t \geq 1 \\ 0 & \text{if } \Pi_I = \Pi_F \\ -(1 - q(t))Z_t & \text{if } \Pi_I < \Pi_F \end{cases} \quad (5)$$

Finally, the colonizer payoff is as follows:

$$\Pi_c = \tau F(g, Z) - g = \tau\beta(g)[1 - Z]^\theta - g \quad (6)$$

Taking α , γ and θ as given, relative payoffs depend on the level of g and τ , that is, on the strategy chosen by the colonizer. An extractive strategy would be characterized by high levels of τ and low levels of g . In order to allow for a graphical comparison, the following figure only considers variation in g .

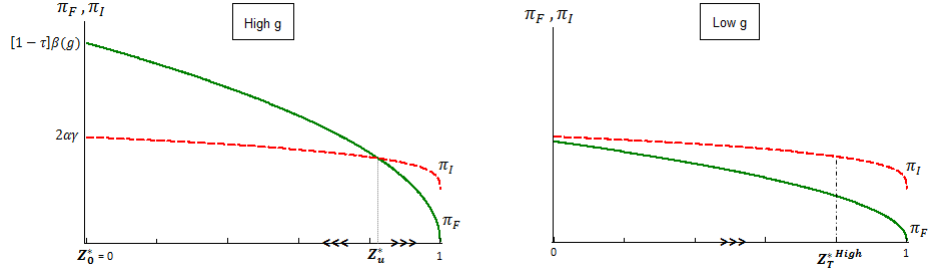


Figure 1: Equilibria depending on the level of g (τ and γ fixed)
 $[\tau = 0.2, \gamma = 0.7, \theta = 1.5, \beta(g) > \alpha \forall g]$

For a sufficiently high level of g , $\Pi_F > \Pi_I \forall Z < Z_u^*$, where Z_u^* is an unstable equilibrium. Given $Z = 0$ in $t = 0$, it is more profitable to be in the formal sector at that point and the economy stays in the stable equilibrium $Z_0^* = 0$.

For a sufficiently low public good, $\Pi_F < \Pi_I \forall Z$. Let T be the period such that $q(t) = 1 \forall t \geq T$; thus, according to (5), the economy converges to Z_T^{*High} ($0 < Z_T^{*High} < 1$), which is a stable equilibrium.

Places subject to the same colonial strategy and production functions can face different informality levels in equilibrium. This is because resources available for the informal sector may differ across areas with diverse geographical characteristics. In other words, the economy can converge to Z_0^* or to Z_T^{*High} depending on γ .

As it is shown in Figure 2, Z_0^* can be always achieved with a sufficiently high level of public good or a sufficiently low γ .

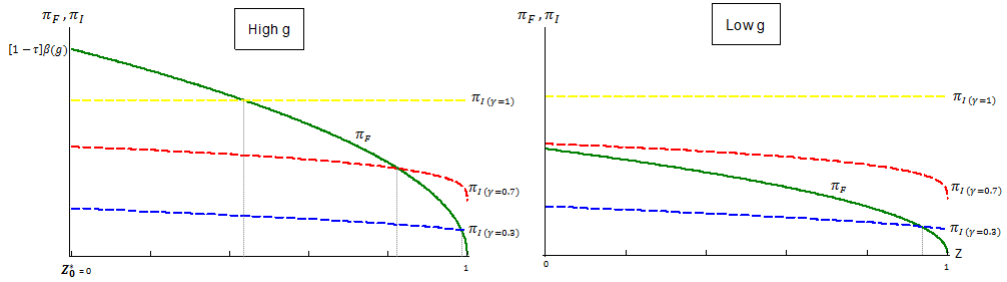


Figure 2: Varying the level of g and γ (τ fixed)
 $[\tau = 0.2, \theta = 1.5, \beta(g) > \alpha \forall g]$

2.2 First stage

In the first stage, the colony can face either a far-sighted or a short-sighted colonizer. The far-sighted colonizer realizes that public goods provision increases productivity in the mining industry and is thus beneficial for his own revenues. Alternatively, the short-sighted colonizer considers the public good a cost that is only necessary in a small quantity in order to set up production, but does not affect production afterwards.

The far-sighted type maximizes:

$$\Pi_c^{fs} = \tau\beta(g)[1 - Z(\tau, \gamma)]^\theta - g \quad (7)$$

First order conditions⁷ for τ and g imply:

$$\tau^* = \frac{1 - Z(\tau, \gamma)}{Z'_\tau \theta} \quad (8)$$

and

$$\beta'(g^*) = \frac{1}{\tau^*[1 - Z(\tau, \gamma)]^\theta} \quad (9)$$

τ^* is decreasing in Z and Z'_τ , which is the expected response of Z by the colonizer to a marginal increase in τ . On the other hand, a higher τ^* chosen by the colonizer should go along with a higher g^* , as $\beta'(g)$ is decreasing with g ($\beta''(g) < 0$).

The short-sighted colonizer maximizes:

$$\Pi_c^{ss} = \tau\beta[1 - Z(\tau, \gamma)]^\theta - g \quad (10)$$

where his underlying production function for the formal sector is given by:

$$\delta(g) = \begin{cases} 0 & \text{if } g < g_{min} \\ \beta[1 - Z(\tau, \gamma)]^\theta & \text{if } g \geq g_{min} \end{cases} \quad (11)$$

This production function can be considered a rational choice by a colonizer if resources to be extracted are generously and visibly provided by nature and labor can be forced in order to extract these resources (if there is no need to attract labor).

foc for τ leads to the same optimal τ^* in (8), whereas the optimal level for g is g_{min} , given that Π_c^{ss} is a strictly decreasing function in g .

In sum, the choice of τ is the same across colonizer types and it will be the highest at the time of entry in the colony, when $Z = 0$ is assumed (if the informal sector starts growing, $Z > 0$ would play a role if we allow the colonizer to adjust his strategy). However, the choice of g will be different: The far-sighted type will choose a high level of g consistent with τ^* at $t = 0$;

⁷Second order conditions guarantee that τ^* and g^* are maximizing values.

the short-sighted type will choose the lowest possible g from the beginning and throughout the colonial period. As a consequence, the colony is more likely (depending on γ) on the way to a high informality equilibrium, Z_T^{*High} , with a short-sighted colonizer.

Note that both the short-sighted and far-sighted type will choose a lower expropriation rate if resources are easier accessible by illegal individuals in the colony, as the latter may translate into a higher observed Z and/or a higher response of Z to a marginal increase in τ . Considering τ as the ability of local states to tax people, we could then expect the formation of weaker states in places with a higher γ .

2.3 Independence and equilibrium after independence

Note that the short-sighted colonizer is more likely to lose interest in the colony at some point. For any sufficiently high γ , Z is in the growing path. If the colonizer sticks to his initial strategy, Π_c will approach zero over time (for some Z critical level, Z_k , the colonizer's payoff will be zero: $\tau F(g, Z) \leq g$ for $Z \geq Z_k$); if we allow the colonizer to adjust his strategy, he would have to reduce τ^* until Z stops growing. Moreover, if Z is large enough by the time the colonizer changes his strategy, any feasible reduction in τ for the colonizer would not yield a reversion in the path for Z at that point.

This decline in the colony's profitability (hence the loss of interest in the colony), combined with an increasing fraction of the population out of the colonizer's control, may be an explanation for the occurrence of an independence movement.

Possible equilibria after independence depend on payoff functions with $\tau = 0$, the size of Z at the end of the colonial period and the time elapsed, which determines $q(t)$ or the strength of the network effect.

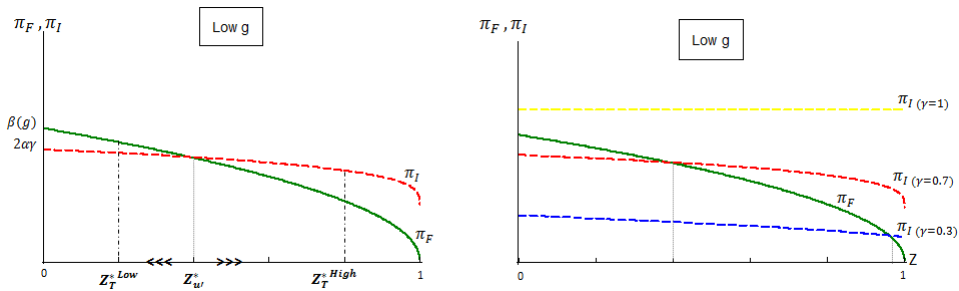


Figure 3: Equilibria after independence with a low g
 $[\tau = 0, \theta = 1.5, \beta(g) > \alpha \forall g]$

In the case of a low public good⁸, Π_F turns bigger than Π_I for any

⁸For a sufficiently high g already during colonization, the economy will stay in the

level of $Z < Z_{u'}^*$. If habits are weak at such Z level (if t is small), Z will be significantly reduced to a Z_T^{*Low} equilibrium, as a high share of individuals will observe relative payoffs and hence will move to the formal sector. However, Z_T^{*Low} will be very close to the initial Z after independence if strong habits have been established. On the other hand, the economy will continue its path to Z_T^{*High} if the informal sector is already big ($Z > Z_{u'}^*$).

3 An explanation for the case of colonial gold mining in Antioquia-Colombia

I argue that the model can explain the emergence of informality and its persistence due to colonial extractive activities in the past and the possibility to access resources in an illegal way. In the following, I will show how the model and its predictions can be supported by historical evidence for Antioquia.

3.1 Historical evidence for the emergence of informality

Model predictions are four: An extractive strategy by the colonizer causes the appearance of an informal sector where the portion of resources that could be accessed in an illegal way is sufficiently high; given the persistence of such strategy, the share of individuals in the informal sector is increasing over time until a stable high informality equilibrium; little changes towards a less extractive strategy (lower τ and/or higher g) will not reverse the path of a growing informality, if the informal sector is already big enough; if this change in the colonizer's strategy happens at a sufficiently low level of the informal sector, the size of this sector could only be partially reduced depending on the strength of the network effect. These predictions are based on the following assumptions: 1) The colonizer can only expropriate individuals in the formal sector; 2) Informal individuals can always secure an individual profit if resources are accesible for them to some extent; 3) there are increasing returns to scale in labor in the formal sector; 4) public goods provision positively affects the production of the formal sector; 5) the share of individuals following their peers' behavior is increasing over time.

Evidence of an informal sector and its growth. Historical evidence points out the existence of informal miners and their increasing number at the end of the 18th century in Antioquia, where these miners were characterized by escaping the colonial control and evading gold taxes. Informal miners replaced the weakened on-site formal mining to a large extent: Formal mining, mainly based on slave work, was producing in the second half of the 18th century about only one third of all gold (Poveda, 1981), and towards

stable equilibrium Z_0^* .

1851, around 80% of all workers in the mining industry were free informal miners. For this reason, the abolition of slavery in the Nueva Granada in that year did not have a big impact in gold production (Restrepo, 1888).⁹

In the presence of informality, gold could not be completely located in its production phase, but it was more likely found in its circulation, that is, in trade. Table 1 shows a decline over time, between 1670 and 1800, in the share of molten gold by miners relative to that share for merchants. This behavior indicates a decline in the miners' contributions, as taxes were paid at the time of melting, thereby suggesting the existence of illegal mining before the 18th century. Traders received gold dust from transactions with miners and then had to convert this gold into currency for further trading goods (Poveda, 1981). This amount of gold dust was not necessarily equivalent to the amount of gold not molten by miners; it was equivalent to what they changed with merchants, that was not used by the latter in smuggling trade.¹⁰

It is worth noting that illegality was already a concern for the colonial power in 1678, consistent with the picture shown in Table 1. An official communication signed in Madrid in that year established the reduction in colonial gold taxes in the whole territory of Nueva Granada. This was done provided the need to effectively set back the “deeply rooted crime of not taxing gold ”(cited by Restrepo (1888), p.220).

Extractive strategy and the emergence of informality. Alvarez and Uribe (1985) claim that informal mining emerged in order to avoid the high fiscal burden and lack of subsistence means that characterized districts with big-mining enterprises. Mining districts did not properly develop other economic sectors and thus the amount of agricultural goods demanded by the labor force was not in place (Colmenares, 1989; Poveda, 1981; Restrepo, 1888). It is even argued that no other industry, except for gold mining, was developed in Colombia during three centuries of Spanish colonization (Alvarez, 1900). This is sign for the purely extractive aims of the colonial power, which saw gold as the unique goal and disregard the promotion of agriculture and trade for most of the colonial period.¹¹

Colonial fiscal burden was supported by enterprises that were legally identified by the colonial offices that looked after tax collection - *Cajas Reales*. These enterprises were identified due to their visible geographical

⁹The abolition of slavery in Antioquia was in 1813.

¹⁰Merchants were required to pay a gold tax since 1695. Although they were more likely forced to stay in the formal sector due to their need of currency, Alvarez and Uribe (1985) also show evidence of illegality in trade; that is, of smuggling by changing gold dust for unregistered foreign goods.

¹¹There are signs of a more illustrated Spain at the end of the 18th century. Agriculture and trade were acknowledged as important complementary activities for the mining industry and therefore started to be promoted (González, 1983).

presence and had to give 20% of their total output to the colonial power, tax called *quinto real*. Low returns given a high fiscal burden, and the difficulties to sustain miners' crews are considered two of the main causes of the big-mining enterprise crisis (Alvarez and Uribe, 1985). However, the lack of appropriate technologies, in particular, those needed for vein mines, is also important to explain a low productivity in the formal sector (Alvarez, 1900; Poveda, 1981; Restrepo, 1888). This is additional evidence of an extractive strategy by the colonizer, by which mineral resources should be obtained at very low investments levels. The crisis of big-mining companies may have not only increased relative returns of other activities, but as Alvarez and Uribe (1985) indicate, it released labor force suitable for mining.

In sum, the historical evidence suggests a causal link between an extractive strategy (high fiscal burden plus lack of subsistence means and technology) and the emergence of informality, through the channel of impoverishing the formal sector.

Informal miners' characteristics: Why could they not be expropriated and their constant productivity. Informal miners were not hired by anyone and not tied to any specific place. They were nomads and they could always move to places with an easy access to gold. They extracted gold from rivers and, in particular, they used to look for dry rivers, which were easier to exploit (Poveda, 1981; Restrepo, 1888). This mobility allowed them to obtain as much gold as they could and not compete for gold sources with other miners. This supports assumption 2). That informal miners were able to move whenever a mine became difficult to exploit also explains the fact that these miners mostly worked on their own, if not, with a small group of slaves¹² taken away from legal mines (Poveda, 1981). This implies the almost absence of division of labor, which also supports the idea that an increasing number of informal individuals did not increase their productivity.

Informal miners had lower production costs and lower investments than those in the formal sector. They did not inform any authority about their work and did not typically buy lands; therefore, they were also called invasive miners. Furthermore, they could have adequate access to subsistence goods, as they were few at a given place.¹³ These features are considered in the literature as explanations for a higher efficiency of informal miners relative to men working for big enterprises (Alvarez and Uribe, 1985).

Since informal miners were highly mobile, did not have any lasting place

¹²The type of relationship between slaves and free men was different in the informal sector. Free-men informal miners were often mulattos and their work, as well as their families', was as important as that of slaves. Slaves could also participate from gold output (Poveda, 1981).

¹³Informal miners either produced goods for themselves or individual merchants went with goods to their place of work (Poveda, 1981).

of work and did not display identifiable factors of production for tax collectors (e.g. big crew of slaves), they could not be taxed, nor restrained by the colonial power (Alvarez and Uribe, 1985). This supports assumption 1).

Increasing returns to scale in formal labor and the influence of public goods. Formal miners worked in mines with a fixed and long-lasting geographical location, hence identified by the colonial power. They were tied to a given place, where big mines, either alluvial or vein mines, were exploited. Given the mines' big size, a large labor force was required (mainly crews of slaves were used in those districts) and division of labor was high (Poveda, 1981; Restrepo, 1888). This supports assumption 3), since miners' efficiency to exploit those big mines was in general increasing with their number. The need of labor became even more critical to the extent that mines were exploited over time, since minerals turned more difficult to extract, provided a constant basic technology. This was in particular the case for vein mines (Poveda, 1981; Restrepo, 1888).

In this context, an adequate level of public goods would have a positive impact on the formal sector productivity, since more labor could be attracted and maintained, and technology would allow a more efficient and lasting exploitation of mines. This corresponds to the counterfactual of a non-extractive strategy in Antioquia, and it is consistent with assumption 4). On the other hand, informal sector productivity would not have been affected by public goods provision. Informal miners would not easily access these goods if they wanted to be out of reach of colonial authorities. Even if they could access these goods to some extent, their productivity did not depend on their number (the informal sector did not need to attract labor and sustain big miners crews in a given place) and their work did not imply large investments.

In the Antioquia case, public goods provision was insufficient. As pointed before, agriculture and trade were not properly developed during most of the colonial period and, hence, there was lack of subsistence means relative to the size of the labor force. Since individuals were mainly forced to work, there was no incentive to attract workers with better services or welfare conditions; yet, given insufficient living conditions, part of the labor force died or escaped mines (Colmenares, 1989). Investments needed for production, such as technology, were also low or inexistent. Mines were still exploited with techniques learned from the indigenous people and with the most rudimentary instruments. The colonial power neglected the construction of roads and the establishment of river transportation means, which also prevented the entry of machines necessary for the exploitation of mines. As a result, the lack of appropriate technologies caused the desertion of many vein mines (Alvarez, 1900; Colmenares, 1989; Poveda, 2002; Restrepo, 1888).

3.2 Evidence for the long run equilibrium

The model predicts a high informality equilibrium in the long run, given an initial extractive strategy in places where resources could be easily exploited in an illegal way. This should be the Antioquia case. It is important to consider that the colonizer's strategy in Colombia was not static over time. Historical evidence reports adjustments in colonial gold taxes since the late 17th century and the promotion of other economic sectors, complementary for gold mining, at the end of the 18th century. This would translate into a reduction in τ and an increase in g in terms of the model. Still, the model predicts that little changes in τ and g do not reverse the path of a growing informality, if the informal sector is already sufficiently big. In fact, there is no evidence in Antioquia of a reversion in informality during the colonial period, nor after independence. It is estimated that 60% of all gold production was informal in the second half of the 18th century (Poveda, 1981), this share was likely higher few decades after independence, when about 80% of all miners were informal (Restrepo, 1888), and the present is not different from two centuries ago: Giraldo and Muñoz (2012) find that about 80% of gold production in 2011 comes from illegal enterprises in Antioquia.

Considering Colombian mining industry as a whole, it has been also characterized by informality. Partial results from a mines' census in 2011 indicate that 63% of all identified mines are informal; in particular for Antioquia, this number rises to 79,1%.¹⁴ These high levels of informality, especially in the gold sector, have implications beyond tax evasion and inferior job quality: Whereas some informal enterprises are run by 'artisan' miners, some other have become a financing source for illegal armed groups, either because these groups demand an output quota from existing informal miners (Giraldo and Muñoz, 2012) or because they exploit labor directly (Ronderos, 2011). Giraldo and Muñoz (2012) note that illegal gold mining is related with land property informality and bad fiscal performance of local governments.

Informality in Antioquia is not only present in the mining industry. The functioning of other natural resource-based sectors, such as wood, displays clear deviations from legal regulations (Giraldo and Muñoz, 2012). Considering all economic sectors, informality in the labor market is of important magnitude, and measures of such informality will be used as outcome variables in the following section.

¹⁴These results are partial since only around 50% of all municipalities have been examined by the census. This census is carried out by the Colombian Ministry of Mines and Energy.

4 Empirical evidence for the persistence of informality

In the following, I present suggestive empirical evidence for a persistent link between colonial informal mining and current informality levels in Antioquia. As historical evidence points out, informal or illegal miners worked in alluvial mines, rather than vein mines, given their ease for being exploited. Hence, the availability of alluvial mines in an area can be considered a necessary condition for the emergence of informality in the past. I will then use an intention-to-treat approach, taking variation in the number of colonial alluvial mines across municipalities, as variation for intensity assignment in the colonial informality treatment. Note that the Antioquia case allows variation in the possibility to become informal in the past (or variation in γ in the model in section 2), while having a constant colonizer's strategy across areas, namely, an extractive strategy.

The number of alluvial mines before independence comes from historical mines records in the Antioquia region at the municipality level during 1739-1810 (72 years before independence). Although registered mines were clearly not those exploited in an illegal way, they provide the only hint of an area's gold richness and the way this richness was available, if in rivers or mountains.

The treatment may proxy the size of colonizers' settlements, since it is correlated with total mines in each area. Therefore, the baseline model below includes total number of mines in the same period (1739-1810) at the municipality level. In this way, the number of alluvial mines, conditional on the total number of gold mines, is not likely capturing the overall effect of a colonizer settlement on current informality, but the effect of extractive colonization that goes through the possibility of being informal in the past.

The baseline model is given by:

$$I_{ij} = \alpha + \beta allu_m_j + \gamma total_m_j + W'_{ij}\theta + X'_j\varphi + U_{ij} \quad (12)$$

where index i denotes individuals and index j refers to the corresponding municipality for individual i . I is a current informality/formality outcome, namely, if a child is working or looking for a job (*childl*), affiliation to a health system (*health*) or having a formal contract (*contract*) among the employed population. *allu_m* is total number of alluvial mines during 1739-1810, *total_m* is total number of gold mines in the same period, W is a vector of individual controls and X is a vector of current socio-economic variables at the municipality level.

4.1 Data description

Data on the number of mines and their type come from a historical mines catalogue for the Antioquia region, which was developed by Mesa (1906),

and includes titled mines between 1739 and 1900.

Informality outcome variables come from the 2006 Colombian household survey -*Encuesta Continua de Hogares*- performed by the Colombian national statistics department, DANE. This survey contains a representative sample of individuals in Antioquia (49298 in 41 municipalities). Individual control variables also come from this survey, and they comprise *gender*, as well as *urban*, *married* and *literate* status.

Current socio-economic variables at the municipality level come from the latest Colombian census in 2005 and they are: population size (*population*), share of immigrants from other municipalities (*immig*), employment rate (*employment*), mean schooling years (*schooling*), share of the population in the agriculture sector (*agric*), share of the population in the mining sector (*s_mining*) and share of individuals belonging to an ethnic group (*ethnic*).

Descriptive statistics of all variables are shown in Table 2. A treatment status is defined for the purposes of this table, where treated municipalities are those with a positive number of alluvial mines in the colonial period 1739-1810. According to a mean comparison test, municipalities are quite homogeneous between treatment and control group (municipalities with no colonial alluvial mines) in terms of all current socio-economic characteristics from the census, and individual characteristics from the survey. Only the availability of mines is significantly different: treated municipalities have on average more mines before and after independence (until 1900).

4.2 Results

First column in tables 3, 4 and 5 show OLS estimates for the baseline model with *contract*, *childl* and *health* as dependent variables, respectively.¹⁵ Results indicate that a larger treatment is significantly related to a lower probability of having a formal contract if employed, and to a higher probability that a child works. One standard deviation increase in the number of colonial alluvial mines is associated with a 16 percentage points decrease in the probability of having a formal contract, and with a 9 percentage points increase in the probability that a child works. The coefficient for *allu_m* has also the expected sign at explaining the probability of affiliation to a health system if employed, but it is not statistically different from zero.

Interestingly, total number of colonial mines is positively associated with the probability of having a formal contract and being affiliated to a health system if employed, as well as with a lower probability of child labor.

¹⁵Tables A1, A2 and A3 in the Appendix provide probit estimates for the baseline model as well as for robustness checks specifications.

4.2.1 Robustness checks

Results above indicate there is a significant link between alluvial mines in the colonial period and current informality outcomes. This can be suggestive evidence for the persistence of informality since colonial times; however, this evidence would be also consistent with the idea that alluvial mines provide in general favorable conditions for informality. In particular, in today's developing countries, low quality institutions and other underdevelopment features may allow the emergence of informality in places where current alluvial mines are available. According to the literature, current gold production in Colombia from colonial gold deposits can be considered insignificant as these deposits are now empty (Acemoglu et al. (2012)); nevertheless, there may be still the concern that current alluvial mines are correlated with the treatment. In order to rule out that the treatment is capturing the effect of modern alluvial mines on informality, column (2) in tables 3, 4 and 5 includes number of alluvial mines (*allu_after*) and number of total mines (*total_after*) during the next 90 years after independence (1811-1900)¹⁶ in each municipality. Besides, note that one of the control covariates is already capturing the effect of the current mining sector size, in terms of the population share employed in this sector.

If informality emerged in the colonial period and has persisted since then, variation in the number of colonial alluvial mines should still explain variation in informality today, after controlling for alluvial and total mines after independence. Results show that it is not a general effect of alluvial mines the one driving current informality outcomes; only colonial alluvial mines are related to these outcomes.

A larger size of the mining sector in the present is significantly related to a lower probability of having a formal contract or being affiliated to a health system if employed, and this result remains also equal from the baseline model. It is important to note that this variable is likely a channel through which persistent colonial informality can explain informality today: if mining was the main economic activity during the colonial period in a given area, and informality could emerged in this sector, the sector's growth or its relative bigger size today may be the product of a growing or persistent share of informal individuals. However, estimates indicate that current informality outcomes are not an exclusive mining sector matter. The treatment is still significant, even after controlling for this possible channel.

Given a significant link between the treatment and current child labor, it is relevant to determine if a lower probability of having a formal contract or being affiliated to a health system if employed are just the outcome of

¹⁶Independence battles started around 1811 and Antioquia was self-declared independent in 1813, as many other Colombian regions, although definitive independence of Colombia was achieved in 1819. I take 1810 as the independence threshold in order to have a more conservative measure of colonial mines.

more children working. Therefore, I consider individuals older than 17 years in column (3) of tables 3 and 5. Coefficients are equally significant and of similar magnitude as before.

Finally, in column (4) of tables 3 and 5, and column (3) of Table 4, I include a fixed effect for municipalities that had once colonial gold mining (*colonial*). These municipalities may share many unobserved characteristics that make them different from municipalities with no mining industry in the colonial period; such characteristics are captured by the fixed effect and the estimated treatment effect should better reflect the influence of the possibility to become informal in the past. Estimates for this specification confirm previous results for the *contract* dependent variable, while the treatment is no longer significant to explain child labor. On the other hand, a larger number of colonial alluvial mines is now significantly associated with a lower probability of being affiliated to a health system if employed. The *colonial* dummy, in turn, is significant and positively related to this probability.

5 Discussion and Conclusion

This paper argues that extractive colonial activities in the past can explain the emergence and persistence of informality, and thereby, underdevelopment path dependence. I develop a theoretical model, which predicts the emergence and persistence of informality due to a colonizer extractive strategy and the availability of resources to be owned. I show how the model and its predictions are supported by historical qualitative evidence, considering the case of Antioquia, large gold producer under Spanish colonial rule, now a Colombian department. Finally, I provide empirical evidence for a persistent link between colonial informal mining and current informality levels within Antioquia.

The emergence of illegality and informality as a consequence of extractive activities is interesting in the light of the Economics literature, as these activities might not only set conditions for institutions that deny property rights to the common people, but also give incentives to enforce property rights out of the law. In particular, extractive activities in the past might have not only caused underdevelopment through persistent bad institutions, but through a persistent gap between de jure and de facto institutions. This study looks at the case of colonial extractive activities; however, incentives to become informal considered in this paper may be also relevant for other events in history or in the present involving extractive states.

Informality or illegality may be understood as a reaction to overcome the negative effects of extractive institutions, that is, as a reaction to avoid expropriation and achieve equal rights. However, informality and illegality are detrimental for economic development, as they may be related with criminal (unproductive) activities, create uncertainty in markets, and under-

mine public goods provision, among other consequences. Furthermore, they are likely responsible for a vicious circle: Public goods cannot be funded if there is a large informal sector, whereas the lack of public goods provision reduces relative gains of staying in the formal sector. In this way a high-informality/underdevelopment equilibrium remains stable.

The latter means that long run implications of an early informality are not clear among former colonies affected by a colonial extractive strategy. In other words, informality may have had an effect on economic growth that has changed over time.

The literature notes that informal miners gave gold mining the character of an egalitarian and popular activity in Antioquia during the colonial period. This significantly pushed the independence movement, in particular due to former slaves' support (Poveda, 1981). More important, however, is the higher development potential that the region may have achieved, provided that all individuals could participate from the gains of gold mining.

The following factors mentioned by the literature give supportive evidence for social mobility in Antioquia. Whereas slavery was abolished in 1813 in this region (38 years before than in the whole country), there were already registered volunteer liberations of slaves since the end of the 18th century, despite those liberations being considered 'subversive' by colonial authorities (Poveda, 1981). The fight for political power between Spanish and creole¹⁷ had a lower intensity in Antioquia than in other regions given the deeper economic and parental linkages between these groups, and thus more clear common interests. Creole people became a majority in the Medellín administrative council -*cabildo*- since 1789¹⁸, and policies applied by this council reflected prevalent miners' interests, even going against the colonial law. The illegal regulation of prices in the benefit of miners is one example of such permeability in the functioning of institutions. It is also known that there was no penalty applied by local justice when merchants openly refused to pay gold taxes between 1786 and 1803 (Alvarez and Uribe, 1985).

The consequences of early informality may have been then twofold. On the one hand, social mobility, which was an outcome of neglecting colonial law, might have set up a higher development potential. On the other hand, neglecting the law may have become a persistent feature of de facto institutions, which is now detrimental for economic growth and welfare.

Arguments presented in this paper have a main policy implication: Incentives have to be built and maintained for individuals to stay in the formal sector. Public goods, in particular goods or services that can be made 'public' only for the formal sector (legal services, advising/consulting services, R&D, infrastructure, among others) allow the perception of a relative benefit

¹⁷Spanish descendants born in the colony.

¹⁸Twinam (1985), cited by Alvarez and Uribe (1985), p. 75.

of being formal. If benefits are not clear, but taxes are, informality becomes an attractive option. In this sense, a more concerning scenario is that of a corrupt state: there may be not only the perception of insufficient public goods and hence no gains of staying in the formal sector, but the perception of expropriation. Thereby, modern democracies with high corruption levels can still come close to the role of extractive states.

References

- Acemoglu, D. (1995). Reward structures and the allocation of talent. *European Economic Review*, 39(1), 17-33.
- Acemoglu, Daron, Camilo Garca-Jimeno, and James A Robinson (2012). Finding El Dorado: Slavery and Long-Run Development in Colombia. *Journal of Comparative Economics* 40, no. 4: 534-564.
- Acemoglu, D., Johnson, S., and Robinson, J. (2002). Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution. *Quarterly Journal of Economics*, 117(4):1231-1294.
- Alvarez, E. (1900). *Las Minas de Oro de Colombia*. Paris. Available in Banco de la República virtual library: <http://www.banrepcultural.org/blaavirtual/geologia/las-minas-de-oro-de-colombia>
- Alvarez, J.M., Uribe, M.T. (1985). Minería, comercio y sociedad en Antioquia 1760-1800. *Lecturas de Economía*. No. 18. Medellín, p. 53-113.
- Baumol, W.J. (1990). Entrepreneurship: Productive, unproductive, and destructive. *Journal of Political Economy*. 98(5), 893-921.
- Colmenares, G. (1989). La economía y la sociedad coloniales 1550-1800. *Nueva Historia de Colombia*, 1, 117-152.
- Fukuyama, F. (1996). *Trust: The Social Virtues and the Creation of Prosperity*, Free Press.
- Giraldo, J., Muñoz, J.C. (2012). Informalidad e ilegalidad en la explotación del oro y la madera en Antioquia. Universidad EAFIT. 197 p.
- González, M. (1983). La política económica virreinal en el Nuevo Reino de Granada: 1750-1810. *Anuario Colombiano de Historia Social y de la Cultura*. Vol.11.
- Knack, S. (2002). Social Capital and the Quality of Government: Evidence from the States. *American Journal of Political Science*, pp. 772-785.
- Mejía, J. (2012). Crecimiento económico de largo plazo en Antioquia, Colombia: Estimación del PIB. 1800-1913.
- Mesa, J. M. (1906). *Minas de Antioquia*. Catálogo de las que se han titulado en 161 años, desde 1739 hasta 1900 con anotaciones ilustrativas. Medellín. Imprenta oficial.

Nunn, N. (2007). Historical legacies: A model linking Africa's past to its current underdevelopment. *Journal of Development Economics*, 83(1), 157-175.

Poveda, G. (1981). *Minas y mineros de Antioquia*. Departamento editorial del Banco de la República.

Putnam, R., Leonardi, R., and Nanetti, R.Y. (1993). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton University press, Princeton, NJ.

Restrepo, V (1888). *Estudio sobre las minas de oro y plata de Colombia*. Bogotá: Imprenta de Silvestre. Biblioteca virtual Luis Angel Arango. Banco de la República.

Ronderos, M.T. (2011). La fiebre minera se apoderó de Colombia. *Semana* magazin: <http://www.semana.com/nacion/articulo/la-fiebre-minera-apodero-colombia/246055-3>.

Tabellini, G. (2010). Culture and Institutions: Economic Development in the Regions of Europe. *Journal of the European Economic Association*, 8(4):677-716.

Twinam, A. (1985). *Mineros, comerciantes y labradores: las raíces del espíritu empresarial en Antioquia. 1763-1810*. Medellín; Fondo Rotatorio de publicaciones FAES.

Figures and Tables

Table 1. Antioquia. Share of molten gold by miners and traders by decades, 1670 -1800.

Decade	Miners share in molten gold	Traders share in molten gold
1670	46,9%	53,1%
1680	24,0%	76,0%
1690	27,4%	72,6%
1700	10,9%	89,1%
1710	40,3%	59,7%
1720	19,4%	80,6%
1730	20,6%	79,4%
1740	14,5%	85,5%
1750	31,6%	68,4%
1760	3,0%	97,0%
1770	0,4%	99,6%
1780	5,7%	94,3%
1790	4,2%	95,8%
1800	10,2%	89,8%

Source: Twinam (1985), Table 3, p.70.

Table 2. Descriptive statistics

	<i>allu_m</i> = 0			<i>allu_m</i> > 0			Total sample		
	N	mean	sd	N	mean	sd	N	mean	sd
<i>health</i>	16	0,847	0,080	12	0,851	0,094	28	0,848	0,085
<i>contract</i>	26	0,231	0,181	15	0,303	0,193	41	0,257	0,186
<i>childl</i>	26	0,160	0,120	15	0,106	0,081	41	0,140	0,109
<i>urban</i>	26	0,561	0,256	15	0,649	0,244	41	0,593	0,252
<i>married</i>	26	0,364	0,053	15	0,343	0,039	41	0,356	0,049
<i>gender</i>	26	0,526	0,049	15	0,530	0,027	41	0,528	0,042
<i>literate</i>	26	0,879	0,060	15	0,886	0,088	41	0,882	0,071
<i>allu_m</i> ***	26	0	0	15	4,067	4,026	41	1,488	3,099
<i>total_m</i> ***	26	0,462	1,581	15	13,133	12,648	41	5,098	9,785
<i>allu_after</i> ***	26	7	16,388	15	48,667	52,019	41	22,244	39,087
<i>total_after</i> ***	26	31,423	58,209	15	125,600	132,606	41	65,878	101,889
<i>colonial</i> ***	26	0,192	0,402	15	1	0	41	0,488	0,506
<i>schooling</i>	26	4,573	1,151	15	5,159	1,752	41	4,787	1,409
<i>employment</i>	26	0,956	0,031	15	0,960	0,018	41	0,957	0,026
<i>population</i>	26	57184	82863	15	190595	563084	41	105993	345682
<i>immig</i>	26	0,393	0,166	15	0,397	0,184	41	0,394	0,170
<i>ethnic</i>	26	0,160	0,203	15	0,111	0,174	41	0,142	0,192
<i>s_mining</i>	14	0,001	0,001	7	0,001	0,001	21	0,001	0,001
<i>agric</i>	20	0,087	0,064	12	0,083	0,085	32	0,086	0,071

Notes: Municipalities are divided into treatment and control group, according to the availability of alluvial mines in the colonial period 1739-1810. ***Difference in means between treated and control municipalities is statistically significant at the 1% level.

Table 3. OLS regressions for having a formal contract among employed individuals

Dependent variable: Having a formal contract among employed individuals				
	(1)	(2)	(3)	(4)
<i>allu_m</i>	-0,0531** (0,0202)	-0,0542** (0,0217)	-0,0479** (0,0221)	-0,0503** (0,0230)
<i>total_m</i>	0,0261*** (0,0076)	0,0284*** (0,0080)	0,0269*** (0,0082)	0,0282*** (0,0083)
<i>s_mining</i>	-41,7293* (20,2743)	-36,7446* (17,8117)	-36,3416* (18,8353)	-34,7344* (17,4695)
<i>allu_after</i>		-0,0017 (0,0011)	-0,0018 (0,0011)	-0,0010 (0,0012)
<i>total_after</i>		0,0005 (0,0004)	0,0005 (0,0004)	0,0004 (0,0004)
<i>colonial</i>				-0,0528 (0,0815)
	All	All	Age>17	All
Obs	16135	16135	15831	16135

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector.***Statistically significant at the 1% level. **Statistically significant at the 5% level. *Statistically significant at the 10% level.

Table 4. OLS regressions for child labor among children (age<18)

Dependent variable: Child working or looking for a job			
	(1)	(2)	(3)
<i>allu_m</i>	0,0306** (0,0119)	0,0242* (0,0140)	0,0274 (0,0165)
<i>total_m</i>	-0,0097** (0,0043)	-0,0089* (0,0046)	-0,0093* (0,0048)
<i>s_mining</i>	9,0601 (9,1665)	5,9773 (9,1198)	7,2569 (8,4060)
<i>allu_after</i>		0,0013 (0,0011)	0,0018 (0,0017)
<i>total_after</i>		-0,0006 (0,0005)	-0,0007 (0,0005)
<i>colonial</i>			-0,0319 (0,0662)
Obs	4639	4639	4639

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector.**Statistically significant at the 5% level. *Statistically significant at the 10% level.

Table 5. OLS regressions for health system affiliation among employed individuals

Dependent variable: Health system affiliation among employed individuals				
	(1)	(2)	(3)	(4)
<i>allu_m</i>	-0,0360 (0,0269)	-0,0298 (0,0273)	-0,026 (0,0306)	-0,081** (0,0305)
<i>total_m</i>	0,0190* (0,0093)	0,018* (0,0085)	0,0174* (0,0094)	0,0283*** (0,0086)
<i>s_mining</i>	-21,8726** (8,9198)	-21,7151* (10,3979)	-21,4429* (10,7212)	-42,9830*** (13,6934)
<i>allu_after</i>		-0,001 (0,0014)	-0,0017 (0,0016)	-0,0016 (0,0013)
<i>total_after</i>		0,0006 (0,0004)	0,0008* (0,0004)	0,0008* (0,0004)
<i>colonial</i>				0,1944** (0,0789)
	All	All	Age>17	All
Obs	10220	10220	9991	10220

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector.***Statistically significant at the 1% level. **Statistically significant at the 5% level. *Statistically significant at the 10% level.

Appendix

Table A1. Probit regressions for having a formal contract among employed individuals

Dependent variable: Having a formal contract among employed individuals				
	(1)	(2)	(3)	(4)
<i>allu_m</i>	-0,1449** (0,0709)	-0,1451** (0,0741)	-0,1267* (0,0728)	-0,1304* (0,0748)
<i>total_m</i>	0,0783*** (0,0270)	0,0838*** (0,0278)	0,0786*** (0,0273)	0,0826*** (0,0278)
<i>s_mining</i>	-135,9165** (67,5415)	-118,5944* (60,9766)	-114,1024* (62,9308)	-110,3730* (63,1097)
<i>allu_after</i>		-0,0057 (0,0041)	-0,0056 (0,0041)	-0,0029 (0,0048)
<i>total_after</i>		0,0016 (0,0016)	0,0015 (0,0016)	0,0013 (0,0014)
<i>colonial</i>				-0,1892 (0,3065)
	All	All	Age>17	All
<i>Obs</i>	16135	16135	15831	16135

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector.***Statistically significant at the 1% level. **Statistically significant at the 5% level. *Statistically significant at the 10% level.

Table A2. Probit regressions for child labor among children (age<18)

Dependent variable: Child working or looking for a job			
	(1)	(2)	(3)
<i>allu_m</i>	0,1853** (0,0926)	0,1786* (0,0924)	0,2112* (0,1135)
<i>total_m</i>	-0,0639* (0,0339)	-0,0690** (0,0339)	-0,0753** (0,0370)
<i>s_mining</i>	60,5273 (59,4302)	45,8793 (57,1816)	58,7284 (55,2188)
<i>allu_after</i>		0,0058 (0,0050)	0,0090 (0,0077)
<i>total_after</i>		-0,0020 (0,0019)	-0,0023 (0,0018)
<i>colonial</i>			-0,2318 (0,3217)
<i>Obs</i>	4639	4639	4639

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector. **Statistically significant at the 5% level. *Statistically significant at the 10% level.

Table A3. Probit regressions for health system affiliation among employed individuals

Dependent variable: Health system affiliation among employed individuals				
	(1)	(2)	(3)	(4)
<i>allu_m</i>	-0,1614 (0,1319)	-0,1416 (0,1139)	-0,1311 (0,1257)	-0,6497*** (0,1724)
<i>total_m</i>	0,0837* (0,0464)	0,0782** (0,0383)	0,0779* (0,0424)	0,1900*** (0,0554)
<i>s_mining</i>	-95,5401** (47,8460)	-96,6678* (53,3592)	-101,8441* (54,9598)	-360,5666*** (79,5041)
<i>allu_after</i>		-0,0014 (0,0056)	-0,0048 (0,0057)	-0,0108* (0,0062)
<i>total_after</i>		0,0019 (0,0013)	0,0028** (0,0014)	0,0044*** (0,0016)
<i>colonial</i>				1,8410*** (0,5193)
	All	All	Age>17	All
<i>Obs</i>	10220	10220	9991	10220

Robust standard errors (in parentheses) clustered at the municipality level. All specifications controlling for gender, if the individual lives in the municipality urban area, if the individual is married, literate, mean schooling years in the municipality, employment rate, population size, share of the population that belongs to an ethnic group, share of immigrants from other municipalities, and share of the population in the agriculture sector.***Statistically significant at the 1% level. **Statistically significant at the 5% level. *Statistically significant at the 10% level.