



Blessing and curse. The gold boom and local development in Colombia

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ABSTRACT

I provide a microeconomic channel for the resource curse using the boom in Colombian gold mining as a case study. Identification strategies exploit trend changes in international gold prices after 2002 and regional gold production capabilities as measured by water supply (the majority of gold mining in Colombia is placer mining and water is important for industrial gold production). I find that the gold boom decreases local unemployment in the short term by 3.5%. However, given the lack of capacity to effectively ban child labor, these economic opportunities are also available for children. My results indicate that, because of the gold boom, the probability that a child works increases by 9.3% and school attendance decreases by 23.9%. Capital accumulation seems to be permanently hurt since the probability that a child is lagging three or more grades behind increases by 9%. These effects are only discernible after 2002. The human capital results can be retrieved from different databases. Furthermore, results are robust to a series of robustness checks (restricting the sample to gold producers and their neighbors, using alternative sets of controls and restricting the sample to non-migrants). Resources are a blessing in the short term but a curse for long term economic growth if human capital is productive.

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The curse of natural resources, the idea that countries rich in oil or minerals are doomed to poor economic growth, has attracted the attention of macroeconomists for decades (Deacon, 2011; Gylfason, 2001; Frankel, 2012; Sachs & Warner, 1997, 2001). More recently, microeconomics followed that lead by studying the impact of resource booms on corruption (Vicente, 2010), violence (Dube & Vargas, 2013) and governance (Caselli & Michaels, 2013; Martinez, 2017; Monteiro & Ferraz, 2017).

Few papers have examined the natural resource curse from a perspective of local economic development. Notable exceptions are Allcott and Keniston (2017), Aragon and Rud (2013), Michaels (2011) and Kotsadam and Tolonen (2016). In general, these papers find that resource abundance leads to improved living standards and attribute this result to the existence of inter-sectoral linkages. These studies suggest that the resource curse is no curse at all.

In this paper I use Colombian gold mining to provide a microeconomic explanation on one mechanism at play behind the curse of natural resources. I show that the boom in gold mining starting in 2002 increased employment in the short term. However, given the lack of capacity to effectively ban child labor, the gold boom also increased child labor and depressed school attendance, school attainment and enrollment.

I interpret these findings as evidence on a microeconomic-level resource curse. The boom in a non-renewable resource in fixed supply discourages schooling (especially in a country with weak institutions). In an environment where technical change is increasing constantly and where education generates positive externalities, the gold boom may actually check future economic growth. This is more likely to occur given that the boom is a temporary windfall but the decision of dropping out of school is often irreversible.¹ Thus, findings are consistent with resource abundance improving living standards in the short term but also with resource abundance being a curse in the long term.

To guide the empirical work, I build a simple model of the microeconomic allocative effects of a commodity boom on child labor and schooling. The model shows that the substitution (income) effect of an increase in gold prices dominates when child labor is initially low (high). Although this is not the most relevant contribution of this paper, this finding reconciles mixed evidence on the child labor literature on the cyclicity of child labor. For Tanzania, Beegle, Dehejia, and Gatti (2006) find that negative income shocks increase children's work hours. For Cote D'Ivoire, Cogneau and Jedwab (2012) find that reductions in administered

¹ Consistent with this irreversibility, I find that the gold boom increases the probability that a child is three or more grades below her expected grade given her age and a normal progression in school.

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cocoa-prices lead to less school enrollment and more child labor (see also Duryea, Lam, & Levison (2007), Edmonds & Pavcnik (2005), Guarcello, Mealli, & Rosati (2010), Thomas et al. (2004)).

² However, for Brazil, Kruger (2007) finds that expansions in the production of coffee depress school enrollment and raise child labor. Consistent with empirical findings, the model predicts that child labor is countercyclical in less developed countries (with high initial levels of child labor) but procyclical in more developed ones (with low initial levels of child labor). If the latter is true, that is if child labor is procyclical, then there is room for natural resources to become a curse through human capital accumulation.

Estimating the effects of the gold boom is thus an empirical matter. To proceed, I define a measure of exposure to the gold boom by interacting time dummies (or, with ideal yearly data, changes in real international gold prices) with a dummy which takes the value of one if a region of Colombia (either the census unit or the municipality) produced any gold in 2001–2002, just before the trend change in international gold prices.

I explicitly acknowledge that regions self-select into producing gold according to underlying characteristics (for example: expectations of gold prices) and that these characteristics might have similar trends to that of gold prices. This endogeneity problem would bias the estimates using OLS in non-obvious ways. To lessen this problem, I instrument the interactions between time dummies and initial gold production with interactions between time dummies and predetermined water supply in 2000. The last variable captures the potential of producing gold of Colombian regions. This simple—but of course, not impervious—instrumental variables approach relies on the importance of placer mining in Colombia and on the importance of water as an input in modern gold production technologies. Others have used gold reserves (Roza, 2016) but the discovery of gold is not a random process (Norman, 2008).

Within this econometric framework, IV estimates indicate that, after 2002, gold producing regions have 3.5% less unemployment. Resources are a blessing. But, after 2002, gold producing regions also have 9.3% higher child labor, 23% less school attendance and 12.5% less school attainment. Municipality level enrollment in public schools decreases by 0.22 standard deviations per standard deviation increase in the interaction between the gold dummy and the change in real international gold prices. Resources are a curse. All these effects are statistically detectable and important in magnitude after the trend change in gold prices; not before.

Initial water supply is preferred over initial gold production because predetermined water supply is not the result of economic decisions. However, water supply can still be correlated with other variables correlated in turn with child labor. I control for the covariates more likely to threaten the identification strategy: The quality of the soil for agriculture, the presence of fluvial ports, and water-related natural disasters. Because in Colombia, as in other countries, mining rents attract non-state armed groups (Berman, Couttenier, Rohner, & Thoenig, 2017; Dube & Vargas, 2013; Idrobo, Mejía, & Tribin, 2014), I also take into account the presence of guerrilla and paramilitary groups using a new database on Colombian armed conflict which spans the years 1980–2012.

Further robustness checks are performed. Throughout the paper I show that the main findings hold if I restrict the sample to gold producers and their neighbors. The data also allow me to conclude that findings are not driven by endogenous in-migration, an important channel identified in other papers (Michaels, 2011) and an important behavior of gold miners (Potter & Lupilya, 2016).

The major contribution of this work is to provide rare micro-economic evidence on the economic mechanisms behind

“the paradox of plenty” (ie: the resource curse, Sachs & Warner (1997, 2001)). In resource-rich areas, an increase in the price of resources improves economic conditions in the short term. However, if child labor cannot be banned, the change in relative prices increases drop out rates and checks future economic growth through lower human capital accumulation.

The paper most related to this, is Aragon and Rud (2013), which examines the consequences of the expansion of the Yanacocha gold mine in Peru on real income. In Peru, gold mining also increases economic opportunities in the short term. The authors do not deal with child labor probably because the Yanacocha gold mine is legal. However, the backward linkages that the authors suggests as an explanation for the short term effects could also interfere with human capital accumulation.

This paper proceeds as follows: Section 1 summarizes gold mining in Colombia. Section 2 lays out a tractable theoretical model of child labor and commodity booms. Section 3 presents the econometric model. Section 4 describes the data and anticipates formal results. Section 5 shows formal results and Section 6 performs a series of robustness checks. Section 7 provides a discussion of the results and Section 8 concludes.

1. Gold mining in Colombia³

Using the statistics of the central bank of Colombia, gold production (both formal and informal) in 2005 was 1,150,554.36 troy ounces.⁴ At a price of 444.5 dollars per troy ounce, this represented approximately 0.5 billion dollars or 0.35% of Colombia's GDP. During the same period total expenditures in education represented about 4.3% of the GDP (The World Bank, 2016). Gold production is concentrated in the west of the country, from the right flank of the western Andes to the Pacific coast (see Fig. 2a). For the five departments⁵ which produced the most gold in 2005 (in descending order: Antioquia, Bolívar, Córdoba, Caldas and Chocó), gold production represented more than 1% of department-level GDP. For Chocó, one of Colombia's poorest departments, gold production represented almost 5% of its GDP.

In part as a response to the trend change in international gold prices, total gold production in Colombia exhibits an increasing trend since 2001. According to Ingeominas, the number of mining titles increased by 351.22% between 2001 and 2005 (quoted in Andrade-Correa (2011)). Official data (Sistema de Información Minero Colombiano, 2015) reveal a 62% increase in gold production for the period 2001–2005. In that period nominal gold prices increased by 64%, real gold prices by 49%. As Fig. 1 illustrates: nominal (real) gold prices were stable (declining) between 1985 and 2001 and they increased continuously between 2002 and 2012.

When looking at gold prices for the census years of 1985, 1993 and 2005; the corresponding nominal (real) prices are 317 (720), 359 (589) and 445 (538) (Fig. 1). But more important for this research than the price level in these three years is the trend change in prices. Looking at the four years before each census the average year-to-year percentage change in nominal (real) prices was –8% (–11%) for 1985, –1% (–5%) for 1993 and 13% (11%) for 2005. Furthermore, for the 1980–2005 period, the only period with 4 years of continuously increasing nominal and real prices is the period of 2002–2005. Noting this is important for interpretation of the results, in particular when using the censuses. The last year for which I have census data is 2005 and although the bulk of the increase in gold prices occurred after 2005, a clear trend

³ Descriptive statistics of child labor in Colombia are presented in the data section. Appendix A presents a more detailed description of child labor in Colombia.

⁴ Or 39.45 tons.

⁵ Colombia is divided into 32 departments and 1101 municipalities. The municipalities are grouped in 530 census units.

² Unconditional (Edmonds, 2006) and conditional (Behrman, Gallardo-Garca, Parker, Todd, & Vélez-Grajales, 2012) cash transfers have been shown to reduce child labor.

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