**Early Exposure to Macroeconomic Shocks: Gold Boom and Birth Weight in Colombia**


## Abstract

The human capital literature has suggested a significant role of individual capabilities in the formation of human capital. There is substantial evidence that inequalities in capacities are consequences of differences in initial endowments (e.g. birth weight).In turn, there exists a hypothesis in the epidemiological literature pointing out that fetuses are vulnerable to environmental factors, which can have a positive or negative impact on their initial endowments. Taken together, we use a difference-in-differences approach by assessing whether changes in gold world prices affect birth outcomes disproportionately in municipalities that produce more of this commodity. Using the records of vital statistics from 1998 to 2014, we find that the surge in world gold prices disproportionately reduced the incidence of low and low birth weight in gold municipalities. We also find that the shock increased fertility for less-educated mothers. We conclude that, given that women's health behavior worsens with gold boom and that incomes are higher in this cycle, it would seem that the income effect is an important determinant of health at birth.



**Keywords**: Human Capital, Inequalities, Fertility, Health behavior.

**JEL classification**: J24, J13, I12, I140

## 1. INTRODUCTION

Advance in human capital accumulation, both in quantity and quality aspect, is one of the fundamental input of economic progress in any modern economy. There is a growing consensus that human capital plays an important role in the determination of living standards and economic growth. As a consequence, international agencies have used this knowledge as the main pillar to promote education as an instrument through which to generate equitable opportunities for citizens during economic growth. Thus, this strategy of education has occupied an important place in the plans of government of most countries.

Evidence recognizes individual capabilities as a key determinant of human capital formation (HECKMAN; STIXRUD; URZUA, 2006).There are both empirical and theoretical contributions, which suggest that inequalities in capabilities are consequences of differences in endowments, where endowments are characteristics, for example, of health or cognitive abilities, determined before human capital accumulation process (CUNHA; HECKMAN, 2008, 2009).These disparities in endowments among people would be related to differences in levels and trajectory of education and individual earnings, among other labor market and behavioral outcomes. In view of this, there is a strong academic and political interest in understand the causes of these disparities. An explanation comes from the medical literature, which argues that poor birth outcomes may adversely affect these endowments. For example, it has been documented that low and very low birth weight (i.e. a weight less than 2500 and 1500 grams, respectively) increases the incidence of problems such as poor visual-motor integration, cerebral palsy, deafness, epilepsy, blindness, asthma, chronic lung disease, impaired learning, dyspraxia, and attention deficit disorder (PANETH, 1995; RICHARDS et al., 2001;COUZIN, 2002, MARLOW; ROBERTS; COOKE, 1989to name but a few).

Along these lines, poor environmental conditions in utero have been shown to have adverse consequences on birth outcomes (ALMOND; MAZUMDER, 2011; CURRIE; NEIDELL; SCHMIEDER, 2009; ROCHA; SOARES, 2015).In this regard, Currie (2011) argue that individuals may begin with very different endowments at birth because of events that happened

during fetal growth and that these disparities at birth have been shown to be predictive of the health and economic outcomes in childhood and adulthood[1].

Taken together, these facts suggest that identifying shocks that affect health at birth must be of particular interest to researchers and policy makers. One intriguing hypothesis is that health outcomes at birth can be affected by macroeconomic cycle (e.g.,aggregate economic expansions and contractions or shocks by exogenous variations in the price of a key export product). To verify this relationship, we investigated how infant health at birth in Colombia responded to boom in the world gold price which increased during 2002-2012. Additionally, we assess how such a boom affects parental behavior as possible mechanism through which the gold shock impacts birth outcomes. In this point, the natural question is: what measure to use to capture fetal nutrition or more generally health at birth. In this paper, we used birth weight as a proxy variable for initial health endowments. Birth weight is determined by fetal growth rate at a given gestation length, which in turn is largely influenced by nutrition (KRAMER, 1987). This feature makes it an attractive measure for the study of the effects of historical events that altered the *in utero* environment on health at birth[2].

The effect of an increase in word gold price can be separated into substitution and income effect. On the one hand, an increase in returns to work decreases the opportunity cost of carrying out time-intensive activities and therefore, ceteris paribus, lowers the time devoted to children health production[3]. This is the substitution effect. On the other one, an increase in returns to work also increases current income and thereby rises expenditures on items vital to maternal and fetal health. This is the income effect.

In addition, the gold mining is specifically associated with heavy metal pollution such as lead, cadmium, chromium and nickel that come to the surface during the extractive process. Lead

[1]The proposition that health conditions at birth have a lasting impact on adult life achievements comes from the so-called "fetal origins hypothesis". The first premise originated with David Barker in the 1980s (ALMOND, 2006). See Barker(2001) for a review of the epidemiological evidence in support of this hypothesis.

[2] In this point, what becomes relevant is to understand the malleability of health at birth. Today it is not difficult to think that the consumption of tobacco, alcohol, and illegal drug cause intrauterine growth retardation, or that good nutrition and better access to medical care have positive effects on fetal health (CURRIE, 2011).

[3]For example, activities as practicing good hygiene and traveling to distant facilities for free preventive and primary health service require time to be performed.

exposure in utero is associated with increased risk of premature birth, low birth weight and retarded growth (IYENGAR; NAIR, 2000).Unfortunately, we do not have information in our database that allows us to separately identify each of the previously mentioned effects. However, because they work in opposite directions, our empirical strategy will offer evidence about relative importance of time and environmental degradation versus current income in the production of healthy children. In other words, we will estimate the net effect of the boom in the international price of gold.

There are three literatures related to our study. The first is focused on studying the relationship between economic shocks around the time of birth and birth outcomes. In this type of research, shocks are more diffuse in terms of time and mechanisms are not clear compared to other health shocks (ALMOND; CURRIE, 2011).The second literature related to our study estimates the relationship between exposure to economic shocks and behaviors health-related. In Dehejia and Lleras-Muney (2004) show that  all mothers in their simple tend to increase their use of prenatal care when unemployment is high. The third type of literature that is associated with our study is that related to demography and economics. This literature has documented a procyclical pattern in fertility. As one example, Schaller (2016) found a countercyclical relationship between fertility and the unemployment rate in the United States from 1980–2009. In this paper, we link these three strands of the literature to children' health outcomes at birth.

Our study makes a few contributions to literature examining the effects of economic shocks on children health, which has yet to come to a consensus. First, although there is a rich theoretical literature that suggest that countries and regions with an abundance of natural resources fail to provide a better living standard for society (including SACHS; WARNER, 1999;MEHLUM; MOENE; TORVIK, 2006), our results show, at least in the short term, the gold boom had a positive impact on the living standards of the local population, and in turn improved the children health. This result is consistent with the findings of previous studies which found that income shocks are a more powerful determinant of health at birth in developing countries than the opportunity cost of time to produce healthy children (e.g., BAIRD; FRIEDMAN; SCHADY,

2011;BURLANDO, 2014; BOZZOLI; QUINTANA-DOMEQUE, 2014) [4]. Second, we see our empirical work as the first to examine the effects of the abundance of gold within a country on birth outcomes of the cohorts affected by the gold boom. Third, our work also contributes to literature on fertility. Specifically, our empirical evidence that the gold boom led to increases in fertility for disadvantaged women (low-educated women) is consistent with life-cycle models in which credit constraints and skill depreciation during pregnancy are important in fertility decisions.

Section 2 describes our micro data and empirical strategy. Section 3 contains our main results.. In Section 4 , we provide a possible exploring market channel through which the gold boom impacts birth weight. Section 5 presents conclusions.

## 2. EMPIRICAL STRATEGY AND DATA

### 2.1. ECONOMETRIC MODEL

Our econometric strategy follows a difference-in-differences estimator by assessing whether changes in gold prices affect birth outcomes disproportionately in municipalities that produce more of this commodity[5]. This analysis is based on a municipality-by month of birth panel. So, our baseline specification has the following structure

$$H_{mdgyt} = \alpha + \beta(Gold_{md} \times PGold_{av_{12}ty}) + \delta' X_{mdgyt} + \eta_{mt} + \gamma_{yt} + \eta_d \times y + \epsilon_{mdgyt} \quad (4)$$

here the left-hand-side variable, $H_{mdgyt}$ ,is a measure of health outcome (average) for infants born in municipality *m* , department d and with gender g (male or female) , on year *y* and month *t* (with t = 1, 2, …, 12). Our key dependent variable ($H_{mdgyt}$ ) are low and very low birth weight, but we also look at other health outcomes such as length of gestation, and APGAR score.$X_{mdyt}$ is a vector that contains mother-specific controls such as age, educational attainment and marital status (municipality average). ($Gold_{md}$ is the gold production level in municipality *m* and the

[4]These results are base on the idea that credit constrains and other market imperfections are more common in developing countries.

[5] This type of methodology has been widely used in recent studies ( See, for instant, Dube and Vargas (2013) and Miller and Urdinola (2010) ).

department $d$ during 2004 (before the increase in gold prices) and $PGold_{av_{12}ty}$ denotes the average of the natural log of the international gold price in the 12 months prior to birth in year $y$ and month $t$[6]. We use the average in the 12-month period before birth to take into account the fact that the mother's nutritional status at the time of conception could also be an important predictor of child's initial health endowment. Note that the condition that all municipalities are facing the same prices implies that we must find a treatment variable which changes at the municipal level.

$\eta_{mt}$ is a set of municipality-by-month fixed effects, which take into account the possibility that any time-invariant differences between municipalities (like Geographical-Features) may be correlated with ($Gold_{md} \times PGold_{av_{12}ty}$)and $H$. The $\gamma_{yt}$ is a set of year-by-month fixed effects, which captures aggregate shocks impacting the entire country and secular trends in health outcomes at birth . To address potential long-run differences in improving public health and other socioeconomic characteristics across department, department-specific trends ( $\eta_d \times y$) are included in our benchmark specification. This linear time trend is common to all municipalities included in a given department (average of 38 municipalities per department). Finally, due to the fact that the intensity of mining activities is a variable aggregate rather than an individual measure, we apply Huber-White robust standard errors throughout the analysis, clustered at the municipality-month level.

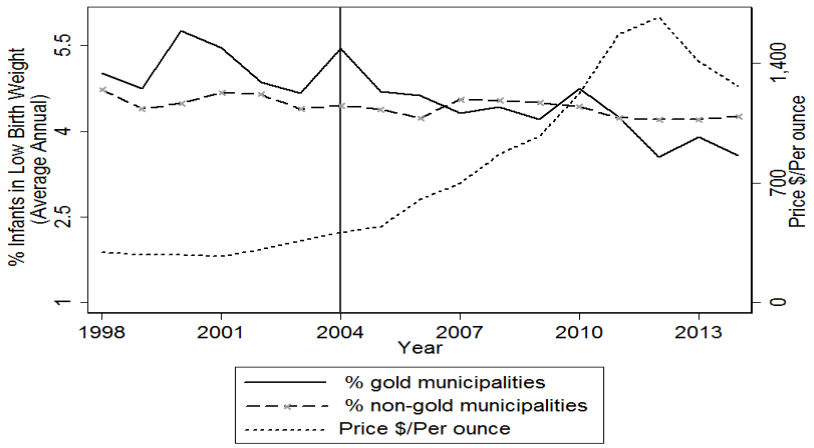
The identifying assumption of our empirical exercise can be summarized in three parts: First, the world price of gold is exogenous to local conditions in Colombian municipalities, i.e., it is not affected by Colombia's gold production. This assumption is not far from the reality, in fact, according to the latest report on the commodities market of the world bank (2016) Colombia is the 14th largest gold-producing economy, producing 49,9t (tonnes) on average of gold between 1995-2015 ( it holds less than one percent of the world gold market). Second, we exploit the fact that this natural resource is not evenly distributed all over country (the distribution depend on natural factors), which produces a totally random assignment of the effect of a boon or bust in

[6]We measure prices in logs so we can assess its effects in percent terms, but the results are robust to specifying prices in levels.

this mineral. Third, the heart of this difference-in-differences setup says that in the absence of a boon or bust in international gold price, our outcome variable ($H_{mdyt}$) evolves naturally over time in the same way in all municipalities. This trend is determinate by the sum of a $X_{mdyt}$, $\eta_{mt}$ and $\gamma_{yt}$.

In this point may be useful to anticipate part of the discussion about the expected sign of the net effect of the gold boom on birth outcomes (β). To do this, we chart basic trend in gold price and low birth weight rate for non-gold and gold municipalities (municipalities with production value exceeding the 95th percentile of the distribution). The figure 2 shows the difference in trends between the two types of municipalities (producer and non-producer), which gives meaning to the application of our difference-in-differences setup.

**Figure 1**. Gold Price and Birth Weight Trends1998-2014




Note: Municipality-year average. Authors' calculation base on data from Vital statistics of Colombia and World Bank Commodity Price : 1998-2014. Gold municipalities are defined as those that have a production level greater than the value of the 95th percentile of the distributi

## 2.2. DATA

### 2.2.1. *Vital Statistics Records*

The main source of data for this study is the vital statistics of Colombia, *Estadísticas Vitales – EEVV-*, which is collected by the Administrative Department of Statistics (DANE) each year as from 1998.The We obtained these data for 1998 and 2014 within the 1120 municipalities in Colombia- approximately 11 million birth records. The sample is limited to births that were

certified by a physician, which implies a reduction of about 6%. Thus, the final sample of our study consists of about 5,152,269 births. After debugging the database, we aggregate the data into cells defined by municipality of residence of the mother, year and months of birth, and gender of the baby.

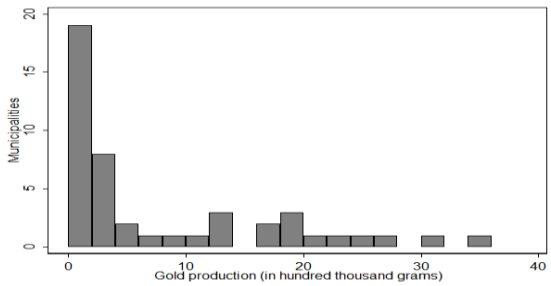
### 2.2.2. *International gold price*

For the construction of our variable of interest we use the World Bank's commodities prices series, which offers monthly price information for different commodities from 1960 to the present.

### 2.2.3. *Local gold production*

To build time series of the local gold production we use gold production data provided by Dube and Vargas (2013).In figure 3, we can observe that the distribution of production varies substantially across the municipalities that are at or above the 75th percentile. As a result of this variation, as we shall see, different areas experienced differential changes in child health in response to changing gold world prices. This is the basis of our empirical strategy.

**Figure 3.** Distribution of gold production in 2004 by municipalities in Colombia




Note: Authors' calculation base on data from Dube and Vargas (2013) and The System of Mining Information of Colombia. Municipalities are defined as those that have a production level equal or greater than the value of the 75th percentile of the distribution.

**Table 1**. Descriptive Statistics

| | Number of Municipalities | Number of Observations | Mean | Standard Deviation |
|---|---|---|---|---|
| ***Child's characteristics (1998–2014)*:** | | | | |
| Number of births | 990 | 5152269 | 195.69 | 220.53 |
| %Male | 990 | 5152269 | 51.28 | 49.98 |
| Very low birth-weight rate( ≤ 1500 gr) | 990 | 5144737 | 0.58 | 1.21 |
| Low birth-weight rate ( ≤ 2500 gr) | 990 | 5144737 | 6.28 | 5.36 |
| | | | | |
| ***Maternal Characteristic (1998-2014):*** | | | | |
| mothers less than age 19 rate | 990 | 5151106 | 25.63 | 9.58 |
| mothers between age 20 and 39 rate | 990 | 5151106 | 72.04 | 12.12 |
| mothers greater than 39 rate | 990 | 5151106 | 2.33 | 3.72 |
| Moms with primary or less rate | 990 | 5149063 | 40.71 | 19.72 |
| Moms with high school incomplete or less rate | 990 | 5149063 | 68.94 | 18.40 |
| Moms with high school rate | 990 | 5149063 | 22.44 | 11.89 |
| Moms with college or more rate | 990 | 4876640 | 4.48 | 5.35 |
| moms married rate | 990 | 5150031 | 19.21 | 13.76 |
| % moms with health security | 990 | 4875931 | 22.36 | 20.38 |

Source: Research results. In panel of child's characteristics all variables are dummies, except for number of births. In panel of maternal characteristic all variables are dummies. Prematurity is the birth of an infant before 37 weeks of pregnancy. Extreme prematurity is the birth of an infant before 28 weeks of pregnancy.

## 3. MAIN RESULTS

### 3.1.1. *Net effect of gold shocks on the Infant Health*

Following the identification strategies outlined above, in this section we present the main empirical results for the fraction of births that are under the condition of LBW and VLBW for 1998 to 2014. In our most basic specification presented in the first column, we regressed our child health measure on a set of controls, which includes month-by-year, municipality and year fixed effects. In the remaining columns we add to the firth specification other controls as follows: Column 2 with municipality-by-month fixed effects, column 3 with mothers' characteristics and newborns' sex, and (4) with department specific linear time trends. In this and all subsequent tables, we use robust standard errors clustered at the municipality-months level to account for the fact that the measure of gold shocks operates at the municipalities by year and month level.

In table 2, in general, the coefficients in columns (1)–(4) seem to suggest that gold price shocks have a cyclical relationship with infant health, that is to say: when international gold price increases, health at birth improves differentially in municipalities that produce gold more intensively. In all the specifications the coefficient on $(Gold_{md} \times PGold_{av_{12}ty})$ ,β, suggest a statistically significant decrease in the incidence of LBW caused by exposure to gold fluctuations during twelve months prior birth. It is notable that our results are extremely robust across specifications, including controlling for department-specific linear time trends and mother's characteristics. To understand the magnitude of the estimated, consider an increase in $\text{PGold}_{\text{av}\,12\,\text{ty}}$ of 0.20 log points and the coefficient estimated in column (4). For the average gold production in producing municipalities, which is 2.335 (hundred thousand grams), the coefficients imply that the increase in prices induced -0.02 less newborn babies with LBW, relative to the non-gold municipalities. Now when this effect is divided by mean of LBW rate, the resulting effect size is a decrease of -0.30% in the prevalence of LBW in producing municipalities relative to non-producers.

This effect estimated of -0.30% that we uncover for the boom in gold world price is almost three times smaller in absolute value than the -1.02% reduction in the cases of LBW due to the introduction of the Food Stamp Program (FSP) in United States estimated by Almond, Hoynes and Schanzenbach (2011). Moreover, our estimated impact for LBW is a little lower than -0.50%

reduction in babies with LBW explained by a 1% increase in the unemployment rate in the US labor market (see DEHEJIA; LLERAS-MUNEY, 2004). Comparing the coefficient found in our work (which is -0.04074) in relation to that found by Bozzoli and Quintana-Domeque (2014) for the Argentine economic collapse is 0.026 lower in absolute value than the -0.067 calculated by them. These comparisons suggest that our estimates are not so far from what has already been found in empirical studies analyzing economic shocks in the pregnancy stage.

**Table 2**. Effects of the Gold Prices Shocks on Birth Outcomes in Colombia, 1998-2014

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| *Panel A: Dependent variable is Low Birth-Weight Rate* | | | | |
| Gold production2004 x gold price | -0.05061*** | -0.05054*** | -0.05060*** | -0.04074*** |
| ( Twelve months before birth) | [0.00381] | [0.00382] | [0.00376] | [0.00643] |
| % effect of 20% Δ in gold price | -0.377 | -0.376 | -0.376 | -0.303 |
| Observations | 302101 | 302101 | 299456 | 299456 |
| R-sq | 0.252304 | 0.280820 | 0.291586 | 0.293949 |
| *Panel B: Dependent variable is Very Low Birth-Weight Rate* | | | | |
| Gold production2004 x gold price | -0.00879*** | -0.00882*** | -0.00875*** | -0.00844*** |
| ( Twelve months before birth) | [0.00111] | [0.00112] | [0.00112] | [0.00148] |
| % effect of 20% Δ in gold price | -0.71 | -0.709 | -0.703 | -0.678 |
| Observations | 302101 | 302101 | 299456 | 299456 |
| R-sq | 0.134930 | 0.169862 | 0.172270 | 0.173906 |
| Departament x linear time | | | | Yes |
| Other controls | | | Yes | Yes |
| Municipality x Month fixed effects | | Yes | Yes | Yes |
| Month x year fixed effects | Yes | Yes | Yes | Yes |
| Municipality fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |

Source: Research results.

Notes: The dependent variable is the fraction of children born - by sex, municipality, month and year. The effect of a 20% increase in gold prices is computed by multiplying the average production of gold- producing municipalities by the coefficient on Gold production2004 x gold price, and dividing the resul ting value by the mean of dependent variable."Other controls" include the newborn's sex,mother's school attainment, maternal age and mother's marital status. Estimates are weighted using the number of birth. Robust standard errors are in parentheses and are clustered at the municipality-months level. *Yes* that means that the group of variables is included in the regressions. Significance: $* p < 0.10$ $** p < 0.05$, $*** p < 0.01$

**Table 3**.Effect of the Gold Prices Shocks on Distribution of Birth Weightin Colombia, 1998-2014

| Dependent variable | Below 1,000 gr | Below 1,500 gr | Below 2,000 gr | Below 2,500 gr | Below 3,000 gr | Below 3,500 gr | Above 3,500 gr |
|---|---|---|---|---|---|---|---|
| Gold production2004 x gold price | -0.00264*** | -0.00844*** | -0.02123*** | -0.04074*** | -0.05513*** | -0.00863 | 0.12244*** |
| ( Twelve months before conception) | (0.00087) | (0.00148) | (0.00294) | (0.00643) | (0.01135) | (0.01077) | (0.00821) |
| % effect of 20% Δ in gold price | -0.646 | -0.678 | -0.634 | -0.303 | -0.088 | -0.006 | 0.427 |
| Observations | 299456 | 299456 | 299456 | 299456 | 299456 | 299456 | 299456 |
| R-sq | 0.089036 | 0.173906 | 0.264033 | 0.293949 | 0.368148 | 0.362237 | 0.613433 |
| Other controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Departament x linear time | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality x Month fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month x year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Source: Research results.

Notes: The dependent variable is the fraction of children born - by sex, municipality, month and year. The effect of a 20% increase in gold prices is computed by multiplying the average production of gold-producing municipalities by the coefficient on Gold production2004 x gold price, and dividing the resulting value by the mean of dependent variable."Other controls" include the newborn's sex,mother's school attainment, maternal age and mother's marital status. Estimates are weighted using the number of birth. Robuststandard errors are in parentheses and are clustered at the municipality-months level.*Yes* that means that the group of variablesis included in the regressions. Significance: $* p < 0.10$ $** p < 0.05$, $*** p < 0.01$.

### 3.1.2. ROBUSTNESS OF FINDINGS

#### 3.1.2.1.*Mother Characteristics*

The gold boom may be associated with several other outcomes. In fact, it can lead to a change in the type of mothers who are giving birth and thus generate a bias in our main estimator of the impact of the boom on health at birth. In particular, a positive gold shock can leads to increases in fertility for women with low educational level and credit restrictions against those women who have a better economic status. This change in the composition of the sample could bias downward the estimated effects of an increase in the international gold price on LBW in producing municipalities.

The table 4 presents the results for mothers with primary or less, mothers with high school incomplete or less, mothers with high school and mother with college or more. The coefficients in columns (1) and (2) show that gold price shocks have a positive relationship with the proportion of mothers with low socioeconomic status (SES) who are having children: when the price of gold increases, babies born to low-SES (low-educated women) mothers increase differentially in municipalities that produce gold more intensively.

**Table 4.** Effect of the Gold Prices Shocks on Mother Characteristics

| Dependent variable | % Moms with primary or less | % Momswith high school incomplete or less | % Moms with high school | % Moms withcollege or more |
|---|---|---|---|---|
| Gold production2004 x gold price ( Twelve months before conception) | 0.09291*** | 0.06704*** | -0.03181** | -0.02558*** |
| | [0.01139] | [0.01908] | [0.01531] | [0.00348] |
| Observations | 305913 | 305913 | 305913 | 305913 |
| R-sq | 0.659689 | 0.672004 | 0.452724 | 0.60982 |
| Departament x linear time | Yes | Yes | Yes | Yes |
| Municipality x Month fixed effects | Yes | Yes | Yes | Yes |
| Month x year fixed effects | Yes | Yes | Yes | Yes |
| Municipality fixedeffects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |

Notes: The dependent variable is the fraction of children born - by sex, municipality, month and year. Estimates are using the number of birth. Robust standard errors are in parentheses and are clustered at the municipality- months level. *Yes* that means that the group of variables is included in the regressions. Significance: ∗ p < 0.10 ∗∗ p < 0.05, ∗∗∗ p < 0.01

This pattern in mothers' education distribution support the hypothesis of that low-SES mothers who are more likely to face credit constraints will tend be more fertile than high-SES women when the economy experiences positive macroeconomic shocks (see DEHEJIA; LLERAS-MUNEY, 2004) . Overall, we consider the estimates in Table 5 are encouraging because they suggest that our main results (table 2) are biased downwards by endogenous sample selection, which means that the effects of gold shocks on health at birth is greater than estimated.

**3.1.2.2.** *Behavioral changes*

We next study the cyclicality of time-intensive child health investments. In addition to changes in the composition women giving birth, gold shocks could also encourage behaviors that could harm or improve infant health. In Table 5, we present the results of this empirical exercise. To obtain these results, we use the specification of equation (4).As the existing literature has documented; we find a countercyclical relationship between prenatal care visits and the gold boom. From column (1) to (3), we observe a significant deterioration in the use of the prenatal care service among mothers: the average number of prenatal care visits decreases, the proportion of mothers with less than 5 prenatal care visits increases, and the proportion of mothers with more than 7 prenatal care visits decreases.

**Table 5.** Effect of the Gold Prices Shocks on Mother Behaviors

| **Dependent variable** | **Average no. Of prenatal care visit** | **% < than 5 prenatal care visit** | **% > than 7 prenatal care visit** |
|---|---|---|---|
| Gold production2004 x gold price | -0.01068*** | 0.29785*** | -0.35283*** |
| ( Twelve months before conception) | [0.00093] | [0.01829] | (0.02004) |
| Observations | 299534 | 299534 | 299534 |
| R-sq | 0.618278 | 0.564033 | 0.545733 |
| Departament x linear time | Yes | Yes | Yes |
| Other controls | Yes | Yes | Yes |
| Municipality x Month fixed effects | Yes | Yes | Yes |

| | | | |
|---|---|---|---|
| Month x year fixed effects | Yes | Yes | Yes |
| Municipality fixed effects | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes |

Source: Research results.

Notes: In column (1), the dependent variable is the average number of prenatal visits by sex, municipality, month, and year. In column (2) and (3),The dependent variable is the fraction of children born - by sex, municipality, month and year. Estimates are weighted using the number of birth. Robust standard errors are in parentheses and are clustered at the municipality-months.Significance: ∗ p < 0.10 ∗∗ p < 0.05, ∗∗∗ p < 0.01

**3.1.2.3.***Composition of births*

Another potential concern that could arise is that gold shocks may generate, through selective mortality, gradual changes in the composition of birth cohorts. Put differently, babies born during the gold boom may be different, for example in terms of health, from what would otherwise they have been. This empirical analysis is presented in the table 6.The finding in column (1) suggests that gold price shocks have a procyclical relationship with the total number of births: when the price of gold increases, the total number of babies increases differentially in municipalities that produce gold more intensively.

**Table 6.** Effect of the Gold Prices Shocks on Number of Births

| Dependent variable | Number of births | log(Number of births) |
|---|---|---|
| Gold production2004 x gold price | 0.09876** | 0.01016*** |
| ( Twelve months before conception) | [0.03587] | [0.00097] |
| Observations | 308896 | 308896 |
| R-sq | 0.925241 | 0.834923 |
| Departament x linear time | Yes | Yes |
| Municipality x Month fixed effects | Yes | Yes |
| Month x year fixed effects | Yes | Yes |
| Municipality fixed effects | Yes | Yes |
| Year fixed effects | Yes | Yes |

Source: Research results.

Notes: The dependent variable is the fraction of children born with - by sex, municipality, month and year. Robust standard errors are in parentheses and are clustered at the municipality-months level. Significance: ∗ p < 0.10 ∗∗ p < 0.05, ∗∗∗ p < 0.01.

## 4. EXPLORING MARKET CHANNEL

We next study whether the surge in gold world prices propelled economic activity in the municipalities that produce this precious metal. The literature on the curse of natural resources points out that the abundance of natural resources would fail to provide a better quality of life for the population, and in particular, under the context of poor quality institutions and bad governance. However, the debate is still open. A recent contribution by Aragón and Rud ( 2013) studied the effect of the expansion of the largest gold mine in Peru on local living standards using households' survey data for the period 1997 to 2006. The authors found that the expansion of the mine has a positive impact on nominal and real income of the local population. They argue that a possible channel of transmission through which these effects emerge is the existence of backward linkages. Given our limited information on the labor market given our source, we will try to verify whether the increase in international gold prices led to an economic boom in the gold producing municipalities[7].For this purpose, we will use information regarding the type of mother's social security regime in health.

Table 7 presents the results for this exercise. In this specification, we restricted the sample to municipalities with gold production in 2004.Note that in all cases, the estimates of are significantly positive and robust to including additional controls. However, we cannot interpret these results as causal because they may be influenced by other variables that are not captured by our methodology. For this reason, these estimates should be interpreted with caution.

**Table 7.** Health Security and Gold Prices Shocks

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| *Panel: variable dependent is % mothers with contributory regimen* | | | | |
| Gold production2004 x gold price | 0.05244*** | 0.05203*** | 0.06684*** | 0.05753** |
| ( Twelve months before birth) | [0.01420] | [0.01448] | [0.01487] | [0.01281] |

[7] According to Ingeominas (*Instituto Colombiano de Geología y Minería*), the number of mining titles increased by 61% between 2001 and 2005 .This fact could suggest a positive dynamic in the economy of producing municipalities.

| | | | | |
|---|---|---|---|---|
| N | 55652 | 55652 | 55280 | 55280 |
| R-sq | 0.805307 | 0.810274 | 0.816869 | 0.833922 |
| Departament x linear time | | | | Yes |
| Other controls | | | Yes | Yes |
| Municipality x Month fixed effects | | Yes | Yes | Yes |
| Month x year fixed effects | Yes | Yes | Yes | Yes |
| Municipality fixed effects | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |

Source: Research results.

Notes: The dependent variable is the fraction of mothers with contributory regimen - by newborn's sex, municipality, month and year of birth."Other controls" include the newborn's sex,mother's school attainment, maternal age and mother's marital status. Estimates are weighted using the number of birth. Robust standard errors are in parentheses and are clustered at the municipality-months level. Significance: $*$ $p < 0.10$ ,$**$ $p < 0.05$, $***$ $p < 0.01$.

## 5. FINAL REMARKS

The occurrence of a boom in the international price of gold approximately between 2001-2012 , combined with the information of around 11 million births between 1998 and 2014 recorded on the Colombia certificates of Live Birth, has allowed us to study the effect of prenatal exposure to these shocks by analyzing the behavior of an important infant health measure, birth weight. We have found that exposure to gold boom improved the initial health endowments.

Because the type of women who have children in positive business cycles may differ from those who choose to postpone fertility, we check whether the shock of gold led to changes in the composition of women giving birth. Knowing this is important since parental characteristics are correlated to the health status of children and therefore, a change in the selective timing of conceptions can lead to differences in the birth outcomes during the economic cycle. In this analysis, we find that less-educated mothers are more likely to have children during gold boom, thus decreasing the average health status of their babies. In contrast, we observed that high-educated mothers choose to postpone fertility. In addition, the gold boom may lead to change in mothers' health-related behaviors. We find evidence that gold price shock had a negative effect on prenatal care visits, which would lead to a decrease in children's health.

Overall, our results can be interpreted as follows: fetal exposure to the boom in international gold price led to improved in initial health endowments differentially in areas that produce more gold, even with negative effects such as the increase in the proportion of low-SES mothers, decrease in the number of prenatal visits and the degradation of the environment. This suggests that, given that women's health behavior worsens with gold boom and that incomes are higher in this cycle, it would seem that the income effect is an important determinant of health at birth. Our main results are compatible with those obtained by Bozzoli and Quintana-Domeque (2014)and Burlando (2014) ,who found a net negative effect on health at the birth of the Argentine macroeconomic collapse between 2001 and 2002 and an electric blackout in Tanzania, respectively.

Regarding possible mechanisms, we analyze the relationship between the world price of gold and the proportion of women with a contributory health regime, which covers people with ability to pay. This suggests that the shock may have generated an increase in the real income of the locating households in the producing municipalities, which led to an improvement in the health of both the mother and the newborn. However we cannot rule out that this relationship is influenced by other factors not considered in our methodology. So it should be interpreted as a simple correlation analysis.

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