Commodity prices and family formation: The impact of commodity booms on fertility decisions and outcomes*

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Abstract

This paper uses international commodity prices and local natural resources endowment as a source of plausibly exogenous variation in local economic conditions to study how these shocks impact fertility behavior of families in a small, developing, open economy market. We find that these commodity shocks lead to an increase in the local employment rate and increase the log number of births and the birth rate, as previous studies have demonstrated. However, more interestingly, we find that economic conditions do not seem to influence the decision to start a family but rather to expand it since only higher-order births are pro-cyclical. Furthermore, we find evidence that fewer single women conceive babies in periods of booms and that their partner is more likely to be employed and have a higher earning occupation, suggesting that booms influence not just fertility but family formation overall. We find limited evidence that babies conceived in periods of booms have worse health outcomes, as compared to the existing literature, maybe because better family formation counteract the births of more marginal children.

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1 Introduction

How do temporary income fluctuations alter decisions related to fertility and family formation? This question is complicated since decisions of income, fertility and marriage are likely jointly taken and thus any correlation between the two variables may not provide a causal relationship. The main challenge for such an estimation is that even at the level of an economy, an anticipated increase in fertility can imply a lower labor supply of women and thus inducing a negative relationship between measures of economic prosperity such as the employment rate and fertility rates. Furthermore, when it has been possible, existing papers have not been able to explore issues regarding to birth order, family characteristics and babies' health using a single experiment. Our setting, in a small open developing economy hit frequently by external price shocks, offers us this opportunity. We use shocks to local geographical entities within Chile stemming from variation in international commodity prices and their relative exposure to it to study the causal impact of local economic booms on fertility decisions, parental characteristics and on the outcomes of babies born.

The impact of economic prosperity on fertility decisions is theoretically complex. The impact of these booms is likely to have a substitution and an income effect. The substitution effect stems from the fact that in a boom, wages are likely to be higher, making women's fertility decisions more costly to them if they choose to step out of the labor force even temporarily to have their children. On the other hand, economic prosperity also implies additional resources which couples can choose to devote to having more children if the latter are a normal good. Which effect dominates is thus an empirical question. What makes the source of variation we exploit particularly interesting is that commodity-producing regions are used to suffering shocks related to foreign prices and the duration of these shocks is clearly never anticipated to be eternal. Thus, we can think of them as transitory income shocks, thus making the substitution effect potentially larger. However, if the commodity sector employs more males than females, this may diminish the substitution effect.

Having set up a simple model to explain the potential relationship between our variables, we then explore the empirical relationship between income shocks and fertility decisions. Many previous studies (Gabraith and Thomas, 1941; Silver, 1965; Ben-Porath, 1973) have documented a that birth rates are pro-cyclical suggesting a positive relationship between income and births. However, none of these studies take seriously the problem that income shocks may be endogenous.

In order to be able to do this, we use as an exogenous shock to local economic conditions international commodity prices. Feigenberg (2014) uses shocks related to copper and difference in copper resources across regions to explore the impact of aggregate income shocks on school pricing. We use a wider set of commodities since there is a large regional difference in natural resources. We first demonstrate that international price variations in different commodities have significantly and differentially affected regions in Chile. In particular, we show that wood products, salmon,

agriculture and mining (each a staple product of a region of Chile) all experienced different timing of economic cycles over the last 20 years. Since we are worried about regions specializing in a given commodity in response to international prices, we measure specialization in a Census previous to our period of interest. We then "allocate" the importance of each commodity shock over time to a county (comuna) depending on its past labor force participation in each sector. We show that these shocks significantly explain variance over time and across regions in employment rates and other proxies of economic conditions in each county of the country. We also how little evidence that these shocks could be endogenous given that Chile is a small producer in the world market. Thus, we argue that this is a good setting for exploiting an exogenous shock in economic conditions.

We then estimate the causal impact of these changes in economic conditions on fertility decisions using the Census of all births in the country from administrative records. We match this predicted economic conditions with the fertility outcomes at two moments: the moment of conception and the moment of birth, at the quarterly level. We find evidence that if anything, better economic conditions increase the log number of births and birth rates in the economy, suggesting little role for the substitution effect and a much more important role for the income effect. An increase in the weighted price index of a comuna of 1 percent increases the log number of births by 0.3 and the birth rate by 3 per 1,000 woman (from a base of about 18). If we were to assume that the only way in which our price index is affecting fertility is through changes in employment rates (which we do not do since we think it is unlikely to hold), this would suggest that a change of 1 percent in the employment rate would increase the number of births by 12 percent. In our period, once we take into account fixed effects for county and quarter, the employment rate has a standard deviation of about 0.02 suggesting that a one standard deviation change in the employment rate would have impacted the log number of births in about 0.24 percent.

These results are consistent with two recent studies that have looked at local income shocks and their link to fertility. Black et. al (2013) find that coal-rich counties in the United States which suffered a boom due to rising energy prices had also an increase in completed fertility. Lovenheim and Mumford (2013) find that increases in a family home value increases the probability that this family will have a child. Compared to these studies, we argue that our setting is particularly interesting since we are looking at more transitory income shocks than those presented above (this fundamentally depends on how international commodity prices evolve) where the substitution effect would thus be much more likely to be stronger. However, we still find a positive causal relationship between fertility and income.

Compared to previous studies, we can also explore whether the identity of the mothers and fathers is also altered. We find evidence that who is likely to be a mother changes in response to commodity booms. When a region is blessed with the international prices of its commodity rising, babies are more often born to both university educated fathers and mothers but also to parents with

less than a high school diploma, suggesting a polarization in times of economic prosperity. It is not obvious that women who benefit the most from the commodity prices in terms of education are the ones having fewer children in those moments, implying potentially little role for the substitution effect. We further document that babies who are conceived in periods of boom are less likely to be born to single moms and that their fathers are more likely to be employed and more likely to be from a higher occupational category. This suggests that the substitution effect may not operate very strongly because men are experiencing a much larger benefit than women, thus rendering the income effect much more determinant.

We also document that it seems to be the extensive margin of fertility and not the intensive margin that responds to these shocks. The fraction of first born is not responding to the price shocks but so is the birth order rank and the number of children ever born to a woman. This suggests that while the timing of starting a family may not be very respondent to the economic conditions, the decision of having subsequent children does depend on income shocks. This again suggests little role for substitution versus income effects since the largest wage cost for a woman would be for her first child. This is also consistent with the very low levels of labor force attachment of mothers in Chile suggesting that for those who already have children, the income effect is likely to be much more important than the substitution effect.

Dehejia and Lleras-Muney (2004) find that mothers who get pregnant during booms have worse behavior during their pregnancy leading to worse health outcomes for babies conceived in low unemployment periods in the United States. We find little evidence of this in our setting. In particular, our IV estimates are much smaller than our OLS estimates suggesting that part of the negative impact of booms on health could be endogenous. However, we do not have information on health behavior during pregnancy like they had in the US thus making it impossible for us to check whether our causal estimate also suggests lower incidence of smoking, drinking, using drugs, etc.

We show that our estimations are robust to various variations, does not seem to be driven by a particular time period or a particular region. We also show that the results remain when we control for the economic conditions at the time of birth, suggesting that it is more the fertility decision that is dependent on economic decisions and not that the boom influences what mothers do during the 9 months of their pregnancy.

The rest of the paper is organized as follows: the next section presents the empirical strategy and Section 3, the data. Section 4 then presents the empirical results and the last section concludes.

2 Empirical strategy

The key empirical relationship we wish to estimate is how local economic conditions may influence fertility decisions. Denote an outcome Y_{ct} as the average outcome of births in county c that were conceived at time t. We would like to correlate this with measures of how well the economy is doing, at that moment in time and in that particular geographical location. Let us imagine that we would focus on the employment rate as one of such measures and denote it as X_{ct}. Given the type of panel data we have, we can think of the regression we would estimate as

$$Y_{ct} = \beta X_{ct} + \nu_c + \delta_t + \varepsilon_{ct}$$

The problem is that the omission of relevant and unobservable factors biases the estimation of β using OLS. These omitted variables may be own income, household income, empleability, education, etc. We are further plague by a problem of simultaneity since it may be that fertility influences the fraction of women in the labor force and through that, the employment rate. The standard errors are clustered by county to allow flexibly for serial correlation within each county.

We will thus propose an instrumental variable as a solution to this problem. A good instrument would be a source of variation of local economic conditions that would be uncorrelated with local fertility patterns and labor supply decisions. We propose here using shocks generated by international commodity prices. However, since we want an instrument at the local geographical level, we must generate a way in which these international commodity prices affect different regions of a country at the same time. Our solution is to weight the impact of different commodities by the relevance importance of each commodity in the local economy. While this can be done in many different ways, the easiest one and the one for which we have the best data is the employment share of these sectors in a period before we measure the shocks. Formally, our instrument will be

$$Z_{ct} = \sum_{i=1}^{7} \frac{N_{ci1992}}{N_{i1992}} * P_{nt}$$

where N_{cnt} represents the number of workers employed in sector n, in county c in quarter t and P_{nt} the price index of sector n over time. Thus, our price instrument documents in which regions would the price of products have increased more rapidly if the industrial composition had remained the same as in 1992 since this is closest Census to the data we are analyzing that is available 100 percent in summary tables by Redatam, a subdivision of CEPAL. We thus prevent regions from increasing their involvement into a particular sector in response to price shocks to make sure that supply factors do not influence our measure. We include 6 different sectors of relative importance in Chile namely copper, other metal mining, agriculture, petroleum, fisheries and forestry. We

also include a residual sector which includes services and manufacturing so that the weights sum to 1 in each county. We assign these sectors prices of commodities that are relevant to them respectively: copper, metals, food, petroleum, fish flour and cellulose. We obtain the first two from the International Monetary Fund (no date) and last four from the SOFOFA (no date). For the residuals, we assign it the Wholesale Price Index for domestic manufacturing, published by the Chilean Central Bank.

For example, let us assume that county A had 80% manufacturing and 20% of agriculture and county B had no mining activity but 90% agriculture in 1992. Our instrument thus would make it such that when food prices are on the rise, the second county would have a larger predicted price index while it would not influence much county A. On the opposite, if copper prices are increasing, then county A would see its economic activity improve but not county B. Given that our regression includes fixed effects for county and quarter, we are exploiting how the change over time in county A will differ from county B, taking into account that these two counties are very different and thus may have different levels of fertility.

What are the challenges with using this instrument? First, we may think that the importance of a commodity in a given county is endogenous to the changes in the prices that would be anticipated and somehow correlated with fertility decisions. However, we can easily think that the specialization levels of each region in Chile are much more likely to be correlated with natural resources endowment than with anticipated price shocks. Thus, it is unlikely that changes in endowments would be correlated with fertility decisions, in particular at a quarterly frequency, which is the time-horizon our data provides us with. There is also no evidence that 1992 would be a particularly special year in Chile's economy, thus leading us to believe that using the fractions from that year would not likely contaminate our results.

As is usual in this type of instrument, we must also show that the price indices are not responding to local conditions. Given that we use prices of commodities determined on world markets, it is difficult to believe that Chile, a relatively small economy, would have a large influence over those. The only good where Chile is a relatively large player is copper where it gathers about 35 percent of the world's production. Despite that, the market for copper is determined on metal stock markets with strong competition forces. We thus see as not highly possible that local economic conditions in copper-producing regions of Chile would significantly affect world prices. Furthermore, a large amount of fluctuation in the price of copper over the period we are analyzing has more to do with demand forces than supply.

Despite the fact that we believe that this instrument is unlikely to be correlated with fertility decisions except through economic conditions, we chose not to present the IV because we fear that the exclusion restriction is unlikely to hold since the only measure of economic conditions we have

at a local level is the employment rate[1]. Thus, it seems to us a bit far-fetched to believe that our "predicted price index" only affects fertility through one measure of economic activity which is the employment rate. Nevertheless, we will show that our predicted price index significantly affects the employment rate at the local level.

3 Data

To achieve the estimations we presented above, we need to measure birth outcomes at a high frequency in each county of Chile over a long enough horizon to observe commodity price fluctuations. We employ the Census of all births in the country between 1994 and 2011, from the DEIS (no date). While not freely accessible, researchers who justify the purpose of their query can obtain access through a web page. The database includes every single birth, codified by the date of birth of the child and the county of residence of the mother. The database is amazingly rich including information regarding the gender, weight and gestational age of the baby and details regarding the delivery (doctor versus midwife, at home versus hospital, etc). It also includes a large set of information regarding the parents: education, age, urbanicity, marital status, labor force status and occupation. What it does not include is information about pre natal care nor actions taken by mothers during their pregnancy. Aggregated by quarter of conception and county leads to a group of 346 counties and 69 periods for a total of 23,874 observations.

However, in order to test whether conditions in place at the moment of birth are relevant, we also aggregate the data by quarter of conception, quarter of birth and counties. In general, quarters of conception have 2 and up to 3 different quarters of birth link to them (premature, on schedule and late births). This makes our database much larger reaching more than 50,000 observations. Nevertheless, most results are unchanged by the use of one aggregation or the other.

To construct natality rate, we must also count on the number of women in each county. We rely on the intercensal estimates of the Instituto Nacional de Estatisticas (INE, no date). Employment rate is obtained only at the regional level from INE (no date). Since we do not have the information at the county-level, we assign to each county the data for the employment level of the region it belongs to. We also, as an alternative, use the employment rate of the household survey (CASEN) which is available at the county level but at a bi or tri-anual basis, leaving us without the high frequency variation we sought to generate.

Table 1 present the main characteristic of our basic sample. On average, we observe about 180 births per quarter per locality, translating into an average rate of 14 births per 1,000 women. Of these births, about 42 percent are first births while the average birth makes the woman have her

[1] Actually, the employment level is not available at a quarterly frequency at the county level but only at the region level

second child. Thirty percent of all births are under the supervision of a doctor, while 68 percent are attended by a midwife. Almost all births are within a hospital or clinic. Health-wise, only a very small fraction of babies are very premature and very low birth weight. About 5 percent weighted less than 2.5kg. This period is one where children are more and more likely to be born out of wedlock with, on average, about 57 percent of births being to single mothers.[2] Finally, at the moment of the birth, 84 percent of fathers are working but only 20 percent of the mothers are. About 4 percent of both mothers and fathers report high-earning occupations. This is even larger than the fraction who completed university education (13 percent of women, 15 percent of men). On the other hand, 57 percent of mothers and 50 percent of fathers had not completed high school. The figures are almost the same when dividing the sample by quarter of conception and birth, except for measures of fertility that are a bit more than halved.

4 Empirical results

4.1 First stage

We now present the results of the above regressions using the data we just described. First, we demonstrate that there is a strong relationship between our predicted price index and our measure of economic activity, namely the employment rate. Table 2 presents the relationship between our endogenous variables and our instrument. We find a very strong relationship between the employment rate and the instrument, whether we measure it at the regional level but at quarterly frequency, like in column (1), or at the county level but at an bi-annual frequency in the Casen, like in column(2). We then show that the results are similarly strong at the beginning or at the end of the period (in the next two columns). Finally, we also show that we can exclude some key regions like the metropolitan region or the North (where most of the mining industries are concentrated) and the results remain as strong, as can be seen in the last two columns.

We then explore how exactly our price index alters the aggregate employment rate. We can only do these exercises using the bi-annual data from CASEN but it is still illustrative of how international commodity prices appear to affect local economic conditions. Table **??** show, in the first column, the aggregate result where the top panel replicate the second column of the previous table. The first column indicates that in aggregate, the shock affected only employment rates and not labor-related income, as shown in Panel B. Non-labor income, on the other hand, does appear to rise slightly. Columns (2) and (3) next separate this by gender and indicate in part the reason for this pattern. Only men's employment rates respond to the commodity prices, something that is reassuring since the commodity sector is highly male-dominated. Once more, we see no impact

[2]Chile now is the OCDE country with the most out-of-wedlock births at 71.1 percent in 2014.

of the price shocks on labor earnings, indicating that the commodity prices mostly stimulated employment without raising wages. The aggregate increase in non-labor income appears to be highly concentrated among women. Once we look at this more carefully, we find that this is due to a significant increase in government transfers, in particular, transfers that are linked to the number of children that poor individuals have under their supervision. Thus, we see this result on income as being another reflection of the main result of our paper. Finally, when dividing the sample by the sector of the economy where they are working, one confirms the validity of our instrument. Commodity-intensive sectors (agriculture and mining) expand when international price shocks raise the value of their output while manufacturing shrinks (it is negatively impacted by the terms of trade that are generated by the commodity booms). Service sectors are unaffected. Finally, note that the labor and non-labor income are non-responsive, suggesting that our aggregate result stems mostly from women who are not working.

4.2 Impact on natality

Having shown that our price index is strongly altering the local employment rate, in particular of that of man, we now turn to exploring how this local economic shock affected fertility-related outcomes. In Table 5, we show the relationship between our endogenous variable and our instrument and two measures of fertility. In the top panel, we look at the birth rate while in the bottom panel, we present the log number of birth. In the first column, we use the quarterly measure of employment while in the second, we use the data from the CASEN. In both columns, there seems to be a positive correlation between the share of the population that is employed and the fertility measures. However, it is only significant for the bi-annual measure. Once we use our instrument, we find evidence that an exogenous shock to local economic conditions lead to higher fertility, as measured by both the birth rate and the log number of births. This replicates the existing result in correlations or causally estimated in other contexts, that is evidence that more income leads to more births. However, we find significant differences between our causal estimate and the correlations we present in the first two columns. If we were to scale our reduced-form measure by the first stage, we would find that the IV estimate would be much larger than the OLS, suggesting that there is a downward bias in the correlations.

An increase in the weighted price index of a comuna of 1 percent increases the log number of births by 0.3 and the birth rate by 9 per 1,000 woman (from a base of about 18). If we were to assume that the only way in which our price index is affecting fertility is through changes in employment rates (which we do not do since we think it is unlikely to hold), this would suggest that a change of 1 percent in the employment rate would increase the number of births by 12 percent. In our period, once we take into account fixed effects for county and quarter, the employment rate has a standard deviation of about 0.02 suggesting that a one standard deviation change in the

employment rate would have impacted the log number of births in about 0.24 percent.

Now, this positive effect could be linked to the fact that some women have more children or because more women have one child. Our data, compared to previous work, has the richness to allow us to do this distinction, as shown in Table 6. The first column regresses on our index the fraction of births that were for first time mothers in each quarter. The second and third column measure the average rank of the birth and the average rank of the child, respectively. The difference between these two stems from child deaths. What our results suggest is that exogenous local income shocks are less likely to lead to births to first-time mothers and more likely to increase higher-order births. This is likely to be related to the income versus substitution effects that local income shocks may generate in terms of fertility. For first-time mothers, who are likely to be working at the time of conception, an increase in economic opportunities may reduce one's incentives to want to interrupt their work to have a child. This would imply that or them, the substitution effect dominates. On the other hand, for women who already have had a child and who are less likely to be working, better local economic conditions may have mostly an income effect. In response to better conditions, these women appear to decide to expand their existing family. The magnitudes are such that a one-standard deviation in our instrument decreases the fraction of birth to first time mothers by about 1 percentage point and increases the number of births that a mother has had by about 0.04. The results for the OLS, while not reported, suggest that the correlation would have been misleading suggesting a positive association with the probability of being a first-time mother and a decrease in the rank of the birth.

4.3 Impact on parent's identity and family formation

Having shown that commodity prices increase fertility, in particular on the extensive margin, we now check whether the identity of parents changed in some observable characteristics. Again, we anticipate that women for which the substitution effect dominates would be likely to decrease their fertility in response to a commodity booms but that women for whom the income effect dominate would have more children.

The first columns of Table 7 show that in periods of boom, both low-education and high-education parents seem to have more children. This is because we see a positive and large coefficient on the fraction of mothers and fathers who were university educated and a negative coefficient on the fraction of parents with high school education. Given that the sum of the two coefficients is negative, this tells us that we also saw an increase in the fraction of parents who have less than high school education. This may be because these women see the income effect of the shock, one because they are so poor and the others because they have high earning spouses that benefit from the shock.

We then look at the probability that the parents report working at the time of the birth. We find that mothers and fathers are more likely to report that they were working at the moment of the birth if the baby was conceived at a moment of good local economic conditions. However, the coefficient are not significant for both genders. However, the results also suggest that babies conceived during commodity booms are more likely to have parents who are of high occupational categories. Since we did not observe an increase in the fraction of women employed in the aggregate data, we find this suggesting that the type of parents has been altered towards individuals who are more likely to have high-ranked occupations in times of economic booms.

Finally, the last column looks at the probability that the parents are unmarried. We only include information regarding the mother since marital status of the father is not measured. What we find is that babies conceived in times where local economies are benefited by international commodity price booms are less likely to be born to a single mother than those born in less favorable periods.

While not presented here, we find no evidence of change in the age distribution of parents in this case.

4.4 Health outcomes

Finally, since previous literature has highlighted a potential link between economic conditions and health of newborns (see Dehejia and Lleras-Muney, 2004), we explore the link between a number of measures we have of the quality of birth experience and the health of the new babies. Table 8 shows, in the first panel, the correlation between the employment rate and these outcomes while Panel B shows the reduced form with our price index. The outcomes we measure are first whether a doctor, a midwife or none of the two was attending the birth. This is shown in the first 2 columns. It must be noted that births in Chile are usually attended by a midwife who is a trained nurse. In private hospitals and in difficult cases, this is supplemented with a doctor. We then use an indicator variable of whether the birth occurred at a hospital or not. Column (4) then measures whether the birth occurred before 28 weeks of gestation. Finally, the last 2 columns indicate whether the baby was born with a weight of less than 2.5kg and 1.5kg, respectively. We document that while there is a positive correlation between the economic conditions at the time of conception and the quality of care received at the time of the birth, once we take care of the endogeneity, we see no impact on who is attending the birth and potentially even a negative impact of better economic conditions on the probability of having a birth in a hospital. Given the fact that almost all babies close to urban areas are born in hospital, we see this as suggesting that women in rural or more isolated areas are more likely to have a birth in times of commodity booms and that this translates into a few more births outside of the hospital.

We then turn to how economic conditions at the time of conception affect the likelihood that

babies be born with health difficulties. We do not have the APGAR score but use gestational age and birth weight as measures of health at birth. We find no evidence that the causal relationship between these variables and income shocks to be significant. This seems to suggest that in this context, we do not find that the "marginal" children conceived in periods of booms are more likely to suffer health difficulties at birth.

The fact that our results differ from Dehejia and Lleras-Muney (2004) could be in part due to the fact that we do not use correlations but instead focus on a causal channel. However, in Panel A, we also find no significant relationship between health of babies and our measure of employment rate. This may be because marginal women in Chile receive better prenatal care than in the US. However, our results point mostly to the fact that the marginal woman who decides to have a child in good economic times be much less vulnerable, in great part because of more involvement by the father.

5 Robustness checks

We have thus shown that exogenous shocks in local economic condition at the time of conception significantly raises the probability that babies be born 9 months later, mostly through the intensive instead of the extensive margin. It also changed the characteristics of who is having children. However, there are alternative explanations for the patterns we identify that we here explore sequentially.

5.1 Birth versus conception

While we have so far argued that our results highlight the fact that when economic conditions are better, some individuals decide to conceive more babies, an alternative interpretation would be that when economic conditions are better, more babies are carried to term. Furthermore, the fact that more babies are born to parents with given characteristics could not be due to the fact that these parents decide to conceive more children but that economic conditions at the time of birth are influencing what they report on the birth certificate.

To explore this in more details, we first reconstruct our data by quarter of conception AND quarter of birth. Given that babies are born at different gestational age, this implies that we usually have 2 or 3 quarters of birth for every quarter of conception. We then generate another price index which this time measures exogenous shocks at the time of birth, instead of conception. These two measures are clearly correlated but still provide some differences that can be exploited. Thus, the thought experiment is now the following. Take two babies that were born in the same quarter of birth but were conceived in different quarters. One of these babies had a quarter of conception that

had better local economic conditions than the other because of shifts in international commodity prices. Are the characteristics of these two babies likely to be different?

Table 9 shows, for a few outcomes, the results of combining both price indices in a single regression. The first two columns suggest that our aggregate fertility result is solely driven by changes in economic conditions at conception and not at birth. This is not surprising given the low level of perinatal mortality in Chile. Columns (3) and (4) then examine our results on extensive and intensive margins. We find that the negative impact on the probability that the baby be a first born remains but loses significance once both variables are included. The increase in the number of children born to each mother does keep its significance but its magnitude is decreased. Given the highly correlation between the two price index measure, we see this as suggesting that our results are not driven by economic conditions at birth but rather a change in the family fertility's decisions. Finally, the last column explores whether our compositional measures may also depend on the conditions at birth. We find no evidence that the rate of single motherhood is lower because good economic conditions at birth generate more pre-birth marriages. The results suggest that our interpretation that more married women chose to have children in good economic times is maintained. While we only present this outcome, we find similar conclusions for all of our compositional measures, suggesting that our results are not driven by changes in characteristics between the moment of conception and that of birth but instead in a reaction of different types of individuals to the local commodity booms.

5.2 Composition versus behavioral changes

We have previously shown that the educational composition of mothers is altered by the exogenous economic shock we exploit. We now explore whether the other results we document may be entirely driven by this shift across educational groups.

To do so, we re-estimate all of our regressions but separately by educational attainment group of the mother, dividing it by the same way as we had in Table 7. The top panel thus shows the impact of the economic fluctuations to fertility outcomes of mothers with less than high school, Panel B focuses on high school educated mothers, and the bottom panel on university educated mothers. We focus on a few outcomes but the results are similar when looking at others. Specifically, we look at whether the birth correspond to the first one in Column (1), to the number of children and births, in the following two columns, to the fraction of births to single mothers in Column (4) and finally, to the characteristics of fathers in the last two columns.

We find that most of our conclusions do not appear to be driven by compositional changes. We even find that some of the changes within educational group were hidden in aggregates. The first column suggests that the decrease in the probability that children conceived in a given quarter

were first born is particularly strong for women with high school diplomas. It is also the same sign but not significant for women with a university degree. The only group for which we observe an increase in the probability of a first born is the group without high school for which the income effect appears to dominate even for the extensive margin of fertility decisions. The increase in the intensive margin is found most strongly for the lowest two educational group of the mother. For university educated women, we do not see a statistically significant pattern.

We then look at the probability that a child be born to a single mother and finds that in none of the groups we find a statistically significant relationship. The negative aggregate pattern is observed for the two highest educational categories. However, we lose much precision by doing it separately, thus implying that none of the effects are statistically significants.

Next, we study how the characteristics of the father change depending on how local economic conditions are moving. We find that the non-statistically significant relationship between external price shocks and the probability of the father being employed hides heterogeneity by mother's educational level. For all mothers with at least a high school diploma, we find that good local economic conditions lead them to be more likely to declare that the father is employed at the time of the birth. However, for mothers without a high school diploma, the effect is opposite. This suggests that women without a high school diploma are more likely to have babies with men who are less attached and less "good" in terms of economic situation when faced with better local economic conditions while the opposite is true for mothers of higher educational category. This may be because the income effect leads these poor income women to be willing to bear the cost of having a child, even without a father present, while this is not the case for higher socio-economic characteristic women. Finally, our effect on higher occupations for fathers is completely concentrated amongst women of similar educational attainment.

Overall, we thus find little evidence to believe that the aggregate results we documented in the main part of the paper are simply due to a change in the educational attainment of women and not also to change in behavior of these different women in our sample.

6 Conclusions and future research

Overall, this paper has shown that births are procyclical when measuring the income shocks using a plausibly exogenous shock to local economic conditions stemming from international price changes. We are able to show that this is much more due to families getting larger than to new families forming. We document also a change in the identity of the parents and limited impact on health outcomes of newborns. Overall, this seems to suggest a strong income effect and a very limited substitution effect in response to the local economic shocks.

We think that this is interesting since it suggests that local communities may benefit in more ways than one from these commodity price booms. The fact that the extensive margin responds more than the intensive one also sheds important light over the relative opportunity costs faced by women starting a family versus increasing their number of children. We think that this is important policy lesson since this margin has been occulted previously for lack of data.

Our results also highlight the potential beneficial impact of local economic conditions on family composition and fatherly presence at the moment of birth. This is particularly interesting given the beneficial impact seen in other settings on fatherly presence. We think that this is an interesting avenue of future research.

7 References

References

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8 Figures and Tables

Table 1: Summary Statistics

Data by	Quarter of Concep.			Quarter of Concep. and Birth		
Variable	N	mean	sd	N	mean	sd
Births by comuna	24938	181.14	295.41	50645	87.19	181.53
Ln(births)	24938	4.145	1.609	50645	3.177	1.711
Birth rate	24894	14.75	19.03	50620	7.253	12.259
First born rate	24409	0.418	0.111	50627	0.419	0.196
Number of children	24409	2.019	0.336	50627	2.019	0.512
Number of births	24409	2.060	0.353	50627	2.064	0.536
Premature (less than 28 weeks)	24409	0.003	0.013	50645	0.043	0.191
Low birth weight	24383	0.054	0.053	50575	0.117	0.207
Very low birth weight	24383	0.009	0.021	50575	0.054	0.191
Presence of doctor at birth (rate)	24409	0.310	0.191	50645	0.330	0.249
Presence of midwife at birth (rate)	24409	0.681	0.193	50645	0.662	0.249
Birth at hospital (rate)	24409	0.983	0.067	50645	0.984	0.071
Single mother rate	24409	0.575	0.168	50645	0.574	0.228
Mother working (rate)	24397	0.205	0.155	50624	0.210	0.201
Mother of High Rank Occupation	24409	0.039	0.069	50645	0.041	0.092
University educated mothers	24396	0.135	0.135	50588	0.139	0.171
High School educated mothers	24396	0.294	0.150	50588	0.299	0.209
Mothers with less than HS education	24396	0.571	0.198	50588	0.561	0.251
Father working (rate)	24409	0.839	0.216	50645	0.839	0.245
Father of High Rank Occupation	24409	0.044	0.078	50645	0.047	0.101
University educated fathers	24409	0.150	0.147	49911	0.155	0.183
High School educated fathers	24349	0.278	0.153	49911	0.284	0.209
Fathers with less than HS education	24409	0.494	0.185	50645	0.484	0.243

Table 2: First Stage, impact of Price Index on employment rate

	(1)	(2)	(3)	(4)	(5)	(6)
	INE	CASEN	INE before 2002	INE later 2002	INE no MR	INE no North
Price Index	0.025***	0.041***	0.024***	0.021***	0.018***	0.015***
	(0.005)	(0.014)	(0.008)	(0.006)	(0.007)	(0.005)
R2	0.846	0.751	0.868	0.866	0.815	0.867
rmse	0.016	0.038	0.014	0.015	0.017	0.015
N	24,938	2,259	12,132	12,806	21,090	21,756

Table 3: Impact of Price Index on employment rate and income by gender and industry, CASEN

	(1) Aggregate	(2) Males	(3) Females	(4) Agriculture	(5) Manufacturing	(6) Mining	(7) Services
				Employment Rate			
Price Index	0.041***	0.048***	0.021	0.041**	-0.026***	0.017**	0.004
	(0.014)	(0.018)	(0.019)	(0.017)	(0.007)	(0.008)	(0.017)
R2	0.751	0.698	0.754	0.860	0.731	0.892	0.871
rmse	0.038	0.048	0.052	0.044	0.019	0.011	0.042
				Labor Income			
Price Index	0.034	0.058	-0.040	-0.035	-0.056	-0.254	-0.016
	(0.071)	(0.076)	(0.090)	(0.136)	(0.182)	(0.241)	(0.074)
R2	0.816	0.812	0.751	0.635	0.584	0.547	0.733
rmse	0.187	0.208	0.216	0.352	0.380	0.574	0.212
				Total Income			
Price Index	0.157**	0.094	0.210**	-0.065	-0.052	-0.226	-0.017
	(0.069)	(0.077)	(0.087)	(0.136)	(0.176)	(0.231)	(0.073)
R2	0.834	0.818	0.792	0.637	0.588	0.547	0.734
rmse	0.186	0.207	0.217	0.348	0.373	0.568	0.211
N	2,259	2,259	2,259	2,259	2,259	2,259	2,259

Table 4: Impact of Price Index on employment rate and income by sector, CASEN

	(1) Agriculture	(2) Manufacturing	(3) Mining	(4) Services
		Employment Rate		
Price Index	0.041**	-0.026***	0.017**	0.004
	(0.017)	(0.007)	(0.008)	(0.017)
R2	0.860	0.731	0.892	0.871
rmse	0.044	0.019	0.011	0.042
N	2,259	2,259	2,259	2,259
		Labor Income		
Price Index	-0.035	-0.056	-0.254	-0.016
	(0.136)	(0.182)	(0.241)	(0.074)
R2	0.635	0.584	0.547	0.733
rmse	0.352	0.380	0.574	0.212
N	2,207	2,235	1,377	2,259
		Total Income		
Price Index	-0.065	-0.052	-0.226	-0.017
	(0.136)	(0.176)	(0.231)	(0.073)
R2	0.637	0.588	0.547	0.734
rmse	0.348	0.373	0.568	0.211
N	2,207	2,235	1,377	2,259

Table 5: Impact of employment rate on births

	(1) OLS	(2) OLS	(3) RF
	A. Birth Rate		
Employment	2.452	5.199***	
	(8.149)	(2.010)	
Price index			8.840*
			(5.225)
R2	0.145	0.616	0.145
rmse	17.750	2.599	17.743
N	24,894	2,258	24,894
	B. Log of Number of Births		
Employment	0.354	0.496**	
	(0.257)	(0.207)	
Price index			0.269***
			(0.097)
R2	0.967	0.975	0.967
rmse	0.295	0.239	0.295
N	24,938	2,259	24,938

Table 6: Impact of employment rate on extensive and intensive margin of fertility

	First child (1)	Number of children (2)	Number of births (3)
Price index	-0.049***	0.156***	0.152***
	(0.014)	(0.040)	(0.040)
R2	0.122	0.256	0.257
rmse	0.105	0.292	0.307
N	24,409	24,409	24,409

Table 7: Impact of employment rate on fertility by parents education

	(1) University educated	(2) High school educated	(3) Employed	(4) High-rank occupation	(5) Single
			A. Mothers		
Price index	0.067***	-0.098***	0.013	0.042***	-0.040**
	(0.015)	(0.017)	(0.013)	(0.012)	(0.016)
R2	0.724	0.614	0.679	0.617	0.629
rmse	0.071	0.094	0.089	0.043	0.103
N	24,396	24,396	24,397	24,409	24,409
			B. Fathers		
Price index	0.086***	-0.086***	0.014	0.045***	
	(0.014)	(0.019)	(0.011)	(0.010)	
R2	0.735	0.589	0.899	0.677	
rmse	0.076	0.099	0.069	0.044	
N	24,349	24,349	24,409	24,409	

Table 8: Impact of employment rate on health outcomes

	Doctor (1)	Midwife (2)	Hospital (3)	Premature (4)	LBW (5)	VLBW (6)
			A. OLS			
Employment	0.246***	-0.226**	0.187***	-0.003	0.024	0.015
	(0.085)	(0.096)	(0.061)	(0.023)	(0.024)	(0.009)
R2	0.686	0.666	0.466	0.123	0.074	0.055
rmse	0.108	0.112	0.049	0.053	0.051	0.021
N	24,409	24,409	24,409	24,409	24,383	24,383
			A. Reduced form			
Price index	0.010	-0.023	-0.030**	0.013	0.008	0.004
	(0.039)	(0.039)	(0.014)	(0.010)	(0.006)	(0.003)
R2	0.685	0.665	0.465	0.123	0.074	0.055
rmse	0.108	0.112	0.050	0.053	0.051	0.021
N	24,409	24,409	24,409	24,409	24,383	24,383

Table 9: Impact of exogenous economic shocks at conception and birth

	(1) Birth rate	(2) Log number of births	(3) First child	(4) Number of children	(5) Single mothers
Price index	4.730**	0.584***	-0.010	0.097*	-0.052**
at conception	(1.978)	(0.138)	(0.023)	(0.058)	(0.020)
Price index	-1.359	-0.066	-0.019	0.062	0.007
at birth	(1.098)	(0.132)	(0.022)	(0.055)	(0.022)
R2	0.443	0.547	0.041	0.095	0.329
rmse	9.191	1.157	0.193	0.490	0.188
N	50,620	50,645	50,627	50,627	50,645

Table 10: Impact of exogenous economic shocks on fertility decisions, by education of the mother

	(1) First Child	(2) N. of Children	(3) N. of Births	(4) Single mothers	(5) Father employed	(6) Father high occ.
			Less than High School Diploma			
Price index	0.009	0.112**	0.104**	0.014	-0.060***	0.001
	(0.017)	(0.050)	(0.051)	(0.022)	(0.016)	(0.002)
R2	0.092	0.179	0.184	0.562	0.852	0.270
rmse	0.124	0.359	0.379	0.119	0.087	0.019
N	24,227	24,227	24,227	24,227	24,227	24,227
			High School Diploma			
Price index	-0.061**	0.087*	0.075	-0.026	0.036***	0.007
	(0.024)	(0.050)	(0.050)	(0.022)	(0.014)	(0.006)
R2	0.104	0.121	0.116	0.438	0.813	0.175
rmse	0.171	0.327	0.337	0.163	0.102	0.056
N	22,407	22,407	22,406	22,407	22,407	22,407
			University			
Price index	-0.000	-0.022	-0.037	-0.025	0.054***	0.085***
	(0.035)	(0.070)	(0.070)	(0.033)	(0.020)	(0.028)
R2	0.062	0.099	0.095	0.297	0.647	0.262
rmse	0.252	0.481	0.495	0.241	0.152	0.194
N	21,696	21,696	21,696	21,696	21,696	21,696