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The Weight of the Crisis: Evidence From Newborns in Argentina*

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Abstract

Argentina hit world news headlines in 2002 due to the largest debt-default in history and a sudden economic collapse reminiscent of economic statistics from the Great Depression. In this article, we focus on other consequences of the crisis that are not so obvious, but that may linger for decades on. Combining macroeconomic indicators with the Argentine national registry of live births, approximately 1.9 million live births occurring between 2001 and 2003, we show that the crisis led to an average birth weight *loss* of 30 grams. Our estimate is robust to different identification strategies. This deterioration in birth weight occurred in just about 6 months, and represents one sixth of the difference in average birth weight between American and Pakistani babies. We also find that the crisis affected particularly the weight of babies born from low-socioeconomic status mothers. In an attempt to estimate the long-lasting economic cost of the crisis, we simulate the average loss of future individual earnings due to the reduction in average birth weight: about 500 US dollars per live birth in present value.

Keywords: Argentina, birth weight, economic crisis.

JEL Codes: I1, J1.

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1 Introduction

Economic crises might affect children health, and in particular *birth weight*. During recessions households might be prompted to reduce spending on inputs to child health, including nutritious food or medical care for mothers and infants. On top of that, economic contractions are likely to affect prenatal stress, increasing the risk of adverse birth outcomes, and may also cause public health services to deteriorate.

We investigate the effect of the Argentine crisis that began in August 2001 on birth weight. Argentina was shaken by a *traumatic* financial crisis at the turn of the century: its output declined about 11% only in 2002, while it had been decreasing another 7% between 1999 and 2002. At the peak of the crisis, one out of four Argentineans could not even afford buying basic foodstuffs[1] and almost 2 out of 3 were poor.[2]

The occurrence of this Argentine macroeconomic episode, combined with the existence of a national registry of live births, offers the possibility to study the effect of a crisis on the weight of the newborns using approximately 1.9 million live births occurring between 2001 and 2003. We find that in just about 6 months, the weight of newborns in a middle-high income country like Argentina deteriorated in a magnitude that is comparable to one sixth of the difference in average birth weight between American and Pakistani childbirths.

We choose birth weight as our outcome of interest.[3] First, birth weight is a strong predictor of survival (Mc Cormick, 1985): infants who weight less than 2,500 g (low-birth-weight infants) are 20 times more likely to die than heavier babies (UNICEF/WHO, 2004). In fact, birth-

[1] Technically, these were individuals who lived in households whose total income was below a basic foodstuff basket (canasta básica alimentaria) that covers the minimal nutritional requirements for an individual of certain sex and age. For instance, in September 2001 the cost of the basic foodstuff basket was estimated to be at $ 61.02 per month per adult equivalent (the exchange rate used for the conversion was the 1 to 1 parity to the U.S. dollar). More references can be found in an online report prepared by Argentina's National Institute of Statistics and Censuses (INDEC), available at http://www.indec.mecon.ar/nuevaweb/cuadros/74/pobreza2.pdf. Related statistics derived from the periodical National Household Survey (Encuesta Nacional de Hogares) can also be obtained at the INDEC website, http://www.indec.mecon.ar

[2] That is, the proportion of individuals living in households under the poverty line. For reference, the poverty line in September 2001 was estimated to be at $ 150.11 per month per adult equivalent.

[3] Margerison (2010) offers a detailed account of possible pathways linking economic recessions and birth outcomes.

weight-specific neonatal mortality follows a reverse J-pattern, with minimal risk of mortality at about 3,500 g (Wilcox, 2001). Lower birth weight babies have worse outcomes in terms of one-year mortality rates (Van den Berg, Lindeboom and Portrait, 2006) and are significantly shorter through childhood (Case and Paxson, 2010).[4] Economic costs due to low birth weight are also substantial. For example, Almond, Chay and Lee (2005) show that increasing birth weight from 2,000 to 2,500 g reduces inpatient hospital bills by about US $ 10,000.

Second, recent longitudinal studies have shown that lower birth weight babies have worse outcomes in terms of educational attainment, employment and earnings (Behrman and Rosenzweig, 2004; Case, Fertig, and Paxson, 2005; Black, Devereux and Salvanes, 2007; Oreopoulos, Stabile, Walld and Roos, 2008; Royer, 2009). Not only that, but researchers have also found that cohorts affected by health insults *in utero* have lower educational attainment, on average, than do preceding and following birth cohorts that did not face the same health insult. Almond (2006) documents that children born to women infected with influenza during the 1918 pandemic received on average 5 months less education than children born before or conceived after this event. If current economic crisis affect the weight of newborns, economic recessions could result in poverty traps that affect not just the present, but future levels of welfare.

Previous research on the effects of economic crises on children health provides mixed results. Paxson and Schady (2005) find that in Peru infant mortality increased by 2.5 percentage points during a two year period during the macroeconomic crisis of the late 1980s. The authors explain such a finding because of a collapse in public and private expenditure on health. On the other hand, Rucci (2004) finds no change in infant mortality during the Argentine crisis of the late 1990s. According to the author, this is because there was no change in public health expenditures during the crisis years.

In this context, one of the main contributions of our work is the combination of a two million observation sample with an actual "event" study to show that an economic collapse

[4]Using data from the NLSY Child and Young Adult Survey, Case and Paxson (2010) find that children who were heavier and longer at birth are significantly taller through childhood, and taller children are less likely to have a limiting condition, to be reported as having an emotional or neurological limiting condition.

can lead to large losses in birth weight in a *short* period of time, complementing recent work on coffee price fluctuations and child survival in Colombia (Miller and Urdinola, 2010).

Our work is related to a large economic research agenda on the effects of in utero insults on birth weight, mainly nutrition (Ceesay et al., 1997) and psychosocial stressors (Hobel and Culhane, 2003), at different trimesters of pregnancy.[5] Economic contraction can lead to a loss of resources (worsened nutrition in-utero) and psychosocial stress (Margerison, 2010). Evidence coming from extreme cases of nutritional deprivation, such as the "Dutch Hunger Winter" (Stein et al., 2004), where food rations were reduced to below 1,000 Kcal/person for 7 months, indicates that birth weight for those exposed to famine in the *third* trimester registered a drop of about 300 grams. In a recent study based on 4 million childbirth events in Colombia, Camacho (2008) finds that the intensity of random landmine explosions during a woman's *first* trimester of pregnancy has a significant negative impact on child birth weight. We show that birth weight deficits in Argentina are correlated with economic conditions in *both* the first and third trimesters of pregnancy during 2001-2003.

We also find that socio-economic status (proxied by mother's education) could mitigate the effects of economic crisis, consistent with existing evidence linking maternal education and birth weight outcomes (e.g., Starsfield, 1991; Currie and Moretti, 2003; Currie 2009). The average birth weight loss for childbirths from low educated mothers is around 33 grams, while it is 19 grams for those from highly educated mothers.

Our main results are surprisingly robust to the addition of province *specific* time trends, suggesting that the drop in average birth weight was not driven by a reduction in either the quality or the quantity of public resources in children health. Additionally, if we link birth weight statistics with regional time varying household survey data, we document strong links

[5] Although the biological pathways linking psychosocial stressors and birth outcomes have not been completely elucidated, a neuropeptide (corticotrophin-releasing hormone, or CRH) involved in stress response and affecting the initiation of labor is thought to be a central factor. The role of CRH also matches well with the finding that job status (in particular jobs that demand physical exertion, and thus create physiological stress) are known to adversely affect birth outcomes. Recently, Aizer, Stroud and Buka (2009) find that in-utero exposure to elevated levels of the stress hormone cortisol negatively affects the cognition, health and educational attainment of offspring.

of average birth weight with indicators of deprivation, in particular regional extreme poverty (indigence) rates.

In a back-to-the-envelope calculation, we estimate that the reduction in birth weight that operated during the economic collapse reduced the income prospects of the crisis cohort in about 500 US dollars per childbirth. This is a lower bound estimate that does not take into account other long-term costs stemming from the crisis, such as the increased health burden in adult life.[6]

The paper is organized as follows. Section 2 presents a description of the data. Section 3 reports the estimates of the effect of the Argentine crisis on average birth weight. Section 4 provides an estimate of the loss in future earnings of the newborns affected by the crisis. Section 5 presents some robustness checks. Section 6 concludes.

[6] Adverse conditions at time of birth have been linked to heart disease, diabetes and obesity in adulthood, all of which factors in a reduced life expectancy.

2 The data

The main source of data in this study is the Argentine national registry of live births, *Informe Estadístico del Nacido Vivo* (IENV), which contains characteristics of live births. The main strength of this dataset is the universal coverage of all live births occurring in the country including demographic factors, fertility patterns of the mother and proxies of socioeconomic status. This micro-level dataset contains 1.9 million births occurring between 2001 and 2003 in Argentina.[7] Following previous work on the determinants of birth weight, we focus on mothers aged 15-49, exclude multiple births and those whose weight was under 500 g.

The core of our empirical analysis contains two well-differentiated parts. We first use *month-by-month* average birth weight comparisons between 2001 and 2002 to assess the effect of the crisis. In the second part, we link the *state of the economy* with average birth weight on a monthly basis between January 2001 and December 2003. The state of the economy is captured by means of an index of economic activity which replicates the fluctuations in the gross-domestic product (GDP), but at monthly frequencies.

2.1 Descriptive statistics

Argentina is an upper middle income country (World Bank, 2009), ranking as "high" in UNDP's Human Development Index (UNDP, 2009). In line with this, it has a relatively reduced prevalence of low birth weights (live birth babies weighing less than 2,500 g, UNICEF/WHO, 2004).

[7] Due to a change in the structure of the birth weight report form, data prior to the year 2001 is not directly comparable. Hence, our analysis focuses on short-term fluctuations between 2001 and 2003. In practice, however, this does not appear to be a concern. Previous studies (e.g. Grandi and Dipierri, 2008) show that the decline experienced during the crisis was not a reflection of a secular trend, but an acute phenomenon, occurring in a matter of a few months.

Table 1 shows summary statistics regarding the period 2001-2003.[8] Birth weight fluctuated between 3,263 and 3,231 grams in the period covered, resulting an average of 100 grams below U.S. standards (Martin et al., 2005). Consistent with this, the proportion of low birth weight (< 2,500 g) singletons is between 6.5 and 7%, slightly above comparable statistics from U.S. American babies. Infant Mortality Rates (IMRs) increased only slightly during the economic crisis, but resulted in a four-year period of stagnation after a period of two decades in which IMRs were halved. The second panel in the table shows selected economic indicators. Economic activity contracted about 10% in 2002, resulted in an economy which was 10.6% below its long run trend in the year of the collapse. Unemployment rates reached 20% of the active population and more than half of the population was poor, resulting from a combination of increased unemployment and a sharp contraction in real wages due to inflation pressures caused by a sharp depreciation of the national currency.[9] Different indicators of Public Expenditure in Child Health show a reduction of government expenditure targeted to children, consistent with the findings of Cavagnero and Bilger (2010).[10] Finally, the last panel shows that the characteristics of the mothers remained stable during the period: the age of the mother at birth was 27 years, 36% of mothers were primiparous, 35-40% had completed High School Education and 85% of them had a partner (involving marriage or cohabitation). We use completion of High School as a proxy for high socioeconomic status given that income information is not included in the demographic surveillance data.[11]

Fig. 1 shows the evolution of the index of economic activity (which replicates GDP fluctuations at monthly frequencies) and the average birth weight of babies born between January 2001 and December 2003. There is a "delay" between the evolution of the economic

[8] Although the IENV has a rich set of proxy measures for underlying risks of poor birth outcomes, it lacks complete information to determine health coverage status of the mother (type of health insurance) and employment status (particularly the employment status of the partner).

[9] By June 2002, the value of the peso against the US dollar was reduced to a quarter of the value it had in December 2001.

[10] These authors find that in terms of utilization of heath services, unemployment and job instability reduced private health plan coverage, which put an additional strain on the already underfinanced public health system.

[11] Returns to schooling, in particular completion of secondary (High School) education and college education, are large and thus represent a good proxy of income opportunities of mothers (Savanti and Patrinos, 2005).

crisis and the changes in average birth weight: although the crisis "peaked" in March 2002 (economic activity had declined by about 16% in a year by that time) birth weight was at its minimum in December of that year. This is what we expect, since birth weight is the cumulative effect of different inputs (e.g. nutrition, quality and quantity of medical checkups, maternal stress, etc.) during the nine months that a pregnancy usually takes, not just those prevailing at time of birth.

3 The effect of the Argentine economic crisis on average birth weight

3.1 Month-by-month estimates

In order to identify the effect of the Argentine crisis on the weight of the newborns, we need to take into account that fertility decisions are likely to be affected by economic conditions, something already acknowledged in the theoretical work of Becker (1974) and empirically shown by Dehejia and Lleras-Muney (2004) using US data, and more recently by Neugart and Ohlsson (2009) in a quasi-experiment that exploites the German parental benefit reform of 2007.

As long as fertility decisions are sensitive to macroeconomic conditions, sensible approaches to estimate the effect of the crisis involve accounting for the full set of characteristics of the mother (related to both macroeconomic conditions and birth weight) or using a quasi-experiment to estimate the impact of the crisis as the mean difference in birth weight between those babies who were and were not exposed to the crisis without anticipation by their mothers. Otherwise, the estimated effect of the crisis can be confounded by the compositional change in the pool of women having children.[12]

There are a plethora of studies documenting the role of different mother-and-pregnancy characteristics on birth weight. In an oft-cited meta-analysis assessment, Kramer (1987) cited 43 potential determinants of low birth weight ($<$ 2,500 g): age of the mother (with mothers under 20 and over 35 experiencing the higher risk of delivering a child with low birth weight); mother's education (mother's higher education is correlated with lower rates of low birth weight, Starfield et al., 1991); parity and birth order (Puffer and Serrano, 1975); behavioral factors (smoking and alcohol intake negatively affect birth weight, Brooke et al.,

[12] However, it must be noted that even when the full set of characteristics is available, compositional changes can create problems if there are interactions and other sources of non-linearities.

1989; Cornelius et al., 1995).

In practice, we adopt a mixed approach: both accounting for some characteristics (those that are both available and reliable) of the mother and her child, and comparing month-by-month average weights of babies born in 2001 and 2002 whose mothers did not anticipate the crisis in the moment of their conception.

A crucial task to implement the quasi-experimental design is to find a "cohort" of newborns who were conceived in a period where the extent of the crisis was not yet anticipated. In order to document the plausibility of this assumption, we resort to two pieces of evidence. The first one comes from looking at **Fig. 2**, from Kannan and Köhler-Geib (2009), which shows the degree of uncertainty around the period of the Argentine crisis, measured by the dispersion of GDP forecasts based on surveys of private sector analysts: the degree of uncertainty experienced a jump in August 2001. If we are willing to assume that anticipation can be proxied by lack of uncertainty, this Figure suggests that until August 2001 the crisis was unanticipated.

The second additional piece of evidence supporting this assumption comes from the evolution of the Consumer Confidence Index for Argentina depicted in **Fig. 3**, which indicates a similar pattern in terms of expectations, with consumer confidence levels dropping sharply after August 2001. Perhaps, more interesting (although not reported here) is the fact that the dropping in consumer confidence is of the same magnitude for both low and high socioeconomic status families.[13] The key point here is that the *magnitude* of the crisis was not expected, even though mildly pessimistic expectations might have prevailed for the whole period.

This paper is concerned about the impact of the crisis on live births. Unfortunately, there is poor information regarding the extent and the fluctuations in abortion, and this is

[13]The Consumer Confidence Index is updated monthly by the Universidad Torcuato Di Tella since 1998. It relies on a monthly survey of consumer expectations similar to those used in OECD countries. We thank the Center for Research in Finance (CIF) of Universidad Torcuato Di Tella, and especially Guido Sandleris, Ernesto Schargrodsky, and Julieta Serna for providing us access to disaggregate consumer confidence indicators.

complicated by the illegality of induced abortion. A recent study by Mario and Pantelides (2009) estimates the number of annual abortions using different indirect methods, which are valid approximations as general trends and not for projecting the evolution of abortion cases from year to year. Very crude and indirect indicators of abortion prevalence are the number of maternal deaths due to pregnancy terminating in abortion and the number of fetal deaths. These indicators have many shortcomings and no discernible trend can be established using data from the Official Statistical Yearbooks (Ministerio de Salud 2000-2007, Estadísticas Vitales). Although we cannot directly study the evolution of abortion during the period under analysis, we can proceed indirectly by looking at the fluctuations in the number of live births. **Fig. 4** shows that number of live births fluctuates in an erratic way with respect to the economic cycle, and not in a systematic way as average birth weight does.

Our comparison group is formed of babies who were both conceived *and* born before August 2001, while our treatment group is composed of babies who were conceived before August 2001 *but* born after August 2001. **Fig. 5** illustrates this. For example, a baby conceived in July 2001 with a 9-month pregnancy would be delivered in April 2002.

In order to account for seasonality effects (patterns) on birth weight, we compare the average birth weight in 2001 and 2002 month-by-month: January, February, March and April. Means of birth weight by month are estimated as the coefficients of the following model:

$$BW_{i,r,m,t} = \sum_{m=1}^{12} \delta_m I_m + \sum_{m=1}^{12} \theta_m Y_t I_m + \kappa_r + X_i \Gamma + \varepsilon_{i,r,m,t} \tag{1}$$

where $BW_{i,r,m,t}$ is the birth weight of child i born in province r in month m in year t, $I_m = 1$ if the month of birth is m, $Y_t = 1$ if the year of birth is 2002, $\kappa_r = 1$ if the province of birth is r, X_i is a vector of mother-pregnancy characteristics (age of the mother, number of pregnancies, mother's education and partner status), and $\varepsilon_{i,r,m,t}$ is a random error term. δ_m is average birth weight in month m, while θ_m is the difference in average birth weight in month m between 2001 and 2002. Equation (1) is estimated by OLS using clustered standard

errors at the "month-by-year" level (24 clusters).

Table 2 displays the monthly mean birth weight in 2001 and 2002 and its difference. The first panel uses as controls province and child gender dummy variables. In all four month-pair comparisons, birth weight in 2002 is lower than in 2001. The largest gap is found in April, almost 30 grams, while the smallest one is in February, around 7 grams. Interestingly, the April 30-gram gap is near to both the bottom of economic activity and the peak of social unrest. Similar estimates are reported in panel II (which adds mother's age and pregnancy categories as controls) and panel III (which additionally controls for mother's education and partner status).

These findings suggest that the crisis had a negative effect on birth weight, which was about 30 grams for babies born in the month of April. Babies born earlier in the crisis were less affected than those born in February and March, probably because the effects of the crisis operate in utero in a cumulative manner: children born in April 2002 were exposed to 9 months of crisis, while those born in February and March 2002 were exposed to 7 and 8 months of crisis, respectively.

Table 3 disaggregates results by sex of the newborn. Although all comparisons point towards a reduction in birth weight, boys are slightly more affected than girls. These findings are consistent with some evidence pointing that boys are particularly vulnerable to food supply shortages in utero (Eriksson, Kajantie, Osmond, Thomburg and Barker, 2010).

In **Table 4** we inquire about the differential effect of the crisis on average birth weight depending on mother's socioeconomic status, proxied for whether the mother completed High School Education. Regardless of the set of controls used, the decline in birth weight is particularly prevalent in boys and girls born to low-SES mothers. If anything, a higher socioeconomic status appears to "cushion" the impact of the crisis.

3.2 Economic cycle and average birth weight

3.2.1 Economic cycle at birth and average birth weight

To assess the state of the economy we calculate the deviation of the economic activity indicator with respect to its long run trend (expressed in log units). This deviation is usually referred to as "cyclical" component, in that it isolates business cycle fluctuations. We use a Hodrick-Prescott filter, which is a standard decomposition method to identify fluctuations at business cycle frequencies (i.e., booms and recessions).[14] In our case, the economy plunges into a deep recession fast enough, so that by mid 2002 economic activity is more than 10% below its long run trend.

We estimate models of the form

$$BW_{i,r,m,t} = \beta C_m + I_m + \kappa_r + Y_t + X_i\Gamma + \varepsilon_{i,r,m,t} \tag{2}$$

$$BW_{i,r,m,t} = \beta C_m + I_m + \kappa_r + \gamma t + X_i\Gamma + \varepsilon_{i,r,m,t} \tag{3}$$

where C_m is the cyclical component of the economic activity indicator during the month of birth m. Both models (2) and (3) contain two types of control variables. The first set of controls include: month of birth fixed effects I_m, to account for seasonality patterns in birth weight; province of birth fixed effects κ_r, to capture regional differences in health infrastructure and other factors fixed in time that vary across provinces; and time effects (either year fixed effects Y_t in (2), or a linear time trend t in (3)) to account for secular trends in birth weight. However, given our small time window (2001-2003), using a time trend, comes at a risk: the overestimation of the secular decline in birth weight.[15] The second set of controls, X_i,

[14] Since we are using monthly data we choose a smoothing parameter of 129,600 (Ravn and Uhlig, 2002). Our findings are not sensitive to the method used, as assessed by using other filtering methods.

[15] Grandi and Dipierri (2008) use data from 1992 until 2002 and find a secular reduction of birth weight of Argentinean babies of about 2 grams per year. The reduction in birth weight that operated in 2002 is, according to Table 1, of 30 grams in a single year. Also, the "secular trend" in the sample from 2001 to 2003

include: mother's age categories, parity categories, an indicator of whether the mother has high-school or above, an indicator of whether the mother is "living" with his partner (married or cohabiting), and the interaction of these last two variables. Unfortunately, we do not have information on smoking or drinking behavior as this is not collected in the birth registry information.

Table 5 displays a series of regressions of birth weight on economic cycle at birth and other variables for the full sample of boys and girls. The estimates indicate that average birth weight is positively associated with the cycle at birth. In other words, average birth weight is a *procyclical* variable. It should be noted, however, that if in utero conditions affect birth outcomes in a cumulative manner (that is, they operate, with more or less strength throughout the entire pregnancy period), one would expect business cycle lags to have also an influence on birth weight.

Looking at the rest of the coefficients on the table we can see that, at birth, girls are on average 103 grams lighter than boys, similar to the findings reported in Kramer (1987). Newborns of high-educated mothers are heavier than those of their counterparts, which resonates with findings linking maternal education and birth weight outcomes (e.g., Starsfield, 1991; Currie and Moretti, 2003; Currie, 2009).

In **Table 6** we report estimates from the last two specifications of **Table 5** for boys and girls separately. If anything, the estimated impact of the business cycle is slightly more important for boys than for girls, which is consistent with the estimates presented in **Table 3** above.

Table 7 presents evidence on the differential impact of the crisis on the weight of newborns by mother's educational level. The table shows that business cycle at birth is strongly correlated with birth weight for children born to low-educated mothers in every specification, and that the effect *doubles* at least the impact found in children born to mothers with high

may absorb business cycle fluctuations and could theoretically reduce the estimates of the impact of business cycle fluctuations (i.e. the collapse) on birth weight for this particular sample period.

education. In fact, a specification using a linear time trend finds an insignificant effect of the business cycle at the month of birth for this subsample of children.[16]

Mothers of low socioeconomic status had on average lighter babies than their counterparts, as reported in **Tables 5 and 6**. Not only that but **Table 7** shows that less educated mothers also experienced a more pronounced downturn during the crisis than mothers with better socioeconomic standing. In other words, babies born in poor families have a disadvantage in "normal times" (without recessions) which becomes even wider in "bad times" (with recessions).

What would be the observed evolution of average birth weight had the economy not entered in the recession? **Fig. 6** shows the evolution of actual average birth weight, predicted average birth weight using model in column (6) of **Table 5** had the economy not entered in the recession, and the difference between them.[17] This simulation (hypothetical situation) is achieved by replacing the actual monthly "cyclical" component from August 2001 to the end of our time window with randomly chosen realizations of the "cyclical" components from January 2001 to July 2001. The negative effect of the crisis in terms of birth weight "peaks" on the third quarter of 2002, six months after the business cycle trough (see **Fig. 1**) and its adverse influence declines over time due to the economic recovery that ensued.

3.2.2 Economic cycle during the trimesters of pregnancy and average birth weight

Since birth weight is affected by economic conditions throughout pregnancy, using the economic cycle at birth may not be accurate. Thus, for each birth, we create a measure of the economic cycle in each of the three quarters that a pregnancy usually takes. For the

[16] If we additionally break down the sample by gender of the child, re-estimation of column (3) separately for boys and girls gives us cycle coefficients of 147.96*** (27.51) and 136.62*** (32.37), respectively. Re-estimating column (6), we obtain coefficients of 28.57 (31.48) and 21.27 (23.59) for boys and girls, respectively. Similar qualitative results are obtained if instead of using a linear time trend we control for year fixed effects. More specifically, the significant estimates, which are obtained for those childbirths from mothers with low education, are 120.53** (49.53) and 100.04** (42.76) for boys and girls, respectively.

[17] Notice that the period over which the comparison takes place now starts on August 2001.

first quarter of pregnancy, we take the average of the monthly "cyclical" component in those three initial months, C_1, and we do a similar procedure for the second and third quarters of pregnancy, C_2 and C_3.

We start by estimating models in which we include the "cyclical" component for only one of the trimesters

$$BW_{i,r,m,t} = \beta_T C_T + I_m + \kappa_r + Time + X_i\Gamma + \varepsilon_{i,r,m,t} \tag{4}$$

where β_T reflects the *sensitivity* of birth weight to economic conditions during trimester T of pregnancy, and $Time$ is either a set of year fixed effects, Y_t, or a linear time trend, t.

Table 8 shows that different indicators of the business cycle during pregnancy have effects of the same order of magnitude on birth weight. This is not surprising given the high auto-correlation displayed by business cycle deviations and the fact that indicators are introduced separately.[18] The impact of quarterly indicators (cycle in a given trimester of pregnancy) shown in the Table is much larger than the effect of the business cycle at the month of birth. Although speculative, this result is expected if monthly time series are *noisier* than quarterly averages, or if the effect of adverse economic conditions operates in a *cumulative* fashion, throughout the pregnancy period.

The next step is to include the cycles in each trimester simultaneously in the same equation:

$$BW_{i,r,m,t} = \sum_{T=1}^{3} \beta_T C_T + I_m + \kappa_r + Time + X_i\Gamma + \varepsilon_{i,r,m,t} \tag{5}$$

Table 9 shows that economic conditions during the first and third quarter significantly affect birth weight. The cumulative impact of the three trimesters is comparable to the estimates shown on **Table 8**. Using these estimates, a deviation of 0.1 log units (about 11%) from the long run trend (similar to that observed in 2002, as shown in Table 1) would explain

[18] The correlation between the cyclical components in the 3rd and 2nd Trimesters of Pregnancy is 0.8866; between the 3rd and the 1st is 0.6437; and between the 2nd and the 1st is 0.9000.

a reduction in birth weight of about 25-30 grams. Using the results in **Table 9**, we can predict the average birth weight lost due to business cycle fluctuations in different months. For example, using estimates in model (5) of **Table 9** as a reference, we predict average birth weight under the actual scenario and under a counterfactual (no crisis) situation that assumes macroeconomic conditions in those observed in August 2001 and other regressors fixed at their observed levels. The difference between the predicted and the counterfactual outcomes are averaged by monthly cohorts (by month of birth) and shown in **Fig. 7**, along with the monthly business cycle indicator.

Table 10 shows how results in columns (5) and (6) of **Table 9** change when breaking down the sample by gender: the effect on boys is somewhat larger than for girls. When the sample is splitted by mother's education, **Table 11**, we find that the sensitivity of birth weight to economic conditions is substantially larger for children of mothers with low education. This subset is sensitive to economic conditions in the first and last trimesters of pregnancy, while children of mothers with high socioeconomic status are sensitive to early pregnancy economic conditions. Thus, depending on the subsample studied, results are consistent with the famine literature (highligthing nutritional deprivation factors) or with the quasi-experimental results of Camacho (2008) from Colombia (emphasizing psychosocial stress factors). Using the estimate from the sum of the cyclical coefficients, a deviation of 0.1 log units (about 11%) from the long run trend (similar to that observed in 2002, as shown in **Table 1**) would explain a reduction in birth weight of about 31-35 grams for childbirths from low-educated mothers and 17-20 grams for those from high-educated mothers.

4 The long-lasting effect of the Argentine economic crisis: a simulation exercise

What can we expect in terms of the lives of babies affected by the crisis? We try to provide a tentative answer to this question by *simulating* life-time earnings of these children under different assumptions regarding their working life (age at which they start working and age at which they retire) and income growth patterns (how fast wages are increasing from one year to another). We calibrate our model with Argentine data on income in current purchasing power parity (PPP) dollars, as is standard in the specialized literature of cross-country comparisons.

Our previous results suggest that the average birth weight loss associated with the crisis was about 30 grams. Since we are interested in the impact of a reduction in birth weight on lifetime earnings, we compare the earnings path of an individual born during the recession (with less birth weight) with the counterfactual income path for an individual not born in the recession (without the 30 grams birth weight loss). For the no-recession path of income, we assume that individuals earn a level of income equal to the expected (national) GDP per capita for each year they are in the labor force. Expected future income is based on a baseline GDP per capita for 2009 and an annual income growth rate that varies from 1 to 5% per year. The income loss is calculated using results from Black, Devereux and Salvanes (2007) to approximate $\Delta\ln(\text{Income})/\Delta\ln(\text{Birthweight})$, as shown in the footnote of **Table 12**, which presents our estimates.[19] We find that the average loss of future earnings due to the reduction in average birth weight is about 500 US dollars per baby born, in present value, although the magnitude (but not the sign) of the costs are sensitive to key model assumptions (namely expected income growth and inter-temporal discount rate). However, these costs are very

[19]The impact of birth weight on lifetime income has been estimated using within-twin variation. Behrman and Rosenzweig (2004) and Black, Devereux and Salvanes (2007) are important contributions in this respect. One should keep in mind that although these estimates control for unobservable factors capturing in utero environment, they are based on a selected sample (twins). Thus, it remains open to discussion whether these results can be extended to the singleton population. However, Behrman and Rosenzweig (2004) provide some evidence suggesting that this generalization is not a strong assumption.

likely exceeding the cost of preventing measures to avoid birth weight loss. For example, eliminating poverty in pregnant mothers (by supplementing their income so that it reaches the poverty line) would have cost only 100 US dollars for the full 9 months of pregnancy, which can be considered an overestimate of the cost of preventing the drop of birth weight from occurring.

How can these costs be averted in the future? Since birth outcomes are affected by different factors, there is no simple "recipe" to avoid these problems. But there is ample evidence that targeted interventions work, even in poor settings, where they are most needed (Ramakrishnan, 2004). Depending on specific circumstances, these interventions would include a combination of strategies: nutritional supplementation, provision of adequate prenatal care, and promoting maternal behavioral changes associated with better health outcomes.

One must keep in mind that the 500 US dollars estimate does not take into account other long-term costs stemming from the crisis, such as the increased health burdens in adult life: adverse conditions at time of birth have been linked to heart disease, diabetes and obesity in adulthood, all of which factors in a reduced life expectancy.

5 Robustness checks

5.1 Additional controls

So far we have neglected the influence of type of health coverage (public or private), the location where the birth took place (public or private hospital/clinic, home, or street), and who was present in aiding the delivery of the baby (doctor or someone else).

For 1,785,384 observations we have information on whether a doctor or someone else was aiding the delivery of the baby. In 2001, 72% of childbirths were attended by a doctor. The percentages were very similar in 2002 and 2003, 71% and 72% respectively.

Regarding the health coverage of mothers who gave birth during the period under analysis, we only have information for 88% of childbirths. 25% of them had public health coverage, 2.8% had coverage with the private sector, 0.3% had both, and 38% had none. Again, for those with available data, we have a large fraction of unknowns (38%) and a few miscodings (736 births).

Finally, our data also contains information on the location where the birth took place. However, it is far from being perfect. We observe the following location categories for the entire period: public clinic-hospital (35.75%), private clinic/hospital (22.5%), home or street (0.75%), miscoded (29.15%) and unknown (11.85%).

In **Table 13** we report specifications similar to **Table 9** (columns 5 and 6), but including the controls mentioned above. The sensitivity of birth weight to business cycle is not substantially altered with respect to those shown in **Table 9**. This indicates that our findings are robust to any compositional changes operating through observable health inputs.

5.2 Alternative indicators of economic activity: indigence and poverty

Our analysis on economic activity and birth weight relied on the (HP-de-trended) cyclical component of economic activity at the national level and in monthly frequency. However, it is

possible that the magnitude of the crisis was different across the country and/or it presented lag/lead shifts with respect to the national indicator. Unfortunately, no monthly (or even quarterly) indicator of economic activity is available at the provincial level. Still, we can obtain information on poverty and indigence rates for about 29 such urban conglomerates, which represent urban population from 22 provinces plus the Federal District (Ciudad de Buenos Aires), from the household survey of urban areas (Encuesta Permanente de Hogares).[20] Information on poverty indicators is available for May and October for each year since 2001. Data after May 2003 are not comparable due to a change in the methodology. Because the data are collected twice a year, in a specified month, we have extrapolated missing observations linearly to generate monthly observations. This procedure is not free of criticisms, but it must be said that the periods in which the data were collected were near turning points of the business cycle (see **Fig. 1**).

We calculate poverty rates at the district level in the third, second and first trimester of pregnancy, respectively. Poverty rates are calculated using international standards by the official National Institute of Statistics and Censuses of Argentina. The poverty line varies according to household composition and month/year in which the survey is carried out, but to give an example, it was \$149 (US dollars/month) per adult equivalent in December 2001, about \$5/day using the prevailing exchange rate at that time (not PPP).

Similarly, the indigence indicators represent the indigence rate (or extreme poverty rate) at different trimesters of pregnancy. The indigence rate is calculated using an "indigence line": for example, in December 2001, this indicator was \$ 60/month per adult equivalent, about \$ 2/day. The "indigence line" is the amount required to buy a basic foodstuff basket (Canasta Básica Alimentaria) that meets minimum nutritional requirements, while the "poverty line" is calculated based on the "indigence line" plus additional expenditures on basic nonfood items (basic expenditures, e.g. transportation, housing and clothing defrayed by poor families) these

[20] Only the urban population of one province (Rio Negro) was not included systematically (it only started in October 2002).

are derived from using an estimate of the Engel coefficient (ratio of total expenditures/food expenditures in the target population).

Table 14 displays regressions of birth weight on poverty and indigence rates. The first column shows a specification with moving averages of the indigence rates. Coefficients are not significant individually, but they are jointly significant. Similar results are obtained for three regressors involving moving averages of poverty rates. Thus, we proceed by eliminating one of the regressors in each specification. Column (3) shows that indigence rates at the district level in the three last months of the pregnancy significantly decrease birth weight. The same result is found in column (4) for poverty in the last three months of pregnancy, although poverty rates in the first three months exhibit a positive (but not significant) sign. However, the sum of both coefficients is negative, and significantly so (p-value=0.045). Column (5) combines poverty and indigence (both in the last term of pregnancy) as predictors of birth weight, with indigence (extreme poverty) resulting significant with the expected sign.

These results show that poverty and indigence may have a *deprivation* effect on birth weight. These five models have very different predictive capabilities. **Fig. 8** displays the change in birth weight using August 2001 as baseline and using the temporal variation in regressors specified in each column of **Table 14** together with their estimated coefficients. For comparison, we present the actual variation in birth weight and the prediction based in the model with the national business cycle indicator displayed in **Table 9** column (5). The models that combine time and regional variation are less powerful in predicting fluctuations in birth weight, with the model in column (5) being the one with the best predictive power. There are different interpretations for this result. First, poverty and indigence indicators are monthly extrapolations based on actual indicators calculated every six months, and this may weaken their predictive ability. Second, poverty and indigence indicators may explain variation for low-educated mothers, whether other indicators may be more useful in predicting fluctuations in high-educated mothers. Finally, the models shown in **Table 14** use information

from June 2001 to May 2003. The methodology of household survey changes after May 2003, no dissagregated data by urban areas is provided before October 2000. This reduces the temporal dimension of the sample missing the early period of 2001 (where the crisis had not hit yet) and the recovery period that occurred during 2003.

These estimates suggest that the results from the national monthly business cycle indicator may be –at least in part– capturing a deprivation effect that is mediated by indigence and poverty, which are good predictors of the fluctuations in birth weight during the crisis.

5.3 Additional checks: transformations of the dependent variable and province-specific-time/month effects

Several other checks have been performed in order to assess the validity of our estimates. Here, we highlight two of them. First, replacing birth weight with its logarithm or using fetal growth, defined as birth weight over weeks of gestation, we obtain similar estimates. Second, the addition of province-specific linear time trends, province-specific month of birth fixed effects, and even interactions between month of birth and a linear time trend leads to estimates of the business cycle on birth weight of the same order of magnitude than those reported in the previous specifications. All these estimates are available from the authors upon request.

6 Conclusions

Economic crises are episodic phenomena that bring concerns about unemployment, poverty, and bail-outs, which are common terms in the public's jargon. In this article, we focus on less obvious –but perhaps equally important– costs stemming from an economic crisis: a birth weight loss. This burden is likely to have long-lasting effects, since birth weight influences life-time earnings, as it has been shown in the literature.

We find that the crisis explained a loss of about 30 grams in average birth weight. It is important to keep in mind that this loss in birth weight only happened in a short period of time (about 6-7 months) and that this is a population average: the impact of the recession was even more pronounced in mothers of low socioeconomic status.

In an attempt to estimate the long-lasting economic cost of the crisis, we simulate the average loss of future individual earnings due to the reduction in average birth weight: about 500 US dollars per live birth in present value. This is a conservative estimate because it does not include other potential losses not reflected in lifetime earnings, for example life-time health care costs or a reduction in life expectancy. This price will not be paid equally, since poor mothers are most affected in terms of birth weight, which may exacerbate income inequalities in the long run.

Our results are also stunning because such a disruption in health status occurred in a middle-high income country with a similar ratio of physicians per person than Germany or Norway. Perhaps, one of our main findings is to show that the adverse effects of economic crises on children health may not only be restricted to periods of starvation or to very low income countries.

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Fig. 1: Economic Activity Index and Average Birth Weight
January 2001 – October 2003

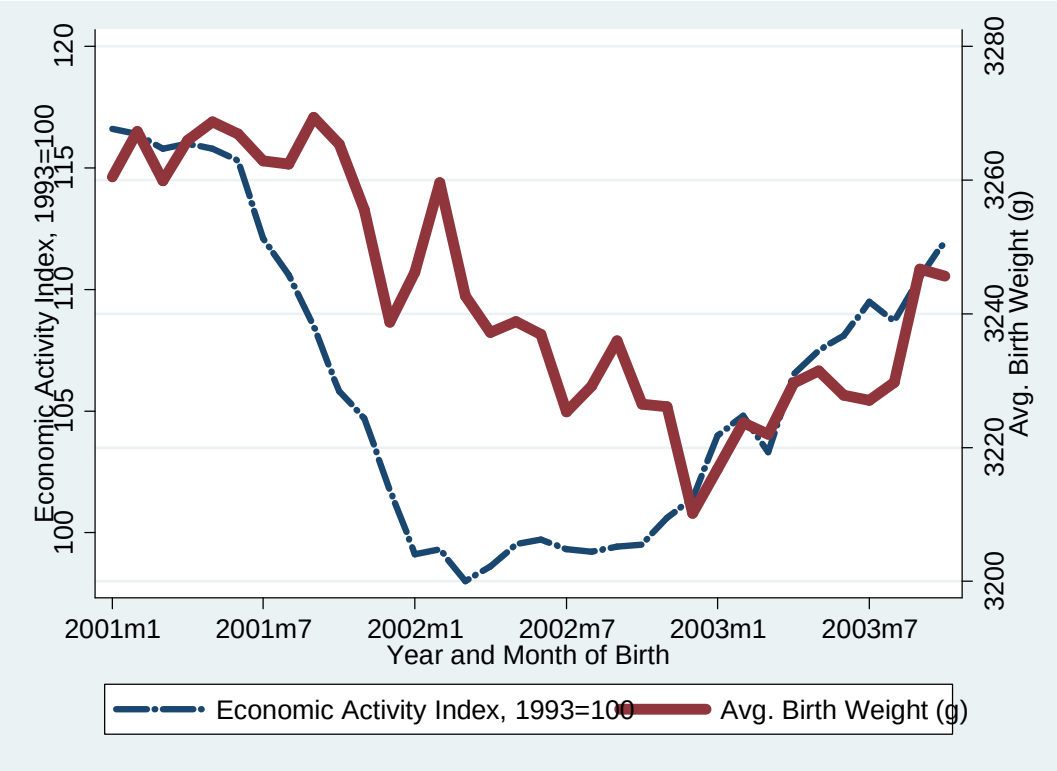
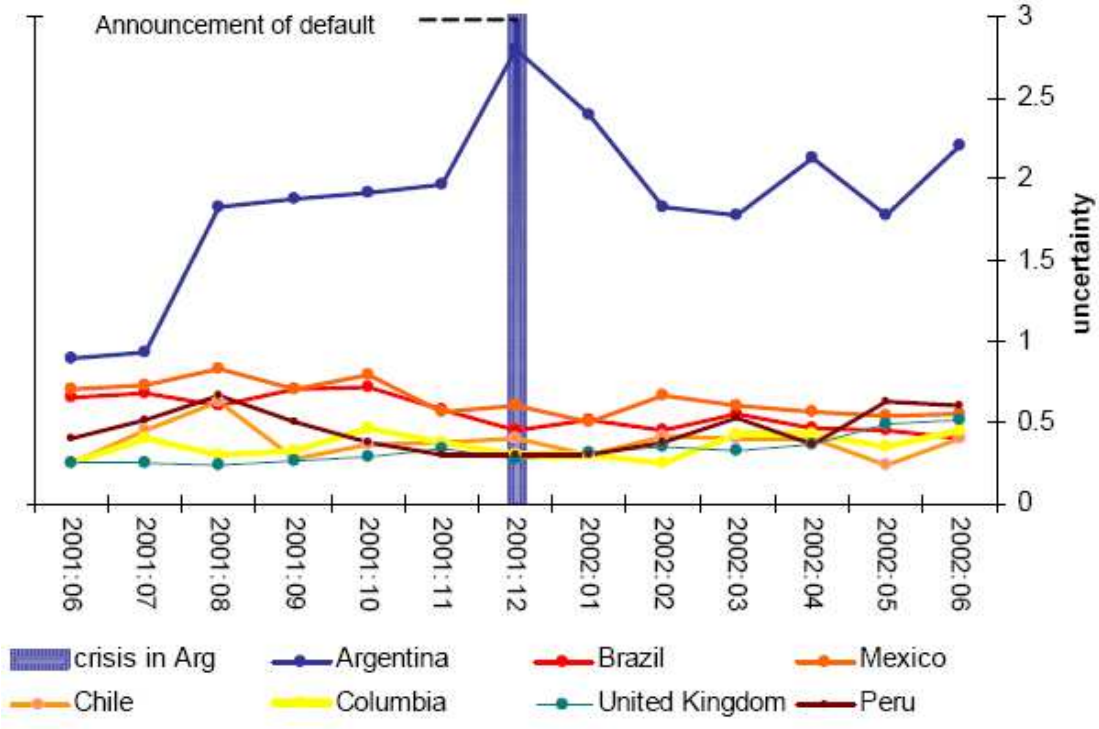


Fig. 2: Evolution of Uncertainty



Source: Figure 2 in Kannan and Köhler-Geib (2009).

Fig. 3: Evolution of Consumer Confidence

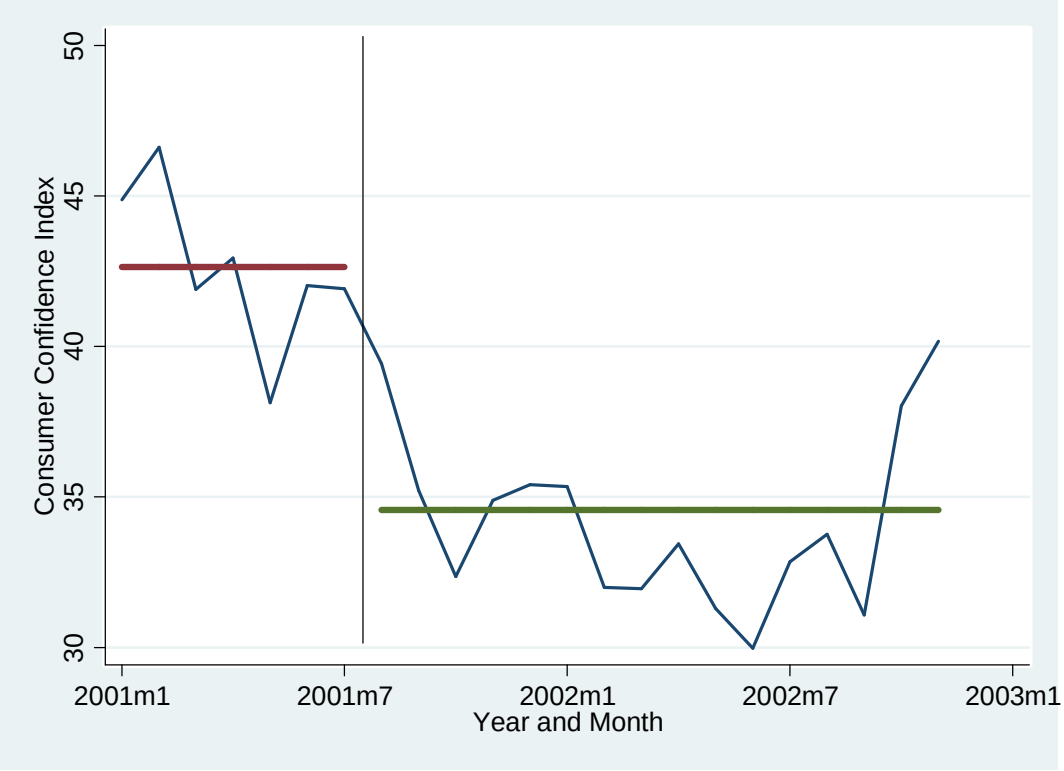


Fig. 4: Evolution of Live Births

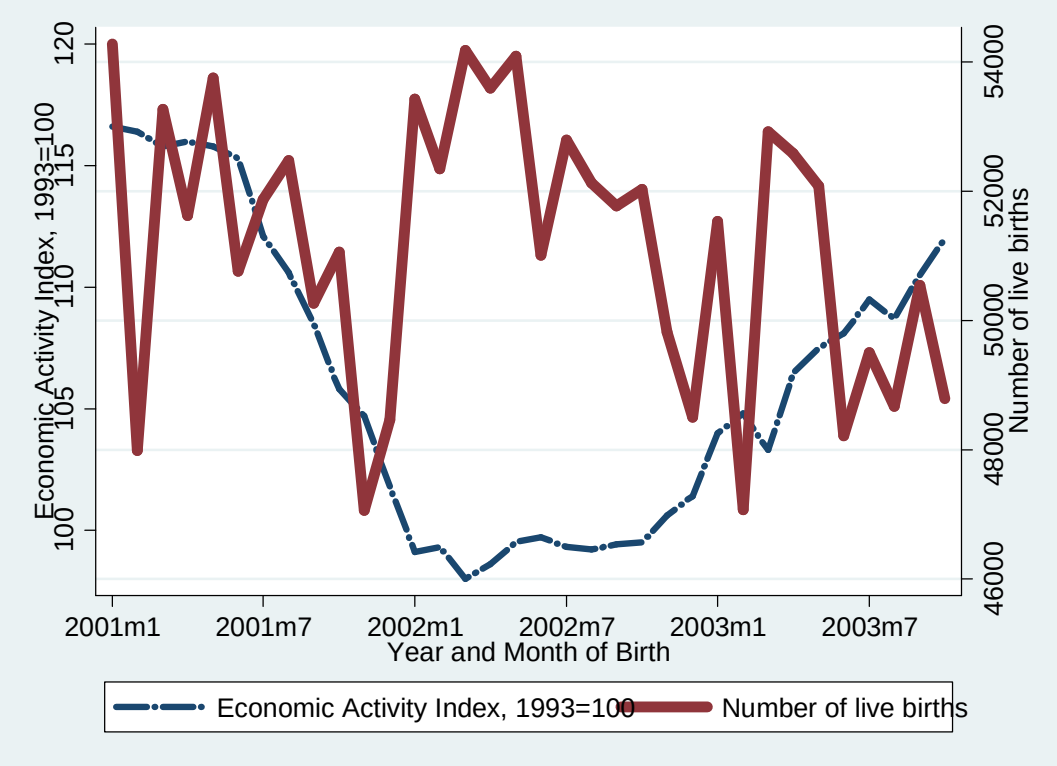


Fig. 5: Comparison and Treatment

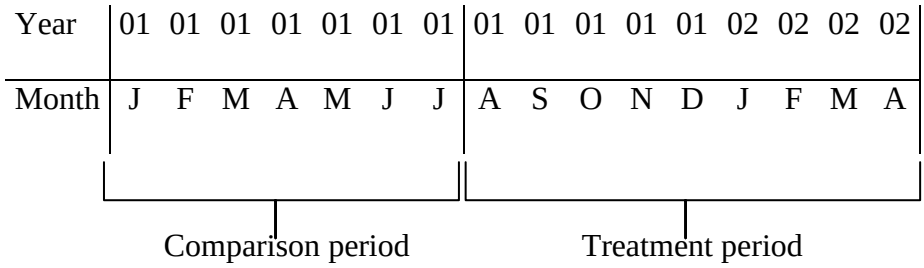


Fig. 6: Loss in Average Birth Weight due to the Crisis
August 2001 – October 2003

Note: Avg. Birth Weight (g), Hyp.: predicted average birth weight (in grams) using model in column (6) of Table 5 replacing cycles from August 2001 to October 2003 with cycles from January 2001 to July 2001 // Avg. Birth Weight (g): actual average BW, in grams, shown in right scale // Difference in BW (g): difference between them.

Fig. 7: Average birth weight loss due to business cycle fluctuations in different months, August 2001 – October 2003

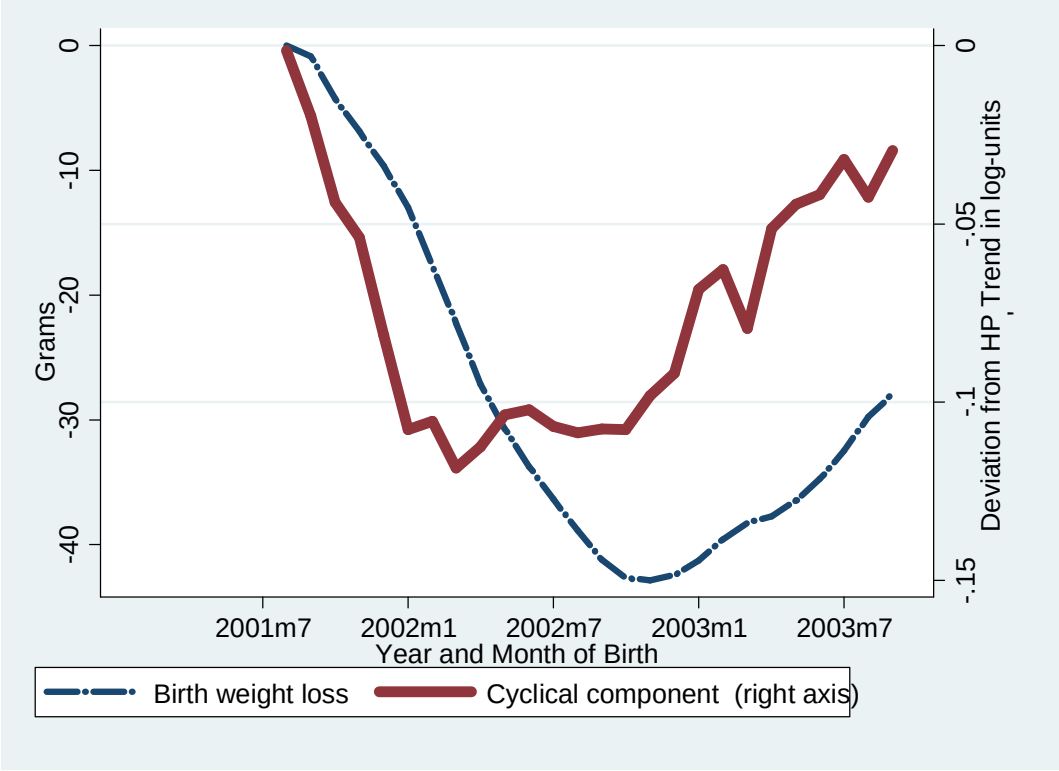


Fig. 8: Comparisons of economic activity, poverty and indigence models

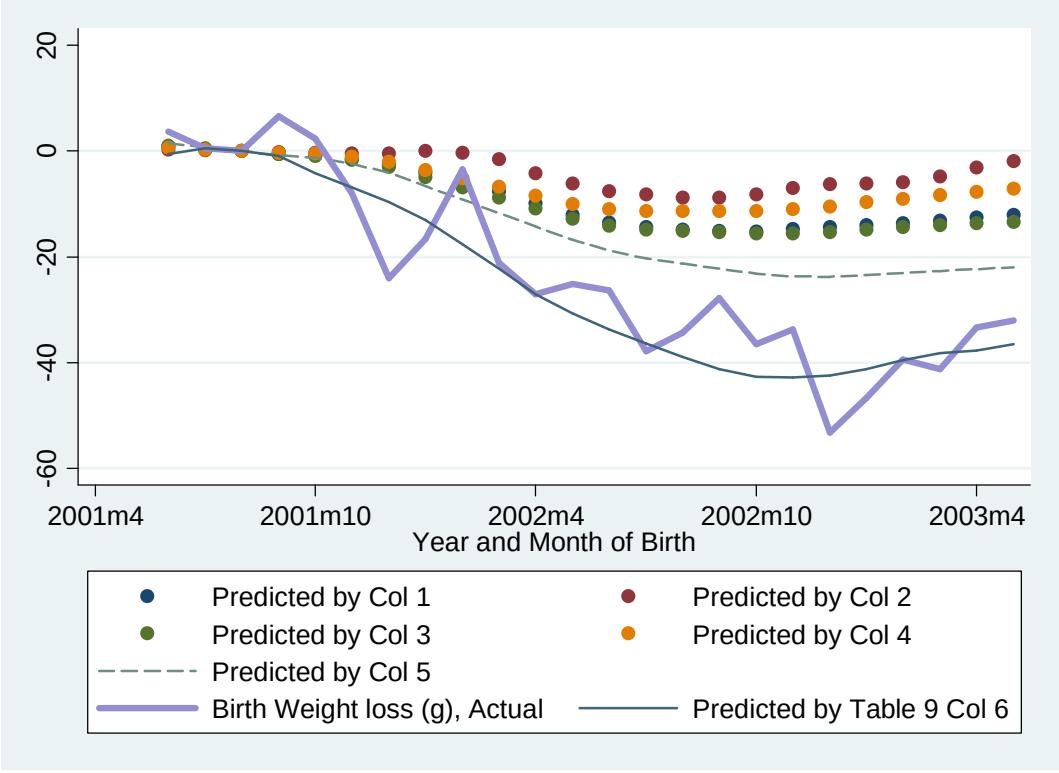


Table 1: Descriptive Statistics, means and (standard deviations)

	2001	2002	2003
Birth Outcomes			
Birth Weight (g)	3263.33	3235.93	3231.30
	(543.64)	(538.36)	(541.07)
Low Birth Weight	0.065	0.069	0.070
	(0.246)	(0.253)	(0.256)
Female	0.488	0.486	0.487
	(0.500)	(0.500)	(0.500)
Infant Mortality Rate[a]	16.3	16.8	16.5
Economic Indicators			
Economic Activity Index[b] (1993 = 100)	95.73	85.30	92.84
Economic Cycle[c]	0.0046	−0.1059	−0.0433
Unemployment[d]	17.4%	19.7%	15.6%
Poverty[e]	37.1%	55.3%	54.7%
Public Expenditure in Children Health (2006 PPP $)[f]			
National Budget per child[g]	24.39	30.72	31.14
National Budget on Mother-Infant Program per child	4.17	5.63	8.11
National and Provincial Budget per child[g]	268.61	192.68	189.34
Characteristics of the mother			
Age (years)	26.62	26.59	26.94
	(6.44)	(6.44)	(6.40)
First pregnancy	0.361	0.353	0.361
	(0.480)	(0.478)	(0.480)
High School	0.356	0.370	0.395
	(0.479)	(0.483)	(0.489)
Partner (married or cohabiting)	0.853	0.834	0.848
	(0.354)	(0.372)	(0.359)

Note: Number of observations to calculate live birth characteristics (birth weight, low birth weight, female, age of the mother, first pregnancy, mother has high-school or above, and mother has a partner) are 595,980 in 2001, 581,188 in 2002, and 548,257 in 2003. The number of observations in 2003 is "artificially" smaller than in 2001 and 2002, since childbirths occurring in the last three months of the year are statistically reported with a lag, and our dataset does not capture the updates occurring after 2003.

[a] Source: Argentine Ministry of Health, Yearbook. // [b] Indicador Sintetico de la Actividad Economica. Source: Instituto Nacional de Estadisticas y Censos (INDEC) // [c] Cyclical component of log Economic Activity Index (in log units) // [d] National Average of Unemployment Rate for May/October (2001 and 2002), and May (2003). Source: Instituto Nacional de Estadisticas y Censos (INDEC) // [e] Proportion of Individuals under the Official Poverty Line. National Average for /October (2001 and 2002), and May (2003). Source: Instituto Nacional de Estadisticas y Censos (INDEC) // [f] Source: DAGPyPS/Unicef (2007) "Gasto Publico Social dirigido a la Niñez en la Argentina 1995-2007" Available online: http://www.gastopubliconinez.gov.ar/inversion_n_04.php. Nominal values are converted to 2006 pesos using a mixed CPI-WPI price index and then converting to PPP dollars at the parity of 2006. // [g] Includes mother-infant programs, prevention programs, vaccination, school health, medication, outpatient/inpatient services, organ transplantation, sexual/reproductive health, AIDS/HIV and other STDs and other services and goods provided by central and provincial government and targeted to individuals ages 0-17.

Table 2: Differences in average birth weight (g) between 2002 and 2001

	2001	2002	Difference
I. Controls: province and child gender dummy variables			
January	3413.77	3400.82	−12.95***
			(0.043)
February	3420.82	3413.38	−7.44***
			(0.052)
March	3414.10	3395.93	−18.17***
			(0.048)
April	3420.59	3390.87	−29.72***
			(0.055)
N	1,238,320		
II. Controls: I + age and pregnancy categories			
January	3370.96	3357.33	−13.63***
			(0.050)
February	3377.89	3370.49	−7.40***
			(0.049)
March	3370.93	3353.52	−17.41***
			(0.056)
April	3378.31	3349.06	−29.25***
			(0.055)
N	1,223,823		
III. Controls: II + mother's education and partner dummy variables			
January	3324.22	3311.45	−12.77***
			(0.188)
February	3330.97	3324.15	−6.82***
			(0.179)
March	3323.78	3308.43	−15.35***
			(0.179)
April	3331.33	3304.10	−27.22***
			(0.183)
N	1,153,457		

Note: OLS regressions of birth weight on month of birth indicators, their interactions with 2002, and controls. Robust standard errors clustered at the "month-year" of birth level are reported in parentheses. *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1

I: excluded province (jurisdiction) is "Tierra del Fuego"

II: excluded age category is "45-49" and excluded pregnancy category is "4 or more"

III: mother's education dummy variable is 1 if high-school or above, 0 otherwise; partner dummy variable is 1 if living with a partner, 0 otherwise.

Table 3: Differences in average birth weight (g) between 2002 and 2001 by gender

	Boys			Girls		
	2001	**2002**	**difference**	**2001**	**2002**	**Difference**
I. Controls: province and child gender dummy variables						
January	3414.16	3399.34	−14.82***	3310.37	3299.32	−11.05***
			(0.051)			(0.067)
February	3424.59	3413.92	−10.67***	3313.87	3309.84	−4.03***
			(0.078)			(0.067)
March	3417.40	3395.60	−21.80***	3307.65	3293.32	−14.33***
			(0.068)			(0.060)
April	3420.80	3390.20	−30.60***	3317.40	3288.59	−28.81***
			(0.077)			(0.073)
N	635,151			603,169		
II. Controls: I + age and pregnancy categories						
January	3364.26	3348.85	−15.41***	3275.20	3263.49	−11.71***
			(0.062)			(0.063)
February	3375.05	3364.83	−10.22***	3278.15	3273.69	−4.46***
			(0.074)			(0.063)
March	3367.79	3347.18	−20.61***	3271.51	3257.47	−14.04***
			(0.067)			(0.077)
April	3372.12	3342.53	−29.59***	3282.06	3253.20	−28.86***
			(0.072)			(0.081)
N	627,661			596,162		
III. Controls: II + mother's education and partner dummy variables						
January	3317.01	3304.15	−12.86***	3228.64	3216.15	−12.61***
			(0.220)			(0.193)
February	3327.10	3317.88	−9.22***	3231.94	3227.64	−4.31***
			(0.226)			(0.168)
March	3320.76	3302.77	−17.99***	3223.86	3211.35	−12.58***
			(0.207)			(0.186)
April	3324.56	3298.24	−26.31***	3235.29	3207.26	−28.12***
			(0.205)			(0.211)
N	591,593			561,864		

Note: See Table 2.

Table 4: Differences in average birth weight (g) between 2002 and 2001 by gender broken down by mother's education

I. Controls: province dummy variables

	Boys		Girls	
	Low	High	Low	High
January	−23.06***	−2.72***	−19.61***	2.15***
	(0.058)	(0.073)	(0.093)	(0.082)
February	−13.57***	−4.55***	−7.81***	−1.76 ***
	(0.105)	(0.132)	(0.071)	(0.134)
March	−31.08***	−4.09***	−20.57***	−6.61***
	(0.122)	(0.089)	(0.071)	(0.079)
April	−33.21***	−23.68***	−34.59***	−18.62***
	(0.120)	(0.093)	(0.082)	(0.117)
N	392,993	225,007	374,852	212,226

II. Controls: I + age and pregnancy categories + partner dummy variables

	Boys		Girls	
	Low	High	Low	High
January	−20.37***	0.796***	−19.16***	−0.445
	(0.262)	(0.244)	(0.253)	(0.279)
February	−13.67***	−1.94***	−5.61***	−2.66***
	(0.266)	(0.262)	(0.212)	(0.241)
March	−28.28***	−0.142	−16.50***	−5.99***
	(0.273)	(0.256)	(0.230)	(0.238)
April	−29.88***	−20.70***	−35.84***	−15.14***
	(0.264)	(0.235)	(0.282)	(0.251)
N	377,109	214,484	359,804	202,060

Note: See Table 2.

Table 5: Regressions of Birth Weight on Economic Cycle in the Month of Birth

	(1)	(2)	(3)	(4)	(5)	(6)
Cycle in the Month of Birth	81.43**	115.66***	73.67*	111.18***	68.57*	99.35***
	(36.41)	(25.86)	(38.06)	(26.57)	(38.52)	(25.85)
Female	−102.92***	−102.92***	−103.08***	−103.08***	−103.44***	−103.44***
	(0.757)	(0.757)	(0.791)	(0.791)	(0.826)	(0.826)
Time and region controls						
Month of birth fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Province of birth fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth fixed effects?	Yes	No	Yes	No	Yes	No
Linear time trend	--	−1.14***	--	−1.22***	--	−1.24***
		(0.109)		(0.113)		(0.111)
Mother's and pregnancy controls						
Mother's age categories?	No	No	Yes	Yes	Yes	Yes
Parity categories?	No	No	Yes	Yes	Yes	Yes
Mother's High School	--	--	--	--	24.02***	24.01***
					(3.44)	(3.45)
Mother's Partner Status	--	--	--	--	58.43***	58.44***
					(1.72)	(1.72)
Mother's High School × Mother's Partner Status	No	No	No	No	−17.18***	−17.18***
					(3.36)	(3.36)
N	1,803,585		1,782,311		1,689,913	

Note: All regressions include a constant term. Robust standard errors clustered at the "month-year" of birth level are reported in parentheses. Month of birth fixed effects: 11 dummy variables; Province of birth fixed effects: 24 dummy variables; Year of birth fixed effects: 2 year dummy variables; Linear time trend = 1…, 36; Mother's age categories: 6 dummy variables (15-19, 20-24, 25-29, 30-34, 35-39, 40-44); Parity categories: 3 dummy variables (1st pregnancy, 2nd pregnancy, 3rd pregnancy); Mother's High School: 1 if mother has high-school or above, 0 otherwise; Mother's Partner Status: 1 if mother is living with a partner, 0 otherwise.

*** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1

Table 6: Regressions of Birth Weight on Economic Cycle in the Month of Birth by Gender

	Boys		Girls	
	(1)	(2)	(3)	(4)
Cycle in the Month of Birth	83.93*	103.57***	52.73	94.89***
	(44.60)	(26.10)	(35.99)	(27.60)
Time and region controls				
Month fixed effects?	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No
Linear Time Trend	--	−1.24***	--	−1.24***
		(0.119)		(0.117)
Mother's and pregnancy controls				
Mother's age categories?	Yes	Yes	Yes	Yes
Parity categories?	Yes	Yes	Yes	Yes
Mother's High School	26.65***	26.65***	21.20***	21.18***
	(4.68)	(4.68)	(3.71)	(3.72)
Mother's Partner Status	58.65***	58.66***	58.28***	58.28***
	(2.38)	(2.38)	(2.37)	(2.37)
Mother's High School × Mother's Partner Status	−13.70***	−13.70***	−20.86***	−20.86 ***
	(4.53)	(4.54)	(3.86)	(3.86)
N	866,812		823,101	

Note: See Table 5.

Table 7: Regressions of Birth Weight on Economic Cycle in the Month of Birth broken down by mother's education

	Mother's Education < High School			Mother's Education >= HS		
	(1)	(2)	(3)	(4)	(5)	(6)
Cycle in the Month of Birth	250.69***	246.22***	142.45***	122.09***	112.32***	24.92
	(31.15)	(33.64)	(28.34)	(30.58)	(30.81)	(24.81)
Female	−98.53***	−98.96***	−98.99***	−110.58***	−110.98***	−110.94***
	(1.06)	(1.13)	(1.13)	(1.39)	(1.43)	(1.42)
Time and region controls						
Month fixed effects?	No	Yes	Yes	No	Yes	Yes
Province fixed effects?	No	Yes	Yes	No	Yes	Yes
Linear Time Trend	--	--	−1.29***	--	--	−1.15***
			(0.124)			(0.112)
Mother's and pregnancy controls						
Mother's age categories?	No	Yes	Yes	No	Yes	Yes
Parity categories?	No	Yes	Yes	No	Yes	Yes
Mother living with a partner	--	56.22***	55.99***	--	46.60***	46.53***
		(1.78)	(1.78)		(2.68)	(2.70)
N	1,099,356	1,059,925	1,059,925	653,899	629,988	629,988

Note: See Table 5.

Table 8: Regressions of Birth Weight on Economic Cycles during Trimesters of Pregnancy

	(1)	(2)	(3)	(4)	(5)	(6)
Cycle 3rd Trimester of Pregnancy	203.28***	133.76***	--	--	--	--
	(41.11)	(21.20)				
Cycle 2nd Trimester of Pregnancy	--	--	245.39***	202.12***	--	--
			(19.09)	(14.50)		
Cycle 1st Trimester of Pregnancy	--	--	--	--	182.27***	204.36***
					(19.36)	(21.48)
Female	−103.45***	−103.44***	−103.45***	−103.45***	−103.46***	−103.45***
	(0.825)	(0.825)	(0.825)	(0.825)	(0.826)	(0.825)
Time and region controls						
Month fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No	Yes	No
Linear Time Trend	--	−0.988**	--	−0.491***	--	−0.362**
		(0.111)		(0.098)		(0.153)
Mother's and pregnancy controls						
Mother's age categories?	Yes	Yes	Yes	Yes	Yes	Yes
Parity categories?	Yes	Yes	Yes	Yes	Yes	Yes
Mother's High School	24.03***	24.04***	24.11***	24.10***	24.12***	24.09***
	(3.44)	(3.44)	(3.44)	(3.44)	(3.44)	(3.44)
Mother's Partner Status	58.36***	58.36***	58.35***	58.33***	58.41***	58.52***
	(1.72)	(1.72)	(1.72)	(1.72)	(1.72)	(1.72)
Mother's High School × Mother's Partner Status	−17.19***	−17.19***	−17.26***	−17.24***	−17.26***	−17.28***
	(3.36)	(3.36)	(3.36)	(3.36)	(3.36)	(3.36)
N	1,689,913		1,689,913		1,689,913	

Note: See Table 5.

Table 9: Regressions of Birth Weight on Economic Cycles during Trimesters of Pregnancy

	(1)	(2)	(3)	(4)	(5)	(6)
Cycle 3rd Trimester of Pregnancy	128.70***	91.43**	119.74***	85.84**	113.28***	79.31**
	(32.90)	(36.01)	(33.15)	(35.91)	(33.87)	(36.18)
Cycle 2nd Trimester of Pregnancy	65.64	43.47	62.36	42.12	51.47	29.46
	(53.82)	(53.86)	(54.41)	(54.38)	(54.04)	(55.55)
Cycle 1st Trimester of Pregnancy	107.93***	126.26***	119.58***	136.28***	126.23***	144.10***
	(33.39)	(33.27)	(33.73)	(33.46)	(33.80)	(34.25)
Sum of Coefficients on Cycle	302.27***	261.16***	301.69***	264.24***	290.99***	252.87***
	(22.98)	(17.67)	(23.63)	(17.59)	(23.32)	(17.61)
Female	−102.93***	−102.93***	−103.10***	−103.10***	−103.46***	−103.46***
	(0.756)	(0.756)	(0.789)	(0.789)	(0.825)	(0.826)
Time and region controls						
Month fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No	Yes	No
Linear Time Trend	--	−0.183**	--	−0.224**	--	−0.263***
		(0.090)		(0.091)		(0.093)
Mother's and pregnancy controls						
Mother's age categories?	No	No	Yes	Yes	Yes	Yes
Parity categories?	No	No	Yes	Yes	Yes	Yes
Mother's High School	--	--	--	--	24.11***	24.12***
					(3.44)	(3.44)
Mother's Partner Status	--	--	--	--	58.34***	58.34***
					(1.72)	(1.72)
Mother's High School × Mother's Partner Status	No	No	No	No	−17.26***	−17.26***
					(3.36)	(3.36)
N	1,803,585		1,782,311		1,689,913	

Note: See Table 5.

Table 10: Regressions of Birth Weight on Economic Cycles during Trimesters of Pregnancy by Gender

	Boys		Girls	
	(1)	(2)	(3)	(4)
Cycle 3rd Trimester of Pregnancy	144.97***	99.28***	79.67	57.63
	(28.52)	(34.18)	(58.26)	(58.02)
Cycle 2nd Trimester of Pregnancy	28.50	−1.08	76.97	62.66
	(41.89)	(50.28)	(103.46)	(101.79)
Cycle 1st Trimester of Pregnancy	148.65***	172.59***	101.82	113.47*
	(30.67)	(33.38)	(67.16)	(66.08)
Sum of Coefficients on Cycle	322.12***	270.80***	258.46***	233.75***
	(23.69)	(19.71)	(33.05)	(26.76)
Time and region controls				
Month fixed effects?	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No
Linear Time Trend	--	−0.197**	--	−0.332**
		(0.099)		(0.140)
Mother's and pregnancy controls				
Mother's age categories?	Yes	Yes	Yes	Yes
Parity categories?	Yes	Yes	Yes	Yes
Mother's High School	26.73***	26.74***	21.31***	21.31***
	(4.67)	(4.67)	(3.71)	(3.71)
Mother's Partner Status	58.57***	58.56***	58.19***	58.20***
	(2.38)	(2.38)	(2.38)	(2.38)
Mother's High School × Mother's Partner Status	−13.76***	−13.76***	−20.97***	−20.97***
	(4.53)	(4.52)	(3.86)	(3.86)
N	866,812		823,101	

Note: See Table 5.

Table 11: Regressions of Birth Weight on Economic Cycles during Trimesters of Pregnancy by Mother's Education

	Mother's Education < High School		Mother's Education ≥ High School	
	(1)	(2)	(3)	(4)
Cycle 3rd Trimester of Pregnancy	182.51***	143.48***	6.93	−24.35
	(45.73)	(48.48)	(41.64)	(36.64)
Cycle 2nd Trimester of Pregnancy	25.84	3.00	86.48	63.00
	(68.76)	(72.62)	(60.38)	(59.05)
Cycle 1st Trimester of Pregnancy	141.12***	159.95***	110.02**	128.64***
	39.94	(42.98)	(43.96)	(41.58)
Sum of Coefficients on Cycle	349.47***	306.43***	203.43***	167.29***
	31.57	(20.89)	(30.84)	(27.95)
Female	−99.01***	−99.01***	−110.97***	−110.97***
	(1.13)	(1.13)	(1.42)	(1.42)
Time and region controls				
Month fixed effects?	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No
Linear Time Trend	--	−0.222*	--	−0.305**
		(0.112)		(0.142)
Mother's and pregnancy controls				
Mother's age categories?	Yes	Yes	Yes	Yes
Parity categories?	Yes	Yes	Yes	Yes
Mother's Partner Status	55.88***	55.89***	46.41***	46.40***
	(1.79)	(1.78)	(2.70)	(2.70)
N	1,059,925		629,988	

Note: See Table 5.

Table 12: A simple calculation of the Future Income Loss due to Lower Birth Weight, in PPP International Dollars of 2009.

		Annual Income Growth		
		1%	3%	5%
Annual Discount Factor	2%	452	925	1981
	5%	175	328	643
	8%	78	136	245

Note: Calculation assumes $\Delta\ln(\text{Wage})/\Delta\ln(\text{BW}) = 0.09$ (lower bound from Black, Devereux and Salvanes, 2007), $\Delta\ln(\text{BW}) = -0.0091$ (mean birth weight in singletons 2002-03 vs. 2001), annual income in 2009 = $ 14,559 (GDP per capita, PPP, 2009). Individuals earn income between age 22 and 65 (for an individual born in 2002 this represents the period 2024-2067). The discounted income loss is calculated as the difference between income with and without birth weight loss, where the gap is calculated using the estimates from Black, Devereux and Salvanes (2007) and above, and the birth weight gap mentioned above ($gap = 0.11*0.0091 \cong 0.001$). Income at year t is $Y_t = 14559(1+g)^{(t-2009)}$, the income loss in year t in dollars is $Y_t(1 - gap)$ and the present value using discount δ is $\sum_{t=2024}^{2065} (1-\delta)^{t-2009} Y_t(1-gap)$

Table 13: Robustness checks with additional controls

	(1)	(2)	(3)	(4)	(5)	(6)
Cycle 3rd Trimester of Pregnancy	111.19***	79.22*	142.72***	107.72**	110.53***	84.64**
	(36.95)	(40.78)	(40.68)	(43.82)	(37.42)	(40.29)
Cycle 2nd Trimester of Pregnancy	65.57	44.82	22.62	6.65	72.30	55.28
	(62.53)	(63.17)	(66.96)	(67.05)	(62.78)	(62.70)
Cycle 1st Trimester of Pregnancy	109.16***	126.02***	131.40***	147.60***	105.51***	119.21***
	(37.72)	(38.14)	(40.09)	(39.51)	(38.21)	(38.32)
Sum of Coefficients on Cycle	285.93***	250.06***	296.73***	261.97***	288.34***	259.13***
	(25.28)	(18.99)	(26.46)	(20.28)	(25.33)	(19.54)
Time and region controls						
Month fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Province fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	No	Yes	No	Yes	No
Linear Time Trend	--	−0.217**	--	−0.214***	--	−0.128
		(0.102)		(0.107)		(0.103)
Mother's and pregnancy controls						
Mother's age categories?	Yes	Yes	Yes	Yes	Yes	Yes
Parity categories?	Yes	Yes	Yes	Yes	Yes	Yes
Mother's Education Status	Yes	Yes	Yes	Yes	Yes	Yes
Mother's Partner Status	Yes	Yes	Yes	Yes	Yes	Yes
Mother's High School × Mother's Partner Status	Yes	Yes	Yes	Yes	Yes	Yes
New controls						
Doctor aiding the delivery of the baby indicator?	Yes	Yes	No	No	No	No
Mother's health insurance coverage indicators?	No	No	Yes	Yes	No	No
Place of birth (public hospital, private hospital, home, street) indicators?	No	No	No	No	Yes	Yes
N	1,737,331		1,541,482		1,754,872	

Note: See Table 5.

Table 14: Regressions of Birth Weight on Indigence and Poverty Rates

	(1)	(2)	(3)	(4)	(5)
Indigence 3rd Trimester	−0.961	--	−1.316***	--	−0.898**
	(0.892)		(0.381)		(0.403)
Indigence 2nd Trimester	−0.629	--	--	--	--
	(1.515)				
Indigence 1st Trimester	0.615	--	0.283	--	--
	(1.017)		(0.337)		
Poverty 3rd Trimester	--	0.158	--	−0.862**	−0.528
		(0.833)		(0.392)	(0.438)
Poverty 2nd Trimester	--	−1.645	--	--	--
		(1.285)			
Poverty 1st Trimester	--	1.265	--	0.356	--
		(0.791)		(0.238)	
Joint Sign. F-test	6.10***	2.16	8.95***	2.43	14.72***
p-value F-test	0.003	0.120	0.001	0.111	0.000
N	1,125,353	1,125,353	1,125,353	1,125,353	1,125,353
Period Covered	Jun01/ May03	Jun01/ May03	Jun01/ May03	Jun01/ May03	Jun01/ May03

Note: Robust standard errors clustered at the "month-year" level. Controls: all used in column (5) in Table 5 (except business cycle indicators).
*** p-value < 0.01, ** p-value < 0.05,* p-value < 0.1.