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Abstract

We investigate how birth weight in Argentina responds to prenatal economic fluctuations during the period from January 2000 to December 2005, and document its procyclicality, in particular with respect to the first and third trimesters of pregnancy. We find evidence that the birth weight of children of low-educated mothers is sensitive to macroeconomic fluctuations during both the first and third trimester of pregnancy, while that of high-educated mothers only reacts to the first trimester of pregnancy. Our results are consistent with low-educated women facing credit constraints and suffering from both nutritional deprivation and maternal stress, while high-educated women are only affected by stress.

Key words

Argentina, birth weight, trimester of pregnancy, economic crisis, macroeconomic shocks.

Resumen

En este documento de trabajo se analiza cómo el peso al nacer en Argentina responde a las fluctuaciones económicas prenatales durante el período de enero de 2000 a diciembre de 2005, documentando su carácter procíclico, en particular con respecto al primer y tercer trimestres de embarazo. Se observa que el peso al nacer de los niños de madres de bajo nivel educativo es sensible a las fluctuaciones macroeconómicas durante el primer y el tercer trimestres de embarazo. Sin embargo, el peso al nacer de los niños de madres de alto nivel educativo reacciona solamente a fluctuaciones durante el primer trimestre de embarazo. Estos resultados son consistentes con una situación en que las madres de bajo nivel educativo, sujetas a restricciones crediticias, sufren de problemas nutricionales y de estrés durante el embarazo, mientras que las madres de alto nivel educativo solamente se ven afectadas por estrés.

Palabras clave

Argentina, peso al nacer, trimestre de embarazo, crisis económica, shocks macroeconómicos.

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1. Introduction

THE analysis of how infant health responds to economic crises, or more generally macroeconomic shocks, has recently attracted considerable attention. During recessions households may be prompted to reduce spending on items vital to children's health, including nutritious food and medical care for mothers and infants. Moreover, economic downturns are likely to worsen prenatal stress, increasing the risk of adverse birth outcomes, and may also cause public-health services to deteriorate. However, evidence coming from developed countries show that infant mortality actually decreases during recessions (e.g., Deheija and Lleras-Muney 2004). Results from developing country-level studies are more mixed (Cutler et al. 2002; Paxson and Schady 2005; Bhalotra 2010).

As recently emphasized by Miller and Urdinola (2010), the variety of conclusions on the impact of macroeconomic shocks on children's health can be explained by the use of diverse methodologies or different *behavioral* responses to distinct macroeconomic shocks. Households may be able to smooth consumption or at least buffer expenditures on goods that protect health, as long as they are not credit constrained, which may explain why the mortality of children born to less educated women is more sensitive to economic shocks (Baird, Friedman and Schady 2011). At the same time, the opportunity cost of time allocated to the production of children's health may decrease with economic contractions. In this regard, Miller and Urdinola (2010) show that when Colombia's coffee trade suddenly booms, mortality rates among children increase in coffee-producing counties. These authors find evidence that when coffee prices go up, parents work more and spend less time in producing children's health.

While previous work has emphasized the role of credit constraints and time allocations in the relationship between economic fluctuations and children's health, it has remained silent on the interaction between behavioral responses and *biological* constraints. This is somewhat surprising in light of the empirical evidence suggesting the existence of critical periods (during gestation) for children's health (in particular birth outcomes), and calls for a more complete understanding of how macroeconomic shocks affect maternal, and subsequently, fetal health, *during gestation*. When households experience a (negative) income shock at a critical period for children's health, they may react accordingly by substituting consumption of nutritious food from a non-critical period to a critical one, as long as they are not credit constrained. If the

shock happens instead during a non-critical period, households may not need to update their allocation of resources.

The goal of this paper is not only to study the impact of economic crises on children's health, but to investigate the importance of biological constraints in shaping behavioral responses. To this end, we focus on *birth weight*, which is mainly a function of the length of the gestation (GL) and the intrauterine growth (IUG) of the fetus (Kramer 1987). While IUG depends on maternal nutrition, maternal stress appears to be the most important determinant of GL. During "bad times", food security is threatened, and individuals suffer from psychosocial stress. In addition, deep recessions can lead to dramatic losses of resources, to the extent that credit constrained people may be forced to reduce their food expenditures below poverty levels. Hence, there are (at least) two plausible channels whereby exposure to a macroeconomic shock could affect birth weight: nutritional deficits, and maternal (psychosocial) stress, with their impact varying according to the stages of gestation. Indeed, there is evidence that birth weight is generally most responsive to nutritional changes affecting the *third trimester* of pregnancy (evidence ranging from the Dutch Famine —e.g., Stein and Lumey 2000—to the Food Stamp Program in the U.S.— Almond, Hoynes and Schanzenbach 2011), while maternal stress appears to impact birth weight when it occurs during the *first trimester* of pregnancy (Camacho 2008; Torche 2011).

We investigate the effects of the Argentine macroeconomic episode of 2001-2002 on birth weight, and the channels through which these effects emerge. Argentina was shaken by a traumatic financial crisis at the turn of the century; its output (economic activity indicator) declined from 112 to 100 (its level in 1993) between 2001 and 2002, with economic activity in 2002 deviating 11% below its secular trend. The crisis started after mid-2001, and at the peak of the crisis, in April 2002, one out of four Argentines could not even afford to buy basic foodstuffs, and nearly two out of three were categorized as urban poor (i.e., under the urban poverty line) [1]. The occurrence of this Argentine macroeconomic episode, combined with the existence of the national registry of live births, offers the possibility of studying the effect of such a crisis

[1] Technically, these were individuals who lived in households whose total income was below a basic-foodstuffs basket (canasta básica alimentaria) that covers the minimal nutritional requirements for an individual of a certain sex and age. Further information can be found in an online report prepared by Argentina's National Institute of Statistics and Censuses (*Instituto Nacional de Estadística y Censos,* INDEC), available at http://www.indec.mecon.ar/nuevaweb/cuadros/74/pobreza2.pdf. Last accessed: October 13, 2012.

on the weight of the newborns by means of administrative data on more than 4 million live births that occurred over a six year period, from 2000 through 2005.

Measuring the state of the economy during pregnancy as the mean of the monthly cyclical (i.e., business cycle deviation respect to secular trend) component of the economic activity indicator during the period of gestation (i.e., 1-9 months before birth), we find that average birth weight (the prevalence of low birth weight) is procyclical (countercyclical) with respect to economic activity during pregnancy: a negative deviation of 0.1 log units (about 11%) from the long-term trend in economic activity during the gestational period would explain a reduction in average birth weight (increase in the prevalence of low birth weight) of about 34-35 grams (respectively 0.007 percentage points), depending on the empirical specification. In addition, we document that the statistically relevant periods of pregnancy are the first and third trimesters, and seek to understand the channels behind the birth weight procyclicality with respect to these trimesters.

After stratifying the sample by mother's education (our socioeconomic status indicator), our data reveal that economic fluctuations during both the first and the third trimesters of pregnancy matter for low-educated mothers, while for high-educated mothers only economic fluctuations during the first trimester are relevant. This is consistent with nutritional deficiencies affecting low-educated mothers, who are more likely to be credit constrained, while stress associated to the economic downturns affects both low- and high-educated mothers. Our results are robust to controlling for several observable characteristics (mother's age, parity, mother's marital status), and both region-specific month of birth fixed effects and region-specific year of birth fixed effects. In addition, our empirical strategy is reinforced by the fact that postnatal economic fluctuations (1-9 months after birth) are not related to birth weight (or the prevalence of low birth weight).

To account for selection into pregnancy based on unobservable characteristics, we make use of an event study within the period under analysis: the economic collapse of 2002. In light of the evolution of both the economic activity and the consumer confidence indicators, the collapse was very unlikely to be anticipated by mothers who decided to become pregnant before August 2001. Within this group, some of them gave birth to babies who were exposed in utero to the collapse, while the rest gave birth to babies who were not exposed in utero to the collapse. Using month-by-month average-birth-weight comparisons between years, we obtain reduced form estimates. The largest gap among babies conceived before August 2001, 36 grams, is

found in April 2002, i.e., for the group of babies who were exposed in utero to the crisis from the very beginning (August 2001) to its peak (April 2002). Month-by-month deviations of average birth weight in 2000 with respect to those of 2001 indicate that the 2001-2002 mean birth weight drop was just too big to reflect an underlying time trend.

Although birth weight is the most important determinant of perinatal, neonatal and post neonatal outcomes (McCormick 1985; Pollack and Divon 1992), there is very limited evidence on its response to economic crises, as documented by Friedman and Sturdy (2011). The estimated 30-gram effect that we uncover for the Argentine sudden economic collapse is more than three times higher than the 8.7-gram reduction due to stressful events estimated by Camacho (2008), and more than half of the 57-gram difference explained by the intensity in mothers' smoking behavior (20 cigarettes/day vs. > 1 pack/day), see Abel (1980). While the annual aggregate statistics on both infant mortality and neonatal mortality rates display stable negative secular time trends without any sudden change in their evolution during the period 2001-2002, suggesting that none of them was affected by the crisis, it is important to highlight that children with low birth weight who survive into adulthood have (on average) worse outcomes in terms of educational attainment and earnings (e.g., Behrman and Rosenzweig 2004; Black, Devereux and Salvanes 2007).

The paper is organized as follows. In Section 2 we present a description of the data. In Section 3 we report our estimates of the effect of prenatal economic fluctuations on birth weight. In Section 4 we investigate the channels explaining our main results. In Section 5 we present an event study to address potential endogeneity concerns of our previous estimates. Section 6 concludes.

2. Data

2.1. *Informe Estadístico del Nacido Vivo*

The main source of data for this study is the Argentine national registry of live births, *Informe Estadístico del Nacido Vivo* (IENV), from the Dirección de Estadísticas e Información en Salud (DEIS). The main strength of this dataset is its universal coverage of all live births occurring in the country (see Bozzoli, Quintana-Domeque and Todeschini 2012). The IENV

contains information on birth weight and weeks of gestation, but not on other child health metrics (such as AGPAR score or head circumference). Regarding mother's characteristics, there is information on her age, parity history, marital status, and educational attainment, but not on risky behaviors such as smoking or drinking. By definition, the IENV only contains information on live births, mortality cannot be examined. We use information on more than 4 million births occurring from 2000 through 2005 in Argentina. Following previous work on the determinants of birth weight, we focus on mothers aged 15-49, we exclude multiple births and those newborns whose weight was either under 500 grams or above 9,000 grams. Our sample size is 4,201,324 live births, which decreases to 4,013,936 after our exclusions (161,550: non-singletons; 120,302: age below 15 or above 49; 143,582: birth weight below 500 g or above 9,000 g), and to 4,002,392 due to missing mother's province of residence (and two observations with missing month of birth information). The final sample constitutes 95% of all live births.

2.2. Descriptive statistics

Argentina is an upper-middle-income country (World Bank 2009), ranking as 'high' in UNDP's Human Development Index (UNDP 2009). Table 1 displays summary annual statistics for the period 2000-2005 grouped into three different panels: (i) birth outcomes, (ii) economic, financial and social indicators, and (iii) characteristics of the mother. The first panel shows that mean birth weight started at 3,272 grams in the beginning of the period (pre-crisis), and experienced a drop of 27 grams between 2001 and 2002 (during the economic crisis), from 3,263 to 3,236 grams, resulting in an average that was 100 grams below the U.S. standard (Martin *et al*. 2005). This reduction was exacerbated in 2003 and, after that (post-crisis period), in 2004 mean birth weight began to recover its pre-crisis path going back to a similar pre-crisis level (3,275 grams) in 2005. The evolution of the proportion of LBW (low birth weight, i.e., <= 2,500 g) was the opposite of birth weight: its prevalence increased during the crisis, from 7.3% to 7.7%, and went back to the pre-crisis fraction by 2004. Although we do not have individual data on children deaths, the evolution of infant and neonatal mortality rates do not reveal any pattern that matches those of birth weight or LBW, but just reflects secular negative time trends. Similarly, fertility (as measured by the birth rate per 1,000 people) does not deviate from its negative long-term trend either. Finally, the fraction of girls was stable at 0.49 during the period.

TABLE 1: **Descriptive statistics: Means (standard deviations) of selected variables**

	2000	2001	2002	2003	2004	2005
Birth outcomes						
Birth weight (grams)	3,272.2 (546.6)	3,262.9 (544.2)	3,235.6 (540.0)	3,229.9 (541.7)	3,259.1 (542.8)	3,274.9 (542.5)
Low birth weight (fraction of live births ≤ 2,500 g)	0.072 (0.259)	0.073 (0.260)	0.077 (0.267)	0.079 (0.270)	0.073 (0.261)	0.070 (0.255)
Infant mortality rate (per 1,000 live births)[a]	18.1	17.6	17.0	16.4	15.9	15.4
Neonatal mortality rate (per 1,000 live births)[a]	11.2	10.8	10.4	10.0	9.6	9.3
Birth rate, crude (per 1,000 people)[a]	18.8	18.4	18.2	18.0	17.8	17.7
Female (fraction)	0.49 (0.50)	0.49 (0.50)	0.49 (0.50)	0.49 (0.50)	0.49 (0.50)	0.49 (0.50)
Economic, financial and social indicators						
Economic activity index (EAI), 1993 = 100[b]	116.8	111.6	99.5	108.3	118.0	128.9
HP-cyclical component of the log (EAI)[b]	0.032	0.003	–0.108	–0.044	–0.003	0.024
Interest rate spread (lending rate minus deposit rate, %)[a]	2.8	11.5	12.4	9.0	4.2	2.4
Poverty head count ratio at urban poverty line (% urban population)[a]	28.9	35.4	54.3	47.8	40.2	33.8
Health expenditure per capita PPP (constant 2005 international $)[a]	684.5	706.1	562.3	615.9	696.9	795.7
Characteristics of the mother						
Age of the mother (years)	26.5 (6.5)	26.6 (6.5)	26.6 (6.5)	26.8 (6.4)	26.8 (6.5)	26.8 (6.5)
Mother has completed high school (fraction)	0.34 (0.47)	0.35 (0.48)	0.36 (0.48)	0.38 (0.49)	0.39 (0.49)	0.41 (0.49)
Total number of births	2.23 (1.17)	2.24 (1.17)	2.26 (1.17)	2.26 (1.17)	2.23 (1.17)	2.18 (1.14)
Mother has a partner (fraction)	0.74 (0.44)	0.85 (0.36)	0.83 (0.37)	0.84 (0.37)	0.84 (0.37)	0.86 (0.34)
Number of observations	660,610	644,525	660,880	666,994	693,018	676,445

Note: If not indicated, data sources are IENV (DEIS). Otherwise, data sources are: [a] World Bank, World Development Indicators and Global Development Finance (http://databank.worldbank.org, last accessed: October 5, 2012); [b] INDEC. The number of observations reported is the number used to compute the mean of average birth weight and the fraction of low birth weight. Total number of births (including current one) equals 1, 2, 3, or 4 (4 or more).

The second panel in the table contains selected economic, financial, and social indicators. The economic activity indicator declined by more than 12 points between 2001 and 2002, resulting in an economy that was an 11% below its long-term trend in 2002. The increase in (urban) poverty between 2001 and 2002 was dramatic: from 35% to 54%, almost a 20 percentage points increase, as a result of a combination of increased unemployment and a steep drop in real wages due to inflation pressures caused, in turn, by a sharp depreciation of the national currency[2]. The financial turmoil is illustrated by the explosion suffered by the interest rate spread between 2000 and 2001. The evolution of health expenditure per capita, with its drop between 2001 and 2002, highlights the importance of accounting for province-specific year fixed effects when analyzing the relationship between birth weight and prenatal economic fluctuations[3].

The last panel, devoted to mother's characteristics, shows positive time trends in both age and educational attainment of mothers, reflecting the well-known global trends of female educational attainment growth and postponed fertility. On the other hand, there is a bit of cyclicality in terms of number of pregnancies and partnership status: the average number of total births per mother is higher with the economic crisis, and the fraction of mothers without a partner is lower with the crisis[4].

Figure 1 plots the annual evolution of the index of economic activity and the average birth weight of babies born from 1997 through 2006. Two dimensions merit attention in this Figure. First, the evolution of average birth weight almost mimics that of the economic activity indicator, with a bust between 2001 and 2003. Second, although the crisis peaked in 2002, birth weight was at its nadir in 2003. This can be explained if birth weight is the cumulative effect of different inputs during the pregnancy period or by the existence of critical development periods (i.e., critical trimesters of gestation), even if no cumulative exposure exists. Similarly, we observe that while the economy started its recovery in 2003, average birth weight started recovering one year later. By 2005 average birth weight fully recovered its pre-crisis level.

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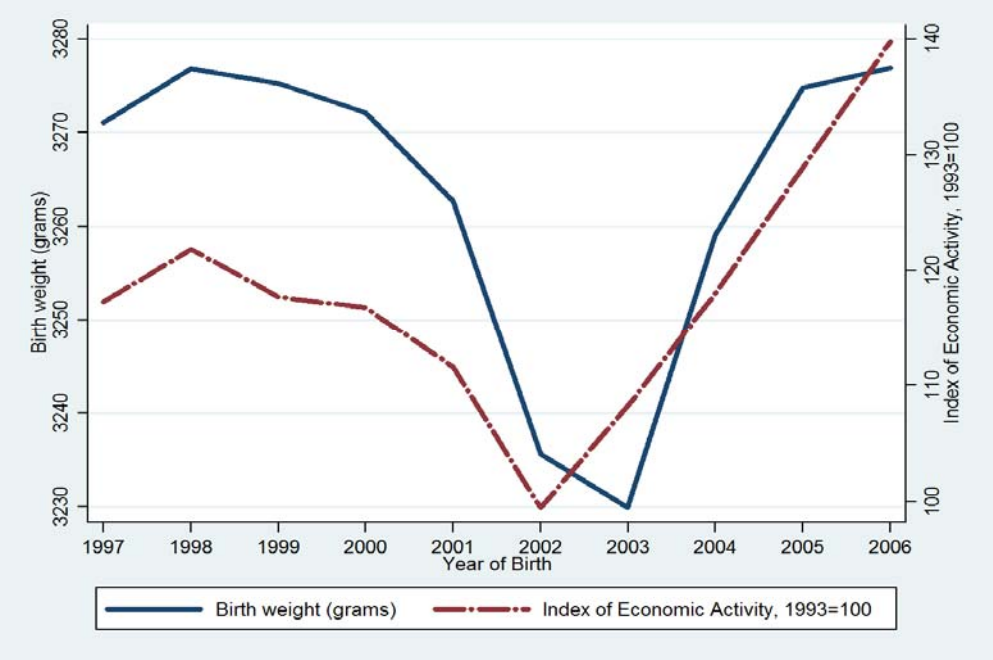
[2] By June 2002, the value of the peso relative to the US dollar was reduced to a quarter of what it had been in December 2001.

[3] Health expenditure per capita is defined as the sum of public and private health expenditures as a ratio of total population. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health.

[4] There is a change in the IENV questionnaire between 2000 and 2001. This may explain the jump in partnership status between 2000 and 2001.

FIGURE 1: **Annual evolution of average birth weight and economic activity, 1997-2006**



Source: Data on average birth weight come from Bozzoli, Quintana-Domeque, and Todeschini (2012).

3. Economic Fluctuations and Birth Weight

ECONOMIC fluctuations are measured at the month level and defined as the deviations of the log index of economic activity with respect to its long-term trend (expressed in log units)[5]. This deviation is usually referred to as the cyclical component, in that it isolates business-cycle fluctuations. We denote the cyclical component in month *m* of year *t* by $C_{m,t}$[6]. In the case under

[5] Why not using the *level* of economic activity rather than its *deviation*? It is not clear that the level of economic activity is more important than the deviation from its trend when thinking of the relationship between economic conditions and *stress*. In particular, given the existing bulk of empirical research, it is easy to think of negative deviations of economic activity with respect to its secular trend as major determinants of both *economic insecurity* and stress. While the level may well be more important in explaining the relationship between economic activity and nutrition, deviations of economic activity are more 'exogenous' than levels of economic activity, at least from the parents' point of view regarding the decision to have a child.

[6] $C_{m,t}$ is obtained by using Hodrick-Prescott (HP) filter, which is a standard decomposition method of identifying fluctuations at business-cycle frequencies (i.e., booms and recessions). We apply the HP-filter to the monthly log seasonally adjusted economic activity index from January 1993 through December

consideration, the economy plunges into a recession so quickly that by January of 2002 economic activity is more than 10% below its long-term trend.

We first link birth weight with economic fluctuations during pregnancy, estimating regressions of the form

$$BW_{i,r,m,t} = \beta_P C_{P,m,t} + \beta_A C_{A,m,t} + G_i + I_m + \kappa_r + \tau_t + \rho_{rt} + \sigma_{rm} + X_i\Gamma + \varepsilon_{i,r,m,t} \qquad (1)$$

where $BW_{i,r,m,t}$ is the birth weight in grams (or a low birth weight [LBW] indicator) of child i whose mother's residence was r born in month m in year t, $C_{P,m,t}$ is our measure of economic fluctuations during pregnancy (the average of the monthly cyclical component during 1-9 months before birth) for a birth occurred in month m in year t, and $\varepsilon_{i,r,m,t}$ is a random error term. The parameter of interest is β_p, which reflects the sensitivity of birth weight to prenatal economic fluctuations. Our full specification includes the following list of covariates: $C_{A,m,t}$, which is a measure of postnatal economic fluctuations (the average of the monthly cyclical component during the first nine months after birth) for a birth occurred in month m in year t. β_A reflects the sensitivity of birth weight to postnatal economic fluctuations; G_i, a gender of the child fixed effect; I_m, month of birth-fixed effects, to account for seasonality patterns in birth weight; κ_r, mother's province of residence-fixed effects, to capture regional differences in fixed prenatal infrastructure (among other fixed factors) that vary across provinces; τ_t, year-fixed effects, to account for flexible trends in birth weight; ρ_{rt} province-specific year-fixed effects, to capture omitted variables that vary simultaneously at the year and regional levels; and σ_{rm}, province-specific month-of-birth fixed effects, to capture monthly-related birth weight patterns or factors that differ across regions. In addition, it also includes the set of controls X_i: mother's age categories, parity categories, an indicator of whether the mother has completed high school, an indicator of whether the mother is living with her partner (married or cohabiting), and the interaction of these last two variables. Regressions are estimated by Ordinary Least Squares (OLS) using clustered standard errors at the month-by-year level (72 clusters).

2006. Since we are using monthly data, we follow Ravn and Uhlig (2002) and choose a smoothing parameter of 129,600. The seasonally adjusted economic activity index, elaborated by the INDEC, is available at http://www.indec.mecon.ar/nuevaweb/cuadros/17/Estim-mensual-activ-econ_SH.xls. Last accessed: October 13, 2012.

The estimates corresponding to various forms of regression (1) are reported in Table 2. In the first column, we run an OLS regression of birth weight on our measure of prenatal economic fluctuations controlling for month of birth, mother's province of residence and year of birth fixed effects: the point estimate is 341.80 (p-value < 0.01). Birth weight is procyclical with respect to prenatal economic fluctuations. To understand the magnitude of our estimate, note that a (negative) deviation of 0.1 log units (about 11%) from the long-term trend in the economic activity during the gestational period would explain a reduction in average birth weight of about 34 grams (0.1 × 341.80). In column (2) we add a gender of the child indicator and mother's characteristics[7]: the new point estimate is virtually the same. Looking at the rest of the coefficients we can see that at birth girls are on average 103 grams lighter than boys: a finding similar to that of Kramer (1987). In addition, newborns of highly educated mothers are on average 19 grams heavier than those whose mothers are not, which is consistent with previous studies linking maternal education and birth-weight outcomes (e.g., Currie 2009).

Column (3) includes our measure of postnatal economic fluctuations. Its estimated coefficient is 23.03 and far from being statistically significant at conventional levels. The magnitude is very small as well: a (negative) deviation of 0.1 log units (about 11%) from the long-term trend in the economic activity during the first nine months after birth would explain a reduction in average birth weight of about 2 grams (0.1 × 23.03). This result is reassuring, and it serves as a falsification test for our empirical strategy: while economic fluctuations during pregnancy matter for child health at birth, child health at birth is not affected by economic fluctuations after birth (as long as there are no anticipation effects). In columns (4) and (5), we include province-specific year of birth fixed effects and province-specific month of birth fixed effects. These additional adjustments make no difference for either our point estimate of β_p, or its statistical significance. Finally, in columns (6)-(10) we conduct the same analysis as in columns (1)-(5) but using a LBW indicator (≤ 2,500 g) rather than birth weight. The main message of these new regressions is that LBW is coun-tercyclical with respect to prenatal economic fluctuations: A (negative) deviation of 0.1 log units (about 11%) from the long-term trend in the economic activity during the prenatal period would explain an increase in the prevalence of LBW of 0.007 percentage points.

[7] The gender of the child is not associated with prenatal economic fluctuations. Mother's age, mother's total number of births and mother's educational attainment are related to prenatal economic fluctuations. However, the magnitudes of the corresponding point estimates imply very small effects: A (positive) deviation of 0.1 log units (about 11%) from the long-term trend in the economic activity during the prenatal period would explain a decrease in: average mother's age of 0.1 years, average number of births of 0.02 births, and in the fraction of high educated mothers of 0.004 points. Results available upon request.

TABLE 2: **Regressions of birth weight and low birth weight on cyclical components of economic activity before and after birth I**

	Birth weight (grams)					Low birth weight (1 if birth weight ≤ 2500 grams)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cyclical component 1-9 months before birth	341.80***	345.95***	345.75***	346.13***	346.02***	–0.069***	–0.066***	–0.066***	–0.067***	–0.067***
	(29.01)	(31.25)	(32.22)	(32.44)	(32.45)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)
Cyclical component 1-9 months after birth	–	–	23.03	22.83	22.81	–	–	0.008	0.008	0.008
			(18.96)	(19.23)	(19.25)			(0.006)	(0.006)	(0.006)
Region and time controls										
Month of birth (MOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year of birth (YOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province-specific YOB FE?	NO	NO	NO	YES	YES	NO	NO	NO	YES	YES
Province-specific MOB FE?	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Other controls										
Female	–	–103.63***	–103.63***	–103.63***	–103.64***	–	0.011***	0.011***	0.011***	0.011***
		(0.578)	(0.578)	(0.578)	(0.578)		(0.000)	(0.000)	(0.000)	(0.000)
Mother's age categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Parity categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Mother has completed high school (HS)	–	19.15***	19.15***	19.60***	19.57***	–	–0.008***	–0.008***	–0.008***	–0.008***
		(1.99)	(1.99)	(1.97)	(1.97)		(0.001)	(0.001)	(0.001)	(0.001)
Mother has a partner (Partner)	–	52.00***	51.99***	51.59***	52.62***	–	–0.016***	–0.016***	–0.016***	–0.016***
		(2.22)	(2.22)	(2.23)	(2.21)		(0.001)	(0.001)	(0.001)	(0.001)
HS × Partner	–	–17.63***	–17.64***	–18.18***	–18.17***	–	0.001	0.001	0.001	0.001
		(2.19)	(2.19)	(2.14)	(2.15)		(0.001)	(0.001)	(0.001)	(0.001)
Number of observations	4,002,392	3,778,830	3,778,830	3,778,830	3,778,830	4,002,392	3,778,830	3,778,830	3,778,830	3,778,830

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

Note: All regressions include a constant term. Province FE: 23 dummy variables for the region of residence of the mother. Female is a binary indicator that takes value 1 if the child is a girl. Mother's age categories: 6 dummy variables corresponding to the age groups15-19, 20-24, 25-29, 30-34, 35-39, and 40-44. Parity categories: 3 dummy variables corresponding to first pregnancy, second pregnancy, and third pregnancy. HS is a binary indicator that takes value 1 if the mother's educational attainment is at least high-school. Partner is a binary indicator that takes value 1 if the mother lives with a partner (married or cohabiting). Robust standard errors clustered at the month-by-year level (72 clusters) are reported in parentheses.

Since the literature on the determinants of birth weight suggests that the effects of economic shocks (fluctuations) vary according to the stages of gestation, for each birth we now create a measure of economic fluctuations in each of the three quarters that a preg-nancy usually takes. For the first quarter of pregnancy, we take the average of the monthly cyclical component in those three initial months, $C_{1,m,t}$, and we do a similar procedure for the second and third quarters of pregnancy, $C_{2,m,t}$ and $C_{3,m,t}$ [8].

We estimate regressions of the form

$$BW_{i,r,m,t} = \sum_{T=1}^{3} \gamma_T \, C_{T,m,t} + \gamma_A C_{A,m,t} + G_i + I_m + \kappa_r + \tau_t + \rho_{rt} + \sigma_{rm} + X_i \Gamma + u_{i,r,m,t} \quad (2)$$

where $C_{T,mt,}$ is our measure of economic fluctuations in the trimester *T* of pregnancy (the aver-age of the monthly cyclical component in the trimester *T* of pregnancy) for a birth occurred in month *m* in year *t,* and $u_{i,r,m,t}$ is a random error term. γ_T reflects the sensitivity of birth weight to economic fluctuations during trimester *T* of pregnancy.

Table 3 contains the estimates of various forms of regression (2). The different columns follow the same strategy of Table 2, including additional controls sequentially. The bottom line of this table is that only economic fluctuations in the first and third trimester of pregnancy affect birth weight (or low birth weight), consistent with the existence of critical stages of gestation[9].

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[8] We define $C_{3,m,t} = \frac{1}{3}\sum_{k=1}^{3} C_{(m\times t)-k}$, $C_{2,m,t} = \frac{1}{3}\sum_{k=4}^{6} C_{(m\times t)-k}$, and $C_{1,m,t} = \frac{1}{3}\sum_{k=7}^{9} C_{(m\times t)-k}$, where $(m \times t) \equiv m + 12 \times (t - 2000)$. Babies are born from 2000 through 2005. For the group of babies born in January 2000, the cyclical component 9 months before birth would be the one corresponding to $(1 \times 2000) - 9 = 1 + 12 \times (2000 - 2000) - 9 = -8$ (i.e., April of 1999). Our results are robust to the alternative definition: $C_{3,m,t} = \frac{1}{3}\sum_{k=0}^{2} C_{(m\times t)-k}$, $C_{2,m,t} = \frac{1}{3}\sum_{k=3}^{5} C_{(m\times t)-k}$, and $C_{1,m,t} = \frac{1}{3}\sum_{k=6}^{8} C_{(m\times t)-k}$. Results available upon request.

[9] The correlation between the cyclical components is: 0.9176 between the third and second trimesters of pregnancy; 0.7241 between the third and the first; and 0.9167 between the second and the first. Hence, although there is no clear biological reason to expect an effect of economic activity in the second trimester of pregnancy on birth weight, it is important to keep in mind that the not-statistically different than zero correlation between birth weight and the state of the economy in the second trimester of pregnancy can be driven by the collinearity of the second trimester with respect to the first and the third trimesters. The correlations between the prenatal and postnatal cyclical components are: 0.6739 between the third and the postnatal, 0.4291 between the second and the postnatal, and 0.1866 between the first and the postnatal.

4. Exploring the Channels: Nutrition or Stress?

WHY negative economic fluctuations during the prenatal period reduce average birth weight? In order to offer an answer to this question, we first need to review the main determinants of birth weight. In a nutshell, and following Kramer (1987), birth weight can be thought of as being a function of the gestation length (GL) and intrauterine growth (IUG). Maternal *nutrition* and cigarette smoking are the two most important and potentially modifiable determinants of IUG. While GL is more important in determining birth weight, it is also more difficult to manipulate its determinants, such as maternal *stress*[10].

Economic crises may compromise food security and increase psychosocial stress. Dramatic reductions in resources can force credit constrained people to reduce their food expenditures below poverty levels. Hence, there are (at least) two plausible channels whereby in utero exposure to a macroeconomic shock could affect birth weight: Nutritional deficits, and maternal (psychosocial) stress. More importantly: The impact of these determinants on birth weight varies according to the stages of gestation. In this section we investigate the plausibility of each of these channels by exploring the sensitivity of birth weight to economic fluctuations in each trimester of pregnancy by mother's socioeconomic status (SES), which is estimating regressions of the form (2), without including mother's education and its interaction with partnership status, by mother's SES.

4.1. The nutrition channel

The role of nutrition in affecting fetal growth (or IUG) is clear[11]. If the nutritional channel is at work, a macroeconomic shock should be expected to have stronger effects on the birth weight of newborns to low-SES mothers. Why? While high-SES mothers may be able to smooth the consumption of nutritious food during pregnancy, low-SES mothers are more likely to face credit constraints. However, high-SES mothers may be able to smooth not just the consumption of nutritious food, but of other critical inputs.

[10] Malnutrition may cause stress in the fetus which is an important factor regarding preterm birth. See Hobel and Culhane (2003) on the role of psychosocial and nutritional stress in explaining poor pregnancy outcomes.

[11] The adequacy of fetal nutrition is dependent upon many factors and regulating mechanisms. These include nutrient intake of the mother; nutrient uptake of the nutrients and fetal regulation of the nutrients.

TABLE 3: **Regressions of birth weight and low birth weight on cyclical components of economic activity before and after birth II**

	Birth weight (grams)					Low birth weight (1 if birth weight ≤ 2500 grams)				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cyclical component 1-3 months before birth	153.50***	166.18***	129.27*	131.01*	126.02*	–0.024**	–0.026**	–0.041**	–0.042**	–0.040*
	(41.67)	(43.91)	(68.97)	(69.35)	(69.78)	(0.012)	(0.013)	(0.020)	(0.020)	(0.020)
Cyclical component 4-6 months before birth	85.29	26.21	44.71	38.12	45.52	–0.015	0.003	0.011	0.013	0.010
	(57.67)	(61.58)	(65.88)	(66.16)	(66.53)	(0.016)	(0.019)	(0.021)	(0.021)	(0.021)
Cyclical component 7-9 months before birth	118.19***	164.70***	167.71**	172.70***	168.89***	–0.029**	–0.041***	–0.040***	–0.042***	–0.041***
	(36.33)	(39.52)	(40.60)	(40.45)	(40.58)	(0.011)	(0.014)	(0.014)	(0.014)	(0.014)
Cyclical component 1-9 months after birth	–	–	30.63	30.98	32.35	–	–	0.012	0.012	0.012
			(37.77)	(37.92)	(38.20)			(0.011)	(0.011)	(0.011)
Region and time controls										
Month of birth (MOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year of birth (YOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province-specific YOB FE?	NO	NO	NO	YES	YES	NO	NO	NO	YES	YES
Province-specific MOB FE?	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Other controls										
Female	–	–103.63***	–103.63***	–103.63***	–103.64***	–	0.011***	0.011***	0.011***	0.011***
		(0.578)	(0.578)	(0.578)	(0.579)		(0.000)	(0.000)	(0.000)	(0.000)
Mother's age categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Parity categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Mother's has completed high school (HS)	–	19.14***	19.15***	19.59***	19.57***	–	–0.008***	–0.008***	–0.008***	–0.008***
		(1.99)	(1.99)	(1.97)	(1.98)		(0.001)	(0.001)	(0.001)	(0.001)
Mother has a partner (Partner)	–	52.01***	52.01***	52.62***	52.64***	–	–0.016***	–0.016***	–0.016***	–0.016***
		(2.21)	(2.21)	(2.22)	(2.20)		(0.001)	(0.001)	(0.001)	(0.001)
HS × Partner	–	–17.62***	–17.63***	–18.18***	–18.16***	–	0.001	0.001	0.001	0.001
		(2.19)	(2.20)	(2.15)	(2.16)		(0.001)	(0.001)	(0.001)	(0.001)
Number of observations	4,002,392	3,778,830	3,778,830	3,778,830	3,778,830	4,002,392	3,778,830	3,778,830	3,778,830	3,778,830

Note: See Table 2.

In order to further investigate the nutrition channel, we note that a woman's nutritional need varies according to the stages of gestation. In general, birth weight is found to be most responsive to nutritional changes affecting the *third trimester* of pregnancy. For example, evidence coming from the end of the Second World War shows that the cohort exposed to the Dutch Famine in the third trimester had lower average birth weight than cohorts exposed earlier in pregnancy (e.g., Stein and Lumey 2000)[12]. More recently, Almond, Hoynes, and Schanzenbach (2011) show that in the U.S. pregnancies exposed to the Food Stamp Program *three months prior to birth* yielded deliveries with increased birth weight[13]. In summary, if the nutritional channel explains (part of) the loss in birth weight during the Argentine crisis, we should find that the birth weights of children born to low-SES mothers are more affected than those of high-SES mothers by economic fluctuations in the third trimester of pregnancy.

This sort of heterogeneity is analyzed in Table 4. We split the sample according to the mother's educational level. Although we do not have information on family income, completion of secondary (high school) education (and above) represents a good proxy for income opportunities in Argentina (Savanti and Patrinos 2005). We find that the sensitivity of birth weight to economic fluctuations in the third trimester of pregnancy is only present for babies born to low-educated (less than high-school) mothers, which is consistent with nutritional shocks affecting low-SES women, but not their high-SES (high school or above) counterparts. Our most complete specifications, column (5) for low-educated mothers and column (10) for high-educated mothers, reveal that a (negative) deviation of 0.1 log units (about 11%) from the long-term trend in economic activity during the third trimester of pregnancy would explain a reduction in average birth weight of about 18 grams (p-value < 0.05) for low-educated mothers, and of 3 grams (not statistically different from zero) for high-educated mothers. The results from this table suggest that the previous procyclicality of birth weight with respect to the economic fluctuations in the third trimester of pregnancy was driven by babies born to low educated mothers.

These findings support the existence of nutritional deficits as a mediating channel in our context. While low-educated mothers, which are more likely to be credit constrained, cannot

[12] During the Dutch 'Hunger Winter' of 1944-1945 food rations were reduced to below 1,000 Kcal per person for seven months: the birth weight of those exposed to famine in the third trimester dropped by about 300 grams.

[13] The Food Stamp Program is the most expensive of the U.S. food and nutrition programs. Although the program is means tested, there is no additional targeting to specific populations or family types.

TABLE 4: **Regressions of birth weight cyclical components of economic activity before and after birth by mother's educational attainment**

	Low-educated mothers					High-educated mothers				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cyclical component 1-3 months before birth	203.30***	224.94***	188.07**	189.56**	183.18**	75.02	78.38	34.21	35.92	32.96
	(47.44)	(50.69)	(76.46)	(76.66)	(76.95)	(48.64)	(48.95)	(76.99)	(77.11)	(77.24)
Cyclical component 4-6 months before birth	68.86	18.88	37.49	30.35	38.86	74.69	21.44	43.31	40.28	44.69
	(66.18)	(67.95)	(71.61)	(71.87)	(72.19)	(68.08)	(71.05)	(78.16)	(77.96)	(77.89)
Cyclical component 7-9 months before birth	128.88***	175.10***	178.02***	183.51***	179.50***	123.32***	163.95***	167.72***	168.76***	166.05***
	(42.54)	(44.27)	(45.45)	(45.40)	(45.44)	(39.78)	(43.51)	(44.37)	(44.06)	(44.11)
Cyclical component 1-9 months after birth	–	–	30.59	32.34	33.87	–	–	36.68	35.67	37.14
			(40.72)	(40.83)	(41.02)			(47.10)	(47.04)	(47.47)
Region and time controls										
Month of birth (MOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year of birth (YOB) FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Province-specific YOB FE?	NO	NO	NO	YES	YES	NO	NO	NO	YES	YES
Province-specific MOB FE?	NO	NO	NO	NO	YES	NO	NO	NO	NO	YES
Other controls										
Female	–	–99.28***	–99.27***	–99.29***	–99.30***	–	–110.91***	–110.91***	–110.91***	–110.92***
		(0.788)	(0.788)	(0.789)	(0.790)		(0.894)	(0.894)	(0.895)	(0.894)
Mother's age categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Parity categories?	NO	YES	YES	YES	YES	NO	YES	YES	YES	YES
Mother has a partner	–	50.01***	50.01***	50.48***	50.50***	–	39.00***	38.99***	39.19***	39.19***
		(2.08)	(2.08)	(2.14)	(2.10)		(2.06)	(2.05)	(2.08)	(2.05)
Number of observations	2,436,476	2,364,850	2,364,850	2,364,850	2,364,850	1,451,199	1,413,980	1,413,980	1,413,980	1,413,980

Note: See Table 2.

buffer expenditures on nutritious foods, high-educated mothers do not face credit constraints and do not suffer from nutritional deprivation. Still, it remains to be explained why birth weight is sensitive to economic fluctuations in the first trimester of pregnancy for both low- and high-SES mothers: columns (5) and (10) indicate that a (negative) deviation of 0.1 log units (about 11%) from the long-term trend in economic activity during the first trimester of pregnancy would explain a reduction in average birth weight of about 18 grams (p-value < 0.01) for low-educated mothers, and of 17 grams (p-value < 0.01) for high-educated mothers. We turn now to the stress channel to shed some light on this issue.

4.2. The stress channel

Stressful events are linked to pregnancy outcomes. Although the exact mechanism of onset of preterm labor is not known, there is growing evidence of an interaction or interplay of neuro-endocrine and immunological processes (Wadhwa *et al.* 2001). Stress experienced by the individual plays a role in altering both processes[14]. Perhaps more interesting is the existing evidence showing that birth weight is most responsive to stressful events affecting the first trimester of pregnancy (Camacho 2008; Torche 2011). Camacho has found that in Colombia the intensity of random land-mine explosions during a woman's first trimester of pregnancy has a negative significant impact on her child's birth weight. More recently, Torche (2011) has shown that in Chile infants exposed to a major earthquake (a source of acute maternal stress) in the first trimester of gestation had significantly lower birth weight than those unexposed or exposed later in the pregnancy.

Whether a macroeconomic shock is expected to be more stressful for low-SES than high-SES mothers is hard to know ex ante. On the one hand, high-SES mothers may have more coping mechanisms than low-SES mothers. For example, high-SES mothers have better access to counseling services, which is widespread in Argentina, a country with an exceedingly high ratio of psychologists per 100,000 (World Health Organization, WHO 2005). Moreo-

[14] The biological pathways linking psychosocial stressors and birth outcomes have not been completely elucidated. However, a neuropeptide (corticotrophin-releasing hormone, or CRH) involved in stress response and affecting the initiation of labor is thought to be a central factor. 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.

ver, not surprisingly, unemployment rates in May 2002 were higher for both low-SES men and women. On the other hand, in Argentina, high-SES families were particularly exposed to the freezing deposits in banks (whose value diminished in real terms due to a large devaluation). They also may suffer from higher initial costs of adaptation to a crisis situation. As highlighted by Friedman and Sturdy (2011), the emerging evidence suggests that negative (or positive) life shocks are linked to worse (or improved) psychosocial health among adults in developing countries (e.g., Stillman, McKenzie, and Gibson 2009), which indicates that transitions into poverty and the conditions associated with transition are linked to an increased likelihood of poor mental health (rather than poverty per se). The estimates in Table 4 reveal that economic fluctuations in the first trimester of pregnancy are associated with birth weight for both low- and high-SES mothers[15].

Finally, we conclude with an important remark. Not only mothers of low socioeconomic status had on average lighter babies than did the others (around 19 grams according to Tables 2 and 3), but less-educated mothers were hit harder by the crisis (Table 4): the total birth weight loss associated to an 11% negative deviation from the long-term trend in economic activity during the first and third trimesters of pregnancy would be (adding up the corresponding coefficients) around 36 grams for children born to low-educated mothers and 20 grams for those born to high-educated mothers. In other words, babies born into poor families have a disadvantage in 'normal times' (without recessions) which becomes even wider in 'bad times' (with recessions).

5. An Event Study to Measure the Weight of the Crisis

OUR previously estimated associations between birth weight and economic fluctuations in the first and third trimesters of pregnancy can be explained by (at least) two different reasons. First, it is possible that a child born to a woman of given characteristics is more likely to suffer from low birth weight if economic circumstances are unfavorable. Indeed, we have

[15] Maternal psychosocial stress is negatively associated to length of gestation. We have investigated the stress channel by examining the effects of *economic fluctuations* on length of gestation. Our findings revealed that length of gestation is a procyclical variable with respect to prenatal economic fluctuations.

already shown that birth weight is positively related to economic fluctuations in the third trimester of pregnancy for low-educated mothers but not for their high-educated counterparts. Second, it may also be the case that the composition of pregnant women (and women giving birth) changes with economic circumstances[16]. In our previous analysis we adjusted for compositional changes including several observable mothers' characteristics[17]. However, this does not rule out the possibility that pregnant women in periods of crises have different unobservable characteristics than pregnant women in "normal times" [18].

In this section we use month-by-month variation in the timing of the crisis to exploit the fact that (the extent of) the Argentine crisis could not be anticipated for a group of mothers. Within this group some of them gave birth to babies who were exposed to crisis while in utero, while the rest gave birth to babies who were *not* exposed. This comparison allows us to have an alternative estimate of the *weight* of the crisis.

5.1. Identification strategy

The first step in our identification strategy relies on finding a cohort of newborns who were conceived during a period when (the extent of) the crisis could not be anticipated. After the crisis of 1999, the Argentine economy entered into a plateau or growth slowdown in 2000 and until mid-2001. In light of the evolution of both the economic activity and the consumer confidence indicators, as depicted in Figure 2, the *extent* of the crisis, with the *collapse* of 2002, was not likely to be anticipated before August 2001. The Figure shows that the deviation of economic activity with respect its long-term trend became negative in August 2001, and from there went down to the collapse of

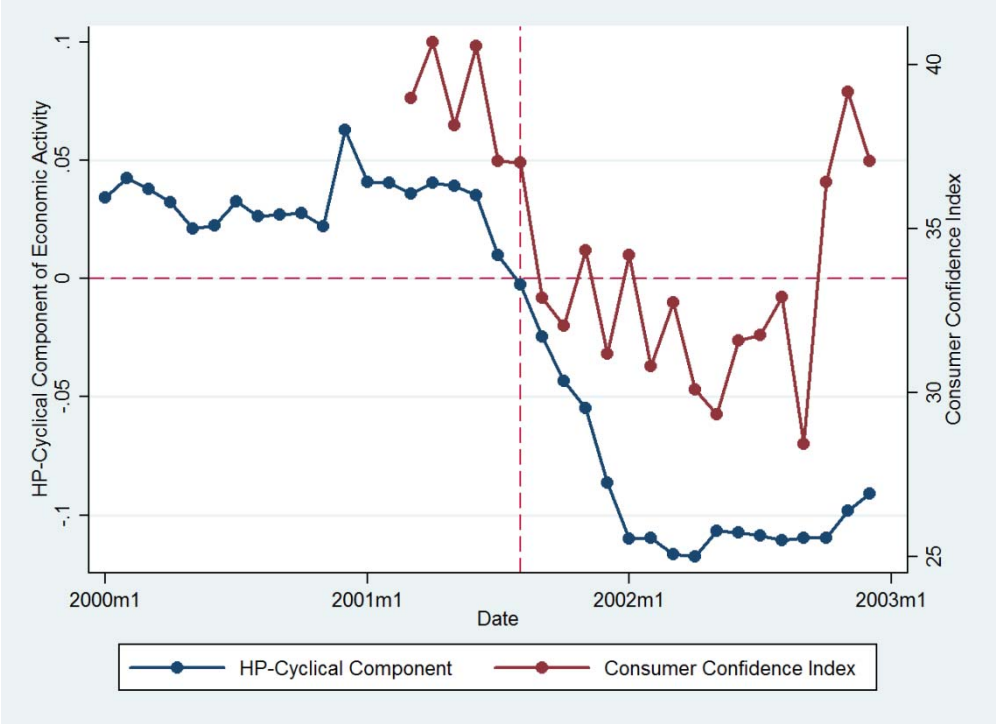
[16] Fertility decisions are likely to be affected by economic conditions, and heterogeneous mothers are likely to react differently to the crisis. This fact has proven empirically by Dehejia and Lleras-Muney (2004).

[17] 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.

[18] What about abortion? Unfortunately, not only are such data scant but the entire issue is complicated by the fact that in Argentina abortion is illegal. A recent study by Mario and Pantelides (2009) estimates the number of annual abortions by means of various indirect methods, adequate for describing general trends but 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 by means of data from the Official Statistical Yearbooks (Ministerio de Salud 2000-2009).

2002. In addition, it also reveals that the consumer confidence index dropped sharply after August 2001[19]. Perhaps more interesting (although not reported here) is the fact that this drop is of the same magnitude whether the consumers in question are of low or of high socioeconomic status[20]. Hence, even though mildly pessimistic expectations may have prevailed throughout the period, it is reasonable to assume that (the extent of) the crisis could not be anticipated before August 2001.

FIGURE 2: **Monthly evolution of economic activity and the consumer confidence index, 2000-2002**



Source: CCI data come from Serie Histórica - Índice de Confianza del Consumidor, Torcuato di Tella University.

[19] Cárdenas and Henao (2010) compute an index (Latin America and the Caribbean Economic Recovery [LACER]) combining real, financial and confidence variables, using principal component analysis, which shows the same sort of jump by mid-2001.

[20] The Consumer Confidence Index, available from March 2001 at the national level and elaborated by the Centro de Investigación y Finanzas (CIF) of Torcuato Di Tella University, is based on a monthly survey of consumer expectations similar to surveys used in OECD countries (http://www.utdt.edu/download.php?fname=_133036398737682600.xls). Last accessed: October 13, 2012. We thank the CIF of Torcuato Di Tella University, and especially Guido Sandleris, Ernesto Schargrodsky, and Julieta Serna, for providing us with the access that we needed in order to disaggregate consumer-confidence indicators by socioeconomic status. However, due to confidentiality reasons, the disaggregated indicators cannot be reported.

By using information on births occurred from 2000 through 2005, we can distinguish three groups of births according to their exposure and anticipation of the crisis: (i) *pre-treatment* group (babies both conceived and born before the onset of the crisis in August 2001); (ii) *unanticipated treatment* group (babies conceived before August 2001 and born from August 2001 to April 2002); (iii) *anticipated-* and *post-treatment* group (babies conceived after August 2001 and born after April 2002).

5.2. Estimation and results

In order to account for seasonality patterns in birth weight, we compare monthly average birth weights in 2000, 2002, 2003, 2004 and 2005 with those of 2001 (reference year). Means of birth weight by month are estimated as the coefficients of the following model:

$$BW_{i,r,m,t} = \sum_{m=1}^{12} \delta_m I_m + \sum_{m=1}^{12} \sum_{t \neq 2001}^{2005} \theta_{m,t} I_m Y_t + G_i + \kappa_r + X_i \Gamma + v_{i,r,m,t} \quad (3)$$

where G_i=1 if the gender of the child i is female, I_m = 1 if the month of birth is m, Y_t=1 if the year of birth is t, K_r=1 if the mother's province of residence is r, X_i is defined as before, and $v_{i,r,m,t}$ is a random error term. δ_m is the adjusted average birth weight in month m of year 2001, while $\theta_{m,t}$ is the adjusted difference in average birth weight between t and 2001 in month m.

Importantly, the interpretation of $\theta_{m,t}$ depends on m and t. If t=2000 and $m \geq 8$ or t=2002 and $m<5$, $\theta_{m,t}$ captures unanticipated treatment effects of the economic crisis as the differences in average birth weight between 2000 and 2001 by month (from August through December), and as the differences in average birth weight between 2002 and 2001 by month (from January to April). Note that since 2001 is the year of reference, $\theta_{m \geq 8,2000} > 0$ and $\theta_{m<5,2002} < 0$ would be interpreted as reductions in average birth weight due to the crisis. The identification strategy requires that there are no month-of-birth-specific time trends in average birth weight (or positive jumps or drops between years by month). Reassuringly, Figure 1 indicates that the 2001-2002 difference in average birth weight documented in Table 1 (27 grams) exceeds any underlying downward trend in the data. If $t \geq 2002$ and $m \geq 5$, the effects of the economic crisis (and the subsequent recovery) are potentially confounded with the effect of selection into pregnancy (or fertility post-ponement) of mothers who already knew (or anticipated) the extent of the crisis (with the collapse of 2002). Hence, in that case, $\theta_{m,t}$

captures both anticipated treatment effects and post-treatment effects. Finally, if t=2000 and m<8, $\theta_{m,t}$ captures pre-treatment effects by comparing average birth weight between 2000 and 2001 by month from January to August. In principle, if the crisis was unanticipated before August 2001, we should not find pre-treatment effects.

TABLE 5: **Adjusted differences in monthly average birth weights with respect to 2001 (reference year) for pregnancies of 38-40 weeks controlling for mothers' characteristics**

	2000	2001	2002	2003	2004	2005
January	4.5***	3,405.7	**–15.9*****	*–26.4****	*–6.1****	*10.6****
February	0.7***	3,413.5	**–17.9*****	*–30.5****	*–11.9****	*15.4****
March	12.5***	3,409.7	**–26.2*****	*–27.7****	*–5.9****	*18.8****
April	11.4***	3,412.4	**–36.0*****	*–24.9****	*–1.9****	*21.8****
May	8.9***	3,416.8	*–40.1****	*–28.9****	*–1.3****	*19.2****
June	9.0***	3,413.8	*–36.6****	*–26.7****	*0.4****	*23.3****
July	–0.6***	3,414.0	*–45.3****	*–27.9****	*3.6****	*18.8****
August	**–1.5*****	3,415.4	*–40.0****	*–25.7****	*9.2****	*25.8****
September	**6.2*****	3,419.2	*–44.1****	*–17.9****	*11.4****	*28.8****
October	**8.7*****	3,414.6	*–40.6****	*–9.7****	*16.8****	*29.8****
November	**15.2*****	3,408.7	*–37.2****	*–10.3****	*24.2****	*32.1****
December	**26.0*****	3,396.9	*–26.0****	*–4.7****	*29.1****	*31.1****
Mean	8.4	3,411.7	–33.8	–21.8	5.6	22.9
Number of observations			2,860,246			

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

Note: The reported coefficients are estimated from equation (3). The second column (2001) reports the estimates of δ_m controlling for year-specific month of birth fixed effects plus the previous controls: female, mother's age categories, parity categories, mother's high education, mother has a partner, and the interaction of mother's high education with mother has a partner. The rest of columns (2000, 2002, 2003, 2004 and 2005) report the estimates of $\theta_{m,t}$. p-values based on robust standard errors clustered at the month-by-year level (72 clusters).

Table 5 displays the monthly mean birth weight in 2001 (column 2) and the monthly differences in average birth weight of 2000, 2002, 2003, 2004 and 2005 with respect to 2001 (reference year). Our main focus is on estimated unanticipated treatment effects, which are highlighted in bold. Pre-treatment effects are reported in normal font, while anticipated- and post-treatment effects are displayed in italics. Not surprisingly, the estimated (unanticipated) treatment effects range from a negligible 1.5 grams for those born in August 2001, who were exposed to the beginning of the crisis during (at most) the *last month* of pregnancy, to -36 grams for those born in April 2002, who were exposed to the economic crisis during *all trimesters* of pregnancy from its low intensity in economic terms August 2001 (economic activity was 0.2 % below its long-term trend) to its peak in April 2002 (economic activity was 11% below its long-term trend). Estimated post-treatment and anticipated treatment effects range from -45 grams for those born in July 2002 to 32.1 for those born in November 2005. Finally,

estimated pre-treatment effects are small: the mean of the monthly differences in average birth weight between 2000 and 2001 from January to July is 6.6 grams. This magnitude is roughly half of the 11 grams mean reduction for those born from August to December 2001, and one fourth of the 24 grams for those born from January to April 2002. The bottom row of the table displays the evolution of adjusted average birth weight over the period 2000-2005: its drop of 33.8 grams between 2001 and 2002, and its recovery after 2003[21].

5. Conclusions

THE occurrence of the Argentine macroeconomic collapse in 2001-2002, combined with the existence of administrative data on more than 4 million live births that occurred over a six-year period, from 2000 through 2005, has allowed us to investigate the effects of economic crises on an important child health metric, namely birth weight. We have shown that birth weight is procyclical with respect to the first and third trimester of pregnancy. However, splitting our sample by mother's socioeconomic status, we uncover that economic fluctuations during both the first and the third trimester of pregnancy matter for low-educated mothers, while for high-educated mothers only economic fluctuations during the first trimester are relevant. This is consistent with nutritional deficiencies affecting low-educated mothers, who are more likely to be credit constrained, while stress associated to the negative economic fluctuations affects both low- and high-educated mothers.

To address endogeneity concerns, we perform an event study analysis. In light of the evolution of both the economic activity and the consumer confidence indicators in Argentina, the extent of the crisis could not be anticipated before August 2001, even though mildly pessimistic expectations may have prevailed throughout the period. The results from the event study, with an estimated loss in average birth weight of around 30 grams, are consistent with our previous estimates on the relationship between birth weight and economic fluctuations by trimester of pregnancy. The average birth weight loss due to the Argentine crisis is more than three times higher the 8.7-gram reduction due to stressful events estimated by Camacho

[21] Similar qualitative results are obtained without either controlling for mothers' characteristics or restricting our sample to births with 38-40 weeks of gestation. Results available upon request.

(2008), and more than half of the 57-gram difference explained by the intensity in mother's smoking behavior (Abel 1980).

The results of this paper contribute to our understanding of the impact of economic crises on child health, and complement an emerging body of evidence showing that both maternal nutrition late in pregnancy (e.g., Almond *et al.* 2011) and stress early in pregnancy (e.g., Torche 2011), affect birth outcomes. Generalizing results based on the stress induced by the freezing of deposits (including a 70% depreciation of its value in dollars) to other types of stress is a challenging task. As recently emphasized by Torche (2011), the response to different types of stressors, depending on duration (chronic versus temporary) and intensity, may be quite complex. Only the accumulation of evidence on different types of stressors in different contexts will allow us to elucidate the exact role of socioeconomic stressors in explaining birth outcomes.

Our findings are striking because the reduction in average birth weight occurred in a middle-to-high-income country with a physician-to-patient ratio similar to those of Germany and Norway, affecting both low- and high-educated mothers. Although it is too early to have any longer-term follow-up outcomes (e.g., educational attainment or earnings later in life for the affected cohorts *vs*. those in utero just before), the price paid will be higher for some than for others, since birth weight of children born to low-educated mothers is more sensitive to economic shocks. This discrepancy may exacerbate income inequalities in the long run.

There are certain limitations of the present study that must be acknowledged. Probably, the most important one is the absence of information on direct measures of maternal nutrition and stress, which should be taken into account in the design of future data collection schemes. However, our findings represent an advance in understanding the impact of economic crises, and more generally macroeconomic activity, on children's health, after accounting for the interactions between biological channels, timing of (economic) insults, and household behavioral responses.

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