Household Financial Distress and Initial Endowments:

Evidence From the 2008 Financial Crisis

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Abstract

This paper studies in utero exposure to the 2008 financial crisis. Exploiting the sudden and unexpected collapse of the Icelandic economy, I find that first-trimester exposure to the crisis led to a sizable and significant reduction in birth weight, increased the probability of a low birth weight (<2,500 grams), and decreased the probability of a high birth weight (>4,000 grams). I also find evidence that the collapse reduced the sex-ratio, indicating selection in utero due to maternal prenatal stress exposure. My results imply large welfare losses from financial distress that have hitherto been ignored – because children with worse health at birth can expect substantially lower lifetime earnings – and suggest that economic hardships may in general exacerbate income inequalities in the long run as low income households are typically more exposed to financial distress.

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1 Introduction

Financial crises are costly to society, and the 2008 financial crisis and its aftermath have been distinctive: it was the worst downturn in the United States since the 1930s and was responsible for the destruction of around 44% of the median household wealth (Wolff, 2014). Multiple attempts have been made to assess the costs and consequences of the crisis. The effects are most often quantified in direct economic costs due to unemployment, production contraction, and wealth destruction; however, the crisis might also have had other more subtle, but still direct, costs. Because financial difficulties may raise stress levels among the people they affect, and stress is a risk factor for adverse birth outcomes, children who were in utero during the downturn might be at risk of being born with poorer health endowments.[1]

In this paper, I examine the effects of the financial crisis by exploiting its discontinuous onset in Iceland. The Icelandic economy experienced the deepest and most rapid financial crisis in peacetime history when its three major banks collapsed in the same week in October 2008. Such a destructive shock to the economy affects all individuals,[2] and, in particular, sorts pregnant women into more or less stressful pregnancies. I use these to identify the effects of the crisis on birth outcomes.

In recent years, scientists have been developing a new understanding of our earliest experiences and the ways in which various conditions present during pregnancy contribute to negative health outcomes early in life and exert lasting effects on us well into adulthood. Empirical evidence for Barker's fetal origins hypothesis (1990) shows that conditions encountered before birth influence birth outcomes and linger into adulthood: initial health endowments matter for long-term health, human capital, labor market outcomes, and various other measures of life success,[3] although this can be partly moderated by childhood health and educational attainment (Case et al., 2005; Oreopoulos et al., 2008; Black et al., 2007; Bharadwaj et al., 2013, 2014; Persson and Rossin-Slater, 2014).

The evidence on how in utero experiences affect an unborn child's well-being from birth to adulthood have changed the way we think about pregnancies. A pregnancy is not merely a nine-month wait for the big event of birth, but a period that influences the

[1] Financial difficulties and stress could also affect both health-promoting and health-compromising behaviors among pregnant women which can have an effect on their birth outcomes.

[2] This is supported by studies that have documented elevated stress levels among individuals following the collapse (see, e.g., Hauksdóttir et al., 2013, who found that age-adjusted mean stress levels increased between 2007 and 2009).

[3] Marital status, for example, has been found to be negatively affected by early childhood exposure to the 1959-61 China famine (Almond et al., 2010; Brandt et al., 2010), and it has been shown that welfare dependency is increased by in utero shocks (Almond, 2006; Oreopoulos et al., 2008; Nilsson, 2014; Bharadwaj et al., 2013, 2014) as is the probability of living in a low-income neighborhood (Almond, 2006) and that economic conditions at birth matter for mortality later in life (van den Berg et al., 2006).

rest of a child's life. More specifically, in the context of this study, if the financial crisis caused poor birth health, its full costs will not materialize until the children exposed in utero become adults, and the costs of the crisis will continue to be paid for decades.

Confounding selection bias is an obstacle to estimating the effects of financial difficulties during pregnancy, and some of the earlier estimates can be attributed to this (Dehejia and Lleras-Muney, 2004). As a result, researchers have increasingly turned to natural experiments to capture these effects. I am aware of only three studies on the effects of financial conditions on birth outcomes that have overcome the selection problem by exploiting economic shocks. Bozzoli and Quintana-Domeque (2014) found that exposure to lower economic activity during pregnancy in Argentina had a negative impact on birth outcomes for children of less educated mothers who were likely to be credit-constrained. Bejenariu and Mitrut (2013) found that a wage cut in Romania that affected public sector employees improved the health of boys at birth and decreased the sex-ratio of children carried to term among those exposed early. Burlando (2014) found that a blackout in Tanzania led to a sharp decline in earnings in electricity-dependent jobs and that this led to reduced birth weight and an increased probability of low birth weight for children exposed in utero. No existing study establishes credible evidence of a causal link between a sudden deterioration in financial conditions and birth outcomes in an advanced country.[4]

Using data from the National Birth Register, I estimate the effects of exposure to the financial crisis on newborns' health. The data come from hospital records in Iceland and provide detailed demographic information. I use several measures of birth outcomes as dependent variables in my estimations. The main explanatory variable of interest involves the treatment described above, where I define exposure as having been in utero during the first week of October 2008, when Iceland's three biggest banks collapsed. The unexpected nature of the collapse allows me to identify the causal effect of the economic crisis by performing an event study analysis. More specifically, birth outcomes in the years before the economic meltdown should provide valid counterfactual outcomes because of the unexpected onset of the crisis. I can therefore estimate the effect the crisis had on birth outcomes by comparing the birth outcomes of children in utero during the collapse with those of children in utero at the same time of the year in the previous year (2007), because on average they will have similar characteristics except for the treatment. In addition to this event study approach and to verify the validity of my results, I use of mother-fixed effects approach, comparing two children born to the same mother, where the collapse took place during her last pregnancy. This approach allows me to control for any invariant unobserved mother characteristics that might be related to the probability

[4] Eiríksdóttir et al. (2011) perform a multivariate logistic regression analyses to calculate adjusted odds ratios for low birth weight, preterm birth, and being born small for gestational age for children born before and after the collapse of the Icelandic economy.

of expecting a child during the collapse.[5]

According to Kramer (1987), birth weight can be thought of as a function of gestational age and intrauterine growth. To identify the propagation mechanism of the financial crisis on birth weight, therefore, I also investigate the gestational age of children and whether they are born small for their gestational age (SGA), which captures whether they suffer from intrauterine growth restrictions. Furthermore, I investigate the effects of the collapse on the incidence of low birth weight (<2,500 grams, LBW), high birth weight (>4,000 grams, HBW), pre-term birth (<37 weeks of gestational age, PTB), and neonatal diseases. Finally, I investigate the effect of the collapse on gender at birth.

My results show that a sudden deterioration in economic conditions has a negative impact on birth outcomes and that children in the early stages of gestation are more vulnerable to such shocks. I find that first-trimester exposure led to a 66-gram reduction in birth weight and increased the probability of LBW by 1.9 percentage points. It also led to a 4.0 percentage point lower incidence of HBW. Furthermore, I find indications of a decreased sex-ratio at birth of about 3.3 percentage points. This is consistent with previous findings that have established that weaker males are more vulnerable to adverse conditions in utero (see, e.g., Catalano, 2003; Catalano and Bruckner, 2005; Catalano et al., 2012; Bejenariu and Mitrut, 2013) and that spontaneous abortions of weaker fetuses is reflected in a decrease of the sex-ratio at birth. My findings show that financial stress, a common stressor in advanced economies, has an impact on birth weight comparable to one of the most widely cited behavioral taboo during pregnancy, smoking. My results shed light on a difficult to comprehend propagation mechanism in which in utero exposure to deteriorated economic conditions affects individual outcomes.

Iceland is a high-income OECD country (World Bank, 2015) and the circumstances in Iceland when the crisis hit were similar in many ways to those in other countries. The main difference was in the severity and in how sudden and unexpected the event was. To get a sense of the circumstances around the time of the collapse, I provide information on birth outcomes, characteristics of mothers, and economic, financial, and social indicators for the period 2005-2009 in Iceland in Table 1. In spite of the sharp drop in GDP at the end of the period, health care expenditures were constant, health services remained intact, and the poverty rate did not change. Previous event studies of the effects of financial stress on birth outcomes have all been carried out in less-developed countries where children's health at birth is not as good (see Burlando, 2014; Bejenariu

[5]Much of the research in the literature on intra-uterine shocks on child outcomes has used mother-fixed effects (see, e.g., Black, Devereux, and Salvanes, Black et al.). However, as pointed out by Persson and Rossin-Slater (2014), the possibility of endogenous subsequent fertility suggests that a comparison of treated children with younger siblings would result in biased estimates. A mother-fixed effects approach would therefore hinder me from investigating the effect on firstborn children.

and Mitrut, 2013; Bozzoli and Quintana-Domeque, 2014), and it may be argued that their results cannot be generalized to advanced countries. It is therefore important to analyze the effect of financial crises in advanced economies like Iceland where low birth weight and infant mortality are less prevalent and life expectancy is higher.

Even though the crisis went much deeper in Iceland than in other places, there are many reasons to think that my estimates are informative on its effects in other advanced economies. I have argued that my estimates capture the effect of financial stress or stress-induced changes in behavior because the welfare system ensured that everyone retained access to health care and basic needs. The one thing that did change just around the time of the collapse was that a large share of households were pushed into financial difficulties, triggering feelings of stress and changes in some health-promoting and health-compromising behaviors, while the welfare system ensured that the collapse did not limit access to nutritious food and health care. Other economies that were affected by the crisis certainly had individuals who felt financially stressed, even if their financial stress was less universal and lacked the discontinuity that occurred in Iceland and allowed me to conduct this study. My estimates suggest that children in utero in other advanced economies during the crisis could have been affected and that financial stress in general can have a negative impact on birth outcomes.

This paper makes two primary contributions. First, to the best of my knowledge, my study is the first to document a causal link between fetal exposure to a sudden economic shock in an advanced economy and health at birth. From a policy perspective, it is important to understand the mechanisms through which such shocks affect unborn children because this allows policymakers to identify the programs most likely to ameliorate the effect. For example, if prenatal nutrition is the main driver in developing countries while it is not in advanced countries, giving food stamps is likely to have different effect in the two groups of countries. Second, I estimate some direct costs of the Great Recession that have not previously been considered. I therefore contribute to the literature on the determinants of the initial endowments of infants and to the understanding of the long-term effects and full costs of financial catastrophes in advanced economies by exploiting a unique economic collapse that was unexpected in both timing and severity.

The remainder of the paper unfolds as follows. Section 2 provides some background information on the context in which the financial crisis hit Iceland and on the effects of prenatal shocks on birth outcomes. Section 3 explains the empirical approach. estimation strategy. Section 4 describes the data while section 5 presents my results. Section 5 concludes the paper.

2 The Collapse of the Icelandic Economy

The Icelandic economy fell apart during the 2008 financial crisis. This collapse was the most severe relative to the size of the economy that any country has suffered. Iceland's three biggest banks, which accounted for about 85% of its financial system, failed in the same week. These events had immediate and catastrophic effects on the economy that came as a shock to the majority of the population. The clear break in the economic trajectory, evident in Figures 1, eliminates the problems posed by the diffuse timing and endogenous sorting normally associated with economic hardships and enables me to capture the effect of the crisis on children exposed in utero.

The reasons for the bank failures were difficulties of the sort experienced by many financial institutions worldwide. The crucial differences here were the scale of the collapse and how sudden and unexpected it was. While many countries had their shares of troubled banks, their problems were largely confined to just a segment of the whole banking system, and the overall assets of those banks were much smaller relative to local GDPs. Other governments thus had adequate resources to contain the fallout from individual bank failures. That was not the case in Iceland. Iceland appealed to the International Monetary Fund for an emergency loan, the first Western country in thirty years to do so.

The collapse had significant effects on the balance sheets of households and arguably inaugurated a new era of economic distress. A significant portion of private saving were destroyed in the implosion of the stock market, and the currency collapse and ensuing inflation increased household debt because of its indexation to the consumer price index (CPI) and exchange rates. The estimated the wealth lost was 150% of GDP (Benediktsdottir et al., 2011). However, immediate forbearance efforts (freezing of installments and interest payments on loans) and changes to various benefit schemes were made to assist struggling households. Households did therefore remain liquid despite mass insolvency.

The collapse thus led to a discontinuity in the financial security of households, which was found to have induced psychosocial stress among women.[6] Gudjónsdóttir et al. (2012) showed that the economic collapse in October 2008 rebounded to the cardiac emergency department (ED). The pronounced increase in the number of visits to the cardiac ED during the week of the collapse[7] indicates that the crisis came as a big shock to people. Consistently with this, Hauksdóttir et al. (2013) found that the collapse led to an increase

[6]Psychosocial stressors refer to social or environmental exposures or demands that place a burden on adaptive capacities of an individual, causing an experience of stress (Cohen et al., 2007). These can include difficult or negative events and situations related to one's family, friends, work, or community. Here and throughout the paper, financial stress refers to the psychosocial stress related to personal finances.

[7]The results of the study showed that, in comparison to the weeks before and after the collapse, there was a sharp increase in visits to the cardiac ED during the week of the collapse, of 26% overall and 41% among women.

in self-reported psychosocial stress among women.

The effects of the crisis on birth outcomes could have been brought about by psychosocial stress, stress-induced changes in behavior,[8] or both. The data I have used in this study do not allow me to distinguish between these two potential mechanisms, as I do not have information on the health behavior of women during pregnancy. However, the main goal here is to establish whether there is a causal link between birth outcomes and the financial crisis, which significantly affected household balance sheets while a strong welfare system ensured access to prenatal care and basic needs; not to identify the underlying mechanism of the link.

3 Empirical Approach

The unexpected nature of the collapse allows me to identify the causal effect of the financial crisis using an event study analysis. My identification approach estimates the effects of the 2008 financial crisis under the identifying assumption that the timing of the collapse was not correlated with observed or unobserved characteristics of the child and its family. In other words, I assume that there is no selection into treatment, where treatment is defined as being in utero during the collapse. Birth outcomes in the years before the economic meltdown should then provide valid counterfactual outcomes. I can therefore estimate the effect the crisis had on birth outcomes by comparing the birth outcomes of children in utero during the collapse with those of children in utero at the same time in the previous year (2007), because on average they will have similar characteristics except for the treatment. The event study approach is preferable to a regression-discontinuity-approach in the case of birth outcomes because comparing children in utero in the last trimester before and after the collapse would entail the comparison if children conceived in different months where seasonality in birth outcomes would hinder the identification of the effect of the collapse.

Assuming that the collapse had different impacts depending on the gestational age of the fetus, the differential impact of the collapse is estimated by (1), which relates the outcome of child i at time t, Y_{it}, to an indicator of whether they were in the first, second, or third trimester of gestation.

$$Y_{it} = \gamma_0 + \gamma_1 Trim_{1it} + \gamma_2 Trim_{2it} + \gamma_3 Trim_{3it} + \phi_m + X_{it}\delta + \epsilon_{it} \tag{1}$$

$Trim_{1it}$, $Trim_{2it}$, and $Trim_{3it}$ are dummies that identify children as being in the first,

[8] Studies on a range of health behaviors find that the crisis led to reductions in all health-compromising behaviors examined and that it led to reductions in certain health-promoting behaviors but increases in others (Ásgeirsdóttir et al., 2012)

second, and third trimester of pregnancy when the collapse took place; ϕ_m is month-of-birth fixed effects; X_{it} is the vector of additional control variables which includes the age of mothers, indicators for whether the parents are natives, postal code and area of residence, and parity; and ϵ_{it} is the unobserved idiosyncratic variation in outcomes across individuals and the treatment group.

To control for time-invariant unobserved differences between mothers that might be correlated with stress, I implement a mother-fixed effect specification. I restrict my sample to siblings and estimate the following:

$$Y_{ipt} = \gamma_0 + \gamma_1 Trim_{1it} + \gamma_2 Trim_{2it} + \gamma_3 Trim_{3it} + X_{ipt}\delta + \theta_p + \epsilon_{ipt} \tag{2}$$

where Y_{ipt} represents the birth outcome of child i born to mother p, at time t. Including mother-fixed effects, θ_p, in equation (2), I only use within-mother variation to estimate the effects of being in the first, second, and third trimesters of pregnancy. I observe the birth outcomes of 4,006 children born to 1,743 mothers who were pregnant at the onset of the crisis. The variable X_{ipt} includes information on time-varying demographic characteristics. These include whether i is a first-born, the age of the mother when i was born, birthplace, the parents' relationship status, and the area of residence by i's parents at the time of birth.

4 Data and Descriptive Statistics

My data contain detailed information on all births in Iceland for the period 1982-2012. The Directorate of Health, a government agency, has a mandate to collect extensive data on births in the country.[9] The outcome variables of interest are birth weight, dummy variables that categorize birth weight and gestational age, a dummy for pre-term birth, a dummy for neonatal diseases, and a dummy for gender. Live-born infants weighing less than 2,500 grams are defined as low birth weight (LBW), and those of more than 4,000 grams are defined as high birth weight (HBW). Preterm birth is defined as birth at less than 37 weeks of gestational age. The birth weight categories ignore gestational age. In order to take gestational age into account, I use a birth weight measure that is conditional on gestational age. This is an indicator of whether a child is small for gestational age (SGA): smaller in size than normal for sex and gestational age, most commonly defined as having a weight below the 10th percentile in these classes.

My choice of outcomes was mostly determined by the availability of data and by what is known already from existing research. Birth weight, low birth weight, high birth

[9] Records are available from 1972 onward, but the earliest in electronic form are from 1982.

weight, gestation, and prematurity are standard birth outcomes. This study breaks new ground in also looking separately at the two potential explanations for low birth weight: intrauterine birth restrictions and preterm delivery. Furthermore, as pointed out by Currie and Rossin-Slater (2013), any measured effects on birth weight and gestation may be sensitive to the econometric specification, and it may be better to use a more subtle measure of health at birth, such as abnormal conditions of newborns. For this reason I also include an indicator of neonatal diseases as an outcome. Finally, previous research finds that adverse in utero environments can increase the risk of spontaneous abortion of boys more than girls (see, e.g., Catalano, 2003; Catalano and Bruckner, 2005; Catalano et al., 2005; Bejenariu and Mitrut, 2013; Sanders and Stoecker, 2015), therefore I look at the effect of the collapse on the sex-ratio at birth. In line with other studies, I model the sex-ratio at birth as the probability of a male birth.

Low birth weight has been criticized as a health indicator because it includes both preterm infants and infants born small for their gestational age. Most studies cannot distinguish between those two cases because the gestational age recorded on birth certificates is usually based simply on the mother's report of her last menstrual period (Lauderdale, 2006). My own data, however, include an accurate measure of gestational age based on ultrasound tests, which lets me distinguish between these two cases. The reason for infants being born SGA is intrauterine growth (IUG) restrictions, and I would therefore expect only IUG restrictions caused by the crisis to affect children who were in the early stages of gestation during the collapse, whereas I would expect a more pronounced effect of gestational age among those in the later stages.

Two methods are used to measure gestational age: an ultrasound and the mother's menstrual cycle. The ultrasound approach is considered the more accurate measurement, but it was not implemented until 1988. The dataset thus contains both measurements for births after 1988[10] but only one for births before. This affects neither my main specification nor the robustness checks, because gestational age as measured by ultrasound is available during the periods considered there.

Table 2 verifies that there were no observable differences between parents who were expecting a child at the time of the collapse and parents in the same situation one year earlier. This further indicates that there was no selection into parenthood around the time of the collapse. The treatment group consists of $3,111$ children who were in utero in October 2008. The comparison group consists of $3,041$ children who were in

[10]In unreported results, a statistically significant positive relationship was found between a dummy variable for measuring gestational age with the menstrual cycle and the gestational age, which means that when the menstrual cycle is used as a measure of gestational age, that age is most likely overstated. This suggests that the results of previous studies that used menstruation alone as a measure are subject to bias, and highlights the importance of a more precise measure of gestational age when studying birth outcomes.

utero in October 2007. Notably, the maternal characteristics are quite similar in the treatment and comparison groups. However, even this simple unadjusted comparison shows that the treatment children tended to have slightly worse birth outcomes than the comparison children: the mean birth weight is 30 grams lower, the incidence of LBW is 1.0 percentage points higher, the incidence of HBW is 2.0 percentage points higher, the incidence of SGA is 1.0 percentage points higher, and the share of children born preterm is 0.6 percentage points higher. The fact that there are no observable differences between the background characteristics of the two groups alleviates concerns that selection is driving the difference in birth outcomes. If parents knew or anticipated the crisis, for instance, its effects would be confounded with the effect of selection into pregnancy (or postponement of fertility) and this likely lead to differences in observably characteristics. Analogously, already-pregnant women might have reacted to the crisis by terminating their pregnancies. However, Figure 2 shows the distribution of conception around the collapse and suggests that there was no selection at play. Abortion in Iceland is available until the twelfth week of pregnancy. Although I do not have individual-level information on abortions, official statistics show that the number of abortions per pregnancy did not increase during the collapse.[11] However, previous studies have suggested that this has a fundamental importance because stressors can affect birth outcomes differently in different trimesters. Rigorous analysis must therefore account for the timing of exposure. In the next section I will outline the empirical strategy I followed to explore the effects of the crisis and the importance of the trimester more thoroughly.

5 Results

Table 3 presents the results for the effects of in utero exposure to the financial crisis on birth weight, gestational age, low (<2,500 grams, LBW), and high birth weight (>4,000 grams, HBW) births, preterm births, small-for-gestational age (SGA) births, and neonatal diseases. All results are estimated in the form of (1) where the treatment group is children in utero during the collapse and the control group is children in utero one year earlier.

I find a negative and significant effect of first-trimester exposure on birth weight, amounting to 66 g. This effect appears to be driven by impacts at both the upper and lower ends of the birth weight distribution: children whose mothers who were in their first trimester of pregnancy during the collapse are 1.9 percentage points more likely to be LBW and 4.0 percentage points less likely to be HBW. They are also 1.2 percentage points more likely to be SGA and 1.6 percentage points more likely to suffer

[11] The number of abortions per 100 pregnancies was 16.5 in both 2007 and 2008.

from neonatal diseases, even though these effects are not statistically significant. I do not find any effect on gestational age. As discussed earlier, reduced birth weight can be caused both by shorter gestation and by intrauterine growth restrictions. I find a positive effect on the prevalence of children born small for their gestational age and a negative effect of gestational age, although these effects are not statistically significant. My estimates therefore suggest that both mechanisms could be at play in reducing weight at birth. Furthermore, second- and third-trimester exposed children were more likely to suffer from neonatal diseases. Finally, I find a 3.3 percentage point reduction in the sex-ratio at birth among first-trimester exposed children. This is consistent with the selection in utero hypothesis, predicting that population stressors induce selection against males in utero and thereby reduce the sex-ratio at birth.

To determine whether the effects depend on the child's sex, I examined males and females separately. The results are presented in Table 4. My estimates suggest that boys were more affected than girls, even though the difference is statistically insignificant. This is consistent with some evidence in the literature that boys are more vulnerable to insults in utero than girls (see, e.g., Eriksson et al., 2010).

In Table 5, I present estimates based on the mother-fixed effects specification. Descriptive statistics for the sibling sample are reported in Table 6. The estimates from the mother-fixed effects specification are qualitatively the same as those from specification (1).

5.1 Robustness Checks

It should be apparent that the event study methodology presented above hinges critically on the assumption that there is no selection into treatment, where treatment is defined as being in utero during the collapse. I showed earlier that the two groups of parents, those who were and were not expecting a child during the crisis, did not differ in any observable characteristics. I also showed that the estimates from the mother-fixed effects specification are qualitatively the same as those from specification (1). These results therefore support my claim that endogenous sorting is not a problem. To further ascertain the plausibility of this assumption, I will now subject it to various tests.

I start by testing whether selection into treatment is correlated with any of a range of parental characteristics that are determined prior to conception. These include the mother's age, her number of previous births, whether this is her first child, whether she lives in the capital region, whether she works at home, whether either the mother or father is foreign-born or is a student, and whether this is the first child of the mother. As Table 7 shows, I find no evidence of a systematic relationship between treatment and any of these characteristics.

My second test consists of looking at the effect of a child's in utero exposure on the birth outcomes of its older siblings. In Table 8, I present estimates based on my main specification in which the variables of interest are whether a younger sibling was in the first, second, or third trimester of gestation during the collapse. I consider the same outcomes as before, and the results show that there is little evidence of spurious correlation between a younger sibling's exposure and an older sibling's birth outcomes, which supports my claim that the collapse of the economy was not correlated with any family characteristics of people expecting a child at the time.

An additional concern with the estimation strategy is the fact that its results might be driven by residual seasonality that is not captured by the fixed effects. To test this, I move the collapse to earlier and future years to create placebo collapses. For a systematic testing of the credibility of the estimated effect of first trimester exposure to the collapse, I compare the estimated effect on birthweight to the effect of first trimester exposure to falsified collapses in October 1985-2007 and 2009-2012 in Figure 3. The control group for each falsification is assigned in the same way as in the main analysis, i.e., I compare the birth outcomes of children in utero in during the collapse each year to the children in utero one year earlier. For each year, I plot the estimated effect with 95% confidence interval bars. None of the 25 falsified collapses is found to have an effect on birth weight.

In my main specification, I cluster standard errors at the mother's postal code at birth, to account for area specific shocks.[12] Mother's postal code at birth clustering results in 36 clusters, close to the minimum number of clusters to perform inference. Too few clusters could potentially lead to downwards-biased standard errors. My results are however robust to a range of alternative clustering schemes, including clustering at the mother's age at birth and two-way clustering at mother's age and area of residence at birth levels.[13]

5.2 Comparison with Previous Findings

Having documented the fact that in utero exposure to the financial crisis in an advanced country affects health at birth, I turn now to a comparison between these estimated effects and the effects found in other events and derived from estimates of the effects of other risk factors. It is well established that birth weight is an important determinant of future outcomes (Black et al., 2007), and researchers have put considerable effort into estimating the effects of various events and behaviors on birth weight.

One of the first things that come to most people's minds as risky behavior during pregnancy is cigarette smoking. Previous economic studies have taken various approaches

[12]Parents in some areas may have been more exposed to the crisis than parents in other areas.
[13]These results are available upon request.

to identifying the effects of smoking on birth outcomes, and these estimates can be used to put the effects of the financial crisis into perspective. Wüst (2010) studied birth outcomes in Denmark using sibling-fixed effects and reported that smoking reduces birth weight by 97 grams. Tominey (2007) used a mother fixed effect approach and and Norwegian administrative data and found that smoking reduces birthweight by 1.7% (about 57 grams). Lien and Evans (2005) used an instrumental variable approach and found that maternal smoking reduces mean birth weight by 182 grams. Bharadwaj et al. (2014) used a difference-in-differences approach to study the effects of a smoking ban in bars and restaurants in Norway and found a positive but not significant effect of 58 grams on birth weight. They also found that children were significantly less likely to be LBW.

My focus on financial stress is related to a number of other studies that have exploited stress-inducing, quasi-exogenous shocks stemming from extreme incidents, such as hurricanes, earthquakes, and terrorist attacks, to estimate the effects of stress on birth outcomes (see, e.g., Camacho, 2008; Torche, 2011; Brown, 2014; Currie and Rossin-Slater, 2013; Lauderdale, 2006; Simeonova, 2011; Currie and Rossin-Slater, 2013). Furthermore, there is a large literature examining the effects of physical insults to the mother while pregnant on the birth outcomes of children that may be confounded by the fact that these physical shocks are also often associated with psychological stress (see, e.g., Scholte et al., 2015; Almond, 2006). The collapse of the Icelandic economy is unique among these rare events in that it did not threaten the people exposed to it with any direct physical harm: policy interventions and the welfare system endured, and despite large changes in household balance sheets pushing a large share of households into insolvency, households still remained liquid. Everyone retained access to medical care and had sufficient resources for sound nutrition. The estimated effect is therefore unlikely to be contaminated by nutritional deprivation or limited access to prenatal care. The fact that I could find an effect only for first trimester exposure supports this conjecture. Previous studies have shown that maternal stress appears to affect birth weight during the first trimester of pregnancy (see, e.g., Camacho, 2008; Torche, 2011), but that birth weight is most affected by nutritional deprivations during the third trimester (see, e.g., Stein and Lumey, 2000; Almond and Currie, 2011). Changes in access to nutritious food would most likely have been detected in the birth outcomes of third-trimester exposed children.

A comparison of my findings with those of previous studies reveals that financial stress, a commonplace stressor in advanced economies, has an impact on birth weight comparable to one of the most widely cited behavioral taboo during pregnancy, smoking. Furthermore, compared to the effects of rare, extreme events, the average loss of birth weight due to the 2008 financial crisis is quite large: it is more than eight times as great as the 8.7 gram reduction caused by landmine explosions in Colombia (Camacho,

2008) and bigger than the reduction caused by earthquakes in Chile (Torche, 2011). The effects are also large compared to the estimated effects of other near-universal stressors like bereavement, which has been found to reduce birth weight by 23 grams (Black, Devereux, and Salvanes, Black et al.).

6 Conclusion

The 2008 financial crisis is considered by many the worst financial crisis since the Great Depression of the 1930s. In this paper, I analyze the implications of this crisis for birth outcomes by exploiting the rapid and unexpected collapse of the Icelandic economy, whose banking failure was the greatest in history relative to the size of its economy. The course of events in Iceland created a rare opportunity to estimate the effects of financial stress in an advanced country because of how abrupt and unexpected it was, in both timing and severity. Another important feature of the Icelandic collapse was the fact that the welfare system and various policy measures ensured that everyone had access to prenatal care and basic needs.

I find that the collapse had statistically significant adverse effects on birth outcomes. Infants whose mothers were in their first trimester of pregnancy during the collapse had lower birth weight and were more likely to have low (<2,500 grams) birth weight and less likely to have high birth weigh (>4,000 grams). This effect remains in a specification with mother-fixed effects, controlling for any invariant unobserved mother characteristics that might be related to the probability of expecting a child during the collapse. I also find indications of a decreased sex-ratio at birth of about 3.3 percentage points. These findings are consistent with the selection in utero theory hypothesizing that pregnant women in stressed populations spontaneously abort fetuses least likely to yield grandchildren and other documented declines in male births after population stressors. The decrease in birthweight seems to be greater for boys than for girls and this is also consistent with selection in utero hypothesis because the weakest male fetuses will not be carried to term while female fetuses will.

This paper contributes to our understanding of the impact of economic stress on child health and my findings are of high relevance in other advanced countries where financial stress is among the most common stressors. The most striking fact about my findings is that financial stress in an advanced country, one where the social safety net of welfare systems and policy interventions secures access to health care and all basic needs for the population, can still have a very large impact on birth outcomes. Financial stress is prevalent in households worldwide, and this study provides evidence that it can affect more than people's wallets: It can also have a detrimental effect on their children's health

at birth, which has been shown to be important for later success in life.

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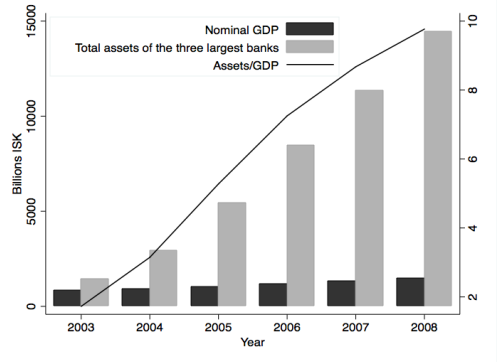
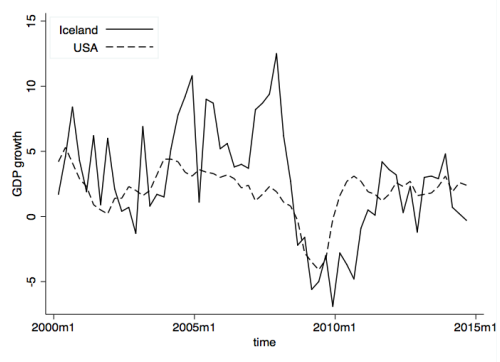


Total Assets of the Three Largest Banks vs. GDP.



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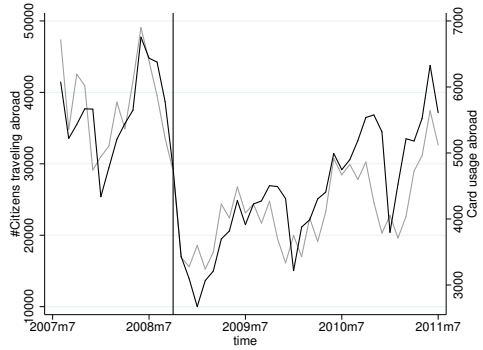

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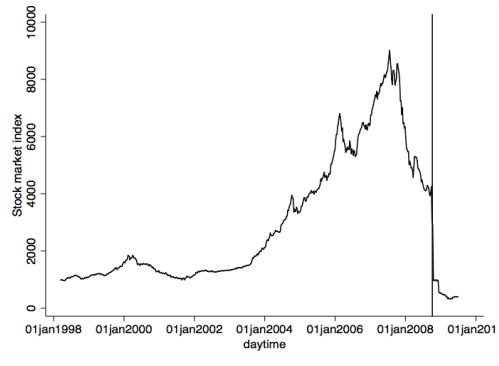

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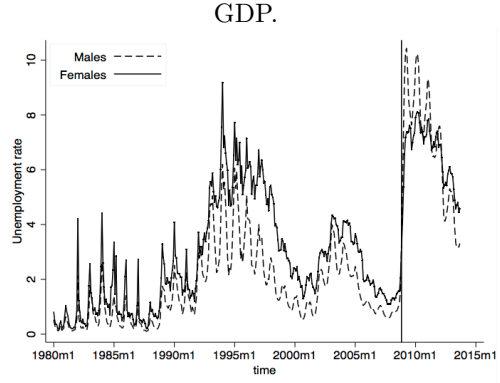

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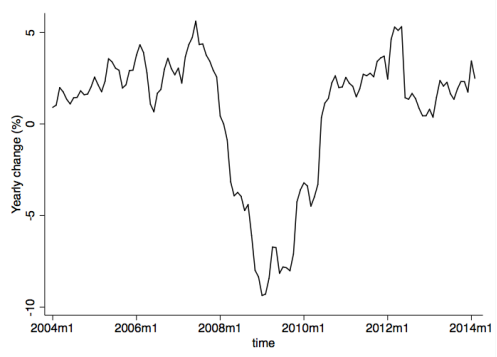

One-year Percentage Point Change in Purchasing Power.

Figure 1: Economic Conditions.

Table 1: Descriptive Statistics

	2005	2006	2007	2008	2009
Health expenditure per capita ($)[a]	3,294	3,258	3,352	3,346	3,286
Doctors per 1.000 inhabitants	3.61	3.6	3.62	3.65	3.66
Nurses per 1.000 inhabitants	13.97	13.72	14	14.89	15.29
Pharmaceutical spending per capita ($)	475	463	453	488	515
Hospital beds per 1.000 inhabitants	NA	NA	4.16	3.95	3.74
Life expectancy at birth	81.6	81.2	81.5	81.7	81.8
Infant mortality[b]	2.3	1.4	2	2.5	1.8
Suicides per 100.000 inhabitants	11.5	10.8	12	12.4	11.8
Poverty rate[c]	0.0633	0.057	0.0646	0.0645	0.0652
Annual GDP growth (%)	6.00	4.23	9.72	1.15	-5.15
GDP per capita ($)	36,093	36,814	39,007	41,276	39,734
LBW	4.31%	4.19%	4.08%	3.95%	4.41%
Mean age	28.9	29.0	29.1	29.2	29.3
Mean age at first child	25.7	25.8	26.0	25.9	26.0
Mean birth weight	3.62	3.62	3.62	3.63	3.60
Mean birth weight - boys	3.71	3.68	3.68	3.69	3.65
Mean birth weight - girls	3.55	3.56	3.57	3.57	3.54

[a] Health spending is defined as the final consumption of health goods and services plus capital investment in health care infrastructure. It includes spending by both public and private sources (including households) on curative, rehabilitative and long-term care as well as on medical goods such as pharmaceuticals. It also covers spending on public health and prevention programmes, and on administration. The numbers are in constant USD per capita (2005 prices using PPP). [b] Infant mortality rate is the number of infants dying before reaching 1 year of age, per 1,000 live births in a given year. [c] The poverty rate is the share of people (in a given age group) whose income falls below the poverty line; taken as half the median household income of the total population. However, two countries with the same poverty rates may differ in terms of the relative income-level of the poor. Data sources are $https://data.oecd.org/$, $http://www.cdc.gov/nchs/data/nvsr/nvsr62/nvsr62_01_tables.pdf$, $http://data.un.org/Data.aspx?d=WDI\&f=Indicator_Code:NY.GDP.MKTP.KD.ZG$

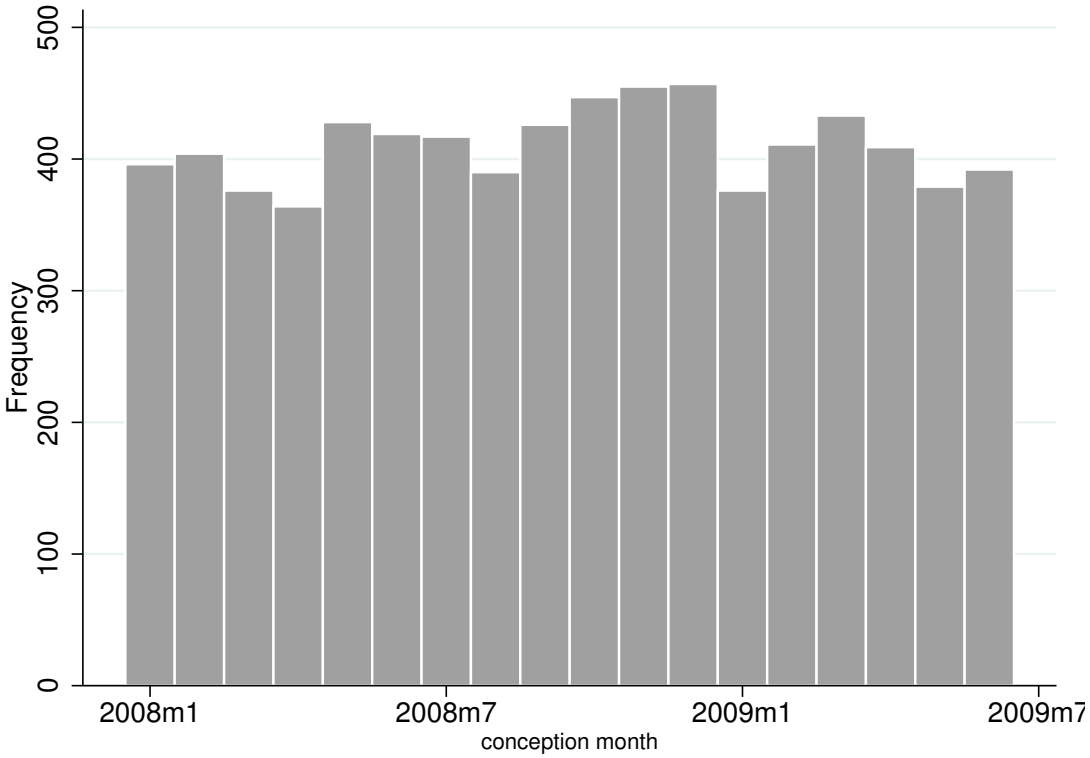

Figure 2: Distribution of Conception.

Table 2: Descriptive Statistics

	In utero October 2007	**In utero October 2008**	
	Mean	**Mean.**	**Difference**
Mother's age	29.1	29.2	-0.08
	5.57	5.56	
Mother Icelandic	0.89	0.87	0.02
	0.31	0.33	
Father Icelandic	0.88	0.87	0.01
	0.32	0.34	
Parents married or cohabiting	0.86	0.85	0.01
	0.35	0.36	
Previous births	0.92	0.93	-0.01
	0.94	0.97	
First child	0.40	0.41	0.00
	0.49	0.49	
Mother works in private sector	0.59	0.58	0.01
	0.49	0.49	
Father works in private sector	0.88	0.87	0.01
	0.32	0.34	
Mother works in financial sector	0.05	0.06	0.00
	0.22	0.23	
Father works in financial sector	0.05	0.05	0.00
	0.21	0.22	
Mother works in public sector	0.24	0.24	0.01
	0.43	0.43	
Father works in public sector	0.05	0.05	0.00
	0.21	0.22	
Boy	0.52	0.50	0.02
	0.50	0.50	
Capital region	0.67	0.67	0.01
	0.47	0.47	
Neonatal death	0.00	0.00	0.00
	0.06	0.05	
Birthweight	3,673	3,642	30.04**
	565.93	562.93	
LBW	0.03	0.03	-0.01
	0.16	0.17	
HBW	0.26	0.25	0.02
	0.44	0.43	
Gestational age[a]	40.0	39.9	0.07
	1.79	1.63	
SGA	0.10	0.11	-0.01
	0.30	0.32	
PTB	0.04	0.04	0.00
	0.19	0.20	
Apgar 5	9.30	9.31	-0.01
	1.10	1.04	
Neonatal diseases	0.20	0.23	-0.031***
	0.40	0.42	
No. of children	3,111	3,041	

Note: [a] Gestational age is measured in weeks.
The group in utero 2008 includes all children who were exposed to the collapse of the economy while in utero, and the group in utero 2007 includes all children who were in utero at the same time of the year in 2007. To assign children to the two groups, I estimate each child's month of conception by subtracting the number of gestation days from the month of birth. I then define the set of treated individuals as those in utero in October 2008 and the control group as the set of children conceived before, but born after, October 2007.

Table 3: Effects of the Financial Crisis on Birth Outcomes

	Birth Weight	Low Birth Weight	High Birth Weight	Gestational Age	Pretirm Birth	Small for Gestational Age	Neonatal Diseases	Boy
1st Trimester	-66.019***	0.019**	-0.040**	-0.073	0.004	0.012	0.016	-0.033*
	(21.0063)	(0.0073)	(0.0158)	(0.0733)	(0.0104)	(0.0121)	(0.0193)	(0.0185)
2nd Trimester	4.552	-0.006	0.009	-0.029	-0.003	0.012	0.048**	0.007
	(22.5146)	(0.0072)	(0.0151)	(0.0773)	(0.0085)	(0.0140)	(0.0181)	(0.0228)
3rd Trimester	-24.768	0.006	-0.004	-0.133	0.014	0.024	0.040**	-0.015
	(32.7926)	(0.0077)	(0.0217)	(0.0892)	(0.0109)	(0.0185)	(0.0157)	(0.0254)
#obs	6,125	6,125	6,125	6,125	6,125	6,125	6,125	6,125

Note: I use the intense increase in stress that followed the collapse of the Icelandic economy to examine the effects of financial stress on birth outcomes by comparing singleton children who were in utero during the collapse of the economy, in October 2008, to singleton children who were in utero one year earlier. Standard errors are clustered by mother's postal code of residence at birth and are shown in parentheses. All regressions include a constant term as well as controls for mother's age, indicators for whether the parents are natives, postal code and area of residence, and parity. * p<0.1 ** p<0.05 *** p<0.01

Table 4: Effects of the Financial Crisis on Birth Outcomes by Gender

	Birth Weight	Low Birth Weight	High Birth Weight	Gestational Age	Pretirm Birth	Small for Gestational Age	Neonatal Diseases
Panel A: Girls							
1st Trimester	-57.458**	0.015	-0.047**	-0.066	0.016	0.007	0.037
	(27.3191)	(0.0102)	(0.0187)	(0.0999)	(0.0124)	(0.0204)	(0.0218)
2nd Trimester	2.537	0.003	0.012	-0.036	-0.002	0.003	0.076***
	(37.6525)	(0.0102)	(0.0306)	(0.1076)	(0.0127)	(0.0184)	(0.0230)
3rd Trimester	-39.785	0.007	-0.013	-0.127	0.007	0.028	0.035
	(44.6665)	(0.0119)	(0.0293)	(0.1182)	(0.0149)	(0.0242)	(0.0227)
#obs	3,014	3,104	3,104	3,104	3,104	3,104	3,104
Panel B: Boys							
1st Trimester	-68.993**	0.021*	-0.028	-0.070	-0.009	0.018	-0.001
	(27.3883)	(0.0109)	(0.0227)	(0.0981)	(0.0122)	(0.0171)	(0.0289)
2nd Trimester	2.660	-0.014	0.003	-0.027	-0.003	0.020	0.024
	(23.6683)	(0.0082)	(0.0238)	(0.0945)	(0.0110)	(0.0179)	(0.0282)
3rd Trimester	-7.054	0.004	0.006	-0.158	0.019	0.015	0.047
	(46.2297)	(0.0092)	(0.0362)	(0.1104)	(0.0125)	(0.0281)	(0.0294)
#obs	3,111	3,111	3,111	3,111	3,111	3,111	3,111

Note: I use the intense increase in stress that followed the collapse of the Icelandic economy to examine the effects of financial stress on birth outcomes by comparing singleton children who were in utero during the collapse of the economy, in October 2008, to singleton children who were in utero one year earlier. Standard errors are clustered by mother's postal code of residence at birth and are shown in parentheses. All regressions include a constant term as well as controls for mother's age, indicators for whether the parents are natives, postal code and area of residence, and parity. * p<0.1 ** p<0.05 *** p<0.01

Table 5: Effects of the Economic Crisis on Birth Outcomes: Mother-fixed Effect Estimates

	Birth Weight	Low Birth Weight	High Birth Weight	Gestational Age	Pretirm Birth	Small for Gestational Age	Neonatal Diseases	Boy
1st Trimester	-65.878	0.033**	-0.049	-0.357**	0.018	-0.027	0.014	-0.008
	(40.9077)	(0.0132)	(0.0346)	(0.1394)	(0.0163)	(0.0256)	(0.0347)	(0.0449)
2nd Trimester	61.420	-0.009	-0.005	0.095	-0.036**	-0.028	-0.021	0.011
	(41.7182)	(0.0135)	(0.0353)	(0.1420)	(0.0166)	(0.0261)	(0.0354)	(0.0458)
3rd Trimester	37.619	-0.031*	-0.066	0.246	-0.055***	-0.042	-0.067	-0.009
	(51.0627)	(0.0165)	(0.0432)	(0.1770)	(0.0203)	(0.0319)	(0.0433)	(0.0562)
#obs	3,394	3,394	3,394	3,394	3,394	3,394	3,394	3,394

Note: I use the intense increase in stress that followed the collapse of the Icelandic economy to examine the effects of financial stress on birth outcomes by comparing siblings conditionally on the youngest one of them being in utero during the collapse, in October 2008. Standard errors are shown in parentheses. The sample includes all women who gave birth at least twice during the sample period.
* p<0.1 ** p<0.05 *** p<0.01

Table 6: Summary Statistics: Sibling Sample

	Full Sample	Sibling Sample
Mother's age	27.81	27.50
	5.62	5.54
Mother Icelandic	0.96	0.95
	0.19	0.22
Father Icelandic	0.90	0.93
	0.30	0.25
Parents married or cohabiting	0.89	0.86
	0.32	0.35
# Previous births	1.03	0.89
	1.06	0.93
First child	0.38	0.40
	0.49	0.49
Boy	0.51	0.50
	0.50	0.50
Living in the capital	0.57	0.61
	0.50	0.49
Neonatal death	0.00	0.00
	0.06	0.07
Birthweight	3658.1	3694.3
	572.5	549.6
LBW	2.7%	2.1%
	0.161	0.145
HBW	25.7%	27.6%
	0.437	0.447
Gestational age	39.91	39.96
	1.773	1.587
Small for gestational age	0.12	0.10
	0.325	0.304
Pretirm birth	0.0	0.0
	0.187	0.184
Apgar 5 score	9.28	9.27
	1.09	1.12
Neonatal diseases	15.7%	18.8%

Note: Sample size in the full sample is 110,143. Sample size in the sibling sample is 4,006. Children in the sibling sample were born to 1,743 mothers.

Table 7: Correlation Between Being In Utero During the Collapse and Parental Characteristics

	Mother's age	Mother Icelandic	Father Icelandic	First child	# previous births
In utero during collapse	0.097	-0.019*	-0.013	0.003	0.005
	(0.1596)	(0.0097)	(0.0104)	(0.0112)	(0.0219)
#obs	6,337	6,337	6,337	6,337	6,337

	Parents Married or cohabiting	Mother student	Living in the capital area	Father student	Stay-at-home mother
In utero during collapse	-0.012	-0.004	-0.000	0.000	0.008
	(0.0091)	(0.0088)	(0.0105)	(0.0018)	(0.0069)
#obs	6,337	6,337	6,337	6,337	6,337

Note: This table reports the correlation between in utero exposure to the collapse of the economy and parental characteristics determined prior to conception. All regressions control for month of conception. Standard errors are clustered by mother's postal code of residence at birth and are shown in parentheses. * p<0.1 ** p<0.05 *** p<0.01

Table 8: Placebo Effects of the Collapse on Older Siblings' Birth Outcomes

	Birth Weight	Low Birth Weight	High Birth Weight	Gestational Age	Pretirm Birth	Small for Gestational Age	Neonatal Diseases	Boy
Sibling in 1st	-19.824	0.003	-0.014	0.110	0.000	0.016	-0.002	-0.016
Trimester	(19.0001)	(0.0068)	(0.0150)	(0.0699)	(0.0077)	(0.0108)	(0.0130)	(0.0150)
Sibling in 2nd	34.592	-0.008	0.020	0.113*	-0.013*	0.006	-0.003	-0.004
Trimester	(22.8434)	(0.0054)	(0.0187)	(0.0669)	(0.0072)	(0.0088)	(0.0139)	(0.0195)
Sibling in 3rd	-3.453	0.007	-0.008	-0.044	0.009	-0.003	0.005	0.003
Trimester	(31.7182)	(0.0093)	(0.0170)	(0.0985)	(0.0112)	(0.0122)	(0.0184)	(0.0218)
#obs	70,367	70,367	70,367	70,367	70,367	70,367	70,367	70,367

Note: This table reports the effect of having a younger sibling in utero during the collapse of the economy in October 2008 on birth outcomes. Standard errors are clustered by mother's postal code of residence at birth and are shown in parentheses. All regressions include a constant term as well as controls for mother's age, indicators for whether the parents are natives, postal code and area of residence, and parity. * p<0.1 ** p<0.05 *** p<0.01

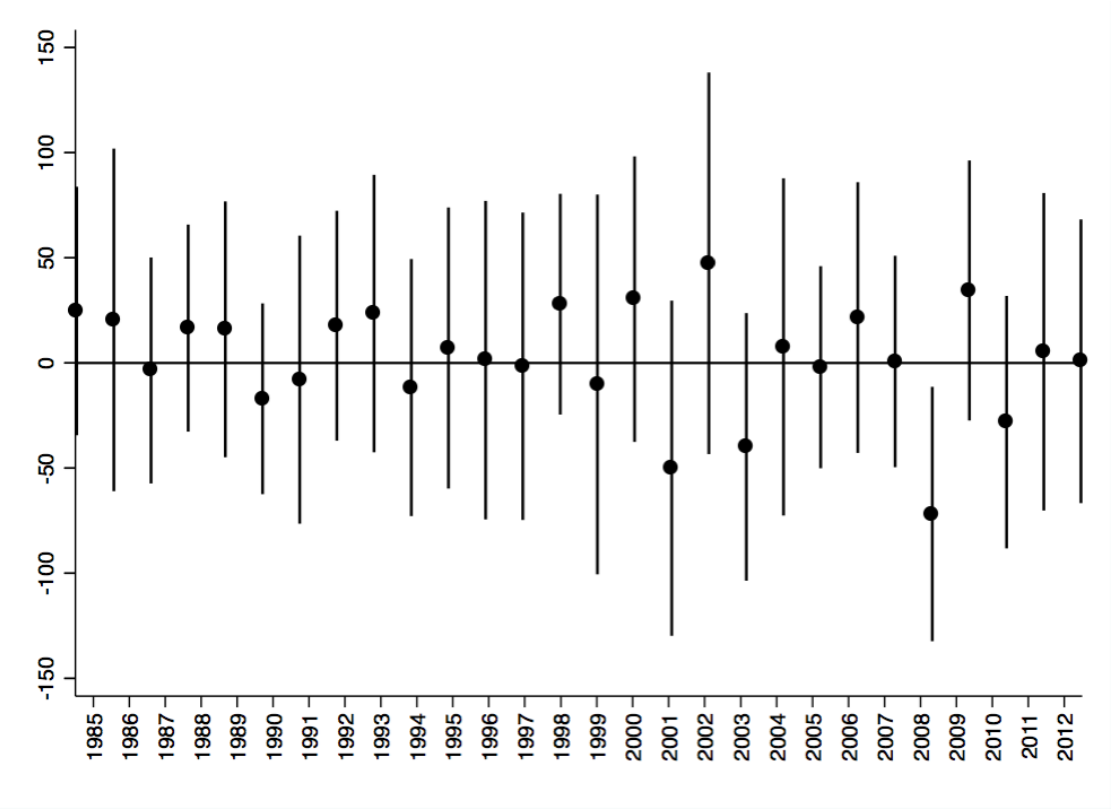

Figure 3: Placebo tests.