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Gerard J. van den Berg
University of Bristol, IFAU, IZA, ZEW and CEPR

Alexander Paul
Aarhus University and TrygFonden's Centre for Child Research

Steffen Reinhold
E.CA Economics and MEA, Max Planck Institute for Social Law and Social Policy

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Economic Conditions, Parental Employment and Health of Newborns*

We examine whether economic downturns are beneficial to health outcomes of newborn infants in developed countries. For this we use merged population-wide registers on health and economic and demographic variables, including the national medical birth register and intergenerational link registers from Sweden covering 1992–2004. We take a rigorous econometric approach that exploits regional variation in unemployment and compares babies born to the same parents so as to deal with possible selective fertility based on labor market conditions. We find that downturns are beneficial; for example, a one-percentage-point increase in the unemployment rate during pregnancy reduces the probability of having a birth weight less than 1,500 grams or of dying within 28 days of birth by 10–15%. Effects are larger in low socio-economic status households. Health improvements cannot be attributed to the parents' own employment status. The results suggest pathways through stress and air pollution.

JEL Classification: I1, J1
Keywords: recession, unemployment, fertility, infant health, stress

Corresponding author:
Gerard J. van den Berg
School of Economics, Finance and Management
University of Bristol
2C3, The Priory Road Complex
Priory Road, Clifton
Bristol, BS8 1TU
United Kingdom
E-mail: gerard.vandenberg@bristol.ac.uk

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1 Introduction

A currently expanding literature examines how up- and downturns of the economy affect the health of newborn children. For developing countries, there is strong evidence that recessions tend to increase infant mortality, while booms tend to lower it.[1] In contrast with this evidence, it has been suggested that the effect of the cycle differs in developed countries, with newborn health improving in recessions. The pivotal study by Dehejia and Lleras-Muney (2004), using U.S. state-level data, estimates that an increase in the unemployment rate by one percentage point lowers both the infant mortality rate and the incidence of very low birth weight (below 1,500 grams) by 0.5 percent.

There are several reasons for why babies' health suffers less from recessions in developed countries than in developing countries (see also the discussion in Ferreira and Schady (2009)). First, while spending on public health care has been shown to decline during downturns in developing countries (Cutler et al. 2002; Paxson and Schady 2005), fiscal policy generally tends to be countercyclical rather than procyclical in developed countries (Lane 2003). Second, recessions are often shorter in developed countries, and given the higher level of health spending, marginal reductions are less severe. Third, credit markets are more widespread, allowing mothers to smooth income and thus spending on health care and nutrition.

Studies on effects of economic fluctuations in developed countries on health of the adult population confirm that contemporaneous health improves in recessions. Pioneering work by Ruhm (2000) and many subsequent studies provide strong evidence for the procyclicality of the total mortality rate.[2] Several of the channels linking the business cycle to adult health also apply to babies, both in utero and shortly after birth. This includes channels that are related to parental job loss, since downturns give rise to displacements and lower chances of re-employment. Job loss reduces the available income that can be spent on tobacco and alcohol. Smoking and

1. See Cutler et al. (2002) for Mexico, Paxson and Schady (2005) for Peru, Lin (2006) for Taiwan and Bhalotra (2010) for India. Baird et al. (2011) using a dataset from 59 developing countries in Africa, Latin America and Asia, find that a 5 percent reduction in GDP per capita increases the number of infant deaths by 1 to 2 per 1,000 children born. A notable exception is Miller and Urdinola (2010), who document that higher world coffee prices raise infant mortality in Colombia in coffee-growing regions. Higher prices lead to higher income but also to lower time-intensive investments in child health, due to increased labor supply.

2. Gerdtham and Ruhm (2006) show that this relationship also holds in a panel of 23 OECD countries. See van den Berg, Gerdtham, et al. (2017) for recent evidence on procyclicality of mortality in the current labor force in Sweden, exploiting regional variation in unemployment rates over time and relating them to outcomes at the individual level.

drinking during pregnancy are highly detrimental to newborns' health. It has been shown that these behaviors are less prevalent in downturns (Ruhm 2000; Ruhm and Black 2002). Further, as a result of job loss, the mother's opportunity cost of time decreases, so she may become more engaged in time-intensive activities that benefit babies' health, such as prenatal care, physical exercise or breast-feeding (Miller and Urdinola 2010), and her exposure to hazardous working conditions decreases. One may also consider channels that are not propelled through actual job loss. First, mothers staying in their jobs might enjoy fewer hours of work, which again leaves more time for health-improving activities during pregnancy. In addition, for both the mother and father, lower workloads decrease job-related stress and positive spillovers among parents are likely. There is plenty of evidence that stress affects birth outcomes, in particular during the first trimester of pregnancy (Camacho 2008; Torche 2011; Mansour and Rees 2012; Bozzoli and Quintana-Domeque 2014; Foureaux Koppensteiner and Manacorda 2016). Reductions in stress extend to unemployed parents who face lower pressure to find a job and benefit from a general slowdown of hectic life. Second, recessions are associated with less traffic and lower air pollution levels. Air pollution has been shown to be an important determinant of newborn health (Chay and Greenstone (2003), Knittel et al. (2016), see Currie et al. (2014) for a review of the literature). Relatedly, there has been speculation that aircraft and traffic noise affect children adversely (Hygge et al. 2002; Makles and Schneider 2017). Third, economic upturns are characterized by a shortage of medical staff, resulting in lower availability and quality of prenatal and neonatal care (Stevens et al. 2015).

In the light of the importance of the issues at hand, it is perhaps surprising that there is only little evidence for developed countries. Margerison-Zilko (2010) does an extensive literature search and finds about 15 studies, almost all of which concern aggregate data. One major complication in estimating the effect of the cycle is that women who give birth in a recession may systematically differ from those who give birth in a boom. Dehejia and Lleras-Muney (2004) argue that low-educated women — who do not suffer from skill depreciation — prefer to give birth in recessions when the wage they would receive is low. The authors provide evidence that the fraction of low-educated mothers indeed rises in times of high unemployment, at least for white mothers. The effect is reversed for black mothers, a finding that Dehejia and Lleras-Muney (2004) attribute to credit constraints. In this line of reasoning, low-educated black mothers would also prefer to give birth in recessions, but cannot afford to do so since credit constraints prevent them from smoothing income over

time. Salvanes (2013) and Aparicio and González (2014) find that low-educated mothers are overrepresented in recessions.

The composition of newborns has also been studied in the literature on long-run health effects of conditions at birth. After all, late-life health problems among cohorts exposed to adverse early-life conditions may be affected by selective fertility in the corresponding birth years. Most of these studies do focus on what are now developed countries; however, the birth cohorts are from years in which governmental social safety nets were largely absent. Some studies examine how exposure relates to birth rates or to the composition of newborns in terms of observed characteristics of the families into which they are born, following the line of reasoning that if such a relation exists then it is also more likely that there are systematic differences between exposed and non-exposed in terms of unobserved characteristics of the families. Van den Berg and Modin (2013) provide an overview of those studies (see e.g. Kåreholt 2001; van den Berg et al. 2009; van den Berg et al. 2011). They all conclude that the composition of newborns does not vary systematically over the business cycle.

One approach to deal with compositional changes over the business cycle is to compare babies born to the same mother at different stages of the cycle. Econometrically, this may be achieved by including mother fixed effects in the model equations, which requires individual-level data. Interestingly, when Dehejia and Lleras-Muney (2004) use the Californian subsample of mothers who had at least two births to control for mother fixed-effects, the estimated effects on the health of newborns is greatly reduced. Other studies of developed countries employing fixed-effects identification strategies also fail to establish a significant relationship with the cycle (Salvanes (2013) for Norway and Aparicio and González (2014) for Spain).[3] Most studies of developing countries find their results unaltered when accounting for selection bias (Paxson and Schady 2005; Bhalotra 2010; Baird et al. 2011). Van den Berg and Modin (2013) consider individual records from Swedish birth cohorts 1915–1929, where birth weigth was recorded at birth by health care workers. Note that at that time, Sweden was not yet a developed economy according to today's standards. They find no relationship between the business cycle and birth weight, both in basic analyses and in fixed-effects analyses with mother-specific fixed effects.Van den Berg, Lindeboom, Popławska, et al. (2017) use family-specific fixed-effects in the analysis of long-run effects of conditions at birth among Dutch birth cohorts around 1850 on individual longevity, and they subsequently examine the distribution of the esti-

3. In robust specifications with parental and time fixed effects, Aparicio and González (2014) find a negative effect of unemployment only on late fetal death. It is significant at the 10% significance level; however, it vanishes when additionally accounting for province time trends.

mated unobserved family-specific fixed effects over the various birth years. They find no evidence of an association between conditions around birth on the one hand, and the unobserved family-specific "frailty" determinant of longevity on the other hand.

In this paper we utilize population-wide register data from Sweden from 1992 to 2004 to address whether downturns improve newborns' health. The data include comprehensive register-based information of infant health and conditions around birth, from the neonatal and patient registers. These are recorded at the individual in real time by professional health care workers. We match these data with local-labor-market unemployment rates which provide indicators of the business cycle. Exploiting geographical variation in unemployment within Sweden, we control for variables that may confound a relation between unemployment and newborns' health. Moreover, we use identifiers of the mother and father in order to enable comparisons of health outcomes of babies born to the same parents. In this way, we control for the possibility that parents select into pregnancy depending on the state of the business cycle. We find that an increase in the unemployment rate by one percentage point reduces the incidence of neonatal mortality and very low birth weight by about 10–15 percent. The effect is entirely driven by the unemployment rate of men. We also find evidence for selective fertility over the cycle, which underlines the importance of controlling for parental fixed effects.[4]

We use merged socio-economic and demographic information about the parents to investigate possible mechanisms underlying the effects. First of all, we consider the role of actual parental unemployment, which is more prevalent in times of recessions. This sheds some light on whether health-enhancing activities — due to lower opportunity cost of time — or reduced smoking and drinking — due to lower available income — drive the estimated effects. As a next step, we investigate whether the effects vary by socio-economic status (SES) of the parents. Stress and air pollution are plausibly reduced in recessions, so if stress and air pollution disproportionately affect low-SES families then such an interaction effect may hint at a pathway through stress and air pollution. Related to this, we examine whether recessions decrease the occurrence of premature birth which has been shown to be affected by air pollution and stress in earlier studies. Our paper also contributes to the literature on birth weight determinants. In particular, the effect sizes on the incidence of low birth

4. Tapia Granados and Ionides (2008, 2011) and Svensson and Krüger (2012) consider time series on mortality and economic conditions at the national level for Sweden. As a by-product of their analyses, they find some evidence for a positive association between infant mortality and national-level indicators of the business cycle. This does not control for selection into childbirth.

weight may be compared to those due to other interventions (Kramer 1987; Currie and Cole 1993; Kaestner and Lee 2005).

This paper is structured as follows: Sections 2 and 3 explain the data and econometric method, respectively. Section 4 presents the results, starting with an analysis of selective fertility. We then report baseline effects on newborn health, followed by an investigation of different types of unemployment and potential mechanisms. Section 5 concludes.

2 Data

2.1 Unemployment Data from the HÄNDEL Register

We start this section with a brief outline of some notable features of Swedish society. Sweden has a large welfare state acting as a social safety net. Every citizen has access to the tax-funded public health care sector. Private health insurance and patient cost-sharing only play a tiny role.[5] Income inequality is among the lowest in the world and consumer credit is widely available. Female labor force participation is relatively high. Sweden has traditionally had a high level of prenatal and neonatal care, as reflected in one of the smallest infant mortality rates worldwide (World Bank 2016b). We therefore suspect that fluctuations in the quality and availability of medical care over the cycle are rather limited. At the same time, there are reasons to suspect that boom years are not particularly detrimental to health either. Specifically, since overtime work is regulated through collective bargaining agreements, the stress caused by overtime hours in booms is limited.

We should point out that our observation window does not include the 2008 recession and its aftermath. However, Sweden experienced a severe downturn in the early 1990s, with GDP per capita shrinking in three consecutive years between 1991 and 1993 (World Bank 2016a).

For the purposes of our study, we construct a dataset from two sources: monthly unemployment data at the municipality level and, secondly, population-wide administrative data on newborn infants and parental characteristics at the individual level. The former are discussed in the current subsection and the latter in the next subsection.

The unemployment data come from the so-called HÄNDEL register created by

5. See e.g. Tertilt and van den Berg (2015), for a description of the Swedish health care system.

Swedish public employment offices. HÄNDEL captures all persons in Sweden who register as "openly" unemployed with the employment office. Persons who classify themselves as unemployed in surveys because they are temporarily unemployed (e.g. due to a job change) or expect to be unemployed soon (e.g. due to a short-term contract or the notification of lay-off), but do not register with the employment office, are not included in HÄNDEL. However, Carling et al. (2001) report that more than 90% of the individuals who are ILO-unemployed according to labor force surveys are also registered as unemployed.

From the HÄNDEL registers starting in January 1992, the number of unemployed individuals by month and municipality can be deduced, stratified by gender, age group (18–24, 18–30, 18–40 and 18–64 years) as well as the interaction of gender and age group. These numbers can then be divided by the corresponding numbers of individuals in the population, to obtain the unemployment-to-population ratio. We simply refer to these as "the" unemployment rates. Unfortunately, the registers at our disposal do not allow for observation of the size of the labor force.

If the labor market that is relevant from the individual's perspective extends to or even centers in a municipality other than the municipality of residence, then the unemployment rate in the municipality of residence is only an incomplete indicator of economic conditions. In fact, an individual can (and might find it optimal for job search to) register with an employment office in a different municipality. To capture spillovers from surrounding areas, we aggregate municipality-level unemployment rates to the local labor market level. This approach also alleviates concerns about measurement error in municipality-level unemployment.[6] We use the definition of local labor markets provided by *Tillväxtanalys* (formerly Nutek), the Swedish Agency for Growth Policy Analysis (Tillväxtanalys 2005). Mainly based on commuting patterns in 2003, this definition divides Sweden into 72 non-overlapping so-called functional analysis regions (FA-regions).[7] The basic idea is to construct regions that include both the place of residence and the place of work for the majority of people. Previous papers using FA-regions are, for example, Eliasson et al. (2012) and Moretti and Thulin (2013). Clearly, the benefits of aggregation to local labor markets must be weighed against the reduced power due to ignoring idiosyncratic variations of

6. For example, measurement error could arise because an individual moves to another municipality without registering with the new employment office.

7. There are two steps in the formation of FA-regions: First, a municipality is defined as independent if the share of commuters to any other municipality does not exceed 20 percent in the working population and the share of commuters to any single municipality does not exceed 7.5 percent. Second, municipalities that are found not to be independent are merged with connected independent ones to form a FA-region. For more details, see ITPS (2008, pp. 195–196).

unemployment within smaller regional units. We therefore explore the sensitivity of our results to various degrees of aggregation.

The upper panel of Figure 1 illustrates the evolution of the unemployment rate for six randomly selected local labor markets between 1992 and 2004. Reflecting the deep recession that occurred in Sweden in the early 1990s, unemployment is relatively high at the beginning of the time period with values of more than 20 percent. Unemployment then sinks to a low around 2001/02 and subsequently rises again. To capture business cycles, we use a detrended version of the unemployment rate stripped of permanent differences across local labor markets and month-specific national shocks as well as seasonal variations. The detrended time series is illustrated in the lower panel of Figure 1. Note that the residual variation in unemployment after detrending is fairly large. For some local labor markets there appear to be secular trends in unemployment towards the end of the time period. It is unclear whether these trends are driven by third factors that might also affect newborn health outcomes or whether they constitute independent variation in unemployment. We check the sensitivity of our results to controlling for local-labor-market-specific time trends in the results section.

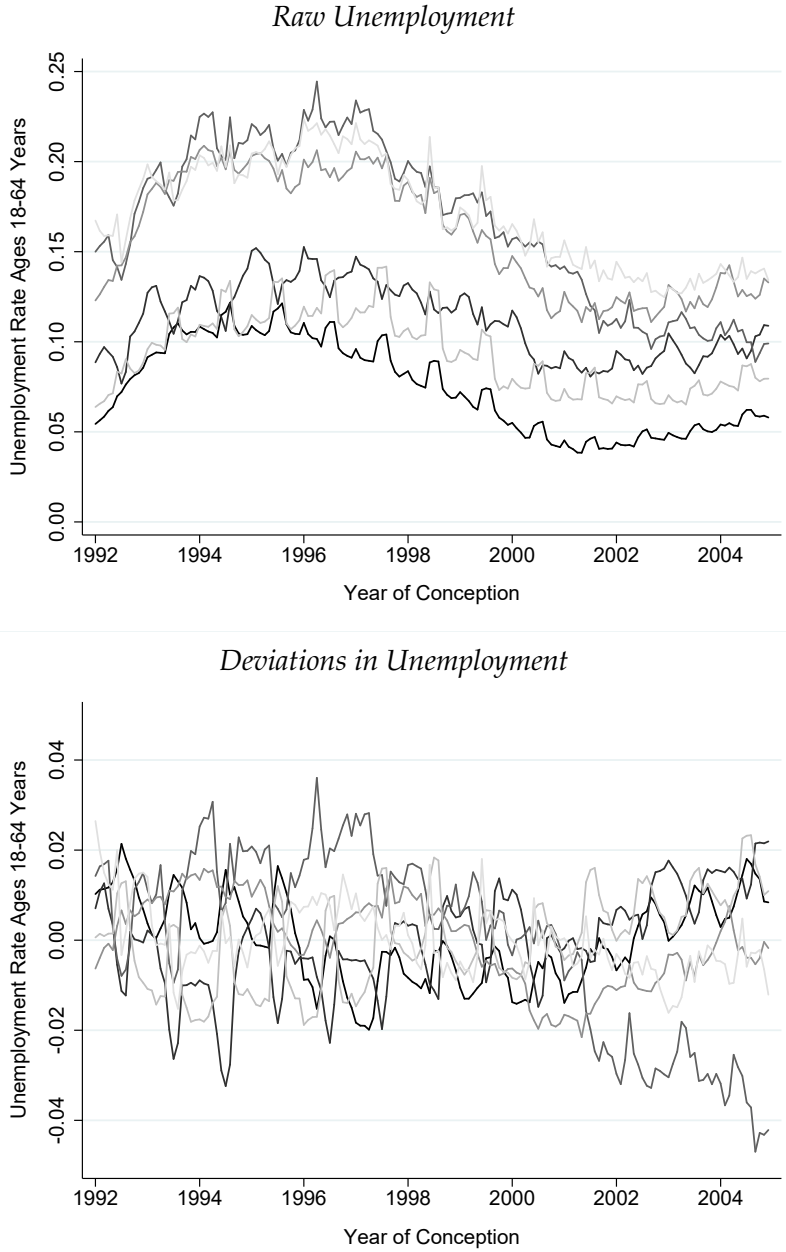
Since we are interested in how economic conditions during pregnancy shape birth outcomes, our main measure of unemployment will be the average unemployment rate in the nine-month period following conception, where the measurement of conception is explained in the next subsection. We also study the impact of lags and leads of unemployment, which we define as the nine-month periods before and after the nine-month period capturing pregnancy, respectively.

2.2 Individual Register Data

We merge the unemployment data with an individual-level administrative dataset that integrates a number of different registers. The linkage of registers is possible thanks to a unique personal identifier that each individual gets assigned at birth. Because we are interested in the effect of labor market conditions during pregnancy, we use the Vital Statistics register and the Medical Birth register to identify all infants whose month of conception was after January 1992, the earliest month for which we have unemployment data.[8]

8. We define the month of conception to be the month of the first day of the last menstrual cycle. Since this variable is sometimes missing or inaccurate, we also construct the month of conception using the more accurate variables birth month and gestation length. If the month of conception as given in the data differs from the constructed month by more than 1 month or is entirely missing,

Figure 1: Unemployment Rate (18–64 Years) for a Few Local Labor Markets



Notes: Monthly unemployment rates (18–64 years) for six randomly selected local labor markets. Deviations in unemployment are after detrending the unemployment rate by taking out permanent differences across local labor markets as well as month-specific national shocks, which account for countrywide fluctuations in unemployment such as seasonal variation.

we replace it with the constructed month. If gestation length is missing we only retain the month of conception if its implied gestation length — given birth month — ranges between 5 and 11 and set it to missing otherwise. We ignore birth records for which both month of conception and gestation

The Medical Birth register also contains data on birth weight, Apgar scores [9] and neonatal mortality, i.e. whether a newborn infant died within 28 days after birth. For infant mortality, i.e. deaths within a year of birth, we add information from the Cause of Death register, which includes deaths up until 2005, so that infant mortality is observable up until 2004. Finally, the Medical Birth register also indicates the mother's municipality of residence, which — together with the month of conception — allows us to determine local labor market conditions around the time of birth.

Where municipality of residence is not available in the Medical Birth register, we take it from the mother's socio-economic and demographic data records — the so-called LISA register. This register also provides maternal income, earnings, unemployment benefits, marital status and education. The same variables are available for the father too. However, since the Medical Birth register only indicates the mother but not the father, for fathers we have to rely on the Intergenerational Link register, which does not provide father links for children born in 2005 and later. This restriction implies that the inclusion of parents fixed effects in the empirical analysis limits the sample to the time period 1992 to early 2004.[10] To determine the birth order of a newborn infant, we count the number of children that the mother has given birth to in the past. Finally, we match records from the National Inpatient register to obtain information about hospitalizations of both the mother during pregnancy and the child after birth.

2.3 Sample

The starting point for our sample is the universe of newborn infants that were conceived in 1992 or later and born in Sweden in 2004 or earlier, as dictated by the availability of unemployment data and paternal information (see the previous subsection). We apply a number of restrictions to obtain the final sample: First, we disregard all parents from those municipalities that did not remain the same over the time period we study. More specifically, there were four municipalities that were each split into two.[11] Besides measurement error in unemployment rates due to employment offices not following the splits carefully, there might be idiosyncratic shocks to affected municipalities. Therefore, for each split, we ignore both the munic-

length are missing.

9. The Apgar score is a summary measure for the health of newborn infants. It ranges between 0 and 10, with higher values indicating better health. It is taken 1, 5 and 10 minutes after birth.

10. Babies conceived later in 2004 are born in 2005, so that we do not have father information.

11. The splits were as follows: Bollebygd broken out of Boras (1995), Nykvarn broken out of Södertälje (1999), Knivsta broken out of Uppsala and Lekeberg broken out of Örebro (both 2003).

ipality that retained the original name and the one that was newly created. Second, we exclude extremely light newborn babies weighing less than 500 grams who have very a low chance of survival. Third, we focus on singleton births. Multiples such as twins and triplets have typically quite low birth weight, which adds noise to the analysis. Moreover, since labor market conditions during pregnancy are identical for multiples, within-multiples comparisons are not informative for the relationship between unemployment and newborn health outcomes. Finally, we limit attention to mothers who were aged between 18 and 49 at the time of conception because the drivers of pregnancy are likely different for mothers outside this age interval.

After excluding infants whose father is still unknown (to us), which applies to about 6 percent of births, we are left with 874,503 babies conceived between 1992 and early 2004. They are born to 590,503 distinct pairs of parents. A woman might be part of several parent pairs if she has children with different partners. Of women who have at least two children in the time period we study, 14.9 percent have them with two or more different partners. The corresponding number for men is a little smaller (12.3 percent), but recall that we exclude babies for whom the father is unknown.

In an econometric model with parents fixed effects, identification rests on parent pairs with at least two births. There are 245,008 parent pairs in the sample that fulfill this criterion (529,008 births). In the empirical analysis, we will cluster standard errors at the level of the local labor market that parents reside in at the time of birth. We therefore focus on parent pairs that have several births in exactly one local labor market (235,554 parent pairs). There are parent pairs that have several babies in multiple local labor markets, but rather than selecting a random local labor market, we choose to disregard these parent pairs. The parent pairs that we keep might have additional isolated births in a different local labor market, but then we exclude these observations from the analysis. Our final regression sample consists of 506,501 birth records.

Table 1 provides descriptive statistics for both the whole sample and the sample we ultimately use in the analysis. The main health outcomes of interest in this paper are neonatal mortality (death within 28 days of birth) and very low birth weight (birth weight less than 1,500 grams, VLBW). The incidence of these variables is relatively low. In the regression sample, only about 0.2 percent (2 out of 1,000 infants) suffer from neonatal mortality and about 0.4 percent (4 out of 1,000 infants) have a birth weight less than 1,500 grams. So to ease interpretation of the estimated effects, we scale up these variables to express them as per 1,000 infants in the regressions below.

Table 1: Summary Statistics by Sample

	Whole Sample			Regression Sample		
	Mean	Std. Dev.	N	Mean	Std. Dev.	N
Neonatal Mortality	0.0016	0.0405	874,503	0.0022	0.0468	506,501
Infant Mortality	0.0027	0.0516	874,503	0.0035	0.0594	506,501
Weight (in Grams)	3,584.0170	563.4740	871,460	3,605.6292	551.3155	504,682
Weight $<$ 1,500 Grams (VLBW)	0.0051	0.0710	871,460	0.0042	0.0647	504,682
Gestational Age (in Days)	278.9491	12.6360	874,381	279.0924	12.1686	506,437
Gestational Age $<$ 37 Weeks	0.0494	0.2166	874,381	0.0451	0.2075	506,437
Gestational Age $<$ 32 Weeks	0.0064	0.0794	874,381	0.0054	0.0730	506,437
Small for Gestational Age	0.0210	0.1435	870,289	0.0180	0.1329	504,001
Apgar Score (5 min) $<$ 5	0.0056	0.0749	867,824	0.0054	0.0733	502,550
Unemployment 18-40 Years - Month	0.1380	0.0534	874,503	0.1388	0.0529	506,501
Unemployment 18-40 Years - Pregnancy	0.1377	0.0528	874,503	0.1371	0.0521	506,501
Unemployment 18-64 Years - Pregnancy	0.1087	0.0346	874,503	0.1093	0.0345	506,501
Unemployment Men 18-40 Years - Pregnancy	0.1444	0.0586	874,503	0.1424	0.0573	506,501
Unemployment Women 18-40 Years - Pregnancy	0.1306	0.0486	874,503	0.1315	0.0486	506,501
Birth Order						
1	0.4195	0.4935	874,503	0.3795	0.4853	506,501
2	0.3738	0.4838	874,503	0.4349	0.4957	506,501
3	0.1467	0.3538	874,503	0.1311	0.3375	506,501
4	0.0412	0.1987	874,503	0.0359	0.1861	506,501
Mother's Age						
Below 25 Years	0.1981	0.3985	874,503	0.2018	0.4013	506,501
25-35 Years	0.7120	0.4528	874,503	0.7308	0.4436	506,501
Above 35 Years	0.0900	0.2861	874,503	0.0675	0.2508	506,501
Mother's Marital Status						
Single	0.5763	0.4941	873,761	0.5685	0.4953	506,307
Married	0.3875	0.4872	873,761	0.4097	0.4918	506,307
Divorced	0.0362	0.1869	873,761	0.0218	0.1461	506,307
Mother's Education						
Primary and Lower Secondary	0.0684	0.2524	850,572	0.0559	0.2297	500,113
Secondary Education and Vocational	0.5673	0.4955	850,572	0.5682	0.4953	500,113
Graduate and Postgraduate	0.3643	0.4812	850,572	0.3759	0.4844	500,113
Mother's Country of Birth						

Continued on next page

Sweden	0.9599	0.1962	874,496	0.9666	0.1798	506,499
Developed Countries	0.0211	0.1436	874,496	0.0173	0.1303	506,499
Developing Countries	0.0190	0.1366	874,496	0.0162	0.1261	506,499
Father's Age						
Below 25 Years	0.1017	0.3022	874,503	0.0979	0.2972	506,501
25-35 Years	0.6952	0.4603	874,503	0.7274	0.4453	506,501
Above 35 Years	0.2031	0.4023	874,503	0.1747	0.3797	506,501
Father's Marital Status						
Single	0.5721	0.4948	872,630	0.5612	0.4962	505,718
Married	0.3893	0.4876	872,630	0.4108	0.4920	505,718
Divorced	0.0385	0.1925	872,630	0.0280	0.1648	505,718
Father's Education						
Primary and Lower Secondary	0.1165	0.3209	860,740	0.1024	0.3032	503,044
Secondary Education and Vocational	0.5698	0.4951	860,740	0.5720	0.4948	503,044
Graduate and Postgraduate	0.3136	0.4640	860,740	0.3256	0.4686	503,044
Father's Country of Birth						
Sweden	0.9572	0.2025	874,442	0.9626	0.1898	506,487
Developed Countries	0.0241	0.1535	874,442	0.0214	0.1448	506,487
Developing Countries	0.0187	0.1355	874,442	0.0160	0.1254	506,487
Father's Unemployment: No Wage	0.0818	0.2740	873,097	0.0710	0.2568	505,895
Mother's Unemployment: No Wage	0.1041	0.3054	874,485	0.1014	0.3018	506,498
Father's Unemployment: No Reimbursements	0.0540	0.2259	801,967	0.0431	0.2031	475,021
Mother's Unemployment: No Reimbursements	0.0953	0.2937	803,264	0.0912	0.2879	475,590

Notes: Summary statistics for selected variables by sample. The regression sample focuses on parents that have several births in exactly one local labor market, see Section 2.3. Month unemployment is the unemployment rate in the month of conception. Pregnancy unemployment is the average unemployment rate in the nine months following conception. Developed countries include EU-15 (excl. Sweden), Norway, North America and Oceania. Developing countries include the rest of Europe, Africa, South America, Asia and Soviet Union. "No Wage" takes on the value 1 if a gross wage of zero is reported in the statement of income submitted to the tax agency. "No Reimbursements" takes on the value 1 if no work-related reimbursements are received.

3 Econometric Specification

The first equation that we examine captures how the birth rate and demographic composition of the parents vary over the cycle. Specifically, in line with the literature,

$$(1) \qquad Y_{lt} = \alpha + \beta \text{Unemployment Rate}_{lt} + \delta_t + \lambda_l + \theta_l(\lambda_l \times t) + \varepsilon$$

where Y_{lt} is an outcome relating to all births conceived in month t by parents living in local labor market l. Specifically, Y_{lt} is the birth rate — the number of births per 1,000 women aged 18–49 years — or the share of parents belonging to some demographic subgroup, such as low-educated individuals. The parameter β captures the effect of unemployment on the outcome, while δ_t are month-fixed effects that capture nationwide fluctuations in unemployment in the month of conception. These are included to control for third factors that affect unemployment (such as labor market policies or long-run increases in educational attainment) and also correlate with newborns' health outcomes. As a result, the identifying variation in unemployment stems from regional variation in transitory economic conditions. The λ_l are local-labor-market fixed effects that account for persistent differences in unemployment across local labor markets, as illustrated in Figure 1. In some specifications, we also allow for local-labor-market-specific linear time trends. These may help reduce omitted variable bias further but come at the cost of increasing estimation uncertainty.

Given that local labor markets vary considerably in population size and a few small regions do not encounter a single birth in some months, we use the number of births as weights in the regression. This also makes our results more comparable with the individual-level analysis later on. To account for serial correlation in the error term, we cluster standard errors at the level of the local labor market.

For health effects we adopt the following equation which is similar in spirit to equation (1), except that it is specified at the individual (newborn) level. Accordingly, we include parental fixed effects. This results in the key model equation of the paper,

$$(2) \qquad Y_{it} = \alpha + \beta \text{Unemployment Rate}_{lt} + \delta_t + \rho_i + \theta_l(\lambda_l \times t) + X_i'\gamma + \varepsilon$$

Here, i refers to a pair of parents consisting of mother and father. Y_{it} is a health

outcome such as whether the infant has a very low birth weight ($<$ 1,500 grams) or suffers from neonatal mortality (death within 28 days of birth).[12] By including parental fixed effects ρ_i, we essentially identify β by comparing babies born to the same parents but at dfferent stages of the business cycle. This accounts for selective fertility over the cycle. Note that ρ_i also absorbs local-labor-market fixed effects since — by construction of the sample — all births belonging to the same parents were conceived in the same local labor market (see Subsection 2.3). In sensitivity analyses, we include parental characteristics that may vary across siblings, such as marital status and birth order (X_i). We once again cluster standard errors at the level of the local labor market.

4 Results

4.1 Setting the Stage: Preparatory Analyses on the Relevance of Selection

Before studying how economic conditions impact newborn health outcomes, we first investigate how the composition of parents of newborns changes over the business cycle. This exercise yields insights into which variables potentially confound health outcomes. It also sheds light on the determinants of fertility decisions, which are of independent interest.[13]

Table 2: Effect of Unemployment in Month of Conception on Birth Rate

	Mother		Father	
	Baseline	With Trends	Baseline	With Trends
Overall	-0.1882	0.0908		
	(0.1430)	(0.2327)		
% Change	-0.42%	0.20%		
Birth Order 1	0.0188	0.2324		
	(0.0904)	(0.1593)		
% Change	0.10%	1.27%		
Birth Order 2	-0.0620	0.0538		
	(0.0714)	(0.0911)		
% Change	-0.35%	0.31%		
Birth Order 3	-0.0224	-0.0749		

Continued on next page

12. In specifying linear probability models rather than binary choice models such as logit or probit we follow the literature.

13. Rather than arising from deliberate fertility decisions, differential fertility by demographic group might also arise due to a differential propensity for fetal loss (Bhalotra 2010) or differential mobility to low-unemployment regions (Lindo 2015). The former may be more prevalent in developing countries. We return to this issue below.

	(0.0551)	(0.0469)		
% Change	-0.26%	-0.86%		
Birth Order 4	-0.0343	-0.0665*		
	(0.0370)	(0.0401)		
% Change	-0.95%	-1.84%		
Age - Below 25 Years	-0.1623*	-0.1423*	-0.1296**	-0.1136**
	(0.0979)	(0.0801)	(0.0507)	(0.0505)
% Change	-1.35%	-1.19%	-1.95%	-1.71%
Age - 25-35 Years	0.0226	0.2093	-0.1142	0.0666
	(0.1446)	(0.2182)	(0.1158)	(0.1561)
% Change	0.07%	0.68%	-0.37%	0.21%
Age - Above 35 Years	0.0019	0.0944	0.0637	0.1333
	(0.0451)	(0.0711)	(0.0612)	(0.1194)
% Change	0.04%	1.88%	0.63%	1.32%
Marital Status - Single	-0.1509	-0.1112	-0.1405	-0.1028
	(0.1347)	(0.1609)	(0.1222)	(0.1509)
% Change	-0.52%	-0.39%	-0.49%	-0.36%
Marital Status - Married	-0.0799	0.1461**	-0.0459	0.1743**
	(0.1396)	(0.0737)	(0.1256)	(0.0841)
% Change	-0.50%	0.91%	-0.28%	1.08%
Marital Status - Divorced	0.0416	0.0370	0.0168	0.0117
	(0.0309)	(0.0363)	(0.0351)	(0.0361)
% Change	1.47%	1.31%	0.62%	0.43%
Education - Primary and Lower Secondary	-0.0316	-0.0999**	0.0400	-0.0436
	(0.0339)	(0.0404)	(0.0708)	(0.0606)
% Change	-0.74%	-2.33%	0.59%	-0.64%
Education - Secondary Education and Vocational	-0.2494**	-0.1151	-0.3167***	-0.2459***
	(0.1072)	(0.1114)	(0.1175)	(0.0925)
% Change	-0.89%	-0.41%	-1.06%	-0.83%
Education - Graduate and Postgraduate	0.0403	0.4506***	0.0735	0.4804**
	(0.0957)	(0.1677)	(0.1150)	(0.2190)
% Change	0.29%	3.19%	0.68%	4.43%
Country of Birth - Sweden	-0.2976*	0.0030	-0.3366**	0.0160
	(0.1544)	(0.1921)	(0.1580)	(0.1934)
% Change	-0.69%	0.01%	-0.77%	0.04%
Country of Birth - Developing Countries	0.1109***	0.0924***	0.1347***	0.0522
	(0.0348)	(0.0280)	(0.0489)	(0.0359)
% Change	8.84%	7.37%	12.02%	4.66%
Country of Birth - Developed Countries	-0.0180	-0.0776	-0.0566	-0.0789
	(0.0952)	(0.0714)	(0.0901)	(0.0676)
% Change	-0.80%	-3.46%	-2.59%	-3.62%

Notes: OLS regressions of the birth rate on the unemployment rate in the age group 18-64 years in the month of conception. Birth rates are defined as the number of births with the same month of conception in the given subgroup per 1,000 women aged 18–49 years in the overall population. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate, but coefficients are scaled up by 12 to obtain annualized figures. Sample includes months January 1992 to March 2004. Controls are month fixed effects, local-labor-market fixed effects and local-labor-market-specific linear time trends where indicated. Regressions are weighted by the number of births. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

We start with estimating the effect of unemployment on the birth rate — defined as the number of births per 1,000 women aged 18–49 years in the overall population. Here we use the overall unemployment rate among individuals aged between 18 and 64 years in the month of conception. Recall from Subsection 2.3 that the sample

in the health regressions below only includes babies conceived in 1992 or later and born in Sweden in 2004 or earlier. Consistent with this restriction, we thus focus in this exercise on months of conception between January 1992 and March 2004.

Table 2 shows that higher unemployment has no effect on the overall birth rate. When we stratify the analysis by parental characteristics, we find a negative impact on the rate of parents that are young, low-educated and Swedish. Moreover, there is a positive effect on the birth rate among high-educated and married parents and parents from developing countries. Specifically, a 1-percentage-point increase in the unemployment rate implies a rise in the birth rate among mothers from developing countries of about 7-9%. Table A.1 shows that results are similar when using the average unemployment during pregnancy, rather than unemployment in the month of conception.

We investigate the effect of the cycle on the composition of births more directly by regressing shares of demographic groups on unemployment (see Table 3). By comparing Tables 2 and 3 we see that changes in birth rates do not always result in notable changes in the composition. There is a significantly negative effect on the share of low-educated mothers and high-educated fathers, and a positive effect on the share of mothers that are divorced and parents that come from developing countries. When using the average unemployment rate during pregnancy (see Table A.2 in the appendix), we additionally find that the share of single parents increases at the expense of the share of married parents. The negative effect on high-educated fathers disappears.[14]

Table 3: Effect of Unemployment in Month of Conception on Composition of Birth Cohorts

	Mother		Father	
	Baseline	With Trends	Baseline	With Trends
Birth Order 1	-0.0752	0.0293		
	(0.0771)	(0.1072)		
% Change	-0.19%	0.08%		
Birth Order 2	-0.0160	0.0026		

Continued on next page

14. Our findings are consistent with some findings in existing studies on the compositional impact of the cycle in recent years (see the references in Section 1). In particular, similar to the Norwegian study by Salvanes (2013), we observe that the share of married mothers tends to decrease with higher unemployment. In agreement with Salvanes (2013) and Aparicio and González (2014), we fail to detect a clear pattern in parental age. However, Dehejia and Lleras-Muney (2004) find fewer young- and more medium-aged mothers in recessions in the United States, and Lindo (2015), also using U.S. data, reports an increase in teen births in times of high unemployment. Finally, we find low-educated mothers to be underrepresented in recessions, which is in line with the work by Bhalotra (2010) for India, but in contrast to several studies of developed countries Dehejia and Lleras-Muney (2004), Salvanes (2013), and Aparicio and González (2014).

	(0.0846)	(0.0916)		
% Change	-0.04%	0.01%		
Birth Order 3	0.0413	-0.0521		
	(0.0652)	(0.0710)		
% Change	0.25%	-0.32%		
Birth Order 4	0.0096	-0.0110		
	(0.0365)	(0.0344)		
% Change	0.18%	-0.20%		
Age - Below 25 Years	-0.0204	0.0265	-0.0058	0.0122
	(0.0903)	(0.0997)	(0.0673)	(0.0631)
% Change	-0.08%	0.11%	-0.05%	0.10%
Age - 25-35 Years	0.1178	-0.0315	0.0211	0.0060
	(0.1367)	(0.1087)	(0.0814)	(0.0806)
% Change	0.17%	-0.05%	0.03%	0.01%
Age - Above 35 Years	-0.0974	0.0049	-0.0153	-0.0183
	(0.0819)	(0.0469)	(0.0659)	(0.0744)
% Change	-1.14%	0.06%	-0.08%	-0.09%
Marital Status - Single	0.3052	0.0986	0.3269	0.1353
	(0.2407)	(0.1242)	(0.2136)	(0.1194)
% Change	0.48%	0.16%	0.52%	0.21%
Marital Status - Married	-0.4081	-0.1715	-0.3555	-0.1327
	(0.2593)	(0.1344)	(0.2239)	(0.1186)
% Change	-1.24%	-0.52%	-1.08%	-0.40%
Marital Status - Divorced	0.1029***	0.0729**	0.0285	-0.0026
	(0.0337)	(0.0356)	(0.0364)	(0.0370)
% Change	2.64%	1.87%	0.78%	-0.07%
Education - Primary and Lower Secondary	-0.0190	-0.1729***	0.1378	-0.0351
	(0.0708)	(0.0607)	(0.0894)	(0.0785)
% Change	-0.27%	-2.47%	1.13%	-0.29%
Education - Secondary Education and Vocational	0.1676	0.1130	0.2003	0.0856
	(0.1507)	(0.0839)	(0.1709)	(0.0891)
% Change	0.26%	0.18%	0.30%	0.13%
Education - Graduate and Postgraduate	-0.1486	0.0599	-0.3381**	-0.0504
	(0.1674)	(0.0867)	(0.1346)	(0.1183)
% Change	-0.50%	0.20%	-1.63%	-0.24%
Country of Birth - Sweden	-0.1324	-0.0242	-0.2043**	0.0071
	(0.1039)	(0.0542)	(0.0985)	(0.0431)
% Change	-0.14%	-0.02%	-0.21%	0.01%
Country of Birth - Developing Countries	0.1077***	0.0438*	0.1330**	0.0023
	(0.0416)	(0.0226)	(0.0523)	(0.0190)
% Change	11.44%	4.65%	17.98%	0.31%
Country of Birth - Developed Countries	0.0247	-0.0196	0.0713	-0.0094
	(0.0689)	(0.0451)	(0.0548)	(0.0332)
% Change	1.12%	-0.89%	3.17%	-0.42%

Notes: OLS regressions of the share of infants with the same month of conception in a given subgroup on the unemployment rate in the age group 18-64 years in the month of conception. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate, but coefficients are scaled up to express them as per 100 infants. Sample includes months January 1992 to March 2004. Controls are month fixed effects, local-labor-market fixed effects and local-labor-market-specific linear time trends where indicated. Regressions are weighted by the number of births. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

If parental characteristics are correlated with newborns' health, then compositional changes in birth cohorts caused by the business cycle entail changes in average health outcomes among newborns. We explore the implications of such selective fer-

tility for average health outcome levels using Table A.2. Recalling from Table 1 that the average number of VLBW infants is 0.0051 and that of infants dying with 28 days within birth (neonatal mortality) is 0.0016, Table A.3 provides summary statistics of VLBW and neonatal mortality for demographic subgroups of the population. As for mother's education, more highly educated mothers are less likely to have VLBW children. No such clear-cut pattern is visible for neonatal mortality, but on average a smaller fraction of low-educated mothers in recessions — ceteris paribus — tends to improve health among newborn infants. Similarly, babies born to married mothers suffer from neonatal mortality significantly more often. However, the pattern is opposite for VLBW, so that the effect on average health remains unclear. Regarding country of origin, mothers from developing countries have a higher propensity to give birth to babies that suffer from VLBW or neonatal mortality. An increase in the proportion of these mothers in recessions would imply reductions in average newborn health. Overall, while the evidence from Table A.3 clearly demonstrates that newborn health varies by demographic group, it remains inconclusive about the direction of the effect that compositional changes induced by recessions have on average health outcome levels.

The selection on observables means that the correlation between unemployment and newborns' health provides a biased estimate of a causal effect. However, note that compositional changes related to the characteristics included in Table A.3 generate only negligible health effects. As an example, consider the shift from low-educated and medium-educated mothers to high-educated mothers by about 0.0034 for a 1 percentage point increase in the unemployment rate.[15] From Table A.3, the incidence of VLBW among high-educated mothers is about 0.0018 lower relative to the average of low- and medium-educated mothers. Given an average VLBW of 0.0051, this implies that a change in the unemployment rate of 1 percentage point will decrease VLBW by only about 0.1 percent.

While selective fertility based on observable characteristics appears negligible, there may be unobserved variables that govern fertility over the cycle, potentially leading to fluctuations in aggregate newborns' health. This is of course why, in the key analyses in the subsequent subsections, we include parental fixed effects. In doing so, we control for time-invariant parental characteristics, both observed and unobserved.[16]

15. In the specification with trends, add up the reductions in the shares of low-educated mothers, -0.17, and the combined increase in the share of medium-/high-educated mothers, 0.17. Divide the result by 100, since reported coefficients are scaled up by this factor.

16. Selection into pregnancy might also occur independently of the cycle. If a disproportionate

When using parental fixed effects, identification comes from parent pairs with at least two births. Moreover, at least two births of a parent pair have to differ in, first, the economic conditions under which they were conceived and, second, the newborns' health outcome of interest. As our indicator of economic conditions is a continuous variable, the first condition is mechanically fulfilled. The second condition is fulfilled if parents experience a specific health outcome such as VLBW in some but not all of their children. As shown above, the prevalence of VLBW and neonatal mortality, while being low overall, varies by demographic group. As a consequence, among the parents who contribute to identifying the effect of interest, the fraction of those belonging to a demographic group in which a certain health outcome (such as VLBW) is relatively frequent should be disproportionately high. This is confirmed by Table A.4, in which we compare the characteristics of those parents in the regression sample that never had a child with VLBW or neonatal mortality ("No child") and those parents that experienced VLBW or neonatal mortality in at least one but not all of their children ("At least one but not all"). Consistent with the findings from above, it can be seen that mothers and fathers who exhibit variation in either health outcome are significantly more likely to be old, non-single, low-educated and non-Swedish and have babies with higher birth orders. At the same time, there remains sufficient demographic variation to explore heterogeneity in effects, which we will turn to when discussing mechanisms (see Subsection 4.5.2).

In this context it is interesting to examine medical abortions as a means to control fertility. If the result of an abortion is that the family ends up with exactly one newborn child in our observation window then the abortion effectively causes the family to be omitted from the sample used in the fixed effects analyses. By analogy to the paragraph above, this should not affect the results if the model specification is correct. However, if, for example, effects of unemployment are heterogeneous across families, and if this is not taken into account, then selectivity of abortions across the cycle may affect the results. Dehejia and Lleras-Muney (2004) discuss earlier studies and conclude that the evidence for an association between unemployment and the abortion rate is inconclusive. Medical abortions are ambulatory and thus not observed in the inpatient registers. Hence they are not included in our data. Instead,

number of women from a certain demographic group become pregnant and give up their jobs in response to pregnancy, then this generates a mechanical shift in the unemployment rate that will be correlated with the level of newborn health specific to this group. Note that also this type of selective fertility will be captured by parental fixed effects. Moreover, note that maternal leave laws exist in Sweden, meaning that women on maternal leave are not counted as unemployed and even encouraged to work during most of the pregnancy so as to maximize the replacement rate while on leave.

they are recorded in a different register called the Outpatient Register. For a small number of years we have access to the latter for one region in Sweden (Skåne; see Tertilt and van den Berg (2015)). In this region we observe a positive association between unemployment and the medical abortion rate. However, given that the association is not large, and given that abortions constitute only a small fraction of the birth rate, and given that the potential health outcomes in the absence of an abortion should not be dramatically worse than those among actual newborns, we are confident that abortions do not affect the estimation results below. It is also useful to point out that the results below when stratified by parental characteristics appear to be similar for different subgroups (see the subsequent subsections), so that effect heterogeneity does not seem to be a key issue.

4.2 Baseline Effects on Newborns' Health

We next turn to the micro-level analysis of how unemployment affects newborn health. We estimate versions of equation 2, which controls for parents fixed effects to address selective fertility. The baseline results are presented in column 1 of Table 4.

We present estimates for our preferred unemployment indicator, which is the unemployment rate at the local labor market level among men aged 18-64 years. The reason for this choice and alternative indicators will be discussed in Subsection 4.3.

Note that in addition to unemployment during pregnancy, defined as the average unemployment during the 9 months following conception, we also report results for values of unemployment in the 9-months-periods before and after pregnancy. The rationale for looking at lagged unemployment (before pregnancy) is that economic conditions might have a delayed effect on health. Stress, for example, which is a likely link between economic conditions and health, might need to accumulate before becoming harmful for health. The rationale for studying lead unemployment (after pregnancy) is that adjustments in employment often take time so that unemployment data follow data on economic activity with some delay.

There is a negative and in most cases significant effect of unemployment on both very low birth weight and neonatal mortality when using unemployment during pregnancy as the indicator for economic conditions.[17] For neonatal mortality, there is also a significant and even larger coefficient for unemployment *before* pregnancy, suggesting that economic conditions have a delayed effect here.

17. Coefficients are for a one-percentage point (= 0.01) increase in the unemployment rate and scaled up by 1,000 to improve readability.

Table 4: Baseline Effect of Unemployment on Health

		LLM-specific Time Trends		Maternal Controls			
	Baseline	Linear Trends	Quadratic Trends	Birth Order	Age	Marital Status	Without Parents FE
Weight < 1,500 Grams (VLBW)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment Before Pregnancy	-0.241	-0.270	-0.255	-0.234	-0.244	-0.247	-0.119
	(0.231)	(0.261)	(0.334)	(0.231)	(0.227)	(0.227)	(0.184)
% Change	-5.91%	-6.60%	-6.23%	-5.74%	-5.97%	-6.04%	-2.90%
Mean × 1,000	4.086	4.086	4.086	4.086	4.086	4.086	4.086
N	474,738	474,738	474,738	474,738	474,738	474,560	474,738
Unemployment During Pregnancy	-0.429**	-0.503**	-0.417	-0.419**	-0.426**	-0.425**	-0.160
	(0.213)	(0.252)	(0.325)	(0.212)	(0.209)	(0.209)	(0.180)
% Change	-10.24%	-12.00%	-9.95%	-10.01%	-10.18%	-10.15%	-3.82%
Mean × 1,000	4.189	4.189	4.189	4.189	4.189	4.188	4.189
N	503,275	503,275	503,275	503,275	503,275	503,081	503,275
Unemployment After Pregnancy	-0.230	-0.173	-0.056	-0.216	-0.216	-0.214	-0.119
	(0.209)	(0.262)	(0.337)	(0.208)	(0.207)	(0.207)	(0.156)
% Change	-5.49%	-4.13%	-1.34%	-5.16%	-5.15%	-5.12%	-2.85%
Mean × 1,000	4.189	4.189	4.189	4.189	4.189	4.188	4.189
N	503,275	503,275	503,275	503,275	503,275	503,081	503,275
Neonatal Mortality	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment Before Pregnancy	-0.316***	-0.341**	-0.249	-0.292**	-0.306**	-0.306**	-0.091
	(0.121)	(0.152)	(0.259)	(0.121)	(0.120)	(0.120)	(0.079)
% Change	-15.15%	-16.36%	-11.93%	-13.98%	-14.65%	-14.68%	-4.36%
Mean × 1,000	2.086	2.086	2.086	2.086	2.086	2.085	2.086
N	477,873	477,873	477,873	477,873	477,873	477,695	477,873
Unemployment During Pregnancy	-0.243**	-0.257*	-0.129	-0.219**	-0.230**	-0.227**	0.033
	(0.106)	(0.135)	(0.205)	(0.110)	(0.110)	(0.110)	(0.094)
% Change	-11.03%	-11.69%	-5.85%	-9.96%	-10.47%	-10.34%	1.48%
Mean × 1,000	2.199	2.199	2.199	2.199	2.199	2.198	2.199
N	506,501	506,501	506,501	506,501	506,501	506,307	506,501
Unemployment After Pregnancy	-0.161	-0.158	-0.006	-0.146	-0.148	-0.144	0.069
	(0.132)	(0.154)	(0.208)	(0.136)	(0.137)	(0.137)	(0.117)
% Change	-7.32%	-7.21%	-0.28%	-6.65%	-6.73%	-6.55%	3.16%
Mean × 1,000	2.199	2.199	2.199	2.199	2.199	2.198	2.199
N	506,501	506,501	506,501	506,501	506,501	506,307	506,501

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among individuals in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before and after pregnancy are the average unemployment rates during the 9-months-period before and the period 10–18 months after conception, respectively. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate. Coefficients and means are scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Additional controls are indicated in the column header. In columns 4–6, indicated controls are added step-by-step to the regression. In column 7, we report the baseline regression without parents fixed effects and instead only include local-labor-market fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

The size of the effect is quite large. A one-percentage point (= 0.01) increase in the unemployment rate is associated with a 10 percent decrease in very low birth weight and a 11–15 percent decrease in neonatal mortality. This is an order of magnitude

larger than the health effects implied by compositional changes with respect to some observable variables such as marital status computed in Subsection 4.1. Hence, our results cannot be driven by fluctuations in these variables. The estimates are also an order of magnitude larger than comparable estimates from earlier literature, which ranged between 0.5 and 0.7 percent for very low birth weight and between 0.2 and 0.6 for neonatal mortality (Dehejia and Lleras-Muney 2004; Lindo 2013; Aparicio and González 2014). But note that these numbers come from regressions without parental fixed effects.

We test the robustness of this estimate by allowing for labor-market-specific time trends in columns 2 and 3. As it turns out, adding time trends affects the estimate only slightly. However, the residual variation in unemployment shrinks considerably, as reflected in enlarged standard errors, especially with quadratic trends. For this reason and because regional time trends are more likely to emerge for a longer time span — ours being relatively short compared with e.g. Dehejia and Lleras-Muney (2004) — our preferred specification will not include time trends in the following.

In columns 4–6, we step-by-step additionally control for birth order, a third-order polynomial in mother's age and mother's marital status. These variables might help reduce bias in the estimation, but are only imprecisely identified if simultaneously controlling for parents and year fixed effects eliminates most of their variation. Once again, coefficients change negligibly with the inclusion of these variables. We therefore do not include them in our preferred specification.

Finally, in column 7, we present results from a specification without parents fixed effects. The estimates become not only smaller in absolute value, but also insignificant. The finding that omitting fixed effects conceals beneficial health effects suggests that those parents who select into pregnancy when unemployment is high tend to have sicker children, thus counteracting the positive impact on health. This once again emphasizes the need for using parents fixed effects to help correct for the bias resulting from selective fertility.[18]

18. In order to cluster standard errors at the local-labor-market level, we focus on parents that have several babies in exactly one local labor market. This approach excludes parents who have several babies and each of the babies while residing in a different local labor market. In additional sensitivity analysis, we include in the sample *all* parents who have at least two babies, regardless of whether or not the parents moved between births. We cluster standard errors at the parents rather than local-labor-market level. Table A.5 presents regression results for the extended sample and demonstrates that our baseline estimates are not much influenced by excluding certain parents that move between births.

4.3 Health Effects by Type of Unemployment

4.3.1 Additional Leads and Lags

The previous subsection showed that not only unemployment during pregnancy, but also unemployment shortly before pregnancy is associated with lower neonatal mortality. A plausible explanation are delayed effects or simply serial correlation in the unemployment variable. At the same time, it would be worrying if newborn health outcomes were correlated also with unemployment in periods even further in the past, or in the future. In column 1 of Table 5, we extend the analysis to unemployment 10–18 months before and after pregnancy. Recall that unemployment data are only available to us from 1992 onwards so that the number of observations decreases when we go further back in time. It is encouraging to see that the estimates become insignificant as we move away from pregnancy, suggesting that our specification actually captures the effect of the cycle.[19]

4.3.2 Male and Female Unemployment

Table 5 also investigates whether male and female unemployment affect health outcomes differently. Columns 2 and 3 of Table 5 show that the effect of unemployment is entirely driven by male unemployment, for which coefficients are larger and more precisely estimated. Male unemployment is typically a better proxy for the business cycle than female unemployment. One reason is that men are over-represented in the private sector, where employment is sensitive to the cycle, rather than the public sector, where employment is more stable. Using annual county-level GDP data for the period 2000–2011, we also find that in Sweden male unemployment is more strongly related to GDP than female unemployment. Moreover, note from Table 1 that the standard deviation of female unemployment is lower than that of male unemployment. Because male unemployment appears to be a better indicator of the business cycle, we will focus on it in the following. We return to this point in Subsection 4.5.1, when discussing mechanisms.

19. In Table A.6 in the appendix, we simultaneously include unemployment before, during and after pregnancy in the same regression. Given that unemployment exhibits high serial correlation, it does not come as a surprise that none of the individual coefficients is any longer significant. However, note that the effects are the most negative for unemployment during pregnancy, which is very much consistent with the notion that economic conditions affect birth outcomes.

Table 5: Effect of Additional Leads and Lags of Unemployment by Gender

	Unemployment		
Weight < 1,500 Grams (VLBW)	Male	Female	Overall
Before Pregnancy: 10-18 Months	0.007	0.201	0.115
	(0.248)	(0.255)	(0.293)
% Change	0.17%	5.00%	2.87%
N	448,148	448,148	448,148
Before Pregnancy: 9 Months	-0.241	-0.088	-0.208
	(0.231)	(0.219)	(0.257)
% Change	-5.91%	-2.15%	-5.09%
During Pregnancy	-0.429**	-0.181	-0.382*
	(0.213)	(0.180)	(0.223)
% Change	-10.24%	-4.31%	-9.11%
After Pregnancy: 9 Months	-0.230	-0.044	-0.172
	(0.209)	(0.194)	(0.213)
% Change	-5.49%	-1.05%	-4.12%
After Pregnancy: 10-18 Months	-0.159	-0.192	-0.210
	(0.208)	(0.228)	(0.230)
% Change	-3.80%	-4.59%	-5.01%
Neonatal Mortality	Male	Female	Overall
Before Pregnancy: 10-18 Months	-0.081	-0.047	-0.076
	(0.155)	(0.142)	(0.165)
% Change	-4.17%	-2.41%	-3.89%
N	451,182	451,182	451,182
Before Pregnancy: 9 Months	-0.316***	-0.105	-0.264**
	(0.121)	(0.108)	(0.126)
% Change	-15.15%	-5.01%	-12.65%
During Pregnancy	-0.243**	-0.091	-0.210**
	(0.106)	(0.096)	(0.100)
% Change	-11.03%	-4.14%	-9.53%
After Pregnancy: 9 Months	-0.161	0.002	-0.104
	(0.132)	(0.131)	(0.137)
% Change	-7.32%	0.11%	-4.72%
After Pregnancy: 10-18 Months	-0.186	0.047	-0.094
	(0.150)	(0.158)	(0.167)
% Change	-8.47%	2.13%	-4.26%

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among the indicated gender in the age group 18–64 years. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate, but coefficients are scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table 6: Effect of Male Unemployment by Age Group

Weight < 1,500 Grams (VLBW)	18–24 Years	18–30 Years	18–40 Years	18–64 Years
Unemployment Before Pregnancy	-0.157*	-0.200*	-0.258*	-0.241
	(0.085)	(0.105)	(0.143)	(0.231)
N	474,738	474,738	474,738	474,738
Unemployment During Pregnancy	-0.164*	-0.289***	-0.376***	-0.429**
	(0.094)	(0.107)	(0.134)	(0.213)
N	503,275	503,275	503,275	503,275
Neonatal Mortality	18–24 Years	18–30 Years	18–40 Years	18–64 Years
Unemployment Before Pregnancy	-0.094**	-0.109*	-0.132*	-0.316***
	(0.047)	(0.060)	(0.075)	(0.121)
N	477,873	477,873	477,873	477,873
Unemployment During Pregnancy	-0.068	-0.075	-0.102	-0.243**
	(0.051)	(0.067)	(0.083)	(0.106)
N	506,501	506,501	506,501	506,501

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among men in the indicated age group. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

4.3.3 Age Groups

In Table 6 we explore how the effect varies depending on the age group we use to compute the unemployment rate. If the business cycle primarily affects newborn health via parental unemployment, focusing on unemployment among younger individuals – including most parents – might yield more precise estimates. However, including older individuals will increase the number of observations. This reduces measurement error in the unemployment rate, especially if newborn health is not so much influenced by parental unemployment, but rather general economic conditions.

First note that the size of the estimate rises as we include older men. This partly reflects a mechanical inflation of coefficients as a result of adding individuals for whom unemployment varies less with the cycle, so that changes in health are attributed to smaller fluctuations in the unemployment rate. However, larger – and more often significant – coefficients are also an indicator of reduced measurement

error. The unemployment rate among men aged 18–64 years produces the largest and most significant effects, so we will choose this variable as our baseline indicator for economics conditions.[20]

4.3.4 Regions

As discussed earlier, there is a trade-off when choosing the optimal degree of geographic aggregation of the unemployment rate. We have chosen to compute unemployment rates at the level of the local labor market, but alternative regional units are conceivable. In Table 7, we report results for the unemployment rate aggregated to the municipality and county level. Each of the 283 municipalities belongs to only one local labor market. In contrast, one local labor market might extend to several counties, although in total the number of local labor markets (72) is larger than the number of counties (21).[21]

Table 7 shows that estimates at the municipality level are generally smaller than those at the local-labor-market level. This is in line with spill-over effects from surrounding areas that are ignored at the municipality level. Probably for the same reason, estimates are also larger at the county level, but only for neonatal mortality. They are smaller and insignificant for very low birth weight, possibly because countervailing variation in unemployment cancels out at more aggregated levels. Overall, the local labor market level appears to balance the up- and downsides of aggregation adequately.[22]

4.3.5 Economic Crisis in Early 1990s

Sweden encountered a severe economic crisis at the beginning of the 1990s with GDP per capita shrinking in every year from 1991 to 1993. As a consequence, the unemployment rate escalated to 30 percent and more. A marginal increase in the unemployment rate from 29 to 30 percent in times of crisis might have different effects on newborn health than a marginal increase from 5 to 6 percent in normal times. The positive effects of unemployment are mitigated if the income shocks associated with crises become so large that they cannot be buffered anymore, even in a developed country with social welfare and functioning capital markets. However, Ruhm (2016) using U.S. data finds that national-level crises tend to amplify the

20. See Table A.7 for corresponding regressions for female unemployment.
21. More precisely, 9 local labor market extend to 2 counties and one local labor market to 3 counties.
22. See Table A.8 for corresponding regressions for female unemployment.

Table 7: Effect of Male Unemployment by Region

Weight < 1,500 Grams (VLBW)	County	Local Labor Market	Municipality
Unemployment Before Pregnancy	0.192	-0.241	-0.196
	(0.229)	(0.231)	(0.140)
N	476,342	474,738	436,111
Unemployment During Pregnancy	0.065	-0.429**	-0.251*
	(0.238)	(0.213)	(0.142)
N	504,976	503,275	462,489
Neonatal Mortality	County	Local Labor Market	Municipality
Unemployment Before Pregnancy	-0.343**	-0.316***	-0.140
	(0.139)	(0.121)	(0.088)
N	479,504	477,873	438,985
Unemployment During Pregnancy	-0.370***	-0.243**	-0.104
	(0.134)	(0.106)	(0.090)
N	508,232	506,501	465,450

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the level of the indicated region are given in parentheses. There are 21 counties, 72 local labor markets and 283 municipalities in the sample. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

positive effects of unemployment.

In Table 8, we present results from regressions in which we interact the unemployment rate with an indicator for the early-1990s crisis, using alternative year ranges to define the crisis. When we define the crisis to include the recession years 1992/1993, there is no indication that unemployment would have a differential effect on health in these years. However, the picture changes when adding the year 1994, when unemployment was still high even though the economy already started to grow again. We find that unemployment is associated with even larger reductions in VLBW in times of crisis. This also holds true if we extend the year range further to 1996, until which high levels of unemployment prevailed. As a whole, the estimates suggest that unemployment is beneficial to newborn health both in times of crisis and non-crisis, with effects appearing to be even larger on very low birth weight in times of crisis.

Table 8: Heterogeneous Effects During the Economic Crisis in the Early 1990s

Crisis Years	1992-1993	1992-1994	1993-1994	1992-1996
Weight < 1,500 Grams (VLBW)	(1)	(2)	(3)	(4)
Unemployment During Pregnancy	-0.435**	-0.458**	-0.317	-0.336*
	(0.216)	(0.203)	(0.250)	(0.196)
Unemployment During Pregnancy × Crisis	-0.039	-0.205*	-0.217*	-0.256***
	(0.134)	(0.110)	(0.113)	(0.075)
Mean - Non-Crisis	3.960	3.997	3.997	4.033
Mean - Crisis	5.497	4.809	4.457	4.402
% - Non-Crisis	-10.98%	-11.45%	-7.93%	-8.32%
% - Crisis	-8.62%	-13.78%	-11.99%	-13.43%
N	503,275	503,275	465,528	503,275
Neonatal Mortality	(1)	(2)	(3)	(4)
Unemployment Before Pregnancy	-0.295**	-0.309**	-0.251**	-0.317***
	(0.121)	(0.126)	(0.121)	(0.122)
Unemployment Before Pregnancy × Crisis	0.120	0.039	0.024	0.047
	(0.109)	(0.082)	(0.088)	(0.064)
Mean - Non-Crisis	1.889	1.827	1.827	1.795
Mean - Crisis	3.919	3.195	3.115	2.551
% - Non-Crisis	-15.6%	-16.9%	-13.72%	-17.68%
% - Crisis	-4.45%	-8.45%	-7.29%	-10.60%
N	477,873	477,873	468,633	477,873

Notes: In each column, all coefficients come from the same regression. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate. Coefficients and means are scaled up to express them as per 1,000 infants. Controls are parents fixed effects, month fixed effects as well as crisis-specific month fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

4.4 Effects on Other Health Outcomes

Above we found that recessions change the incidence of neonatal mortality, i.e. deaths within 28 days of birth, by -0.316 to -0.243 (using the effect on male unemployment before and during pregnancy, respectively, in Table 5). In Table 9, we report estimates of the effect on infant mortality — deaths within 1 year of birth — and postneonatal mortality — deaths after 28 days and within 1 year of birth. Note that the coefficients of infant mortality (-0.348 and -0.141) are about the same size as or smaller than the coefficient on neonatal mortality, and less significant. This has two

Table 9: Effect of Male Unemployment on Other Health Outcomes

	Infant Mortality	Postneonatal Mortality	Weight (in Grams)	Apgar Score (5 min) < 5	Small for Gestational Age
Unemployment Before Pregnancy	-0.348*	-0.032	-0.940	-0.132	-0.311
	(0.193)	(0.143)	(1.559)	(0.265)	(0.411)
% Change	-10.39%	-2.54%	-0.03%	-2.44%	-1.77%
Mean $\times$ 1,000	3.352	1.266	3,610.4	5.405	17.541
N	477,873	477,873	474,738	471,374	473,563
Unemployment During Pregnancy	-0.141	0.101	-1.721	0.065	-0.295
	(0.153)	(0.104)	(1.463)	(0.243)	(0.539)
% Change	-3.98%	7.54%	-0.05%	1.21%	-1.64%
Mean $\times$ 1,000	3.544	1.345	3,605.7	5.399	17.972
N	506,501	506,501	503,275	499,556	502,055

	Gestational Age < 32 Weeks	Gestational Age < 37 Weeks	Hospitali-zations Pregnancy	Hospitali-zations 1 Year	Hospitali-zations 3 Years
Unemployment Before Pregnancy	-0.286	0.085	0.001	-0.002	-0.001
	(0.227)	(0.664)	(0.002)	(0.002)	(0.004)
% Change	-5.39%	0.19%	0.95%	-1.04%	-0.31%
Mean $\times$ 1,000	5.298	44.691	0.133	0.166	0.365
N	477,766	477,766	477,873	475,415	425,995
Unemployment During Pregnancy	-0.440**	0.279	0.001	0.001	0.006
	(0.204)	(0.548)	(0.002)	(0.003)	(0.005)
% Change	-8.19%	0.62%	0.61%	0.40%	1.53%
Mean $\times$ 1,000	5.365	45.108	0.134	0.168	0.370
N	506,390	506,390	506,501	503,824	454,298

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate. Except for weight, coefficients and means are scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

implications: First, since effects are not significantly larger, recessions have no effect on deaths later than 28 days after birth, also shown by the insignificant estimate for postneonatal mortality. Second, since effects are sometimes smaller, some of the deaths not happening within 28 days of birth might just be deferred to a later point in time within the first year. However, the estimated effects are still negative, significant in one case and not significantly different from those on neonatal mortality. This indicates that some lives are actually saved in the long run.

Table 9 also explores the effects of unemployment on absolute birth weight, log birth weight, the 5-minute Apgar score and small for gestational age (SGA). For any given gestational age, the SGA definition gives upper bounds of birth weight below which an infant is deemed "light" or "small" for gestational age. We also look at indicators for being born before 32 completed weeks of gestation ("very preterm" according to the WHO classification) and before 37 completed weeks of gestation ("preterm"). Finally, we investigate the effect on the number of hospitalizations, both during pregnancy and within 1 and 3 years of birth. There are no significant effects on these outcomes, except for the likelihood of being born with less than completed 32 weeks of gestation. We return to this finding below when discussing mechanisms.

As an additional outcome we also study stillbirth, i.e. being born without signs of life after at least 28 weeks of gestation. It turns out that the effects of the business cycle on having a stillbirth as opposed to a live birth are small and insignificant (results available upon request). This indicates that the mechanisms leading to stillbirths are not identical to those giving rise to infant mortality. Note that all results reported for neonatal mortality are relative to both surviving infants and stillborn babies. However, the number of stillbirths is neglectably small, and including them as neonatal deaths does not affect the main conclusions.

4.5 Mechanisms

The previous subsections established a positive relationship between economic downturns and newborns' health. In analyzing the channels linking downturns to improvements in newborns' health, we distinguish two main categories. The first category refers to channels that are related to parental job loss and includes more time for health-enhancing activities and lower consumption of tobacco and alcohol. The second category includes all channels unrelated to parental job loss, including reductions in stress and air pollution as well as higher availability of prenatal and neonatal care. For each of the two categories, we now evaluate whether it can rationalize the above findings, starting with the first category, which includes channels related to parental job loss.

4.5.1 Parental Unemployment

Recall from Subsection 4.3.2 that the effect of the cycle on newborn health was entirely driven by the male unemployment rate, with the female unemployment rate being virtually uncorrelated with newborn health. At the same time, while

Table 10: Effect of Parental Unemployment ("No Wage")

	Baseline	Mother		Father		Both Parents	
Weight < 1,500 Grams (VLBW)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment During Pregnancy	-0.429**	-0.428**	-0.426**	-0.421**	-0.419**	-0.422**	-0.425**
	(0.213)	(0.213)	(0.207)	(0.211)	(0.212)	(0.211)	(0.212)
No Wage		-0.005	-0.003	-0.018***	-0.015	-0.028***	-0.044
		(0.005)	(0.014)	(0.006)	(0.015)	(0.010)	(0.039)
No Wage × Unemployment			-0.002		-0.002		0.013
			(0.012)		(0.011)		(0.029)
N	503,275	503,272	503,272	502,675	502,675	502,675	502,675
	Baseline	Mother		Father		Both Parents	
Neonatal Mortality	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment During Pregnancy	-0.243**	-0.240**	-0.264***	-0.239**	-0.245**	-0.240**	-0.240**
	(0.106)	(0.106)	(0.089)	(0.106)	(0.108)	(0.106)	(0.106)
No Wage		0.002	-0.010	-0.006	-0.015	0.001	-0.001
		(0.005)	(0.011)	(0.005)	(0.017)	(0.012)	(0.047)
No Wage × Unemployment			0.009		0.007		0.002
			(0.008)		(0.014)		(0.034)
N	506,501	506,498	506,498	505,895	505,895	505,895	505,895

Notes: In each column, all coefficients come from the same regression. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. "No Wage" takes on the value 1 if a gross wage of zero is reported in the statement of income submitted to the tax agency. Coefficients involving the unemployment rate are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

uncorrelated with newborn health, female unemployment is a strong indicator of the mother's employment status. Table A.9 in the appendix presents regressions of two binary unemployment indicators on male and female unemployment separately. The first indicator ("No Wage") takes on the value one if a gross wage of zero is reported in the statement of income submitted to the tax agency. The second indicator ("No Reimbursements") is defined analogously, except for being more comprehensive in the sense that — in addition to gross wage — it also accounts for work-related reimbursements such as sickness or pregnancy benefits and income from self-employment. However, it is not available to us in the year 2003.[23]

Irrespective of the indicator used, female unemployment is a much better predic-

23. Both indicators have the limitation that they designate those individuals as unemployed who voluntarily receive zero work-related income, thus introducing measurement error. In our context, this particularly affects students. But note that for some students the continuation of education might only be an involuntary response to bad labor market conditions. Moreover, studying and being unemployed are not too different in terms of available time and income.

tor of mother's unemployment than male unemployment (columns 2 and 6 versus columns 1 and 5). The last two columns of Table A.9 also show that female unemployment decreases log family earnings more than male unemployment. These observation stand in stark contrast with our finding that the effects on newborn health are entirely driven by men rather than female unemployment. With female unemployment strongly affecting mother's unemployment but not newborn health, we conclude that mother's unemployment and, consequently, more time available for prenatal care is only a negligible channel in linking downturns to improved newborn health. It also follows that income reductions — and associated decreases in the consumption of detrimental goods — do not qualify as a likely channel either. These findings demonstrate that parental unemployment plays no major role in explaining the positive health effects of recessions. We corroborate this result with the help of two additional approaches in Tables 10 and 11.

In Table 10, we present a more direct test of the role of parental unemployment. Column 1 reproduces our baseline regression with the unemployment rate during pregnancy as the only regressor apart from controls. In column 2, we add an indicator ("No Wage") for mother's unemployment as an additional covariate. Note that mother's unemployment, even in the case of holding the mother fixed, might be endogenous to third factors also affecting newborn health, such as age. Its coefficient must therefore be treated with caution. However, including this variable controls for the indirect effect of the unemployment rate that operates via mother's unemployment and isolates the direct effect.

For both very low birth weight and neonatal mortality, the coefficient of the unemployment rate does not change at all, confirming that the effect on newborn health does not operate through mother's unemployment. In column 3, we add an interaction term of mother's unemployment with the unemployment rate. The coefficient of the interaction is insignificant, suggesting that the unemployment rate affects employed and unemployed mothers in a similar way. Columns 4 and 5 repeat the analysis for father's and parents' joint unemployment, respectively, and yield comparable results. Table A.10 in the appendix reports the same set of regressions for the "No Reimbursements" indicator of parental unemployment, with results being essentially unaltered.

Finally, we regress newborn health on first differences — rather than absolute levels — in the unemployment rate. First differences capture changes in the unemployment rate, such as a large-scale job loss due to layoffs. They exhibit no variation when unemployment remains constant at a high or low level. If a job loss has strong

immediate effects that fade out over time, then first differences should give different results than levels of unemployment. Table 11 shows the corresponding estimates for first differences in overall, male and female unemployment. There is no robust evidence that first differences in unemployment affect newborn health. We conclude that parental job loss captured by first differences does not explain the positive effects of unemployment on newborn health.

Table 11: Effect of First Differences of Unemployment

Weight < 1,500 Grams (VLBW)	Overall	Male	Female
Unemployment Before Pregnancy	-0.574*	-0.400	-0.536**
	(0.296)	(0.299)	(0.262)
N	448,148	448,148	448,148
Unemployment During Pregnancy	-0.284	-0.228	-0.226
	(0.208)	(0.196)	(0.201)
N	448,148	448,148	448,148
Unemployment After Pregnancy	0.520	0.438	0.361
	(0.391)	(0.313)	(0.381)
N	503,275	503,275	503,275
Neonatal Mortality	Overall	Male	Female
Unemployment Before Pregnancy	-0.166	-0.285	0.090
	(0.257)	(0.239)	(0.253)
N	451,182	451,182	451,182
Unemployment During Pregnancy	-0.092	-0.108	-0.023
	(0.193)	(0.182)	(0.165)
N	451,182	451,182	451,182
Unemployment After Pregnancy	0.265	0.185	0.241
	(0.278)	(0.230)	(0.283)
N	506,501	506,501	506,501

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among the indicated gender in the age group 18–64 years. Unemployment during pregnancy is the first-differenced average unemployment rate in the nine months following conception. Unemployment before and after pregnancy are the first-differenced average unemployment rates during the 9-months-period before and the period 10–18 months after conception, respectively. In each case, first-differencing means subtracting the average unemployment rate from the previous nine-months-period. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Overall, we find that parental employment status cannot account for the beneficial health effects of recessions. This is in line with e.g. Lindo (2011), who finds that the

husband's job loss actually reduces birth weight. Recall from Section 4.3.2 that male unemployment affects newborn health much more than female unemployment and also correlates more strongly with the business cycle. Taken together, these findings suggest that the cycle operates through channels more general than individual unemployment, which will be explored next.

4.5.2 Heterogeneity

Among the most likely alternative mechanisms linking downturns to newborn health are reduced stress, less traffic and air pollution as well as higher availability of prenatal and neonatal care. Note that availability of care is unlikely to be an important channel, as it presumably varies little in Sweden due to its public health care system (see also Subsection 2.1). Moreover, while neonatal care may affect the likelihood that a newborn infant dies, it is hardly relevant for weight at birth, for which we find positive effects just like we do for infant survival. Finally, financial barriers to prenatal care are virtually absent, so that there is no reason to expect differential effects by socioeconomics status of the parents. This is in contrast to stress and air pollution, where we might see stronger effects for low-SES parents. For example, if there is job-related stress due to fluctuations in the workload, this will particularly affect low-educated individuals who are disproportionately employed in sectors sensitive to the business cycle, such as manufacturing or simple services. In addition, low-SES individuals tend to live in neighborhoods with higher levels of pollution.

The upper part of Table 12 explores whether the effect of recessions on very low birth weight varies by socio-economic status of the parents, by marital status or by the gender of the child. Regarding mortality in the general population, Haaland and Telle (2015) find no evidence that the effect of the cycle would depend on socio-economic status. The first column of Table 12 allows for differential effects of unemployment for fathers with different levels of educational attainment.[24] The coefficient in the first row gives the effect on fathers who only have primary or secondary education, which is the reference category in this regression. The estimate of -0.618 is much larger than our baseline estimate of -0.429 from Table 10. The other coefficient in the same column (just below) refers to the interaction of graduate and

24. We define educational attainment as the education level obtained in 2006, the last year in which we observe this variable. In order to ensure that education is completed in this year, we restrict attention to individuals who are at least 26 years old at the end of 2006. This restriction excludes only about 1% of all observations. For individuals who have no education level information in 2006, we instead use the highest value ever obtained, regardless of age.

Table 12: Heterogeneity of Unemployment Effect by Subgroup

	Education				
Weight < 1,500 Grams (VLBW)	Father (1)	Mother (2)	Family Income (3)	Marital Status (4)	Gender (5)
Unemployment During Pregnancy	-0.618**	-0.656**	-0.616	-0.419*	-0.434**
	(0.245)	(0.256)	(0.419)	(0.217)	(0.203)
Graduate and Postgraduate	0.827**				
	(0.397)				
Graduate and Postgraduate		0.742**			
		(0.368)			
Top 25%			0.123		
			(0.251)		
Married				-0.099	
				(0.119)	
Girl					0.014
					(0.068)
Mean - Reference	4.342	4.478	4.419	4.122	4.241
Mean - Interaction	3.824	3.700	3.939	4.081	4.133
% - Reference	-14.24%	-14.64%	-13.93%	-10.16%	-10.24%
% - Interaction	5.45%	2.34%	-12.51%	-12.67%	-10.16%
N	499,854	496,927	218,547	492,121	503,275
Neonatal Mortality	(1)	(2)	(3)	(4)	(5)
Unemployment Before Pregnancy	-0.266	-0.343**	-0.628**	-0.259**	-0.354***
	(0.167)	(0.157)	(0.319)	(0.129)	(0.128)
Graduate and Postgraduate	-0.276				
	(0.368)				
Graduate and Postgraduate		0.088			
		(0.368)			
Top 25%			0.346		
			(0.225)		
Married				-0.163	
				(0.117)	
Girl					0.079
					(0.057)
Mean - Reference	2.113	2.156	2.138	1.801	2.374
Mean - Interaction	2.024	1.955	2.106	2.357	1.780
% - Reference	-12.6%	-15.9%	-29.38%	-14.4%	-14.92%
% - Interaction	-26.81%	-13.05%	-13.39%	-17.93%	-15.49%
N	474,648	471,609	206,839	467,198	477,873

Continued on next page

Notes: This table explores heterogeneous unemployment effects for different subgroups. The first line in each panel reports the unemployment effect in the respective reference subgroup. Reference subgroups are: (1) Primary and Secondary, (2) Primary and Secondary, (3) Bottom 25%, (4) Single, (5) Boy. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate. Coefficients and means are scaled up to express them as per 1,000 infants. Controls are parents fixed effects as well as subgroup-specific month fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

postgraduate education with unemployment. It is significantly positive and so large that it cancels out the effect on low-educated fathers. The results are very similar for mother's education. In sum, the negative effect of unemployment on very low birth weight seems entirely driven by low-educated parents. For high-educated mothers the effect is, if anything, slightly positive.

In column 3, we also study effects by family income, which is another indicator for socio-economic status. This indicator ranks given parents in the distribution of family income of all parents with a baby conceived in the same year.[25] Our reference group are the parents in the bottom quarter of the income distribution and we contrast them with those in the top quarter. With very low birth weight as a health outcome, there are no differential effects of unemployment between top- and bottom-income parents. If we compare single with married mothers and boys with girls, the effects of unemployment do not differ either.

In the bottom part of Table 12, we repeat the above analysis for neonatal mortality. We focus on unemployment in the 9 months before pregnancy, which was shown to have the highest effect on neonatal mortality in Subsection 4.2. Here, unemployment does not become less beneficial with increasing parental education. If anything, the effect seems to be larger for high-educated fathers compared to low-educated fathers, but this difference is not significant. Regarding family income, the coefficient for parents in the bottom quarter of the distribution (-0.628) is much larger than the baseline estimate (-0.429). This indicates larger effects for poor parents, although neither this difference nor the positive interaction effect for top-quarter parents is

25. Ideally, we would like to base this indicator on the income distribution of potential rather than actual parents to prevent bias due to selective fertility. However, we observe family income only for couples who are married or already have common children. We would therefore ignore many potential first-time parents. To reduce bias, we also experiment with ranking today's parents according to today's income distribution of the previous year's parents. The results are very similar.

significant. Overall, Table 12 provides suggestive evidence that the positive effects of recessions on newborn health are stronger for low-SES parents. This is consistent with the channels related to stress and air pollution, to which low-SES parents are more likely to be exposed.

4.5.3 Effects on Gestational Age

We can gain additional insights by exploiting knowledge about the production function of birth weight. Following Kramer (1987), birth weight is determined by length of gestation and by intrauterine growth. The latter is affected by cigarette smoking and nutrition, while length of gestation — besides being affected by smoking — strongly responds to stress (Torche 2011; Foureaux Koppensteiner and Manacorda 2016; Persson and Rossin-Slater 2016). Gestation is also sensitive to air pollution (Currie and Walker 2011). Recall from Subsection 4.4 that unemployment reduces the incidence of being born with less than 32 completed weeks of gestation ("very preterm"). This decrease has about the same size as the decrease in very low birth weight from column 2 of Table 5, suggesting that a short gestation accounts for almost all of the reductions in very low birth weight. In contrast, the effect on the incidence of small for gestational age (SGA), which is an indicator of intrauterine growth (Kramer 1987), is not significantly different from zero. This is consistent with stress and air pollution playing a major role in linking recessions with improvements in newborns' health.

5 Conclusion

Downturns improve newborns' health outcomes. A one-percentage-point increase in the unemployment rate is associated with a 10–15 percent reduction in the incidence of having a birth weight below 1,500 grams and of dying within 28 days after birth. The increase in infant survival is permanent and not offset by delayed death later in the first year of life.

Using detailed micro-level information about the parents, we shed light on the underlying mechanisms. Parental job loss does not act as a mediating factor. Next, the reduction in mortality can fully be accounted for by an equally large reduction in premature birth. Premature birth has been attributed to maternal stress in earlier literature, as well as to air pollution. Downturns disproportionately affect low-SES parents.

In downturns, air pollution decreases due to lower traffic volume. Stress plausibly decreases as a result of reduced working hours and more available time. Reduced working hours might also lead to higher demand for prenatal care, but such a channel would be difficult to reconcile with our finding that the effects on unemployed mothers appear to be similarly large. For them, available time does not change in recessions. However, they might benefit from lower stress of the spouse, reduced pressure to find a job or a general slowdown of the economy.

To distinguish further between air pollution and stress, note that Sweden has rural parts where air pollution is permanently at negligible levels. In additional analyses (not reported), we find that the effect of recessions is even larger in sparsely populated areas, arguing against air pollution as a channel, but other factors might drive this result. We view it as a topic for further research to extend our analysis with local pollution data.

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Appendix

A Tables

Table A.1: Effect of Unemployment During Pregnancy on Birth Rate

	Mother		Father	
	Baseline	With Trends	Baseline	With Trends
Overall	-0.0023	0.3629		
	(0.2088)	(0.3307)		
% Change	-0.01%	0.81%		
Birth Order 1	0.0879	0.3501		
	(0.1364)	(0.2151)		
% Change	0.48%	1.92%		
Birth Order 2	-0.0004	0.1679		
	(0.1005)	(0.1169)		
% Change	-0.00%	0.96%		
Birth Order 3	0.0010	-0.0775		
	(0.0559)	(0.0567)		
% Change	0.01%	-0.89%		
Birth Order 4	-0.0121	-0.0377		
	(0.0402)	(0.0350)		
% Change	-0.33%	-1.04%		
Age - Below 25 Years	-0.1281	-0.1073	-0.1206**	-0.0866
	(0.1010)	(0.0916)	(0.0578)	(0.0596)
% Change	-1.07%	-0.90%	-1.82%	-1.31%
Age - 25-35 Years	0.1411	0.4168	-0.0092	0.2069
	(0.1953)	(0.2899)	(0.1609)	(0.2400)
% Change	0.46%	1.36%	-0.03%	0.67%
Age - Above 35 Years	0.0351	0.1270	0.1260*	0.2234*
	(0.0612)	(0.0819)	(0.0759)	(0.1270)
% Change	0.70%	2.53%	1.25%	2.22%
Marital Status - Single	0.0067	0.1666	0.0197	0.1644
	(0.1648)	(0.2055)	(0.1522)	(0.1955)
% Change	0.02%	0.58%	0.07%	0.57%
Marital Status - Married	-0.0526	0.1352	-0.0249	0.1642
	(0.1324)	(0.1260)	(0.1244)	(0.1425)
% Change	-0.33%	0.84%	-0.15%	1.02%
Marital Status - Divorced	0.0324	0.0333	0.0081	0.0001
	(0.0443)	(0.0454)	(0.0388)	(0.0416)
% Change	1.14%	1.18%	0.30%	0.00%
Education - Primary and Lower Secondary	-0.0177	-0.0951*	0.1123	0.0444
	(0.0430)	(0.0499)	(0.0822)	(0.0779)
% Change	-0.41%	-2.22%	1.64%	0.65%
Education - Secondary Education and Vocational	-0.0780	0.1421	-0.1738	-0.0251
	(0.1301)	(0.1594)	(0.1550)	(0.1329)
% Change	-0.28%	0.51%	-0.58%	-0.08%
Education - Graduate and Postgraduate	0.1132	0.5584**	0.1271	0.5563**
	(0.1626)	(0.2267)	(0.1817)	(0.2705)

Continued on next page

% Change	0.80%	3.96%	1.17%	5.13%
Country of Birth - Sweden	-0.1047	0.2618	-0.1763	0.2417
	(0.2015)	(0.2757)	(0.2107)	(0.2839)
% Change	-0.24%	0.60%	-0.41%	0.56%
Country of Birth - Developing Countries	0.1126***	0.1110***	0.1401***	0.0730*
	(0.0373)	(0.0327)	(0.0504)	(0.0387)
% Change	8.98%	8.85%	12.50%	6.52%
Country of Birth - Developed Countries	0.0269	-0.0016	-0.0924	-0.1163
	(0.1034)	(0.0699)	(0.1217)	(0.1070)
% Change	1.20%	-0.07%	-4.24%	-5.33%

Notes: OLS regressions of the birth rate on the average unemployment rate in the age group 18-64 years in nine months during pregnancy. Birth rates are defined as the number of births with the same month of conception in the given subgroup per 1,000 women aged 18–49 years in the overall population. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate, but coefficients are scaled up by 12 to obtain annualized figures. Sample includes months January 1992 to March 2004. Controls are month fixed effects, local-labor-market fixed effects and local-labor-market-specific linear time trends where indicated. Regressions are weighted by the number of births. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.2: Effect of Unemployment During Pregnancy on Composition of Birth Cohorts

	Mother		Father	
	Baseline	With Trends	Baseline	With Trends
Birth Order 1	-0.0592	0.0405		
	(0.1021)	(0.1396)		
% Change	-0.15%	0.10%		
Birth Order 2	-0.0277	0.0346		
	(0.0972)	(0.1052)		
% Change	-0.08%	0.10%		
Birth Order 3	0.0715	-0.0572		
	(0.0812)	(0.0802)		
% Change	0.43%	-0.35%		
Birth Order 4	-0.0075	-0.0292		
	(0.0467)	(0.0449)		
% Change	-0.14%	-0.54%		
Age - Below 25 Years	-0.0544	-0.0129	-0.0357	0.0064
	(0.1011)	(0.1052)	(0.0839)	(0.0871)
% Change	-0.23%	-0.05%	-0.30%	0.05%
Age - 25-35 Years	0.1775	0.0724	0.0743	0.0761
	(0.1306)	(0.1150)	(0.1147)	(0.1189)
% Change	0.26%	0.11%	0.11%	0.11%
Age - Above 35 Years	-0.1231	-0.0595	-0.0386	-0.0825
	(0.0932)	(0.0702)	(0.0872)	(0.0952)
% Change	-1.44%	-0.70%	-0.19%	-0.41%
Marital Status - Single	0.3023	0.1994	0.3386*	0.2401*
	(0.2208)	(0.1325)	(0.1974)	(0.1355)
% Change	0.48%	0.32%	0.53%	0.38%
Marital Status - Married	-0.3874	-0.2481*	-0.3464*	-0.2079
	(0.2362)	(0.1435)	(0.2011)	(0.1279)
% Change	-1.18%	-0.75%	-1.05%	-0.63%
Marital Status - Divorced	0.0851**	0.0487	0.0079	-0.0322
	(0.0414)	(0.0507)	(0.0410)	(0.0433)
% Change	2.19%	1.25%	0.21%	-0.88%
Education - Primary and Lower Secondary	-0.0317	-0.2154***	0.1354	-0.0767
	(0.0849)	(0.0692)	(0.1162)	(0.0952)
% Change	-0.45%	-3.07%	1.11%	-0.63%
Education - Secondary Education and Vocational	0.0744	0.0765	0.0739	0.0076
	(0.1722)	(0.1051)	(0.2093)	(0.1050)
% Change	0.12%	0.12%	0.11%	0.01%
Education - Graduate and Postgraduate	-0.0426	0.1388	-0.2093	0.0692
	(0.1757)	(0.1013)	(0.1626)	(0.1297)
% Change	-0.14%	0.47%	-1.01%	0.33%
Country of Birth - Sweden	-0.1378	-0.0663	-0.2565***	-0.0755
	(0.1071)	(0.0756)	(0.0974)	(0.0516)
% Change	-0.14%	-0.07%	-0.26%	-0.08%
Country of Birth - Developing Countries	0.1209***	0.0740***	0.1553***	0.0445**
	(0.0451)	(0.0273)	(0.0522)	(0.0218)
% Change	12.84%	7.85%	20.98%	6.02%
Country of Birth - Developed Countries	0.0169	-0.0076	0.1012*	0.0310

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	(0.0723)	(0.0609)	(0.0583)	(0.0403)
% Change	0.76%	-0.34%	4.50%	1.38%

Notes: OLS regressions of the share of infants with the same month of conception in a given subgroup on the average unemployment rate in the age group 18-64 years in nine months during pregnancy. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate, but coefficients are scaled up to express them as per 100 infants. Sample includes months January 1992 to March 2004. Controls are month fixed effects, local-labor-market fixed effects and local-labor-market-specific linear time trends where indicated. Regressions are weighted by the number of births. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.3: Average Health by Subgroup

	Weight < 1,500 Grams (VLBW)				Neonatal Mortality			
	Mean	SD	N	t-value	Mean	SD	N	t-value
Birth Order								
1	0.0067	0.0817	365,315	-	0.0018	0.0423	366,811	-
2	0.0036	0.0596	325,931	-18.48	0.0013	0.0367	326,932	-4.72
3	0.0038	0.0618	127,923	-13.16	0.0017	0.0409	128,302	-0.90
4	0.0051	0.0714	35,916	-4.00	0.0020	0.0450	36,017	0.93
Mother's Education								
Primary and Lower Secondary	0.0069	0.0825	57,932	-	0.0016	0.0404	58,161	-
Secondary Education and Vocational	0.0053	0.0725	480,907	-4.40	0.0017	0.0409	482,514	0.26
Graduate and Postgraduate	0.0043	0.0658	308,773	-6.92	0.0016	0.0400	309,897	-0.16
Mother's Marital Status								
Single	0.0051	0.0715	501,748	-	0.0014	0.0374	503,518	-
Married	0.0048	0.0689	337,420	-2.40	0.0020	0.0445	338,585	6.35
Divorced	0.0074	0.0854	31,551	4.50	0.0018	0.0428	31,658	1.76
Mother's Age								
Below 25 Years	0.0048	0.0694	172,634	-	0.0016	0.0403	173,214	-
25-35 Years	0.0047	0.0685	620,435	-0.64	0.0016	0.0396	622,613	-0.55
Above 35 Years	0.0084	0.0914	78,391	9.77	0.0023	0.0476	78,676	3.31
Mother's Country of Birth								
Sweden	0.0050	0.0708	836,537	-	0.0016	0.0403	839,424	-
Developing Countries	0.0065	0.0801	16,567	2.25	0.0020	0.0452	16,642	1.19
Developed Countries	0.0051	0.0714	18,349	0.15	0.0021	0.0460	18,430	1.44
Father's Education								
Primary and Lower Secondary	0.0062	0.0783	99,919	-	0.0020	0.0442	100,298	-
Secondary Education and Vocational	0.0051	0.0712	488,915	-4.05	0.0016	0.0397	490,483	-2.51
Graduate and Postgraduate	0.0045	0.0671	268,923	-5.91	0.0017	0.0407	269,959	-1.82
Father's Marital Status								
Single	0.0051	0.0715	497,517	-	0.0014	0.0379	499,260	-
Married	0.0048	0.0690	338,585	-2.31	0.0020	0.0443	339,749	5.65

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Divorced	0.0070	0.0833	33,493	3.95	0.0014	0.0374	33,621	-0.20
Father's Age								
Below 25 Years	0.0053	0.0723	88,596	-	0.0015	0.0385	88,905	-
25-35 Years	0.0047	0.0682	605,824	-2.28	0.0016	0.0395	607,952	0.56
Above 35 Years	0.0064	0.0795	177,040	3.57	0.0020	0.0447	177,646	3.07
Father's Country of Birth								
Sweden	0.0050	0.0705	834,081	-	0.0016	0.0404	836,979	-
Developing Countries	0.0070	0.0834	16,284	3.05	0.0018	0.0421	16,359	0.42
Developed Countries	0.0068	0.0819	21,035	3.08	0.0019	0.0440	21,104	1.01

Notes: t-values are from tests of equal means compared with the first subgroup in each category. Developed countries include EU-15 (excl. Sweden), Norway, North America and Oceania. Developing countries include the rest of Europe, Africa, South America, Asia and Soviet Union. Developing countries include other Europe, Africa, South America, Asia and Soviet Union.

Table A.4: Summary Statistics by Whether Parents Have Children with Adverse Health Outcomes

	Weight < 1,500 Grams (VLBW)					Neonatal Mortality				
	No child		At least one			No child		At least one		
	Mean	N	Mean	N	t-test	Mean	N	Mean	N	t-test
Birth Order										
1	0.3796	499,087	0.3430	4,428	-5.09	0.3802	503,607	0.2542	2,884	-15.49
2	0.4350	499,087	0.3959	4,428	-5.29	0.4355	503,607	0.3211	2,884	-13.12
3	0.1312	499,087	0.1640	4,428	5.86	0.1304	503,607	0.2604	2,884	15.88
4	0.0358	499,087	0.0601	4,428	6.79	0.0355	503,607	0.1078	2,884	12.51
Mother's Age										
Below 25 Years	0.2019	499,087	0.1926	4,428	-1.55	0.2020	503,607	0.1637	2,884	-5.54
25-35 Years	0.7311	499,087	0.7003	4,428	-4.45	0.7308	503,607	0.7250	2,884	-0.69
Above 35 Years	0.0671	499,087	0.1070	4,428	8.58	0.0672	503,607	0.1113	2,884	7.51
Mother's Marital Status										
Single	0.5688	498,895	0.5287	4,426	-5.32	0.5693	503,414	0.4402	2,883	-13.92
Married	0.4096	498,895	0.4343	4,426	3.30	0.4090	503,414	0.5238	2,883	12.30
Divorced	0.0216	498,895	0.0371	4,426	5.41	0.0217	503,414	0.0361	2,883	4.12
Mother's Education										
Primary and Lower Secondary	0.0556	492,795	0.0810	4,370	6.13	0.0558	497,256	0.0615	2,847	1.25
Secondary Education and Vocational	0.5682	492,795	0.5856	4,370	2.33	0.5681	497,256	0.5848	2,847	1.80
Graduate and Postgraduate	0.3762	492,795	0.3334	4,370	-5.98	0.3760	497,256	0.3537	2,847	-2.48
Mother's Country of Birth										
Sweden	0.9667	499,085	0.9600	4,428	-2.25	0.9667	503,605	0.9515	2,884	-3.79
Developed Countries	0.0172	499,085	0.0181	4,428	0.42	0.0172	503,605	0.0257	2,884	2.86
Developing Countries	0.0161	499,085	0.0219	4,428	2.63	0.0161	503,605	0.0229	2,884	2.42
Father's Age										
Below 25 Years	0.0979	499,087	0.0962	4,428	-0.39	0.0980	503,607	0.0742	2,884	-4.86
25-35 Years	0.7276	499,087	0.6895	4,428	-5.46	0.7276	503,607	0.6893	2,884	-4.43
Above 35 Years	0.1744	499,087	0.2143	4,428	6.44	0.1743	503,607	0.2365	2,884	7.83
Father's Marital Status										

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Single	0.5614	498,316	0.5280	4,422	-4.42	0.5618	502,826	0.4532	2,882	-11.68
Married	0.4107	498,316	0.4376	4,422	3.58	0.4102	502,826	0.5239	2,882	12.19
Divorced	0.0279	498,316	0.0344	4,422	2.36	0.0280	502,826	0.0229	2,882	-1.82
Father's Education										
Primary and Lower Secondary	0.1022	495,709	0.1255	4,382	4.65	0.1023	500,170	0.1292	2,864	4.29
Secondary Education and Vocational	0.5722	495,709	0.5739	4,382	0.23	0.5720	500,170	0.5677	2,864	-0.46
Graduate and Postgraduate	0.3256	495,709	0.3005	4,382	-3.61	0.3258	500,170	0.3031	2,864	-2.63
Father's Country of Birth										
Sweden	0.9628	499,073	0.9426	4,428	-5.74	0.9626	503,595	0.9549	2,882	-2.00
Developed Countries	0.0214	499,073	0.0316	4,428	3.89	0.0214	503,595	0.0260	2,882	1.56
Developing Countries	0.0159	499,073	0.0257	4,428	4.13	0.0160	503,595	0.0191	2,882	1.22

Notes: Summary statistics for selected variables, separately for those parents in the regression sample that never had a child with VLBW or neonatal mortality ("No child") and those parents that experienced VLBW or neonatal mortality in at least one but not all of their children ("At least one but not all"). The latter parents allow for identifying the effect of economic conditions on health outcomes in the fixed-effects regression. t-values are from tests of equal means of parents in the "Never" group compared with parents in the "Sometimes" group. Developed countries include EU-15 (excl. Sweden), Norway, North America and Oceania. Developing countries include the rest of Europe, Africa, South America, Asia and Soviet Union. Developing countries include other Europe, Africa, South America, Asia and Soviet Union.

Table A.5: Robustness of Baseline Effect in Sample with All Movers

	Weight < 1,500 Grams (VLBW)	Neonatal Mortality
Unemployment Before Pregnancy	-0.290	-0.364***
	(0.194)	(0.133)
% Change	-7.05%	-17.90%
Mean × 1,000	4.118	2.031
N	495,909	499,162
Unemployment During Pregnancy	-0.449**	-0.287**
	(0.187)	(0.123)
% Change	-10.63%	-13.40%
Mean × 1,000	4.227	2.140
N	525,658	529,008
Unemployment After Pregnancy	-0.201	-0.218
	(0.193)	(0.139)
% Change	-4.75%	-10.19%
Mean × 1,000	4.227	2.140
N	525,658	529,008

Notes: Each reported coefficient comes from a separate regression. Sample includes all parents that have at least two children, independently of whether or not they move between births. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before and after pregnancy are the average unemployment rates during the 9-months-period before and the period 10–18 months after conception, respectively. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Both coefficients and percentage changes are for a 1-percentage-point increase in the unemployment rate. Coefficients and means are scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the parents level are given in parentheses. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.6: Unemployment at Different Times in One Regression

	Weight < 1,500 Grams (VLBW)	Neonatal Mortality
Unemployment Before Pregnancy	-0.048	-0.199
	(0.314)	(0.308)
Unemployment During Pregnancy	-0.494	-0.240
	(0.537)	(0.446)
Unemployment After Pregnancy	0.411	0.144
	(0.407)	(0.324)
N	474,738	477,873

Notes: Each column reports coefficients from a regression in which unemployment rates from different times are included simultaneously. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before and after pregnancy are the average unemployment rates during the 9-months-period before and the period 10–18 months after conception, respectively. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Percentage changes divide the unemployment effect by the mean level of the outcome in the observations used in the regression. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.7: Effect of Female Unemployment by Age Group

Weight < 1,500 Grams (VLBW)	18–24 Years	18–30 Years	18–40 Years	18–64 Years
Unemployment Before Pregnancy	-0.106	-0.164*	-0.147	-0.088
	(0.078)	(0.099)	(0.137)	(0.219)
N	474,738	474,738	474,738	474,738
Unemployment During Pregnancy	-0.120	-0.177*	-0.179	-0.181
	(0.085)	(0.103)	(0.132)	(0.180)
N	503,275	503,275	503,275	503,275
Neonatal Mortality	18–24 Years	18–30 Years	18–40 Years	18–64 Years
Unemployment Before Pregnancy	0.003	-0.025	-0.053	-0.105
	(0.048)	(0.055)	(0.070)	(0.108)
N	477,873	477,873	477,873	477,873
Unemployment During Pregnancy	-0.014	-0.015	-0.028	-0.091
	(0.045)	(0.058)	(0.071)	(0.096)
N	506,501	506,501	506,501	506,501

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among women in the indicated age group. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.8: Effect of Female Unemployment by Region

Weight < 1,500 Grams (VLBW)	County	Local Labor Market	Municipality
Unemployment Before Pregnancy	-0.012	-0.088	-0.071
	(0.232)	(0.219)	(0.152)
N	476,342	474,738	436,111
Unemployment During Pregnancy	-0.117	-0.181	-0.061
	(0.180)	(0.180)	(0.151)
N	504,976	503,275	462,489
Neonatal Mortality	County	Local Labor Market	Municipality
Unemployment Before Pregnancy	-0.181	-0.105	-0.035
	(0.117)	(0.108)	(0.099)
N	479,504	477,873	438,985
Unemployment During Pregnancy	-0.205**	-0.091	-0.082
	(0.089)	(0.096)	(0.100)
N	508,232	506,501	465,450

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among women in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the level of the indicated region are given in parentheses. There are 21 counties, 72 local labor markets and 283 municipalities in the sample. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.9: Effect on Labor Market Outcomes

	No Wage				No Reimbursements					
	Mother		Father		Mother		Father		Log Family Income	
Unemployment 18–64 Years	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)	Male (7)	Female (8)	Male (9)	Female (10)
Unemployment Before Pregnancy	2.689***	3.813***	-0.361	-1.396**	2.335***	3.884***	0.328	-0.890	-6.810*	-8.681***
	(0.882)	(1.021)	(0.778)	(0.661)	(0.796)	(0.967)	(0.779)	(0.755)	(3.800)	(3.165)
N	477,870	477,870	476,946	476,946	422,266	422,266	421,464	421,464	385,405	385,405
Unemployment During Pregnancy	2.310***	3.846***	1.089	-0.451	1.786**	3.534***	1.832**	-0.250	-4.752	-6.634***
	(0.816)	(0.939)	(0.732)	(0.580)	(0.763)	(0.892)	(0.772)	(0.682)	(3.584)	(2.244)
N	506,497	506,497	505,528	505,528	450,786	450,786	449,938	449,938	411,500	411,500
Unemployment 18–40 Years	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Unemployment Before Pregnancy	2.622***	3.326***	1.285*	0.197	2.172***	3.193***	1.476**	0.354	-0.551	-2.379**
	(0.937)	(0.866)	(0.687)	(0.485)	(0.735)	(0.743)	(0.602)	(0.461)	(1.062)	(0.978)
N	477,870	477,870	476,946	476,946	422,266	422,266	421,464	421,464	385,405	385,405
Unemployment During Pregnancy	2.173***	3.074***	1.988***	0.639	1.647**	2.659***	2.237***	0.501	1.021	-0.779
	(0.787)	(0.712)	(0.604)	(0.468)	(0.657)	(0.609)	(0.498)	(0.458)	(1.156)	(1.255)
N	506,497	506,497	505,528	505,528	450,786	450,786	449,938	449,938	411,500	411,500

Notes: Each reported coefficient comes from a separate regression. Unemployment refers to the unemployment rate among the indicated gender in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. Unemployment before pregnancy is the average unemployment rates during the 9-months-period before conception. "No Wage" and "No Reimbursements" are indicators for parental unemployment (mother or father). "No Wage" takes on the value 1 if a gross wage of zero is reported in the statement of income submitted to the tax agency. "No Reimbursements" takes on the value 1 if no work-related reimbursements are received. Coefficients are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.

Table A.10: Effect of Parental Unemployment ("No Reimbursements")

	Baseline	Mother		Father		Both Parents	
Weight < 1,500 Grams (VLBW)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment During Pregnancy	-0.429**	-0.525**	-0.518**	-0.517**	-0.509**	-0.516**	-0.516**
	(0.213)	(0.208)	(0.201)	(0.207)	(0.206)	(0.207)	(0.208)
No Reimbursements		-0.006	0.001	-0.009	0.011	-0.030**	-0.030
		(0.005)	(0.018)	(0.008)	(0.021)	(0.015)	(0.056)
No Reimbursements × Unemployment			-0.006		-0.015		-0.000
			(0.015)		(0.015)		(0.040)
N	503,275	472,543	472,543	471,980	471,980	471,980	471,980
	Baseline	Mother		Father		Both Parents	
Neonatal Mortality	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Unemployment During Pregnancy	-0.243**	-0.230**	-0.243**	-0.228*	-0.241**	-0.229**	-0.236**
	(0.106)	(0.116)	(0.116)	(0.117)	(0.118)	(0.116)	(0.116)
No Reimbursements		0.003	-0.010	-0.009*	-0.041	-0.010	-0.071
		(0.005)	(0.012)	(0.005)	(0.027)	(0.012)	(0.064)
No Reimbursements × Unemployment			0.010		0.024		0.046
			(0.009)		(0.021)		(0.049)
N	506,501	475,590	475,590	475,021	475,021	475,021	475,021

Notes: In each column, all coefficients come from the same regression. Unemployment refers to the unemployment rate among men in the age group 18–64 years. Unemployment during pregnancy is the average unemployment rate in the nine months following conception. "No Reimbursements" takes on the value 1 if no work-related reimbursements and no income from self-employment are received. Coefficients involving the unemployment rate are for a 1-percentage-point increase in the unemployment rate and scaled up to express them as per 1,000 infants. Controls are month fixed effects and parents fixed effects. Standard errors clustered at the local labor market level are given in parentheses. There are 72 local labor markets. *, ** and *** denote significance at the 10, 5 and 1 percent level, respectively.