
# HEDG

HEALTH, ECONOMETRICS AND DATA GROUP

WP 17/11


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May 2017

http://www.york.ac.uk/economics/postgrad/herc/hedg/wps/

# ECONOMIC DOWNTURNS AND BABIES' HEALTH

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MAY 2017

**ABSTRACT**

We study the impact of provincial unemployment levels on birthweight using a sample of over 50,000 respondents from Lifelines – a cohort study from the north-eastern Netherlands and we allow the effects to differ by babies' gender. We find that during periods of high unemployment fertility decreases and male babies are born with lower birthweight. The effect of unemployment on birthweight is particularly strong for boys born to older mothers and for babies born to smoking mothers. In addition, we study whether the effects are attributable to changes in cohort composition or in health behaviour of pregnant women. Our results indicate that even though the women who are pregnant during economic downturns are more likely to have higher socio-economic status, the total effect of economic downturns on babies' health is negative.

**KEYWORDS:** Birthweight, Unemployment, Cohort Studies

**JEL-CODES:** I10, J13, J11

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## 1. Introduction

Poor infant health is costly to the society. Poor health in general is welfare reducing as it causes human suffering and increases healthcare costs, but poor infant health has also long-term consequences. The empirical evidence for Barker's hypothesis (1995) shows that health insults early in life and even *in utero* persist through the lifetime and even a minor exposure early in life can increase the risk of chronic diseases later in life (Barker, 1995; van den Berg *et al*., 2006). Moreover, infant health matters for other measures of life success, such as accumulation of human capital, labour market outcomes, marital status and welfare dependency (Behrman and Rosenzweig, 2004; Almond *et al*., 2010; Brandt *et al*., 2010; Cruces *et al*., 2012; Nilsson, 2016). In addition, poor infant health is transmitted to the next generation (Currie and Moretti, 2007). In this sense babies born with poor health are set on a lifetime trajectory of inferior outcomes that spill over to the next generations.

Important determinants of infant health are the socio-economic status and income of the family (Currie, 2009). To understand the relationship between infant health and economic conditions, a number of studies have analyzed how babies' health is affected by the state of the business cycle at the time of birth since the state of the business cycle represents exogenous variation in the economic conditions families face (van den Berg *et al*., 2006).

In this paper we analyse the relationship between economic downturns and babies' health using individual level data from the Netherlands. The Netherlands is an interesting country for exploring the mechanisms behind this for several reasons. First, the Netherlands is a small and homogeneous country with high income. Second, female labour force participation in the Netherlands has been strikingly low throughout the 20th century (see Figure 1) due to Christian-conservative beliefs (Becker, 2000) and started to increase only in the late '80s while, for

example in the US, female labour participation has been steadily increasing since the ’50s. Third, a generous social security scheme was introduced in the Netherlands in 1949 which is right before our period of analysis (see Becker, 2000 for a discussion of the Dutch welfare state and employment). Considering these features, we investigate whether this institutional setting diminishes the effects of business cycle fluctuations on babies’ health and whether all population groups are affected equally.

[FIGURE 1 ABOUT HERE]

There are three broad groups of mechanisms through which an economic downturn might affect babies’ health. First, economic downturns might affect the decision to become pregnant differently for different population groups, thus affecting the cohort composition of the babies born in a given year. As a result, we would observe different (health) outcomes for babies born at different stages of the business cycle. For instance, the findings by Dehejia and Lleras-Muney (2004) and Aparicio and González (2014) can be partially explained by the role of women’s skill level and wages in the fertility decisions. Thus female labour participation likely affects the cohort composition of infants.

The second mechanism concerns the fact that, conditional on the decision to become pregnant, a decrease in income due to an economic downturn can lead to changes in health-related consumption by pregnant women, including changes in quality and quantity of nutrition, but also changes in unhealthy consumption such as smoking or alcohol. Exploring this mechanism, Ruhm (2000, 2003) shows that recessions are associated with a positive change in health behaviour. Dehejia and Lleras-Muney (2004) and Aparicio and González (2014)

demonstrate that fewer babies are born with low birthweight during economic downturns than during booms in the United States and Spain respectively. Angelini and Mierau (2014) document that recessions are associated with higher levels of childhood health in European countries, while van den Berg and Modin (2013) find no relationship between economic conditions and birthweight in Sweden.

Third, economic downturns can lead to changes in the environment that, in turn, affect the fetus. Focusing on the beneficial effects, Chay and Greenstone (2003) show that pollution decreases during recessions. Reassessing and extending the analyses of Ruhm (2000 and 2003) who shows that the health behaviour improves during recessions, Miller *et al.* (2009) highlight that a lion's share of the mortality gains experienced during recessions can be traced back to a decrease in traffic accidents. Focusing on the negative effects, Bhalotra (2010) highlights that in India recessions significantly reduce the availability and quality of health care. Moreover, Bruckner *et al.* (2014) using data from California and Pedersen *et al.* (2005) with Swedish data show that maternal stress increases during economic downturns. In an extensive review, Kuh and Hardy (2002) have shown that maternal stress during pregnancy can hinder fetal growth. Even though our analysis does not allow us to address the environmental effects directly, the sign of the estimated effect would point to the possible contributing environmental influences.

Interestingly, even though it is well established in the medical literature that male fetuses and infants are more harmed by harsh conditions than female fetuses (e.g. Bruckner *et al*., 2009), possibly due to differences in intra-uterine growth strategies (Eriksson *et al*., 2010), the literature on the business cycle and infant health has not accounted for such gender differences (Dehejia and Lleras-Muney, 2004; Angelini and Mierau, 2014; Aparicio and González, 2014) or has limited the analysis to a male-only sample (van den Berg and Modin, 2013).

For our analysis, we use individual level data from a large scale cohort study called Lifelines. Lifelines provides us with a sample of over 50,000 respondents born between 1950 and 1994 who are currently residing in one of the three north-eastern provinces of the Netherlands. Combining Lifelines data with provincial unemployment data from Statistics Netherlands allows us to analyse the relationship between unemployment at the provincial level and birthweight – a standard measure of babies' health (Barker, 1995; Dehejia and Lleras-Muney, 2004). Importantly, Lifelines also provides us with information on the age of the mother at birth as well as on her health behaviour – smoking in particular. We exploit this information to analyse who gives birth during economic downturns and how health behaviour of pregnant women is related to unemployment levels. Moreover, we assess how the effect of unemployment on birthweight differs between babies born to mothers of different age and smoking status. Finally, for the reasons discussed before, we allow all effects to differ between male and female babies.

The remainder of the paper is set up as follows. The next section provides a discussion of the relationship between economic downturns and babies' health within the context of the intertemporal fertility model and its implications for the Dutch setting. Section 3 describes the study population and the empirical methods. Section 4 discusses our empirical results and the final section concludes.

## 2. Economic downturns and babies' health

Within the context of the intertemporal fertility model (Becker, 1960, 1965), we consider two possible mechanisms how economic conditions affect babies' health distribution. First, economic downturns may affect the decision to become pregnant differently in different population groups, thus changing the cohort composition and the resulting distribution of babies' health. Second, an economic downturn can decrease the income of households and in turn affect

the consumption patterns of those women who have become pregnant. In what follows, we discuss each of these mechanisms and their predictions in the Dutch setting. Additionally, economic downturns can lead to changes in the environment that, in turn, affect the fetus; however, our approach does not let us study the environmental effects directly.

### 2.1. Effect on fertility decision

To study the fertility decision we use the framework provided by Becker (1960, 1965) who considers children as normal goods. We assume that changes in the unemployment rate affect the wages of women and their family members. Also, women are assumed to be primarily responsible for raising children in the household.

In the framework of Becker (1960), the effect of unemployment on fertility can be divided in income and substitution effects. The income effect means that a decline in the woman's wage lowers income, decreasing the demand for children along with other normal goods. The substitution effect arises because children are relatively time intensive, and thus, a decrease in wages lowers the relative cost of children and increases the demand for children. If the wages of other family members decrease, the total family income declines without affecting the value of the woman's time. This reduces the demand for children.

As discussed above, the female labour force participation in the Netherlands has been very low historically. Therefore, an increase in unemployment levels, on average, barely affects the woman's individual wages and accordingly the relative cost of children. Thus the substitution effect is expected to be comparatively small. The income effect is dampened by the social security provisions. Thus we expect that on average fertility decreases during periods of high unemployment, although the size of the effect might be small.

Furthermore, if an increase in the unemployment level leads to a transitory decrease in wages, in the standard life-cycle model setting, the total lifetime income and accordingly lifetime demand for children of the family should not be affected by unemployment rates. However unemployment can affect the timing of fertility. If capital markets are perfect, women's fertility decisions will not depend on the path of wages of the household. However, if capital markets are imperfect, couples will postpone fertility to periods when income is high, since households can use the timing of births to smooth consumption. Thus we hypothesize that credit-constrained, lower SES families would postpone fertility during periods of high unemployment, while less credit-constrained, higher SES families would be less inclined to do so.

### 2.1. Effect on consumption of health related goods

The effect of unemployment levels on consumption of health-related goods can also be separated into substitution and income effects. Health-related activities, such as exercising or prenatal care, are time-intensive, and therefore a decrease in a woman's wage would reduce the relative cost of time and might lead to an increase in participation in health related activities. However, decreases in family income would also lead to a lower consumption of all (normal) goods, including health-related goods such as high quality food and prenatal vitamins, but could also reduce the consumption of health-damaging goods such as cigarettes and alcohol. Ruhm (2000 and 2003) using US data, shows that recessions are associated with a positive change in health behaviour. Nevertheless, analyses of Van den Berg *et al.* (2006, 2009 and 2010) and Van den Berg and Modin (2013), using data from various older cohorts show that being born during recessions leads to a host of negative outcomes later in life through deprivation *in utero*.

Given the low female labour participation, we expect that the substitution effect would be small in the Dutch setting. The income effect is also likely to be small, due to the generous unemployment benefits. The sign of the effect depends on whether it is the healthy or the unhealthy consumption that decreases more when unemployment increases.

## 3. Data & Methods

To test our predictions empirically, we analyse the relationship between regional unemployment level and birth outcomes in the Netherlands. In particular, we combine the individual data from the Lifelines cohort study with the regional unemployment data from Statistics Netherlands.

### 3.1. Lifelines

Lifelines is a large population-based cohort study and biobank carried out in the three north-eastern provinces of the Netherlands. The study was established as a resource for research on complex interactions between environmental, phenotypic and genomic factors in the development of chronic diseases and healthy ageing (see Stolk *et al.* (2008) and Scholtens *et al.*, (2015), for a detailed description of the study). For our purpose, Lifelines provides us with a sample of 80,821 respondents born in the Netherlands between 1950 and 1994. Lifelines also contains respondents born before 1950 and after 1994; however, for the former we do not have unemployment data and the latter were administered a different survey due to their age.

The Lifelines questionnaire contains health and life histories, including information surrounding the respondents' birth, such as their birthweight, which is reported by 57,626 respondents. Given the important role attributed to birthweight for a host of outcomes later in life

(Behrman and Rosenzweig,2004) birthweight is a commonly used indicator of babies' health (Dehejia and Lleras-Muney, 2004). Since birthweight is self-reported by the respondent, we take measures to increase the reliability of these data. First, we use the fact that the Lifelines has asked the respondents to report their birthweight in two occasions. Therefore we can compare the answers for consistency and we use the second wave answer if they are different. Second, we exclude all observations that are medically infeasible (that is, extremely high (> 6000g) or extremely low (< 500g)). There is no reason to believe that the remaining measurement error would be correlated either to birthweight or unemployment levels and it should not bias our estimation results (see Wooldrige, 2010, chapter 4.4.).

To assess the potential changes in cohort composition and health behaviour during economic downturns, we need background information about respondents' parents. Even though Lifelines contains rich information about the respondents themselves, the information about their parents is very limited. Nevertheless, Lifelines provide us with two useful pieces of information on the respondent's mother that we use as proxies for socioeconomic status. First, we are able to calculate the mothers' age at the time of childbirth from her date of birth. The mother's age, apart from having a biological effect on child health, might also serve as a proxy for SES of the parents, since early motherhood is associated with lower SES (Hobcraft and Kierman, 2001). Second, Lifelines contains a question whether the respondent's mother had smoked during the pregnancy and whether she stopped before or during pregnancy, decreased smoking or continued smoking as before. Smoking in general and especially smoking during pregnancy is highly correlated with SES (see, for example, reviews in Cutler and Glaeser, 2005; or Cutler and Lleras-Muney, 2006), thus, using this information, we are able to assess whether the mothers change their behaviour during economic downturns (decrease or stop smoking) or the (socioeconomic)

cohort composition changes (the smokers are less or more likely to get pregnant). This approach leaves us with a sample size of 54,853.

By linking the data with birth certificates from the Municipal Personal Records Database (in Dutch: *Gemeentelijke Basis Administratie*), we can obtain information on the province of birth of each respondent. Although the study is based in the north-eastern Netherlands and the three north-eastern provinces (Groningen, Drenthe and Friesland) are overrepresented, our data includes respondents born in all twelve Dutch provinces. All data and their descriptive statistics are summarized in Tables 1a and 1b.

[TABLE 1a ABOUT HERE]

[TABLE 1b ABOUT HERE]

**3.2. Unemployment**

We draw provincial unemployment data from Statistics Netherlands. These are available from 1950 onward, which creates the lower bound for the birth year of our respondents. Over the period between 1950 and 1994, the Netherlands went through all phases of the business cycle multiple times, which is also reflected in the unemployment data (Figure 2). In the post-World War II years (and after the so-called Hunger Winter), the Netherlands enjoyed a period of substantial economic prosperity with low associated unemployment rates. Toward the end of the `70s and for much of the early `80s, the Netherlands were hit by a strong recession due to the second oil crisis. This recession was particularly severe in the north-eastern Netherlands where unemployment peaked at well over 10% at the depth of the recession. In the early `90s alongside the world-wide economic boom, unemployment rates dropped substantially all over the Netherlands.

[FIGURE 2 ABOUT HERE]

### 3.3. Methods

Most of the literature, such as Dehejia and Lleras-Muney (2004) and Aparicio and González (2014) use data aggregated at state and year of birth level in their analysis. We, however, exploit individual level data. Therefore, to analyse the relationship between birthweight and regional unemployment level, we use the following model:

$$Y_{ipt} = \alpha + \beta_1 u_{pt} + \gamma m_i + \theta_t + \rho_p + u_{ipt}, \qquad (1)$$

where $Y_{ipt}$ denotes birthweight of baby $i$ born in province $p$ in year $t$, $u_{pt}$ is the unemployment rate in province $p$ and year $t$, $m_i$ is a dummy variable taking value 1 if male and 0 if female, $\rho_p$ is a province fixed effect, and $\theta_t$ is a time fixed effect.

While above we have referred generically to birthweight as our outcome variable, for the purpose of our analysis we focus on two realizations of birthweight. That is, following Dehejia and Lleras-Muney (2004), we focus on birthweight in grams and on the incidence of low birthweight (<2500g). For birthweight in grams, we estimate the model (1) by OLS. In the case of low birthweight the outcome variable $Y_{ipt}$ becomes a dummy variable such that the estimated model is a linear probability model. As a robustness check, we also estimate our models by probit regressions. The average marginal effects of the probit model are virtually identical to the OLS coefficients. However, we present only the results of the linear probability model because for it we can address the issue of the small number of clusters as discussed below. The probit results are available on request.

Our main explanatory variable – the unemployment level – is measured at the province level; therefore, the error terms are likely to be correlated within province and cluster-robust standard errors are required for statistical inference. The province fixed effects included in the model control for a part of the within-province correlation but perhaps not all of it. In addition,

since there are only 12 provinces in the Netherlands (the three provinces with smallest number of observations, Limburg, North Brabant and Zeeland, were grouped together so effectively we have 10 provinces), the use of the Dutch provincial unemployment level data leads to the issue of "few clusters" which means that the estimated variance matrix of the OLS estimator is likely to be downwards biased (Cameron and Miller, 2015). Therefore, we employ a bias-correction by Bell and McCaffrey (2002), which was named CR2VE in Cameron and Miller (2015, sections VI.B. and VI.D.), to the standard cluster robust variance estimates. CR2VE correction proposes scaling the province specific vector of residuals $\hat{u}_p$ so that $\tilde{u}_p = \left(I_{Np} - H_{pp}\right)^{-0.5} \hat{u}_p$ , where $H_{pp} = X_p(X'X)^{-1}X'_p$ and $N_p$ the size of the sample in province $p$. In addition, we face the problem that the number of observations varies considerably across provinces which basically implies that the effective number of clusters is reduced further (see Imbens and Kolesar, 2015). We therefore base the Wald tests on a $t(\nu^*)$-distribution where the degrees of freedom $\nu^*$are determined by the data as proposed by Imbens and Kolesar (2015).

Further, we exploit the individual data provided to us through Lifelines and extend the model in (1) by including individual specific regressors. First, taking into account the possible differences between men and women, we allow the effect of unemployment depend on the gender. Therefore, we include interaction terms between dummies indicating each gender and the provincial unemployment level. Effectively, we split the effect of unemployment on birthweight by gender, while keeping other covariates and fixed effects non gender-specific. Also, we enrich the model by including the age of the mother when the child was born and a dummy variable indicating whether the mother smoked during pregnancy as additional explanatory variables. Doing so enables us to control for potential changes in the composition of the birth cohort due to high unemployment. Moreover, we allow the effect of the unemployment rate on health

outcomes to depend on the individual characteristics so that we can assess to what extent the effect is stratified over different subgroups of the population.

Finally, we follow a similar empirical approach to analyse changes in cohort composition directly. In that case the outcome variable is the probability of a mother being in a given age or smoking status group while the main explanatory variable is not interacted with gender, since we assume that babies' gender is assigned randomly and should not affect the cohort composition of mothers. Even though studies have shown that even the secondary sex-ratios can be affected by maternal conditions (e.g. Almond et al., 2010; Nilsson, 2016), it seems plausible that in the 20th century Dutch setting the business cycle fluctuations are comparatively mild shocks that are not likely to cause actual fetal deaths.

## 4. Empirical Results

### 4.1. Provincial unemployment and fertility decision

Our theoretical predictions suggest that on average, in the Dutch setting, fertility should decrease during economic downturns. Since Lifelines does not cover the whole population, we cannot analyse birth rates with our data. Nevertheless, in Table 2, we use population data from Statistics Netherlands that are available for the period between 1959 and 1994, to show the effect of provincial unemployment levels on birth rates. The table contains OLS coefficients for a regression of provincial birth rate on provincial unemployment levels. Column 1 provides the results without any covariates, column 2 includes a linear time trend to account for decreasing fertility over time and column 3 includes both time trend and province fixed effects. The results in column 1, 2 and 3 show that when provincial unemployment levels increase by 1 percentage

point (p.p.) the provincial birth rate in the Netherlands decreases by respectively 0.72, 0.35 and 0.39 births per 1000 population. This effect is highly significant and has the predicted sign.

[TABLE 2 ABOUT HERE]

Next, we focus on whether the decreasing fertility changes the cohort composition of mothers. For this purpose we use the information available in the Lifelines about respondent's mother, that is – mother's age and smoking behaviour during pregnancy. Table 3 shows the linear probability model results. We regress dummy variables indicating the mother's age or smoking status on provincial unemployment level and province and year fixed effects. The first three rows of Table 6 show the effect of provincial unemployment level on the probability of the mother being in a given age group. The effect is insignificant in all three age groups indicating that mother's age composition does not vary with the business cycle.

The fourth row of Table 3 shows the effect of provincial unemployment on the probability that the mother smoked during pregnancy. The effect is negative and significant at 5% level. If the unemployment level increases by 1 p.p., the probability that the mother smoked during pregnancy decreases by 0.7 p.p.

[TABLE 3 ABOUT HERE]

In rows 5-8 we unpack this effect by looking in more detail at the probabilities that the mother had never smoked before pregnancy, that she stopped before becoming pregnant, that she decreased smoking or stopped during pregnancy and that she continued smoking as before. The results show that the decrease in smoking is driven by a significant increase in the group that had never smoked before pregnancy and a corresponding decrease in the group that continued smoking as before. This result suggests that instead of mothers changing behaviour in response

to a decrease in income, it is the type of mothers who choose to get pregnant during periods of high unemployment that differs from those who have children when unemployment is low.

Smoking in general and especially smoking during pregnancy has been found to correlate with low SES (see, for example, reviews in Cutler and Glaeser, 2005; or Cutler and Lleras-Muney, 2006). Since we cannot control for SES directly, it is likely that our smoking variable also partially captures differences in SES. In that case, these results are in line with our theoretical prediction that low SES mothers would reduce their fertility more than high SES mothers during economic downturns leading to an "improved" cohort composition. Moreover, this result is also in agreement with the previous literature that attribute a part of the positive effect of economic downturns on babies' health to changes in the type of mothers that give birth during recessions. In the following section we explore whether these improvements in the cohort composition lead to better health outcomes of the babies born during economic downturns.

### 4.1. Provincial unemployment and babies' health

In this section, we investigate how provincial unemployment affects the birthweight of babies. Our main estimation results are displayed in Table 4. The first column provides the OLS estimate of the empirical model in equation (1). The first column reveals that provincial unemployment level has a statistically significant negative effect on birthweight in male babies. The result is significant at a 10% level. The effect in female babies has a negative coefficient, as expected, but is not statistically significant.

[TABLE 4 ABOUT HERE]

In the second column we consider whether an increase in unemployment leads to an increase in the probability of being born with low birthweight (below 2500 grams). While the

sign of the coefficients is in the expected direction - positive, we find that higher unemployment levels are not associated with significantly increased probability of having clinically defined low birthweight in neither male or female babies. This indicates, that on average, the effect of unemployment level on birthweight is too small to cause medical issues for babies born in economic downturns. In Table 4a we compare the size of this effect to the effect sizes found in the literature, in particular Dehejia and Lleras-Muney (2004) and Aparicio and Gonzales (2014) who perform comparable analysis. The size of the effect is on a comparable scale, even though in our case the coefficients have the opposite signs.

[TABLE 4a ABOUT HERE]

Returning to Table 4, in columns 3 and 4 we enrich the model by controlling for mother's age at the time of birth. The results show that the age at which a mother gives birth has a significant effect on birthweight and on the probability of low birthweight. Interestingly, while older mothers on average have babies with higher birthweight, the probability of having a baby with low birthweight increases for older mothers. Naturally, the impact of maternal age on birthweight may reflect both biological and socio-economic factors – an issue that we do not pursue in this paper. Even though controlling for the age of the mother does not change the sign and the size of the effect of unemployment on birthweight or the incidence of low birthweight, the coefficients become insignificant. In the following sections we will investigate whether the loss of significance happened because of a lack of statistical power or because maternal age is correlated to the unemployment levels.

Another potential mechanism driving the relationship between unemployment and babies' health is changes in health-related behaviour. In this regard, Currie *et al.* (2009) show that smoking during pregnancy increases the probability of low birthweight. In the previous section we discovered that the proportion of mothers who smoke decreases during periods of high unemployment. In columns 5 and 6 we explore how controlling for maternal smoking during pregnancy influences the effect of unemployment on birthweight. As expected, we find that smoking during pregnancy has a large and statistically significant negative effect on babies' health – lowering birthweight and elevating the probability of low birthweight. Also, controlling for smoking status increases the coefficient and significance of the effect of provincial unemployment on birthweight of male babies.

To sum up, in our sample economic downturns on average have a negative effect on male babies' health and no effect on female babies' health, which differs from the recent literature that found a positive effect in selected developed countries. Moreover, the size of the negative effect in male babies is too small to cause clinically low birthweight with all the medical consequences of it.

The next section discusses the heterogeneity in our results. In particular, we allow the effects of unemployment to depend on maternal age and mothers' smoking behaviour during pregnancy to identify any vulnerable groups.

**4.2. Maternal age and smoking behaviour**

In Table 5 we observe the heterogeneity revealed by the interaction between the age of the mother and the unemployment level at birth. Columns 1 and 2 show the results in the whole sample. First, we observe that, compared to Table 4, the effect of mothers' age on birthweight has increased. Second, for babies born to mothers under the age 25 (the reference category)

unemployment has no effect on birthweight, while for babies born to older mothers, unemployment has a significant negative effect on birthweight and this effect increases with mother's age. Moreover, for boys born to a mother aged 25-35, unemployment significantly increases the probability of having clinically low birthweight.

In columns 3 to 6 we split the sample by gender. The results show that the effect of unemployment on birthweight is the most pronounced in boys born to older mothers, while in girls the effect is statistically insignificant.

[TABLE 5 ABOUT HERE]

In Table 6, we explore the heterogeneity in the effect of unemployment on birthweight revealed by including an interaction term between unemployment and maternal smoking in the regression. Columns 1 and 2 show the results for the whole sample. Even though mother's smoking and provincial unemployment both have a significant negative effect on birthweight, for babies born to smoking mothers, unemployment has additional negative effect on health. In columns 3 to 6 we again split the sample by gender. The results show that the effect of unemployment on birthweight does not statistically differ between boys and girls born to smoking mothers. However, controlling for smoking and the interaction terms reveals that high unemployment levels increase the probability of clinically low birthweight in boys born to non-smoking mothers and even more in boys born to smoking mothers.

[TABLE 6 ABOUT HERE]

## 5. Conclusions

In this paper, we revisit the relationship between the business cycle and babies' health using Lifelines – a large cohort study from the north-eastern Netherlands. Contrasting the findings of, amongst others, Chay and Greenstone (2003), Dehejia and Lleras-Muney (2004) and Angelini and Mierau (2014) we find that in periods of high unemployment, health of male babies and fertility of mothers decrease. Even though the result differs from the previous literature in developed countries, it is in line with the predictions of intertemporal fertility models for the situation in the Netherlands. Reductions in income likely lead to a decrease in healthy consumption, while our smoking results show no behavioural change in unhealthy consumption.

On average, the size of the effect we find is small and it causes birthweight fluctuations within the normal range. Accordingly, an increase in the unemployment level on average does not lead to an increase in the probability of clinically low birthweight, which would cause a number of medical issues. In that sense, it seems that the generous Dutch unemployment benefits protect the health of the babies. Nevertheless, the sub-sample analysis reveals that in some population groups the negative effects are large enough to cause medical problems. Particularly, boys born to older women and to smoking women are at risk for low birthweight when unemployment levels are high at the time of birth. If the policy objective is to improve birth outcomes, these results clearly point to the groups that deserve particular attention during economic hardship.

Considering selection into pregnancy, we find evidence that fertility decreases when unemployment is high. This is in line with the prediction that, given the low female labour participation, increases in unemployment levels do not affect women's wages and time value and therefore only the decrease in income plays a role in the fertility decision. We also find

suggestive evidence that the less healthy, and likely more credit-constrained population groups decrease the fertility more when unemployment is high.

More generally, our results suggest that the effects of the business cycle on child health and fertility are country specific and the positive effects found in the United States and other countries are not universal. Although our findings are specific to the Dutch setting they are still consistent with the intertemporal fertility model.

In sum, we establish that even though the mothers who give birth during recessions are healthier and possibly have higher SES, the negative income and environmental effects on babies' health outweigh the positive selection effects and the overall impact of economic downturns on babies' health is negative in the Netherlands. Given the fact that low birthweight is a known risk factor for a variety of late-life outcomes, our results imply that during periods of high unemployment policy makers should pay particular attention to prenatal and neonatal care and policies providing more economic security for new families, especially in the most vulnerable population groups might benefit babies' health.

**Acknowledgments:** The authors wish to acknowledge the services of the Lifelines Cohort Study, the contributing research centres delivering data to Lifelines, and all the study participants. Lifelines is a multi-disciplinary prospective population-based cohort study examining in a unique three-generation design the health and health-related behaviours of 167,729 persons living in the North East region of The Netherlands. It employs a broad range of investigative procedures in assessing the biomedical, socio-demographic, behavioural, physical and psychological factors which contribute to the health and disease of the general population, with a special focus on multimorbidity. In addition, the Lifelines project comprises a number of cross-sectional sub-studies which investigate specific age-related conditions. These include investigations into metabolic and hormonal diseases, including obesity, cardiovascular and renal diseases, pulmonary diseases and allergy, cognitive function and depression, and musculoskeletal conditions.

The Lifelines Cohort Study, and generation and management of GWAS genotype data for the Lifelines Cohort Study is supported by the Netherlands Organization of Scientific Research NWO (grant 175.010.2007.006), the Economic Structure Enhancing Fund (FES) of the Dutch government, the Ministry of Economic Affairs, the Ministry of Education, Culture and Science, the Ministry for Health, Welfare and Sports, the Northern Netherlands Collaboration of Provinces (SNN), the Province of Groningen, University Medical Center Groningen, the University of Groningen, Dutch Kidney Foundation and Dutch Diabetes Research Foundation.

This study was supported by the Netherlands Organisation for Scientific Research (NWO) and benefitted from comments received at the Essen Summer School in Health Economics 2015 and Healthwise Congress 2015. Special thanks to Tom Wansbeek for advice on econometrics.

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## Tables

### Table 1a: Descriptive statistics

| Variable | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Birthweight (grams) | 54853 | 3412.982 | 732.7671 | 500 | 6000 |
| Low birthweight | 54853 | 0.063078 | 0.243105 | 0 | 1 |
| Provincial unemployment (%) | 54,853 | 4.762 | 3.117 | 0.5 | 13.8 |
| Year of birth | 54853 | 1969.559 | 9.884822 | 1950 | 1994 |
| Male | 54853 | 0.357082 | 0.479144 | 0 | 1 |
| Mother's age | 54306 | 27.76163 | 5.151489 | 10 | 56 |
| Mother smoked during pregnancy | 54334 | 0.185556 | 0.388752 | 0 | 1 |
| Mother never smoked before pregnancy | 54334 | 0.543822 | 0.498081 | 0 | 1 |
| Stopped before pregnancy | 54334 | 0.165955 | 0.372044 | 0 | 1 |
| Decreased/stopped during pregnancy | 54334 | 0.11917 | 0.323992 | 0 | 1 |
| Smoked as before | 54334 | 0.066386 | 0.248957 | 0 | 1 |
| Age of the mother at birth <25 | 54306 | 0.371082 | 0.483099 | 0 | 1 |
| Age of the mother at birth 25-35 | 54306 | 0.54296 | 0.498156 | 0 | 1 |
| Age of the mother at birth >35 | 54306 | 0.085957 | 0.280304 | 0 | 1 |

### Table 1b: Number of observations per province

| Province | Observations |
|---|---|
| **Friesland** | **20,726** |
| **Groningen** | **15,662** |
| **Drenthe** | **9,581** |
| Zuid-Holland | 2,112 |
| Overijssel | 1,876 |
| Noord-Holland | 1,874 |
| Gelderland | 1,230 |
| Utrecht | 709 |
| Noord-Brabant | 607 |
| Zeeland, Flevoland and Limburg | 476 |
| Total | 54,853 |

Note: The three Northern provinces are marked in bold.

**Table 2. Provincial unemployment and birth rate**

| | (1) | (2) | (3) |
|---|---|---|---|
| Provincial unemployment | -0.718*** | -0.348*** | -0.390*** |
| | *0.064* | *0.050* | *0.038* |
| Observations | 622 | 622 | 622 |
| R-squared | 0.354 | 0.696 | 0.790 |
| Linear time trend | No | Yes | Yes |
| Province FE | No | No | Yes |

Note: OLS coefficients. Standard errors clustered at the province level are reported in italics under the coefficients. P-values are calculated from t-tests based on a t distribution with 9 degrees of freedom (*** p<0.01, ** p<0.05, * p<0.1). The dependent variable is the number of live births in a given province per 1,000 average population. Data source: Statistics Netherlands (www.cbs.nl)

**Table 3: Cohort composition by mothers' characteristics**

| | **Dependent variables**<br><br>**Mothers' characteristics** | **Effect of provincial unemployment level** | **Standard error** | **Observations** | **IK degrees of freedom, unemployment** |
|---|---|---|---|---|---|
| (1) | Age <25 | -0.00171 | *0.00295* | 54,306 | 6.5 |
| (2) | Age 25-35 | 0.000169 | *0.00235* | 54,306 | 6.5 |
| (3) | Age >35 | 0.00154 | *0.00206* | 54,306 | 6.5 |
| (4) | Smoked during pregnancy | -0.00747** | *0.00276* | 54,334 | 6.5 |
| | Detailed smoking | | | | |
| (5) | Never smoked | 0.0170*** | *0.00281* | 54,334 | 6.5 |
| (6) | Stopped before pregnancy | -0.00198 | *0.00124* | 54,334 | 6.5 |
| (7) | Decreased/stopped during | -0.00435 | *0.00293* | 54,334 | 6.5 |
| (8) | Smoked as before | -0.00311* | *0.00143* | 54,334 | 6.5 |

Note: Linear probability model regression results. CR2VE standard errors are clustered at the province level. The Imbens Kolesar degrees of freedom used in the t-tests for the key variables are reported in the last column (*** p<0.01, **p<0.05, * p<0.1). The specification includes birth year and province fixed effects.

**Table 4: Birthweight and provincial unemployment level, effect by gender**

| VARIABLES | (1) Birthweight | (2) Low birthweight | (3) Birthweight | (4) Low birthweight | (5) Birthweight | (6) Low birthweight |
|---|---|---|---|---|---|---|
| Male* unemployment | -5.918* | 0.0017 | -5.682 | 0.0016 | -7.579** | 0.0021 |
| | *2.856* | *0.0014* | *3.045* | *0.0014* | *2.869* | *0.0014* |
| Female*unemployment | -3.641 | 0.0020 | -3.585 | 0.0020 | -5.158 | 0.0024 |
| | *2.726* | *0.0014* | *2.740* | *0.0014* | *2.719* | *0.0014* |
| Male | 203.3*** | -0.0110* | 202.1*** | -0.0102* | 201.2*** | -0.0109* |
| | *13.25* | *0.0049* | *13.51* | *0.0047* | *12.68* | *0.0045* |
| Age of mother 25-35 | | | 68.82*** | -0.0085*** | | |
| | | | *7.180* | *0.0018* | | |
| Age of mother 35+ | | | 97.47*** | 0.0067** | | |
| | | | *10.83* | *0.0019* | | |
| Mother smoked | | | | | -108.2*** | 0.020*** |
| | | | | | *8.524* | *0.0029* |
| Observations | 54,853 | 54,853 | 54,306 | 54,306 | 54,334 | 54,334 |
| *Imbens-Kolesar (IK) data-determined degrees of freedom*: | | | | | | |
| male*unemployment | 6.7 | 6.7 | 6.7 | 6.7 | 6.8 | 6.8 |
| female*unemployment | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |

Note: OLS regression results. CR2VE standard errors clustered at the province level are reported in italics under the coefficients. The Imbens Kolesar degrees of freedom used in the t-tests for the key variables are reported at the bottom of the table (*** p<0.01, **p<0.05, * p<0.1). The reference group for age of mother is mothers younger than 25. The specification includes birth year and province fixed effects.

**Table 4a: Effects of unemployment. Comparison with the literature.**

| | | This paper | Dehejia and Lleras-Muney | Aparicio and Gonzales |
|---|---|---|---|---|
| Birthweight | male | -5.918* | - | 9.724*** |
| | female | -3.641 | | |
| Low bw | male | 0.0017 | -0.00003*** | -0.0015** |
| | female | 0.0020 | | |

Note: This table compares the marginal effect of unemployment on babies' health found in this paper to the effects found in by Dehejia and Lleras-Muney (2004) and Aparicio and Gonzales (2014).

**Table 5: Birthweight and provincial unemployment level, nonlinearities by mother's age**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | All | | Males | | Females | |
| VARIABLES | Birthweight | Low birth weight | Birthweight | Low birth weight | Birthweight | Low birth weight |
| Unemployment | -0.0372 | 0.0009 | 0.256 | 0.0033* | -0.764 | -0.0004 |
| | *2.869* | *0.0015* | *13.01* | *0.0015* | *7.070* | *0.0019* |
| Age of mother 25-35 * unemployment | -5.309** | 0.0015** | -9.174* | 0.0017* | -3.196 | 0.0014* |
| | *1.372* | *0.0005* | *4.348* | *0.0008* | *2.598* | *0.0006* |
| Age of mother 35+ * unemployment | -9.233** | 0.0012 | -24.74** | 0.0025 | -1.347 | 0.0006 |
| | *2.268* | *0.0007* | *7.215* | *0.0017* | *3.535* | *0.0014* |
| Male | 192.3*** | -0.0122 | | | | |
| | *8.639* | *0.0019* | | | | |
| Age of mother 25-35 | 93.20*** | -0.0155*** | 115.9*** | -0.0125** | 80.49*** | -0.0172*** |
| | *12.31* | *0.0033* | *21.09* | *0.0041* | *12.45* | *0.0041* |
| Age of mother 35+ | 137.5*** | 0.0016 | 273.3*** | -0.0143 | 68.33*** | 0.009 |
| | *17.75* | *0.0035* | *40.65* | *0.0164* | *13.56* | *0.0097* |
| Observations | 54,306 | 54,306 | 19,354 | 19,354 | 34,952 | 34,952 |
| *IK degrees of freedom*: | | | | | | |
| unemployment | 6.7 | 6.7 | 6.8 | 6.8 | 6.7 | 6.7 |
| Age of mother 25-35* unemployment | 4.7 | 4.7 | 4.7 | 4.7 | 4.8 | 4.8 |
| Age of mother 35+* unemployment | 4.9 | 4.9 | 4.8 | 4.8 | 4.9 | 4.9 |

Note: OLS regression results. CR2VE standard errors clustered at the province level are reported in italics under the coefficients. The Imbens Kolesar degrees of freedom used in the t-tests for the key variables are reported at the bottom of the table (*** p<0.01, **p<0.05, * p<0.1). The reference group for age of mother is mothers younger than 25. The specification includes birth year and province fixed effects.

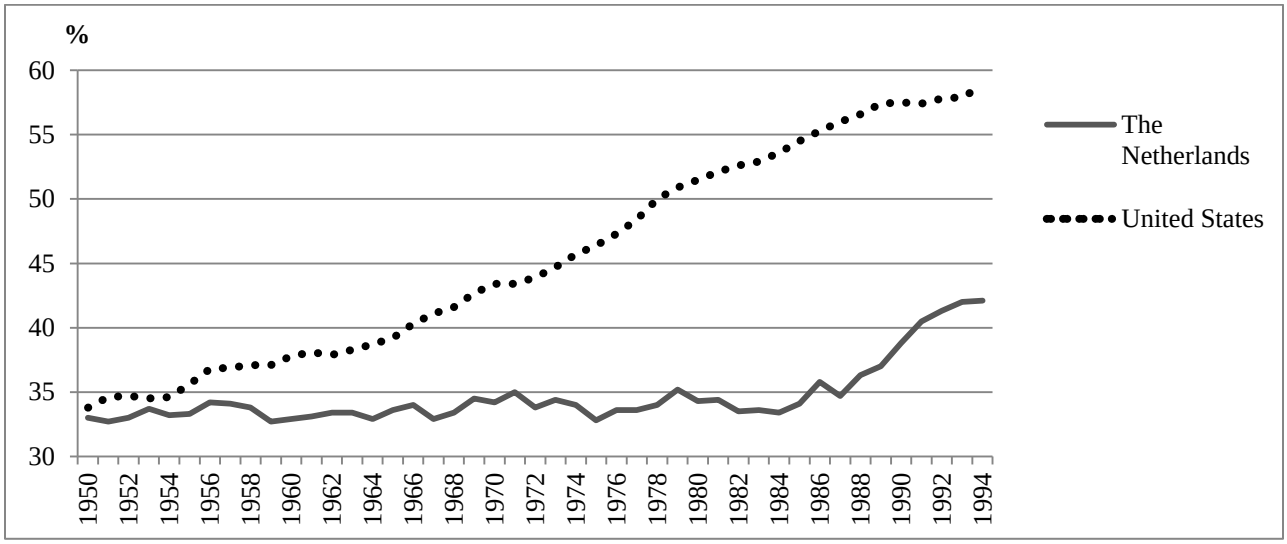
**Table 6: Birthweight and provincial unemployment level, nonlinearities by mother's smoking behaviour**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | All | | Males | | Females | |
| VARIABLES | Birthweight | Low birth weight | Birthweight | Low birth weight | Birthweight | Low birth weight |
| Unemployment | -5.321 | 0.0022 | -10.46 | 0.0052*** | -3.040 | 0.0007 |
| | *2.920* | *0.00137* | *7.634* | *0.0014* | *5.900* | *0.0016* |
| Mother smoked* unemp | -6.819** | 0.001 | -7.536** | 0.0013* | -6.497* | 0.0007 |
| | *1.664* | *0.0006* | *2.010* | *0.0005* | *2.553* | *0.0008* |
| Male | 189.7*** | -0.0119*** | | | | |
| | *8.666* | *0.002* | | | | |
| Mother smoked | -74.50*** | 0.0153*** | -65.87* | 0.0057 | -80.09*** | 0.0206*** |
| | *11.32* | *0.0029* | *30.64* | *0.0079* | *13.86* | *0.0032* |
| Observations | 54,306 | 54,306 | 19,354 | 19,354 | 34,952 | 34,952 |
| *IK degrees of freedom*: Unemployment | 6.5 | 6.5 | 6.6 | 6.6 | 6.5 | 6.5 |
| Mother smoked* unemp | 4.6 | 4.6 | 4.5 | 4.5 | 4.6 | 4.6 |

Note: OLS regression results. CR2VE standard errors clustered at the province level are reported in italics under the coefficients. The Imbens Kolesar degrees of freedom used in the t-tests for the key variables are reported at the bottom of the table (*** p<0.01, **p<0.05, * p<0.1). The specification includes birth year and province fixed effects.

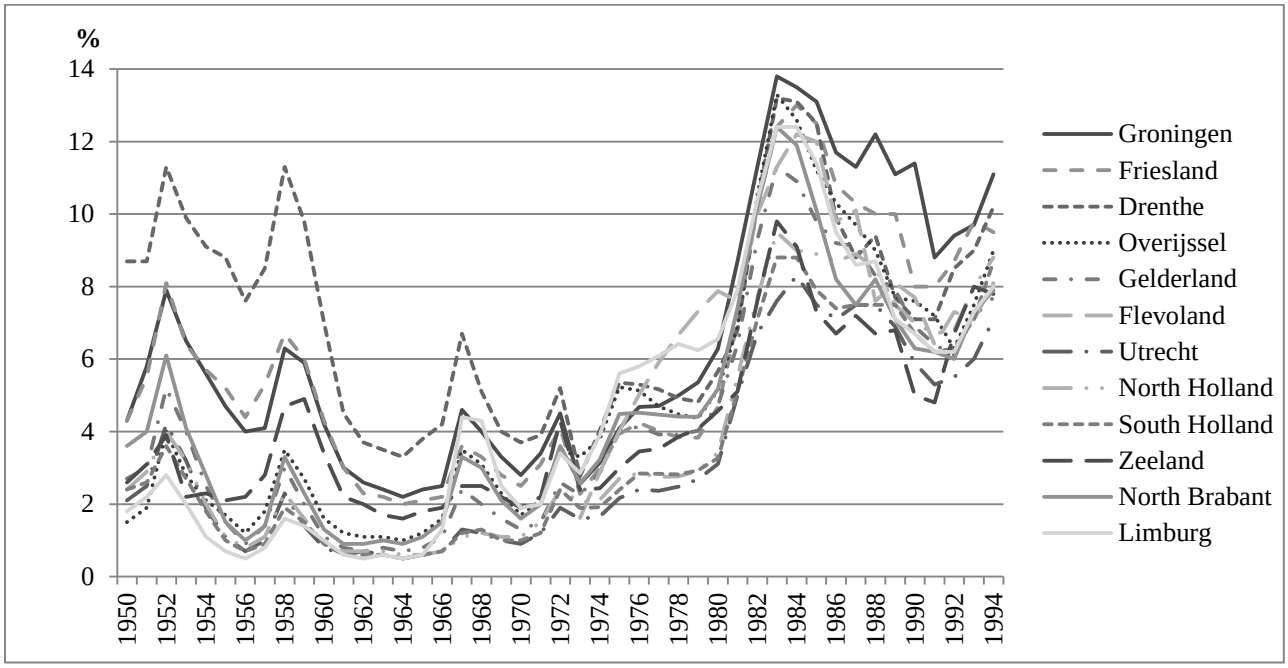
## Figures

### Figure 1. Female labour participation rate, US and The Netherlands (1950-1994)




Data source: Compiled from Statistics Netherlands (www.cbs.nl) and US Bureau of Labor Statistics (www.bls.gov)

### Figure 2. Provincial unemployment rates in the Netherlands (1950-1994)




Data source: Statistics Netherlands (www.cbs.nl)