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# **Can Economic Openness Improve Health?**

**An empirical study on the relationship between economic liberalization and infant and neonatal mortality**

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First year master thesis

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## Abstract

Since the Washington consensus in the 1980s, economic liberalization has been seen as a panacea for increasing the economic development and the welfare of a developing country. By reducing trade tariffs and barriers, moving from a socialistic economic system and removing state monopoly on major exports, it is believed that a developing country will increase its income and economic growth while benefiting from various positive globalization factors such as new technologies and knowledge. This will, in turn, benefit the general population by improving living standards and thus also individual health.

Most empirical literature on the effect of economic liberalization on health studies the relationship on a macro level. This study contributes to the existing literature by using micro-level data. By combining data on more than 160,000 women from 30 sub-Saharan African countries and their 500,000 births, using Demographic Health Surveys (DHS), with Wacziarg and Horn-Welch's data on country-specific timing of economic liberalization, this study investigates if economic liberalization effects child and neonatal mortality. Both an OLS model controlling for country effect and a mother fixed effect model is used for estimation.

Although results from previous empirical studies on macro level show that economic openness has a positive effect on health, it is not possible from this study to draw any conclusions about the causality of this relationship. This holds also when conducting sub-sample analyses on different socio-economic groups. The results suggest that there exists unobserved heterogeneity on country and mother level that confounds this correlation. More research, in particular on individual level, is thus needed in order to fully understand how economic liberalization may affect health.

Key words: *Economic liberalization, openness, health, infant mortality, individual level, DHS*

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## 1. Introduction

The perhaps clearest indicator of a nation's development is the health of its population. A lack of income, poor infrastructure, low education levels and unstable institutions are all obstacles for health improvements of people in low-income countries. The health inequalities between low and high-income countries remain significant. For instance, life expectancy in Japan is 24 years higher than in Malawi, and the child mortality rate (i.e. the number of children per 1,000 births that dies before reaching the age of five) in Chad is 98 whereas for Sweden the same number is three (WHO, 2015; World Bank, 2015).

Even though there is no easy fix to improvements of public health, certain policies are believed to be particularly important for developing countries' development—one of these policies is economic liberalization.

Economic integration and economic openness has, for the past thirty years, been promoted by large international organizations such as the World Bank and the IMF as a necessity to increase economic growth and welfare in developing countries. Perhaps the most important role in the promotion of economic liberalization and economic integration concerns the Washington Consensus, a term coined in 1989 consisting of ten economic policy recommendations aimed at boosting developing countries' heavily burdened economies (Williamsson, 2009). The term has since come to represent the neoliberal view that trade and market liberalization is the most efficient way for developing countries to achieve economic growth and to improve welfare.

Economic liberalization, although a multifaceted concept, generally refers to a process of promoting and increasing the openness of a country in terms of international trade and market liberalization. By undertaking economic liberalization, economic theory suggests that a nation's welfare will increase as an effect of the economic growth that is expected to result from increased openness (IMF, 2001). According to neo-classical theories such as the Ricardian model or the Heckscher-Ohlin model, a country can achieve efficiency and productivity gains by reducing trade barriers and focusing on the export markets in which they have comparative advantages. This economic growth generated from the increased openness is thus believed to increase income, reduce poverty, increase national

revenues and, by extension, improve the health of a population (UN, 2010). Moreover, increased openness and increased trade enable countries to gain access to new goods and technologies that may also improve public health (Bussmann, 2009).

In this thesis, I investigate the relation between economic liberalization and health. Economic globalization is, of course, not a one-time event but a slow process involving political decisions and implementations of economic and political policies, among many other factors, that can take several years before they are fully implemented. However, it is possible—on the basis of commonly used indicators of economic openness—to distinguish a proxy date from which a country can be viewed as economically liberalized. For my analysis, I use Wacziarg and Horn-Welch's (2004) data on timing of economic liberalization, which classifies a country as economically liberalized if it meets five conditions related to economic openness.

As measurements of health I use infant and neonatal mortality (death before 12 months and 1 month respectively). Infant and neonatal mortality are relevant indicators of health as it is assumed that structural factors that would affect the general health of the population would have an effect also on newly born (Reidpath and Allotey, 2003). Moreover, compared to other measures of general health (such as self-assessed health), data on infant and neonatal mortality is more readily available and suitable for comparisons across nations. I use data on infant and neonatal mortality from Demographic Health Surveys (DHS) conducted in sub-Saharan African countries, containing individual-level data on mothers and their births. By both using an OLS model controlling for country effects, and a mother fixed effect model, I attempt to establish the casual effect of economic liberalization on health.

The relation between economic liberalization and health is most frequently studied at macro level. Thus, this thesis is a relevant contribution to the research area as it instead investigates the relationship on a micro level. The advantage of using micro-level data instead of macro-level data is that using the former makes it possible to control for individual factors affecting health such as age, place of residence and education. Being able to control for such factors are of particular importance when looking at health, as the main determinants of individual health are found on individual level.

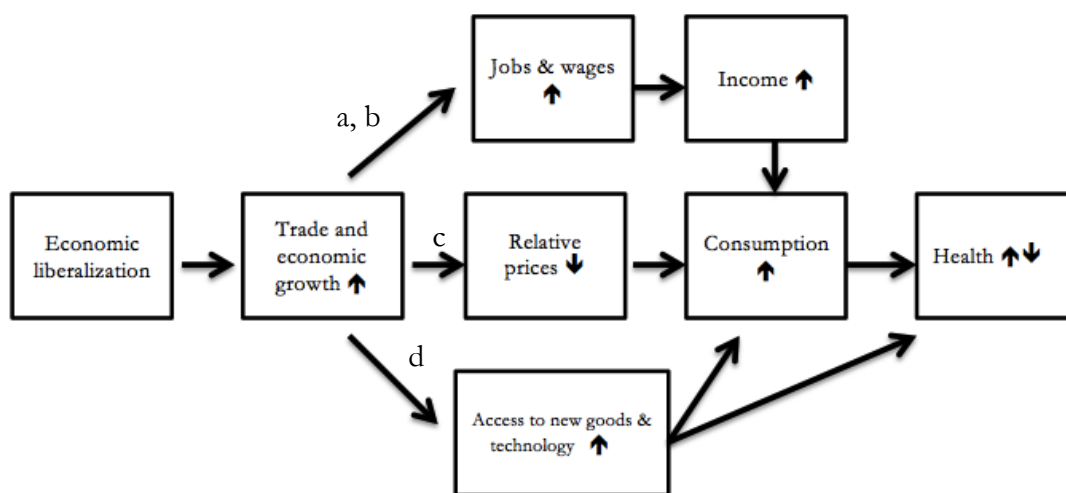
Moreover, using sibling data such as provided by DHS, and a mother fixed effect model has the advantage of controlling for unobserved heterogeneity on family level—such as genetic and environmental factors—that might confound the relationship between economic liberalization and health.

The thesis is structured as follows: The next section gives a theoretical background to the links between economic liberalization and health. This is followed by a chapter on related empirical research. Chapter Four and Five present the empirical strategy and the data I will use for the analysis. The two following chapters present the baseline results and the result of a number of sensitivity analyses. The thesis ends with a discussion of the results, and concluding remarks.

## 2. Theoretical Background

There are two main mechanisms through which economic liberalization is believed to have a positive effect on health: First, through its positive effect on individuals' and states' income generated from increased economic growth and lower relative prices. Second, increased international trade may also improve access to pharmaceuticals, medical devices and other goods, and also lead to “knowledge spillover” that in turn may have a positive effect on health (Welander et al., 2015; Bergh and Nilsson, 2010). However, economic liberalization may also affect health negatively, for instance through faster spread of diseases and changes in consumption patterns (Bergh and Nilsson, 2010).

Through figure 1 I describe, in a simplified way, how economic liberalization may affect health.



**Figure 1: Economic liberalization and health**

As seen in the health production function developed by Fayissa and Gutema (2005) that explains individual determinants of health in a sub-Saharan context, income is one of the factors having a positive effect on health. More specifically, the model, which is based on the commonly used Grossman model (Grossman, 1972), states that an individual's health status ( $h$ ) is a function of income factors ( $Y$ ), social factors ( $S$ ), and environmental factors ( $V$ ):

$$h = F(Y, S, V)$$

Thus, the model would imply that the higher income, ( $Y$ ), generated from economic liberalization enables people to spend more on nutrition, pharmaceutical products and medical services, both for themselves and for their children, leading to general health improvements (Grown, 2005).

As mentioned, economic theory suggests that economic liberalization increases countries' international exports by lowering or the elimination of trade barriers, such as tariffs or quotas. Hence, countries are enabled to specialize in those export sectors in which they have a comparative advantage. As many developing countries are abundant in unskilled labour, they have a comparative advantage in labour-intense sectors, which explains why economic liberalization is suggested to increase individual income and reduce poverty by the resulting increase in employment (Cain et al., 2012). This connection is indicated by arrows  $a$  in figure 1.

Moreover, as indicated by arrow  $b$ , the increased trade and economic integration followed from economic liberalization is also suggested to increase wage levels in export sectors and to lower the relative price of imported goods, thereby increasing individual incomes and further reducing poverty (Sirgy et al., 2004) (arrow  $c$ ). The wage improvements are a result of the increased national and international competition following from international trade, which is believed to improve the effectiveness of production and thus lead to increased productivity of a firm—something that affects wages positively (Sirgy et al., 2004). Also, less costly and easier import of technology due to lower trade barriers may increase the productivity of a firm, which, in turn, may have a positive effect on wages (Guadalupe, 2003).

It is not just individual income that is positively affected by economic liberalization; increased government revenues from exports and taxes enables more resources to be spent on public social services such as education and health care—both of which are believed to have a positive effects on the general health of the population (Sirgy et al., 2004).

The second mechanism through which economic liberalization can affect individual health is through better access to medical and pharmaceutical products by increased and easier international trade (Bussman, 2009; Bergh and Nilsson, 2010) (arrow  $d$ ). Moreover,



openness is associated with spill-overs of knowledge (for example, new health-improving technologies like water sanitation and medical devices). As openness increases the interaction between countries, spill-overs in terms of knowledge on treatment of diseases, good health practices, health care system and technology are also facilitated when a country becomes more economically liberalized (Owen and Wu, 2007).

However, as figure 1 depicts, increased economic integration might also affect individual health negatively. Increased trade and economic integration may lead to faster spread of diseases and epidemics as well as an increase in pollution (Dollar, 2002, Levine and Rothman, 2006), which is indicated by  $V$  (environmental factors) in Fayissa and Gutema's model. Moreover, economic integration may also increase the consumption of "bads" such as tobacco, and also increase access to "non-traditional" food in developing countries increasing the intake of fat and sugar, which may affect health negatively (Bergh and Nilsson, 2010; Medez and Popkin 2004).

### **3. Related Research**

Although the relationship between economic liberalization and economic growth has been extensively researched, the effect of economic liberalization on individual health remains understudied. Moreover, the vast majority of the existing empirical literature studying the relationship between economic liberalization and health uses aggregated data on a macro level. Though it is possible and relevant to study this relationship on a macro level, most of the variables affecting individual health are found on individual level; this is why it is of interest to conduct this type of research on a micro level whenever suitable data is available.

Most of the empirical studies examining the effect of economic liberalization on health use economic openness and trade-related measures as indicators of economic liberalization. However, there are also a number of studies widening the economic liberalization concept, studying the relationship between globalization and health—thus including more aspects than the ones related to increased economic integration. Due to the many ways of both defining and measuring economic liberalization and health, the existing empirical studies present somewhat mixed results and are not directly comparable. Nonetheless, the majority present findings of positive effects of economic liberalization on various health outcomes - see Table 1 (page 14) for a summary of the results and methods of the studies presented below.

Bussman (2009) investigates whether economic liberalization (e.g. trade openness measured as total trade/GDP) improves women's welfare in terms of education and health. Using women's life expectancy at birth as a proxy for health, Bussman argues that trade openness and the resulting economic growth will improve women's quality of life both by greater access to health care and medicines and through more balanced nutrition and a sufficient food intake. Using panel data from 134 countries and controlling for various factors that potentially affect life expectancy such as GDP per capita, civic rule of the country (democracy or not), fertility rates, Bussman finds, contrary to what is suggested by theory, that trade openness has no direct effect on female life expectancy.

Conversely, Owen and Wu (2007) find that economic openness has a significantly positive effect on health. Owen and Wu investigate the relationship of economic

openness and health using various measures of both health and economic openness. For health, Owen and Wu use three indicators: child mortality, female life expectancy and male life expectancy. Their main economic openness variable is total trade in relation to GDP—the same measure used by Bussman (2009)—but also used are two policy-based measures of openness: the black market premium and the Sachs-Warner index.<sup>1</sup> By using a fixed effects model including 219 countries over five-year intervals between 1960 and 1995 and controlling for variables such as GDP per capita, population growth and secondary school enrolment rates, the analysis shows that all of the economic openness variables have a positive effect on all three of the health indicators. Further, by using interaction variables, the authors conclude that trade openness has a more profound effect on health of individuals in low-income countries than in high-income countries.

Bergh and Nilsson (2010) use a panel of 92 countries and to investigate how various aspects of globalization affect health, measured as life expectancy at birth. For this reason, they use the KOF-index of globalization that includes three globalization components: economic, social and political globalization<sup>2</sup>, where economic globalization is measured through trade flows and trade restrictions. Bergh and Nilsson construct a panel consisting of 92 countries with different income levels. By using a panel-corrected standard errors (PCSE) procedure, as well as fixed-effect regressions, and controlling for potential mediators and control variables such as share of population living in urban areas, average daily intake of calories, average years of schooling and the number of physicians per 1000 people, they find, in line with Owen and Wu, that economic globalization has a positive effect on individual health. The results are robust to various sensitivity analyses where also alternative measures of globalization are used.

Tsai (2007) also uses the KOF index of globalization in his study on how globalization affects not just health but overall quality of life (QoL). As a measure of QoL, Tsai uses the Human Development Index (HDI), where one of the four components constituting the index is life expectancy. Also included in HDI is GNI per capita, expected years of schooling, and mean years of schooling. Tsai finds there exists a positive relation between economic globalization and HDI when estimating panel data with a GLS random effect model and controlling for GNI per capita, population growth and

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<sup>1</sup> A dummy that takes on the value 'one' if a country fulfills certain economic openness-criteria.

<sup>2</sup> For more information on the KOF-index, see Dreher (2006) and Dreher et al. (2008)

dummies over regional characteristics. However, the interpretation of Tsai's results is somewhat complicated because only one of four components of the QoL measure is a direct measure of health (life expectancy). Nevertheless, when Tsai uses life expectancy as well as child mortality rate alone as dependent variables; he finds that economic globalization has a positive effect also on these two health measures of QoL.

A third study that uses the KOF globalization index is one by Mukherjee and Kriekhaus (2011). Mukherjee and Kriekhaus analyse how globalization (economic, social and political globalization) affects human well-being (dependent variable) by using three health measures: Infant mortality, child mortality and life expectancy. By pooling data from 132 countries between 1970-2007 and using fixed effects with a lagged dependent variable to correct for autocorrelation as well as potential problems with omitted variables, they find that economic globalization is significantly positively correlated with all three measures of health. Mukherjee and Kriekhaus perform a robustness check first by excluding all OECD-countries in the analysis, second by using panel correction standard errors (PCSE), and finally by also performing the analysis including all countries using an AR(1) model instead of the lagged depended variable used in the main regression. In their robustness check, the aggregated measure of globalization is used, thus not showing the effect of economic globalization, explicitly, on health. However, the overall baseline results remains fairly stable throughout the sensitivity analyses, but the effect of globalization on life expectancy remains less robust than the effect on infant and child mortality.

Levine and Rothman (2006) also look at whether trade affects child mortality, but—in contrast to the previous studies—they emphasize that increased openness would potentially have a negative effect on child health, for example, due to increased pollution and spread of diseases. Furthermore, Levine and Rothman argue that purely studying the link between trade and child mortality might not reveal a causal relation as countries that trade more may differ from countries that trade less in ways that are also related to child health (for instance, tropical diseases that have been found to decrease both trade and health). For this the authors use a gravity model of trade to predict how much countries trade by using exogenous geographic characteristics. More specifically, the gravity model predicts bilateral trade flows between countries based on, for example, if two countries share a border, how large the respective populations are or how close the countries are

geographically. Summing these predicted bilateral trade flows over all potential trading partners generates an exogenous estimate for predicted trade for all nations included in the model. These trade predictions are then used as an instrument for actual trade in two stage least square (2SLS) regressions estimating the effect of trade on children's health.

Levine and Rothman use two pairs of measures for children's health: infant and child mortality rates, and anthropometric measures of child stunting (low height for child's age) and wasting (low weight for height). The primary results of the regressions do not suggest that increased openness has a *negative* effect on child health; on the contrary, a trade is correlated with lower infant and child mortality and lower stunting. These effects are found to be caused by the higher GDP generated by the increased trade. Numerically, the results imply that a 15 percentage point increase in predicted trade as share of GDP leads to approximately four fewer infant deaths per 1,000 births in an average country.

Thus far, the empirical studies presented examine the relationship between economic liberalization and health on a *macro* level. To my knowledge, the only paper studying this relation using *individual* level data is a working paper by Panda (2014).

In an unpublished working-paper, Panda looks at the impact of a trade policy on child mortality in sub-Saharan Africa. More specifically, she analyzes child mortality trends before and after countries have joined the African Growth and Opportunity Act (AGOA), a trade agreement between sub-Saharan Africa and the US. By constructing a micro panel of mothers in 30 sub-Saharan countries and using the within variation amongst mothers who have given birth both before and after their home country become eligible for AGOA, Panda exploits how AGOA membership effects infant survival. Using a linear probability model both with country-fixed effects and mothers-fixed effects, Panda's results imply that the trade policy reduce infant mortality by about seven infant deaths per 1,000 births. The results hold for various robustness checks such as making placebo tests by using fake timing of AGOA and checking for potential outliers. As mentioned, a study such as Panda's that uses individual-level data means that it is possible to control for those individual-level factors amongst, in this case mothers that may affect the health of their children, factors that are unobservable in a macro-level study and might thus affect the estimates.

**Table 1: Summary of presented empirical literature**

Study	Research topic	Health Measure of health	Measure of Economic liberalization	Data	Method	Main findings
Bussman (2009)	The effect of economic openness on women's health and education	Women's life expectancy at birth	Total trade/GDP	Panel of 134 countries for the years 1970–2000	Fixed-effects (FE) and the generalized method of moments (GMM). Controlling for GDP per capita, civic rule of the country, fertility rates	Economic openness has no direct effect on female life expectancy, but it affects women's professional lives.
Owen and Wu (2007)	The relationship between a country's openness to international trade and several health outcomes	Child mortality, female life expectancy and male life expectancy	Total trade/GDP, Sachs-Warner's economic openness dummy, and the black market premium	Panel of 219 countries over five-year intervals between 1960 and 1995	Fixed-Effect. Controlling for GDP per capita, population growth and secondary school enrolment rates. They also use an interaction variable between trade and income to see how trade openness affects health for different income levels	Increased openness is robustly associated with lower infant mortality and higher life expectancies. The effect is more profound in developing countries.
Bergh and Nilsson (2010)	The relationship between globalization (economic, political and social) and health	Life expectancy at birth	KOF globalization index (Economic globalization: trade flows and trade restriction)	Panel of 92 countries of various income levels covering the period 1970–2005	Panel-corrected standard errors (PCSE) procedure and fixed-effect regressions	The positive effect that globalization has on life expectancy is largely driven by economic factors rather than social factors of globalization.
Tsai (2007)	How globalization affects Quality of Life (QoL)	Quality of life (QoL): Human development index	KOF globalization index (Economic globalization: trade flows and trade restriction)	Panel of 112 countries during 1980–2000 (three wave)	GLS random effect model controlling for GNI per capita, population growth and dummies over regional characteristics.	Economic globalization has a positive effect on QoL measured as HDI.
Mukherjee and Kriekhaus (2011)	How globalization affects human well-being	Welfare measures: Infant mortality, child mortality and life expectancy	KOF globalization index (Economic globalization: trade flows and trade restriction)	Panel of 132 countries between 1970-2007	Fixed effects with a lagged dependent variable	Economic globalization is significantly positively correlated with all three measures of health.
Levine and Rothman (2006)	Does openness to the international economy affect children's health?	Infant and Child mortality as well as anthropometric measures of child stunting (low height for age) and wasting (low weight for height)	Predicted trade	100–130 countries depending on variables used in the regressions	First a Gravity model of trade where predictions of trade flows are estimated. These predictions are used as an instrument for actual trade using two-stage least squares regressions (2SLS)	Trade decreases infant and child mortality as well as stunting.
Panda (2014).	The effect of trade on infant mortality	Infant mortality	Membership of trade agreement African Growth and Opportunity Act (AGOA)	30 Sub-Saharan African countries	A linear probability model - both with country fixed effects and mothers fixed effects	AGOA reduces infant mortality by about seven infant deaths per 1,000 births.

## 4. Variables and Data Sources

### 4.1 Economic Liberalization

There is no standardized method on how to measure economic liberalization or economic openness. As seen in the previous chapter, total trade as share of GDP, as well as the KOF index, are frequently used indicators. In this thesis, I use Wacziarg and Horn-Welch's (2008) updated version of Sachs and Warner's (1994) dataset consisting of the year of economic liberalization for a total of 122 countries<sup>3</sup>.

In this dataset, a country is defined as economically liberalized (open) if *none* of the following five conditions can be applied:

1. Average tariff rates are 40 percent or more
2. Nontariff barriers cover 40 percent or more of trade
3. A black market exchange rate that is at least 20 percent lower than the official exchange rate
4. A socialistic economic system (as defined by Kornai, 1992)
5. A state monopoly on major exports

The date from which a country is classified as economically liberalized is subsequently the year from which it first does *not* meet any of these criteria and is continuously open until the end of the sample period.

Condition one and two are obviously related to economic liberalization as low trade barriers and tariffs are a prerequisite for economic openness. A black market exchange rate that is depreciated by 20 percent or more relative to the official exchange rate is an indicator of macroeconomic distortions that affect the foreign exchange rate and thus also international trade. Condition four, a socialistic economic system, refers to the countries with a planned, closed economy as opposed to a market economy that promotes openness (Sachs and Warner, 1994), whereas condition five stresses that an open country needs competition.

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<sup>3</sup> Only sub-Saharan African countries are included in this analysis

However, there has been critique towards the criteria that Sachs and Warner set up for defining openness. The critique foremost concerns the arbitrariness of the chosen conditions for openness (Rodriguez and Rodrik, 2001). Sachs and Warner also recognize that their definition of openness is somewhat simplified and that the levels they have chosen on, for instance, the black market exchange rate may be arbitrary. However, they still argue that the dates of liberalization are based on correct and reliable assumptions (Sachs and Warner, 1995)—a view shared by Wacziarg and Wallack (2004). Wacziarg and Wallack (2004) check the accuracy of Sachs and Warner’s dates of liberalization by looking at case study literature on trade liberalization from 25 developing countries; they find that the dates by Sachs and Warner are good indicators of major trade policy changes for these countries. Moreover, despite the critique, Sach and Warner’s data remains a frequently used measurement of openness in academic work.

In 2008, Wacziarg and Horn-Welch updated the Sachs and Warner data set to also include those countries liberalizing their economies throughout the 1990s until 2001. For a few countries, Wacziarg and Horn-Welch disagreed with Sachs and Warner’s date of liberalization and have thus changed this date with a motivation as to why. In this thesis, I will use the Wacziarg and Horn-Welch dates of liberalization for consistency. Also, as seen in table 2 below, many of the countries included in this study became open in the end of 1990’s. Wacziarg and Horn-Welch’s extension of the dataset thus is of importance when wanting to study effect of economic openness in developing countries.

The advantage of using Sachs and Warner’s/Wacziarg and Horn-Welch’s data is that it presents a clear cutoff point for economic liberalization, making it possible to use estimation techniques to investigate changes in health trends before and after a cutoff point, something that is not possible when using time series data over, for example, trade/GDP ratio—an otherwise common measure of economic openness. Nevertheless, it is important to emphasize that economic liberalization is a long process, not a random event that can be thought of, or modeled, as an exogenous shock. However, a country for which none of the conditions above apply has, at the minimum, reached a further point in the liberalization process than those countries that fulfill at least one of the conditions have not.



### **4.1.1 Economic Liberalization in sub-Saharan Africa**

In 1981, the World Bank presented its report *Accelerated Development in sub-Saharan Africa: An Agenda for Action*, with policy suggestions on how to spur the slow economic growth the sub-Saharan region was experiencing. Amongst these policy suggestions was the elimination of trade barriers such as tariffs, the removal of subsidies and to allow the market control the prices of raw material exports. Although many argue that the economic liberalization undertaking has increased welfare in sub-Saharan Africa, it is also suggested that in many countries in sub-Saharan Africa the economic liberalization took place too early as many sectors were not yet competitive enough to fully benefit from the increased openness (Sundaram and Arnin, 2008).

The countries included in this study and their timing of economic liberalization according to Wacziarg and Horn-Welch's updated version of Sachs and Warner's data are presented in table 2. In the analysis the identification is based on each country's exposure to economic liberalization at different points in time.

**Table 2: Countries included in study**

<b>Countries liberalized by 2001</b>	<b>Timing of liberalization</b>
Benin (BEN)	1990
Burkina Faso (BFA)	1998
Burundi (BDI)	1999
Cameroon (CMR)	1993
Cote D'Ivoire (CIV)	1994
Ghana (GHA)	1985
Guinea (GIN)	1986
Kenya (KEN)	1993
Madagascar (MDG)	1996
Mali (MLI)	1998
Mozambique (MOZ)	1995
Niger (NER)	1998
Sierra Leone (SLE)	2001
Tanzania (TZA)	1995
Uganda (UGA)	1988
Zambia (ZMB)	1993
South Africa (ZAF)	1991

#### **Countries *not* liberalized by 2001**

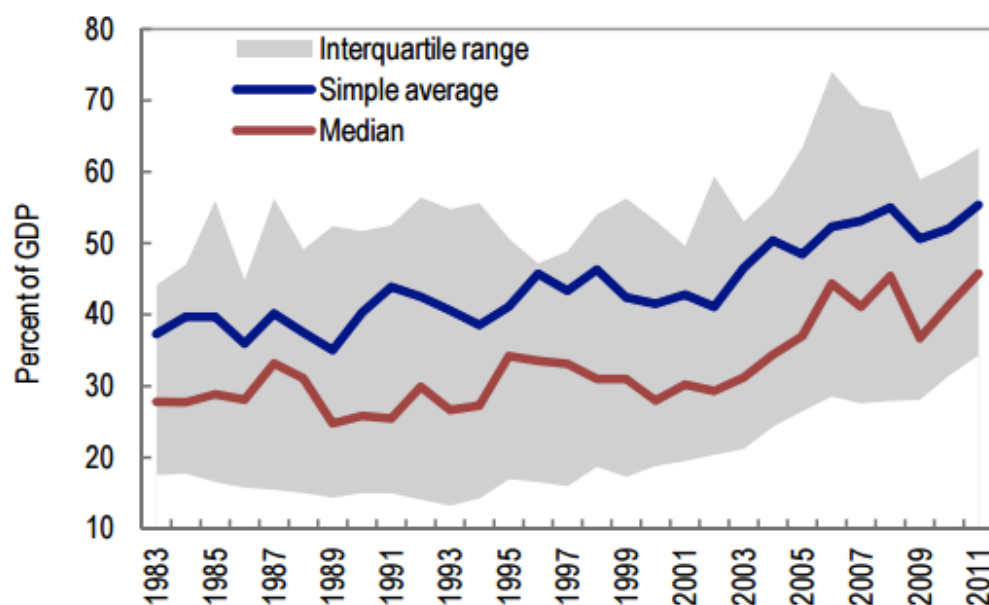
Angola (AGO)  
Congo Brazzaville (COG)  
Congo, Democratic Republic (ZAR)

Gabon (GAB)  
 Liberia (LBR)  
 Lesotho (LSO)  
 Malawi (MWL)  
 Nigeria (NGA)  
 Rwanda (RWA)  
 Senegal (SEN)  
 Swaziland (SWZ)  
 Togo (TGO)  
 Zimbabwe (ZWE)

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Figure 2 below shows total trade (as share of GDP) trade openness for Sub-Saharan African countries for the period 1983 to 2011. The picture shows that from the beginning of the 1990's, when many of the countries in the region became liberalized, total trade increased from 41 percent of GDP to 45 percent of GDP in the 2000s (IMF, 2015).

**Figure 2: Trade openness Sub-Saharan Africa**



Source: IMF 2015

## 4.2 Dependent Variable: Health

I use infant and neonatal mortality (death before the age of twelve months and one month, respectively) as a measure of health. Child health is a commonly used indicator of public health in empirical literature since structural health-related factors affecting the health of the population as a whole would also impact infant mortality rates (Reidpath

and Allotey, 2003). Infant and neonatal mortality is thus also a good indicator of a country's development level, which is what economic liberalization is believed to improve.

#### ***4.2.1 Child Mortality Trends in sub-Saharan Africa***

Although the infant, neonatal and child mortality rates (death before the age of 5) has declined rapidly during recent decades in most developing countries, sub-Saharan Africa remains the region with the highest rates (WHO, 2015).

The most common causes of infant mortality in sub-Saharan Africa are diseases and infections such as Malaria, HIV and diarrhea. Despite expansion in immunization programs across the region, many babies and children also die from vaccine-preventable diseases (Rao et al., 2006). A factor that has an impact on the causes of infant, neonatal and child mortality is the socio-economic status of the mother and her household. A higher socio-economic status in terms of income is in several studies empirically found to have a negative effect on infant mortality (Wagstaff 2000; Gwatkin et al. 2007). This effect runs through various channels, such as the income of the household and education and occupational situation of the mother. For instance, the mother's education impacts family planning and often delays fertility decisions and reduces the number of births (Basu, 2002). This, in turn, has a negative effect on infant mortality as both adolescent births and higher order births are associated with higher risks for the baby (WHO, 2015). Moreover, the occurrence of infant mortality is higher among mothers who do not work outside the home. Outside work increases the income for the household and enables purchases of medicines, health care services and other health improving goods both for mother and for the newborn, thus reducing the risk of death due to diseases and infections (Mondal et al., 2009).

Figure 3<sup>4</sup> below shows the trend in infant mortality between 1990 and 2015 per WHO region. The figure shows that the, although the clear declining trend, the level of infant mortality in Africa, which mainly consists of sub-Saharan countries, is still higher than in other regions. In 2015, 55 children per 1000 live births die before the age of one in the African region, whereas the equivalent number in Europe was 10 births.

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<sup>4</sup> Source: UNICEF, WHO, World Bank, UN DESA/Population Division "Levels and Trends in Child mortality 2015". UNICEF, 2015 Available at: [http://www.who.int/gho/child\\_health/mortality/neonatal\\_infant/en/](http://www.who.int/gho/child_health/mortality/neonatal_infant/en/)

Figure 3: Trends in infant mortality per region

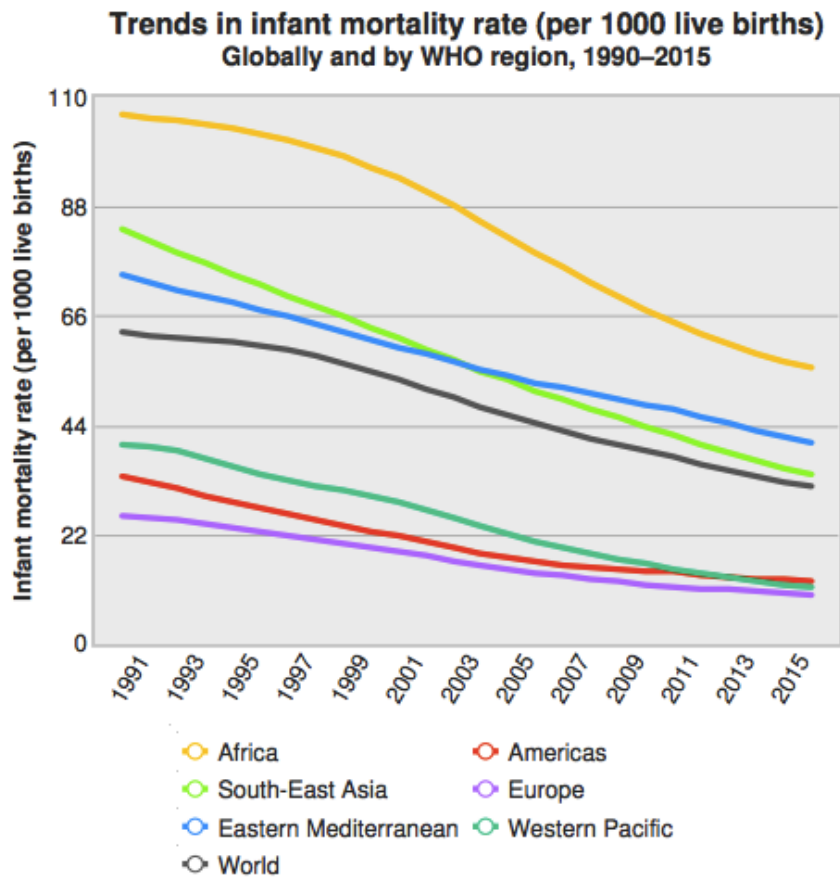


Figure 4 and 5<sup>5</sup> show the clear negative trends in infant mortality for the countries included in this study for the period 1980-2015. Of these countries, Angola is the country with the highest infant mortality rate today (96 infant deaths per 1,000 live births), whereas Rwanda has the lowest rate (34 infant deaths per 1,000 live births).

<sup>5</sup> Source: World Bank Development indicators, 2015

Figure 4: Infant mortality over time in sub-Saharan Africa (countries A-L)

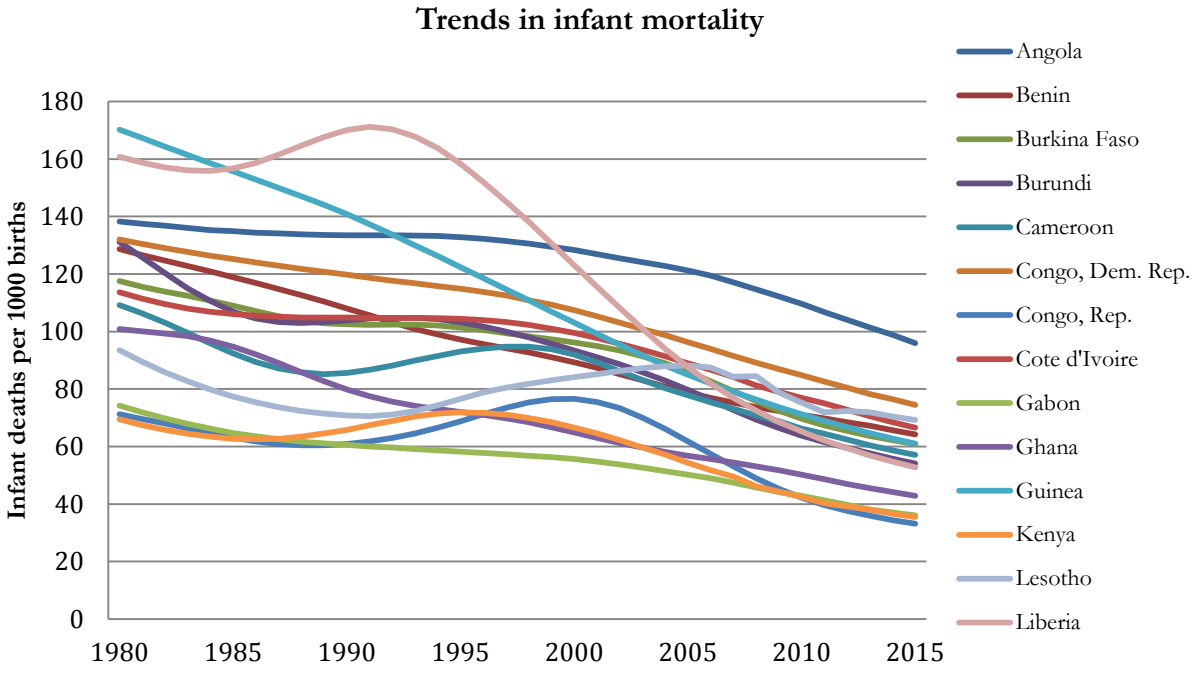
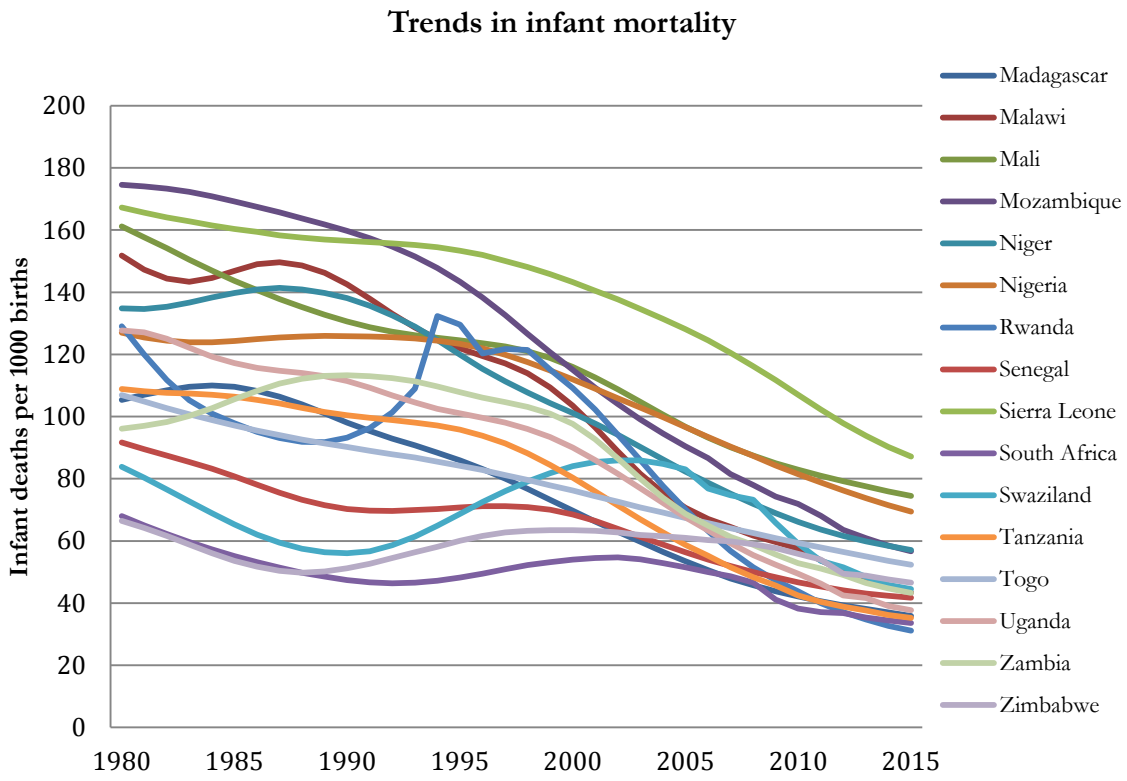


Figure 5: Infant mortality over time in sub-Saharan Africa (countries M-Z)



### 4.2.2 Data

For this study, I use data on infant and neonatal mortality collected from Demographic Health Surveys (DHS<sup>6</sup>). DHS are conducted frequently in developing countries in most regions of the world, and have a primary focus on women and their health. For each wave of survey, thousands of women (generally aged 15-49 years) are interviewed. The surveys contain information on all of the participating women's births and thus include micro-level information on infant and neonatal mortality. As the surveys are, to a great extent, standardized for all countries, it is possible to combine them into one dataset. For the purpose of this study, surveys from 30 sub-Saharan African<sup>7</sup> countries have been individually downloaded and merged into one large dataset using STATA. From this, I construct a micro panel of more than 500,000 births from more than 160 000 mothers, which is used to analyze the effect of economic liberalization on infant and neonatal mortality. In such a panel, the mother can be thought of as the cross-sectional unit, and her children—that are born in different years—as the time dimension (Bhalotra, 2008).

Using individual-level data instead of data on the macro level for this type of analysis makes it possible to control both for country level effects and for individual factors that might affect infant and neonatal mortality – for instance age of the mother, education, sex of the baby etc. Moreover, by using sibling data such as DHS, it is possible to control for mother level unobserved heterogeneity in a mother level—such as genetic, environmental and behavioral factors—that might confound the relationship between economic liberalization and infant and neonatal mortality (Bhalotra, 2008).

Table 3 show some descriptive statistic on the women included in the dataset. For more descriptive statistics see appendix A.

**Table 3: Descriptive statistics mothers**

Variable	No. Of observations	Mean	Std. Dev.	Min	Max
Mother's age at first birth	167936	22.20428	5.210474	8	48
Number of births per mother	167936	3.323308	2.215583	1	17
Number of years in school	94903	4.072927	2.000601	0	11

<sup>6</sup> Surveys are available upon request at [www.dhsprogram.com](http://www.dhsprogram.com)

<sup>7</sup> Demographic health surveys are conducted for other regions in the world, but in order to simplify the analysis somewhat by not having to control for potential regional trends and differences in economic liberalization and infant/neonatal mortality, this study focuses on one region.

## 5. Empirical Strategy

To investigate whether economic liberalization has an effect on child and neonatal mortality, I will use two different estimation techniques. First, I use an ordinary least squares (OLS) model. The full specification looks as follows. I employ variations to this specification to determine the robustness of the results.

$$y_i = b_1 + b_2L_i + b_3TREND_{ct} + b_4X_i + \varepsilon_i$$

The dependent variable,  $y_i$ , is a dummy taking on the value one if baby  $i$  dies before twelve months (infant mortality) or one month (neonatal mortality), and zero otherwise. The OLS model, which is a linear probability model, is used despite the non-linearity of the dependent variable. An alternative estimation method would be to use a nonlinear estimation technique such as a Logit or Probit model. However, the marginal effects are likely to be similar but easier to interpret in a linear probability model (Hellevik, 2010; Kudamatsu, 2012).

$L_i$  is the main variable of interest. This is a treatment dummy indicating whether the birth took place after the country of birth for baby  $i$  was economically liberalized, in which case it takes on the value one—otherwise zero. Thus, this dummy indicates whether a birth was “treated” with economic liberalization.

As seen in figure 4 and 5 there is a negative trend in infant mortality amongst the sub-Saharan countries. A linear time trend variable,  $TREND_{ct}$  is therefore included to control country-specific time trends that may affect infant or neonatal mortality.

A challenge in establishing the causal relation between economic liberalization and infant or neonatal mortality is to isolate the effect of economic liberalization from other factors that are believed to have an impact infant mortality rates. For this reason various exogenous control variables,  $X_i$ , are included in the specification to increase the precision of the estimates of the treatment variable.

First, control variables on birth level are included. These consist of a dummy for girls, a dummy for the birth order of baby  $i$ , and a dummy for if the baby  $i$  was part of a

multiple birth (i.e., in a twin, triplet or quadruplet birth). Due to biological reasons, boys have a higher risk of dying before the age of one than girls do (Fuse and Crenshaw, 2005). Also, babies born as twins have been found to have a higher chance of dying within their first year than singleton births do (Pison, 1992). Moreover, babies of high birth order may have a higher chance of dying due to scarcity of household resources. On the other hand may babies of low birth order have an increased risk of dying within twelve months due to lack of mother's child bearing experience (Kudamatsu, 2012).

I also control for potential confounding variables of economic liberalization on country level to see how these affect the estimates. These are: (logged) GDP per capita, (logged) official development assistance and official aid (ODA) as share of GDP, annual rainfall and one year lagged annual rainfall<sup>8</sup>. As discussed previously, a higher income per capita is expected to have a positive impact on health thus reducing infant and neonatal mortality. Overseas development aid is often aimed at improving health – especially women and child health and is therefore expected to have a negative effect on newborn mortality. Kudamatsu et al. (2012) have found that draughts in arid climate zones in sub-Saharan Africa increases the risk of infant mortality. Moreover, rainfall can also be seen as an exogenous proxy for economic growth as many of the sub-Saharan countries rely on agriculture (Miguel et al. 2004). Rainfall is therefore also assumed to have a positive effect on child health. Moreover, country dummies are also added to control for potential county fixed effects that might confound between economic liberalization and infant and neonatal mortality.

The error term,  $\varepsilon_i$ , captures all relevant factors that may affect infant or neonatal death that are not included in the model.

As the method using an OLS model is unable to capture potential bias in the estimates arising from unobserved heterogeneity amongst the mothers, I will also use a mother fixed effect model. Even though I do not have panel data with a time dimension, we can nonetheless use the fixed effects approach provided the important unobserved variables are shared by some group of individuals—in this case, by siblings. More specifically, this fixed effect model uses the within variation amongst mothers who have given birth both

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<sup>8</sup> GDP per capita and ODA data comes from World Bank development indicators, and data on annual rainfall from Miguel et al. (2004). Data is compiled and made available by Kudamatsu (2012).



before and after the timing of liberalization. This means that the model is implicitly controlling for mother-specific effects<sup>9</sup> (the unobserved heterogeneity) that may confound the relationship between economic liberalization and child and neonatal mortality.

The mother fixed effect model looks as follows<sup>10 11</sup>:

$$y_{imact} = \alpha_m + \beta_t + \gamma_1 L_{ct} + \delta_c TREND_{ct} + X_{imact} \theta + \varepsilon_{imact}$$

The dependent variable  $y_{imact}$  is a dummy variable taking the value one if baby  $i$ —born by mother  $m$  from birth cohort  $a$  in country  $c$  in year  $t$ —dies before he or she is one year old (for infant mortality) or one month old (for neonatal mortality). The model control for mother fixed effect,  $\alpha_m$  and child’s birth-year fixed effects,  $\beta_t$ .

$L_{ct}$  is also here the treatment dummy that is switched on the year after country  $c$  was liberalized and  $TREND_{ct}$  a linear country-specific trend-variable for country  $c$ .  $X_{imact}$  is a vector of exogenous control variables that can affect infant or neonatal mortality. As in the OLS-specification, the vector consists of a dummy for girls, a dummy for the birth order, and a dummy for if the baby was born in a multiple birth. The same country specific control variables used in the OLS model are also included in the mother fixed effect model.

In both the OLS and the mother fixed effect model, births from 30 sub-Saharan countries are included, out of which 17 are liberalized according to Sachs and Warner’s (2001) liberalization index. Babies born less than twelve months after the survey are dropped, as it is not possible to know whether they survived their first year. Babies born after 2001 are also dropped, as the economic liberalization data only exists until 2001. Since it is possible that some of the non-liberalized countries have become liberalized

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<sup>9</sup> By controlling for mother fixed effects, I also implicitly control for country fixed effects, as the country of residence is a time invariant factor.

<sup>10</sup> This specification follows Kudamatsu’s (2012) model where he estimates the effect of democracy on infant mortality.

<sup>11</sup> As in the case with the OLS model, despite the non-linearity of the dependent variable a linear probability model is used for estimation. The alternative binary model, a fixed effects logit model, would generate coefficient estimates that are harder to interpret. It also require that there are no serial correlation in the error term which, when using sibling data, is not likely achieved (Kudamatsu, 2012).

from 2002 and onwards, including births after 2001 would potentially cause measurement errors.

Standard errors are clustered at country level in both the OLS and mother fixed effect model. This means that errors for births within a country can be correlated, while the model errors for births across countries are assumed uncorrelated (Cameron and Miller, 2015).

## 6. Results

### 6.1 Results OLS Model

Columns 1-5 in Table 4 show the results when using infant mortality as the dependent variable, whereas column 6-10 present the result when using neonatal mortality as the dependent variable.

Column 1 shows that economic liberalization, the *treatment* variable, has a negative effect on infant mortality when controlling for gender, birth order and multiple birth being statistically significant on a one percent significance level. The coefficient indicates that economic liberalization reduces the probability of infant mortality by 1,5 percentage points. This translates to a 15 reduction in infant deaths per 1000 live births. The treatment variable remains significant when controlling for a country-specific time trend (column 2), for mother's age and age squared (column 3), and when controlling for potentially confounding macro economic variables - although, the coefficient values become smaller indicating 8-6 reductions in infant mortality per 1000 live births.

However, when controlling for country specific effects by adding country dummies, the significant results no longer hold (although the coefficient still exhibit a negative sign). This suggests there are some unobserved effects on the country level that removes the previously significant relationship between economic liberalization and infant mortality.

Furthermore, the results in table 4 show that, in line with theory, girls have a lower risk of dying before the age of twelve months than boys. The results also indicate that a baby of second birth order has a higher chance of surviving past twelve months than a first-born baby. However, this result does when controlling for mother's age, country level confounders or country effects (column 3-5). A baby born as a higher birth order (10+) has a higher chance of dying before twelve months than a first-born. The results also suggest that babies born as twins, triplets or quadruplets have higher risk of infant death than those born as a singletons. The age of the mother have a negative effect on infant mortality. However, as indicated by the mother's age squared, this effect is diminishing suggesting that the relation is not linear and at that after some age being an older mother increases the risk of infant mortality.

Looking at the macro economic control variables, the results from the OLS model show that a higher GDP per capita indeed has a negative effect on infant mortality. Contrary to theory, the results show that lagged rainfall has positive effect on infant mortality, although only being significant on a ten percent level when adding country dummies.

Very similar results are given when using neonatal mortality as the dependent variable (column 6-10). The estimated coefficients of the significant variables are, however, somewhat smaller in size, indicating smaller effects on neonatal mortality than on infant mortality.

## 6.2 Results Mother Fixed Effects Model

Table 5 presents the results from the mother fixed effects model. Column 1-4 and 5-8 show the results when using infant mortality and neonatal mortality as the dependent variable respectively. In column 1 and 5 mother fixed effects are controlled for as well as whether the baby is a girl, its birth order and whether it is included in a multiple birth. In column 2 and 6 the country specific time trend variable is added.

The results from the mother fixed effect model when using infant mortality as dependent variable, show no significant effect of the treatment variable. Not surprisingly, this supports the results from the OLS model when controlling for country fixed effects, as the mother fixed effect implicitly also control unobservable factors on country level.

The results from the first specification using neonatal mortality as the dependent variable (column 5), the treatment variable does however exhibit a significant *positive* effect on neonatal mortality on a ten-percentage significance level. Although, the significant effect disappears when adding the trend variable, indicating that this may be a spurious result.

The results from the mother fixed effects model when including all control variables (column 4 and 8) are somewhat different to the coefficient estimates given when using the OLS model with country fixed effect (table 4, column 5 and 10). This suggests that also the unobserved heterogeneity on mother level have some effect on infant and neonatal mortality.

The significant negative effect on infant and neonatal mortality when being a girl holds when using the mother fixed effects model and the size of the coefficients are almost identical. The same applies for the multiple birth variable. Contrary to the results from the OLS model, the birth order variable 10+ indicate that having a high birth order number has a statistically significant *negative* effect on both infant and neonatal mortality compared to being first-born, suggesting that there are some unobserved factors on mother level affecting this relationship. The relationship between mother's age and age squared and infant and neonatal mortality found in the OLS results are also seen in the results from the mother fixed effects model. The coefficients are however somewhat smaller when the unobserved heterogeneity on mother level is taken into consideration.

Looking at the macro economic variables, GDP per capita remains significant when controlling for mother fixed effects indicating that income has negative effect on infant and neonatal mortality. The size of the coefficients are close to the ones obtained from the OLS model, and also here show that GDP per capita has a smaller negative effect on neonatal mortality than on infant mortality. None of the other macro economic confounders show any statistic significant effect on any of the dependent variables.

**Table 4: Results OLS model**

VARIABLES	(1) Infant mortality	(2) Infant mortality	(3) Infant mortality	(4) Infant mortality	(5) Infant mortality	(6) Neonatal mortality	(7) Neonatal mortality	(8) Neonatal mortality	(9) Neonatal mortality	(10) Neonatal mortality
Economic liberalization	-0.0151*** (0.000847)	-0.00839*** (0.00124)	-0.00501*** (0.00124)	-0.00646*** (0.00130)	-0.00112 (0.00179)	-0.00624*** (0.000591)	-0.00568*** (0.000859)	-0.00437*** (0.000861)	-0.00549*** (0.000908)	-0.000140 (0.00126)
Girl	-0.0148*** (0.000759)	-0.0147*** (0.000757)	-0.0146*** (0.000754)	-0.0148*** (0.000781)	-0.0147*** (0.000781)	-0.0117*** (0.000528)	-0.0116*** (0.000528)	-0.0116*** (0.000527)	-0.0119*** (0.000546)	-0.0118*** (0.000546)
Birth order 2	-0.0174*** (0.00104)	-0.0176*** (0.00104)	0.00116 (0.00111)	-0.000280 (0.00115)	-0.000610 (0.00115)	-0.0161*** (0.000733)	-0.0162*** (0.000733)	-0.00715*** (0.000781)	-0.00800*** (0.000817)	-0.00815*** (0.000818)
Birth order 10+	0.0376*** (0.00587)	0.0319*** (0.00587)	0.0959*** (0.00615)	0.0929*** (0.00622)	0.0928*** (0.00622)	0.0202*** (0.00449)	0.0164*** (0.00448)	0.0421*** (0.00467)	0.0409*** (0.00473)	0.0407*** (0.00473)
Multiple birth	0.203*** (0.00348)	0.203*** (0.00346)	0.200*** (0.00345)	0.202*** (0.00355)	0.202*** (0.00355)	0.150*** (0.00298)	0.150*** (0.00298)	0.149*** (0.00297)	0.152*** (0.00307)	0.152*** (0.00307)
Mother's age			-0.0171*** (0.000598)	-0.0174*** (0.000635)	-0.0170*** (0.000640)			-0.00934*** (0.000438)	-0.00942*** (0.000467)	-0.00924*** (0.000469)
Mother's age^2			0.000239*** (1.17e-05)	0.000246*** (1.24e-05)	0.000240*** (1.25e-05)			0.000141*** (8.54e-06)	0.000143*** (9.09e-06)	0.000142*** (9.13e-06)
GDP per capita_log				-0.0283*** (0.00156)	-0.0226*** (0.00390)				-0.0139*** (0.00108)	-0.00940*** (0.00257)
ODA share of GDP_log				0.00103 (0.000723)	0.00149 (0.000921)				-0.000515 (0.000514)	0.000115 (0.000645)
Annual rainfall				0.00314 (0.00260)	0.00405 (0.00317)				-0.00211 (0.00182)	0.000666 (0.00222)
Annual rainfall lagged				0.00636** (0.00256)	0.00617* (0.00318)				0.00384** (0.00180)	0.00542** (0.00223)
Country time trend	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Country dummies	No	No	No	No	Yes	No	No	No	No	Yes
Constant	0.104*** (0.000848)	0.110*** (0.00128)	0.336*** (0.00727)	0.474*** (0.0212)	0.406*** (0.0423)	0.0547*** (0.000623)	0.0576*** (0.000909)	0.178*** (0.00534)	0.268*** (0.0150)	0.196*** (0.0290)
Observations	558,103	558,103	558,103	522,680	522,680	558,103	558,103	558,103	522,680	522,680
R-squared	0.017	0.023	0.029	0.030	0.030	0.019	0.022	0.024	0.025	0.026

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 5: Results Mother Fixed Effects Model**

VARIABLES	(1) Infant mortality	(2) Infant mortality	(3) Infant mortality	(4) Infant mortality	(5) Neonatal mortality	(6) Neonatal mortality	(7) Neonatal mortality	(8) Neonatal mortality
Economic liberalization	0.00363 (0.00298)	0.00426 (0.00274)	-0.00152 (0.00193)	-0.00276 (0.00224)	0.00288* (0.00160)	0.00318 (0.00205)	-0.000344 (0.00119)	-0.00100 (0.00158)
Girl	-0.0146*** (0.00104)	-0.0146*** (0.00105)	-0.0146*** (0.00104)	-0.0148*** (0.00110)	-0.0118*** (0.00101)	-0.0118*** (0.00101)	-0.0118*** (0.00101)	-0.0121*** (0.00102)
Mother's age			-0.00816*** (0.00128)	-0.00932*** (0.00149)			-0.00292*** (0.000916)	-0.00343*** (0.00108)
Mother's age^2			0.000246*** (2.11e-05)	0.000261*** (2.35e-05)			0.000119*** (1.51e-05)	0.000127*** (1.74e-05)
Multiple birth	0.212*** (0.00901)	0.213*** (0.00907)	0.212*** (0.00905)	0.215*** (0.00929)	0.153*** (0.00738)	0.153*** (0.00740)	0.153*** (0.00738)	0.157*** (0.00753)
Birthorder 2	-0.0267*** (0.00279)	-0.0345*** (0.00402)	-0.0297*** (0.00319)	-0.0308*** (0.00307)	-0.0213*** (0.00243)	-0.0275*** (0.00329)	-0.0261*** (0.00277)	-0.0269*** (0.00264)
Birth order 10+	-0.0739*** (0.0114)	-0.132*** (0.0227)	-0.157*** (0.0196)	-0.161*** (0.0203)	-0.0391*** (0.00801)	-0.0846*** (0.0157)	-0.103*** (0.0136)	-0.105*** (0.0136)
GDP per capita_log				-0.0222*** (0.00450)				-0.00933*** (0.00251)
ODA as share of GDP_log				0.00108 (0.00159)				-0.000471 (0.000937)
Annual rainfall				0.00408 (0.00449)				0.00349 (0.00368)
Annual rainfall lagged				0.00874 (0.00522)				0.00563 (0.00358)
Country time trend	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Constant	0.117*** (0.00224)	0.0722*** (0.0117)	0.195*** (0.0177)	0.273*** (0.0638)	0.0613*** (0.00192)	0.0263*** (0.00828)	0.0783*** (0.0125)	0.0876* (0.0436)
Observations	558,103	558,103	558,103	522,680	558,103	558,103	558,103	522,680
R-squared	0.018	0.019	0.020	0.021	0.020	0.021	0.021	0.022
Number of motherid	167,936	167,936	167,936	161,409	167,936	167,936	167,936	161,409

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

### 6.3 Sensitivity analysis

For all the following analyses the mother fixed effects model is used and infant mortality is the dependent variable. The same controls as in the specification of table 5, column 4, are included in the model.

It is possible that the effect that economic liberalization has on infant mortality is delayed, and that the true effect of economic liberalization happens a few years later than the time of liberalization. To see whether the effect of economic liberalization on infant mortality may be delayed, I use a lead treatment variable. That is, if the actual year of liberalization according to Wacziarg and Horn-Welch's index is 1990, I add 1-5 years and instead assume that the year of liberalization is 1991, 1992, 1993, 1994 and 1995 respectively. However, as presented by table 6, none of the lead treatment variable shows any statistical significance and no conclusion concerning a delayed effect of economic liberalization can be drawn.

**Table 6: Results lead treatment variable**

Years from Economic liberalization	+1 years	+ 2 years	+ 3 years	+ 4 years	+ 5 years
Economic liberalization	-0.00132 (0.00192)	2.40e-05 (0.00223)	-0.000149 (0.00272)	0.00263 (0.00297)	0.00238 (0.00432)
Constant	0.276*** (0.0640)	0.277*** (0.0640)	0.277*** (0.0635)	0.279*** (0.0629)	0.277*** (0.0633)
Observations	522,680	522,680	522,680	522,680	522,680
R-squared	0.021	0.021	0.021	0.021	0.021
Number of motherid	161,409	161,409	161,409	161,409	161,409
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Using the opposite reasoning, we may assume that the true effect of economic liberalization on newborn mortality actually took place *before* the actual year of liberalization. Therefore, I also re-estimate the effect of economic liberalization by assuming that countries were economically liberalized one to five years earlier than Wacziarg and Horn-Welch's index indicates. However, as the results in table 7 show, no significant effect is found for any of the lagged treatment variables.



**Table 7: Results lagged treatment variable**

<b>Years from Economic liberalization</b>	<b>- 1 years</b>	<b>- 2 years</b>	<b>- 3 years</b>	<b>- 4 years</b>	<b>- 5 years</b>
Economic liberalization	-0.00258 (0.00280)	-0.00132 (0.00264)	0.00329 (0.00263)	0.00360 (0.00332)	0.00450 (0.00290)
Constant	0.275*** (0.0634)	0.278*** (0.0649)	0.268*** (0.0658)	0.268*** (0.0653)	0.270*** (0.0634)
Observations	522,680	522,680	522,680	522,680	522,680
R-squared	0.021	0.021	0.021	0.021	0.021
Number of motherid	161,409	161,409	161,409	161,409	161,409
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

As previously discussed, socio-economic status matters for individual health. Results from previous empirical research show for instance that economic openness has a larger effect on individuals in low-income countries (Owen and Wu, 2007). To see if this is the case in the context of this study, I re-estimate the effect of economic liberalization on infant mortality on sub-samples of the population included in the analysis. Firstly, only mother living in rural areas will be included in the analysis. Living in a rural area can be considered as a proxy for lower socio-economic status as opposed to women living in urban areas (Bhalotra, 2008)<sup>12</sup>. Secondly, only those mothers living in urban areas are included in the estimation. Another indicator of socio-economic status is education. A sub-sample only including mothers with no education is therefore used in order to see how economic liberalization affect infant mortality for those births with a lower socio-economic status. Finally, a sub-sample of mothers both living in rural areas and with no education is used. However, from these results presented in table 8 no conclusion can be drawn whether economic liberalization affect infant mortality in lower socio-economic groups differently compared to those with higher socio-economic status.

<sup>12</sup> However, it should be noted that the place of living refers to whether a woman lived in a rural or urban area at the time she was interviewed for the survey, not at the time of her births. It may therefore not be an accurate indicator of socio-economic status at the time of giving birth.

**Table 8: Results sub-samples**

	Only rural	Only urban	No education	No education and rural
	(1)	(2)	(3)	(4)
VARIABLES	Infant mortality	Infant mortality	Infant mortality	Infant mortality
Economic liberalization	-0.00287 (0.00237)	-0.00235 (0.00376)	-0.00101 (0.00311)	-0.00216 (0.00304)
Observations	380,383	142,297	258,963	208,483
R-squared	0.020	0.022	0.020	0.020
Number of motherid	111,949	49,460	71,763	57,100

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 8. Discussion

Based on theory and previous empirical studies covering the relationship of economic openness and health, a negative relationship between the treatment variable *economic liberalization* and infant or neonatal mortality was expected to be found in this study. However, the results above indicate such a casual relationship cannot be established. The sub-sample analyses on groups of different socio-economic status do neither show any significant results, why no conclusion can be drawn whether economic liberalization affects infant mortality in differently depending on education level or place of residence.

The results from the OLS model (table 4) do indicate there is a positive effect of economic liberalization on infant and neonatal mortality; however, when adding a restriction to the model in terms of country fixed effects, the results suggest there are unobserved factors on a country level that confound this relationship. It is thus reasonable to assume that the OLS results obtained without controlling for country fixed effects were biased due to the influence of unobserved factors on country level. As the mother fixed effects model implicitly controls for unobserved country factors, it is not surprising that the results from this model neither show any significance. Although, it is not possible from the results of the mother fixed effects model to disentangle to what extent unobservable factors on country versus mother level affect the relationship between economic liberalization and child health.

It should be noted that the results of this study do not need to contradict the results of previous studies that all find a casual relationship between economic openness and health. However, this study indicates that although economic openness appears to a positive effect on health when studying the relationship on an aggregated level using cross-country data, this effect is not necessarily captured when studying the relationship on a micro level. As the only other empirical work also using individual data (Panda, 2014) do find that trade openness (measured as membership of a trade agreement) have a negative effect on infant mortality, it is evident that more research is needed to fully understand though which channels economic liberalization may affect health.

Measuring economic liberalization and economic openness is not a straightforward task and as seen in the review of previous literature there are a number of different ways to measure this – and no measure is likely to be a perfect measure. The measure of economic liberalization used in this study, Sachs and Warnern’s index, is likely to capture a broader process of economic openness than for instance the directly trade-related measure total trade as share of GDP. Economic liberalization is not a one-time event or an exogenous shock but a process that a country undertakes over many years. If the economic liberalization process is continuously affecting health through various channels and mechanisms, it is difficult to identify a clear-cut point (i.e., a specific year) from where the process can be said to have the largest impact on health. Thus, a model that uses a specific year to assume that a birth is “treated” with economic liberalization and another birth is not may not capture the positive effect that economic liberalization is believed to have on child health. Furthermore, this approach may also capture any other potential common feature shared by those countries assumed to be economically liberalized, which may affect child health negatively or positively.

Moreover, it is also plausible that infant and neonatal mortality, in the setting of this study, is not capturing the positive effects that economic openness is assumed to have on health. It may also be that the *negative* effects that economic openness is also believed to have on health, such as smoking and consumption of “bads”, may impact the results and making it difficult to draw any conclusion on how economic liberalization actually affects health.

Given the results of this study, it can be concluded that further studies are needed in order to confirm the casual relationship between economic liberalization and health. Foremost, more studies are needed on individual level in order to disentangle the differences in results between studies on aggregated and individual level, and to fully understand the underlying mechanisms through which economic liberalization and openness may affect health.

## **9. Concluding remarks**

For the past four decades, economic liberalization has been seen as a panacea for economic growth and for improvement of countries' welfare. The relationship between economic openness and health has been studied in several empirical studies on macro level. This study contributes to previous empirical literature both by investigating the relationship between economic liberalization and health on individual level and by using a combination of data not previously used for this purpose. Studying the relationship between economic openness and health is of great relevance, as many determinants of individual health are found on individual level. However, from the results of this study it is not possible to draw any conclusions about the casual effect of economic liberalization on infant or neonatal mortality. This holds also when conducting sub-sample analyses on different socio-economic groups. The results suggest that there exists unobserved heterogeneity on country and mother level that confounds this relationship. More research, in particular on individual level, is thus needed in order to fully understand how economic liberalization may affect health.

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# Appendix A

Figure 5: Number of births per country

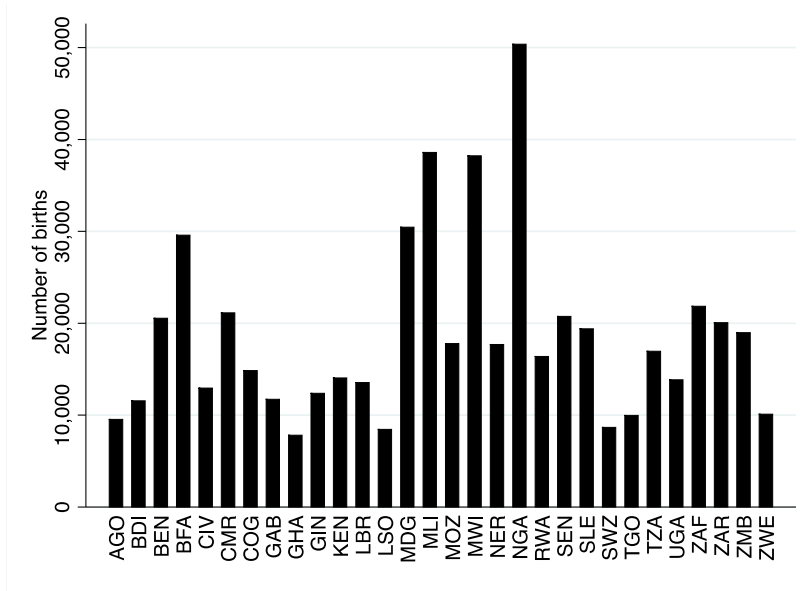
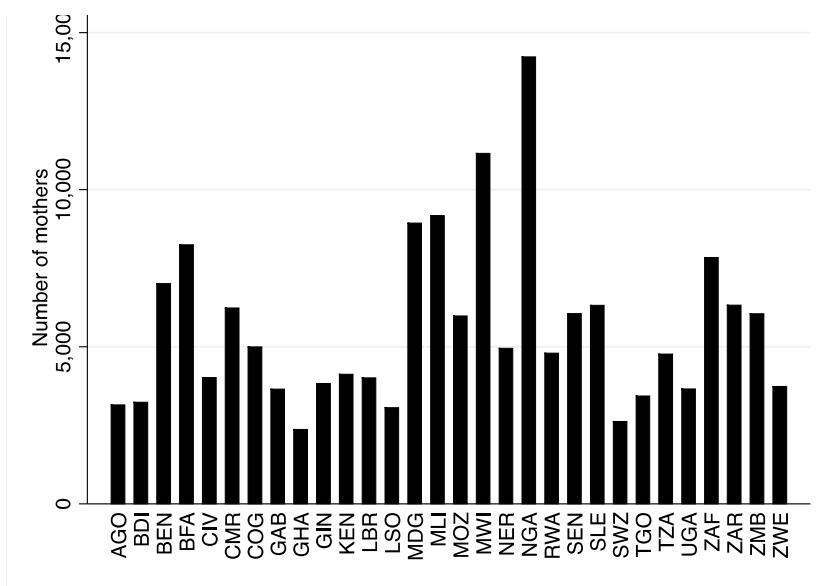
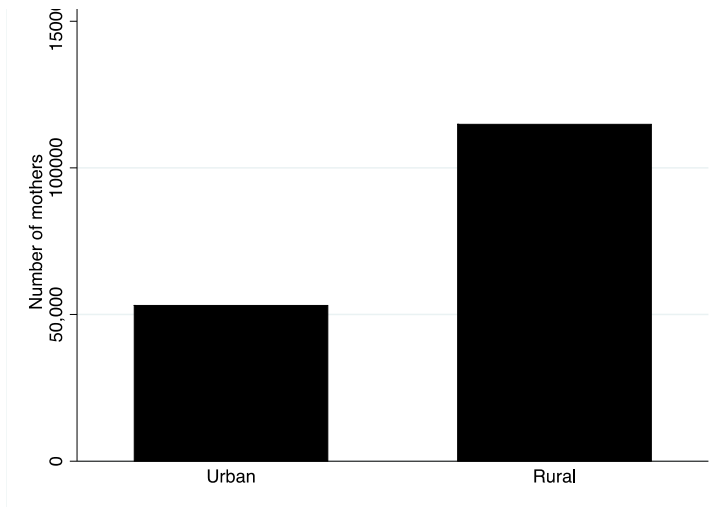


Figure 6: Number of mothers per country



**Figure 7: Place of residence mothers**



**Figure 8: Number of years in school**

