

# Essays on the economics of education and health

Iman Dadgar





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Iman Dadgar

Academic dissertation for the Degree of Doctor of Philosophy in Economics at Stockholm University to be publicly defended on Friday 13 May 2022 at 13.00 in Nordenskiöldsalen, Geovetenskapens hus, Svante Arrhenius väg 12.

## Abstract

**Study I:** This paper investigates the effect of the academic ordinal rank position of Swedish grade 9 students relative to their school peers on future educational achievement and adult earnings. The results show evidence of a positive impact of being more highly ranked in the class, and the effects are concentrated to the top and the bottom of the ordinal rank distribution. High-ability students from low-income families gained the most from having a higher ordinal rank in grade 9. The results contrast with US findings, which suggest a similar impact across the rank distribution.

**Study II:** This paper studies the effect of a reform that increased school-level autonomy in determining how to allocate time between different subjects in Sweden. It evaluates the impact of the reform using registry data in a Difference-in-Differences framework. The results suggest that students' educational outcomes, including the subsequent choice of educational track, were not affected by the reform. However, there are some indications that students in large schools and students from low socioeconomic households may have benefited from the reform.

**Study III:** Research suggests that increases in gross domestic product (GDP) lead to increases in traffic deaths plausibly due to the increased road traffic induced by an expanding economy. However, there also seems to exist a long-term effect of economic growth that is manifested in improved traffic safety and reduced rates of traffic deaths. Previous studies focus on either the short-term, procyclical effect, or the long-term, protective effect. The aim of the present study is to estimate the short-term and long-term effects jointly in order to assess the net impact of GDP on traffic mortality. We performed error correction modelling to estimate the short-term and long-term effects of GDP on the traffic death rates. The estimates from the error correction modelling for the entire study period suggested that a one-unit increase (US\$1000) in GDP/capita yields an instantaneous short-term increase in the traffic death rate by 0.58 ( $p < 0.001$ ), and a long-term decrease equal to  $-1.59$  ( $p < 0.001$ ). However, period-specific analyses revealed a structural break implying that the procyclical effect outweighs the protective effect in the period prior to 1976, whereas the reverse is true for the period 1976–2011.

**Study IV:** Unemployment might affect several risk factors of cardiovascular disease (CVD), which is the leading cause of death globally. The characterization of the relation between these two phenomena is thus of great significance from a public-health perspective. The main aim of this study was to estimate the association between the unemployment rate and mortality from CVD and from coronary heart disease (CHD). We used time-series data for 32 countries spanning the period 1960–2015. We applied two alternative modelling strategies: (a) error correction modelling, provided that the data were co-integrated; and (b) first-difference modelling in the absence of co-integration. Separate models were estimated for each of five welfare state regimes with different levels of unemployment protection. We also performed country-specific ARIMA-analyses. Because the data did not prove to be co-integrated, we applied first-difference modelling. Our findings, based on data from predominantly affluent countries, suggest that heart-disease mortality does not respond to economic fluctuations.

**Keywords:** *education, ordinal rank, decentralization, timetable, accident mortality, heart-disease mortality, unemployment, GDP.*

Stockholm 2022

<http://urn.kb.se/resolve?urn=urn:nbn:se:su:diva-203003>

ISBN 978-91-7911-830-3

ISBN 978-91-7911-831-0

ISSN 0283-8222



Stockholm  
University

Department of Economics

Stockholm University, 106 91 Stockholm



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ISBN print 978-91-7911-830-3

ISBN PDF 978-91-7911-831-0

ISSN 0283-8222

Printed in Sweden by Universitetsservice US-AB, Stockholm 2022



To my parents, Hossein  
and Shahin.



## Contents

Acknowledgment .....	2
Abstract .....	5
Svensk sammanfattning .....	7
Introduction .....	9
School autonomy, student grade rank, and educational achievement .....	10
The effect of ordinal rank in school on educational achievement and income in Sweden .....	10
School autonomy and subject-specific timetables .....	11
Economic fluctuation and different causes of death .....	11
Short-term and long-term effects of GDP on traffic deaths .....	11
Is there a link between cardiovascular mortality and economic fluctuations? .....	12
References .....	13

# Acknowledgment

Starting and completing Ph.D. programs can either result in success (=1) or fail (=0). The question is: which factor contributes to making a Ph.D. journey a success? For me, the probability to start and succussed was about zero unless many variables – exogenously - pushed it to 1. I was born in a middle-class family; I was in the middle part of the ability distribution in the middle of the class and always got the middle grades. Therefore, I am fortunate that I was randomly assigned to people who helped me finish this journey.

First and foremost, a warm thanks to Karin Edmark, my main supervisor, for her support and advice. Karin, I have learned a lot from you, especially from how you address critical comments on papers and your clever solutions. Our continuous research discussions have truly been a source of comfort during my Ph.D. studies. You always had planned ahead and knew the next steps- Matthew Lindquist, my co-advisor, you have a visionary view on research, which I hope has transmitted to me. Thank you, Matthew, for being a source of inspiration and encouragement. You have always helped me to envision my long-term research paths. Thanks to both of my supervisors, I could not wish for better ones.

I started at SOFI by being a research assistant to Thor Nordström, I was fortunate to co-author three papers with him. Totto, thank you for your trust, endless support, and great dinners with Thelmo! It has always been my pleasure to work for/with you.

I also want to thank my master thesis supervisor, Hans Grönqvist, for his encouragement, which led me to SOFI. Anders Stenberg, thank you for patiently reading my papers and providing constructive and detailed feedback for last year. I am also grateful to Jonas Vlachos, the discussant in my final seminar, for providing helpful comments.

I feel privileged to have been in a dynamic and constructive research environment like the one at SOFI. Malin, I am glad that we were fellow Ph.D. colleagues – our chats about research, life, and kids have been a source of comfort during these years! Christine, thanks for your openness and idea exchange. Roza, thanks for being generous with your time and advice. Orsa and Marie-Pascal, thank you for helping and encouraging me to apply for various jobs-last year. Jose, you have brought the Spanish warmth to SOFI.

SOFI would not have been the same without the guidance and support of its administrative staff, which have helped (and shielded) me from various administrative matters. Maria Mårtensson, thanks for all the letters to Migrationverket. Tara Nabavi, for your structure, Anne Jenson, for managing

courses and study plans. Katarina Hagelin, Irma Muñoz, Elma Sose, Julio Lundborg, and Daniel Rossetti, thank you for your help and patience!

I would like to express my gratitude to Yassaman Rostamian (@yassamanrostamian) for the great illustration of my thesis cover.

I appreciate the funding from Handelsbanken and IFAU. The Handelsbanken scholarship allowed me to go to Oxford University as an exchange. This was a unique chance for me to visit a great institution and get inspired by Oxford's leading researchers' interaction. I also would like to thank Prof. Brian Nolan for hosting me during my time at Oxford.

When I came to Sweden ten years ago, I only knew one person, but now Sweden is my second home, and I am surrounded by lovely friends.

Roujman, it is impossible to thank you in a couple of sentences. I am lucky that our paths crossed, and I got to know you. You have supported me during all these years, from the first presentation I had at the master's program to the last steps of finalizing my dissertation. We have spent lots of time together: laughing, improving each other's ideas, and discussing everything from how "good" research should be conducted to which is the tastiest candy bar on campus! I cannot imagine finishing this journey without you. Thank you for being my closest friend.

Amir and Fatemeh, we have known each other from the beginning of my journey in Sweden; your kindness is endless, and the world would have been a better place if there were more people like you. Mahsa & MR. Asadi and the crew, for the love, support, and "Bahman koochik"! Amin & Behnaz being with you make winter nights brighter and more pleasant; thank you for being such amazing friends and for "Eshgh o Haal"! Omid, I have learned so much from you, and I am proud to have you as "Amo." Hoda and Adonis, we are going to have more excitement next year!

Justine and Nico, thank you for being true friends through the years, for all the great times we spent together, and for many more! Amin & Ghazal, thank you for all your kindness and for always being great friends. Mehdi, I have known you since high school, and you have not been changed a bit all these years! Thanks for your "Ma'refat"!

My old-economist friend, Javad, for being a true companion since our BSc, you were always a great source of will and motivation. I am looking forward to starting working on various projects together. Mohammad, thanks for all the musical exchanges and discussions; I hope we see each other more in the near future. All my old friends, Behnam, Inoor, Ali M, Ali H, Reza, Sajedeh, Parisima, Ehsan, for the great time we spent together.

My mother in-law, Farideh, thank you for always being kind and caring! Alireza, for all the memories and the times we spent together.

My dear "Khanom Darabi," my mom, you were the symbol of a real teacher in our family; we always had discussions about the education system, teachers' rights, and improving students' grades. I miss you a lot. I hope you were here. Ali, thanks for being a perfect "big brother" to me; you were always available

when I needed you. You are a great source of energy in our family. Laya, Artin, Liane and Ali, I missed you lot and I hope see you more.

Pouneh, you are not just a sister but my oldest friend. We shared a lot of critical moments in life together. You are the source of inspiration and a role model to me! Baba Janam, thanks for your unconditional love and support. You are the kindest person I know; I wish I could be more like you.

Nava, since you came into my life, I deeply understood that nothing matters more than your smiles. You are a source of joy, fun, and love. Thanks for making our life colorful and beautiful.

Idayi, how can I even thank you? In every single step, from the first day we met at SBU in Iran until now that I am graduating from SU, you were always supportive, kind, patient, and most importantly, you always believed in me. To me, you are the definition of love. To you, Ida;

ورزند مجلس زندان خبری نیست که نیست

(حافظ)

مصلحت نیست که از پرده برون اقتدر از

Iman Dadgar

Stockholm, April 2022

# Abstract

**Study I:** This paper investigates the effect of the academic ordinal rank position of Swedish grade 9 students relative to their school peers on future educational achievement and adult earnings. The results show evidence of a positive impact of being more highly ranked in the class, and the effects are concentrated to the top and the bottom of the ordinal rank distribution. High-ability students from low-income families gained the most from having a higher ordinal rank in grade 9. The results contrast with US findings, which suggest a similar impact across the rank distribution.

**Study II:** This paper studies the effect of a reform that increased school-level autonomy in determining how to allocate time between different subjects in Sweden. It evaluates the impact of the reform using registry data in a difference-in-differences framework. The results suggest that students' educational outcomes, including the subsequent choice of educational track, were not affected by the reform. However, there are some indications that students in large schools and students from low socioeconomic households may have benefited from the reform.

**Study III:** The aim of the present study is to estimate the short-term and long-term effects jointly in order to assess the net impact of GDP on traffic mortality. We performed error correction modeling to estimate the short-term and long-term effects of GDP on traffic death rates. We used time-series data for 18 countries spanning the period 1960–2011. The estimates suggested that a one-unit increase (US\$1000) in GDP/capita yields an instantaneous short-term increase in the traffic death rate by 0.58 and a long-term decrease equal to  $-1.59$ . However, period-specific analyses revealed a structural break implying that the procyclical effect outweighs the protective effect in the period prior to 1976, whereas the reverse is true for the period 1976–2011.

**Study IV:** The main aim of this study was to estimate the association between the unemployment rate and mortality from cardiovascular disease (CVD) and from coronary heart disease (CHD). Additional aims were (a) to assess whether the associations are modified by the degree of unemployment protection, (b) to determine the impact of GDP on heart-disease mortality, and (c) to assess the impact of the Great Recession in this context. We used time-

series data for 32 countries spanning the period 1960–2015. The estimated effect of unemployment and GDP on CVD as well as CHD was statistically insignificant across age and sex groups and across the various welfare state regimes. An interaction term capturing the possible excess effect of unemployment during the Great Recession was also statistically insignificant.



# Svensk sammanfattning

## Studie 1

Studien undersöker om svenska elevers rangordning i förhållande till skolkamraterna, med avseende på deras studieprestationer, påverkar deras utbildning och inkomster senare i livet. Resultaten tyder på att det har en positiv effekt att vara högre rankad i klassen, och att effekterna är koncentrerade till toppen och botten av den fördelningen. Studenter med höga betyg från låginkomstfamiljer påverkas särskilt starkt av att vara högre upp i rangordningen. Resultaten kontrasterar mot tidigare studier från USA, där man funnit en likartad effekt i hela fördelningen.

## Studie 2

Studien studerar effekten av en decentraliseringsreform som ökade svenska skolors inflytande över fördelningen av undervisningstid mellan skolämnena. Reformens effekter undersöks genom att applicera difference-in-difference-metoden på ett detaljerat registerdatamaterial. Resultaten tyder på att reformen inte hade någon effekt på att elevernas utbildningsresultat eller val av utbildningsval i genomsnitt. Det finns dock indikationer på att elever i stora skolor och elever från familjer med lägre socioekonomisk status kan ha gynnats av reformen.

## Studie 3

Syftet med studien är att skatta de kortsiktiga och långsiktiga effekterna av BNP på trafikdödlighet. Vi använde tidsseriedata för 18 länder som täckte perioden 1960–2011. Resultaten av den ekonometriska analysen tyder på att en ökning av BNP/capita motsvarande 1000 USD ger en omedelbar kortsiktig ökning av trafikdödlighetsraten (per 100 000) med 0,58, och en långsiktig minskning lika med -1,59. Periodspecifika analyser visade dock på ett strukturellt skifte, som innebär att den procykliska effekten uppväger den skyddande effekten under perioden före 1976, medan det omvända gäller för perioden 1976–2011.

## Studie 4

Huvudsyftet med denna studie var att skatta sambandet mellan arbetslöshet och dödlighet i hjärt-kärlsjukdom och kranskärlssjukdom. Ytterligare syften var (a) att undersöka om sambandet varierar beroende på utformningen av arbetslöshetsskyddet, (b) att skatta BNP:s inverkan på dödligheten i hjärt-kärl-

sjukdomar och kranskärslssjukdom, och (c) att skatta effekten av finanskrisen 2008 i detta sammanhang. Vi använde tidsseriedata för 32 länder som täcker perioden 1960–2015. Den skattade effekten av arbetslöshet och BNP på dödlighet i hjärt-kärlsjukdom och kranskärslssjukdom var statistiskt insignifikant; detta gällde för olika ålders- och könsggrupper liksom för olika system för arbetslöshetsskydd. En interaktionsterm avsedd att skatta effekten av arbetslöshet under lågkonjunkturen 2008 var också statistiskt insignifikant.

# Introduction

This thesis uses insights and methods from Economics to study two aspects central to society's welfare: health and education. The first part of the thesis includes two single-authored papers on the topic of the Economics of Education, while the second part of the thesis includes two co-authored papers (together with Thor Norström) on the relationship between macroeconomic fluctuations and mortality.

Two fundamental yardsticks of any welfare state are to what extent and at what level of quality it provides education and healthcare to its citizen. The share of GDP allocated to these areas indicates how high these two aspects are placed on the political agenda. In the year 2018, almost 11% of Gross Domestic Product (GDP) was spent on healthcare in Sweden and 7% on education.<sup>1</sup>

The main objective of an economist is to investigate how resources are allocated and what are the consequences of these allocations for individuals, groups, and society as a whole. The aim of this thesis is to contribute to such analyses in several aspects: The first study analyzes the impact that the ordinal rank of students in school, in terms of academic achievement, has on their long-term educational and labor market outcomes. Although ordinal rank has received some attention in previous literature (Jonsson and Mood 2008, Booi, Leuven et al. 2017), I contribute by applying a sophisticated empirical strategy (Murphy and Weinhardt 2020, Denning, Murphy et al. 2021) to Swedish register data. In the second study, I investigate the long-term effects of a decentralization policy, implemented in the year 2000, that gave Swedish schools more authority over the timetable. Surprisingly, very little research has been performed on this policy, and the studies that do exist are mostly of a qualitative nature (Nyroos, Rönnerberg et al. 2004, Rönnerberg 2007). The second study of this thesis aims to quantitatively evaluate if this decentralization policy has had any effect on pupils' long-term outcomes, such as their Grade Point Average (GPA), the probability of attending the STEM field, and years of education. Third, previous research on health and macroeconomic fluctuations has tended to either focus on the short-term (procyclical effect) or the long-term (protective effects) between GDP growth and traffic deaths. In the third study, we combine both of these effects in the same model in order to assess the net impact of GDP on traffic mortality. The

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<sup>1</sup> Source: World Bank

fourth study continues this line of research by investigating how cardiovascular mortality responds to changes in unemployment.

## **School autonomy, student grade rank, and educational achievement**

In modern society, students spend almost one-third of their lives in schools, and it is vital to have an efficient and equal education system. Hanushek (2020) listed four essential factors of the education production function: family attributes, school resources, teacher quality, and the quality of peers. This part of the thesis focused on two empirical questions about school management and peers' effects on students. The first paper discusses the impact of the ordinal educational performance rank of the students within schools on their long-term outcomes, and the second paper investigates how higher school autonomy affects students' educational achievement.

### *The effect of ordinal rank in school on educational achievement and income in Sweden*

This paper investigates the effect of the academic ordinal rank position of Swedish grade nine students relative to their school peers on future educational achievement and adult earnings. The ordinal rank effect is a version of the peer effect, but instead of focusing on the average effect of peers, it focuses on students' positions in the ability distribution. A lower rank in the class could impact student self-confidence and social status, leading to lower efforts in the future. It is also possible that being surrounded by high-performance students (and having lower rank) increases students' motivation (Black, Devereux et al. 2013) and gives them better networks in the future. There are also effects of parents and teachers who can react to the low ordinal rank in different ways (Lavy, Paserman et al. 2012).

To empirically analyse the effect of ordinal rank on student outcomes, it is essential to control for all confounding factors that affect outcomes from other channels. The model isolates the rank effect by conditioning on student ability, school-cohort fixed effects, and school types.

The results show evidence of a positive impact of being more highly ranked in the class, and the effects are concentrated to the top and the bottom of the ordinal rank distribution. These results contrast with US findings, which suggest a similar impact across the rank distribution (Denning, Murphy et al. 2021). For example, increasing the rank from the 75<sup>th</sup> percentile to the top of the class increases the probability of attending the STEM field by almost 6%. The ordinal rank had an extreme effect on students with very low ability: going from the bottom to the second percentile increased the probability of finishing upper secondary school by almost 25%. The paper also finds

heterogeneous effects of ordinal rank: high-ability students from low-income households and immigrants gained the most from having a higher ordinal rank in grade nine. The paper also investigated if those students are more prone to comparing themselves to students of the same gender. The girls' rank among girls strongly affects attending in the STEM track, years of education, and income rank for girls at the top of the class. In the left part of the distribution, the effect of boys' position among boys is more substantial among low achieving boys. Here, a boy's lower rank hurts income, finishing upper secondary school, and attending vocational track.

### *School autonomy and subject-specific timetables*

This paper studies the effect of a reform that increased school-level autonomy in determining how to allocate time between different subjects in Sweden. The reform took place in 900 of Sweden's approximately 3000 primary and lower secondary schools in the early 2000s. This study evaluates the impact of the reform using registry data in a difference-in-differences framework. The results suggest that students' educational outcomes, including the subsequent choice of academic track, were not affected by the reform. However, there are some indications that students in large schools, and students from low socioeconomic households may have benefited from the reform.

## **Economic fluctuation and different causes of death**

This part contains two papers. The first paper investigates the short-term and long-term effects of GDP growth on traffic accident mortality. The second paper studies the effect of unemployment on heart disease mortality.

### *Short-term and long-term effects of GDP on traffic deaths*

Previous research suggests that increases in the GDP lead to increases in traffic deaths plausibly due to the increased road traffic induced by an expanding economy (Neumayer 2004, Ruhm 2015, He 2016). However, there also seems to exist a long-term effect of economic growth that is manifested in improved traffic safety and reduced rates of traffic deaths (Van Beeck, Borsboom et al. 2000, Yannis, Papadimitriou et al. 2014). Previous studies focus on either the short-term, procyclical effect, or the long-term, protective effect. The aim of the present study is to estimate the short-term and long-term effects jointly in order to assess the net impact of GDP on traffic mortality.

We extracted traffic death rates for the period 1960–2011 from the WHO Mortality Database for 18 OECD countries. Data on GDP/capita were obtained from the Maddison Project. We performed error correction modeling to estimate GDP's short-term and long-term effects on traffic death rates. The estimates from the error correction modeling for the entire study period

suggested that a one-unit increase (US\$1000) in GDP/capita yields an immediate short-term increase in the traffic death rate by 0.58 ( $p < 0.001$ ) and a long-term decrease equal to  $-1.59$  ( $p < 0.001$ ). However, period-specific analyses revealed a structural break implying that the procyclical effect outweighs the protective effect in the period prior to 1976, whereas the reverse is true for the period 1976–2011.

*Is there a link between cardiovascular mortality and economic fluctuations?*

Unemployment might affect several risk factors of Cardiovascular Disease (CVD) (Catalano, Goldman-Mellor et al. 2011), which is the leading cause of death globally. The characterization of the relation between these two phenomena is thus of great significance from a public-health perspective. The main aim of this study was to estimate the association between the unemployment rate and mortality from CVD and from Coronary Heart Disease (CHD). Additional aims were (a) to assess whether the associations are modified by the degree of unemployment protection, (b) to determine the impact of GDP on heart-disease mortality, and (c) to assess the impact of the Great Recession in this context. We used time-series data for 32 countries spanning the period 1960–2015. We applied two alternative modeling strategies: (a) error correction modeling, provided that the data were co-integrated, and (b) first-difference modeling in the absence of co-integration. Separate models were estimated for each of the five welfare state regimes with different levels of unemployment protection. We also performed country-specific ARIMA-analyses. Because the data did not prove to be co-integrated, we applied first-difference modeling. The estimated effect of unemployment and GDP on CVD as well as CHD was statistically insignificant across age and sex groups and across the various welfare state regimes. An interaction term capturing the possible excess effect of unemployment during the Great Recession was also statistically insignificant. Our findings, based on data from predominantly affluent countries, suggest that heart-disease mortality does not respond to economic fluctuations.

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