The London School of Economics and Political Science

Essays on inequalities in health and health care during economic recessions

Ilias-Ioannis Kyriopoulos

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Declaration of Authorship

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

I warrant that this authorisation does not, to the best of my belief, infringe the rights of any third party.

I declare that my thesis consists of 57,607 words including footnotes, excluding references and appendices.

Statement of Conjoint Work

Parts of the work presented in this thesis have been published or are currently under review in peer-reviewed academic journals.

A modified part of the introduction has been accepted for publication as a peer-reviewed book chapter, co-authored with Professor Elias Mossialos. I reviewed the literature, drafted the introductory chapter, contributed to subsequent drafts, and I am the guarantor. Professor Elias Mossialos reviewed and commented on drafts of the chapter. The citation of the book chapter is:

- Kyriopoulos I., Mossialos E. (forthcoming), Health policy and reforms in Greece: an overview (1989-2017), In: Immergut E., Anderson K., Devitt C., Popic T. (Eds.), Health Politics in Europe: A Handbook, Oxford: Oxford University Press

A modified version of Chapter 2 has been published in a peer-reviewed journal, co-authored with Dr Zlatko Nikoloski and Professor Elias Mossialos. I conceived the study, reviewed the literature, analysed the data, ran the models, interpreted the findings, wrote the paper, submitted the paper for publication, revised the subsequent drafts, and I am the guarantor. Dr Zlatko Nikoloski provided methodological suggestions and feedback on drafts. Professor Elias Mossialos approved the methodology, supervised the study, and reviewed and commented on drafts of the paper. The full citation of the published study is:

- Kyriopoulos I., Nikoloski Z., Mossialos E. (2019), The impact of the Greek economic adjustment programme on household health expenditure, Social Science & Medicine, 222, 274-284.

A modified version of Chapter 4 has been published in a peer-reviewed journal, co-authored with Dr Zlatko Nikoloski and Professor Elias Mossialos. I conceived the study, reviewed the literature, collected and analysed the data, ran the models, interpreted the findings, wrote the paper, submitted the paper for publication, revised the subsequent drafts, and I am the guarantor. Dr Zlatko Nikoloski provided methodological suggestions. Professor Elias Mossialos approved the methodology, supervised the study, and reviewed and commented on drafts of the paper. The full citation of the published study is:

- Kyriopoulos I., Nikoloski Z., Mossialos E. (2019), Does economic recession impact newborn health? Evidence from Greece, Social Science & Medicine, 237 (available online, the printed version will be published in September 2019)

Apart from the parts of the thesis that have been already published or have been unconditionally accepted for publication, the following studies will be submitted in peer-reviewed journals:

- A modified version of Chapter 3, titled “Financial protection in health among middle-aged and elderly: evidence from the Greek economic recession” will be submitted to a leading health policy journal.
- A part of Chapter 4, titled “Economic conditions and fertility decisions: evidence across socioeconomic groups” will be submitted to a leading health economics journal.

The published papers can be found in Appendix D.

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Abstract

During the past decade, Greece faced an unprecedented economic crisis and signed an economic adjustment programme (EAP) that brought about changes and reforms to the Greek health system. Comprised of three empirical studies, this thesis focuses on the impact of the Greek crisis on the health sector, with a particular interest in the responses to and implications of the crisis across socioeconomic groups.

The first paper studies how household spending behaviour and responses towards health care have changed across socioeconomic groups in the face of an economic shock and the relevant health policy measures. Our analysis suggests that the income elasticity of household health expenditure (HHE) is below unity and exhibits a significant increase after the introduction of the EAP. Thus, households exhibit greater health care consumption responses to changes in their income. Contrary to high socioeconomic status (SES) groups, lower SES households did not become more sensitive to income changes in the post-EAP period, and have been more "protective" about their health care consumption.

Focusing on the older population, the second study concentrates on the potential changes and implications in terms of financial protection against health payments during the Greek recession. We find that the headcount and overshoot of catastrophic health expenditure (CHE) increased during the crisis, with low-income and households with multimorbid patients being disproportionately affected. Prior to the crisis, CHE was mainly due to inpatient and nursing care. During the recession, however, the contribution of pharmaceutical spending to CHE substantially increased. Our analysis also reveals that there are widening inequalities in the risk of CHE across socioeconomic groups after the onset of the crisis.

The third paper mainly focuses on population health status. It studies how economic climate and uncertainty influence fertility decisions and responses across population groups, and further investigates whether economic conditions during pregnancy impact newborn health. Our findings generally suggest that birth weight and pregnancy length are procyclical. We also report heterogeneity in the relationship between economic conditions during pregnancy and newborn health across socioeconomic groups, with the birth outcomes of high-SES newborns being responsive to economic volatility only in the first trimester of pregnancy. Further, economic adversity during the preconception period increases the probability that women who conceive are highly educated and married. After

accounting for selection, we find that newborns exposed to the crisis while in utero tend to be lighter, with the effect being more detrimental for low-SES children.

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List of Abbreviations

2SLS: Two-stage Least Squares

BMI: Body Mass Index

BW: Birth weight

CHE: Catastrophic Health Expenditure

CI: Concentration Index

CPI: Consumer Price Index

CWI: Composite Welfare Indicator

DRG: Diagnosis Related Group

EAP: Economic Adjustment Programme

ECB: European Central Bank

EFSF: European Financial Stability Facility

EOPYY: National Organization for the Provision of Health Services

EPU: Economic Policy Uncertainty Index

ESI: Economic Sentiment Indicator

ESM: European Stability Mechanism

EU: European Union

EU-SILC: European Union Statistics on Income and Living Conditions

FE: Fixed Effects

GALI: Global Activity Limitation Instrument

GDP: Gross Domestic Product

GG: General Government

GLM: Generalized Linear Model

HBS: Household Budget Survey

HHE: Household Health Expenditure

HICP: Harmonised Index of Consumer Prices

HP: Hodrick-Prescott

IMF: International Monetary Fund

IV: Instrumental Variable

LBW: Low Birth Weight

MLE: Maximum Likelihood Estimation

MPO: Mean Positive Overshoot

MTPM: Modified Two-Part Model

OECD: Organization for Economic Co-operation and Development

OLS: Ordinary Least Squares

OOPE: Out-of-pocket Expenditure

PPP: Purchasing Power Parity

PSM: Propensity Score Matching

SES: Socio-Economic Status

SHARE: Survey of Health, Ageing and Retirement in Europe

SSM: Sample Selection Model

TPM: Two-Part Model

VLBW: Very Low Birth Weight

WHO: World Health Organization

Chapter 1

Background and Motivation

1.1. The Greek crisis

Since the late 2000s, economic recession in Europe and the relevant policy responses have dominated the public dialogue and the political agenda. Europe experienced a multifaceted crisis, uncovering the Eurozone's structural and design problems and threatening its stability[1] (Baldwin & Giavazzi, 2015; De Grauwe & Ji, 2012). In particular, the European economy faced three interlinked crises: a sovereign debt crisis due to the rising government bond spreads and the concerns about sovereign debt sustainability, a banking crisis due to liquidity constraints, and a macroeconomic crisis associated with the moderate growth outlook and the lack of competitiveness, especially among the peripheral countries (Blundell-Wignall, 2012; Shambaugh, 2012).

The debt crisis broke out during the autumn of 2009, when the Greek government announced the revision of the fiscal deficit that was significantly higher than the previous estimate, exceeding 15% of the GDP (Gibson, Palivos, & Tavlas, 2014; Honkapohja, 2014). This announcement, along with Greece's high public debt and mediocre growth projections, raised concerns about the economic environment in Greece and decreased market confidence (Ardagna & Caselli, 2014). Creditors, rating agencies and financial markets questioned the solvency of the government bonds and the country's ability to refinance its debt, and also challenged the sustainability of the public debt (Featherstone, 2011; Gourinchas, Philippon, & Vayanos, 2016). Between the autumn of 2009 and July 2011, the 'big three' agencies downgraded Greece's credit rating 19 times (Ardagna & Caselli, 2012), with one them putting Greece on 'selective default' category at the end of February 2010 (Gibson, Hall, & Tavlas, 2014). In light of these developments, the spreads and sovereign credit risk dramatically increased, with Greece being the first Eurozone country to be excluded from the bond market.

Being unable to borrow from the private capital markets, Greece agreed to implement a large-scale economic adjustment programme (EAP) in exchange for financial

[1] Back in the 2000s, the economic and financial environment was, however, quite different. The sovereign debt spreads between Germany and other Eurozone countries were relatively low, reflecting the solvency and the close substitutability of bonds among the Euro Area countries, and the low perceived risk of default (Ardagna & Caselli, 2012; Favero, Missale & Beck, 2012).

assistance from the European Union (EU), the European Central Bank (ECB) and the International Monetary Fund (IMF) (the so-called 'Troika') (European Commission, 2010). In this context, Greece received the largest bailout package in history, partly due to increasing concerns about the systemic risks and contagious effects of the Greek debt crisis on other European countries (Gourinchas et al., 2016). In contrast to the other countries that successfully graduated from their adjustment programmes, Greece signed three successive programmes, all of which adopted a tight fiscal stance, included large-scale reforms and imposed substantial conditionality (Pagoulatos, 2018). In the first programme, signed in May 2010, Greece received a bilateral loan of 110 billion euros through the Greek Loan Facility, with 80 billion euros coming from Eurozone countries and the remaining provided by the IMF (European Commission, 2010). To put it in context, the loan amount approximated 44% of Greece's GDP in 2010 (Gourinchas et al., 2016). In March 2012, Greece signed a second EAP, with the total amount of financial assistance eventually rising to 240 billion euros (European Commission, 2012). In order to deal with public debt sustainability issues, the second programme also included a debt restructuring for the government bonds held by private creditors. These bonds thus incurred a voluntary haircut of 53.5% on their nominal value, resulting in debt relief of approximately 106 billion euros (European Commission, 2012). The Greek debt restructuring is generally regarded as the largest debt relief in modern history, and was the first to take place across European countries in the post-war period (Dreger, 2012; Forni, Palomba, Pereira, & Richmond, 2016; Zettelmeyer, Trebesch, & Gulati, 2013). After a turbulent period of negotiations in the first half of 2015, Greece agreed to the third successive EAP in August 2015 and to a new loan of up to 86 billion euros, conditional upon the adoption of a large-scale set of structural reforms and the continuation of fiscal discipline (European Commission, 2015b). In August 2018, and after eight years of financial assistance programmes, Greece finally completed the last EAP. Overall, the loans to Greece amounted to 288.7 billion euros, with almost 89% of them provided by the Eurozone, the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM), and the remaining being disbursed from the IMF (European Stability Mechanism, 2018).

There are several underlying reasons that explain why Greece was at the epicentre of the Eurozone crisis. Notwithstanding Greece's high GDP growth performance during the 2000s (almost 4% compared to an average of 2% in the Eurozone), the growth model largely relied on domestic consumption and borrowing (Tsakloglou & Anastasatou, 2014).

In the decade before the breakout of the crisis, the Greek economy was far from exhibiting fiscal discipline and did not meet the fiscal targets, with the general government and primary deficit exceeding 15% and 10% respectively (Eurostat, 2019b), and the public debt approximating 130% of GDP in 2009. Following a considerable deterioration of Greece's external competitiveness over the 2000s, the current account deficit also exceeded 10% in 2009. Apart from the twin deficits and the precarious and problematic growth model, Greece's capacity to promote and implement structural reforms was rather poor, not only in labour and product markets but also across various public policy domains including public administration, taxation, business environment, and the welfare state (Davaki & Mossialos, 2005; Featherstone, 2008). In this context, the EAP aimed to deal with these chronic deficiencies and weaknesses of the Greek economy, and thus focused on three main objectives: fiscal consolidation, external rebalancing and the implementation of large-scale structural reforms.

Table 1. 1: Main macroeconomic indicators in Greece (2008-2017)

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Real GDP per capita (in euros)	22600	21500	20300	18500	17200	16800	17000	17100	17100	17400
Real GDP growth rate (% change)	-0.3	-4.3	-5.5	-9.1	-7.3	-3.2	0.7	-0.4	-0.2	1.5
GG gross debt (% GDP)	109.4	126.7	146.2	180.6	159.6	177.9	180.2	177.8	181.1	179.3
GG expenditure (% GDP)	50.8	54.1	52.5	54.1	52.8	51.6	50.2	50.6	48.9	47.3
GG revenue (% GDP)	40.7	38.9	41.3	43.8	46.2	47.9	46.2	47.9	49.5	48.3
GG balance (% GDP)	-10.2	-15.1	-11.2	-10.3	-6.6	-3.6	-4.0	-2.8	0.6	1.0
GG primary balance (% GDP)	-5.4	-10.1	-5.3	-3.0	-1.5	0.4	-0.1	0.8	3.8	4.1
Cyclically adjusted balance (% of potential GDP)	-12.1	-15.0	-8.9	-4.4	1.9	4.8	2.8	3.0	5.6	4.8
Cyclically adjusted primary balance (% of potential	-7.1	-10.0	-3.3	2.0	6.2	8.2	6.2	6.1	8.4	7.6

GDP)										
Exports (in million euros)	56,533	45,089	49,958	52,866	54845	54,835	57,837	55,931	53,059	59,455
Imports (in million euros)	87,040	68,319	69,452	66,889	63353	59,915	62,130	55,840	54,317	61,292
Current account balance (% GDP)	-15.1	-12.3	-11.4	-10.0	-3.8	-2.0	-1.6	-0.8	-1.7	-1.8
HICP inflation rate (% change)	4.2	1.3	4.7	3.1	1.0	-0.9	-1.4	-1.1	0.0	1.1
Output gap (% of potential GDP)	8.7	4.1	-0.8	-8.8	-14.0	-15.5	-13.9	-13.7	-13.7	-12.6
Private debt (% of GDP)	126.3	130.1	141.2	144.4	147.3	145.8	143.1	140.8	139.3	131.2
Household debt (% GDP)	56.6	59.3	68.4	71.8	75.6	74.5	71.9	69.5	66.7	62.8
Unemployment	7.8	9.6	12.7	17.9	24.5	27.5	26.5	24.9	23.6	21.5
Long-term unemployed	47.1	40.4	44.6	49.3	59.1	67.1	73.5	73.1	72.0	72.8
Youth unemployment	21.9	25.7	33	44.7	55.3	58.3	52.4	49.8	47.3	43.6

Source: Eurostat, IMF World Economic Outlook, Eurostat, OECD

During the period of the EAP, Greece achieved a remarkable improvement in some key macroeconomic indicators and gradually returned to positive growth rates after a prolonged recession, as shown in Table 1.1. The general government primary balance gradually ameliorated and turned into a surplus in 2014. In this context, the fiscal consolidation programme has been arguably characterized as the largest and fastest adjustment in the OECD, with the cyclically adjusted fiscal consolidation exceeding 20% of potential GDP during 2009-2016 (Giannitsis & Zografakis, 2018; Tsakloglou, 2019). Besides the unprecedented fiscal adjustment, Greece managed to rebalance its external position, achieved a considerable adjustment in unit labour costs and boosted competitiveness (European Commission, 2019). According to Table 1.1, the current account deficit, for example, decreased from 12.3% in 2009 to less than 2% during the last four years (OECD, 2018a).

Table 1. 2: Main social indicators in Greece (2008-2017)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
At-risk-of-poverty rate (%)	20.1	19.7	20.1	21.4	23.1	23.1	22.1	21.4	21.2	20.2
At-risk-of-poverty rate (anchored in 2008) (%)	20.1	18.9	18.0	24.9	35.8	44.3	48.0	48.0	47.8	46.3
At risk of poverty or social exclusion (%)	28.1	27.6	27.7	31.0	34.6	35.7	36.0	35.7	35.6	34.8
Mean equivalized net income (in euros)	12,766	13,505	13,974	12,626	10,676	9,303	8,879	8,683	8,673	8,800
Median equivalized net income (in euros)	10,800	11,496	11,963	10,985	9,513	8,371	7,680	7,520	7,500	7,600
S80/S20 income quintile share ratio	5.9	5.8	5.6	6.0	6.6	6.6	6.5	6.5	6.6	6.1
Gini coefficient	33.4	33.1	32.9	33.5	34.3	34.4	34.5	34.2	34.3	33.4
Gini coefficient (before social transfers)	35.2	34.8	34.9	35.6	36.6	37.0	37.0	36.5	36.8	36.0
People living in households with very low work intensity	7.5	6.6	7.6	12.0	14.2	18.2	17.2	16.8	17.2	15.6
Severe material deprivation rate (%)	11.2	11.0	11.6	15.2	19.5	20.3	21.5	22.2	22.4	21.1
Households with arrears (%)	24.4	28.7	30.9	31.9	39.0	45.3	46.4	49.3	47.9	44.9
Making ends meet with great difficulty (%)	20.0	22.3	24.2	25.6	35.0	39.6	39.5	38.2	40.6	39.9
Social expenditure (% of GDP)	21.3	24.0	24.9	26.0	26.9	25.1	25.2	25.4	25.7	24.8
Social expenditure	51,481	56,945	56,171	53,904	51,392	45,325	44,973	44,828	N/A	N/A

(in million euros)										

Source: Eurostat (EU-SILC), OECD

Along with the positive macroeconomic developments, the economic adjustment came at an unprecedented cost. First, the cumulative GDP decline amounted to more than a quarter during the decade-long recession, with the Greek crisis being the most severe and protracted economic downturn among developed countries in the post-war period (Andriopoulou, Karakitsios, & Tsakloglou, 2017; Reinhart & Rogoff, 2014). Second, the unemployment rate peaked at 27.5%, and was consistently higher than 20% until 2017, with three out of four unemployed persons being long-term unemployed. With the exception of Spain, the corresponding figures were substantially lower among European countries during the same period, with the EU average peaking at 10.8% in 2013 and gradually returning to the pre-crisis levels. Besides unemployment, there are also some additional implications of the economic crisis on the labour market. For instance, the percentage of individuals living in households with very low work intensity was 7.5% in 2008, and rose to 17.2% in 2016. Third, the implementation of a strict programme entailed heavy conditionality, and rapid and front-loaded fiscal adjustment (Meghir, Pissarides, Vayanos, & Vettas, 2017), having significant implications in terms of household disposable income and living conditions (European Commission, 2019; OECD, 2014). During 2009-2016, for instance, the mean equivalized income decreased by almost 36%. Based on a subjective non-monetary indicator, Eurostat data also reveal that the share of households making ends meet with great difficulty escalated from 20% to more than 40% during the same period. Fourth, several studies show that poverty, inequality and other social indicators have dramatically deteriorated in the wake of the crisis, suggesting that the social consequences and the distributional effects of the crisis have been strong (Kaplanoglou & Rapanos, 2016; Matsaganis & Leventi, 2014). For example, the severe material deprivation rate increased from 11.2% to 22.4%, while the percentage of the population at risk of poverty or social exclusion went from 28.1% to 35.6% during 2008-2016. The poverty rate, anchored in the 2008 threshold, also climbed from 18.9% to almost 48% over the same period. As shown in Table 1.2, inequality measures, such as the Gini index and the S80/S20 index, indicate that income inequality rose during the economic recession (Hellenic Statistical Authority, 2018). Last, the gross value of non-performing loans amounted to 106 billion euros in 2017, corresponding to approximately 47% of total

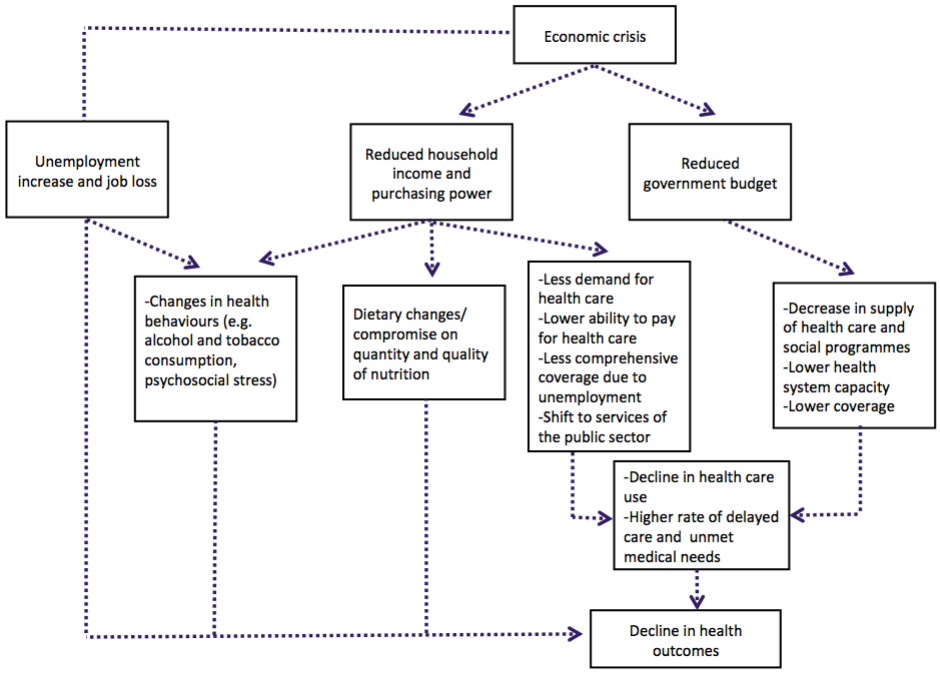
loans (OECD, 2018b). In the same spirit, EU-SILC data reveal that the share of households in arrears increased from a quarter to almost 48% during 2008-2016.

1.2. Economic crisis, health system performance and health outcomes

Being exogenous and unexpected, the breakout of the economic crisis in Europe has been characterized as a "health system shock" (Mladovsky et al., 2012). Understanding how such a shock influences health status and health system performance is a complex exercise, since it induces various changes in government resources and households' behaviour and financial situation, resulting in increased pressure on health system spending and revenue (Hou, Velényi, Yazbeck, Iunes, & Smith, 2013; Musgrove, 1987; Thomson et al., 2015a). Figure 1.1 shows the main transmission mechanisms through which an economic downturn influences health outcomes and the health sector in general.[2] On the demand side, an economic crisis, manifested in household disposable income decrease and rising unemployment, increases household financial difficulties and strain. Household financial distress is in turn expected to increase psychosocial stress and influence health behaviours, such as nutritional habits, and alcohol and tobacco consumption (Brinkman, De Pee, Sanogo, Subran, & Bloem, 2010; Nandi, Charters, Strumpf, Heymann, & Harper, 2013). In addition, household financial distress may erode insurance coverage, increase unmet medical needs and lead to lower levels of health care utilization (H. Waters, Saadah, & Pradhan, 2003a). Demand for health care may also shift from private providers to public services (World Health Organization, 2009; Yang, Prescott, & Bae, 2001). On the supply side, an economic crisis results in lack of fiscal space, with the fiscal contraction having implications for the public financing of the health system (Karanikolos et al., 2013; Morgan & Astolfi, 2015). In this spirit, the reduced public resources and the diminishing capacity of the public sector may reduce the availability of services, restrict access to health care and compromise the quality of care (Cylus, Mladovsky, & McKee, 2012; A. E. Kentikelenis, 2017; Nolan, Barry, Burke, & Thomas, 2014).

[2] This framework relies on previous work (Hou et al., 2013; Musgrove, 1987; H. Waters et al., 2003a). Given the complexity of this link and the multiple pathways, Figure 1.1 is by no means exhaustive but it presents the main and most policy-relevant mechanisms. In addition, the presence of these reactions and mechanisms generally varies in terms of timing; some are evident in the short run, while others are particularly relevant in a longer-term horizon.

Figure 1. 1: Explaining the effects of the economic crisis on the health sector and health status

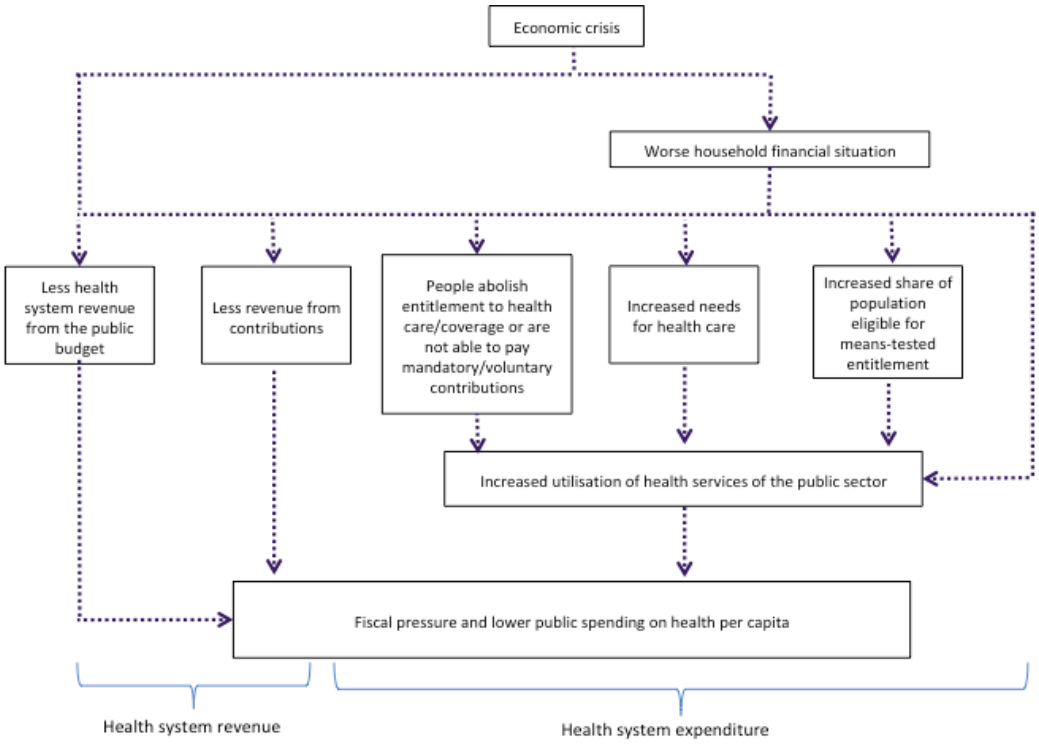


Source: Adapted from Musgrove (1987); Waters et al. (2003); Hou et al. (2013)

Despite its theoretical interest, the framework presented in Figure 1.1 does not fully capture all potential pathways, since government policy responses and household financial situation are often interlinked. In particular, fiscal space and public policy priorities largely determine the degree to which economic turmoil affects public expenditure on health and social care, whereas social spending and policy influence a recession's impact on the household financial situation (Hou et al., 2013; Thomson et al., 2014). Figure 1.2 presents a complementary framework for the factors that aggravate fiscal pressure in health systems during periods of recession. In this context, both public budget cuts and worsened household financial situation tend to generate additional financial pressure on the health system, threatening its sustainability (OECD, 2015). As Figure 1.2 shows, factors other than fiscal constraints and policy may also exacerbate the fiscal burden in health systems. In particular, financially distressed households may shift to public providers during economic recessions for various reasons, increasing the health system's fiscal pressure from the expenditure and demand perspective (H. Waters et al., 2003a; Yang et al., 2001).

There are some potential mechanisms that explain the demand-oriented pressure. First, population health status may deteriorate during economic recessions, suggesting increased needs and demand for health care (Kondilis, Giannakopoulos, et al., 2013; Modrek, Stuckler, McKee, Cullen, & Basu, 2013). Second, some household members may abolish the employment-related entitlement to health coverage or be unable to afford the insurance contributions, having access only to some specific services of the public sector (Economou, Kaitelidou, Karanikolos, & Maresso, 2017; van Gool & Pearson, 2014). Third, there is a direct "affordability effect", with households being less likely to spend for privately provided services due to reduced household income and purchasing power (H. Waters et al., 2003a; Yang et al., 2001). Fourth, an increasing share of households may be eligible for means-tested health coverage for the health services provided by the public sector through the use of social protection mechanisms. Last, some patients may also face unmet needs, compromise their adherence to treatment and prevention, and delay health care utilization, with potential implications on future hospitalizations, health outcomes and costs (A. Reeves, McKee, & Stuckler, 2015; World Health Organization, 2003).

Figure 1. 2: Fiscal pressure in health systems during an economic crisis



Source: Adapted from Thomson et al. (2015)

The aforementioned suggest that fiscal adjustment and pressure within the health system may influence some elements of health system performance beyond health outcomes, such as access to health services, quality of care, efficiency, financial protection and equity in financing (A. E. Kentikelenis, 2017; Mitropoulos, 2019; OECD, 2010; Peabody, 1996; Thomson et al., 2015a). However, the effects of recession on the health sector are generally contingent on various factors, such as the country context, the extent and severity of the recession, the existence of strong welfare state and social protection mechanisms and the relevant health policy responses (Kaplan, 2012; Suhrcke & Stuckler, 2012; Toffolutti & Suhrcke, 2014).

Evidence from European countries suggests that health policy responses to the recent crisis were quite heterogeneous, reflecting not only the variation in the extent of the economic decline but also the different public policy priorities across countries (Karanikolos et al., 2013; Maresso et al., 2014). Generally speaking, the policy responses can be classified into three broad categories (Thomson et al., 2015b). The first health policy domain focused on public financing of the health system. In particular, almost half of the European countries introduced measures regarding public resources devoted to the health sector during the crisis, with many of them following retrenchment policies in health care due to fiscal constraints and the implementation of adjustment programmes (Aaron Reeves, McKee, Basu, & Stuckler, 2014). Evidence, however, suggests that some countries were more resilient and protected, to some extent, their public budget for health, possibly due to higher fiscal space and the implementation of countercyclical policies (Karanikolos et al., 2013; Morgan & Astolfi, 2014). A relatively smaller number of countries confronted the inefficiencies and waste in public spending or raised additional resources for the health sector (Stuckler, Reeves, Loopstra, Karanikolos, & McKee, 2017). Second, most countries adopted changes to the core dimensions of health coverage, as the economic crisis unfolded. The majority of the coverage modifications concentrated on cost sharing strategies and the scope of coverage, with some European countries expanding health coverage and others aiming to restrict it due to the fiscal constraints (van Gool & Pearson, 2014). On the other hand, only a few countries implemented measures affecting population entitlement to health care. The third set of policy responses included changes and reforms in health planning, purchasing and delivery, with a handful of countries focusing on the reduction of administrative costs and organizational restructuring (Mladovsky, Thomson, & Anna Maresso, 2015). On the supply side, the policy responses

concentrated on cuts in hospital funding and health professionals' payments, and price reductions for pharmaceuticals and medical technology (Carone, Schwierz, & Xavier, 2012; Correia, Dussault, & Pontes, 2015; Stuckler et al., 2017). A relatively smaller number of countries adopted long-term, complex and efficiency-enhancing policies, such as hospital sector restructuring, reduction of unnecessary inpatient admissions, changes in the doctor reimbursement system, and greater emphasis on public health and prevention strategies (Clemens et al., 2014; Mladovsky et al., 2015)

1.3. Policy responses and implications of the Greek crisis

1.3.1. Health policy responses: a brief overview

Over the past decades, and long before the breakout of the crisis, the Greek health system has been generally characterized by numerous chronic distortions, which have mitigated its dynamics and worsened health system performance. In terms of financing, it is a mixed system with high out-of-pocket expenditure (OOPE), which leads to high regressivity, unmet needs and inequity in access (Economou & Giorno, 2009). In particular, Greece's OOPE is significantly larger than that of its EU and OECD counterparts; it historically and consistently exceeds 30% of total health expenditure, whereas the EU average is only 15% (OECD/European Observatory on Health Systems and Policies, 2017). Historically, coverage has been fragmented, resulting in further inequity. Delivery of health care has also suffered from several deficiencies, such as poor allocation of human resources, lack of incentives for health care providers, limited emphasis on prevention and public health, inefficient hospitals, and heavy reliance on expensive medical technology (C. Economou, 2010; Mossialos, Allin, & Davaki, 2005). Further, the Greek health system is highly centralized and exhibits poor allocation of resources, which does not rely on performance-based indicators and equity considerations (Davaki & Mossialos, 2005).

Given that the dysfunctions and deficiencies of the health and welfare system were, to some extent, responsible for the poor fiscal performance in Greece (Matsaganis, 2011; Petmesidou, Pavolini, & Guillén, 2014), health system reforms were inevitably among the main priorities in the public policy agenda during the crisis (OECD, 2014; Pagoulatos, 2018). With this in mind, there are at least four aspects that should be considered when analysing the measures and policy responses adopted during the economic downturn in Greece (Economou, Kaitelidou, Kentikelenis, Maresso, & Sissouras, 2015; WHO Regional

Office for Europe, 2019). First, the deep structural and operational problems of the health and social protection system have diminished its resilience, ability and preparedness to absorb and cope with external shocks, such as an economic crisis (OECD, 2014). Second, Greece adopted a series of important and necessary structural reforms, aiming to deal with the chronic health system challenges and shortcomings. Third, some of these changes, proposed and specified in the EAP (Economou et al., 2017; Fahy, 2012), led to significant fiscal retrenchment within the health system. Last, Greece implemented a large set of reforms and changes in a short period under the pressure of the recession and the limited fiscal space. Table 1.3 summarizes the main policy measures implemented during the economic crisis in Greece, the most important of which are further analysed in this section.

Table 1. 3: Summary of the main health policy measures during the Greek crisis

Policy area	**Year (s)**	**Policy/reform**
Health financing	2010	Cap of 6% of GDP in public spending for health, leading to significant budget cuts
	2011-2015	-Increased co-insurance rates for pharmaceuticals -User changes for inpatient and outpatient care (later revoked)
Health insurance	2011	Merger of insurance funds, introduction of the single insurer (EOPYY), and standardization of the benefits package
	2014-2016	Measures for ensuring health insurance coverage for the uninsured population
Health care management and provision	2010-2012	Changes in accounting procedures and methods in hospitals
	2011-	Restructuring of the hospital sector
	2013	Changes in the reimbursement system from a per diem basis to a prospective payment method (based on DRGs)
	2014	Restructuring of primary care and establishment of the National Primary Health Care Network (PEDY)
	2015-	-Further reorganization of the primary care structure, with greater emphasis on gatekeeping, -Introduction of local health units with health professionals from various disciplines
Pharmaceuticals	2010-	-Cap on public spending, and introduction of clawback and rebate for pharmaceuticals -Introduction of an electronic prescribing system to control prescribing behaviour and costs -Reintroduction of updated positive/negative reimbursement lists for pharmaceuticals -Changes in pricing and reimbursement process and price reductions -Generic substitution mandate and measure to promote generic

		penetration -Decreased profit margins for pharmacists and wholesalers

Source: Adapted from Economou et al. (2017)

The first set of policy responses to the crisis focused on public financing of the health system, with the public spending on health being capped at 6% of GDP. Approximately 61% of the total health expenditure in 2017, public expenditure fell by more than 40% over the period 2010-2017. As Table 1.4 shows, it has been well below the cap of 6% of GDP since 2011, corresponding to only 4.9% of GDP in 2017. Public spending for health, as a share of GDP, is thus among the lowest in Europe (OECD & European Observatory on Health Systems and Policies, 2017). The public budget reduction mainly emanated from major cuts in hospital and pharmaceutical spending. For example, public spending for hospital care decreased by more than 40% during 2010-2017, through a series of cost-containment measures in medical supplies and equipment, hospital medicines, and the health workforce (Xenos et al., 2017). Having peaked at 5.1 billion euros in 2009, public pharmaceutical expenditure dropped by almost 62% over the period of the economic turmoil and fell to less than 2 billion euros after 2015, partly due to the introduction of rebate and clawback (Greek Foundation for Economic and Industrial Research, 2018; Vandoros & Stargardt, 2013).

Table 1. 4: Public expenditure on health in Greece (2008-2017)

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Health expenditure (in million euros)	22,707	22,491	21,609	18,836	16,985	15,201	14,203	14,340	14,616	14,492
Health expenditure (% GDP)	9.4	9.5	9.6	9.1	8.9	8.4	8.0	8.1	8.3	8.0
Public expenditure (in million euros)	13,248	15,412	14,921	12,425	11,287	9,446	8,267	8,312	8,924	8,816
Public expenditure (% GDP)	5.5	6.5	6.6	6.0	5.9	5.2	4.6	4.7	5.1	4.9
Public expenditure (% THE)	58.3	68.5	69.1	66.0	66.5	62.1	58.2	58.0	61.1	60.8
Curative and	N/A	9,013	8,659	6,644	6,630	5,789	4,964	4,825	5,362	5,308

rehabilitative care[3] (in million euros)										
Inpatient	N/A	7,254	6,858	5,013	5,289	4,215	3,784	3,665	4,019	3,962
Outpatient	N/A	1,608	1,658	1,478	1,288	1,518	1,066	1,064	1,214	1,209
Long-term care	N/A	86	116	67	156	125	83	177	163	221
Anciliary services (in million euros)	N/A	520	473	491	299	422	414	464	273	270
Medical products (in million euros)	N/A	5,159	5,116	4,685	3,690	2,612	2,212	2,408	2,689	2,580
Preventive care (in million euros)	N/A	274	271	218	176	168	211	169	167	160
Governance and health system and financing administration (in million euros)	N/A	360	285	321	336	330	383	269	269	277

Source: OECD, Greek Foundation for Economic and Industrial Research

Second, economic recession and the relevant policy measures brought significant changes in health coverage. The rising unemployment rate had a devastating effect on the breadth of coverage, with the uninsured population rapidly increasing to approximately 2.0-2.5 million in Greece (European Commission, 2015a; Greek Ministry of Health, 2016). Despite the standardization of the benefits introduced with the establishment of the EOPYY, there was a decrease in the range of services covered by the benefit package, affecting the scope of health coverage (Economou, Kaitelidou, Kentikelenis, Sissouras, & Maresso, 2014; WHO Regional Office for Europe, 2019). In order to generate additional revenue and reduce demand for unnecessary care, the government also enacted several changes in cost sharing, with subsequent implications on the depth of coverage. These changes primarily focused on outpatient prescription drugs and diagnostic tests (Economou et al., 2014; Thomson et al., 2014) and, along with the internal reference pricing for

[3] According to the OECD definitions, the expenditure on curative and rehabilitative care is further disaggregated into the following types of expenditure: inpatient care, day care, outpatient care, and home-based care. In this Table, we only include inpatient and outpatient care, which correspond to the bulk of the spending for curative and rehabilitative care.

medicines, shifted the health costs to patients[4] (Kentikelenis, Karanikolos, Reeves, McKee, & Stuckler, 2014; World Health Organization, 2018). Furthermore, the government introduced user charges for inpatient admission in the public sector, and increased the corresponding fees for outpatient care. However, these changes were later revoked due to increasing concerns about their implications for equity in access to health services.

Third, there were several changes and reforms in health planning, purchasing and delivery, with the introduction of a mix of efficiency-enhancing and cost-control measures. A major structural reform stipulated the reorganization of the fragmented social health insurance system in 2011, with the establishment of the National Organization for the Provision of Health Services (EOPYY). In doing this, the government merged the social health insurance funds and established a single purchaser, aiming to gradually equalize benefits and contributions, enhance bargaining power and provide coverage to the whole population (European Commission, 2018). As shown in Table 1.3, another health system reform, legislated in 2014, focused on restructuring the primary care system, with the establishment of a primary health care network (PEDY) consisting of health centres, outpatient services of the insurance funds and contracted physicians. Primary care was further reorganized and defined as the first point of contact with the health system in 2017, following the establishment of local health units staffed by a multidisciplinary health workforce (WHO Regional Office for Europe, 2019). Several reforms also focused on procurement and the efficiency of inpatient care, including hospital sector restructuring, changes in operational, managerial and accounting procedures, improvement of the procurement process for health supplies and technologies, and adoption of a prospective hospital reimbursement method based on DRGs (Kastanioti, Kontodimopoulos, Stasinopoulos, Kapetaneas, & Polyzos, 2013; Polyzos, Karanikas, Thireos, Kastanioti, & Kontodimopoulos, 2013). Last, the Greek authorities adopted various measures aiming to control pharmaceutical expenditure and consumption, the most important of which concentrated on pricing and reimbursement, generic substitution and promotion, rebates and clawback (Vandoros & Stargardt, 2013; Yfantopoulos & Chantzaras, 2018).

[4] The authorities introduced a coinsurance rate of 10% for some medicines that were previously fully reimbursed (e.g. for type 2 diabetes, Alzheimer, dementia, epilepsy). The coinsurance rate also rose from 10% to 25% in various diseases, including coronary heart disease, hyperlipidemia, osteoporosis, arthritis, cirrhosis and COPD (Economou et al., 2014). In addition, patients may also need to bear the cost between the retail and the reimbursed price of medicines, due to the introduction of an internal reference pricing system (Greek Foundation for Economic and Industrial Research, 2018).

1.3.2. Implications for health status and health system performance

Against this background, a strand of the literature has examined the trends in some selected health outcomes and indicators during the crisis. Generally speaking, the potential consequences of an economic crisis on population health are lagged; it takes time for the impact to be completely revealed. Based on aggregate data, evidence suggests that all-cause mortality continued to decrease following the Greek crisis, but the rate of decline was significantly lower (Laliotis, Ioannidis, & Stavropoulou, 2016). Moreover, self-rated health trends have also deteriorated during the period of recession (Kentikelenis et al., 2011; Vandoros, Hessel, Leone, & Avendano, 2013).

Apart from population health, some other dimensions of health system performance might have been affected by the prolonged recession. First, access to health care has been significantly compromised in Greece, with the percentage of the population reporting unmet health needs and barriers to accessing health services or pharmaceutical care being significantly higher during the crisis (Economou, 2015; Filippidis, Gerovasili, Millett, & Tountas, 2017; Tsiantou, Zavras, et al., 2014). For example, Eurostat data shows that the share of the population reporting unmet needs increased from 4.0% to 12.0% during 2008-2016 (Eurostat, 2018d), while the lower socioeconomic groups have been more severely affected (Kentikelenis et al., 2014; I.-I. Kyriopoulos et al., 2014). Apart from households' financial difficulties, the unfavourable trends in access to care can be attributed to the reduced capacity of the public system, which should cover the increasing health needs with reduced financial and human resources (Economou, 2015; Kentikelenis & Papanicolas, 2012). Second, there are signs of erosion in financial protection mainly due to the introduction of user charges, coupled with the traditionally low and inequitable financing of the public health system (Chantzaras & Yfantopoulos, 2018). For instance, the effective co-payment rate for prescription medicines has been, on average, somewhat higher than 20% during the crisis (Gouvalas, Igoumenidis, Theodorou, & Athanasakis, 2016; Kanavos & Souliotis, 2017), while recent estimates show that it rose from 9% to 30% over the period 2009-2016 (WHO Regional Office for Europe, 2019). Third, the relevant policy responses may have a positive impact on the efficiency and productivity of public hospitals, mainly for those of large and medium capacity (Mitropoulos, Mitropoulos, Karanikas, & Polyzos, 2018; Xenos et al., 2017). However, it appears that there are significant grounds for improvement since less than a third of Greek hospitals are considered as efficient (Kaitelidou et al., 2012), whereas mergers and further restructuring

could generate additional efficiency gains (Flokou, Aletras, & Niakas, 2017). Fourth, despite the Greek authorities' adoption of various measures, such as the introduction of clinical protocols and the establishment of an organization for quality assurance, there are increasing concerns regarding the potential consequences of the crisis for the quality of health services (Keramidou & Triantafyllopoulos, 2018). The combination of extensive budgetary cuts, higher needs for medical care and the increasing number of admissions may have overwhelmed the health system[5], resulting in a deterioration in the quality of care (Kaitelidou & Kouli, 2012). In addition, a body of evidence suggests that shortages of health workers, medical equipment, consumables and pharmaceuticals may have also worsened the quality of services (Economou et al., 2014; Karamanoli, 2015; Karidis, Dimitroulis, & Kouraklis, 2011; Simou & Koutsogeorgou, 2014). Last, the adverse implications of the economic decline on the Greek health system and services are also manifested in the changes in amenable mortality. Contrary to the trends in most European countries, amenable mortality increased in Greece during the recession, reflecting a potential deterioration in the health system's ability to avoid deaths through the provision of effective and timely health services (Karanikolos, Mackenbach, Nolte, Stuckler, & McKee, 2018)

1.4. Focus and structure of the thesis

This thesis comprises of three studies on the impact of the Greek economic crisis on the health sector, and its main focus is presented in Figure 1.3. These studies employ empirical analysis to generate evidence and provide answers to policy-relevant topics, with a particular focus on the responses to and implications of the crisis across different socioeconomic groups.

Chapters 2 and 3 concentrate on out-of-pocket expenditure (OOPE), which has traditionally been a major financing source for the Greek health system (Economou et al., 2017; Thomson, Foubister, & Mossialos, 2009). Apart from the high reliance on OOPE over the past decades, the Greek authorities implemented various policy responses related

[5] Several studies have reported evidence of an increase in the number of admissions in Greece (Economou et al., 2015; Ifanti, Argyriou, Kalofonou, & Kalofonos, 2013; Kaitelidou & Kouli, 2012; Kentikelenis et al., 2011; Kentikelenis & Papanicolas, 2012; Kounetas & Papathanassopoulos, 2013). The reduced spending for inpatient care could be attributed to a "pricing effect", as there has been a decrease of wages of health workforce, as well as the significant reduction in the unit prices of medical supplies and of the medicines used during hospitalizations.

to health financing, which further stimulate interest in the study of private health financing in Greece.

In light of these remarks, Chapter 2 examines how household spending behaviour towards health care has changed across different household types and socioeconomic groups in the face of an economic shock and the relevant health policy responses. Using data from the Household Budget Surveys (HBS) and various regression techniques, this study identifies the determinants of household health expenditure (HHE) and explores potential changes in consumer behaviour and the income elasticity of HHE following a severe economic crisis and the introduction of a large-scale EAP. In particular, it examines the following hypotheses:

In periods of economic downturn, households often reduce HHE and shift towards public services because of their lower ability to pay out-of-pocket expenditure (OOPE) (H. Waters et al., 2003a; Yang et al., 2001). In Greece, this is depicted by the significant increase in hospital admissions, outpatient visits, and laboratory tests in public health services after the introduction of the EAP (Institute of Social and Preventive Medicine, 2016; Kentikelenis & Papanicolas, 2012). Moreover, households may decide to reduce non-essential health care expenses in response to economic distress (Yang et al., 2001) and private health care payments might become less "necessary" given the alternative of using public services in a period of severe financial hardship. On that basis, we formulate the first hypothesis:

Hypothesis 1: HHE became more sensitive to income changes (income elastic) in the post-EAP period.

The composition of HHE may differ across households of different socioeconomic status (SES). For instance, the HHE of less-privileged households primarily comprises OOPE for pharmaceuticals, while they tend to incur lower expenses at hospitals, as outpatients, and for dental care. In this context, a different mix of health care goods and services might result in heterogeneous consumption changes in response to altering income since expenses for some types of health care (e.g. cost-sharing for medicines) are more essential and cannot be easily avoided or postponed. Hence, the second hypothesis is as follows:

Hypothesis 2: Health care consumption responses to income changes (different income elasticities) differ across household types.

As mentioned above, households have the option to shift to public services and avoid OOPE for some types of health care. Moreover, they may reduce OOPE for non-

essential goods and services because of financial constraints. However, there is no substitute for user charges, which constitute a prerequisite for gaining access to some types of health care. For instance, cost-sharing schemes in pharmaceutical care imply that individuals should pay user charges to receive and adhere to their therapy. In this context, one could expect that those households whose HHE primarily consists of payments for user charges would not become more sensitive to income changes after the introduction of the EAP because their HHE is relatively rigid, consists of payments for essential goods and services, and cannot be substituted by shifting towards public services. We thus develop the following hypothesis:

Hypothesis 3: Contrary to privileged households, vulnerable households did not become more sensitive to income changes in the post-EAP period.

Our last hypothesis largely relies on the notion of permanent income. In particular, several formal and informal mechanisms for borrowing, saving, and selling assets allow households to smooth their consumption over time (Damme, Leemput, Por, Hardeman, & Meessen, 2004). In this context, consumption responses to current income changes may be more modest, since one could expect that consumers will alter their behaviour and respond strongly to more permanent income changes (Hall & Mishkin, 1982). We thus test such a hypothesis for the case of HHE:

Hypothesis 4: HHE responses to permanent income changes are greater than those arising from current income changes (i.e., permanent income elasticity is higher than current income elasticity).

Chapter 3 focuses on the heavy users of health services with high need and costs for medical care, who have also faced a greater health and financial burden during the crisis. In particular, this study investigates the extent to which financial catastrophe due to OOPE has changed among the older households during the Greek economic crisis, thus studying the implications in terms of financial protection.[6] Apart from estimates for the whole sample of older population, this study further examines the respective changes in financial protection across different household types, aiming to identify potential socioeconomic differentials and inequalities in the risk of financial catastrophe due to OOPE during the crisis. The relevant hypotheses we examine are formed as follows:

[6] It is a core element of health system performance assessment and a major consideration for household welfare that may have been significantly influenced over the period of the crisis, especially for households with older members.

The recent health policy responses to the Greek crisis may have significant impact on the scope, breadth and depth of health coverage. First, the benefits package became less comprehensive, having potential implications for the scope of coverage (Economou et al., 2014). Second, given that entitlement to health insurance is contingent on employment status, the uninsured population rapidly increased due to rising unemployment rate during the recession (European Commission, 2015a; Greek Ministry of Health, 2016). Third, user charges substantially increased, especially for outpatient prescription drugs and diagnostic tests (Kanavos & Souliotis, 2017; Thomson et al., 2014). However, whether the incidence of household financial catastrophe due to health payments increases during periods of economic hardship cannot be easily answered a priori (Palladino, Lee, Hone, Filippidis, & Millett, 2016). Some studies, for example, show that households tend to curtail OOPE and shift towards public services or do not even seek health care during economic recessions resulting in lower reliance on OOP payments (H. Waters et al., 2003a; Yang et al., 2001). On the other hand, policy responses to the crisis have been expected to decrease disposable income and have presumably eroded health coverage, resulting in weakened financial protection mechanisms and potentially higher incidence of catastrophic health payments (Stuckler et al., 2017). The concerns about the risk of CHE and financial protection during recessions are more pronounced for the older people who tend to have greater needs for health care, encounter greater financial strain, struggle to cope with the negative financial changes and are also more prone to health shocks and the adverse impact of recession [7] (Bloom et al., 2015; Hwang, Weller, Ireys, & Anderson, 2001; Quintal & Lopes, 2016). On that basis, we formulate the first hypothesis:

Hypothesis 1: Financial protection has eroded among older households during the economic crisis.

Despite the increased financial hardship, worse-off households should still pay out-of-pocket for some types of health care due to the erosion of the depth of insurance coverage during the recession, especially in pharmaceutical care (Gouvalas et al., 2016; Siskou et al., 2014). Additionally poorer have worse health status and greater needs for

[7] There are various reasons that explain the increasing concern for older people. First, older people tend to suffer from multiple conditions, and have greater needs for and utilization of health services but fewer resources to cover them (Goldman & Zissimopoulos, 2003; Jayawardana et al., 2019; Lehnert et al., 2011). Second, they encounter greater financial strain and struggle to cope with the negative changes in their financial situation (Bierman, 2014; Fenge et al., 2012; Lyberaki & Tinios, 2018). Both these factors are expected to result in a further reduction in households' ability to pay for medical care. Last, older people are more prone to health shocks and more vulnerable to the adverse effects of recession (Cutler et al., 2002; Laliotis et al., 2016).

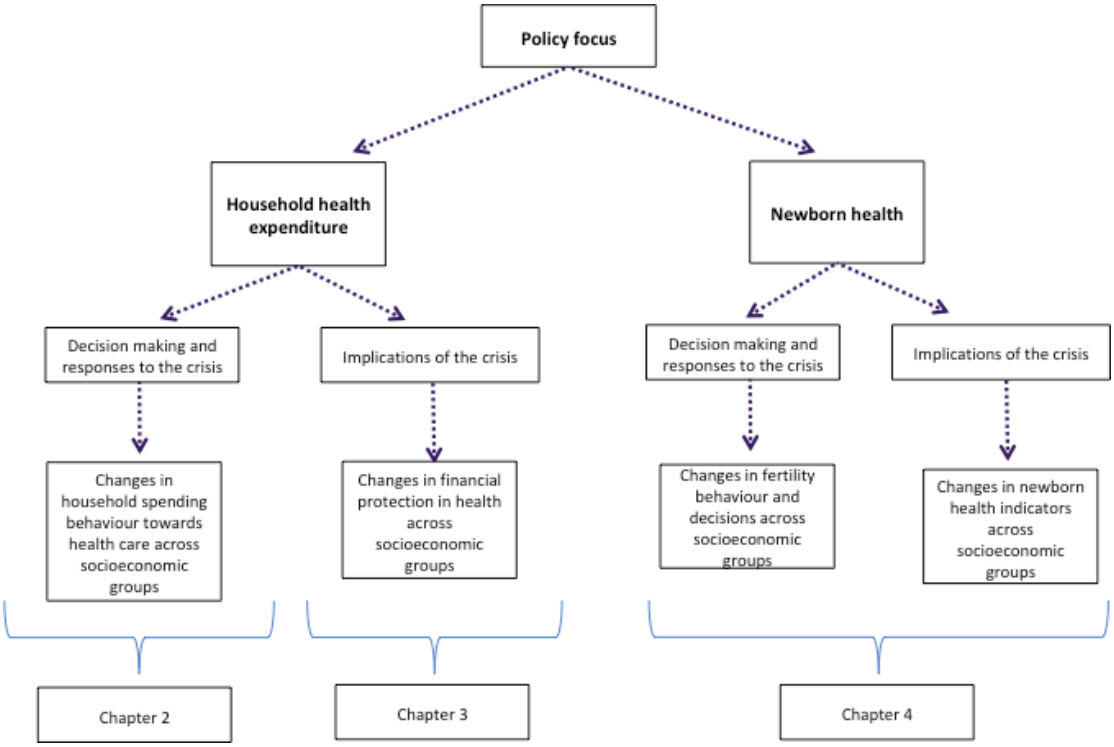
health care (Marmot, 2005), and these gaps in depth of coverage would thus leave them exposed to the financial consequences of ill health. Having higher ability to pay, better-off households are expected to better cope with the gaps in depth of coverage, as those costs are only a modest proportion of their health payments. We thus test the following hypothesis for older households in Greece:

Hypothesis 2: The erosion of financial protection was relatively more detrimental for the poorer households.

Several reforms in cost-sharing policy were implemented during the Greek recession, with the user charges for medicines being at the core of these changes (Economou et al., 2014; Kanavos & Souliotis, 2017). Apart from the increase in co-insurance rates for several therapeutic areas, older patients may also bear the additional financial burden of the difference between the retail and the reimbursed price of outpatient medicines, due to the introduction of an internal reference pricing system. In contrast to medicines –for which paying user charges is a prerequisite for gaining access- patients can shift to public services due to affordability reasons and avoid excessive health payments for inpatient and outpatient care. In this context, the changes in cost-sharing policy are expected to influence the extent to which household pharmaceutical payments contribute to CHE after the onset of the crisis. Hence, the second hypothesis is as follows:

Hypothesis 3: The contribution of household pharmaceutical expenditure to the overall catastrophic health expenditure (CHE) increased after the onset of the economic crisis

Figure 1. 3: Overview of the studies



As shown in Figure 1.3 above, Chapter 4 focuses on newborn health and fertility responses during the economic crisis. Apart from health measures themselves, newborn health indicators are also linked with future health, cognitive and socioeconomic outcomes (Almond, Chay, & Lee, 2005; S. E. Black, Devereux, & Salvanes, 2007; Gluckman, Hanson, Cooper, & Thornburg, 2008). Their study is thus interesting from both public health and socioeconomic perspectives, especially in the context of an economic crisis. Moreover, examining differential fertility responses during the crisis is particularly important, since business cycle volatility might influence fertility decision differently across population groups, having potential implications on the cohort composition of women who become pregnant.

Taking these points into consideration, Chapter 4 employs data from a large administrative dataset and has a twofold objective. It first studies how economic climate influences fertility decisions and responses across different population groups. Moreover, it concentrates on the potential link between economic conditions during pregnancy and newborn health across different socioeconomic groups, testing whether inequalities in newborn health have widened during the economic crisis. In doing so, it examines the following hypotheses:

During economic recessions, the prevalence of depression and psychosocial stress tends to increase (Economou, Madianos, Peppou, Patelakis, & Stefanis, 2013; Frasquilho

et al., 2016; Hamilton, Broman, Hoffman, & Renner, 1990), with both of them being risk factors for adverse perinatal outcomes (Grote et al., 2010). Additionally, household financial distress is expected to change the quantity and quality of maternal nutrition and to impede access to nutritious food, resulting in food insecurity during pregnancy (Brinkman et al., 2010; Studdert, Frongillo, & Valois, 2001). Increased level of maternal stress and poor maternal nutrition during pregnancy may adversely affect gestational length, and intrauterine growth respectively (Bernabé et al., 2004; Hedegaard, Brink Henriksen, & Jørgen Secher, 1996), both of which are, in turn, expected to influence birth outcomes (M.S. Kramer, 1987). On this basis, we formulate our first hypothesis:

Hypothesis 1: Birth outcomes are sensitive to business cycle fluctuations during pregnancy, and the relationship varies depending on the stage of gestation.

During economic recessions, low-SES households are more likely to compromise food quality and quantity, as they are more likely to experience severe financial hardship (Bonaccio et al., 2017; Brinkman et al., 2010). This might not apply to the families of higher SES, who possess more assets, have access to various coping mechanisms and credit and can smooth consumption without resorting to unhealthy dietary changes. Additionally, low-SES individuals are more susceptible to stress and mental health problems while also facing more limited access to mental health services during economic contraction (R. A. Catalano & Bruckner, 2005; Hauksdottir, McClure, Jonsson, Olafsson, & Valdimarsdottir, 2013; Wahlbeck & McDaid, 2012; World Health Organization, 2011). Considering this range of impacts, we develop the following hypothesis:

Hypothesis 2: There is heterogeneity in the relationship between prenatal business cycle fluctuations and birth outcomes across socioeconomic groups.

Evidence suggests that fertility declines during periods of economic crisis, while economic contraction and uncertainty is generally associated with fertility postponement[8] (Chevalier & Marie, 2017; Sobotka, Skirbekk, & Philipov, 2011). However, economic adversity might influence differently the decision to conceive across household types and groups. In particular, less-privileged families may have faced credit constraints and reduction in their already low income, and may thus be unable to afford the costs of childbearing (Schneider & Hastings, 2015). They also have fewer savings and financial reserves to confront negative income shocks (Lusardi, Schneider, & Tufano, 2011). In this

[8] Economic distress leads to two effects that have opposite direction. In particular, it is associated with a negative income effect that reduces the demand for children, and a positive substitution effect which shifts demand towards the opposite direction. Given that empirical studies show a fertility decline during recessions, income effect is generally larger than the substitution effect (Gronau, 1977).

context, low-SES mothers may be less likely to conceive during recessions. The characteristics of women who conceive during economic recession might be thus different compared to those of women who conceive during periods of normality. However, evidence on this topic is rather contradictory (Aparicio & González, 2014; R. Dehejia & Lleras-Muney, 2004). Given that these relationships are complex, and largely depend on the country setting, we examine the following hypothesis in the context of the Greek crisis:

Hypothesis 3: Economic fluctuations influence the fertility decision differently across different population groups.

Economic distress might be associated with fertility postponement and changes in the types or characteristics of women who conceive during periods of economic adversity (Chevalier & Marie, 2017; R. Dehejia & Lleras-Muney, 2004). This implies compositional characteristics in the type of women who give birth (or selection into pregnancy during an economic downturn). Hence, we form our fourth hypothesis:

Hypothesis 4: After accounting for compositional changes in the type of women who give birth during recessions, an economic crisis affects BW, with the impact being greater for children born to low-SES mothers

Last, Chapter 5 summarizes the findings and main contributions of this thesis, elaborates on the limitations of each study, and identifies potential areas for further research.

Chapter 2

The impact of the Greek economic adjustment on household health expenditure

Abstract

In late 2009, Greece faced an unprecedented sovereign debt crisis and shortly after signed a large-scale economic adjustment programme (EAP) that brought about several changes and reforms to the Greek health care system. As a result, households experienced the "triple hit" of decreased availability and capacity of the public health system, increased user charges, and lower ability to pay for health care. This study examines how households behaved in the face of such an economic shock and the aforementioned "triple hit". It also focuses on how household payments for health care responded to income changes before and after the introduction of the EAP. By using data from the Greek Household Budget Surveys over 2008–2015, we employ a modified two-part model to identify the determinants of household health expenditure (HHE) and estimate the corresponding income elasticities before and after the introduction of the EAP. Our analysis shows that the income elasticity of HHE is consistently below unity and exhibits a statistically significant increase after the introduction of the EAP. Thus, households appear to exhibit greater consumption responses to changes in their income during the post-EAP period. In addition, we report heterogeneity in income elasticity across household types and over the HHE distribution. Lastly, our analysis suggests that the magnitude of income elasticity is sensitive to the household welfare indicator used. In other words, we show that HHE responses to permanent income changes are greater than the ones arising from current income shocks. Our findings can inform policymakers about household health care behaviour and provide useful evidence for health financing and the design of social safety nets.

Keywords: household health expenditure, out-of-pocket payments, economic adjustment, austerity, income elasticity, consumer behaviour, Greece

2.1. Introduction

After notable growth in the 2000s, the Greek economy faced an unprecedented sovereign debt crisis in late 2009. In particular, the budget deficit for 2009 was significantly larger than that initially stated (reaching approximately 15% of GDP), and this adverse announcement along with the country's high debt-to-GDP ratio and moderate growth prospects triggered concerns about the solvency of the Greek economy, with several agencies subsequently downgrading Greece's credit rating[9] (Ardagna & Caselli, 2012). In this context, Greece was at the epicentre of an economic crisis that tested the limits and threatened the stability of the Eurozone (De Grauwe, 2010). The government at the time eventually requested a bailout package and pledged to implement a large-scale economic adjustment programme (EAP) in early 2010 with the technical assistance of the EU, the IMF, and the ECB. To address the chronic weaknesses of the Greek economy, this EAP imposed strict fiscal consolidation, external rebalancing, and large-scale structural reforms across sectors (Thomadakis, 2015). During 2008–2015, GDP shrank by more than 25%, the unemployment rate increased from 7.8% to 24.9%, and residential property values decreased by more than a third (Meghir et al., 2017). At the same time, the fragmented social protection system failed to absorb the consequences of the deep crisis, and social indicators and living conditions dramatically deteriorated (Matsaganis, 2012; OECD, 2014). The share of the population severely materially deprived escalated from 11.2% to 22.2% during 2008–2015, while the share of the population having unmet medical needs for financial reasons increased from 4.2% to 10.9% over the same period.

The Greek crisis has several distinctive features. First, it is characterized by an unprecedented length and intensity, even compared with the Great Depression in the United States. Indeed, it was the deepest and most severe economic downturn across OECD countries in the postwar period (Andriopoulou et al., 2017) and among the worst in modern history. Second, the EAP required an extreme fiscal adjustment to move towards a primary budget surplus. This adjustment has been thus characterized "as everything but painless" (Meghir et al., 2017). Third, although several countries have managed to

[9] In December 2009, a major agency lowered the credit rating from A- to BBB+. It is noteworthy that this was the first time that Greece did not have an A rating since 1999. Following this development, several other agencies also downgraded Greece's credit rating (overall, agencies downgraded Greek bonds 19 times during October 2009-July 2011) (Ardagna & Caselli, 2012). Such events increased the cost of borrowing, and therefore access to private financing was practically impossible.

gradually overcome the post-2009 economic crisis, the Greek economy is still struggling to successfully disengage from the EAP.

Being a crucial field for public policy, health care was among the top priorities in the agenda of the EAP, not only from a fiscal savings perspective, but also in terms of promoting structural reforms within the health system (OECD, 2014). In this context, the EAP included two major measures directly related to health financing. First, it imposed significant cuts in health expenditure as a fiscal consolidation measure. In particular, public health spending was capped at 6% of GDP.[10] In other words, the public sector was forced to address increasing health needs with reduced financial resources, possibly leading supply to be inadequate to respond to households' health care needs (Mladovsky et al., 2012). Second, user charges increased during the post-EAP period, especially for pharmaceuticals (Economou et al., 2014; Gouvalas et al., 2016; Thomson et al., 2014). Hence, households experienced a "double hit" of the decreased availability and capacity of the public health system and higher user charges. In addition, a third hardship for Greek households was associated with the reduced disposable income (due to salary cuts and tax increases) and increase in unemployment, which in turn resulted in lower household purchasing power and ability to pay for health care. In broader terms, an economic crisis is generally associated with insecurity about the future, as households worry about the growing debt and loss of wealth, and thus change their perceptions of their employment and income prospects (Petev & Pistaferri, 2012).

Taking the aforementioned into account, an important, but rather understudied, question relates to how households' health care consumption changes in the face of an economic shock and the aforementioned "triple hit" (i.e. cuts in public health expenditure, increase in user charges, decrease in disposable income). Although several studies have examined household behaviour towards the consumption of health care and the responsiveness of household health expenditure (HHE) to income changes (Chaze, 2005; Getzen, 2000; Zare et al., 2013; Zhou et al., 2011), there is scant evidence on how HHE responds to income changes before and after large-scale economic adjustment and shocks. To our knowledge, the only two relevant studies of this topic focus on countries hit by the 1997 East Asian crisis. By using household data from Thailand, Okunade et al. (2010) found that household consumption of health care became more responsive to income

[10] The fiscal pressure associated with the EAP has four implications regarding public providers: (a) decrease of human and material resources, (b) increased barriers to access to public health services, due to restricted availability, (c) lower quality of care and of hospital stay, and (d) lower levels of patient satisfaction (Rodrigues et al., 2013; Sissouras, 2014).

changes (i.e. higher income elasticity[11]) after the beginning of the 1997 crisis. Yang et al. (2001) reported similar findings for Korea, although their methodology was based on aggregate data and a two-point estimate of income elasticity.

2.2. Hypothesis development

In periods of economic downturn, households often reduce HHE and shift towards public services because of their lower ability to pay out-of-pocket expenditure (OOPE) (H. Waters et al., 2003a; Yang et al., 2001). In Greece, this is depicted by the significant increase in hospital admissions, outpatient visits, and laboratory tests in public health services after the introduction of the EAP (Institute of Social and Preventive Medicine, 2016; Kentikelenis & Papanicolas, 2012). Moreover, households may decide to reduce non-essential health care expenses in response to economic distress (Yang et al., 2001) and private health care payments might become less "necessary" given the alternative of using public services in a period of severe financial hardship. On that basis, we formulate the first hypothesis:

Hypothesis 1: HHE became more sensitive to income changes (income elastic) in the post-EAP period.

The composition of HHE may differ across households of different socioeconomic status (SES). For instance, the HHE of less-privileged households primarily comprises OOPE for pharmaceuticals, while they tend to incur lower expenses at hospitals, as outpatients, and for dental care. In this context, a different mix of health care goods and services might result in heterogeneous consumption changes in response to altering income since expenses for some types of health care (e.g. cost-sharing for medicines) are more essential and cannot be easily avoided or postponed. Hence, the second hypothesis is as follows:

Hypothesis 2: Health care consumption responses to income changes (different income elasticities) differ across household types.

[11] Income elasticity of household health expenditure essentially measures how the household health expenditure changes as household income changes (i.e. how responsive consumers are to income changes). It is given by the ratio between the percentage change in household health expenditure and the percentage change in income. If income elasticity is positive (negative), the goods are considered as normal (inferior). In general, income elasticity is relatively low for necessities, because individuals will normally purchase them, even if they have low income (Mankiw, 2018). In general, income elasticity is regarded as an important measure in equity analysis of health expenditures (O'Donnell et al., 2008).

As mentioned above, households have the option to shift to public services and avoid OOPE for some types of health care. Moreover, they may reduce OOPE for non-essential goods and services because of financial constraints. However, there is no substitute for user charges, which constitute a prerequisite for gaining access to some types of health care. For instance, cost-sharing schemes in pharmaceutical care imply that individuals should pay user charges to receive and adhere to their therapy. In this context, one could expect that those households whose HHE primarily consists of payments for user charges would not become more sensitive to income changes after the introduction of the EAP because their HHE is relatively rigid, consists of payments for essential goods and services, and cannot be substituted by shifting towards public services. We thus develop the following hypothesis:

Hypothesis 3: Contrary to privileged households, vulnerable households did not become more sensitive to income changes in the post-EAP period.

Our last hypothesis largely relies on the notion of permanent income. In particular, several formal and informal mechanisms for borrowing, saving, and selling assets allow households to smooth their consumption over time (Damme et al., 2004). In this context, consumption responses to current income changes may be more modest, since one could expect that consumers will alter their behaviour and respond strongly to more permanent income changes (Hall & Mishkin, 1982). We thus test such a hypothesis for the case of HHE:

Hypothesis 4: HHE responses to permanent income changes are greater than those arising from current income changes (i.e. permanent income elasticity is higher than current income elasticity).

2.3. The Greek case

Examining OOPE[12] in the Greek health care system is particularly interesting for two reasons. First, traditionally, health financing in Greece has been largely funded by HHE [13] (Economou et al., 2017; Thomson et al., 2009). This historical pattern is

[12] The main types of out-of-pocket payments in Greece are the following: (a) direct payments for medical care that is not covered by health insurance, (b) cost-sharing schemes and user charges (e.g. pharmaceuticals), (c) payments for medical care, which is covered by health insurance and is purchased with out-of-pocket payments (in order to facilitate access or receive services of higher quality) (Economou et al., 2017).

[13] Recent OECD data reveal that Greece has the fourth highest OOP expenditure in OECD (as a percentage of total health spending), after Cyprus, Bulgaria and Latvia. When looking at OECD data on OOP spending

particularly evident when examining OOPE from a comparative perspective, as shown in Figure A1 (in Appendix A). In particular, Greece's OOPE (as a share of health spending) is substantially higher than that of the other EU and OECD countries. However, although the Greek health system is highly dependent on OOPE, the role of private health insurance is quite limited (Mossialos et al., 2005; Souliotis et al., 2016). In this context, Greece has the lowest percentage of the population covered by health insurance (public and/or private) among OECD countries, a fact that also exacerbates the problem and increases reliance on OOPE (OECD, 2017).

In general, the high OOPE in Greece can be interpreted by the deficiencies of the public system, including waiting lists, low responsiveness and satisfaction with health services, and low quality of care (C. Economou, 2010). In addition, the public sector is also characterized by undersupply of diagnostics and technology, informal payments, lack of a referral system and weak primary care, all of which further exacerbate the level of OOPE (Mossialos et al., 2005). The main health policy concern arises from the fact that this historical pattern clearly attenuates the extent to which equity in financing can be achieved in the Greek health system, while low-income groups disproportionately contribute to health care financing (Economou, 2010). Increased out-of-pocket payments may also impede access to health services and decrease the use of necessary medical care, especially for the vulnerable household types (Hwang et al., 2001).

In addition to health financing in Greece being highly dependent on OOPE, a second aspect makes the Greek case particularly interesting. As noted above, Greece signed a bailout agreement and implemented a large-scale EAP amid a severe sovereign debt crisis, leading to a "triple hit" with profound implications on health financing. Following the introduction of the EAP, health financing was largely shaped and influenced by fiscal constraints, mainly due to the cap of 6% of GDP for public health expenditure. In this context, the public expenditure on health currently amounts to 5% of GDP,[14] which is low compared to the EU average of 7.2% of GDP (OECD/European Observatory on Health Systems and Policies, 2017). Second, several cost-sharing schemes were introduced, the most important of which were co-insurance charges for medicines (Economou et al., 2017). In Greece, there are three potential cost-sharing rates (25%, 10%

as a share of household consumption, Greece has also the fourth highest share among the EU countries (after Bulgaria, Malta and Cyprus).

[14] Total health expenditure was approximately 8.4% of GDP in 2015, and amounted to 9.5% of GDP before the onset of the crisis and the introduction of the EAP. What should be noted, however, is that GDP decreased by more than a quarter during the economic crisis.

and 0%) for medicines. After the introduction of the new cost-sharing scheme, a larger number of diseases is included in the highest co-insurance rate of 25%, while only some life-threatening medicine are fully covered (Gouvalas et al., 2016). The third hit was not directly related to health financing sources. In particular, the sharp decline of several types of labour and capital income (e.g. from wage and salaries, self-employment, business activities, dividends, rents etc.) (Giannitsis & Zografakis, 2018) along with the increased unemployment rate have significant implications for households' purchasing power and ability to pay for health care. These changes (the "triple hit") appear to have significant implications for health financing. Hence, both the level and the composition of average HHE from 2008 to 2015 differ substantially, which motivates further empirical research on HHE in the Greek context (see Figure A2 in Appendix A).

Therefore, analysing the relationship between income and HHE for the Greek case is particularly interesting because of: (a) the high HHE; and (b) the change in the level and composition of HHE associated with the impact of the EAP both on demand for and on the supply of health care.

2.4. Literature review

2.4.1. Health financing and out-of-pocket payments during periods of economic adjustment

A strand of the literature has examined the changes, trends and patterns in health financing during economic recessions associated with the changes in macroeconomic and fiscal environment and the subsequent health policy responses (Mladovsky et al., 2012; Thomson et al., 2014). The vast majority of the evidence relies on aggregate data, examines the trends from a descriptive perspective, and elaborates on the impact of health policy responses to the crisis on health care financing across countries. With this in mind, this review will briefly summarize some main points and elements about health financing during periods of economic adjustment and will particularly focus on the literature on OOPE.

Implications for public expenditure on health

Economic crises are generally associated with GDP reduction, growing fiscal deficits, high public debt, and increasing borrowing costs, which in turn constrict or lead to changes in the allocation of public budgets. In this context, several studies have demonstrated that the countercyclicality of public spending for health is particularly

important in order to mitigate the negative impact of recessions, protect population health status and ensure access to health care during periods of economic downturn (Cashin, 2016; Velenyi & Smitz, 2014).

Although some developing countries have adopted countercyclical policies for health financing, public expenditure on health has been generally considered as procyclical in low- and middle-income countries, with evidence suggesting that it follows the same direction as the overall economic performance (G. Chen, Inder, Lorgelly, & Hollingsworth, 2013; Hou et al., 2013; Liang & Tussing, 2019).

On the other hand, evidence from developed countries is rather mixed and contradictory. For example, some papers indicate that public expenditure on health tends to be acyclical (Afonso & Jalles, 2013; Del Granado, Gupta, & Hajdenberg, 2013), while another strand of the literature corroborates countercyclical patterns among advanced economies (Darby & Melitz, 2008; Velenyi & Smitz, 2014). Furthermore, it appears that prolonged and severe recessions may bring about procyclical responses even among developed countries, mainly due to fiscal and credit constraints that limit the fiscal space (Velenyi & Smitz, 2014).

Generally speaking, a recent analysis suggests that European countries responded differently to the challenges posed by the economic decline, with some of them –including Greece- adopting large budgetary cuts in health under the pressure of the rising fiscal constraints (Cylus & Pearson, 2014; Morgan & Astolfi, 2014; Thomson et al., 2014). Additionally, evidence shows that the potential public budget cuts are not merely linked with recession severity, but are rather associated with the implementation of adjustment programmes that usually entail heavy conditionality and specific health policy measures (Aaron Reeves et al., 2014). In that spirit, the extent to which government pursues and adopts countercyclical responses relates to a country's fiscal space, borrowing constraints, political polarization and institutional capacity (Abbott & Jones, 2012; Calderón, Duncan, & Schmidt-Hebbel, 2016)

Implications for out-of-pocket expenditure

There are many channels through which an economic crisis and the relevant adjustment programmes could influence out-of-pocket payments, thus making the link unclear and more complex (Cylus & Pearson, 2014; Morgan & Astolfi, 2014). In this sense, whether and how economic contraction and adjustment policies affect OOPE cannot be easily predicted a priori, due to multiple factors that move in contradictory directions

(Du & Yagihashi, 2015).

Generally speaking, economic recessions have widespread effects on household financial situation and living conditions, with many households experiencing significant income reduction, greater debt level, unemployment and increased financial insecurity. Households may thus reduce, avoid or postpone some of their payments, purchase fewer health care goods and services, or shift to public services (Dranove, Garthwaite, & Ody, 2014; H. Waters, Saadah, & Pradhan, 2003b). This channel can be essentially regarded as a direct demand-driven effect, predominantly associated with households' lower affordability and ability to pay during economic crises.

On the other hand, there are some indirect channels through which economic decline could influence households' health care consumption decisions (Docteur, 2009). First, the public budget cuts essentially imply that the public sector should address the increasing needs for health care with reduced financial and human resources. On the supply side, the public sector may be thus inadequate to meet population needs and the demand for health care due to reduced availability and capacity, especially in a period of increasing demand (Kentikelenis et al., 2014; Mladovsky et al., 2012). In an overwhelmed public health system,[15] some households may thus consider a substitute for public services to facilitate access to health care and receive timely and high quality care, shifting to private services (de Belvis et al., 2012; Hoel & Sæther, 2003; Rodrigues, Zólyomi, Schmidt, Kalavrezou, & Matsaganis, 2013). Put another way, the declining performance of the public sector implies that some households may prefer to visit private providers and/or bear the burden of higher out-of-pocket payments, aiming at less waiting time and better responsiveness and quality of care. Second, some of the health policy responses during an economic crisis are normally expected to influence out-of-pocket payments. For example, evidence indicates that various countries tend to adopt several cost-sharing schemes in response to an economic crisis, which in turn shift costs onto households and increase out-of-pocket payments (Karanikolos et al., 2013; Thomson et al., 2014). Third, supply reduction, doctors' salary cuts and the increased barriers to accessing health services may exacerbate doctors' pressure for informal payments in public services (Docteur, 2009; Economou et al., 2014). This is particularly relevant for Greece, where informal payments often constitute a means – or even a prerequisite - to facilitate access to health care in

[15] In particular, public budget cuts appear to have, among others, the following implications: decrease of human and material resources, increased barriers to access to public services due to reduced availability, lower quality of care, and lower levels of patient satisfaction (Grigorakis, Floros, Tsangari, & Tsoukatos, 2016; Rodrigues et al., 2013; Sissouras, 2014).

Greece (Davaki & Mossialos, 2005; WHO Regional Office for Europe, 2018a). Considering that fact, recent evidence suggests an increasing demand for informal payments during the post-crisis period (Souliotis et al., 2016).

Descriptive evidence for the impact of economic recessions and adjustment programmes on out-of-pocket spending is rather mixed, reflecting the various and conflicting channels described above. Findings from the 1997 East Asian crisis reveal that out-of-pocket payments decreased due to significant reduction in household income and purchasing power (H. Waters et al., 2003a; Yang et al., 2001). However, evidence from the OECD countries is somewhat conflicting, showing that out-of-pocket expenditure was procyclical in 20 out of 32 countries; a fact that is possibly explained by the household income loss, switch to less expensive medical care and shift to public services (Cleeren, Lamey, Meyer, & De Ruyter, 2016). In the same spirit, several studies for the recent European crisis also indicate that the trends in out-of-pocket spending during the crisis are rather mixed, with Greece being among the countries with the largest decline in Europe (Cylus & Pearson, 2014; Thomson et al., 2014).

2.4.2. Income elasticity of household health expenditure

During the past decades, a strand of the literature has examined and estimated the income elasticity of health expenditure using both aggregate and micro-level data. The existing evidence, however, consists of conflicting empirical findings and a vigorous discussion regarding the size of income elasticity (Costa-Font, Gemmill, & Rubert, 2011; Getzen, 2000). In this section, we will briefly review the key findings from the macro-level studies, and further elaborate on the estimates that rely on micro-level data.

Macro-level studies

Since the late 1970s, several papers have employed macro-level data to examine the association between GDP and health expenditure since the 1970s. In one of the first and most influential papers dealing with this topic, Newhouse (1977) used annual aggregate data for 13 countries, and showed that income elasticity of health expenditure ranged from 1.15 to 1.31, suggesting that health care is a luxury good (Newhouse, 1977). Most of the subsequent empirical work has indeed corroborated the “health care luxury hypothesis” and the high explanatory power of the association between GDP and health spending per capita (U.-G. Gerdtham & Jönsson, 2000).

Following Newhouse's study, an increasing body of literature employed multivariate regression models aiming to address omitted variable bias and its potential implications on the magnitude of the coefficient of interest.[16] Similar to previous evidence, most of these studies also supported the "health care luxury hypothesis" (Gerdtham, Snrgaard, Andersson, & Jonsson, 1992; Gerdtham, Sogaard, Jonsson, & Andersson, 1992; Leu, 1986). In addition, Parkin et al. (1987) replicated Newhouse's exercise using data for 18 OECD countries, and raised two methodological issues with significant implications for empirical work (Parkin, McGuire, & Yule, 1987). First, they found significant differences in the magnitude of the income elasticity, depending on the model's functional form. Second, they showed that international comparisons of health expenditure should rely on purchasing power parity (PPP) rather than exchange rates, since such an approach considers both price and quantity.[17] In particular, they found an income elasticity of 1.12 when using a linear regression model and an exchange rate conversion, while the elasticity dropped to 0.90 after a conversion based on PPP.

The literature gradually shifted from cross-sectional to panel data analysis, given that the latter takes into account the unobserved time-invariant heterogeneity across countries. For instance, Sen (2005) argues that the cross-sectional findings based on aggregate-level data may be misleading, since most studies do not control for unobserved heterogeneity and the models may suffer from omitted variable bias (Sen, 2005). Using data for the OECD countries and panel data techniques, various studies have estimated that income elasticity ranges between 0.7 and 0.8 after controlling for country- and time-specific dummies and a comprehensive set of regressors (U.-G. Gerdtham, 1992; U.-G. Gerdtham, Jönsson, MacFarlan, & Oxley, 1998). In contrast, some other panel data studies have reported evidence of income elasticity that exceeds unity among the OECD countries (Hitiris, 1997; Hitiris & Posnett, 1992; Liu, Li, & Wang, 2011).

Panel data approaches in turn raised further methodological concerns due to the spurious association between GDP and health spending, arising from non-stationarity and cointegration properties (Hansen & King, 1996). In this regard, a series of studies adopted

[16] These studies controlled for some additional regressors, such as the share of population aged under 15 and over 65 years old, urbanization, demand- and supply-side variables, and institutional and health system characteristics.

[17] After the study by Parkin et al. (1987), there was a vigorous debate regarding the issue of conversion factor instability. A few years later, Gerdtham and Jonsson (1991) used OECD data and, contrary to Parkin et al. (1987), did not report evidence of conversion factor instability, concluding that health care is indeed a luxury even when using PPP as conversion factor (U. G. Gerdtham & Jonsson, 1991) In a brief note published in Journal of Health Economics, Murthy (1992) has also discussed conversion factor instability, and elaborated on the findings of Gertham and Jonsson (1991) (Murthy, 1992).

approaches that address these issues and found evidence in favour of the "health care luxury hypothesis", especially in the long run (Okunade & Karakus, 2001; Okunade & Murthy, 2002; Woodward & Wang, 2012). In contrast, some relatively recent studies employed panel data from the OECD (Baltagi & Moscone, 2010; Sen, 2005) and some broader sets of countries (Baltagi, Lagravinese, Moscone, & Tosetti, 2017; Fan & Savedoff, 2014; Farag et al., 2012; Xu, Saksena, & Holly, 2011) and showed that income elasticity is consistently below unity. For instance, two recent studies employed panel datasets and found that health care is a necessity, with the income elasticity of health expenditure differing depending on country's income level (Baltagi et al., 2017; Farag et al., 2012).

In contrast to the literature using datasets from multiple countries, the vast majority of regional-level studies reveal that income elasticity is well below unity (Getzen, 2000). For instance, Di Matteo and Di Matteo (1998) employed data from the Canadian provinces, and estimated that income elasticity is 0.77 (Di Matteo & Di Matteo, 1998). Using regional data, some other papers have further confirmed that income elasticity is below unity in the USA (D. G. Freeman, 2003; Moscone & Tosetti, 2010), Canada (Di Matteo, 2005), Italy (Giannoni & Hitiris, 2002) and among regions in the OECD (López-Casasnovas & Saez, 2007). For instance, Freeman relied on regional-level data from different states in the USA, and showed that the income elasticity of health spending ranges between 0.82 to 0.84 (D. G. Freeman, 2003).

Micro-level studies

Although aggregate data have been widely employed for estimating income elasticity of health spending, their use has been subject to criticism, mainly because such approaches essentially imply "the application of microeconomic analysis to macroeconomic data" (Parkin et al., 1987). In this section, we thus focus on a strand of the literature that employs micro-level analysis, using either individual or household data. In this context, apart from the papers focusing on health expenditure, we also review some key studies on the estimates for income elasticity of health care utilization.

A widely quoted paper on the microeconometric analysis of demand for health care relied on data from the RAND experiment (Newhouse & Phelps, 1976). In particular, this study estimated the income elasticity with respect to hospital and physician services and found that both types of services are income inelastic. Several studies have also employed micro-data from the USA, and have made similar findings (Willard G. Manning &

Marquis, 1996; Silver, 1970). For example, Feenberg and Skinner (1994) employed a Tobit model and cross-sectional data, and found that the income elasticity of HHE is approximately 0.35 (Feenberg & Skinner, 1994).

Apart from the USA, the income elasticity of health expenditure has been examined in several countries, with most evidence from survey data indicating that health care is indeed a necessity. Using a cross-sectional dataset, Chernichovsky and Meesok (1986) employed a linear regression model with log-transformed dependent variable, and showed that the income elasticity of HHE is approximately 0.70 (Chernichovsky & Meesook, 1986). Based on survey data, Trivedi (2002) employed a two-part model, with the magnitude of the income elasticity of HHE ranging from 0.6 to 0.7 (Trivedi, 2002). In the same spirit, Mocan et al. (2004) relied on micro-data from urban regions in China and demonstrated that the income elasticity of HHE lies between 0.30 and 0.52 (Mocan, Tekin, & Zax, 2004), while another study found slightly higher estimates and further confirmed that health care is income inelastic (Jowett, Contoyannis, & Vinh, 2003). Using cross-sectional data from the Swiss Household Income and Consumption Survey, Chaze (2005) employed Box-Cox censoring models to derive the income elasticity of HHE, which amounted to approximately 0.51 (Chaze, 2005). Furthermore, a number of studies have employed micro-level data, and also support that health care is indeed a necessity across countries of different development level and with different health system structure (Abegunde & Stanciole, 2008; Bago d'Uva & Jones, 2009; Kumara, Samaratunge, AJ, JP., & K., 2016; Lépine, 2015; Zhou et al., 2011). In contrast to the majority of micro-level studies, a smaller strand of the literature has found that health care is a luxury, at least according to some econometric specifications and estimation techniques (Rous & Hotchkiss, 2003; Sepehri, Sarma, & Simpson, 2006). For example, Sepehri et al. (2006) employed a Tobit and a truncated model, and found that the magnitude of the income elasticity differs depending on the model specification (Sepehri et al., 2006). In particular, the point estimate of income elasticity was found to range between 0.77 and 1.17 when using a truncated and a Tobit model respectively.

Although various studies have estimated the income elasticity of HHE, little is known about the heterogeneity across different household types and income levels. One of the few relevant papers employed linear and quantile regression models, and revealed that income elasticity of HHE lies between 0.4 and 0.5, and was generally lower for poorer households (Zare et al., 2013). The latter finding is opposite to the one found by Parker and Wong, who reported that income elasticity is higher for the low-income groups (S. W.

Parker & Wong, 1997). In addition, another strand of the literature does not find a specific pattern to how income elasticity changes across income groups (Okunade, Suraratdecha, & Benson, 2010; Trivedi, 2002).

Explaining the discrepancy between micro- and macro-level studies

As shown in this brief review, there is a discrepancy regarding the magnitude of the income elasticity of health expenditure in the literature using aggregate-level data (Mocan et al., 2004). For instance, although many studies support the 'health care luxury' hypothesis, a meta-regression approach showed that income elasticity lies between 0.4 and 0.8 (Costa-Font et al., 2011). In contrast, the vast majority of microeconometric studies clearly demonstrate that health care is a necessity. The two types of study have substantial differences, the most fundamental of which relates to the source of variation. In particular, aggregate-level studies rely on variation "between groups", whereas the source of variation in micro-level studies arises "within groups" (Getzen, 2000).

Newhouse (1977) explained this discrepancy, and argued that although price is a significant "rationing factor" across countries and over time, this is not the case for the studies that rely on "within country" variation due to the presence of health insurance (Newhouse, 1977). In particular, health insurance and social protection mechanisms allow consumers to purchase health care without bearing the full price. This is evident even in the US health system, whose financing largely relies on private health expenditure[18]. In this spirit, the existence of such schemes (i.e. health insurance or redistributive mechanisms) can largely explain the differences in the estimates of micro- and macro-level studies[19] (Blomqvist & Carter, 1997). For example, Phelps and Newhouse (1974) showed that income elasticity decreases as the monetary price that consumers should pay falls (Phelps & Newhouse, 1974). A second aspect that might explain this discrepancy relates to potential model misspecification (e.g. spurious regression). For example, Gertham and Jonsson (1992) argued that some aggregate analyses may suffer from omitted variable bias, and this methodological shortcoming could partly explain the size of income elasticity (U.-G. Gerdtham & Jönsson, 1992).

[18] For example, Medicare and Medicaid or other redistributive schemes essentially subsidize health care for specific population groups and weaken the link between household income and health expenditure.

[19] Contrary to micro-level studies, aggregate studies exploit variation in country or regional level (i.e. from cross sections of several countries). In this case, the country bears the full costs of health care, and income should thus have a greater role in explaining health expenditure compared to studies using micro-level data (Newhouse, 1977).

Generally speaking, Engel curves and income elasticity are clearly microeconomic terms, and their estimates normally require the analysis of individual (or household) data (Parkin et al., 1987). They are thus sceptical about the use of macroeconomic tools when analysing and explaining microeconomic concepts. In this context, Deaton and Muellbauer (1980) have also argued that[20]:

> "If, however, as is frequently the case, the data are available only for aggregates of households, there are no obvious grounds why the theory, formulated for individual household, should be directly applicable (Deaton & Muellbauser, 1980)"

It is thus evident that treating aggregate behaviour as the natural outcome of an individual decision/behaviour (i.e. exact aggregation) requires a number of conditions, which are not always met. Therefore, using and analysing aggregate data to infer aspects related to individual behaviour may incur aggregation bias. This issue has been widely discussed in the existing literature, and is widely known as the "problem of aggregation" or the so-called "social multiplier"[21] (Getzen, 2000; Glaeser, Scheinkman, Sacerdote, & Jose Scheinkman, 2003).

2.4.3. Modelling household health expenditure: some methodological considerations

In this section, we briefly review some technical details that need to be considered when modelling health expenditure at micro-level, and briefly elaborate on the main distributional characteristics of HHE (Deb & Trivedi, 2002). First, the distribution of health expenditure is characterized by restricted range, since it does not take negative values by definition. Second, there are households and/or individuals that might not seek or purchase health care within the period of observation, and some observations thus have zero value. Third, the distribution of health expenditure is positively skewed with a heavy right-hand tail (Dormont, Grignon, & Ne Huber, 2006; W G Manning & Mullahy, 2001). These properties also arise from the fact that a relatively small fraction of individuals with severe health problems tends to consume high cost medical care, due to comorbidities and health complications. HHE can be thus characterized as a limited dependent variable, with

[20] They also noted that: "In general, it is neither necessary, nor necessarily desirable, that macroeconomic relations should replicate their microeconomic foundations so that exact aggregation is possible."

[21] For instance, estimated elasticity of health expenditure from regional-level data tend to be lower than those from cross-country datasets. This means that the level of analysis influences the estimates, and potentially implies the presence of aggregation bias (Costa-Font et al., 2011).

its distribution having substantial differences compared to a Gaussian or symmetric distribution. Given these characteristics, an OLS estimate of a conventional linear regression model is inefficient, and also leads to biased estimates (Buntin & Zaslavsky, 2004; Manning, 2012). Taking these remarks into account, there are three main econometric approaches for modelling micro-level data for health expenditure: (a) single-equation modelling, (b) two-part models (TPM), and (c) selectivity models (SSM) (Jones, 2000).

Single-equation modelling

The first type of single-equation approaches consists of linear models, the use of which generally requires the transformation of the dependent variable due to the distributional characteristics of health expenditure data. Besides, employing an OLS estimation method on the original scale of the dependent variable may have significant implications in terms of consistency and efficiency of the estimate (Manning, 1998). This transformation leads to a more symmetric distribution, and the normality assumption is thus more plausible. The most commonly applied technique to reduce skewness and make the distribution more symmetric is a log-transformation (Jones, 2010a). In general, such a model is given by the following expression:

$$\ln(y_i) = x_i'\beta + \varepsilon_i, \qquad E(\varepsilon) = 0 \; and \; E(x'\varepsilon) = 0$$

where y_i is the dependent variable, x_i is a set of regressors, β is the vector of the corresponding coefficients and ε_i is the error term.

A drawback of this approach relates to the scale of the predicted expenditures, which are presented in logarithmic terms, although the variable of interest is the actual expenditure. It is noteworthy that the exponentiated predictions of the log-scale values would not coincide with the actual predictions, given that $E(\ln(y)) \neq \ln(E(y))$. In this context, the most popular approach for estimating the predicted value on the actual scale is based on a non-parametric smearing factor proposed by Duan (Duan, 1983).

GLM is the second type of single-equation models used for the econometric analysis of HHE, and relies on two main components: (a) a link function *g* that reflects the relationship between the mean to the linear predictor and (b) a variance function that links the variance with the mean (Wooldridge, 2010). The link function can take several functional forms such as identity, logit, probit and log. Generally speaking, the form for the link function is given by the following expression:

$$\eta_i = g(\mu_i) = \beta_0 + \beta_1 x_{1i} + \ldots + \beta_k x_{ki}$$

where η_i is the linear predictor.

In addition, the variance function identifies the relationship between the mean and the variance, and is generally given by the following expression (W G Manning & Mullahy, 2001):

$$var(Y|x) = \kappa(\mu(x\beta))^{\lambda}$$

where Y is the dependent variable, and λ is a finite and non-negative parameter that defines the distributional family.

Contrary to the linear models with log-transformed dependent variable, GLM does not require retransformation, since the predicted values are estimated on the original scale (W G Manning & Mullahy, 2001). Most of the empirical work on HHE has used log-link and a Gamma distribution (Manning, 2012), whereas Poisson and binomial distribution are generally more relevant when modelling count data, such as health care utilization (Mihaylova, Briggs, O'Hagan, & Thompson, 2011). In general, the identification of the appropriate functional form is important, given that a misspecification of the distribution form implies efficiency loss. Hence, there are some established diagnostic and statistical tests in order to identify the appropriate link and distributional family (Jones, 2010a; Willard G. Manning, Basu, & Mullahy, 2005; Pregibon, 1980).

Two-part and selection models

Going beyond single-equation techniques, TPM and SSM have attracted much interest since the early 1980s, in the context of an interesting debate on the econometrics of health care demand (a comprehensive overview of this debate can be found in Jones (2000)). TPM is an empirical approach that has been closely associated with the models proposed and adopted in the context of the RAND approach (Duan, Manning, Morris, & Newhouse, 1983; W.G. Manning, Duan, & Rogers, 1987), whereas SSM is a technique that has been used to address selection issues especially in labour economics (Heckman, 1979; Puhani, 2000).

The TPM distinguishes spenders from non-spenders, and models the HHE conditional on its positive value. The first part of a TPM is a binary response model, which models the probability of having positive expenditure $P(y > 0|x) = F(x'\beta)$, where F is the cumulative distribution function (i.e. normal and logistic for probit and logit respectively). The second part of the TPM predicts the HHE conditional on its positive

value (i.e. subsample of non-zero HHE) and is essentially a linear model, with the logarithmic transformation of HHE as a dependent variable. Thus, the unconditional predicted health expenditure is given by the probability of spending for health care (first part) times the expected level of HHE (second part), and can be derived from the following expression:

$$E(y_i|x_i) = P(y_i > 0|x_i) \times E(y_i|x_i, y_i > 0)$$

A detailed description of the statistical details, identification and estimation of the TPM is presented by Mullahy (1998), who also elaborates on alternative specifications such as the modified TPM (MTPM). In particular, the MTPM uses a binary response model for the first part, while the second part consists of a GLM instead of a conventional linear model (Mullahy, 1998).

A common problem in the empirical analysis of limited dependent variables relates to potential selection issues. In order to address such problems, Heckman proposed a regression technique, based on a two-step estimation (Heckman, 1976, 1979). The first step is the selection mechanism (binary response model) and aims to distinguish those whose outcome is observed. Using latent variables notation, the SSM is expressed by the following:

$$y_{ji}^* = x_{ji}\beta_j + \varepsilon_{ji}, \quad j = 1,2$$

$$y_i = \begin{cases} y_{2i}^* \; if \; y_{1i}^* > 0 \\ 0 \; otherwise \end{cases}$$

Based on this model formulation, the first step of the Heckman's SSM is based on a probit model. For the selected (second) part of the sample, the parameters of interest are estimated using a linear regression of the outcome variable on the independent variables and the inverse Mills ratio (O'Donnell et al., 2008; Puhani, 2000). The second step is thus given by the following expression:

$$y_i = x_{2i}\beta + \rho\sigma_2 \frac{\varphi(x_{1i}\widehat{\beta_1})}{\Phi(x_{1i}\widehat{\beta_1})} + e_{2i}$$

where σ_2 is the standard deviation of ε_{2i}, ρ is the correlation coefficient between the residuals, and $\frac{\varphi(x_{1i}\widehat{\beta_1})}{\Phi(x_{1i}\widehat{\beta_1})}$ corresponds to the inverse Mills ratio.

The main contribution of Heckman's SSM is the inclusion of the inverse Mills ratio in the second part of the model, which particularly aims to correct for selection bias. However, the application of SSM in the empirical work often suffers from some practical problems, mainly due to potential collinearity between the inverse Mills ratio and the

independent variables included in vector X (Leung & Yu, 1996; Puhani, 2000). This is often the case, especially when there are no available "exclusion restrictions"[22].

In this context, there are some important theoretical and practical criteria that should be considered when evaluating the relative advantages of these approaches (Dow & Norton, 2003; Madden, 2008). From a theoretical and conceptual standpoint, the choice of the model largely relies on the nature of the research hypothesis. With this in mind, the main methodological question relates to whether we aim to model actual or potential outcomes (Duan, Manning, Morris, & Newhouse, 1984; Madden, 2008). More specifically, the actual outcomes are observed variables, in which zeros demonstrate a genuine decision of zero spending for health care (i.e. zero values for actual HHE correspond to the fact that households incur no monetary costs for health care). Therefore, if zeros are actual decision of zero expenditure, there are no selection issues. On the other hand, a potential outcome essentially corresponds to a latent and partially observed outcome (Dow & Norton, 2003). The positive cases are true observations of the potential outcomes, whereas zeros illustrate the cases in which there is a missing (latent) outcome. Therefore, zeros do not represent zero value for the potential outcome. In the case of health expenditure, zero is considered as an actual decision of no spending, and a model of HHE thus concentrates on the actual expenditure. In this context, albeit selection constitutes a major concern in several econometric applications, a model of health expenditure focuses on actual outcomes, in which zeros are genuine (Dow & Norton, 2003; Duan et al., 1984; Mihaylova et al., 2011).

The second criterion relates to the practical issues arising from the exclusion restrictions in a SSM. In fact, it is practically difficult to identify variables that influence the decision to spend for health care, but not the level of expenditure (Vella, 1998). Indeed, in the case of health spending, the selection and the expenditure equation essentially depend on similar variables (Salas & Raftery, 2001). The absence of plausible exclusion restrictions may lead to collinearity problems and large standard errors in the parameter estimates[23] (Puhani, 2000; Wooldridge, 2010).

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[22] Generally, a SSM requires the separate identification of the selection and the level equation (i.e. a different set of independent variables in each equation). Thus, some variables (the so-called "exclusion restrictions") influence the decision for participation, but they are not included in the second step of the Heckman model.

[23] In case there are no exclusion restrictions, the only potential way of separate identification is the non-linearity of the inverse Mills ratio that is added as an additional term in the level equation. Leung and Yu (1996) have emphasized the importance of the collinearity between the inverse Mills ratio and the independent variables of the level equation, and concluded that this issue constitutes a critical factor for choosing between TPM and SSM (Leung & Yu, 1996).

2.5. Data and methods

2.5.1. Data

We analyse a pooled dataset drawn from the repeated cross-sectional Household Budget Surveys (HBS), which are nationally representative surveys carried out annually by the Hellenic Statistical Authority from 2008 to 2015. These surveys include variables about demographics, household size and composition, employment, education, income, insurance characteristics, nationality and region and provide detailed information on household expenditure for goods and services. The dataset we used consists of 33,089 observations.[24]

The dependent variable of this study is HHE. By using the corresponding CPI, expenditure is deflated and converted into 2015 prices to reflect real values. The main variable of interest is net household income, deflated and adjusted to 2015 prices. We also use a dummy for the EAP, which takes the value of 1 for the years after the introduction of the EAP (2010–2015). Moreover, our model includes an interaction term between the EAP dummy and net income, which aims to capture whether the introduction of the EAP modifies the association between income and HHE.

We also control for three main sets of variables widely employed in the literature for household consumption behaviour. The first set of regressors includes several characteristics of the household head, including age, employment, educational attainment, sex, marital status, and insurance status. Second, in terms of household characteristics, we control for (a) household size, (b) squared household size, (c) household members aged less than 4, and (d) the number of elderly (aged more than 65 years old). We focus on these age groups because they are generally considered to have a greater need for and utilization of health care. In addition, our model includes region fixed effects to control for regional variation. Table A1 in Appendix A further presents and describes the variables we employed.

Apart from income, we extend the analysis by using an alternative proxy for the household's financial situation (i.e. consumption). Household spending decisions are often based on long-run resources rather than current income. For instance, households may

[24] The annual sample size for the surveys of the period 2008-2013 was approximately 3500 households. Specifically, the sample size was 3460, 3524, 3512, 3515, 3572, and 3468 households in 2008, 2009, 2010, 2011, 2012 and 2013 respectively. In addition, the sampling fraction was 0.08% and the response rate ranged from 63% to 72%, depending on the year of survey. It is noteworthy that the sample size for the last two surveys was larger, as it approximated 6000 households. Specifically, it was 5888 (response rate: 63.2%) and 6150 households in 2014 and 2015 respectively.

decide to relax their budget constraints either by liquidating assets or by bearing additional debt to afford the burden of OOPE for health care. Indeed, several studies have used total expenditure as a proxy for household income (Chernichovsky & Meesook, 1986; Zare et al., 2013). Additionally, based on previous studies of income inequality and poverty (Abul Naga & Burgess, 1997; Abul Naga, 1994), we use the available welfare indicators in the HBS (i.e. disposable income and consumption expenditure) to construct a composite welfare indicator (CWI) that captures the concept of permanent income. Previous work based on data from the Greek HBS has created a similar CWI (Mitrakos & Tsakloglou, 1998, 2010). Appendix A presents additional methodological details for the construction of the CWI.

Identifying vulnerability

As pointed out above, we estimate income elasticity of HHE for different population groups, depending on household vulnerability[25]. Household vulnerability can be explained as "the propensity to suffer from a welfare shock, bringing the household below a socially defined minimum level" (Haughton & Khandker, 2009). Therefore, this definition implies that vulnerability is not strictly associated with exposure to poverty, but it essentially identifies the probability of being exposed to adverse welfare shocks (Chaudhuri, Jalan, & Suryahadi, 2002). According to the existing literature, some of the main household characteristics associated with increased vulnerability to economic shocks are the following: (a) low-educated household head, (b) female household head, (c) older household head, (d) unemployed household head, (e) large number of elderly, (f) low household income, (g) large number of children (Corbacho, Garcia-Escribano, & Inchauste, 2003; Glewwe & Hall, 1998; Ligon & Schechter, 2003; Nikoloski & Ajwad, 2013). Therefore, we provide some estimates with a particular focus on these groups, aiming to identify potential differences in the income elasticity across different household types.

[25] Household income and/or consumption are widely considered as measures that summarize and approximate household well-being. The latter, however, does not defined in terms of income. Rather, it incorporates the risk of being exposed to shocks and adverse consumption changes (Ligon & Schechter, 2003).

2.5.2. Empirical models

Two-part model

Our main empirical model is a modified two-part model (MTPM) (Mullahy, 1998), which has slight differences compared to the conventional TPM. In particular, the first part identifies whether health expenditure is positive; this is a binary response model in which the dependent variable equals 1 if health expenditure is positive. Conditional on a positive value, the second part focuses on the level of HHE. Based on these remarks, our main model consists of (a) a logit for the whole sample and (b) a generalized linear model (GLM) with a gamma error distribution for the set of positive outcomes (i.e. the variance is proportional to the squared mean) and a log-link function (i.e. exponential conditional mean model)

In particular, the first part of the model is a logit given by the following expression:

$$\Pr(y_i > 0 \mid x_i) = \frac{\exp(x_i a)}{1 + \exp(x_i a)} \quad (1)$$

where x is the vector of the regressors and a is the vector of the regression coefficients.

The second part of the MTPM is a GLM, as described above. In this context, the second part can be presented by the following equation:

$$E(y_i | y_i > 0, x_i) = \exp(x_i \beta) \quad (2)$$

where β is the vector of the regression coefficients for the second part of the model. Based on (1) and (2), the MTPM can be written as

$$E(y_i | x_i) = \Pr(y_i > 0 \mid x_i) \times E(y_i | y_i > 0, x_i) =$$
$$= \frac{\exp(x_i \alpha) \times \exp(x_i \beta)}{1 + \exp(x_i \alpha)} = \frac{\exp(x_i (a + \beta)}{1 + \exp(x_i \alpha)} \quad (3)$$

The choice of this model is based on several specification tests. In particular, we employ a modified Park test to choose the distribution family (i.e. the relationship between the mean and the variance), and several tests (Pregibon link test, Pearson correlation test, modified Hosmer and Lemshow test) to identify the GLM link function (i.e. the relationship between the linear predictor and the mean) (Deb & Norton, 2018; Willard G. Manning et al., 2005). Last, we present some measures for goodness of fit and model performance (i.e. mean squared error, root mean squared error, mean absolute prediction error) (Jones, 2010b). More details are presented in Appendix A (Tables A3 and A4).

In addition to the baseline model, we also estimate alternative models for robustness checks. First, we employ a TPM with a logistic regression as a first part, and a linear regression model with a log-transformed dependent variable in the second part. For

this model, we also use the Duan smearing method of retransformation (Duan, 1983). Second, we carry out a similar analysis using a MTPM, in which the second part has a log link function and a Poisson family distribution.

Single-equation modeling

Apart from the TPM, we employ single-equation models for the total sample that have been also used in the existing literature for modelling health expenditure (Buntin & Zaslavsky, 2004; Mihaylova et al., 2011). In particular, we focus on (a) linear regression model with log-transformed outcome variable, estimated by OLS, (b) GLM with log link and Gamma family distribution, and (c) GLM with log link and Poisson family distribution.

Quantile regression models

Empirical techniques such as OLS and GLM model the dependent variable by using a conditional mean function. However, the income elasticity of HHE may vary depending on the level of HHE. We thus undertake an additional analysis to describe the relationship between HHE and the independent variables at different points of the conditional HHE distribution. To do so, we employ quantile regressions models (Koenker & Bassett, 1978; Koenker & Hallock, 2001). In particular, such a technique allows us to identify the potential variation in the income elasticity of HHE at different points of the conditional distribution of the response variable.

Instrumental variable approach

Most estimates of income elasticity of HHE generally tend to ignore potential endogeneity concerns (Trivedi, 2002; Zare et al., 2013). As an additional robustness check, we relax this assumption, and employ an instrumental variable (IV) approach aiming to address potential endogeneity issues, such as measurement error in income. In particular, the presence of measurement error might induce bias in our estimates, and we thus check their robustness after obtaining exogenous variation in income. In this context, an IV should be correlated with income, and should not be correlated with the error term (Hausman, 2001).

We instrument income with a household-specific asset/wealth index to address potential endogeneity issues. In order to construct the wealth index, we employed a principal component analysis to aggregate the available household indicators into an index

(Filmer & Pritchett, 2001; Vyas & Kumaranayake, 2006). Given that Greece is a high-income country, the indicators and assets included in the wealth index are not similar to the ones used for the construction of similar indices for low- and middle-income countries (Foubert, Levecque, Van Rossem, & Romagnoli, 2014; E. E. Freeman et al., 2013; Nikoloski & Mossialos, 2013). Tsakloglou and Panopoulou (1998) and Ferguson et al. (2003) have used assets as proxies for household welfare and have provided relevant details for the variables that could be used for the construction of an index in Greece[26] (Ferguson, Tandon, Gakidou, & Murray, 2003; Tsakloglou & Panopoulou, 1998). As a robustness test, we employed an IV model using the sum of the household assets as an IV for income.

Several studies that examine household demand have used ownership of assets or an asset/wealth index as an instrument for household income (Ali, Villa, & Joshi, 2018; Lépine, 2015; Lindelow, 2005; Rous & Hotchkiss, 2003; Skoufias, Di Maro, González-Cossío, & Ramírez, 2009; Skoufias, Tiwari, & Zaman, 2012). Indeed, a large body of the literature suggests that such an index and its components (e.g. ownership of assets, housing characteristics) are generally correlated with household income (Jofre-Bonet, Serra-Sastre, & Vandoros, 2018; Skoufias et al., 2012; Strauss et al., 2004), and our instrument satisfies the relevance condition. In addition, households are generally expected to make negligible errors when reporting this type of information especially compared to reporting their income (Filmer & Scott, 2012; Glewwe & Nguyen, 2002; Wittenberg & Leibbrandt, 2017).

Given that the first-stage F statistic exceeds the minimum threshold of 10, empirical evidence supports the strength of our instruments. Therefore there is no weak identification problem (Staiger & Stock, 1997). Additionally, we obtain the Kleibergen-Paap rk LM statistic and the Cragg-Donald Wald F-statistic to test for under-identification and weak identification respectively. These tests provide evidence in favour of the choice of our instrument, since they suggest that our models do not suffer from under-identification or weak identification.

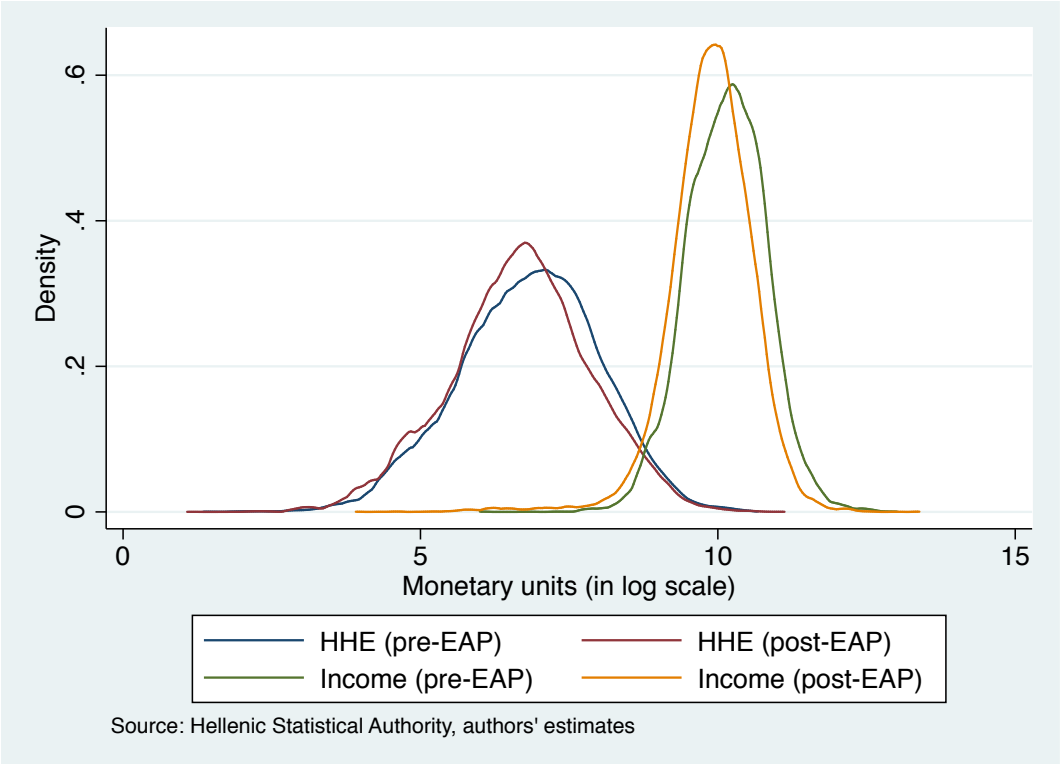
[26] The variables we used for the construction of the index were the following: house ownership without financial obligations (e.g. mortgage), hot water, central heating, car ownership, washing machine, more than two television sets, personal computer, second house ownership, and area per equivalent member (binary variables that equals 1 if the area per member is more than 30 square meters).

2.6. Results

2.6.1. Summary statistics

Figure HHE decreased after the introduction of the EAP, and Figure 2.1 illustrates that there is a shift of the Kernel density function to smaller values. Approximately 13.2% of the observations report zero HHE, while the percentage of the sample with zero expenditure is much higher for the other types of expenditure[27] (more details are presented in Appendix A Table A2). The high frequency of zeros is essentially the main reason we opt for a TPM as our main empirical specification. There are substantial differences in the means of net household income, age, household head education, and employment as well as in household size and the composition between households with zero and non-zero HHE.

Figure 2. 1: Kernel density estimate of household health expenditure and income



[27] In particular, 39.6% of the households report zero pharmaceutical expenditure, while the corresponding percentages for hospital, dental and outpatient expenditure are 81.5%, 64.5% and 39.1% respectively.

2.6.2. Regression analysis

Probability of health care spending

According to Table 2.1, income is positively associated with the probability of HHE, while the coefficient of the variable for the EAP is negative, suggesting that the period after the introduction of the EAP is associated with a lower probability of spending for health care. Our analysis also demonstrates that the relationship between income and the probability of having non-zero HHE changes with the introduction of the EAP. These findings remain robust across different model specifications and after using IV techniques to address potential endogeneity issues.

We find a strong association between the household head's demographics and probability of HHE. The odds of health spending by households with older household heads are higher (and increasing with age) relative to the odds of spending for the age group of 15–34. For instance, the odds of health care spending by a household whose head is more than 75 years old are more than twice the odds for a household with a young head. Similarly, the odds of having non-zero HHE for a household with a male head are approximately 0.71 times the odds for one with a female head[28]. In constrast to educational level, urbanity, household size and composition, and household heads' marital, employment, and insurance status are all statistically significant determinants of the probability of incurring OOPE. For instance, household size, the number of members aged under 4, and the number of members aged over 65 years old are all positively linked with the probability of having non-zero health spending.

Based on the first part of the MTPM, Figure 2.2 presents the predicted probability of non-zero HHE for different income levels, which is increasing with income for both periods. Moreover, in the post-EAP period, the predicted probability of non-zero HHE is lower than that in the pre-EAP period, especially for low-income households.

[28] The odds ratio for each variable is given by the exponentiated coefficient.

Figure 2. 2: Predicted probability of non-zero household health expenditure

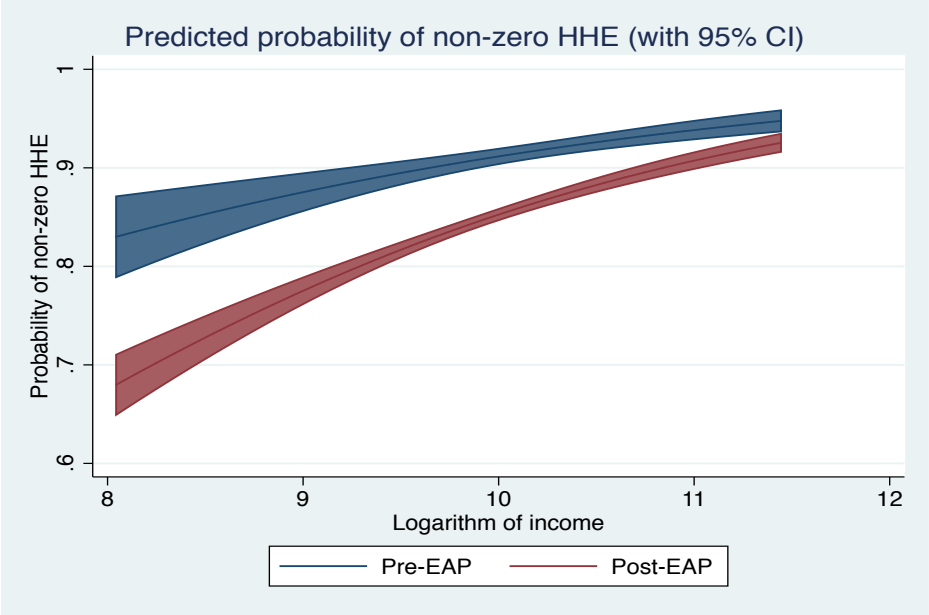


Table 2. 1: Two-part model, total sample (2008-2015 household data)

	MTPM (logit, Gamma)		TPM (logit, log-transformed OLS)		MTPM (logit, Poisson)		IV probit	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Participation equation	Expenditure equation	Participation equation	Expenditure equation	Participation equation	Expenditure equation	Participation equation	Expenditure equation
EAP	-2.113***	-0.901***	-2.113***	-0.901***	-2.113***	-1.836***	-1.974***	-0.961**
	(0.774)	(0.324)	(0.774)	(0.289)	(0.774)	(0.418)	(0.615)	(0.384)
Log income	0.402***	0.421***	0.402***	0.405***	0.402***	0.447***	0.487***	0.707***
	(0.073)	(0.030)	(0.073)	(0.026)	(0.073)	(0.035)	(0.067)	(0.044)
EAP x Log income	0.151**	0.079**	0.151**	0.075***	0.151**	0.172***	0.177***	0.089**
	(0.077)	(0.032)	(0.077)	(0.029)	(0.077)	(0.041)	(0.061)	(0.038)
Male	-0.342***	-0.018	-0.342***	-0.060**	-0.342***	-0.022	-0.215***	-0.086***
	(0.064)	(0.031)	(0.064)	(0.027)	(0.064)	(0.033)	(0.028)	(0.022)
35-44	0.165**	-0.020	0.165**	-0.017	0.165**	-0.045	0.082**	-0.057*
	(0.076)	(0.047)	(0.076)	(0.040)	(0.076)	(0.051)	(0.039)	(0.035)
45-54	0.116	-0.036	0.116	0.014	0.116	-0.088*	0.024	-0.036
	(0.079)	(0.047)	(0.079)	(0.042)	(0.079)	(0.052)	(0.041)	(0.037)
55-64	0.339***	0.081	0.339***	0.124***	0.339***	0.052	0.108**	0.059
	(0.088)	(0.050)	(0.088)	(0.044)	(0.088)	(0.055)	(0.046)	(0.040)

65-74	0.538***	0.004	0.538***	0.081	0.538***	0.028	0.235***	0.017
	(0.134)	(0.062)	(0.134)	(0.052)	(0.134)	(0.072)	(0.061)	(0.047)
75+	0.996***	0.034	0.996***	0.194***	0.996***	0.061	0.471***	0.171***
	(0.150)	(0.066)	(0.150)	(0.055)	(0.150)	(0.073)	(0.066)	(0.048)
Primary/lower secondary education	-0.129	-0.044	-0.129	-0.079***	-0.129	-0.059*	-0.120***	-0.079***
	(0.082)	(0.027)	(0.082)	(0.024)	(0.082)	(0.030)	(0.035)	(0.021)
Upper and post-secondary education	-0.111	0.078**	-0.111	0.017	-0.111	0.066*	-0.202***	-0.077***
	(0.090)	(0.034)	(0.090)	(0.029)	(0.090)	(0.038)	(0.041)	(0.027)
Higher education	0.072	0.145***	0.072	0.107***	0.072	0.095**	-0.224***	-0.080**
	(0.101)	(0.039)	(0.101)	(0.034)	(0.101)	(0.044)	(0.052)	(0.036)
Intermediate population density	0.031	-0.020	0.031	-0.006	0.031	-0.028	0.052**	0.008
	(0.058)	(0.027)	(0.058)	(0.023)	(0.058)	(0.030)	(0.026)	(0.019)
Sparsely populated	-0.125**	0.034	-0.125**	0.030	-0.125**	0.024	-0.023	0.068***
	(0.062)	(0.025)	(0.062)	(0.022)	(0.062)	(0.028)	(0.027)	(0.019)

Household size	0.201***	0.051	0.201***	0.048	0.201***	0.042	0.002	-0.056*
	(0.069)	(0.034)	(0.069)	(0.032)	(0.069)	(0.037)	(0.040)	(0.029)
Household size squared	-0.030***	-0.006	-0.030***	-0.004	-0.030***	-0.006	-0.006	0.003
	(0.010)	(0.004)	(0.010)	(0.005)	(0.010)	(0.005)	(0.005)	(0.004)
Divorced	-0.194*	-0.027	-0.194*	-0.073	-0.194*	0.008	-0.068	-0.069*
	(0.102)	(0.052)	(0.102)	(0.046)	(0.102)	(0.057)	(0.045)	(0.038)
Never married	-0.341***	-0.148***	-0.341***	-0.233***	-0.341***	-0.119**	-0.158***	-0.203***
	(0.083)	(0.047)	(0.083)	(0.039)	(0.083)	(0.057)	(0.040)	(0.033)
Widowed	-0.231**	-0.095**	-0.231**	-0.128***	-0.231**	-0.098**	-0.109***	-0.120***
	(0.098)	(0.039)	(0.098)	(0.036)	(0.098)	(0.040)	(0.042)	(0.030)
Members aged below 4	0.607***	0.142***	0.607***	0.154***	0.607***	0.145***	0.285***	0.164***
	(0.072)	(0.030)	(0.072)	(0.027)	(0.072)	(0.029)	(0.031)	(0.021)
Members aged more than 65	0.285***	0.116***	0.285***	0.122***	0.285***	0.101***	0.133***	0.115***
	(0.065)	(0.024)	(0.065)	(0.020)	(0.065)	(0.025)	(0.024)	(0.016)
Self-employed	0.338***	0.188***	0.338***	0.142***	0.338***	0.171***	0.108***	0.121***
	(0.070)	(0.034)	(0.070)	(0.028)	(0.070)	(0.036)	(0.033)	(0.025)

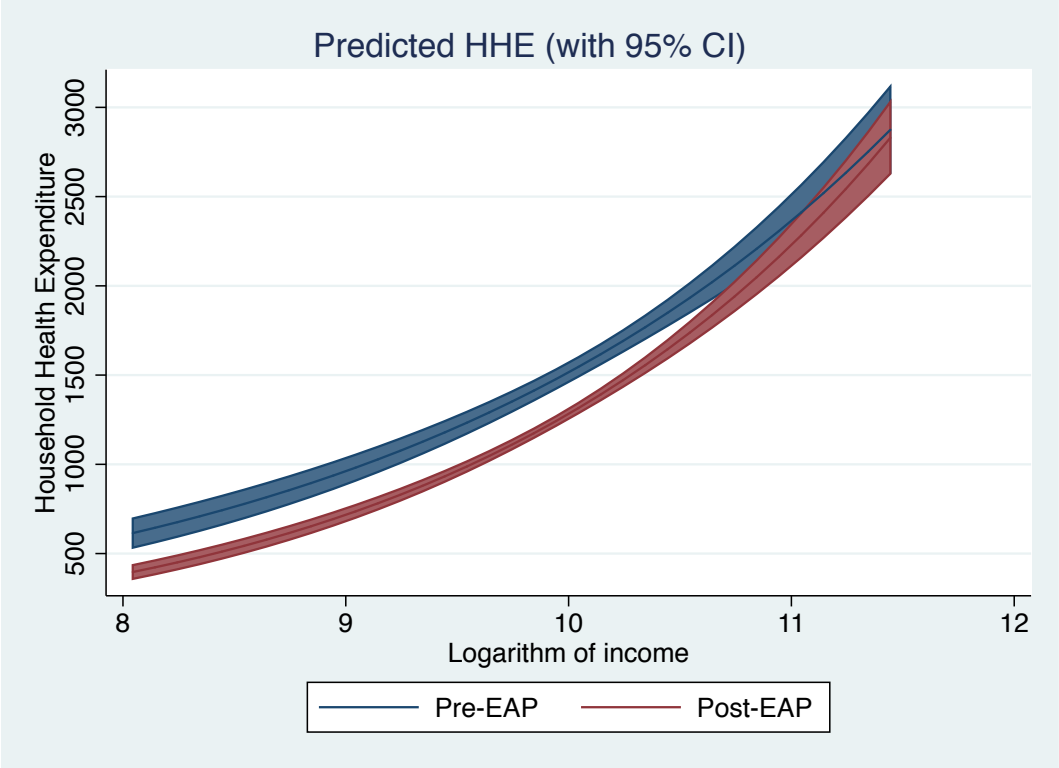
Farmer	0.225**	0.084*	0.225**	0.037	0.225**	0.088*	0.098**	0.103***
	(0.112)	(0.049)	(0.112)	(0.047)	(0.112)	(0.050)	(0.050)	(0.039)
Unemployed	0.070	0.098	0.070	0.019	0.070	0.085	0.170***	0.147***
	(0.092)	(0.063)	(0.092)	(0.050)	(0.092)	(0.069)	(0.047)	(0.044)
Retired	0.351***	0.215***	0.351***	0.211***	0.351***	0.177***	0.209***	0.209***
	(0.075)	(0.037)	(0.075)	(0.030)	(0.075)	(0.042)	(0.033)	(0.025)
Other inactive	0.652***	0.250***	0.652***	0.235***	0.652***	0.200***	0.343***	0.237***
	(0.100)	(0.046)	(0.100)	(0.037)	(0.100)	(0.049)	(0.044)	(0.032)
Uninsured	0.488***	-0.010	0.488***	0.026	0.488***	-0.014	0.054	-0.145***
	(0.088)	(0.065)	(0.088)	(0.055)	(0.088)	(0.071)	(0.052)	(0.051)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-2.860***	2.898***	-2.860***	2.472***	-2.860***	2.721***	-3.693***	-0.129
	(0.743)	(0.300)	(0.743)	(0.266)	(0.743)	(0.350)	(0.631)	(0.407)
Observations	31,940	27,878	31,940	27,878	31,940	27,878	31,920	27,860

Level of HHE

Column 2 in Table 2.1 shows the baseline estimates of the second part of the MTPM, which models health expenditure conditional on its positive value. The dummy indicating the EAP has a negative coefficient, suggesting that the post-EAP period is also negatively associated with HHE. Income is positively associated not only with the probability of spending for health care (as suggested in the first part), but also with the level of expenditure. The significance and sign of the interaction term indicate that the introduction of the EAP modifies the association between income and HHE. These findings also remain robust to alternative specifications in the second part of the TPM, as shown in columns 4 and 6 in Table 2.1. Estimates from single-equation models, reported in the Appendix Table A5, further validate our results. Last –using an asset index as instrument for income- Table 2.1 (column 8) shows the estimates of a 2SLS model, and indeed confirms that our findings are strong and robust after using an IV approach.

Apart from income, other socioeconomic characteristics such as educational level, employment, and marital status also appear to be statistically significant determinants of HHE. In contrast, although a household head's core demographics (sex, age) are statistically significant predictors of the probability of incurring non-zero HHE, they are not significantly associated with the level of HHE conditional on its positive value. As expected, the numbers of household members aged under 4 and more than 65 years old are both positively associated with HHE. Finally, the predicted level of HHE is increasing with income and generally lower after the introduction of the EAP (Figure 2.3).

Figure 2. 3: Predicted level of household health expenditure



2.6.3. Income elasticity of HHE

Following Mullahy (1998), we measure the responsiveness of HHE to income changes, using two measures. First, we estimate the probability semi-elasticity, which measures the absolute change in the probability of health spending following a percentage change in income. As shown in Table 2.2, the probability semi-elasticity (evaluated at means) is 0.055.

Table 2. 2: Income elasticity of household health expenditure

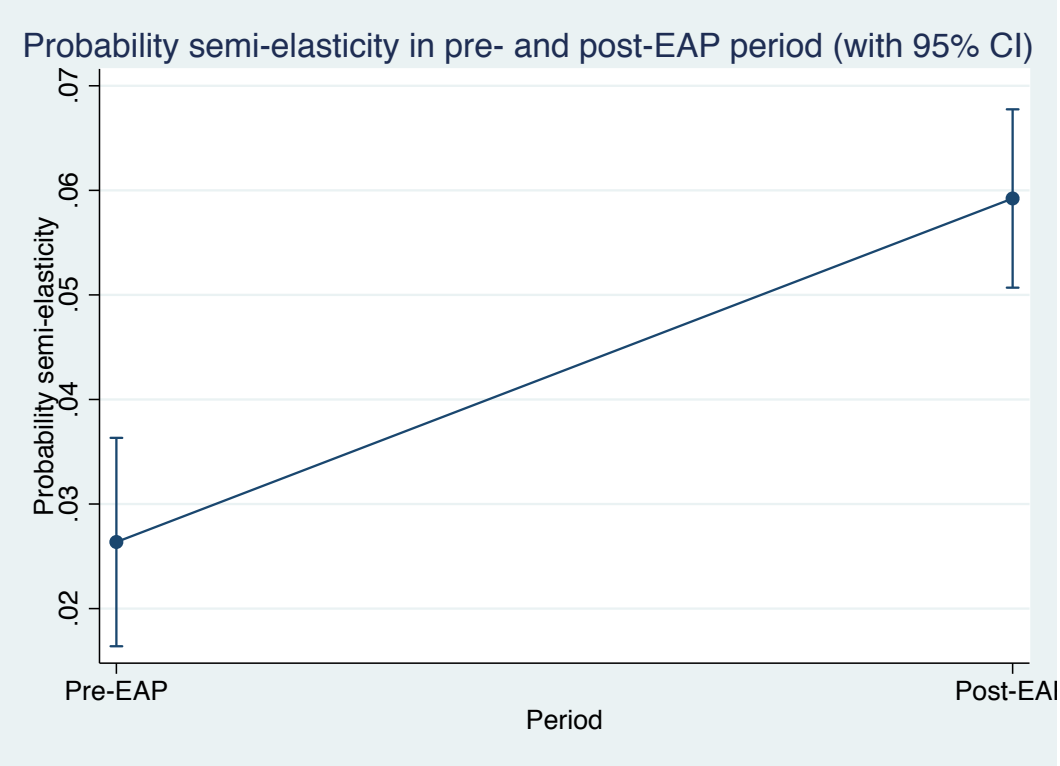
	Total period	Pre-EAP	Post-EAP	Significant difference[29]
Probability semi-elasticity				
Probability semi-elasticity	0.055	0.026	0.059	Yes
	(0.004)	(0.005)	(0.004)	
Unconditional income elasticity				
Main model	0.54	0.45	0.56	Yes

[29] Pairwise comparisons of elasticities were performed, using t-test statistics. This analysis was conducted using the relevant version of margins command in STATA.

TPM (logit, GLM Gamma)				
	(0.02)	(0.03)	(0.02)	
TPM (logit, OLS)	0.52	0.43	0.54	Yes
	(0.02)	(0.03)	(0.02)	
TPM (logit, GLM Poisson)	0.64	0.47	0.68	Yes
	(0.03)	(0.04)	(0.03)	
GLM Gamma	0.54	0.45	0.57	Yes
	(0.02)	(0.03)	(0.03)	
OLS	0.46	0.41	0.48	Yes
	(0.02)	(0.03)	(0.02)	
GLM Poisson	0.64	0.49	0.70	Yes
	(0.03)	(0.04)	(0.03)	
2SLS	0.77	0.71	0.79	Yes
	(0.04)	(0.04)	(0.04)	

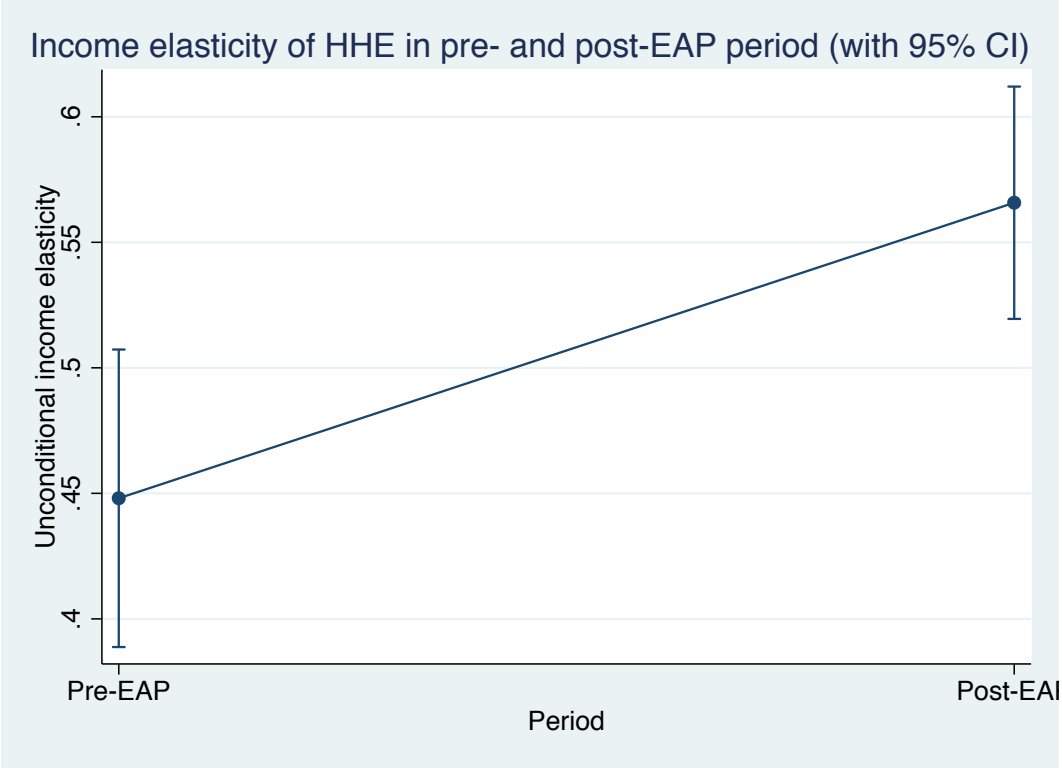
We also estimate the probability semi-elasticity for the periods before and after the introduction of the EAP in Greece. We find a significant rise in the probability semi-elasticity of HHE with respect to income after the introduction of the EAP, suggesting that an equal percentage change in income is associated with a greater change in the probability of spending after the EAP. As shown in Figure 2.4, the probability semi-elasticity is 0.026 in the pre-EAP period and 0.059 in the post-EAP period.

Figure 2. 4: Probability semi-elasticity of household health expenditure in pre- and post-EAP period (with 95% CI)



Further, we provide evidence regarding the size of the unconditional income elasticity of HHE, which captures both probability and conditional elasticity (given by the first and second parts of the MTPM, respectively) (Mullahy, 1998). In particular, the income elasticity of HHE is estimated as 0.54, demonstrating that a 10% increase in household income is associated with a 5.4% rise in HHE. Thus, the size of the elasticity indicates that health care is—in technical terms—a necessity. In addition, our analysis shows that income elasticity rose from 0.45 to 0.56 following the introduction of the EAP (Figure 2.5). In the same vein, Table 2.2 shows that –after using an IV approach- income elasticity increases in the post-EAP period.

Figure 2. 5: Income elasticity of HHE in pre- and post-EAP period (with 95% CI)



Overall, HHE is more responsive to income changes in the post-EAP period. Although these estimates rely on our baseline model, our results are robust to alternative models and estimation techniques, such as (a) TPM with log-transformed linear model as second part, (b) MTPM with GLM with Poisson family as second part, (c) several single-equation models. Using different models, the magnitude of the income elasticity of HHE is similar to the one derived from the main model (see Table 2.2), while –according to all models we estimated-there is also a statistically significant increase in income elasticity in the post-EAP period. For example, the estimates of the conventional TPM (logit, OLS) show that the income elasticity amounts to 0.52, which is slightly lower than the baseline estimate. It also appears to increase after the introduction of the EAP (from 0.43 to 0.54).

Apart from being robust to different modelling approaches, our results are also insensitive and robust to the inclusion/exclusion of explanatory variables. For instance, if we estimate the baseline model without including education as a control variable, income elasticity amounts to 0.51 and 0.59 for the pre- and post-EAP period respectively, while the relevant figure for the total period is 0.57. We also test the robustness of our findings, after controlling for a quadratic term of income, and income elasticity is 0.56. In the pre-EAP period, it approximates 0.45, and increases to 0.60 in the post-EAP period. We

estimate the elasticities using other empirical models and further confirm the baseline findings. More details can be found in the Appendix Tables A6 and A7.

2.6.4. Income elasticity of HHE, by household type

Grouping households is interesting for our analysis since households of different SES may have different behaviour towards HHE and may react differently to income changes. Examining the income elasticity of HHE across household types therefore allows us to provide a more detailed and analytical overview of the way in which HHE responds to income changes.

To check the potential heterogeneity in income elasticity, we stratified the sample by the following household types: (a) the bottom 40% of the income distribution, (b) female household heads, (c) low-educated household heads, (d) unemployed household heads, (e) uninsured household heads, (f) no working household members, (g) households with unmarried mothers as the household head, and (h) elderly couples.

Table 2.3 presents the estimates of the income elasticity of HHE for different household types. The results are consistent with the findings presented in Section 2.6.3, confirming that health care is a necessity regardless of household type and SES. Moreover, our findings suggest heterogeneity across household types: HHE is more elastic for households with a higher SES. For instance, households in the bottom income quintiles exhibit a lower income elasticity of HHE relative to households in the top 60%. Similar results are reported for households whose heads are women, with a low level of education, unemployed, or uninsured as well as for households with no working members. For example, households headed by an unemployed member tend to have a lower income elasticity compared to those with an employed household head. In addition, in contrast to the households headed by employed individuals, the income elasticity of HHE did not increase among households with an unemployed household head.

Table 2. 3: Income elasticity of household health expenditure, by household type

	Total period	Pre-EAP	Post-EAP	Significant difference (pre-post)
Income level				
Bottom 40%	0.29	0.40	0.26	No
	(0.04)	(0.07)	(0.05)	
Top 60%	0.75	0.59	0.79	Yes
	(0.04)	(0.06)	(0.04)	
Gender of household head				
Female	0.52	0.50	0.52	No
	(0.05)	(0.06)	(0.05)	
Male	0.54	0.43	0.58	Yes
	(0.02)	(0.04)	(0.03)	
Education of household head				
No formal education	0.49	0.34	0.52	No
	(0.06)	(0.10)	(0.06)	
Formal education	0.54	0.46	0.57	Yes
	(0.02)	(0.03)	(0.02)	
Employment status of household head				
Unemployed	0.46	0.52	0.47	No
	(0.06)	(0.15)	(0.06)	
Employed	0.55	0.45	0.58	Yes
	(0.02)	(0.03)	(0.03)	
Insurance status				
Uninsured	0.38	0.62	0.36	No
	(0.08)	(0.18)	(0.08)	
Insured	0.56	0.45	0.59	Yes
	(0.02)	(0.03)	(0.02)	
Working members				
No working members	0.40	0.30	0.42	No
	(0.04)	(0.06)	(0.04)	
Other type	0.64	0.46	0.68	Yes
	(0.03)	(0.06)	(0.03)	
Unmarried mother				
Unmarried mother	0.63	0.59	0.74	No
	(0.08)	(0.10)	(0.11)	
Other type	0.53	0.42	0.56	Yes
	(0.02)	(0.03)	(0.02)	
Elderly couple				
Elderly couple	0.42	0.44	0.41	No
	(0.04)	(0.09)	(0.05)	
Other	0.55	0.45	0.59	Yes
	(0.02)	(0.03)	(0.03)	

Our results also suggest a significant increase (at the 5% level) in income elasticity between the pre- and post-EAP periods for the majority of the subgroups. However, there is no significant increase in income elasticity for socially less-privileged population groups. Compared with the pre-EAP period, the higher socioeconomic strata become more responsive to income changes, whereas this is not the case for the lower socioeconomic groups. Therefore, a 10% change in income in the post-EAP period is associated with a higher percentage change for higher socioeconomic groups (compared with the pre-EAP period). We do not report similar findings for households of lower SES, which appear to retain the same sensitivity to income changes. This finding has various policy implications, as it indicates the differential responses in HHE across household types.

2.6.5. Income elasticity of HHE, by the level of HHE

The previous analysis focused on modelling HHE by using a conditional mean function. We also examined the potential heterogeneity in the income elasticity of HHE at different points of the conditional distribution of the response variable. By focusing on the non-zero observations of the HHE distribution, we ran quantile regressions at different points, finding that the income elasticity of HHE is positive and below unity; in other words, health care is a necessity across all quantiles of the HHE distribution. However, the size of the elasticity differs across these quantiles, as it is more income inelastic for households having relatively low HHE. Income elasticity is lower in the 0.10 quantile and gradually increases until the 0.60 quantile. In addition, it is relatively constant across the 0.70–0.90 quintiles.

Table 2. 4: Income elasticity of household health expenditure, by level of household health expenditure

Quantile of HHE distribution	**Total period**	**Pre-EAP**	**Post-EAP**	**Significant difference**
0.10	0.36	0.40	0.35	No
	(0.03)	(0.05)	(0.03)	
0.20	0.39	0.35	0.40	No
	(0.03)	(0.04)	(0.03)	
0.30	0.43	0.41	0.43	No
	(0.02)	(0.03)	(0.02)	
0.40	0.44	0.44	0.44	No
	(0.02)	(0.03)	(0.02)	

0.50	0.48	0.46	0.49	No
	(0.02)	(0.03)	(0.02)	
0.60	0.51	0.45	0.53	Yes
	(0.02)	(0.03)	(0.02)	
0.70	0.50	0.42	0.53	Yes
	(0.02)	(0.03)	(0.02)	
0.80	0.50	0.40	0.54	Yes
	(0.02)	(0.03)	(0.02)	
0.90	0.50	0.43	0.53	Yes
	(0.02)	(0.03)	(0.02)	

In addition, we find a statistically significant increase in income elasticity for the higher quintiles (0.60–0.90 quintiles), whereas this is not the case for the lower quintiles. This finding is consistent with those reported in Section 2.6.4 since those in the lowest quintiles of the HHE distribution are less-privileged socioeconomic groups, for which we do not report an increase in the income elasticity of HHE.

2.6.6. Using alternative measures of household welfare

Household spending decisions are often based on long-run resources rather than current income. For instance, households may decide to liquidate assets, use savings, or bear additional debt to incur OOPE for health care. In this context, the elasticity with respect to permanent income might be different compared with the one with respect to current income. By using two alternative measures of a household's financial situation (i.e. consumption expenditure and the CWI) and based on additional models (Tables A9 and A10 in Appendix A), we thus test the fourth hypothesis of this study. Our findings show that the elasticity of HHE with respect to permanent income is consistently higher than that with respect to current income, suggesting that HHE responses to permanent income changes are greater than those arising from current income changes (Table 2.5). This finding is robust when using either consumption or the CWI, both of which can better capture the notion of "permanent income" (Meyer & Sullivan, 2003; Mitrakos & Tsakloglou, 2010).

Table 2. 5: Income elasticity of household health expenditure (proxies for permanent income)

Model	Welfare measure	Total period	Pre-EAP	Post-EAP	Significant difference
TPM (logit, GLM Gamma)	Log expenditure	0.92	0.75	0.97	Yes
		(0.02)	(0.03)	(0.02)	
TPM (logit, GLM Gamma)	CWI	1.09	0.83	1.17	Yes
		(0.03)	(0.04)	(0.03)	

By using the alternative measures of a household's financial situation, our analysis shows that the income elasticity of HHE is consistently higher after the introduction of the EAP across all empirical models and estimation methods. These findings further confirm our first hypothesis regarding the increased income elasticity of HHE in the post-EAP period since they suggest that this finding is robust even when using alternative measures of household welfare.

2.7. Discussion

Using household data from repeated cross-sections over 2008–2015, our analysis identifies the determinants of HHE and examines potential changes in the income sensitivity of HHE and consumer behaviour following a severe economic crisis and the introduction of a large-scale EAP. The regression estimates suggest that the introduction of the EAP is associated with a lower probability of health care spending and lower HHE. Further, we find that the introduction of the EAP modifies the association between income and HHE.

Our analysis reveals that the income elasticity of HHE is less than unity, implying that health care is a technical necessity. In other words, HHE increases (decreases) less than proportionally in response to an income increase (decrease). This finding is generally consistent with the vast majority of the literature using micro-data (Getzen, 2000). The size of our estimate can be attributed to the lack of adequate prepayment mechanisms and the high OOPE in Greece, not only as a share of health spending but also as a fraction of the household budget (OECD/EU, 2016). In a review of the literature, Getzen (2000) indeed notes that evidence suggests that income elasticity tends to be somewhat greater –ranging from 0.2 to 0.7- in cases where "insurance is less prevalent and most payment is made out

of pocket" (Getzen, 2000). The results are generally robust across econometric specifications, and indicate that HHE is not a voluntary and deliberate choice (Lépine, 2015). Rather, it is related to either health shocks or households' responses to gaining access to health services in the context of a fragmented health system that does not ensure the accessible and timely provision of high-quality care (Davaki & Mossialos, 2005; Economou, 2010).

Examining whether health care is a necessity or luxury has significant implications from a public policy perspective, especially regarding health financing. For instance, if health care is indeed a necessity, then there are further grounds and arguments for more active public involvement in health financing and in the health care system more generally (Baltagi et al., 2017; Costa-Font et al., 2011; Gertler & Hammer, 1997). However, evidence in favour of the hypothesis that health care is a luxury suggests weaker public intervention in health financing and coverage and a greater role for market forces (Di Matteo, 2005).

In terms of Hypothesis 1, our analysis indicates a statistically significant increase in the income elasticity of HHE between the pre- and post-EAP periods (from 0.45 to 0.56). Households are more responsive to income changes after the introduction of the EAP, and this finding is robust across econometric specifications. Furthermore, it is in line with other studies that have found that the income elasticity of HHE increased after the 1997 economic crisis in Thailand and Korea (Okunade et al., 2010; Yang et al., 2001). In contrast to the crises in Thailand and Korea, the Greek crisis was much stronger in terms of length and intensity. We also show a significant increase in the probability semi-elasticity of HHE with respect to income, suggesting that a proportionally similar change in income is associated with a higher change in the probability of incurring HHE in the post-EAP period (relative to the pre-EAP period). Therefore, it appears that households' decisions to spend on health care as well as the level of HHE became more sensitive to income changes after the introduction of the EAP. These findings imply a change in household behaviour towards health care, since households appear to exhibit greater consumption responses to changes in their income during the post-EAP period.

This finding can be further explained from a theoretical perspective. One explanation for the greater income sensitivity is associated with the unnecessary use of and non-essential payments for health care. In particular, households may decide to reduce OOPE for non-essential health care goods and services after an economic crisis (in the same way that they may reduce expenses for restaurants or clothing), as a response to

increasing financial difficulties (Yang et al., 2001). Second, households may become more sensitive to income changes since they normally reduce their HHE and shift towards public services during periods of economic distress because of their reduced purchasing power and ability to pay OOPE (H. Waters et al., 2003a; Yang et al., 2001). This is indeed depicted in the increase in hospital admissions, outpatient visits, and laboratory tests in public health services after the introduction of the EAP (Institute of Social and Preventive Medicine, 2016; Kentikelenis & Papanicolas, 2012). Our findings confirm that households continue to consider health care to be a necessity. They also suggest that different priorities and preferences exist regarding the consumption of health care and HHE in the post-EAP period. OOPE for health care is more elastic and generally considered to be less "necessary" in the post-EAP period given the alternative of using public services.

To examine Hypothesis 2, we estimated the income elasticity of HHE by household type. While HHE is generally income inelastic across all household types, we did find heterogeneous responses of HHE to income changes based on households' SES or degree of vulnerability. In particular, HHE is more inelastic for lower SES households. Overall, lower socioeconomic groups exhibit lower flexibility in HHE as income changes than higher socioeconomic strata. Based on a descriptive analysis of the Greek HBS data for 2005 and 2009, another study also reported that HHE is more inelastic among low-income households because of the relatively inflexible need for care (Kondilis, Giannakopoulos, et al., 2013). Our finding can be explained on the basis of the different mixes of medical goods and services consumed by each socioeconomic group and their relative costs. For instance, the HHE of less-privileged households primarily consists of payments for pharmaceuticals (i.e. user charges and payments for non-reimbursed medicines), while they tend to incur lower expenses for hospital/outpatient visits and dental care. These combinations of health care goods and services might result in heterogeneous consumption responses to income changes since the expenses for some health care goods and services (e.g. cost-sharing for medicines) are more essential and cannot be easily avoided or substituted by shifting to the public sector.

In addition, the heterogeneity in income elasticity can be attributed to several structural barriers to accessing health care for the poorer segments of society. This result highlights the need for progressive policies that aim for equity in health care access and financing (Zare et al., 2013). Several barriers impede access to health care in Greece, especially for the most vulnerable groups (Kyriopoulos et al., 2014; Zavras, Zavras, Kyriopoulos, & Kyriopoulos, 2016). In this context, appropriate public policy responses

are needed, especially for less-privileged households. Further, the lower income sensitivity of HHE among lower socioeconomic groups can be interpreted on the basis of the socioeconomic gradient in health and the fact that poorer individuals tend to have lower health status and greater health care needs.

In terms of Hypothesis 3, in contrast to higher socioeconomic groups, less-privileged households did not become more sensitive to income changes in the post-EAP period. As pointed out above, households often shift to public services and avoid OOPE for some types of health care because of reduced disposable income (Yang et al., 2001). However, such mechanisms cannot work for certain types of OOPE. In particular, there is no substitute (in the public sector) for user charges, which constitute a prerequisite for gaining access to certain health care. For instance, cost-sharing schemes in pharmaceutical care imply that individuals should pay user charges to receive and adhere to their therapy. Households whose HHE primarily consists of payments for pharmaceuticals (or user charges more generally) did not become more sensitive to income changes because their HHE is relatively rigid. Poor households appear to be more "protective" about their health care consumption compared with richer ones, and this intensified in the post-EAP, during which HHE became more elastic for higher socioeconomic groups, but not for less-privileged households. This relative "rigidity" of poorer households as income changes combined with the high share of income devoted to health care raises concerns about the implications of the EAP on household welfare because of the increased incidence of catastrophic expenditure at the household level. Given the budget constraints faced by poorer households, such a finding illustrates that they may cut spending on other goods and services rather than that for health following an income decrease.

Further, HHE is income inelastic over its conditional distribution. However, the quantile regression estimates show that HHE is more income inelastic in the lower quantiles of the HHE distribution. A statistically significant increase in the income elasticity of HHE is only observed in the top quantiles of the HHE distribution (0.6–0.9 quintiles), suggesting that contrary to those at the bottom, "big spenders" are those who actually became more sensitive to income changes during the post-EAP period. This finding serves as an additional robustness check to the aforementioned findings, as households in the lower quantiles are expected to be lower socioeconomic groups (neither of which exhibited a statistically significant increase in income elasticity between the pre- and post-EAP periods).

Finally, Hypothesis 4 concerned income sensitivity with respect to permanent income. To our knowledge, this is the first study examining how HHE responds to current and permanent income and identifying potential differences depending on the welfare measure used. Measures of permanent income are particularly important to better understand households' health care consumption since households tend to smooth consumption over their lifetime and their consumption decisions are rather based on permanent income or the notion of lifetime wealth rather than current income. Transitory income changes tend to have only small effects on consumption, whereas permanent shocks are associated with greater consumption responses (Jappelli & Pistaferri, 2010). We show that the size of income elasticity is greater when using more permanent measures of welfare. In other words, HHE responses to permanent income are greater than those arising from variations in current income. In addition, by using consumption expenditure and the CWI, we present strong evidence of greater income sensitivity in the post-EAP period, a finding that further validates our baseline results.

Finally, our study has some limitations. First, the aggregate nature of the EAP as well as the cross-sectional design of the surveys do not allow us to employ quasi-experimental approaches or estimate the causal effects. Therefore, the interpretation of associations as causal relationships should be made with caution. Second, our model does not include a health variable. This is a common limitation in studies using household data (Amuedo-Dorantes & Pozo, 2011; Okunade et al., 2010; Zare et al., 2013), since it is practically difficult to approximate health status at the household level and most budget surveys do not ask questions about health status. However, we control for proxies for the need for health care at the household level, especially those groups considered to be heavy health care users. Last, the impact of each of the "triple hits" cannot be isolated and tested separately, due to lack of relevant data.

2.8. Conclusion

The unprecedented length and intensity of the Greek crisis as well as the magnitude of the fiscal adjustment make this case particularly interesting in several respects. In particular, Greek households experienced the "triple hit" of public budget cuts, increased user charges, and a large decrease in disposable income and household purchasing power. The presented analysis of how households behaved in the face of this economic shock (and the associated "triple hit") suggests that the introduction of the EAP is associated with a

lower probability of health care spending and lower HHE. Apart from the regression estimates, we show that households became more sensitive to income changes after the introduction of the EAP. We also find heterogeneity in the income elasticity of HHE across household types and over the HHE distribution as well as show that lower SES households did not become more sensitive to income changes after the onset of the economic crisis. Lastly, by using a novel proxy for permanent income, our findings suggest that HHE responses to permanent income changes are greater than those arising from current income changes. From a public policy perspective, this study provides evidence and informs policymaking about households' behaviour towards health care, health financing, and the design of social safety nets.

Our findings have several policy implications. Estimating the income sensitivity of HHE is useful for evidence-based health policy because it thoroughly informs policymaking about resource allocation decisions and financing (Lépine, 2015; Zare et al., 2013) and allows governments to improve the design of social safety net programmes aiming to protect the vulnerable from structural adjustments (Rous & Hotchkiss, 2003). Low income elasticity provides grounds for public policy responses and interventions that aim to reduce the OOP price through subsidies or abolish cost-sharing mechanisms for lower socioeconomic groups, which are less responsive to income changes (Zare et al., 2013). Based on our findings, and considering that health financing in Greece largely relies on OOPE, a potential policy response could incorporate exemptions from user charges for vulnerable households or income-related user charges. The introduction of such a scheme would improve equity in financing by reducing the financial burden of OOPE for less-privileged households, leading to higher progressivity in health financing. Although the introduction of income-related user charges constitutes the "first-best solution", it incorporates several practical problems and difficulties (Barros, 2012). First, the implementation of this system is associated with high administrative costs and might be complicated. Second, there is a dearth of data on actual income in Greece because of high levels of informal activity, deficiencies in the tax system, and tax evasion, which lead to significant distributional effects (Matsaganis & Flevotomou, 2010). Therefore, relying on tax data for introducing differential user charges may be misleading. Such a problem clearly threatens the objective of this system (i.e. to establish equity and higher progressivity in health financing). Instead of such a complicated scheme, another policy response could simply promote reductions in the OOP price (e.g. subsidies or abolish cost-sharing mechanisms) for specific types of households with a low ability to pay. In addition,

our findings highlight the need to protect basic health care, especially during prolonged economic recessions. This appears to be necessary in order to preserve adequate human health capital for investment and consumption, which in turn can be catalysts for triggering economic recovery and also improve labour productivity.

Chapter 3

Financial protection in health among middle-aged and elderly: evidence from the Greek economic recession

Abstract

Since the late 2000s, the Greek economy has entered a long period of recession and adopted various fiscal consolidation measures, with reforms and retrenchment in health care being among the main public policy priorities. Based on data from the Survey of Health, Ageing and Retirement in Europe (SHARE), this study investigates the extent to which financial risk protection in health has changed among older households during the economic crisis in Greece. We focus on the middle-aged and elderly; the heavy users of health services with high need and costs for health care, who have also faced a substantial health and financial burden during the crisis. Our analysis shows that the headcount and overshoot of catastrophic health expenditure (CHE) substantially increased during the crisis, suggesting that financial protection has eroded to a great extent among the middle-aged and elderly. Prior to the economic crisis, CHE was mainly due to inpatient and nursing care, followed by outpatient care and medicines. However, our findings reveal that the contribution of household pharmaceutical spending to CHE substantially increased during the study period. The headcount of CHE rose across all population groups we examined, with low-income and households with chronic and multimorbid patients being disproportionately affected. Our results are generally robust to different scenarios and definitions of CHE. Although we do not report signs of socioeconomic inequalities in the risk of CHE in 2007, our findings show that the probability of CHE is decreasing with households' financial situation in 2015, revealing substantial inequalities. Hence, especially after the onset of the crisis, low-income households are less protected against the financial catastrophe due to OOPE; a finding that raises significant distributional and equity concerns. Strengthening financial protection among the middle-aged and elderly is an imperative challenge for the Greek health system, and several policy responses need to be adopted towards this direction.

Keywords: financial protection, catastrophic health payments, health coverage, older households, elderly, fiscal adjustment, Greece

3.1. Introduction

Since the late 2000s, the Greek economy has entered a long period of economic recession, which is possibly the most severe economic decline among high-income countries in the past decades (Reinhart & Rogoff, 2014). Greece was effectively excluded from the credit markets in early 2010, and eventually received the largest bailout package in history (Gourinchas et al., 2016). The Greek government agreed to implement a set of fiscal consolidation measures and reforms aiming to reduce fiscal deficit and restore external competitiveness in exchange for official assistance from the EU, the ECB and the IMF (Ardagna & Caselli, 2012; Zettelmeyer et al., 2013). However, in contrast to the countries that successfully graduated from their adjustment programmes, Greece signed three successive programmes, all of which adopted a tight fiscal stance, included large-scale reforms and imposed substantial conditionality (Pagoulatos, 2018).

The fiscal consolidation came at an unprecedented cost. Having peaked at 27.5%, the unemployment rate has exceeded 20% during recent years, whereas GDP has shrunk by more than a quarter (Eurostat, 2018c). In terms of the long-term effects, Greece also faced the largest loss in potential output among OECD countries (Ball, 2014). In addition, the deep decade-long recession had significant implications on inequality and poverty rates (Andriopoulou et al., 2017; Kaplanoglou & Rapanos, 2016; Leventi & Matsaganis, 2016). In a similar spirit, Eurostat data demonstrate that some important social indicators, such as the percentage of the population with severe material deprivation and the share of those who are unable to make ends meet, deteriorated after the inception of the crisis[30] (Eurostat, 2019a).

Given that the fiscal imbalances in Greece can be largely linked to the dysfunctions and inefficiencies of the health and welfare system (Matsaganis, 2011; Petmesidou et al., 2014), reforms and retrenchment in health care were inevitably among the main priorities of the public policy agenda during the crisis (OECD, 2014; Pagoulatos, 2018). Focusing on health care, Greece implemented various cost-containment measures to cut down the

[30] According to Eurostat, for example, the percentage of the population with severe material deprivation was approximately 11% before the inception of the crisis, and escalated to more than 20% in the period after 2013. Likewise, the percentage of the population who are unable to make ends meet increased from 20% to almost 40% in the period after 2013.

public budget, with public expenditure on health being capped at 6% of GDP [31] (Karanikolos et al., 2013; Kentikelenis & Papanicolas, 2012). Second, user charges substantially increased especially for outpatient prescription drugs and diagnostic tests (Thomson et al., 2014). The cost-sharing schemes, along with the internal reference pricing for medicines, shifted the health costs to patients (Kentikelenis et al., 2014; World Health Organization, 2018). For example, recent estimates suggest that the effective co-payment rate for prescription medicines is, on average, higher than 20% (Gouvalas et al., 2016; Kanavos & Souliotis, 2017). Third, the benefits package became less comprehensive, having potential implications in the scope of coverage (Economou et al., 2014). Lastly, given that entitlement to health insurance largely depends on employment status, the uninsured population rapidly increased due to the rising unemployment trends during the recession (Economou et al., 2017). Data from the Greek Ministry of Health and the European Commission, for example, indicate that the uninsured population approached 2.0-2.5 million in Greece (European Commission, 2015a; Greek Ministry of Health, 2016)

The looming erosion of health coverage, along with the adverse effects of the economic turmoil on households' financial situation, pose significant challenges to Greek households, which historically incur high out-of-pocket health payments compared to their counterparts in other OECD countries (I. Kyriopoulos, Nikoloski, & Mossialos, 2019; Mossialos et al., 2005). Whether the incidence of financial catastrophe due to these payments increases during periods of economic hardship cannot be easily answered a priori. Some studies, for example, show that households tend to curtail OOPE and shift towards public services, or do not even seek health care during economic recessions (H. Waters et al., 2003a; Yang et al., 2001). If this is the case, households' reliance on out-of-pocket payments is expected to scale down. On the other hand, policy responses to the crisis have been expected to decrease disposable income and have presumably eroded health coverage, resulting in weakened financial protection mechanisms (Stuckler et al., 2017).

This study particularly focuses on financial protection and catastrophic health payments among older households. The concerns about the risk of CHE and financial protection are more pronounced for this age group (Bloom et al., 2015; Hwang et al., 2001; Quintal & Lopes, 2016), for four key reasons. First, the elderly tend to suffer from multiple

[31]At the time of writing this paper, public spending on health was approximately 5.1% of GDP. In 2010, before the implementation of the fiscal adjustment programme, it peaked at 6.6% of GDP.

chronic conditions and have greater needs and costs for health care but fewer financial resources to cover them (Goldman & Zissimopoulos, 2003; Jayawardana, Cylus, & Mossialos, 2019; Kawabata, Xu, & Carrin, 2002; Lehnert et al., 2011). Second, in contrast to countries in which pensions and salaries were largely protected, the income of older people fell substantially due to the large pension and salary cuts in Greece (Giannitsis & Zografakis, 2018; McKee & Stuckler, 2016), while the probability of reemployment success is low among the middle-aged who lost their jobs during the recession (Wanberg, Kanfer, Hamann, & Zhang, 2016). Both these factors resulted in a further reduction in households' ability to pay for medical care. Third, evidence indicates that older people may be more vulnerable to the negative health consequences of an economic crisis (Cutler, Knaul, Lozano, Méndez, & Zurita, 2002; Laliotis et al., 2016). Last, Greece has one of the highest percentages of population aged more than 60, with the projected share being more than 40% by 2050 (United Nations, 2017).

Against this background, this study investigates financial protection among older households in Greece, and examines the extent to which the incidence and intensity of CHE have changed over the period of the recent economic crisis. The study contributes to the literature in the following ways. First, it extensively explores the changes in financial protection for high-need, high-cost patients during a period of economic recession. Although a recent comparative paper analysed the trends in OOPE during 2007-2013 across some European countries (Palladino et al., 2016), it did not particularly focus on the changes in financial protection across different population groups. This is important, given that health policy responses during an economic crisis may have different implications across different population groups (Kondilis, Giannakopoulos, et al., 2013; Stuckler et al., 2017). Additionally, this study did not include Greece, which has been arguably hardest hit by the recession in Europe. Second, we identify which types of expenditure are the main contributors to the overall CHE among older households, and how they have changed over the period of the recession. Third, we employ regression models that address potential selection issues, arising from the fact that some households may not use medical care due to financial barriers to accessing medical services (S. Brown, Hole, & Kilic, 2014; Kawabata et al., 2002). This is particularly relevant in our case, given that the share of people reporting unmet needs and barriers to accessing health services has significantly risen during the economic crisis (Eurostat, 2018d; Kentikelenis et al., 2014; Kyriopoulos et al., 2014).

3.2. Literature review

3.2.1. Financial protection in health: theoretical background and stylized facts

Financial protection is a key factor for universal health coverage and a crucial element of health system performance assessment (Saksena, Hsu, & Evans, 2014; Wagstaff, 2008). There are at least three reasons that explain the need for and the importance of financial protection for patients. First, OOPE and demand for health care are irregular, unpredictable, and not "steady in origin", unlike that for other goods and services (Arrow, 1963). In particular, there is increased uncertainty about the incidence of OOPE, and the timing and severity of disease. Second, health care is often costly and households may be unable to bear the financial burden of health payments. In some cases, even low-cost medical care can lead to severe financial difficulties, especially for the poor and vulnerable population groups (WHO, 2005). Third, poor health and illness are linked with productivity loss and a fall in income and also increase the risk of poverty, which is in turn associated with worse health status (Cole & Neumayer, 2006; OECD and WHO, 2003).

Financial protection can be achieved by sharing the risk of financial hardship across individuals (pooling) and by spreading the risk over time (prepayment) (Mossialos & Dixon, 2002). Pooling protects households from high and unpredictable health payments and equates contributions regardless of the risk of illness and the need for medical care. Prepayment reduces uncertainty as contributors pay an average expected cost in advance (Carrin, Buse, Heggenhougen, & Quah, 2009). In this context, pooling and prepayment are particularly important for cross-subsidization between richer and poorer (equity subsidy), and between high- and low-risk individuals (risk subsidy) (Gottret & Schieber, 2006)

Strong financial protection serves two important policy objectives: equity and efficiency (Moreno-Serra, Thomson, & Xu, 2013). From an equity perspective, financial protection can substantially improve equity in financing and facilitate access to health services (Kutzin, 2013). For example, strong financial protection arises from the presence of adequate prepayment schemes, which are expected to lower OOPE and reduce the regressivity of health financing (Murray, Knaul, Musgrove, Xu, & Kawabata, 2000). Comprehensive coverage is also expected to facilitate access to health services for the most vulnerable population groups, which might have previously forgone care due to financial barriers to access (Moreno-Serra & Smith, 2012). In addition to equity considerations, financial protection also generates substantial efficiency gains. From a health system

perspective, pooled resources can be better used to cover population needs for health care compared to OOPE, leading to more health benefits. In the absence of financial protection mechanisms, patients may postpone the use of medical care or face unmet needs, which may in turn exacerbate the severity of their health problems in the future, resulting in greater need for more expensive medical care due to late diagnosis and treatment (J. Chen, Rizzo, & Rodriguez, 2011). This is expected to generate additional future costs and substantial inefficiencies. From a macroeconomic standpoint, if households do not need to save resources to pay OOPE, consumption and investment will possibly increase and further promote economic growth[32] (Frenk & De Ferranti, 2012; Moreno-Serra et al., 2013; Soucat, 2017).

Generally speaking, health systems with strong financial protection mechanisms share some common characteristics. First, countries with a low incidence of financial catastrophe tend to have a low level of OOPE, which is normally less than 15% of their total health expenditure (WHO, 2005; WHO Regional Office for Europe, 2018b). Second, financial protection mechanisms are better and stronger in countries with high public expenditure on health. Cross-country evidence shows that financial protection is linked not only with the fiscal space and a government's capacity to devote resources to public expenditure (i.e. public spending as a share of GDP), but also with the public policy priorities when allocating the public budget (i.e. public spending on health as a share of total public spending) (Heller, 2006; Tandon & Cashin, 2010). Third, the accurate design of all health coverage dimensions (breadth, scope, depth) is widely considered as a significant aspect affecting the strength and extent of financial protection across countries[33] (Thomson et al., 2009). In this context, evidence suggests that countries with comprehensive financial protection mechanisms tend to adopt specific strategies for health coverage and cost sharing, such as low fixed co-payments instead of percentage co-insurance rate, caps for co-payments for each individual or household, and several exemptions for the most vulnerable population groups, such as the low-income households and the heavy users of health care (WHO Regional Office for Europe, 2018b).

[32]Further information on the potential macroeconomic effects of weak financial protection mechanisms are summarized in several reports, which also elaborate on the 'poverty trap' due to health payments and the potential implications of restricted access to health care and poor health on labour productivity (WHO, 2000, 2010).

[33] Breadth of coverage is defined on the basis of entitlement to healthcare, and identifies who is covered by prepayment and statutory schemes. The scope of coverage is determined by the range and quality of services and benefits covered, and relates to the health services included in the benefits package. Last, the depth of coverage is determined by the level of user charges and the proportion of costs covered by prepayment mechanisms (WHO, 2010).

3.2.2. Empirical evidence on financial catastrophe due to health payments

Measuring financial protection across countries has attracted scholarly interest, from both a methodological and policy perspective. In a seminal cross-country study, Xu et al. (2003) employed cross-country survey data and provided comparative evidence on the incidence of CHE from the mid to late 1990s. Xu et al. defined health payments as catastrophic if they were higher than 40% of a household's capacity to pay, and showed that there was considerable variation in the frequency of CHE, which was relatively greater among transition and Latin American countries (Xu et al., 2003). In a follow-up study, they used 116 datasets from 89 countries, covering almost 89% of the world population (Xu et al., 2007). Similar to their previous findings, they showed that there were substantial differences in financial protection across countries. For example, more than one out of ten households incurred CHE in Brazil and Vietnam, whereas the corresponding figure approximated 0% in the United Kingdom, Slovakia and the Czech Republic.

In a recent study covering 133 countries, Wagstaff et al (2018) estimated the global incidence of CHE, setting the CHE threshold at 10% of total household expenditure (Wagstaff et al., 2018). According to their estimates, the global rate of CHE was 9.7% in 2000, rose to 11.4% in 2005, and slightly increased to 11.7% in 2010. The latter corresponds to approximately 808 million people, with most of them living in Asian countries (World Health Organization and World Bank, 2017). The highest headcount of CHE was observed in Latin American and Caribbean countries (14.8%) followed by Asian and African countries, the CHE incidence of which approximated 12.8% and 11.4% respectively. The share of households having CHE was 7.2% in Europe, and somewhat lower in Northern America (4.6%) and Oceania (3.9%).

Evidence from the USA and the European region

Apart from the cross-country findings, a strand of the literature focuses on particular countries, aiming to conduct a more comprehensive analysis of the incidence, intensity and potential determinants of the risk of CHE. For instance, Waters et al. (2004) employed household-level data and estimated the extent of financial protection in the US population (H. R. Waters, Anderson, & Mays, 2004). Using a threshold of 10% of income, they showed that 7.5% of households faced CHE, with the poorer and those with chronic patients being more susceptible to CHE. Evidence from the USA also suggests that almost seven out of ten uninsured patients who had emergency surgery incurred CHE due to hospital costs (Scott et al., 2017), while a similar incidence has also been reported among

uninsured trauma patients (Scott et al., 2018). By employing a threshold of CHE at 10% of income, another study found that 18.2% of the population aged between 65 and 74 faced CHE in the USA, whereas the corresponding percentage for those above 75 years was 23.2% (Baird, 2016). With the exception of France and Slovenia, the incidence of CHE among American households in these age groups was generally comparable with that of European countries.

A recent analysis showed substantial differences across European countries, with Moldova, Georgia and Latvia having the highest headcount of CHE followed by Albania and various East European countries (WHO Regional Office for Europe, 2018b). According to these estimates, the share of households at risk of financial catastrophe due to health payments was also quite high in Greece and Portugal. However, some countries appear to perform quite well in terms of financial protection. Recent evidence, for example, shows that the headcount of CHE is less than 2% in France, Sweden, Ireland, Slovenia, the Czech Republic and the United Kingdom (O'Dowd, Kumpunen, & Holder, 2018).

Besides the cross-country variation in the rate of CHE, there are also differences in the trends of the headcount of CHE over recent years, possibly reflecting the different health financing policies and the heterogeneous responses to the economic crisis. For instance, the incidence of CHE increased from 2.1% to 3.2% during 2010-2015 in Austria (Czypionka, Röhrling, & Six, 2018), remained relatively stable at 1.5% in the UK, and decreased in Croatia and Germany (Siegel & Busse, 2018; Voncina & Rubil, 2018). Setting the threshold of CHE at 30% of a household's capacity to pay, a recent study from Greece also showed that the incidence of CHE increased from 2.18% to 3.46% during 2010-2015 (Chantzaras & Yfantopoulos, 2018). Setting the threshold of CHE at 30% of the total income, another comparative study found substantial cross-country differences in the headcount of CHE among the older population. In 2013, Italy and Spain had the higher share of households at risk of CHE, followed by Czech Republic and Austria (Palladino et al., 2016). Focusing on the period 2007-2013, Palladino et al. showed that the incidence of CHE increased only in Italy, Spain and the Czech Republic, but not in the other European countries included.

Using a cut-off point of 40% of capacity to pay, Kronenberg and Barros (2014) found that the incidence of CHE decreased from 7.9% to 5.0% in Portugal during 2000-2005 (Kronenberg & Barros, 2014). Another study employed data from the 2010 Portuguese HBS, and found that the frequency of CHE was 2.1% (Quintal & Lopes, 2016),

with the risk of CHE being substantially higher for households with an elderly household member. Both studies suggest that higher income is associated with a lower probability of having CHE in Portugal. A similar pattern is observed in Belgium, where the headcount of CHE is somewhat lower among the richer households (De Graeve & Van Ourti, 2003). For example, almost 2% of households incurred CHE in Belgium, with the incidence of CHE being more than 5% in the first income quintile and less than 1% among the high-income households. Dukhan et al. (2010) employed a cut-off point of 40% of household capacity to pay and found that CHE incidence decreased from 2% to less than 1% over the period 1995-2006 in France (Dukhan, Korachais, Xu, Saksena, & Mathonnat, 2010). Contrary to the results from Portugal and Belgium, CHE was more common among the high-income households.

Apart from the core EU countries, a strand of the literature has also examined the extent of financial protection in Eastern Europe and the Balkan region. Bredenkamp et al. (2011) provided comparative evidence for financial protection in the Western Balkans (Bredenkamp, Mendola, & Gragnolati, 2011). Using a cut-off point of 10% of total expenditure, they found that the incidence of CHE exceeded 20% in Albania and Kosovo in the early 2000s, but was noticeably lower in the other countries of the region. Updated findings from Albania revealed that the rate of CHE substantially decreased from more than 20% to approximately 13% during 2002-2008. However, there were still significant socioeconomic disparities, with low-income households being more prone to financial catastrophe due to health payments than their richer counterparts (Tomini, Packard, & Tomini, 2013). Using data from Serbia, another study also documented that poor households are more susceptible to CHE (Arsenijevic, Pavlova, & Groot, 2013). Additionally, it showed that rural residence, a large number of household members and the presence of chronic patients in the household are expected to further increase the risk of CHE.

Setting a cut-off point of 10% of total expenditure, evidence from Turkey shows that the share of households with CHE ranged from 3.2% to 4.8% over the period 2004-2010 (Özgen Narcı, Şahin, & Yıldırım, 2015). Various studies corroborate that household income is a significant determinant of CHE, with poorer households being less likely to encounter CHE in Turkey (S. Brown et al., 2014; Yardim, Cilingiroglu, & Yardim, 2010). Contrary to these results, evidence from various countries, such as Georgia (Gotsadze, Zoidze, & Rukhadze, 2009; Zoidze, Rukhazde, Chkhatarashvili, & Gotsadze, 2013) and Estonia (Habicht, Xu, Couffinhal, & Kutzin, 2006), show that the worse-off tend to be

more susceptible to financial catastrophe due to health payments.

Evidence from other countries

A large body of evidence has focused on financial protection in Asia. For example, a study estimated the headcount and overshoot of financial catastrophe due to health payments in 14 Asian countries (van Doorslaer et al., 2007). Their findings reveal that there is substantial variation in CHE measures in Asia, with Bangladesh, Vietnam, China and India being the countries with the highest incidence of CHE. Assuming that the threshold of CHE is 10% of total household expenditure, 10-15% of households faced CHE among these countries. Focusing on patients who suffered from acute coronary events, a comparative study examined the extent of financial protection across some Asian countries (Jan et al., 2016). Overall, two out of three uninsured patients encountered CHE, whereas the corresponding figure for the insured patients was approximately 50%. Similar to van Doorslaer et al. (2007), this study also reported significant cross-country differences in the headcount of CHE. For instance, almost 80% of uninsured and 56% of insured patients suffering an acute coronary event incurred CHE in China, while the incidence of CHE was almost zero in Malaysia. In China, more than one in ten households experienced financial catastrophe due to health payments, with the incidence being significantly greater among poor households and those with chronic patients (Li et al., 2012; Meng et al., 2012). Using alternative definitions, another study showed that more than a quarter of elderly households incurred CHE in China (Z. Wang, Li, & Chen, 2015), and also found that health insurance is not a protective factor against the risk of CHE. Lastly, a significant strand of the literature has examined the trends in financial protection in Thailand, especially after the implementation of various policies to achieve universal health coverage. Using several thresholds to define CHE, a study showed that both headcount and overshoot of CHE gradually declined after the introduction of universal health coverage (Somkotra & Lagrada, 2008). Assuming a cut-off point of 10% of total expenditure, for example, the CHE headcount declined from 6.4% to 4.9% during 2000-2004. In a follow-up analysis, another study found a further reduction in the incidence of CHE, which approached 4% of Thai households in 2006 (Somkotra & Lagrada, 2009). Evidence also reveals that high-income households and households with chronic patients or hospitalized members are more likely to incur CHE in Thailand (Limwattananon, Tangcharoensathien, & Prakongsai, 2007; Somkotra & Lagrada, 2009).

Using a cut-off point of 30% of non-food expenditure, a cross-country analysis

examined the headcount of CHE in twelve Latin American and Caribbean countries during the 2000s, with the highest incidence of CHE being observed in Chile (approximately 15.4%) followed by Guatemala, Nicaragua, Dominican Republic and Argentina (Knaul, Wong, Arreola-Ornelas, & Méndez, 2011). Low-income, uninsured households and those with children and elderly members were more likely to experience financial catastrophe due to health payments. In another study, Wagstaff et al. (2015) showed that almost all Latin American countries have achieved substantial improvements in terms of financial protection and universal health coverage over the period 1990-2013 (Wagstaff et al., 2015). Using data from 1992 to 2004, Knaul et al. (2006) found that financial protection deteriorated during the Mexican economic crisis in the mid 1990s, but gradually improved in the late 1990s (Knaul et al., 2006). It is noteworthy that this pattern was generally robust to different thresholds and definitions of CHE. Some other studies have also examined the trends in CHE and the impact of health insurance reforms on financial protection in Mexico, and have showed that the incidence of CHE generally varies between 2% and 5% depending on income group and insurance status (Doubova, Pérez-Cuevas, Canning, & Reich, 2015; Knaul et al., 2012; Nikoloski & Mossialos, 2018).

3.3. Data and methods

3.3.1. Data

Our analysis relies on survey data from the SHARE, a cross-national survey that includes micro-level data about physical and mental health, health care use and costs, household consumption and assets, housing, behavioural risks, cognitive function, social network, family relationships, demographics and socioeconomic characteristics (Börsch-Supan et al., 2013). This survey particularly focuses on the older segments of the population, and covers those aged more than 50 years old.

In order to conduct this analysis, we employ cross-sectional data from Waves 2 and 6 for Greece, which took place in 2007 and 2015 respectively.[34] Wave 2 was conducted just before the onset of the economic crisis, whereas Wave 6 took place in a period when the effects and implications of the crisis were pronounced and fully evident. Therefore, we employ micro-level data for a period spanning the economic crisis (Lyberaki & Tinios,

[34] SHARE Wave 3 (SHARELIFE) is not relevant for this study, since it focuses on variables about respondents' life history. Wave 2 is thus the latest available wave for the pre-crisis period. In addition, Greece did not participate in SHARE waves 4 and 5, which took place in 2011 and 2013 (Lyberaki & Tinios, 2018; SHARE Release Guide, 2018).

2018). The sample size in Wave 2 is 3,412 individuals, with 1,524 of them aged more than 65. Likewise, Wave 6 includes 4,937 observations, and approximately half of them are more than 65 years old. The sample size for the pooled dataset amounts to 8,349 individuals, who live in 5,558 households.

3.3.2. Measuring incidence and intensity of catastrophic health payments

Baseline measures

Our analysis relies on some established measures of headcount and overshoot of CHE. In particular, OOPE is regarded as catastrophic if the health payments budget share (i.e. ratio between health payments and household total expenditure) exceeds a specific threshold (van Doorslaer et al., 2007). With this in mind, if the OOPE of a household i is oop_i, and the total household expenditure is exp_i, then a household i has incurred CHE if the health payments budget share, oop_i/exp_i, is greater than the predefined cut-off point z.

Given that there is no consensus on the cut-off point above which health expenditure is considered as CHE, we present several scenarios using thresholds ranging from 5% to 20% of the total expenditure (O'Donnell et al., 2008; WHO, 2018b). We employ total expenditure as an indicator for household financial resources, since the ratio between OOPE and household income is not sensitive to how households finance their health care consumption[35] (O'Donnell et al., 2008).

Our analysis examines both the headcount and overshoot of financial catastrophe, and relies on three measures for financial catastrophe due to health payments. First, we estimate the headcount (incidence) of CHE, which corresponds to the share of the sample that incurs CHE. Let N the number of households, and E a binary indicator that takes the value of 1 if oop_i/exp_i is greater than the respective threshold z, and 0 otherwise. The headcount can be thus expressed as follows:

$$Headcount = \frac{1}{N}\sum_{i=1}^{N} E_i$$

[35] In other words, using income does not allow us to identify potential variations in consumption over time, due to changes in household borrowing and saving patterns (World Health Organization and World Bank, 2017).O'Donnell et al. (2008) gave an illustrative example for this case. In particular, if two households have similar OOPE and income, the OOPE-income ratio will be the same. Assume that the first household relies on its own savings to cover the health payments. The second households, however, does not have savings, and should thus reduce its current expenditure to pay for medical care. Therefore, although the OOPE-income ratio is identical for both households, this is not the case for the health payments budget share (i.e. health payments divided by total household expenditure), which is greater for the second household (World Health Organization, 2001)

Second, we estimate the intensity (overshoot) of CHE, which measures the average extent by which the OOPE exceeds the corresponding cut-off point of CHE (O'Donnell et al., 2008; Tomini et al., 2013). The overshoot is given by the following expression:

$$Overshoot = \frac{1}{N}\sum_{i=1}^{N} Overshoot_i$$

where $Overshoot_i = E_i \times (\left(\frac{oop_i}{exp_i}\right) - z)$. Simply put, $Overshoot_i$ is the difference between the health payments budget share and the predefined threshold for each household i.

Mean positive overshoot (MPO), the last measure we employ, is simply given by the ratio between overshoot and headcount. This measure essentially demonstrates the average OOPE among the households that exceeded the predefined threshold of CHE (Tomini et al., 2013). In contrast to headcount and overshoot[36], a higher predefined threshold does not necessarily imply a lower MPO (O'Donnell et al., 2008).

Besides the estimates for the total sample, we also stratify our sample and calculate the incidence and intensity of CHE for different total expenditure quintiles and depending on the presence of chronic or multimorbid patients in the household. By using the CPI (Eurostat, 2018b), expenditure is adjusted into 2015 prices.

Additional measures of CHE

We also employ some additional measures and techniques, aiming to test and strengthen the robustness of our main results. First, we derive the rank-weighted incidence and intensity of CHE. In particular, the measures presented in the previous section do not take into consideration whether the households that tend to incur CHE are poor or rich, although this aspect is important from a policy perspective (Somkotra & Lagrada, 2008). In order to account for these distributional aspects, we first estimate CI_{HQ} and CI_O, the concentration indices for headcount and overshoot respectively.[37] Using these indices, we then adjust[38] the headcount and overshoot (Wagstaff, 2008; Wagstaff & Doorslaer, 2003), and provide the corresponding rank-weighted measures. In this context, the rank-weighted

[36] In general, headcount and overshoot decrease as the respective CHE threshold increases.

[37] A positive (negative) CI_{HQ} implies that the CHE is more common among richer (poorer) households. In the same vein, a positive (negative) CI_O means that the richer (poorer) tend to have a higher overshoot.

[38] Using concentration indices to construct the rank weighted measures, we assign a weight of two in the poorest household. The weights fall with income, and the weight for the household with the highest income is zero.

measures do not only show the headcount and overshoot of financial catastrophe, but also reflect aspects about their distribution with respect to household living conditions (Somkotra & Lagrada, 2008). They thus incorporate normative considerations and value judgments associated with the distribution of CHE across households of different income level (Gottret, Schieber, & Waters, 2008). These measures are given by the following expressions:

$$Headcount^{w} = (1 - CI_{HQ}) \times Headcount$$

$$Overshoot^{w} = (1 - CI_{O}) \times Overshoot$$

Based on the above expressions, if catastrophic health payments are more common among the worse-off (i.e. negative CI_{HQ}), the ranked-weighted headcount will be higher than the headcount, and vice versa. Likewise, if poorer households tend to have a larger overshoot, CI_O will be negative and the rank-weighted overshoot will be greater than the standard measure of overshoot.

Second, apart from using health payments budget share to define CHE, our analysis also considers alternative definitions and uses a different denominator instead of total household expenditure. In particular, we perform a similar analysis, and examine CHE with reference to the ratio between OOPE and non-food expenditure (Khan, Ahmed, & Evans, 2017; Wagstaff & Doorslaer, 2003). In this case, the thresholds range from 20% to 50%.

3.3.3. Regression models

Our analysis also focuses on the determinants of the probability of incurring CHE. In doing so, we employ two types of regression analysis. First, and similar to the common practice in regression models for the probability of having catastrophic health payments, we employ a logistic regression model. Let $p_i = \Pr(CHE_i = 1)$ be the probability that a household i incurs CHE. Then the logistic regression model is given by the following expression:

$$\text{logit}(p_i) = \log\left(\frac{p_i}{1 - p_i}\right) = X_i\beta$$

and the probability of CHE is:

$$\Pr(CHE_i = 1) = p_i = \frac{\exp(X_i\beta)}{1 + \exp(X_i\beta)}$$

where X_i is the set of regressors, and β is the vector of the parameter estimates.

Second, we address potential selection issues, arising from the fact that some households may postpone health payments and may not use health care due to financial restrictions and barriers to access (S. Brown et al., 2014; Kawabata et al., 2002). In doing so, we employ a maximum likelihood estimator proposed by Sartori (2003), which relies on a two-step approach that distinguishes those who seek medical care[39] (Sartori, 2003). Generally speaking, the selection equation models the health care use, while the outcome equation focuses on the probability of facing CHE adjusted for the selection issues (S. Brown et al., 2014). This approach can be employed in cases of binary outcomes of interest, does not require a different set of regressors for the two equations, and relies on a different assumption about the error terms in the two equations.[40] In particular, the selection and outcome equations are given by the following expressions:

$$\text{Selection equation: } U_{1i} = X_i\gamma + \varepsilon_{1i}$$

$$\text{Outcome equation: } U_{2i} = X_i\delta + \varepsilon_{2i}$$

where U corresponds to the unobserved continuous dependent variables, and γ and δ are the vectors of the regression coefficients for the selection and the outcome equation respectively. Last, ε_{1i} and ε_{2i} are normally distributed residual terms.

Given that U is unobserved, the observed outcomes are the following:

$$Z_{1i} = \begin{cases} 0 \; if \; U_{1i} < 0 \\ 1 \; if \; U_{1i} \geq 0 \end{cases}$$

$$Z_{2i} = \begin{cases} 0 \; if \; U_{2i} < 0 \\ 1 \; if \; U_{2i} \geq 0 \end{cases}$$

where Z_{1i} equals 1 if the household i uses health care, and Z_{2i} indicates whether the household i incurred CHE (i.e. the observed outcome of the equation of interest).

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[39] Generally speaking, the Heckman model is the most commonly used approach to address potential selection (Heckman, 1979). Identification of the Heckman model requires a different set of regressors in each equation (i.e., the so-called 'exclusion restrictions'). The exclusion restrictions imply that there are some independent variables, which influence the selection but not the outcome equation. In fact, this poses several problems since it is practically difficult to find those variables, while several studies often use exclusion restrictions without the appropriate theoretical justification, leading to model misspecification (Puhani, 2000; Sartori, 2003).

[40] This model relies on an assumption about identical errors in the two equations. It is noteworthy that the Sartori estimator is more accurate than and preferable to a binary response model (e.g. probit, logit), if this assumption is fairly plausible (Marinescu, 2006). This assumption is satisfied if the explanatory variables and decision process for the selection and outcome are similar, and both processes are close in time and geographical proximity (Sartori, 2003). In our case, the conditions needed to satisfy the assumption of the Sartori estimator are arguably met; the process and determinants of seeking medical care are similar to those of spending for health care and having CHE, while the condition for time and geographical proximity is fairly reasonable (S. Brown et al., 2014; Salas & Raftery, 2001).

Following the approach proposed by Sartori (2003), we further define the following random variables Y_{ij}:

$$Y_{i0} = \begin{cases} 1 \; if \; Z_{1i} = 0 \\ 0 \; otherwise \end{cases}$$

$$Y_{i1} = \begin{cases} 1 \; if \; Z_{1i} = 1 \; and \; Z_{2i} = 0 \\ 0 \; otherwise \end{cases}$$

$$Y_{i2} = \begin{cases} 1 \; if \; Z_{1i} = 1 \; and \; Z_{2i} = 1 \\ 0 \; otherwise \end{cases}$$

In particular, Y_{i0} is unity if the household does not seek health care (i.e. not selected). Additionally, Y_{i1} equals 1 if the household seeks medical care and the main dependent variable is 0 (i.e. the households does not face CHE), whereas Y_{i2} equals 1 if the household uses health care and the outcome variable equals 1 (i.e. the household incurs CHE). Following the definitions of the random variables Y_{ij}, the probability that Y_{ij} takes the value of 1, $\Pr(Y_{ij} = 1)$, is defined as follows:

$$\Pr(Y_{i0} = 1) = \Phi(-X_i\gamma)$$

$$\Pr(Y_{i1} = 1) = \begin{cases} \Phi(-X_i\delta) - \Phi(-X_i\gamma) \; if \; (\gamma - \delta)X_i > 0 \\ 0 \; \; if \; (\gamma - \delta)X_i \leq 0 \end{cases}$$

$$\Pr(Y_{i2} = 1) = \begin{cases} \Phi(X_i\delta) \; if \; (\gamma - \delta)X_i > 0 \\ \Phi(X_i\gamma) \; if \; (\gamma - \delta)X_i \leq 0 \end{cases}$$

where Φ is the cumulative standard normal distribution function.

As explained above, the dependent variable is a binary indicator that takes the value of 1 if a household faces CHE. Apart from a dummy that takes the value of 1 for the wave after the introduction of the EAP, we control for the following characteristics of the household head: marital status, gender, age, age-squared, education and employment status. The set of regressors also includes some key household characteristics, which can be considered as potential predictors of the risk of CHE: total expenditure quintile, household size, squared household size, presence of multimorbid patients, members with long-standing activity limitation (GALI), members admitted to a hospital.

3.4. Results

3.4.1. Headcount and overshoot of catastrophic health expenditure

Table 3.1 shows the headcount and overshoot of CHE for Waves 2 and 6, which took place in 2007 and 2015 respectively. In doing so, we rely on several scenarios for the threshold above which household health expenditure is considered as CHE. As expected, the use of a lower threshold implies a greater estimate for the headcount of CHE. Using 2015 data, for example, we find that the incidence of CHE falls from 34.00% to 13.55%, when we set the cut-off point at 10% and 20% of total household expenditure respectively. What is interesting, however, is that the trends in the incidence of CHE are generally consistent regardless the cut-off point we adopted.

Our findings suggest that there is a sharp increase in the headcount of CHE from 2007 to 2015. Setting a threshold of 20% of total household health expenditure (baseline scenario), our findings suggest that the incidence of CHE increased from 5.83% to 13.55% over the period 2007-2015. As shown in Table 3.1, the trends of the headcount of CHE are not sensitive to the threshold we adopt; a fact that further validates the robustness of our findings. For example, using a cut-off point of 10% of total expenditure, we find that the percentage of those having CHE increased from 18.49% to 34.00% during 2007-2015. We also estimate the incidence of CHE, after defining the financial catastrophe in terms of non-food expenditure. As shown in Table 3.1, our findings also indicate a rise in the share of households facing financial catastrophe regardless the threshold of CHE.

Table 3. 1: Headcount and overshoot of catastrophic health payments

	% Total health expenditure		**% Non-food expenditure**	
	5%		**20%**	
	Pre	**Post**	**Pre**	**Post**
Head count	36.25	55.85	22.47	33.31
	(1.10)	(1.00)	(0.98)	(0.91)
Overshoot	3.02	5.85	-	-
	(0.15)	(0.18)	-	-
MPO	8.32	10.48	-	-
	(0.34)	(0.27)	-	-
	10%		**30%**	
	Pre	**Post**	**Pre**	**Post**
Head count	18.49	34.00	16.24	27.84
	(0.88)	(0.92)	(0.85)	(0.86)
Overshoot	1.70	3.67	-	-
	(0.12)	(0.15)	-	-

MPO	9.22	10.80	-	-
	(0.53)	(0.35)	-	-
	15%		**40%**	
	Pre	**Post**	**Pre**	**Post**
Head count	9.91	20.73	12.63	23.83
	(0.67)	(0.76)	(0.78)	(0.81)
Overshoot	1.02	2.35	-	-
	(0.10)	(0.12)	-	-
MPO	10.33	11.33	-	-
	(0.78)	(0.44)	-	-
	20%		**50%**	
	Pre	**Post**	**Pre**	**Post**
Head count	5.83	13.55	9.34	21.23
	(0.50)	(0.63)	(0.67)	(0.77)
Overshoot	0.65	1.50	-	-
	(0.08)	(0.10)	-	-
MPO	11.12	11.09	-	-
	(1.04)	(0.55)	-	-

Aiming to identify the extent to which households' health payments exceed the CHE threshold, we also estimate the intensity of CHE. Table 3.1 corroborates that the overshoot of CHE rose during the study period in all cases we examined. Our baseline estimates reveal that the CHE overshoot was 0.65% in 2007, and increased to 1.50% in 2015. Similar to the headcount of CHE, the overshoot is decreasing with the size of the threshold for CHE. In 2015, for example, the overshoot was 5.85% and 1.50% in the case of the lowest (5%) and the highest (20%) threshold respectively.

Contrary to the headcount and overshoot, we do not expect that MPO necessarily falls as the threshold increases (O'Donnell et al., 2008). According to our baseline scenario, households that experienced CHE spent an average of 31.12% of household expenditure for medical care in 2007. Although the fraction of households facing CHE substantially increased during 2007-2015, they tended to pay a similar share of their total expenditure for health care in 2015. In particular, the average health payments budget share among those households approached 31.09% in 2015; a share that is almost similar to the corresponding figure in 2007.

Last, we also estimate the rank weighted headcount and overshoot, both of which allow us to account for the distribution of CHE with respect to household living conditions. Using a cut-off point of 20% of total household expenditure, we show that the rank weighted headcount increased from 5.77% to 15.79% over the period 2007-2015, suggesting that the change in the incidence of CHE is even higher after taking into account

distributional aspects. As pointed above, these changes can be attributed to the negative sign of the concentration index, which implies that the poor population groups are more likely to encounter CHE. Likewise, the rank weighted overshoot also rose from 0.46% to 1.51% in 2007 and 2015 respectively. Further details are presented in Table B1 in the Appendix B.

3.4.2. Headcount and overshoot of catastrophic health expenditure, by total household expenditure quintile

Table 3.2 presents the incidence and intensity of CHE across different expenditure quintiles. Generally speaking, our analysis reveals that the proportion of households with CHE is greater in 2015 than in 2007 across all socioeconomic groups. After splitting the sample by educational level, we find that the fraction of households with CHE also increased across all groups during 2007-2015[41]. What is interesting, however, is that the change in the headcount of CHE was substantially greater in the first quintile. Under the baseline scenario, the headcount of CHE among the households in the bottom quintile escalated from 6.44% to 22.24% during 2007-2015, whereas the corresponding change in the richest quintile was quite lower (i.e. from 6.00% to 8.21%). The incidence of CHE more than doubled among the households in the second quintile; it increased from 5% in 2007 to almost 13% in 2015. Among those in the third quintile, the frequency of CHE in 2015 approximated 14%, and was almost twice the incidence in 2008. Likewise, 5.16% and 10.75% of the households in the fourth expenditure quintile experienced CHE in 2007 and 2015 respectively. Using different thresholds and definitions for CHE, we further confirm our baseline findings in all socioeconomic groups we examined.

As shown in Table 3.2, the overshoot of CHE also increased across all socioeconomic groups. Among the households in the lowest quintile, for example, the overshoot went from 0.28% to 1.84% during 2008-2015. The smallest absolute change in intensity of CHE was observed among the richest households. In this group, the overshoot increased from 1.08% to 1.53% during the study period. After calculating the ratio between overshoot and headcount, we find that the MPO among the households in the lowest quintile was 4.39% and 8.27% in 2008 and 2015 respectively. This finding implies that the health payments for those who faced CHE was, on average, 24.39% and 28.27% of their total expenditure in 2008 and 2015 respectively. On the other hand, the MPO among

[41] Results are presented in Table B2 (Appendix B).

the richest households was quite higher, possibly due to the relatively lower headcount of CHE. In the fifth quintile, for instance, the health payments budget share for those having CHE increased from 37.92% to 38.58% during 2008-2015.

Table 3. 2: Headcount and overshoot of catastrophic health payments, by total household expenditure quintile

	Q1		Q2		Q3		Q4		Q5	
5%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	46.08	68.15	38.43	57.06	39.08	59.59	32.55	47.21	25.04	47.24
	(2.38)	(2.00)	(2.42)	(2.22)	(2.53)	(2.21)	(2.54)	(2.28)	(2.32)	(2.30)
Overshoot	3.36	7.92	2.98	5.72	3.36	6.41	2.56	4.52	2.81	4.68
	(0.26)	(0.41)	(0.30)	(0.38)	(0.37)	(0.41)	(0.32)	(0.38)	(0.43)	(0.41)
MPO	7.73	11.63	7.76	10.03	8.60	10.75	7.86	9.57	11.24	9.91
	(0.43)	(0.51)	(0.63)	(0.54)	(0.76)	(0.58)	(0.80)	(0.68)	(1.39)	(0.75)
10%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	24.38	47.29	20.66	34.44	19.50	37.73	14.39	25.68	13.46	24.84
	(1.98)	(2.11)	(1.93)	(2.07)	(2.12)	(2.07)	(1.86)	(1.92)	(1.84)	(1.90)
Overshoot	1.66	5.10	1.56	3.52	1.96	3.99	1.44	2.76	1.91	2.99
	(0.18)	(0.35)	(0.23)	(0.31)	(0.30)	(0.35)	(0.26)	(0.32)	(0.37)	(0.35)
MPO	6.80	10.78	7.54	10.22	10.05	10.59	9.98	10.74	14.16	12.02
	(0.51)	(0.59)	(0.87)	(0.67)	(1.24)	(0.73)	(1.46)	(1.00)	(2.14)	(1.15)
15%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	13.33	31.05	10.32	22.25	10.98	21.85	7.19	14.91	7.72	13.57
	(1.56)	(1.93)	(1.42)	(1.78)	(1.68)	(1.70)	(1.35)	(1.49)	(1.43)	(1.45)
Overshoot	0.77	3.16	0.80	2.14	1.22	2.56	0.93	1.82	1.40	2.06
	(0.12)	(0.29)	(0.18)	(0.24)	(0.24)	(0.28)	(0.21)	(0.27)	(0.31)	(0.30)
MPO	5.56	10.17	7.78	9.62	11.07	11.73	12.96	12.23	18.19	15.16
	(0.57)	(0.71)	(1.30)	(0.76)	(1.81)	(0.95)	(2.32)	(1.29)	(2.99)	(1.69)
20%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	6.44	22.24	4.99	12.97	6.52	13.56	5.16	10.75	6.00	8.21
	(1.12)	(1.74)	(1.04)	(1.44)	(1.15)	(1.37)	(1.00)	(1.27)	(1.30)	(1.10)
Overshoot	0.28	1.84	0.44	1.27	0.80	1.70	0.64	1.18	1.08	1.53

	(0.07)	(0.23)	(0.14)	(0.18)	(0.20)	(0.23)	(0.17)	(0.22)	(0.27)	(0.25)
MPO	4.39	8.27	8.86	9.81	12.29	12.51	12.36	11.01	17.92	18.58
	(0.72)	(0.88)	(1.97)	(0.88)	(2.04)	(1.12)	(2.19)	(1.50)	(3.58)	(2.04)

3.4.3. Headcount and overshoot of catastrophic health expenditure, by chronic condition status

As shown in Table 3.3, the incidence of CHE increased over 2007-2015, regardless the number of household members with chronic conditions or multimorbidity. Among households without chronic patients, for example, the headcount of financial catastrophe due to health payments went up from 0.44% to 2.92% during 2007-2015. The headcount of CHE was much greater in households with chronic or multimorbid patients. For the households with one chronic patient, the incidence of CHE increased from 5.04% to 15.16% during the study period. The corresponding figures for households with two or more chronic patients were approximately 12% and 20% in 2007 and 2015 respectively. Lastly, under the baseline scenario, one out of ten households with multimorbid patients were at risk of financial catastrophe due to health payments in 2007, with this figure being almost doubled in 2015.

Similar to the headcount of CHE, the overshoot was also greater among the households with more than two chronic patients and multimorbid patients. During the study period, the overshoot increased from 1.18% to 2.44% in the households with multimorbid patients, and from 1.35% to 2.17% among those with more than two chronic patients. In the households with no or one chronic patient, the intensity of CHE also increased during 2007-2015, but its magnitude was smaller than that of the other household types. As shown in Table 3.3, results are robust to different scenarios and definitions of CHE.

Table 3. 3: Headcount and overshoot of catastrophic health payments, by chronic condition status

	Households without chronic patients		**Households with one chronic patient**		**Households with 2 or more chronic patients**		**Households with multimorbid patients**	
Threshold: 5%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	12.14	23.73	36.44	60.48	57.57	75.52	52.35	72.65
	(1.67)	(2.05)	(1.47)	(1.32)	(2.28)	(1.55)	(1.58)	(1.13)
Overshoot	0.60	1.61	2.84	6.37	5.58	8.64	4.89	8.61
	(0.13)	(0.23)	(0.19)	(0.26)	(0.41)	(0.38)	(0.27)	(0.28)
MPO	4.93	6.80	7.80	10.53	9.69	11.44	9.33	11.85
	(0.69)	(0.78)	(0.44)	(0.36)	(0.61)	(0.45)	(0.45)	(0.34)
Threshold: 10%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	4.81	10.61	17.54	35.99	32.93	51.28	28.55	47.67
	(1.25)	(1.48)	(1.12)	(1.27)	(2.16)	(1.80)	(1.42)	(1.25)
Overshoot	0.22	0.84	1.56	4.04	3.36	5.50	2.91	5.66
	(0.07)	(0.17)	(0.16)	(0.22)	(0.35)	(0.34)	(0.23)	(0.25)
MPO	4.54	7.93	8.91	11.21	10.20	10.72	10.18	11.87
	(0.70)	(1.27)	(0.69)	(0.49)	(0.89)	(0.54)	(0.66)	(0.42)
Threshold: 15%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	1.81	5.11	9.03	22.40	19.19	31.53	16.45	31.09
	(1.00)	(1.02)	(0.82)	(1.07)	(1.79)	(1.68)	(1.15)	(1.15)
Overshoot	0.04	0.48	0.93	2.64	2.11	3.45	1.82	3.73
	(0.02)	(0.13)	(0.12)	(0.18)	(0.29)	(0.28)	(0.19)	(0.21)
MPO	2.44	9.29	10.34	11.78	10.99	10.94	11.06	12.01
	(1.08)	(1.86)	(1.00)	(0.61)	(1.23)	(0.68)	(0.92)	(0.50)
Threshold:	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**

20%								
Head count	0.44	2.92	5.04	15.16	12.42	19.89	10.06	20.96
	(0.32)	(0.77)	(0.62)	(0.91)	(1.47)	(1.44)	(0.90)	(1.01)
Overshoot	0.01	0.27	0.59	1.72	1.35	2.17	1.18	2.44
	(0.01)	(0.10)	(0.10)	(0.15)	(0.24)	(0.23)	(0.16)	(0.17)
MPO	1.68	9.49	11.74	11.35	10.87	10.89	11.73	11.65
	(0.62)	(2.38)	(1.32)	(0.75)	(1.60)	(0.84)	(1.18)	(0.60)

We further provide evidence for the headcount and overshoot of CHE among households with members who suffer from specific chronic conditions. For example, our baseline estimates show that the headcount of CHE among households with diabetic patients increased from 10.37% to 24.32% during 2007-2015. Likewise, the frequency of financial catastrophe due to OOPE in households with hypertensive members in 2015 was more than twice the incidence of 2007 (i.e. it increased from 8.11% to 18.50%). More details are presented in Table B3 in Appendix B.

3.4.4. Contribution of different types of health expenditure to overall catastrophic health payments

This section analyses the contribution of each type of expenditure to the overall CHE under the baseline scenario. In other words, we disaggregate the OOPE of those who experienced CHE into its major components. Overall, household payments for outpatient care were a major driver of financial catastrophe due to health payments. As shown in Figure 3.1, outpatient services accounted for 31.53% of the CHE in 2007, and increased to 44.3% in 2015. Additionally, CHE can be largely attributed to payments for pharmaceuticals, especially in the period after the onset of the economic crisis. In particular, pharmaceuticals were responsible for 18% and more than 40% of CHE in 2007 and 2015 respectively. Contrary to these payment types, the contribution of inpatient and nursing care to CHE fell from 50% to less than 14% during 2007-2015.

Figure 3. 1: Contribution of health expenditure components to overall CHE (among households with CHE)

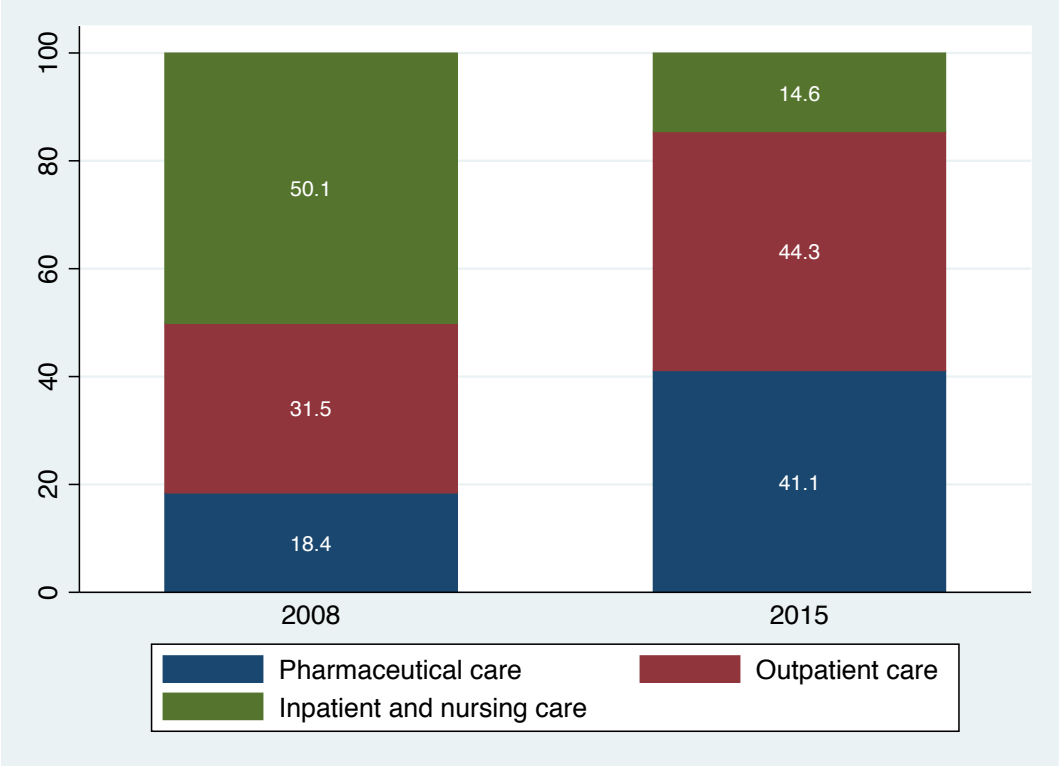


Figure 3.2 shows that the drivers of CHE differ across socioeconomic groups. Generally speaking, our analysis shows that the contribution of inpatient care spending to CHE increases with socioeconomic status. On the contrary, the pharmaceutical share is greater in lower quintiles, and therefore CHE among poorer households can be largely attributed to payments for medicines.

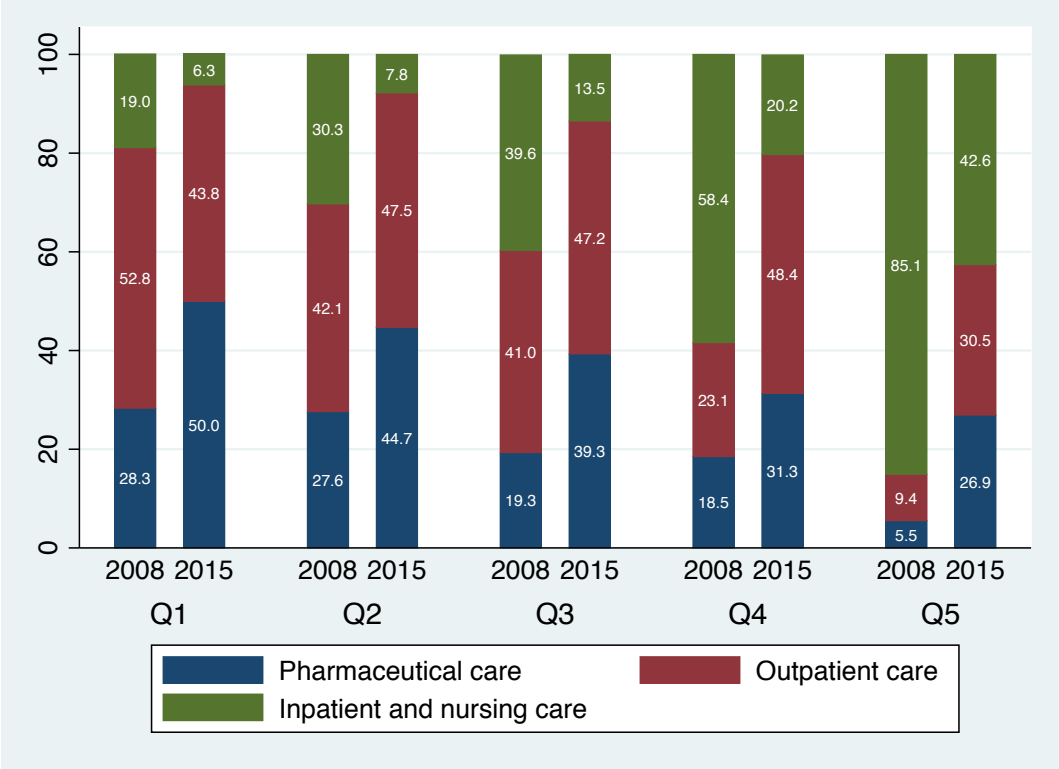
What is also interesting, however, relates to the changes over the study period. For example, we find some interesting differences in the types of expenditure that lead to financial hardship among the poorest households. In the first quintile, for example, the contribution of pharmaceuticals to the CHE increased from 28% to almost 40% during 2007-2015. Expenditure for outpatient care was also a significant component leading to CHE, and accounted for almost 53% and 44% in 2007 and 2015 respectively.

In both periods, payments for outpatient care accounted for the highest share of CHE among the households in the second and third quintile. In these socioeconomic groups, the contribution of pharmaceuticals to catastrophic health payments also increased between 2007 and 2015. In the second quintile, for example, the pharmaceutical share of CHE rose from 27.63% to almost 45%. Likewise, the contribution of pharmaceuticals to

CHE increased from 20% to 40% among households in the third quintile. On the other hand, the share of CHE arising from payments in inpatient and nursing care fell during the study period.

Similar to the other socioeconomic groups, the contribution of pharmaceutical expenditure to CHE also rose from 18.50% to more than 30% in the fourth quintile. Outpatient care accounted for 23% and 48% of CHE in 2007 and 2015 respectively. Last, inpatient care was generally the largest driver of financial hardship in the richest households. However, its contribution to CHE fell from 85% to less than 43% over the period 2007-2015. In contrast, the share of medicines and outpatient care substantially increased among those in the fifth quintile. In particular, payments for medicines accounted for 5.5% and 27% of the CHE in 2007 and 2015 respectively. Among the households of the fifth quintile that faced CHE, outpatient spending was 9.4% and 30.5% of the total OOPE in 2007 and 2015 respectively.

Figure 3. 2: Contribution of health expenditure components to overall CHE (among households with CHE), by total household health expenditure



3.4.5. Determinants of catastrophic health payments

This study also aims to identify which households are at risk of financial catastrophe due to health payments. As explained above, we employ two types of analysis: a logistic regression model, and a selection model with a Sartori estimator. Tables 3.4 and 3.5 present the regression estimates based on the pooled dataset, and confirm that the determinants of CHE after estimating the logistic regression model are almost identical to those derived from the selection model.

As shown in Table 3.4, our baseline findings (i.e. threshold at 20% of total household expenditure) reveal that the odds of incurring CHE for a household in 2015 are 2.43 times the odds of CHE for a household in 2007.[42] In addition, the odds of having CHE for the households in the top expenditure quintile are almost 36% lower than the odds for their low-income counterparts. We also show that the households headed by employed or self-employed individuals are less likely to encounter CHE compared to those headed by pensioners, whereas we do not find any difference in the probability of CHE between the other employment categories. The variables associated with the health status of the household members appear to be strong predictors of the probability of CHE. In particular, the odds of facing CHE are 80% higher for a household with multimorbid members than for a household without those patients. Likewise, households with hospitalized patients and members with long-standing activity limitation are also more likely to experience CHE. However, we do not find a significant relationship between some core demographics of the household head (e.g. gender, age, marital status) and the probability of having CHE. As shown in Table 3.4, our baseline results are generally robust to a wide range of alternative definitions for financial catastrophe due to health payments.

Table 3. 4: Probability of facing catastrophic health payments (logistic regression estimates)

	(1)	**(2)**	**(3)**	**(4)**
	CHE (threshold: 5%)	**CHE (threshold: 10%)**	**CHE (threshold: 15%)**	**CHE (threshold: 20%)**
	Logit	**Logit**	**Logit**	**Logit**
Year dummy	0.989***	0.946***	0.933***	0.886***
	(0.072)	(0.081)	(0.096)	(0.116)

[42] The odds ratio for each variable is given by the exponentiated regression coefficient.

Unmarried	-0.404**	-0.256	-0.145	-0.056
	(0.168)	(0.194)	(0.220)	(0.259)
Divorced	-0.388**	-0.190	-0.193	-0.241
	(0.174)	(0.178)	(0.219)	(0.250)
Widowed	-0.246**	-0.087	-0.053	-0.253
	(0.125)	(0.139)	(0.169)	(0.164)
Male	-0.075	-0.044	-0.126	-0.174
	(0.088)	(0.096)	(0.109)	(0.124)
Age	0.002	-0.073*	-0.050	-0.035
	(0.041)	(0.044)	(0.054)	(0.063)
Age squared	0.000	0.001*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Second quintile	-0.269**	-0.282**	-0.229*	-0.367**
	(0.107)	(0.115)	(0.130)	(0.158)
Third quintile	-0.184	-0.197	-0.222	-0.228
	(0.115)	(0.121)	(0.142)	(0.165)
Fourth quintile	-0.512***	-0.611***	-0.555***	-0.283
	(0.121)	(0.133)	(0.159)	(0.182)
Fifth quintile	-0.645***	-0.655***	-0.592***	-0.441**
	(0.124)	(0.140)	(0.161)	(0.190)
Primary education	0.021	-0.125	-0.159	-0.464***
	(0.105)	(0.106)	(0.121)	(0.137)
Secondary education	-0.065	-0.155	-0.097	0.005
	(0.104)	(0.104)	(0.117)	(0.133)
Tertiary education	-0.078	-0.086	-0.007	-0.111
	(0.121)	(0.126)	(0.146)	(0.176)
Employed or self-employed	-0.152	-0.312**	-0.492***	-0.442**
	(0.104)	(0.127)	(0.176)	(0.223)
Unemployed	-0.679***	-0.449*	0.020	0.285
	(0.226)	(0.254)	(0.273)	(0.318)
Homemaker	-0.083	-0.100	-0.087	-0.111
	(0.098)	(0.104)	(0.119)	(0.141)
Other	0.298	0.662***	0.591***	0.591***
	(0.185)	(0.178)	(0.184)	(0.190)
Household size	-0.158	-0.056	-0.009	-0.313
	(0.165)	(0.183)	(0.233)	(0.218)
Household size squared	-0.004	-0.028	-0.030	0.018
	(0.027)	(0.031)	(0.040)	(0.039)
Member with multimorbidity	0.768***	0.630***	0.615***	0.590***

	(0.062)	(0.066)	(0.074)	(0.094)
Member with long-standing activity limitation	0.733***	0.771***	0.742***	0.767***
	(0.080)	(0.086)	(0.101)	(0.122)
Hospitalized member	1.204***	1.320***	1.324***	1.426***
	(0.143)	(0.126)	(0.126)	(0.127)
Constant	-0.738	0.866	-1.123	-2.228
	(1.461)	(1.589)	(1.982)	(2.312)
Observations	5,552	5,552	5,552	5,552

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

For binary variables, the reference category is the complementary group. The reference categories for the other variables are married, first expenditure quintile, no education, retired for marital status, total household expenditure, education and employment status respectively.

Table 3.5 presents some alternative regression estimates, after using a selection model with a Sartori estimator. The results presented in Column 1 suggest that age, gender and marital status of the household head are significant predictors of health care utilisation. They also reveal a socioeconomic gradient in the probability of health care use, with the richer households being more likely to use and spend on medical care. Additionally, having multimorbid and hospitalized patients or members with long-standing activity limitations in the household is positively associated with health care spending.

In addition to the estimates derived from the selection equation, Table 3.5 also shows the regression estimates for the determinants of the probability of CHE. The findings are generally consistent with those of the logistic model. Our baseline analysis indicates that a household in 2015 is more likely to face CHE compared to 2007. Households in the fifth expenditure quintile are also less likely to encounter CHE than those in the bottom quintile. In addition, the probability of CHE is positively related to the presence of multimorbid or hospitalized members. Likewise, the households with members suffering from long-standing activity limitations have a higher probability of facing CHE. Similar to the results presented in Table 3.4, marital status, age, and gender of households head are not significant determinants of the risk of CHE.

Table 3. 5: Probability of incurring catastrophic health payments (Sartori selection model estimates)

	(1)	(2)	(3)	(4)	(5)
		CHE (threshold 5%)	CHE (threshold 10%)	CHE (threshold 15%)	CHE (threshold 20%)
	Selection	Outcome	Outcome	Outcome	Outcome
Year dummy	0.167***	0.540***	0.518***	0.507***	0.466***
	(0.049)	(0.040)	(0.043)	(0.050)	(0.058)
Unmarried	-0.372***	-0.160*	-0.076	-0.059	-0.063
	(0.106)	(0.091)	(0.098)	(0.113)	(0.128)
Divorced	-0.242**	-0.205**	-0.078	-0.084	-0.065
	(0.098)	(0.083)	(0.092)	(0.107)	(0.122)
Widowed	-0.200**	-0.161**	-0.051	-0.059	-0.126
	(0.080)	(0.063)	(0.067)	(0.076)	(0.087)
Male	-0.129**	-0.075*	-0.057	-0.079	-0.083
	(0.057)	(0.045)	(0.049)	(0.055)	(0.063)
Age	0.054**	-0.027	-0.051**	-0.034	-0.037
	(0.026)	(0.021)	(0.023)	(0.026)	(0.030)
Age squared	-0.000**	0.000	0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Second quintile	0.093	-0.142**	-0.137**	-0.115*	-0.199***
	(0.072)	(0.058)	(0.059)	(0.065)	(0.075)
Third quintile	0.321***	-0.073	-0.063	-0.092	-0.092
	(0.079)	(0.061)	(0.062)	(0.068)	(0.077)
Fourth quintile	0.150*	-0.252***	-0.315***	-0.276***	-0.099
	(0.080)	(0.063)	(0.067)	(0.075)	(0.082)
Fifth quintile	0.272***	-0.338***	-0.351***	-0.346***	-0.261***
	(0.083)	(0.066)	(0.069)	(0.079)	(0.089)
Primary education	0.103	-0.021	-0.127**	-0.125**	-0.256***
	(0.075)	(0.057)	(0.057)	(0.062)	(0.070)
Secondary education	0.061	-0.076	-0.144**	-0.118*	-0.064
	(0.072)	(0.056)	(0.057)	(0.063)	(0.069)
Tertiary education	0.069	-0.068	-0.091	0.003	-0.046
	(0.081)	(0.064)	(0.067)	(0.075)	(0.086)
Employed or self-employed	-0.099	-0.190***	-0.175***	-0.211***	-0.203**
	(0.069)	(0.057)	(0.065)	(0.078)	(0.094)
Unemployed	-0.307**	-0.422***	-0.204	0.082	0.089
	(0.132)	(0.120)	(0.129)	(0.142)	(0.163)
Homemaker	-0.016	-0.099*	-0.083	-0.050	-0.050
	(0.070)	(0.053)	(0.056)	(0.063)	(0.071)
Other	0.133	0.217**	0.409***	0.380***	0.395***

	(0.138)	(0.101)	(0.095)	(0.095)	(0.101)
Household size	-0.122	-0.106	-0.089	-0.107	-0.258**
	(0.102)	(0.083)	(0.093)	(0.107)	(0.118)
Household size squared	0.010	-0.000	-0.004	0.002	0.028
	(0.016)	(0.013)	(0.015)	(0.018)	(0.019)
Member with multimorbidity	0.446***	0.437***	0.377***	0.344***	0.321***
	(0.045)	(0.032)	(0.033)	(0.037)	(0.043)
Member with long-standing activity limitation	0.281***	0.449***	0.458***	0.424***	0.403***
	(0.060)	(0.043)	(0.044)	(0.049)	(0.057)
Hospitalized member	0.298***	0.684***	0.749***	0.769***	0.786***
	(0.100)	(0.068)	(0.060)	(0.061)	(0.064)
Constant	-0.949	0.634	0.860	-0.382	-0.548
	(0.922)	(0.767)	(0.832)	(0.965)	(1.107)
Observations	5,552	5,552	5,552	5,552	5,552

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

For binary variables, the reference category is the complementary group. The reference categories for the other variables are married, first expenditure quintile, no education, retired for marital status, total household expenditure, education and employment status respectively. For brevity, we only present the estimates of the selection equation for the baseline scenario.

Further to the analysis of the pooled dataset, we employ similar models for each wave separately. Table 3.6 presents the baseline estimates from the logistic regression and the selection model with Sartori estimator. Controlling for various confounders, the analysis of the 2007 wave reveals that the probability of CHE does not significantly differ across consumption quintiles. Instead, the probability of CHE is mainly driven by the health status of household members (e.g. presence of multimorbid and hospitalized members and of members with long-standing activity limitation). Likewise, our analysis shows that the variables capturing the health status of household members are also strong predictors of the probability of CHE in 2015. What is interesting, however, is that we find a clear socioeconomic differential in the probability of CHE in 2015. In other words, the analysis of the 2015 survey suggests that household financial situation is negatively associated with the probability of CHE, although this was not the case in 2007. This finding implies that low-income households are less protected against the financial risk of poor health, and can possibly be explained on the basis of several policy responses

implemented at that period. These findings are generally robust to different definitions of CHE. More details are presented in the Appendix Tables B3 and B4.

Table 3. 6: Probability of incurring catastrophic health payments in each wave (baseline estimates)

	Wave 2			**Wave 6**		
	(1)	(2)	(3)	(4)	(5)	(6)
	Logit	**Selection**	**Outcome**	**Logit**	**Selection**	**Outcome**
Unmarried	0.006	-0.198	0.001	-0.024	-0.507***	-0.071
	(0.530)	(0.172)	(0.273)	(0.300)	(0.136)	(0.148)
Divorced	-0.594	-0.325**	-0.211	-0.146	-0.207	-0.017
	(0.740)	(0.157)	(0.319)	(0.270)	(0.129)	(0.136)
Widowed	-0.492	-0.161	-0.201	-0.126	-0.246**	-0.084
	(0.360)	(0.125)	(0.183)	(0.189)	(0.106)	(0.101)
Male	-0.101	-0.092	-0.047	-0.195	-0.161**	-0.095
	(0.262)	(0.087)	(0.132)	(0.141)	(0.076)	(0.074)
Age	0.065	0.077**	0.015	-0.114	0.027	-0.076**
	(0.121)	(0.037)	(0.060)	(0.076)	(0.038)	(0.036)
Age squared	-0.000	-0.001**	-0.000	0.001*	-0.000	0.001**
	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Second quintile	-0.153	0.118	-0.092	-0.446**	0.059	-0.247***
	(0.322)	(0.111)	(0.161)	(0.181)	(0.095)	(0.088)
Third quintile	0.263	0.303**	0.172	-0.400**	0.351***	-0.187**
	(0.348)	(0.123)	(0.167)	(0.185)	(0.107)	(0.089)
Fourth quintile	0.071	0.277**	0.075	-0.417**	0.050	-0.172*
	(0.375)	(0.129)	(0.181)	(0.205)	(0.102)	(0.095)
Fifth quintile	0.597	0.384***	0.142	-0.813***	0.186*	-0.403***
	(0.388)	(0.135)	(0.197)	(0.207)	(0.107)	(0.102)
Primary education	-0.610**	0.172	-0.334**	-0.440***	0.024	-0.271***
	(0.279)	(0.128)	(0.135)	(0.160)	(0.104)	(0.086)
Secondary education	-0.367	0.143	-0.334**	0.074	0.014	-0.019
	(0.329)	(0.141)	(0.168)	(0.146)	(0.085)	(0.077)
Tertiary education	-0.481	0.010	-0.261	-0.029	0.132	-0.004
	(0.407)	(0.152)	(0.205)	(0.193)	(0.099)	(0.096)
Employed or self-employed	-0.332	-0.106	-0.162	-0.517*	-0.083	-0.248**
	(0.349)	(0.102)	(0.185)	(0.272)	(0.095)	(0.112)
Unemployed	0.732	-0.284	0.491	0.224	-0.333**	0.045
	(1.114)	(0.299)	(0.518)	(0.325)	(0.151)	(0.174)
Homemaker	-0.215	0.079	-0.087	-0.096	-0.091	-0.055

	(0.310)	(0.105)	(0.145)	(0.163)	(0.096)	(0.084)
Other	0.927**	0.015	0.490**	0.484**	0.179	0.367***
	(0.431)	(0.245)	(0.219)	(0.211)	(0.170)	(0.114)
Household size	-0.354	0.005	-0.140	-0.292	-0.244*	-0.310**
	(0.379)	(0.151)	(0.223)	(0.284)	(0.143)	(0.144)
Household size squared	0.022	-0.013	0.010	0.011	0.033	0.034
	(0.055)	(0.023)	(0.033)	(0.052)	(0.024)	(0.024)
Member with multimorbidity	0.402**	0.486***	0.233***	0.621***	0.427***	0.340***
	(0.188)	(0.072)	(0.086)	(0.112)	(0.059)	(0.051)
Member with long-standing activity limitation	0.968***	0.294***	0.389***	0.758***	0.273***	0.442***
	(0.273)	(0.091)	(0.114)	(0.136)	(0.082)	(0.067)
Hospitalized member	2.199***	0.354**	1.209***	0.957***	0.224*	0.534***
	(0.232)	(0.159)	(0.113)	(0.148)	(0.130)	(0.079)
Constant	-6.225	-2.047	-2.659	1.487	0.380	1.389
	(4.447)	(1.338)	(2.239)	(2.778)	(1.318)	(1.307)
Observations	2,258	2,258	2,258	3,294	3,294	3,294

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

For binary variables, the reference category is the complementary group. The reference categories for the other variables are married, first expenditure quintile, no education, retired for marital status, total household expenditure, education and employment status respectively.

3.5. Discussion

Given the significant household income loss during the recession and the recent health policy responses, the extent to which the Greek population is financially protected against the risk of illness is a matter of interest and great importance for health system performance assessment[43] (Maresso et al., 2014; OECD, 2016). The concerns about financial protection are more pronounced for the older people, especially in a country where the population is rapidly ageing (United Nations, 2017). Apart from being high-need, high-cost patients with complex multimorbidities, older people tend to encounter greater economic strain, struggle to cope with the negative changes in their financial

[43] The World Health Reports of the WHO have considered financial risk protection as one of the main dimensions of health system performance. More recently, the United Nations included it among the Sustainable Development Goals (Indicator 3.8.2).

situation during economic recession, and are also more prone to health shocks and the adverse effects of recession (Bierman, 2014; Fenge et al., 2012; Lyberaki & Tinios, 2018). Despite the importance and policy relevance of the topic, little is known about the impact of OOPE on financial protection among older households in Greece from an empirical perspective, and even less regarding the trends in incidence and intensity of CHE during the economic crisis.

Our analysis draws on data from the SHARE survey and indicates that the headcount and overshoot of CHE more than doubled among older households during 2007-2015. Setting the CHE threshold at 20% of total household expenditure, for example, our baseline results show that 5.83% of elderly households faced CHE in 2007, with the respective figure being almost 14% in 2015. This finding is further confirmed by our pooled regression estimates, which indicate that controlling for several confounders the odds of facing CHE for a household in 2015 are more than twice the odds of CHE for a household in 2007. Likewise, the overshoot of CHE also rose over the study period, suggesting that the average extent by which OOPE exceeds the corresponding threshold increased. The findings are robust to different thresholds of catastrophic health payments, and can be interpreted considering the broader socioeconomic environment and the relevant health policy responses during the economic recession. According to the WHO, there are three main elements that intensify the financial catastrophe due to health payments: weak prepayment mechanisms for financial risk pooling, households' low ability to pay, and the presence of health care services that involve out-of-pocket contributions (WHO, 2005). In Greece, prepayment mechanisms are historically weak, and further eroded during the economic recession. This is indeed revealed not only by the heavy reliance on out-of-pocket payments, but also by the fact that Greece has currently the highest share of uncovered population in the OECD countries (OECD, 2017). Second, household ability to pay dramatically deteriorated due to salary and pension cuts, tax increases and rising unemployment. For example, the cumulative reduction of pensions in the public sector ranged from 20% to more than 45% during 2010-2013, while almost similar cuts were introduced in the private sector (Tinios, 2016). Third, the depth of coverage has been largely affected due to the introduction of user charges, especially for pharmaceuticals and diagnostic tests. Although the medicines for life-threatening diseases are fully reimbursed, a co-insurance rate of 10% was introduced for some medicines that were previously fully reimbursed (e.g. for type 2 diabetes, Alzheimer, dementia, epilepsy). The co-insurance rate also increased from 10% to 25% in various diseases, including

coronary heart disease, hyperlipidemia, osteoporosis, arthritis, cirrhosis and COPD (Economou et al., 2014). In addition, patients may also bear the additional financial burden of the difference between the retail and the reimbursed price of medicines, due to the introduction of an internal reference pricing system (Greek Foundation for Economic and Industrial Research, 2018). Evidence suggests that the average co-insurance rate increased from 11.3% to approximately 29% during 2011-2014 (Gouvalas et al., 2016). Another study analysed administrative data, and showed that the share of medicines with a 25% co-insurance rate increased from 53% to 77%, whereas the average co-insurance rate rose from 13.3% to 18% during 2012-2013 (Siskou et al., 2014).

After splitting the sample by expenditure quintile, we show that the headcount of CHE increased across all socioeconomic groups over 2008-2015. Among the households in the bottom expenditure quintile, the incidence of financial catastrophe escalated from 6.44% to 22.24% during that period. The corresponding increase was, however, lower in the highest quintile. Given that the share of people with unmet medical needs also increased over the study period, especially among the poor segments of the population (Eurostat, 2018d), the incidence of CHE could have been even greater in the absence of financial barriers to access[44] (Moreno-Serra, Millett, & Smith, 2011). It thus appears that a large share of the low-income older households is locked into a "bad trade-off": they either pay OOPE and experience the risk of financial catastrophe, or face significant barriers to accessing health care and unmet medical needs.

Next, we further disaggregate households by chronic condition status, and find that financial protection has eroded across several household types. Consistent with findings from European and Asian countries (Arsenijevic, Pavlova, Rechel, & Groot, 2016; Z. Wang et al., 2015), the rate of CHE is higher among households with chronic or multimorbid patients compared to those without. Our findings indicate that the Greek health system fails to protect those with poor health status, especially after the onset of the economic crisis. For example, more than one out of ten elderly households with multimorbid patients faced financial catastrophe in 2007, whereas the respective figure increased to more than 20% in 2015. Evidence from the recession period suggests that

[44] The incidence of CHE may be relatively low because some households do not use health care due to several barriers to access associated with waiting lists, financial constraints, or limited availability of services. Therefore, they do not incur CHE, because their OOPE is zero. Removal of these barriers would potentially facilitate use of medical care and could increase the reliance on OOPE (WHO Regional Office for Europe, 2018b). Although financial protection measures adequately examine financial hardship for households that use health care, they cannot identify whether health payments lead to barriers to access and subsequent unmet medical needs.

despite the significant barriers (Kyriopoulos et al., 2014), ensuring access to health services was particularly important for chronically ill patients in Greece, even if they had to cut down expenses for other goods and services to finance health care. (Greek National School of Public Health, 2014; Skroumpelos et al., 2014). Generally speaking, the high incidence of CHE among elderly households with chronic patients, as well as the significant increase during 2007-2015 can possibly be interpreted by several characteristics of the Greek health system, and the lack of a thorough strategy to protect chronic patients from the financial burden of OOPE. In particular, although primary care is important for the provision of integrated and patient-centred care for chronic and older patients (WHO, 2016, 2018c), there is no comprehensive, coordinated, and continuous primary care system in Greece (Lionis et al., 2009; Oikonomou & Mariolis, 2010), with its funding being largely dependent on out-of-pocket payments (Groenewegen & Jurgutis, 2013; Kentikelenis & Papanicolas, 2012). Furthermore, chronic disease management is rather fragmented in Greece, with the economic recession posing additional challenges associated with quality, funding and access to care (Oikonomou & Tountas, 2011; Tsiantou, Mylona, et al., 2014). Additionally, although self-management of chronic conditions or the introduction of an integrated chronic care management model could, in some circumstances, reduce costs and improve outcomes (Bodenheimer, Wagner, & Grumbach, 2002), such approaches have not been adopted or extensively discussed in Greece.

Our analysis also focuses on the breadown of CHE by type of health care. Prior to the economic crisis, CHE was mainly due to inpatient and nursing care, followed by outpatient care and medicines. During 2007-2015, the contribution of household pharmaceutical spending to CHE substantially increased; a result that is potentially linked with the significant changes in cost-sharing for medicines and the introduction of the internal reference pricing system, along with the low generic penetration rate (Economou et al., 2017; Gouvalas et al., 2016). This finding is in line with recent evidence, which show that CHE is driven by payments for pharmaceutical in countries with weak financial protection mechanisms (WHO Regional Office for Europe, 2018b). On the contrary, the contribution of inpatient care to CHE decreased over 2007-2015, possibly because households shifted to public services and became less willing to incur informal payments in hospitals (Economou, 2015; Souliotis et al., 2016).

Last, we examine which household types tend to experience financial catastrophe due to health payments. As already discussed, whether poorer households are more susceptible to CHE is difficult to answer a priori. Evidence from several countries, for

example, suggests that the better-off have a lower probability of CHE (Amaya Lara & Ruiz Gómez, 2011; Gotsadze et al., 2009; Kronenberg & Barros, 2014; Meng et al., 2012), whereas another strand of the literature finds that richer households are more prone to financial catastrophe due to health payments (S. Brown et al., 2014; Somkotra & Lagrada, 2009; Yardim et al., 2010).

Our pooled regression estimates show that the households in the top quintile are generally less likely to incur financial catastrophe compared to the poorer population groups. This finding implies that low-income households are less protected against the financial risk associated with ill health. What is interesting, however, is that although the probability of CHE is decreasing with households' financial well-being in 2015, this was not the case in 2007. In a similar spirit, Table 3.3 also indicates that the incidence of CHE differs to a great extent across expenditure quintiles in 2015, but not in 2007. These findings raise substantial distributional and equity concerns, and can be possibly explained on the basis of the policy responses implemented at that period. However, they contrast with recent evidence for older people in some European countries, which shows that financial protection is stronger among the lower socioeconomic groups (Palladino et al., 2016). This discrepancy possibly reflects some idiosyncratic features of the Greek case. First, the breadth of coverage dramatically eroded during the crisis in Greece, affecting a large proportion of low-income people who ended up without entitlement to health insurance. Second, health financing in Greece is highly regressive due to the heavy reliance on OOPE, especially compared to other European countries (Economou et al., 2017; Mossialos et al., 2005). Third, user charges were introduced in Greece, without adequately considering households' vulnerability and income level (Thomson, 2015), and low-income households thus faced higher OOPE as a share of their income compared to their richer counterparts (Gemmill, Thomson, & Mossialos, 2008; Schokkaert & Van de Voorde, 2011).

This study has some policy implications. In Greece, several attempts to facilitate access to health care and improve coverage did not fully serve their purpose for various reasons, including incomplete information about the legal arrangements, stigmatization, administrative deficiencies and bureaucratic rigidity (Chantzaras & Yfantopoulos, 2018; A. Kentikelenis, 2015; Polyzou et al., 2015). Building on the relevant experience from other high-income countries, there are some policy responses, which could strengthen financial protection mechanisms. First, targeted and means-tested exemptions from user charges, focusing on certain income and demographic groups, could reduce the incidence of CHE

especially among vulnerable households (Hossein & Gerard, 2013). Second, the introduction of an annual cap on all user charges per person or household could mitigate the extent to which households are exposed to the adverse effects of high OOPE (Cylus et al., 2018; Thomson & Mossialos, 2004). Third, in some cases low fixed co-payments could replace the percentage co-insurance rates, given that the latter normally shift the financial risk from insurers to patients (WHO Regional Office for Europe, 2018b). Besides reforming cost-sharing mechanisms, and considering Greece's rapidly ageing population, another policy response could relate to the establishment of a functioning primary and long-term care system. Striving for an integrated health and social care system and more holistic chronic disease management could be the basis for stronger financial protection among older people (Sadana, Soucat, & Beard, 2018; WHO, 2018a).

This study has some limitations. First, the data for out-of-pocket spending are self-reported; however, OOPE reporting is not expected to change by year (Goldman & Zissimopoulos, 2003; Kawabata et al., 2002; Lehnert et al., 2011). Second, we only analyse two waves (before and after the onset of the crisis) due to data limitations, and cannot adjust for underlying trends or other time-related factors, which could influence OOPE and the probability of CHE. Third, we could not examine how CHE evolved in the years between 2007 and 2015, since only Waves 2 and 6 are available for Greece (SHARE Release Guide, 2018). Fourth, we cannot investigate the coping strategies that households adopt due to excessive OOPE. Examining the role of coping strategies is important, since the ways through which health care is financed (e.g. savings, borrowing, selling assets, cutting down other types of consumption) have important implications on household consumption and welfare in the long run.

3.6. Conclusion

This study examines financial protection among older households in Greece, a country that experienced a severe economic crisis and implemented several health policy responses that directly affected health coverage. Our findings reveal that the headcount and overshoot of CHE substantially increased over 2007-2015, suggesting that financial protection eroded to a great extent during the period of economic crisis. Incidence of CHE increased across all population groups, with low-income and households with chronic patients being disproportionately affected. Although we do not report signs of socioeconomic inequalities in the risk of CHE in 2007, our findings show a clear

socioeconomic differential in the probability of CHE and reveal substantial inequalities in 2015. This can possibly be attributed to the policy responses implemented at that period, and raises significant distributional and equity concerns. Prior to the onset of the economic crisis, household payments for inpatient and nursing care were the major drivers of CHE, followed by OOPE for outpatient care and medicines. However, our findings reveal that the contribution of household pharmaceutical spending to CHE substantially increased during the study period. Strengthening financial protection among older households is an imperative challenge for the Greek health system and other countries affected by the crisis, and several policy responses towards this direction should be adopted. In addition, targeted measures towards reducing the burden of OOPE for the poorer households are also needed, since those households have been disproportionately affected.

Chapter 4

Does economic recession impact newborn health? Evidence from Greece

Abstract

In the context of an interesting debate regarding the effects of economic recession on health outcomes in Europe, this study examines the potential impact of the Greek crisis on newborn health. Using a large administrative dataset of 838,700 births over the period 2008-2015, our analysis shows that birth weight (BW) and pregnancy length are generally procyclical with respect to economic conditions during gestation, while the probability of low birth weight (LBW) and preterm birth are both countercyclical. Further, we report heterogeneity in the association between business cycle fluctuations and newborn health across socioeconomic groups. Birth outcomes of infants born to families of lower socioeconomic status (SES) are responsive to economic conditions during the first and third trimester of the gestation. This is not the case for the high SES newborns, whose birth outcomes respond only to economic volatility in the first trimester. Further, economic adversity during preconception period raises the probability that women who conceive are highly educated and married, having implications for the cohort composition of women who get pregnant. After accounting for selection, the exposure to economic crisis is linked with a BW loss, which is driven by the children of lower SES parents. Our findings have some social policy implications. In particular, the impact of the crisis on birth indicators is more detrimental for the children of lower SES, resulting in a widening of the BW gap between infants of lower and higher SES families. This could in turn exacerbate long-term future socioeconomic and health inequalities and hinder social mobility.

Keywords: birth outcomes, birth weight, business cycle fluctuations, economic crisis, recession, Greece

4.1. Introduction

In the late 2000s, Europe faced a severe sovereign debt crisis, uncovering the Eurozone's structural and design problems, and threatening its stability. Despite the previous global financial crisis, there was little concern about sovereign debt sustainability in Europe, and the markets were relatively calm in 2008, all the way until late 2009 (Lane,

2012). The crisis began in the autumn of 2009, when the Greek government announced a revision of the budget deficit that was actually more than twice the size of the previous estimate, exceeding 15% of GDP (Gibson, Palivos, et al., 2014; Honkapohja, 2014). After the dramatic increase of sovereign bond spreads, Greece was the first European economy to be excluded from the credit market, and subsequently, the country reached a bailout agreement with its creditors and implemented an EAP.

During that period, the Eurozone crisis gradually broadened and deepened, with several other countries facing similar problems. However, the Greek economy was hit much harder than its counterparts. First, it faced a massive and prolonged recession (Romer & Romer, 2017), which was possibly the most severe economic crisis among developed countries in the post-war period (Reinhart & Rogoff, 2014). Second, the strict economic adjustment programme that followed entailed heavy conditionality, extreme fiscal consolidation measures (Featherstone, 2011) and a grinding process of internal devaluation, having significant implications in terms of household disposable income and living conditions, mainly through salary adjustments in both the public and private sector (I. Kyriopoulos et al., 2019; OECD, 2014). Last, evidence suggests that poverty and inequality have risen in the wake of the economic recession, suggesting that the social aftermath and the distributional effects of the crisis are rather strong (Kaplanoglou & Rapanos, 2016; Matsaganis & Leventi, 2014).

Even before the recent crisis, the impact of recessions on health attracted much scholarly interest. However, research findings have been rather inconclusive, due to the presence of several countervailing pathways (Ralph Catalano, 2009). For example, there is evidence that population health indicators, such as all-cause mortality, tend to deteriorate during periods of economic prosperity (Laporte, 2004; C. J. Ruhm, 2000; Christopher J Ruhm, 2003; Toffolutti & Suhrcke, 2014; van den Berg et al., 2017). The higher mortality rates appear to be driven by deaths from cardiovascular conditions, motor vehicle accidents, influenza/pneumonia, liver disease and other accidents, whereas some other cause-specific deaths are generally countercyclical (U.-G. Gerdtham & Ruhm, 2006; Neumayer, 2004). Another strand of the literature, however, challenges the previous findings, with several studies reporting that mortality exhibits an acyclical variation and others suggesting that economic downturns are detrimental for health (Cutler et al., 2002; U.-G. Gerdtham & Johannesson, 2005; McInerney & Mellor, 2012; Christopher J. Ruhm, 2015; Svensson, 2007). Generally speaking, it appears that the effects of recessions vary

with the level of analysis, country context, extent and severity of the recession, studied health outcomes, and potential role of the welfare state (Suhrcke & Stuckler, 2012).

Evidence from Greece shows that all-cause mortality fell after the inception of the crisis but the rate of decline was significantly lower (Laliotis et al., 2016). Using self-rated health status, several other papers showed that health trends deteriorated during economic recession (Kentikelenis et al., 2011; Vandoros et al., 2013; Zavras, Tsiantou, Pavi, Mylona, & Kyriopoulos, 2013). Mental health indicators also worsened during the Greek crisis (Drydakis, 2015; Mylona, Tsiantou, Zavras, Pavi, & Kyriopoulos, 2014), with the prevalence of major depression substantially increasing from 3.3% to 12.3% (M. Economou et al., 2016).

Despite the growing academic and policy interest for the health consequences of the recent recession in Greece - and more generally, in Europe - a systematic review points out that evidence is "still unclear and fragmented". The effects of the crisis on health indicators appear to be heterogeneous, and studies have tended to focus on adult health (Parmar, Stavropoulou, & Ioannidis, 2016). Additionally, there is scant evidence on the impact of the recent economic recession on newborn health, and little is known about the potential socioeconomic differential in the impact of economic recession on health. Previous evidence is contradictory and rather inconclusive (Eiríksdóttir et al., 2013; Margerison Zilko, 2010), with some studies showing newborn health improvements (R. Dehejia & Lleras-Muney, 2004), and others suggesting worse newborn birth outcomes during economic downturns (Bozzoli & Quintana-Domeque, 2014; R Catalano, Hansen, & Hartig, 1999; Olafsson, 2016).

Our analysis concentrates on birth outcomes. Focusing on newborn health indicators is crucial both from both public health and socioeconomic perspectives. Adverse birth outcomes are associated with greater mortality and morbidity, not only during infancy, but also later in life, during childhood and adulthood (Blumenshine, Egerter, Barclay, Cubbin, & Braveman, 2010). For example, LBW children appear to have greater rates of coronary heart disease, diabetes, metabolic syndrome, high blood pressure, osteoporosis and stroke during their adulthood (Almond et al., 2005; Gluckman et al., 2008). Thus, newborn health can be considered as input in a health production function that essentially approximates the initial endowment of "human health capital". Besides its association with various health indicators, poor newborn health can also affect cognitive function and development (Jefferis, Power, & Hertzman, 2002), anthropometry measures

(height, BMI), educational attainment, labour market outcomes and earnings[45] (S. E. Black et al., 2007).

Based on the above, this chapter intends to investigate the association between economic conditions during gestation and health at birth. It contributes to the literature in several ways. First, we use a large administrative dataset from Greece, a country that faced an unprecedented economic crisis in terms of duration, intensity and severity (Andriopoulou et al., 2017). The Greek case is important, since previous research focused on shorter recessions that had a lower impact on economic and social indicators. Previous studies have examined the 2001-2002 crisis in Argentina and the 2008 financial collapse in Iceland (Bozzoli & Quintana-Domeque, 2014; Olafsson, 2016), both of which lasted almost three years, and were less severe than the Greek crisis (Reinhart & Rogoff, 2014). Second, compared to most other studies -which tend to focus on the link between unemployment and newborn health (Alessie, Angelini, Mierau, & Viluma, 2017; Schempf & Decker, 2010)- we examine the relationship between economic climate and uncertainty during pregnancy and birth indicators using two alternative measures: the Economic Sentiment Indicator (ESI) and the Economic Policy Uncertainty Index (EPU). Different from previous studies, our analysis captures the overall economic climate, expectations and uncertainty, which are not directly reflected in standard measures of economic activity such as GDP and unemployment rate (Gelper & Croux, 2010). Third, we use various detrending techniques to capture the cyclical component of the economic indicators, and test the robustness of our findings. Fourth, to our knowledge, this is the first paper documenting a socioeconomic differential in an economic crisis' impact on newborn health. Fifth, using individual-level data, we provide additional evidence on potential selection into pregnancy during periods of economic uncertainty, and examine how the economic climate during preconception period might influence the type and characteristics of mothers who conceive. Last, using propensity score matching (PSM), we address potential selection arising from compositional changes on the type of mothers who conceive, and further employ various robustness checks.

[45] A substantial body of evidence suggests that in utero conditions strongly influence future health and socioeconomic outcomes, and have particularly examined the so-called 'fetal origins' hypothesis. David Barker, a British epidemiologist, was among the first proponents who linked in utero conditions with adult disease (Almond & Currie, 2011).

Hypothesis development

In this study we are testing three hypotheses, formulated as follows.

During economic recessions, the prevalence of depression and psychosocial stress tends to increase (Economou et al., 2013; Frasquilho et al., 2016; Hamilton et al., 1990), with both of them being risk factors for adverse perinatal outcomes (Grote et al., 2010). Additionally, household financial distress is expected to change the quantity and quality of maternal nutrition and to impede access to nutritious food, resulting in food insecurity during pregnancy (Brinkman et al., 2010; Studdert et al., 2001). Increased level of maternal stress and poor maternal nutrition during pregnancy may adversely affect gestational length, and intrauterine growth respectively (Bernabé et al., 2004; Hedegaard et al., 1996), both of which are, in turn, expected to influence birth outcomes (M.S. Kramer, 1987). On this basis, we formulate our first hypothesis:

Hypothesis 1: Birth outcomes are sensitive to economic conditions during pregnancy, and the relationship varies depending on the stage of gestation.

During economic recessions, low-SES households are more likely to compromise food quality and quantity, as they are more likely to experience severe financial hardship (Bonaccio et al., 2017; Brinkman et al., 2010). This might not apply to the families of higher SES, who possess more assets, have access to various coping mechanisms and credit and can smooth consumption without resorting to unhealthy dietary changes. Additionally, low-SES individuals are more susceptible to stress and mental health problems while also facing more limited access to mental health services during economic contraction (R. A. Catalano & Bruckner, 2005; Hauksdottir et al., 2013; Wahlbeck & McDaid, 2012; World Health Organization, 2011). Considering this range of impacts, we develop the following hypothesis:

Hypothesis 2: There is heterogeneity in the relationship between prenatal business cycle fluctuations and birth outcomes across socioeconomic groups.

Evidence suggests that fertility declines during periods of economic crisis, while economic contraction and uncertainty is generally associated with fertility postponement[46] (Chevalier & Marie, 2017; Sobotka et al., 2011). However, economic adversity might influence differently the decision to conceive across household types and groups. In particular, less-privileged families may have faced credit constraints and reduction in their

[46] Economic distress leads to two effects that have opposite direction. In particular, it is associated with a negative income effect that reduces the demand for children, and a positive substitution effect which shifts demand towards the opposite direction. Given that empirical studies show a fertility decline during recessions, income effect is generally larger than the substitution effect (Gronau, 1977).

already low income, and may thus be unable to afford the costs of childbearing (Schneider & Hastings, 2015). They also have fewer savings and financial reserves to confront negative income shocks (Lusardi et al., 2011). In this context, low-SES mothers may be less likely to conceive during recessions due to the reasons explained above. The characteristics of women who conceive during economic recession might be thus different compared to those of women who conceive during periods of normality. However, evidence on this topic is rather contradictory (Aparicio & González, 2014; R. Dehejia & Lleras-Muney, 2004). Given that these relationships are complex, and largely depend on the country setting, we examine the following hypothesis in the context of the Greek crisis:
Hypothesis 3: Economic fluctuations influence the fertility decision differently across population groups.

Economic distress might be associated with fertility postponement and changes in the types or characteristics of women who conceive during periods of economic adversity (Chevalier & Marie, 2017; R. Dehejia & Lleras-Muney, 2004). This implies compositional characteristics in the type of women who give birth (or selection into pregnancy during an economic downturn). Hence, we form our fourth hypothesis:
Hypothesis 4: After accounting for compositional changes in the type of women who give birth during recessions, an economic crisis affects BW, with the impact being greater for children born to low-SES mothers

4.2. Health effects of the Greek crisis

Since 2011, there has been an interesting discussion regarding the health effects of the Greek crisis, which are still being debated (McKee & Stuckler, 2016). A widely quoted paper characterized the health consequences of the Greek crisis as "omens of a tragedy" (Kentikelenis et al., 2011) and, along with other empirical work, triggered a vigorous debate regarding the Greek case, with some studies expressing scepticism about the extent to which economic distress was harmful for health (Liaropoulos, 2012; Tapia Granados & Rodriguez, 2015). In general, most evidence examined the impact of the recession on financing, delivery and access to health services, while research on population health primarily focused on comparisons of various indicators between the pre- and post-crisis period (Simou & Koutsogeorgou, 2014).

According to a recent study, all-cause mortality has decreased following the economic crisis but the rate of decline was significantly lower, especially for women

(Laliotis et al., 2016). This study reported heterogeneous impact of the recession on cause-specific deaths. In particular, it found that mortality due to diseases of the circulatory system decreased at a slower pace after the crisis, whereas the decline in deaths due to road accidents was actually greater during the period of economic downturn. It also showed that suicide mortality and deaths from mental illness, neurological diseases, and adverse events during treatment increased during the post-crisis period. Additionally, most ecological studies primarily focus on suicides, showing that the economic recession and austerity are associated with increased suicidality in Greece (Branas et al., 2015; Rachiotis, Stuckler, Mckee, & Hadjichristodoulou, 2015). For example, using time-series data over the period 1968-2011, Antonakakis and Collins (2014) showed that overall and male suicide rates increased during the period of fiscal austerity and economic downturn in Greece[47], while this was not the case for women (Antonakakis & Collins, 2014).

Apart from the papers focusing on aggregate mortality trends, a strand of the literature also investigates the impact of economic decline on some other health indicators. The majority of these studies employ individual-level data from various surveys, thus avoiding potential bias arising from ecological inference fallacy. For example, evidence suggests that self-rated health trends have deteriorated after the onset of the Greek crisis (Vandoros et al., 2013; Zavras et al., 2013). Another study also employed survey data and a difference in differences approach, and found that economic crisis led to worse health trends in Greece but not in Ireland, although the latter also faced a severe financial crisis (Hessel, Vandoros, & Avendano, 2014). In another study, Drydakis (2015) employed longitudinal data and showed that unemployment led to negative effects on health status and mental health in Greece, whereas its adverse impact was stronger during periods of recession (Drydakis, 2015).

In addition, various studies have employed repeated cross-sectional datasets to examine potential association between economic distress and mental health (M. Economou et al., 2014). For instance, descriptive evidence shows an increasing prevalence of major depression during the recession (from 3.3% to 12.3% during 2008-2013), while low-educated, unemployed and those suffering from financial hardship had a higher likelihood of being depressed (M. Economou et al., 2016; Economou et al., 2013). Furthermore, the

[47] Prior to these empirical studies, there was an interesting debate regarding the trends in suicide mortality during the Greek crisis, which mainly relied on descriptive evidence (M. Economou, Madianos, Peppou, Theleritis, & Stefanis, 2012; Fountoulakis, Grammatikopoulos, Koupidis, Siamouli, & Theodorakis, 2012; Fountoulakis, Savopoulos, et al., 2013; Fountoulakis, Siamouli, et al., 2013; Kondilis, Ierodiakonou, Gavana, Giannakopoulos, & Benos, 2013).

share of the sample that reported suicidal ideation increased from 2.4% to 6.7% between 2008 and 2011, with this increase being driven by male respondents (M. Economou et al., 2013). However, an update of this study suggested that the prevalence of suicidal ideation gradually declined to the pre-crisis level, down to 2.6% in 2013. Similar results are also reported for the one-month prevalence of suicidal attempt (M. Economou et al., 2016). Contrary to these findings, a recent paper did not show a significant difference in the prevalence of diagnosed mental health problems (depression or anxiety disorders) between 2010 and 2015 (Filippidis et al., 2017). However, the authors interpreted this finding with caution, and noted that the counterintuitive finding can be possibly attributed to under-diagnosed cases during economic recession.

These studies have concentrated on adult physical and mental health, without considering potential effects of economic distress on child and newborn health. At the moment of writing this chapter, there are two short reports that examine the link between economic recession and child mortality in Greece. Using a descriptive analysis, a paper noted an increase in stillbirths in Greece during 2009-2010, potentially associated with the onset of the economic crisis (Vlachadis & Kornarou, 2013). Another study did not find evidence of rising infant mortality and stillbirth rate between the pre- and post-crisis periods (Michas, Varytimiadi, Chasiotis, & Micha, 2014).

4.3. Literature review

4.3.1. Determinants of birth outcomes

Previous evidence shows that BW is essentially determined by the rate of intrauterine growth and the gestational duration (Abu-Saad & Fraser, 2010; Goldenberg & Culhane, 2007; Kramer, 2003), with both of them being influenced by various factors. In this section, we will group and briefly summarize the most important determinants of birth outcomes, as suggested by various studies in medical and social science literature.

The determinants of adverse birth outcomes can be broadly categorized into the following categories: (a) genetic and constitutional characteristics (newborn gender, race, additional genetic factors); (b) parental sociodemographic and psychological characteristics (age, marital status, income, educational level, occupation, maternal stress and psychological situation) (Blumenshine et al., 2010; Kogan, 1995); (c) obstetric factors (parity, previous obstetric history) (Goldenberg et al., 2008); (d) nutrition and lifestyle factors (consumption of specific proteins and vitamins, physical exercise, smoking,

drinking) (Chomitz et al., 1995; Ramakrishnan, 2004) and (e) prenatal care utilisation (intensity of doctor visits for prenatal care, timing and quality of visits) (Kramer, 1987).

Based on this classification, it appears that some genetic and constitutional characteristics influence fetal growth and could lead to adverse birth outcomes. For example, some chromosomal anomalies are associated with intrauterine growth retardation, resulting in lower BW. Additionally, various studies document a relationship between maternal weight and birth weight (Bernabé et al., 2004), and also show that race may influence birth outcomes (Goldenberg et al., 2008).

A second set of factors affecting birth outcomes relates to sociodemographic and psychological characteristics. According to a comprehensive literature review, there is a well-established socioeconomic gradient in birth outcomes, with infants born to high-SES mothers having better birth outcomes (Blumenshine et al., 2010). The nexus between parental socioeconomic status and BW appears to be strong and robust to different socioeconomic proxies, such as income, education and occupation (Conley & Bennett, 2001; Kogan, 1995). Another strand of the literature reveals that neighbourhood socioeconomic characteristics also affect birth outcomes (Luo et al., 2006; Pearl et al., 2001). For instance, a few studies have indeed found evidence for the contextual effects of income inequality on birth outcomes (Huynh et al., 2005; Nkansah-Amankra et al., 2010). Additionally, a growing body of evidence shows a rather counterintuitive finding regarding the link between immigration status and newborn health. In particular, most studies find that children born to immigrant mothers tend to be healthier and generally have better perinatal outcomes. This finding is known as the "healthy immigrant effect" and can be possibly attributed to selection, since the immigrant mothers generally tend to be younger and healthier (Guendelman et al., 1999; Janevic et al., 2011). Apart from the socioeconomic factors affecting BW, various studies elucidate potential relationships between demographic characteristics and BW. For instance, evidence suggests that maternal age is strongly associated with birth outcomes (Love et al., 2010), and mothers aged less than 18 and more than 35 years old are more likely to give birth to children with lower BW (Lee et al., 1988). Last, babies born to unmarried mothers generally tend to have poorer newborn health (Conley & Bennett, 2001; Holt et al., 1997; Phung et al., 2003).

Third, a series of obstetric factors, and obstetric history in general, influence the probability of preterm birth and LBW. For instance, primiparity relates to increased probability of preterm birth and LBW. However, parity and birth outcomes are essentially characterized by a U-shaped relationship, given that the risk of LBW and adverse birth

outcomes also increases after the fourth pregnancy (Bernabé et al., 2004). Evidence from the medical literature also indicates that previous miscarriages further raise the probability of adverse birth outcomes (Basso et al., 1998; Thom et al., 1992).

A fourth set of determinants relates to lifestyle and nutritional habits. For example, maternal smoking is among the most crucial preventable risk factors for intrauterine growth retardation and LBW (Hellerstedt et al., 1997; Wang et al., 1997), and has an independent and strong effect on birth outcomes, even after adjusting for socioeconomic characteristics and other potential confounders (Bouckaert, 2000). In this context, there are several biological mechanisms that potentially explain the link between maternal exposure to smoke and birth outcomes (Bernabé et al., 2004). A strand of the literature has also linked drinking alcohol with adverse birth outcomes (Jaddoe et al., 2007; Larroque et al., 1993), with the magnitude of the effect depending on the level of alcohol consumption (Mills et al., 1984). Last, maternal nutrition appears to be a significant predictor of birth outcomes, since consumption of specific nutrients and several nutritional habits influence placental and fetal growth (Godfrey et al., 1996)

Last, most evidence indicates that adequate prenatal care utilization is associated with higher BW (Donaldson & Billy, 1984; Rous et al., 2004), and can decrease the probability of LBW and preterm birth (Alexander & Kotelchuck, 2001; Kogan, Alexander, Kotelchuck, & Nagey, 1994). Apart from its impact on birth weight and the length of gestation, lack of prenatal care utilization is also linked with greater rates of perinatal mortality and morbidity (Herbst, Mercer, Beazley, Meyer, & Carr, 2003).

4.3.2. Stressful events and birth outcomes

An increasing body of evidence shows that conditions during the prenatal period are associated with birth indicators, with maternal stress and psychosocial situation during pregnancy largely affecting fetal development. In this section, we will briefly review some key studies on the impact of exogenous and stressful events on newborn health indicators. With this in mind, various studies show that in utero exposure to exogenous events (e.g. terrorist attacks, natural disasters) affect birth outcomes (Hedegaard et al., 1996), and/or birth defects (Carmichael, Shaw, Yang, Abrams, & Lammer, 2007).

In this context, some papers have examined the impact of terrorist attacks on birth outcomes, with most studies focusing on the 9/11 attack on the World Trade Center. In particular, findings from the medical and epidemiological literature support that the 9/11

attack was generally associated with worse birth outcomes in New York, such as lower BW and shorter length of gestation (Lederman et al., 2004). Apart from the negative effects in New York, women in California were also found to be more likely to give birth to LBW children in the period after the 9/11 attack (Lauderdale, 2006). Using data from Dutch infants, another paper showed that children who were in utero during the 9/11 attack were lighter compared to non-exposed children, and explained this finding on the basis of the stress generated by the extensive media coverage (Smits, Krabbendam, de Bie, Essed, & van Os, 2006). Likewise, a few studies also indicated that this terrorist attack affected secondary sex ratio due to male fetal loss (Bruckner, Catalano, & Ahern, 2010; R. Catalano, Bruckner, Marks, & Eskenazi, 2006). Although most studies have indeed noted that the 9/11 attack led to poorer newborn health, a strand of the literature showed insignificant or mixed results (El-Sayed, Hadley, & Galea, 2008; Endara et al., 2001; Eskenazi, Marks, Catalano, Bruckner, & Toniolo, 2007). Apart from the terrorist attack on the World Trade Center, the impact of terrorism and/or violence on birth indicators has been analysed using different case studies. For example, children who experienced in utero exposure to the landmine explosions in Colombia weighted 8.7 grams less than their siblings (Camacho, 2008). Similarly, a recent paper showed that intrauterine exposure to ETA terrorism in the early months of gestation had a strong negative impact on BW, increased the prevalence of LBW and reduced the percentage of infants without complications during pregnancy (Quintana-Domeque & Ródenas-Serrano, 2017). Mansour and Rees (2012) also showed that intrauterine exposure to conflict-related fatality early in the pregnancy is linked with greater risk of LBW, with the effect of the intrauterine exposure during the third trimester being somewhat weaker (Mansour & Rees, 2012). These empirical findings are further supported by recent studies that have also examined the effects of exposure to violence (captured by local homicide rates) on birth outcomes in Latin American countries (R. Brown, 2018; Foureaux Koppensteiner & Manacorda, 2016). Both articles found that intrauterine exposure to violence during the first trimester is associated with lower BW, higher probability of LBW and greater risk of prematurity, with the effects being stronger for the infants born to low-SES mothers. Contrary to these findings, another analysis noted that prenatal exposure to violence in Mexico led to greater BW and decreased the proportion of LBW infants (Torche & Villarreal, 2014).

Another body of the literature has examined whether exposure to natural disasters during pregnancy impacts health at birth. For example, increasing evidence reveals that intrauterine exposure to earthquakes results in lower BW and increases the proportion of

LBW infants, with the effect being stronger for mothers exposed to the earthquake during the first trimester of gestation (Kim, Carruthers, & Harris, 2017; Tan et al., 2009; Torche, 2011). In the same spirit, some other papers indicate that intrauterine exposure to Hurricane Katrina increased the risk of LBW (Callaghan et al., 2007; Xiong et al., 2008), whereas Tong et al. (2011) found that children born to mothers who experienced the catastrophic flood in North Dakota had greater risk of LBW and preterm delivery (Tong, Zotti, & Hsia, 2011). A comprehensive analysis found that exposure to hurricanes impacts the probability of abnormal conditions for infants in the USA, while the results for the effects on BW and pregnancy length were rather mixed (Currie & Rossin-Slater, 2013). Another strand of the literature also shows that prenatal exposure to weather shocks leads to lower length of pregnancy and reduced BW, with the effects being stronger for those being exposed in the second and early third trimester (Simeonova, 2011). These findings are further confirmed by some other papers, which also document a relationship between weather shocks during pregnancy and newborn health (Andalón, Azevedo, Rodríguez-Castelán, Sanfelice, & Valderrama-González, 2016; Deschênes, Greenstone, & Guryan, 2009).

4.3.3. Economic performance and birth outcomes

Although the impact of intrauterine exposure to exogenous and stressful events on newborn health has been extensively discussed in medical and social science literature, the relationship between economic climate during gestation and birth outcomes has attracted less interest (Eiríksdóttir et al., 2013). According to a review, the empirical findings about the newborn health effects of economic adversity are contradictory and rather inconclusive, and further empirical work is thus needed on this topic (Margerison Zilko, 2010). The discrepancy in existing evidence can possibly be attributed either to different methodologies or to different behavioural responses to economic crises and shocks (Miller & Urdinola, 2010).

A strand of the literature shows that economic contraction improves newborn health, or does not report evidence of a significant link between economic conditions during gestation and birth outcomes. For instance, a widely quoted paper employed data from the USA and explored the link between unemployment rate and child health. It found that infants born during periods of recession generally have a lower rate of LBW and fewer congenital malformations (R. Dehejia & Lleras-Muney, 2004). According to their findings,

the observed newborn health improvements can be mainly attributed to the changes in the composition of women who conceive, and the changes in health-promoting behaviours during periods of economic contraction. In a similar spirit, another study focused on an unexpected wage cut policy in Romania, and also found evidence of improved birth outcomes for the children exposed to the unexpected shock (Bejenariu & Mitrut, 2013). Evidence from Sweden indicates that economic conditions are not significantly associated with BW and the probability of LBW (Van Den Berg & Modin, 2013). Likewise, Joyce (1990) used monthly aggregate data from New York City, and found no evidence of a relationship between unemployment rate and the percentage of LBW infants (Joyce, 1990).

In contrast to the previous literature, some studies indicate that BW is essentially procyclical. Based on individual-level data for live births, previous work on Argentina's economic crisis in the early 2000s pointed out that intrauterine exposure to macroeconomic fluctuations is associated with lower BW and greater probability of LBW (Bozzoli & Quintana-Domeque, 2014). According to this analysis, the BW loss associated with this crisis was approximately 30 grams. The study also showed that BW responds differently to prenatal economic conditions depending on maternal socioeconomic status, and also provided plausible explanations for these findings. Another paper tested the relationship between regional unemployment rate and newborn health in Argentina, and showed that higher unemployment is associated with reduced fetal growth rate, especially for better-educated parents (G. L. Wehby, Gimenez, & López-Camelo, 2017). However, this paper concluded that increasing unemployment reduces BW and raises the probability of LBW for the children born to better-educated parents. Contrary to both studies using data from Argentina, an article about the Peruvian crisis did not report any heterogeneous effects of the economic crisis on birth outcomes across different socioeconomic groups (Gutierrez, 2017).

A recent study focused on the financial crisis in Iceland and compared the birth indicators of children exposed to the banking collapse of October 2008 during gestation, with those of children who were in utero in 2007 (Olafsson, 2016). The study's empirical strategy implied that the exposure to the banking collapse was the only difference between the two cohorts. According to its findings, exposure to the financial crisis affected birth outcomes, especially for the children exposed to the shock during the first trimester of pregnancy. Another article examined the same case study, and concluded similar results (Eiríksdóttir et al., 2013). In particular, the article showed that the risk of LBW and small for gestational age (SGA) was significantly higher for the children born during the post-

crisis period, with the effect being somewhat greater for the infants of younger and unemployed women. Nonetheless, this analysis did not reveal a significant difference in the probability of preterm birth between the period before and after the financial collapse.

The economic recessions in Latin America and Iceland were deep and severe, and this potentially explains the increasing interest for these countries. The existing literature, however, has also examined similar research questions using data from some other countries. For example, a study employed quarterly data for live births in Norway and Sweden, and reported a positive relationship between male unemployment rate and the incidence of LBW (R Catalano et al., 1999). Furthermore, Varea et al. (2016) showed that the prevalence of LBW significantly increased following the recent economic crisis in Spain (Varea, Terán, Bernis, Bogin, & González-González, 2016). Using micro-level data from the Netherlands, another study found a small, but statistically significant, effect of unemployment rate on BW, but not on the risk of LBW (Alessie et al., 2017).

Apart from the effects on BW and the risk of LBW, a strand of the literature has also tested whether economic contraction impacts secondary sex ratio (i.e. the ratio of male to female births). Using data from East and West Germany over the period 1946-1999, Catalano (2003) found that economic recession is linked with a reduction in secondary sex ratio, while sex ratio in East Germany was at its lowest during the economic recession in 1991 (R. A. Catalano, 2003b). Another study drew on Swedish data and time-series analysis and also reported similar results (R. A. Catalano & Bruckner, 2005).

4.4. Methods

4.4.1. Data

This study is based on administrative data from National Vital Statistics, collected by the Hellenic Statistical Authority. The main advantage of our dataset is that it includes all births (838,700 births) over the period 2008-2015 in Greece, and it provides information about birth outcomes, gestational characteristics and parental sociodemographic variables.

In addition to the administrative data, we also rely on publicly available data for the monthly seasonally adjusted ESI (Eurostat, 2018a). In particular, the ESI is a survey-based and composite indicator, and its construction relies on the weighted aggregation of the following confidence indicators: (a) industrial confidence indicator (weight: 40%), (b) service confidence indicator (weight: 30%), (c) consumer confidence indicator (weight:

20%), (d) construction confidence indicator (weight: 5%), and (e) retail trade confidence indicator (weight: 5%) (Eurostat, 2009, 2018a; Silgoner, 2007). Different from other economic variables, the ESI contains information about the current economic climate according to economic agents, and it also incorporates relevant expectations about future trends. Thus, compared to standard measures such as GDP, industrial production, or unemployment rate, the ESI captures relevant economic information more quickly (Gelper & Croux, 2010).

4.4.2. Dependent variable

The main dependent variable is BW (measured in grams), and we also use some additional birth outcomes such as pregnancy length, foetal growth rate and binary indicators for LBW, preterm birth, macrosomia, stillbirth and the probability of maleness in newborns. LBW is an established medical term that refers to newborns who weigh less than 2,500 grams, and fetal growth is defined as BW divided by gestational age (in weeks) (S. E. Black et al., 2007; G. Wehby, Dave, & Kaestner, 2016). In addition, preterm birth occurs when the duration of the pregnancy is less than 37 weeks, while macrosomic babies are those weighing more than 4,000 grams at birth. We include macrosomia as a dependent variable as it is linked to long-term health consequences such as obesity, hypertension and diabetes (Zhang, Decker, Platt, & Kramer, 2008). Lastly, based on a strand of the literature suggesting that exposure to population stressors is associated with reduced odds of male birth (R. A. Catalano, 2003a; R. A. Catalano & Bruckner, 2005), we modeled the probability of male birth to test whether unfavourable economic conditions impacted the sex ratio.

4.4.3. Independent variables

The independent variable of interest is based on a monthly measure of business cycle fluctuations. Using a Hodrick-Prescott (HP) filter of the log-transformed ESI, we construct variables that capture the cyclical component of the ESI for each month of pregnancy (Bozzoli & Quintana-Domeque, 2014). HP filter is an established technique that distinguishes the cyclical component from the smooth trend of a time-series variable (Hodrick & Prescott, 1997), and has been generally used in various empirical studies (Angelini & Mierau, 2014; Avendano, Moustgaard, & Martikainen, 2017; Leist, Hessel, &

Avendano, 2014). In order to select the smoothing parameter of the HP filter, we rely on the approach proposed by Ravn and Uhlig (Ravn & Uhlig, 2002).

We control for three variables (i.e. one for each trimester of pregnancy), since economic fluctuations or other exogenous events may influence birth outcomes differently depending on their occurrence in a trimester of pregnancy (Camacho, 2008; Torche, 2011; Zhu et al., 2010). Each of the three variables corresponds to the average cyclical component of the (a) first, second, and third month of pregnancy (for the first trimester), (b) fourth, fifth, and sixth month of pregnancy (for the second trimester), and (c) seventh, eighth, and ninth month of pregnancy (for the third trimester).

Based on some seminal epidemiological studies for the determinants of birth outcomes (Goldenberg et al., 2008; Kramer, 1987; Parker et al., 1994), we further control for several regressors, such as marital status, maternal age, education, employment, nationality, number of previous children, multiple birth and newborn gender. Lastly, our models contain month-of-birth fixed effects (FE), year-of-birth FE, day-of-week FE and prefecture FE. More details on the variable definition are shown in the Appendix Table C1.

To test the robustness of our results, we use a monthly measure of economic uncertainty (EPU) instead of the ESI. The EPU is compiled from textual analysis of digital archives of major newspapers, and it reflects the frequency of articles with key terms related to the economy, uncertainty and policy (Baker, Bloom, & Davis, 2016). A comprehensive description of the data collection and construction of the Greek version of the EPU can be found in Hardouvelis et al. (2018)[48] (Hardouvelis, Karalas, Karanastasis, & Samartzis, 2018). Recent literature has employed this index to test the impact of economic uncertainty on adult health in the UK (Antonakakis & Gupta, 2017; Vandoros, Avendano, & Kawachi, 2018, 2019). In our case, EPU and ESI are negatively correlated (ρ=-0.38, p-value=0.0001). The negative correlation coefficient is expected since ESI falls while EPU tends to increase as economic activity declines (Hardouvelis et al., 2018). In this context, we test the robustness of our results even after employing an alternative economic indicator, which is only modestly correlated with the ESI.

[48] In constructing this index, Hardouvelis et al. (2018) relied on articles from four major Greek newspapers (i.e. “To Vima”, “Ta Nea”, “Kathimerini”, “Naftemporiki”).

4.4.4 Empirical strategy

The first part of our analysis relies on both linear and non-linear empirical specifications. Our main model is linear, and the regression coefficients are estimated by OLS. The main specification is given by the following expression:

$$BW_{i,m,y,r} = \beta_0 + \beta_1 FTR_{m,y} + \beta_2 STR_{m,y} + \beta_3 TTR_{m,y} + \beta_4 X_i + a_r + \gamma_m + \varphi_y + \varepsilon_{i,m,y,r} \quad (1)$$

where,

$BW_{i,m,y,r}$ denotes the birth weight of an infant *i* who was born at month *m* and year *y* by a mother who lives in a region *r*.

$FTR_{m,y}$ measures the average cyclical component in the first trimester

$STR_{m,y}$ measures the average cyclical component in the second trimester

$TTR_{m,y}$ measures the average cyclical component in the third trimester

X_i is the vector of several sociodemographic, gestational and other variables

a_r is a region FE term

γ_m is a month-of-birth FE term

φ_y is a year-of-birth FE term

$\varepsilon_{i,m,y,r}$ is the error term

We also employ linear regression models using pregnancy length and foetal growth rate as outcome variables, and logistic regression models for the binary indicators (LBW, preterm birth, macrosomia, stillbirth and the probability of maleness in a newborn). In this case, the regression coefficients are estimated by maximum likelihood estimation (MLE).

To examine potential heterogeneity in the relationship between economic conditions during gestation and newborn health indicators, we stratify the sample by parental education, which is a proxy for family socioeconomic status. After stratifying the sample, we then estimate Equation (1) for newborns whose parents have both completed university education (high-SES) and for children of parents with a lower educational level (low-SES).

The potential changes in the cohort composition of women[49] who become pregnant motivate the third part of our analysis (Hypothesis 3), in which we explore whether

[49] There are several methodological issues arising from potential selection into pregnancy. Simply put, there might be changes on the type of women who conceive and give birth (i.e. the composition of pregnant women), associated with the adverse economic conditions.

economic conditions during preconception period are associated with the type of women who actually conceive. In doing so, we define preconception period as the three months prior to the first trimester of pregnancy (Quintana-Domeque & Ródenas-Serrano, 2017). We thus estimate the following model:

$$CHAR_{i,m,y,r} = \delta_0 + \delta_1 PRECONC_{m,y} + a_r + \gamma_m + \varphi_y + u_{i,m,y,r} \quad (2)$$

$CHAR_{i,m,y,r}$ corresponds to parental characteristic (e.g. maternal education, age, nationality, employment status, marital status, total number of births) of a child *i*, who was conceived at month *m* and year *y* by a mother who lives in a region *r*.
$PRECONC_{m,y}$ measures economic conditions in the preconception period.

As pointed out above, the characteristics of mothers who conceive and give birth during recessions might differ from those of mothers who conceive in stable economic periods. In order to examine our last hypothesis and address potential selection into pregnancy, we conduct a propensity score matching (PSM) (R. H. Dehejia & Wahba, 2002; Rosenbaum & Rubin, 1983). PSM aims to construct a control group of untreated observations, which have the similar observable characteristics as those exposed to the treatment (Blundell & Dias, 2000). Using propensity score as the single source of information for the matching process, the main advantage of this technique is that it overcomes the "curse of dimensionality" (Becker & Ichino, 2002; Rosenbaum & Rubin, 1983). In this case, we employ a nearest neighbour algorithm and match each treated observation with an observation from the control group that has the closest propensity score (Caliendo & Kopeinig, 2008; Garrido et al., 2014). This practically implies that each birth of a child exposed in utero to the crisis is paired with the single most similar observation from the comparison group.

We compare the BW of two cohorts: (a) children born before October 2009 (i.e. before the manifestation of the Greek crisis), and (b) children who were conceived before but born after the onset of the crisis (thus, they were exposed to the crisis during the prenatal period). The latter cohort is the treatment group, consisting of children conceived before October 2009 and born after October 2009. In particular, we define this cohort as a treatment group, since the effects of the crisis were not evident and had not fully kicked in at the time of conception (Chrysoloras, 2013; Geanakoplos, 2014; Matsaganis, 2013;

Zettelmeyer et al., 2013). This group of children, however, experienced intrauterine exposure to the economic crisis. Comparing the two cohorts thus allows us to consider selection into pregnancy associated with maternal characteristics (Bozzoli & Quintana-Domeque, 2014).

As indicated above, we assume that the Greek crisis began in October 2009.[50] This is a reasonable assumption if one considers the broader political and social environment in Greece in 2009. First, a large body of academic evidence and policy reports corroborate that the Greek crisis became evident in October 2009 (Geanakoplos, 2014; Gibson, Hall, et al., 2014; Lane, 2012; Provopoulos, 2014; Zettelmeyer et al., 2013). Second, there were no signs of large-scale fiscal consolidation and potential salary cuts until late 2009, and households did not expect or experience substantial changes in their income, employment prospects and living conditions. According to the EU-SILC data, for example, deterioration in average household income and perceived financial difficulties did not occur in 2008 and 2009 (Eurostat, 2019c). Therefore, households did not face significant financial concerns that could affect their fertility decisions at that time. Third, the unemployment rate did not significantly deviate from the historical rates until late 2009, before which it was generally comparable with the corresponding OECD and EU average (OECD, 2019). The trend in sovereign debt yields, which started increasing in late 2009 (see Figure C1 in the Appendix C), provides further evidence for the timing of the crisis onset. We also use other key dates to test the robustness of our results. Instead of October 2009, the alternative dates used were as follows: (a) December 2009, when credit rating agencies downgraded Greek bonds and the government announced several reforms; (b) January 2010, when the government announced a plan to reduce the budget deficit; and (c) April 2010, when the Greek government actually signed the bailout agreement.

4.5. Results

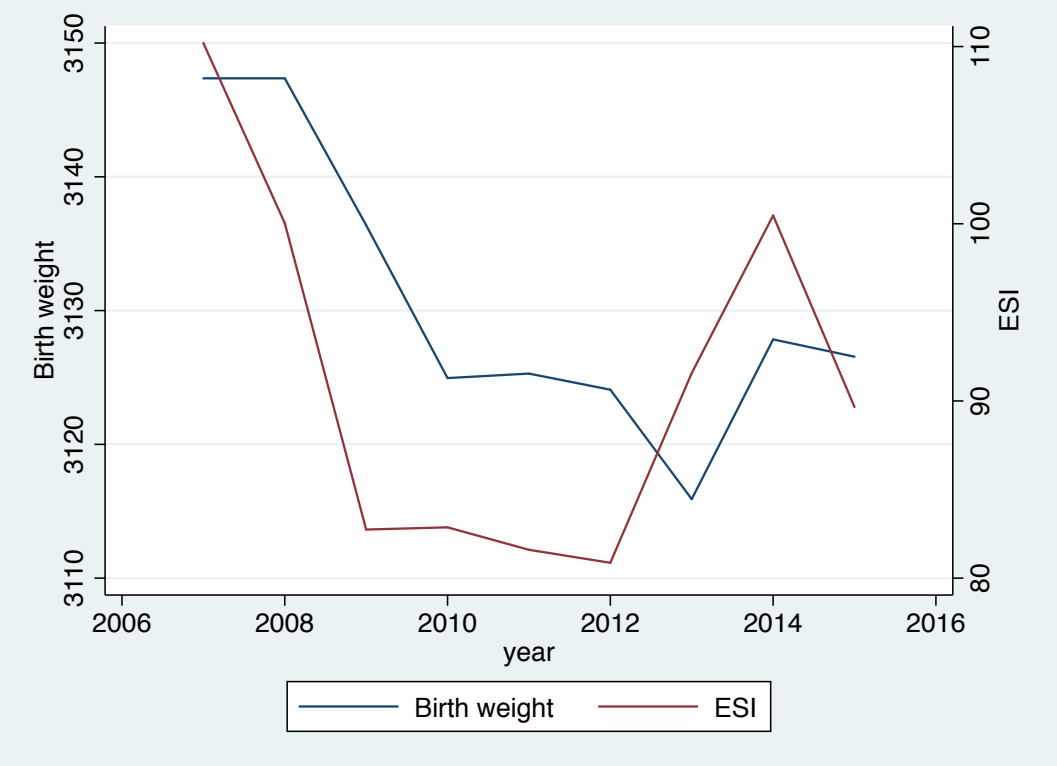
4.5.1. Newborn health and business cycle fluctuations during pregnancy

The ESI sharply dropped during the period of economic crisis, and after some signs of recovery in 2013-2014, it again decreased in 2015 (more details are presented in the Appendix Table C2). In general, the descriptive evidence indicates that BW can be

[50] After the elections in October 2009, the new government announced that Greece faced significant economic problems, and that fiscal deficit was much larger than initially stated by the outgoing government. After this adverse development, the then Prime Minister stated that the Greek economy was in "intensive care". In early December, a credit rating agency downgraded Greece's credit rating from A- to BBB+.

regarded as procyclical. Indeed, the average BW dropped during the period of economic crisis, while some other birth indicators, such as LBW and preterm birth, also deteriorated. From a descriptive perspective, the procyclicality of BW is further documented in Figure 4.1, which essentially presents the evolution of the annual average ESI and the average BW of the newborns born in each year.

Figure 4. 1: Average birth weight and Economic Sentiment Indicator (2008-2015)



Apart from presenting some descriptive evidence, this section explores the relationship between business cycle volatility during the trimesters of gestation and birth outcomes. Therefore, we focus on the cyclical part of the ESI, and examine whether and how business cycle fluctuations are associated with birth outcomes at different trimesters of pregnancy. As explained above, we employ different variables for each trimester of pregnancy, since evidence suggests that intrauterine exposure to adverse or stressful events may affect birth outcomes differently, depending on the stage of gestation (Camacho, 2008; Olafsson, 2016; Torche, 2011).

In this context, Table 4.1 presents the main findings of our analysis. In particular, Model 1 presents the OLS estimates of Equation (1), using BW as a dependent variable. Our analysis shows a strong association between economic conditions in the first and third

pregnancy trimesters and BW, while showing a weaker relationship with fluctuations in the second trimester. We also find a strong negative association between business cycle variation during gestation and the probability of LBW. According to Model 3, the probability of LBW is countercyclical with reference to business cycle variation in the first and third pregnancy trimesters, but this does not apply to economic volatility during the second trimester. For example, a 10% reduction of the detrended ESI (i.e. a 0.1. change in logarithmic scale) during the first trimester of pregnancy would decrease BW by 12.6 grams. Controlling for a variable capturing the economic fluctuations during the whole period of gestation, a similar deterioration of economic conditions during the whole pregnancy period is associated with a BW loss of 22.1 grams and an increase in the probability of LBW by 0.87 percentage points. Similarly, Models 5 and 6 show that the gestational length and the probability of preterm birth are associated with the economic climate during the first and third trimesters; a finding that further validates our initial hypotheses regarding the link between economic fluctuations during gestation and newborn health. Therefore, the results are consistent and suggest that birth outcomes respond to business cycle fluctuations mainly in the first and third trimesters, while the corresponding fluctuations in the second trimester are either weak or insignificant. To provide another example, our estimates suggest that a negative economic fluctuation of 10% would be expected to raise the probability of preterm birth by 1.16 percentage points.

We also perform additional analyses using four alternative birth indicators as dependent variables: the risk of macrosomia, the probability of stillbirth, the probability of male birth and fetal growth rate. In particular, our findings also reveal that business cycle volatility in the first pregnancy trimester is linked with the risk of macrosomia. Although some studies show that economic decline affects the sex ratio, our analysis does not support this finding. We do not find a statistically significant link between economic fluctuations during gestation and the probability of male birth, regardless of the trimester of pregnancy. Last, Model 10 (Table 4.1) shows that business cycle variation in the first and last trimesters is linked with fetal growth rate (i.e. BW divided by gestational age).

As reported by in Table 4.1, boys are, on average, 128 grams heavier than girls. Additionally, children born to married mothers tend to be heavier, and being married is also associated with a lower probability of LBW, preterm birth and stillbirth. Our analysis also reveals that maternal age is negatively associated with BW, and positively linked with the risk of LBW, preterm birth and stillbirth. Further, a socioeconomic gradient in newborn health is also documented, since parental educational attainment generally appears to be a

statistically significant determinant of birth outcomes. Lastly, we show that infants of Greek women are more likely to have LBW and are generally lighter than other children. Although this finding seems counterintuitive, it is consistent with the so-called "healthy migrant effect"[51] (Wingate & Alexander, 2006).

In general, our results are robust across different specifications, and the sensitivity analysis is presented in Table C3 in Appendix C. We also perform a placebo test, and control for economic conditions in the postnatal period, expecting that newborn health does not relate to economic climate in the period after pregnancy. We indeed find that business cycle volatility in the postnatal period is not associated with BW and the risk of LBW (see Columns 2 and 4 in Table 4.1). This finding further strengthens our results regarding the relationship between prenatal economic fluctuations and birth outcomes. Lastly, we estimate Equation (1) using the following: (a) the EPU instead of the ESI (regression estimates are presented in Appendix C, Table C4); (b) the ESI, without employing a HP filter (Table C5 in Appendix C); and (c) a Butterworth filter instead of an HP filter (Angelini & Mierau, 2014; Gómez, 2001) (Table C6 in Appendix C). Our results are robust and consistent, even after changing the measure of the economic climate and detrending technique.

[51] The prevailing explanation for this empirical observation relates to the fact that migrants might be healthier prior to conception. Healthier women -who are more likely migrate and be mobile- are expected to give birth to children with better birth outcomes.

Table 4. 1: Business cycle fluctuations and birth outcomes, 2008-2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BW	BW	LBW	LBW	Pregnancy length	Preterm birth	Macrosomia	Stillbirth	Male	Fetal growth
BC 1st trimester	125.8***	127.6***	-1.066***	-1.059***	0.625***	-0.820***	0.365**	-0.302	0.0479	2.489***
	(22.58)	(24.59)	(0.212)	(0.216)	(0.116)	(0.247)	(0.178)	(0.638)	(0.0615)	(0.545)
BC 2nd trimester	42.95**	38.87*	0.00522	-0.0108	0.110	-0.229	0.428	-1.221**	0.0730	0.665
	(17.76)	(19.82)	(0.190)	(0.200)	(0.0951)	(0.213)	(0.261)	(0.594)	(0.0823)	(0.402)
BC 3rd trimester	60.28***	63.97***	-0.505***	-0.490***	0.548***	-0.541***	0.142	-0.192	0.00259	0.889**
	(14.84)	(17.29)	(0.140)	(0.134)	(0.0872)	(0.181)	(0.190)	(0.743)	(0.0664)	(0.341)
BC 9 months after birth		-10.29		-0.0415						
		(19.05)		(0.115)						
Married	98.43***	98.42***	-0.558***	-0.558***	0.188***	-0.451***	0.235***	-0.757***	0.0313***	2.285***
	(6.588)	(6.592)	(0.0205)	(0.0205)	(0.0220)	(0.0285)	(0.0658)	(0.0461)	(0.0104)	(0.136)
25-29	-3.099	-3.094	0.0833***	0.0833***	-0.0757***	0.0177	0.100***	0.0936	-0.00307	0.0503
	(2.989)	(2.989)	(0.0198)	(0.0198)	(0.0117)	(0.0203)	(0.0276)	(0.0716)	(0.00925)	(0.0686)
30-34	-20.76***	-20.76***	0.209***	0.209***	-0.214***	0.155***	0.0658**	0.149**	-0.00999	-0.135
	(3.535)	(3.536)	(0.0226)	(0.0226)	(0.0141)	(0.0179)	(0.0286)	(0.0718)	(0.00891)	(0.0828)
35-39	-45.99***	-45.99***	0.377***	0.377***	-0.383***	0.356***	0.0216	0.444***	-0.00742	-0.466***
	(3.382)	(3.382)	(0.0240)	(0.0240)	(0.0177)	(0.0230)	(0.0275)	(0.0668)	(0.0101)	(0.0827)
Over 40	-120.9***	-120.9***	0.745***	0.745***	-0.699***	0.752***	-0.181***	0.681***	-0.0262***	-1.860***
	(3.931)	(3.932)	(0.0242)	(0.0242)	(0.0254)	(0.0253)	(0.0548)	(0.0804)	(0.0101)	(0.0966)
Lower secondary education	27.26***	27.27***	-0.151***	-0.151***	0.0349*	-0.197***	0.101***	-0.0894	-0.00410	0.642***
	(5.287)	(5.289)	(0.0330)	(0.0330)	(0.0193)	(0.0341)	(0.0309)	(0.0656)	(0.00984)	(0.122)
Upper secondary education	43.61***	43.61***	-0.323***	-0.323***	0.0121	-0.228***	0.0869***	-0.237***	-0.00652	1.142***
	(5.748)	(5.748)	(0.0361)	(0.0361)	(0.0252)	(0.0331)	(0.0329)	(0.0718)	(0.00910)	(0.125)
University education	67.88***	67.89***	-0.460***	-0.460***	0.0651*	-0.316***	0.104***	-0.568***	0.00129	1.676***
	(5.147)	(5.150)	(0.0344)	(0.0344)	(0.0355)	(0.0433)	(0.0269)	(0.0849)	(0.0106)	(0.117)
Total children	19.85***	19.85***	-0.132***	-0.132***	-0.0718***	0.00475	0.116***	-0.0129	0.00335	0.698***
	(1.901)	(1.901)	(0.0125)	(0.0125)	(0.00607)	(0.00763)	(0.0121)	(0.0295)	(0.00288)	(0.0539)
Multiple birth	-958.3***	-958.3***	3.639***	3.639***	-3.015***	3.160***	-4.900***	1.539***	-0.0556***	-20.50***

	(4.245)	(4.243)	(0.0171)	(0.0171)	(0.0360)	(0.0236)	(0.374)	(0.0480)	(0.0104)	(0.0829)
Male	128.2***	128.2***	-0.330***	-0.330***	-0.0421***	0.0709***	0.818***	0.131***		3.422***
	(1.776)	(1.775)	(0.00985)	(0.00985)	(0.00421)	(0.00657)	(0.0162)	(0.0421)		(0.0530)
Greek nationality	-118.0***	-118.0***	0.395***	0.395***	-0.276***	0.284***	-0.645***	-0.101	-0.0188***	-2.495***
	(3.409)	(3.410)	(0.0273)	(0.0273)	(0.0323)	(0.0318)	(0.0239)	(0.0828)	(0.00574)	(0.128)
Employment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,031***	3,030***	-1.786***	-1.788***	38.502***	-1.897***	-3.950***	-4.603***	0.0615***	78.28***
	(7.940)	(8.229)	(0.0670)	(0.0682)	(0.0758)	(0.0885)	(0.0699)	(0.144)	(0.0153)	(0.270)
Observations	800,970	800,970	800,970	800,970	805,105	805,105	800,970	810,410	807,244	799,668
R-squared	0.189	0.189			0.171					0.161

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

4.5.2. Heterogeneity across socioeconomic groups

The second hypothesis of this study examines potential heterogeneity in the relationship between business cycle variation during pregnancy and newborn health, depending on socioeconomic status. In doing so, we split our sample by parental educational level, which is a proxy for socioeconomic status. We thus estimate Equation (1) for a group of children whose parents have both completed university education (i.e. children born to high-SES families), and for a group of children whose both parents have attended up to upper secondary education.

According to Table 4.2, the BW of children born to low-SES families is responsive to economic volatility during the first and third trimesters. As shown in Columns 1 and 3, we do not report similar findings for babies born to high-SES families. Only first-trimester economic conditions matter for the BW of children born to high-SES families (significant at a 10% level). Again, using education as a proxy for socioeconomic status, our findings for the probability of LBW infants born to low- and high-SES families are similar (Columns 3 and 7 in Table 4.2). Additionally, as shown in Appendix Tables C7 and C8, our results are robust after using different indicators of economic climate and detrending techniques. Using the EPU as an indicator of economic uncertainty and conditions, for example, we find that BW of children born to low-SES families is responsive to business cycle variation in the first and third pregnancy trimesters, whereas only first-trimester economic climate matter for the BW of newborns of higher socioeconomic groups.

Table 4. 2: Business cycle fluctuations and birth outcomes, by parental education

	High-SES				Low-SES			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	BW	BW	LBW	LBW	BW	BW	LBW	LBW
BC 1st trimester	79.35*	78.45*	-0.841**	-0.799**	180.1***	184.7***	-1.370***	-1.378***
	(40.96)	(39.89)	(0.357)	(0.359)	(28.44)	(30.71)	(0.241)	(0.244)
BC 2nd trimester	46.47	48.76	0.151	0.0416	20.57	11.04	-0.00413	0.0134
	(42.59)	(45.91)	(0.367)	(0.390)	(27.05)	(24.68)	(0.218)	(0.215)
BC 3rd trimester	35.48	33.72	-0.222	-0.132	109.6***	119.1***	-0.751***	-0.769***
	(41.53)	(40.47)	(0.383)	(0.374)	(20.12)	(24.09)	(0.217)	(0.230)
BC 9 months after birth		6.054		-0.293		-22.93		0.0437
		(32.80)		(0.248)		(24.79)		(0.169)
Married	27.49**	27.47**	-0.315***	-0.315***	65.43***	65.47***	-0.399***	-0.399***
	(11.46)	(11.44)	(0.104)	(0.104)	(10.42)	(10.42)	(0.0708)	(0.0708)
25-29	-6.699	-6.703	0.0297	0.0299	2.060	2.072	0.0175	0.0175
	(11.79)	(11.80)	(0.103)	(0.103)	(3.733)	(3.731)	(0.0264)	(0.0264)
30-34	-30.40***	-30.40***	0.166*	0.167*	-15.65***	-15.65***	0.158***	0.158***
	(10.41)	(10.41)	(0.0978)	(0.0977)	(4.262)	(4.262)	(0.0308)	(0.0308)
35-39	-62.09***	-62.09***	0.350***	0.350***	-39.99***	-39.98***	0.322***	0.322***
	(10.84)	(10.84)	(0.0900)	(0.0899)	(4.676)	(4.675)	(0.0329)	(0.0329)
Over 40	-146.6***	-146.6***	0.804***	0.805***	-115.8***	-115.8***	0.695***	0.695***
	(11.28)	(11.29)	(0.101)	(0.101)	(5.039)	(5.038)	(0.0379)	(0.0379)
Total children	39.66***	39.66***	-0.281***	-0.281***	14.13***	14.12***	-0.0940***	-0.0940***
	(1.582)	(1.585)	(0.0182)	(0.0182)	(2.156)	(2.156)	(0.0162)	(0.0162)
Multiple birth	-969.4***	-969.4***	3.838***	3.838***	-948.5***	-948.5***	3.566***	3.566***
	(4.840)	(4.843)	(0.0225)	(0.0225)	(5.260)	(5.261)	(0.0232)	(0.0232)
Male	130.4***	130.4***	-0.366***	-0.366***	129.1***	129.1***	-0.337***	-0.337***
	(3.845)	(3.849)	(0.0204)	(0.0205)	(1.264)	(1.264)	(0.0105)	(0.0105)
Greek nationality	-63.42***	-63.42***	0.136**	0.136**	-116.8***	-116.8***	0.347***	0.348***
	(5.783)	(5.783)	(0.0689)	(0.0689)	(3.404)	(3.404)	(0.0232)	(0.0232)
Employment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,104***	3,104***	-1.996***	-2.007***	3,094***	3,093***	-2.101***	-2.098***
	(19.41)	(19.03)	(0.223)	(0.225)	(13.51)	(13.67)	(0.0862)	(0.0891)
Observations	156,794	156,794	156,794	156,794	438,889	438,889	438,889	438,889
R-squared	0.236	0.236			0.177	0.177		

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

4.5.3. Economic conditions and fertility decisions across population groups

We next investigate whether economic conditions during preconception period are associated with maternal characteristics of women who give birth (i.e. the type of women who conceive). In doing so, we define preconception period as the three months prior to the first pregnancy trimester (Margerison-Zilko, 2014; Quintana-Domeque & Ródenas-Serrano, 2017), and estimate Equation (2). This analysis allows us to identify potential changes in the cohort composition of mothers who conceive.

Table 4. 3: Economic fluctuations during preconception period and parental characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
	Married	Maternal age	Greek	High educated	Number of children	Out of labour market
BC (preconception period)	-0.284**	0.212	-0.0721	-0.206**	0.289***	0.172**
	(0.127)	(0.180)	(0.103)	(0.0998)	(0.0731)	(0.0840)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant cut1					0.132***	
					(0.0201)	
Constant cut2					1.992***	
					(0.0384)	
Constant cut3					3.490***	
					(0.0577)	
Constant	2.942***	31.64***	1.248***	-0.856***		-0.811***
	(0.0242)	(0.0417)	(0.0199)	(0.0360)		(0.0240)
Observations	835,364	835,364	835,364	807,244	835,364	835,364
R-squared		0.045				

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

According to Table 4.3, there is a negative association between economic fluctuations during preconception period and the probability that women who conceive are married. This implies that the deterioration of economic climate is associated with a

greater probability that those who are getting pregnant are married. Given that being married is positively linked with BW, economic adversity induces a kind of positive selection into pregnancy. In the same vein, our analysis shows that women who conceive during periods of economic adversity are more likely to be better-educated. In contrast, we do not obtain evidence for a relationship between business cycle fluctuations during preconception period and maternal age, or the probability that pregnant women are Greek.

4.5.4. Addressing selection issues

As shown above, economic recession influences fertility decision differently across population groups, giving rise to changes in the cohort of women who give birth. In other words, women who conceive during recessions appear to have different characteristics than women who conceive during periods of economic normality. To address this issue, we employ a PSM analysis and compare the BW of two specific cohorts of children, as described in the Methods section. We compare the cohort of children born before October of 2009 with children who were conceived before but born after October 2009 (i.e. children born between October 2009 and June 2010). The latter cohort was thus exposed to the economic crisis during the prenatal period, but their mothers could not have expected the extent and severity of the recession when they conceived.

Table 4.4 (Panel A) shows that BW dropped by 12 grams following the economic crisis. After splitting the sample by parental socioeconomic position, we find that BW decreased by approximately 18 grams for children of lower socioeconomic background, whereas the treatment effect for babies in more privileged families is not statistically significant. We also employ an alternative matching process and show that the results are very similar (see Panel B in Table 4.3); the BW loss amounted to 11 grams, with the effect being almost 18 grams for the low-SES infants and insignificant for their high-SES counterparts.

Table 4. 4: Propensity score matching analysis for the impact of economic crisis on BW

Panel A: NN 1:1 with replacement			
Group	**ATT**	**Standard error**	**t -statistic**
Total	-12.0***	2.28	-5.26
Low-SES	-17.6***	2.92	-6.03
High SES	-0.8	5.56	-0.14
Panel B: NN 3:1 with replacement			
Group	**ATT**	**Standard error**	**t -statistic**
Total	-11.1***	2.25	-4.94
Low-SES	-17.8***	2.89	-6.17
High SES	4.3	5.50	0.79

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

Apart from the baseline estimates, we conduct robustness checks using alternative key dates: (a) December 2009, when credit rating agencies downgraded Greek bonds and the government announced several reforms, (b) January 2010, when the government announced a plan to reduce the budget deficit; and (c) April 2010, when the Greek government actually signed the bailout agreement.

Table 4.5 shows the additional estimates, derived from our robustness checks. According to the first scenario, for example, the BW loss ranges between 18 and 19 grams, and is greater among children born to lower-SES families. Similar to the baseline estimates, the corresponding change in BW following the economic crisis is not statistically significant among the high-SES newborns. According to Table 4.4, the BW loss from the economic crisis ranges between 18.4 and 21.9 grams. The corresponding loss for children born to low-SES families is greater: between 22.1 and 26.5 grams. Lastly, these results confirm our baseline findings for children born to high-SES families.

Table 4. 5: Propensity score matching analysis for the impact of economic crisis on BW (robustness checks)

Panel A: NN 1:1 with replacement									
	December 2009			**January 2010**			**April 2010**		
	ATT	**Standard error**	**t -statistic**	**ATT**	**Standard error**	**t -statistic**	**ATT**	**Standard error**	**t -statistic**
Total	-19.1***	2.25	-7.11	-18.7***	2.22	-8.40	-21.9***	2.19	-9.97
Low-SES	-22.1***	2.89	-7.65	-22.8***	2.85	-8.00	-25.0***	2.83	-8.81
High SES	-6.8	5.45	-1.24	-6.1	5.35	-1.13	-7.9	5.25	-1.51
Panel B: NN 3:1 with replacement									
	December 2009			**January 2010**			**April 2010**		
	ATT	**Standard error**	**t -statistic**	**ATT**	**Standard error**	**t -statistic**	**ATT**	**Standard error**	**t -statistic**
Total	-18.4***	2.22	-8.30	-18.8***	2.19	-8.60	-21.5***	2.16	-9.95
Low-SES	-22.1***	2.86	-7.74	-23.2***	2.82	-8.21	-26.5***	2.80	-9.46
High SES	-4.5	5.40	-0.84	-6.0	5.29	-1.13	-9.2*	5.20	-1.77

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

4.6. Discussion

During the last years, the health effects of the Greek crisis attracted much interest and triggered a vigorous debate in the public health community, mainly due to the intense and prolonged economic recession. Despite the growing evidence regarding the health effects of recession in Greece and other European countries, the findings are "still unclear and fragmented", while the existing empirical work has not adequately addressed several types of bias[52] (Parmar et al., 2016).

Our analysis employs a large administrative dataset for 838,700 births (i.e. all deliveries during the study period in Greece), and focuses on newborn health. Apart from serving as health indicators, birth outcomes can also be regarded as inputs in a health production function that approximates the initial endowment of "human health capital". The variables we examine are individual-level health indicators, but contrary to most variables used in previous micro-level studies (e.g. self-reported health indicators) they do not suffer from measurement error.

The first hypothesis examines the association between economic fluctuations and birth outcomes, which can be mainly explained by two main mechanisms. First, economic distress changes the quantity and quality of maternal nutrition, which in turn affects intrauterine growth (Bernabé et al., 2004). In households experiencing financial constraints, maternal access to nutritious food may be compromised, resulting in food insecurity during pregnancy (Brinkman et al., 2010; Studdert et al., 2001). Second, economic recession and financial difficulties lead to increased psychosocial stress and depression, which can also precipitate LBW (Hedegaard et al., 1996).

A strand of the literature maintains that these mechanisms change with gestational stage. In particular, BW is particularly sensitive to nutrition and dietary changes during the third trimester of pregnancy (Almond, Hoynes, & Schanzenbach, 2011; Stein & Lumey, 2000). For instance, Almond et al. (2011) showed that children whose mothers were exposed to a food stamp programme in the third pregnancy trimester had greater levels of BW. Apart from nutrition, BW has also been found to be responsive to maternal stress, especially when the stress appears early in the pregnancy (Camacho, 2008; Paarlberg et al., 1999; Torche, 2011). In this context, the finding that BW responds to economic volatility

[52] Several types of bias potentially threaten the robustness of the findings from a methodological perspective. Parmar et al. (2016) identified the following types of bias in the existing literature regarding health effects of economic crisis in Europe: confounding bias, measurement error in exposure variable, time bias, ecological fallacy, selection bias and sample representativeness and measurement error in dependent variable.

in the first and third trimesters of gestation could reflect the influence of psychosocial stress and maternal nutrition respectively.

Our results are consistent with a study on Argentina's crisis in the early 2000s (Bozzoli & Quintana-Domeque, 2014), but not with evidence for the 2008 financial collapse in Iceland (Eiríksdóttir et al., 2013). In Iceland, babies exposed to the financial collapse during the first trimester tended to be lighter; this was not the case for those exposed in other trimesters. This may be because the short-term economic slowdown in Iceland did not precipitate changes in maternal nutrition, which would have been reflected in the BW of the children exposed in the third trimester (Olafsson, 2016).

We also focus on some additional perinatal outcomes. For instance, there is strong evidence for an association between first- and third-trimester economic conditions and pregnancy length and foetal growth. Likewise, economic contraction during these trimesters raises the risk of preterm birth. Contrary to some studies providing evidence that the secondary sex ratio falls during periods of economic contraction (R. A. Catalano, 2003a; R. A. Catalano & Bruckner, 2005), our findings suggest that business cycle volatility during pregnancy is not associated with the probability of having a male child.

After splitting the sample by SES, we test our second hypothesis and show that business cycle variation during the first and last trimesters of gestation matter for the BW and the risk of LBW in children born to low-SES households. However, this is not the case for the BW of newborns in high-SES families, which is only responsive to the first-trimester economic volatility. This difference could be attributed to nutritional deprivation, which mostly affects low-SES households. In contrast, privileged households are able to smooth consumption and are not expected to suffer from food insecurity during economic recession (Bozzoli & Quintana-Domeque, 2014). On the other hand, low-SES households tend to experience more severe financial challenges during economic recessions, which could influence nutritional habits and compromise the quantity and quality of food (Bonaccio et al., 2017; Brinkman et al., 2010). In Greece, recent data show that more than half of poor households cannot afford to consume meat, chicken, fish or nutrionally equivalent vegetables. For the non-poor households, the corresponding percentage was only 1.8% (Hellenic Statistical Authority, 2017).

This analysis also finds that business cycle volatility during the first trimester is associated with LBW for infants in both lower and higher SES groups. This result could be attributed to the pyschosocial stress from economic volatility that appears to affect both socioeconomic groups. Nonetheless, it seems that the impact is – again - much stronger for

the children of lower socioeconomic background. In general, the effects of economic downturns on stress and mental health tend to be more detrimental among lower socioeconomic groups (R. A. Catalano & Bruckner, 2005; Hauksdottir et al., 2013; World Health Organization, 2011), having potential implications for newborn health. This potentially explains why the BW of low-SES newborns is more responsive to first-trimester economic conditions than that of their high-SES counterparts.

As explained in the third hypothesis of this study, fertility tends to decline during economic recessions due to financial hardship and increased uncertainty (Cherlin, Cumberworth, Morgan, & Wimer, 2013; Schneider, 2015). What is interesting, however, is that business cycle volatility might influence the fertility decisions differently across population groups, having potential implications for the cohort composition of women who get pregnant (Chevalier & Marie, 2017). For example, a study showed that Black mothers were likely to have a higher socioeconomic status during economic downturns, while they found the opposite in the case of White mothers (R. Dehejia & Lleras-Muney, 2004). Our findings reveal that economic adversity during the preconception period increases the probability that women who conceive are better-educated. Likewise, we show that economic downturn during the preconception period decreases the probability that women who conceive are economically inactive (i.e. out of the labour market, e.g. as students, housewives, retired or unemployed). There are several potential interpretations for these findings. Low-SES families may have experienced credit constraints and significant losses in their already low income, and may thus be unable to afford the costs of childbearing (Schneider & Hastings, 2015). They also have fewer savings and financial reserves to cope with the shock associated with income loss (Lusardi et al., 2011). Indeed, a strand of the literature suggests that financial security is probably the most significant factor influencing conception and timing of childbearing (Roberts, Metcalfe, Jack, & Tough, 2011; Tough, Benzies, Fraser-Lee, Newburn-Cook, & Newburn-Cook, 2007). On the other hand, some studies suggest that family formation and fertility decisions do not merely depend on household financial situation, and they do not report evidence of fertility drop among disadvantaged women (Edin & Reed, 2005; Gibson-Davis, 2009). These findings could potentially be explained on the basis of the opportunity costs of childbearing.[53] Besides,

[53] In particular, high-SES women may face greater opportunity costs of childbearing, given they earn higher wages. Therefore, they may have incentives to increase their labour market attachment under the fear of unemployment and avoid childbearing during economic recessions. On the contrary, low-SES women have lower probability of having or finding a good job during economic downturn, a fact that reduces the opportunity cost of childbearing. According to this approach, the opportunity costs of having children

low-SES women may structure their lives around childbearing, especially in a recessionary environment with fewer opportunities for social mobility and career development (Schneider & Hastings, 2015; Sobotka et al., 2011). In any case, our findings strongly support the notion that economic contraction during preconception period increases the probability that women who conceive tend to have higher socioeconomic status.

In our fourth hypothesis, we employ a PSM and address potential selection issues by comparing two cohorts: children born before October 2009, and children who were conceived before but born after October 2009. In this context, the expected impact of correcting for selection is to find larger effect estimates.

Our findings suggest that newborns exposed to the crisis while in utero tend to be lighter; this is mostly driven by infants in low-SES families. In particular, the estimated BW loss for the children born to low-SES parents is greater, whereas the corresponding loss for newborns in high-SES families is insignificant. We thus document that although mothers who conceive and give birth during recession tend to have higher SES and are more likely to be married, the negative impact of recession exceeds and outweighs the effects induced by positive selection into motherhood.

The estimated effect is not negligible. Among children born to low-SES families, the BW loss associated with the economic crisis is 18-27 grams, whereas the BW loss for all newborns is 12-22 grams. To put this in context, we benchmark these findings against the impact of other stressors and risk factors on BW. For instance, Camacho (2008) found that stress from landmine explosions in Colombia led to a significant decline in BW that approximated 8.7 grams. Another study showed that infants exposed to ten or more bomb casualties in the early months of pregnancy tended to be approximately 10 grams lighter (Quintana-Domeque & Ródenas-Serrano, 2017). The estimated BW effects from prenatal exposure to terrorist attacks ranged between 5 and 15 grams (R. Brown, 2014), while another study found a slightly larger BW loss of 8-19 grams (Eccleston, 2011). Intrauterine exposure to floods was associated with a BW loss of 17.9 grams, which was the greatest BW loss associated with various natural disasters (Simeonova, 2011). Our estimated BW loss is similar to the BW loss associated with family bereavement in Sweden (11 grams) (Persson & Rossin-Slater, 2016), but it is half of the BW loss associated with bereavement in Norway (Sandra E Black, Devereux, & Salvanes, 2016). Several studies have also

directly relates to the value of parental time, which is largely determined by wage (Friedman, Hechter, & Kanazawa, 1994). Contrary to some empirical evidence (including our findings) this approach suggests that low-SES women may increase their fertility during periods of economic adversity (Sobotka et al., 2011).

examined the effects of maternal smoking on BW. For example one study found that smoking reduces BW by 57 grams (Tominey, 2007), while other studies showed a larger BW loss, approximating 100 grams (Abrevaya, 2006; Wüst, 2010). Thus, the estimated impact of economic crisis on BW is approximately 10–20% that of maternal smoking. This effect is much greater for the children born to low-SES families.

Compared to other major economic crises, the estimated BW loss is quite moderate. Evidence from Argentina suggests that the BW loss associated with the 2001 crisis approximated 30 grams (Bozzoli & Quintana-Domeque, 2014). Additionally, children exposed to the collapse of the Icelandic economy in 2008 during the first pregnancy trimester were approximately 66 grams lighter (Olafsson, 2016). However, the exposure to the collapse during the second and third pregnancy trimesters did not affect infants' BW.

Several policy implications emanate from our findings. In terms of equality of opportunity, children born to low-SES parents are at a disadvantage, since family background is associated with several future outcomes, such as educational attainment and earnings (Ermisch & Francesconi, 2001; Jerrim, 2015). Based on our findings, they also have poorer birth outcomes, a fact that further intensifies their socioeconomic disadvantage. On top of that, children born to low-SES families are more severely hit by the crisis, and their health appears to be more sensitive to business cycle volatility. Thus, low-SES children are born with a poor initial endowment that deteriorates even further in the presence of economic recession.

Hence, the effects of economic crisis on birth outcomes are relatively more detrimental for the children of poorer families, resulting is a widening of the BW gap between infants of lower and higher socioeconomic groups. This could in turn exacerbate future socioeconomic and health inequalities and hinder social mobility as a result of the long-term impact of poor birth outcomes on adult health status, educational attainment, labour market outcomes and earnings (S. E. Black et al., 2007). Conley and Bennett (2000) have aptly described the aforementioned phenomena as "an intergenerational loop of social inequality and low birth weight" that incorporates biological aspects into the discussion on the intergenerational transmission of poverty (Conley & Bennett, 2000).

A potential policy response to address socioeconomic disparities in newborn health, reduce the differential impact of the economic crisis on birth outcomes and prevent the long-term effects on adult outcomes could focus on improving the nutritional status of the most vulnerable prospective mothers. For example, the state could introduce a targeted

programme that provides or subsidizes specific nutrients and healthy foods (e.g. through vouchers), contributes to nutritional education, and aims at improving pregnant women's nutritional habits and healthy behaviours. Empirical evidence from similar programmes suggests that such initiatives are generally successful in improving newborn health indicators[54] (Bitler & Currie, 2005; El-Bastawissi, Peters, Sasseen, Bell, & Manolopoulos, 2007; Hoynes, Page, & Stevens, 2011; Kowaleski-Jones & Duncan, 2002).

Our study has some limitations. First, we do not know the extent to which each mother has been exposed to the adverse effects of the crisis. This is a common limitation in studies that have examined the effects of exogenous wide-scale events on birth outcomes (Carlson, 2015; Quintana-Domeque & Ródenas-Serrano, 2017). Unlike bereavement, for example, economic crisis is not a stressor in and of itself. Therefore, we rely on economic climate indicators during pregnancy to carry out our assessment. Second, similar to most studies using administrative data, we do not control for mode of delivery, health behaviours, or prenatal care utilization due to data limitations. This might not be a serious problem, however, since all pregnant women in Greece have free access to a comprehensive programme of prenatal care. Third, a richer dataset would allow us to investigate the impact of economic fluctuations on additional birth indicators, such as neonatal diseases, Apgar scores, and congenital malformations. Fourth, there might be price and compositional effects during the crisis, which cannot be identified and tested due to data availability constraints. Last, our study particularly examines the Greek recession. Generally speaking, the health effects of recessions may differ depending on the country context, extent and severity of the recession, and protective role of the welfare state (De Vogli, 2014; Suhrcke & Stuckler, 2012; Toffolutti & Suhrcke, 2014). Hence, our findings should be interpreted with caution and discussed along with evidence from other countries, especially when drawing generalised conclusions about the effects of recession on newborn health.

[54] For instance, participation to the WIC programme is associated with increased BW and a reduction in the share of LBW (Bitler & Currie, 2005; El-Bastawissi et al., 2007; Hoynes et al., 2011; Kowaleski-Jones & Duncan, 2002). Likewise, another study showed that enrolment to a Food Stamp Programme during pregnancy was associated with increased BW in the USA, and the effects was much greater for the children born to the most vulnerable families (Almond et al., 2011). Apart from health benefits, evidence suggests that such programmes generate substantial savings during the first 60 days after pregnancy, exceeding the corresponding costs (Avruch & Cackley, 1995; Devaney, Bilheimer, & Schore, 1992).

4.7. Conclusion

Many studies have explored the effects of the recent crisis on adult health but not on newborn health. Considering the recession's effects on newborn health in Greece is particularly interesting, mainly because of the unprecedented duration and intensity of the Greek economic crisis. The National Vital Statistics provide a comprehensive dataset with individual-level information about objective indicators of newborn health. This data serves as the basis of our study and has allowed us to contribute to the literature on the health consequences of the European crisis. We find that economic uncertainty and conditions during pregnancy are associated with newborn health indicators. In particular, the risk of LBW and preterm birth is countercyclical with reference to business cycle volatility in the first and third trimesters of gestation. Our analysis also reveals heterogeneity in the association between prenatal economic conditions and birth outcomes across socioeconomic groups. Birth indicators of lower-SES children are responsive to economic conditions during the first and third trimesters of gestation, whereas those of higher-SES newborns respond to economic volatility only in the first trimester. Our findings further suggest that economic climate also influences fertility decision differently across different population groups. For example, women who conceive and give birth during recession tend to have higher SES and are more likely to be married. To account for selection into motherhood, we employ a PSM and find that, during pregnancy, maternal exposure to economic crisis is linked with a BW loss that is driven by the low-SES children. The estimated BW loss is not statistically significant for children of high-SES families. Therefore, in addition to the socioeconomic gradient in newborn health, there is also a clear socioeconomic differential in the impact of economic recession on newborn health. In other words, children born to low-SES families were hit more severely by the recent economic recession, and they bear greater health costs. These findings have social policy implications, as they suggest the possibility of widening health and socioeonomic inequalities over time, in light of the nexus between newborn health and future health and socioeconomic outcomes.

Chapter 5

Conclusions

The consequences of the recent recession on the core dimensions of health system performance have attracted much interest across European countries during the last years (Thomson et al., 2014). Indeed, the effect of the recent economic crisis has been generally characterized as a "health system shock" (Mladovsky et al., 2012) with subsequent consequences for health system performance, population health, and the demand for and supply of health care. In this context, the health policy responses in Europe were quite heterogeneous, reflecting not only the variation in the severity and duration of the economic recession but also the different public policy priorities across European countries (Karanikolos et al., 2013; Maresso et al., 2014).

The Greek crisis is a particularly interesting case study from both a macroeconomic and health system perspective. First, it is possibly the most severe and prolonged economic downturn among developed countries in the post-war period, with the GDP loss exceeding 25% over the last decade (Andriopoulou et al., 2017; Meghir et al., 2017). Second, and in contrast to the other European countries that eventually graduated from their adjustment programmes, Greece signed three successive EAPs, all of which were characterized by strict fiscal adjustment and substantial conditionality (Pagoulatos, 2018). In particular, the cyclically adjusted fiscal consolidation accounted for more than 20% of potential GDP during 2009-2016 (Giannitsis & Zografakis, 2018; Tsakloglou, 2019), resulting in the largest and fastest economic adjustment in the OECD. Third, the economic crisis brought about wide and unprecedented social effects (OECD, 2014). Consistently higher than 20% until 2017, the unemployment rate reached 27.5%, with almost three out of four of unemployed persons being long-term unemployed. Additionally, various social indicators (e.g. poverty rate, material deprivation rate) dramatically deteriorated (Hellenic Statistical Authority, 2017; Kaplanoglou & Rapanos, 2016). Last, Greece implemented a number of policy responses and fiscal retrenchment in health care, with various implications for the health sector and for some core dimensions of health system performance (Economou et al., 2014).

This thesis comprises of three studies regarding the impact of the Greek crisis on the health sector, aiming to provide evidence and answers to policy-relevant topics, with a

particular focus on the responses to and implications of the crisis across different socioeconomic groups. As shown in Figure 1.3, Chapter 2 sheds light on decision-making and the relevant responses to the crisis with regard to HHE and demand for health care. It thus explores how household spending behaviour towards health care has changed across different household types and socioeconomic groups in the face of an economic shock and the relevant health policy responses. Focusing on the heavy users of health services, Chapter 3 concentrates on the potential implications of the crisis in terms of financial protection, and elaborates on the extent to which financial protection against OOPE has changed among older households during the Greek crisis. The objective of Chapter 4 is twofold. It first examines how economic climate influences fertility decisions and responses across population groups. Further, it studies the relationship between economic conditions and uncertainty during pregnancy and newborn health in different socioeconomic groups, testing whether inequalities in birth outcomes have increased during the economic crisis.

5.1. Summary and contribution of the studies

5.1.1. Household responses and spending behaviour towards health care

In light of an unprecedented economic crisis and a large-scale fiscal adjustment, the Greek households experienced the "triple hit" of public budget cuts, increased user charges, and lower disposable income and household purchasing power. In Chapter 2, the analysis of how households behaved in the face of this economic shock (and the associated "triple hit") reveals that the introduction of the EAP is associated with a lower probability of spending on health care and lower HHE. Further, we show that the introduction of the EAP modifies the association between income and HHE. Consistent with the evidence from micro-level studies (Getzen, 2000), we show that the income elasticity of HHE is below unity, demonstrating that health care is a technical necessity. In other words, HHE increases (decreases) less than proportionally in response to an income increase (decrease). This finding implies that household spending for health care is not a voluntary, discretionary and deliberate choice (Lépine, 2015). Instead, it is incurred either due to health shocks and poor health or as households' response to improving access to health services within a fragmented health system that does not ensure the accessible and timely provision of high-quality care (Davaki & Mossialos, 2005; Economou et al., 2017).

Our analysis reveals a statistically significant increase in the income elasticity of

HHE between the pre- and post-EAP periods, suggesting that Greek households exhibit greater consumption responses to changes in their income during the post-EAP period. We also show that a proportionally similar change in income is associated with a higher change in the probability of incurring HHE in the post-EAP period (relative to the pre-EAP period). These findings show that households' decisions to spend on health care as well as the level of HHE became more sensitive to income changes after the introduction of the EAP, and imply a change in household behaviour towards health care. OOPE for health care is more elastic and is generally considered to be less "necessary" in the post-EAP period. This can be interpreted from a theoretical perspective, considering that households are expected to reduce unnecessary use of health services and non-essential payments due to financial distress (Yang et al., 2001), while some patients may shift to public services aiming to avoid OOPE (H. Waters et al., 2003a; Yang et al., 2001).

In examining the second hypothesis of this study, we concentrate on different household types, and confirm that HHE is income inelastic regardless of socioeconomic status or degree of vulnerability. However, there are heterogeneous responses of HHE to income changes across different household types, with the HHE of lower SES households being relatively less income elastic. Therefore, lower socioeconomic groups exhibit lower flexibility in HHE as income changes than higher SES households. The heterogeneous consumption responses to income changes can possibly be attributed to the different composition of medical goods and services consumed by each household type and their relative costs. For example, the payments for some health care goods and services (e.g. cost-sharing for pharmaceuticals) cannot be easily avoided or substituted by shifting to the public sector. In addition, this result possibly mirrors some structural barriers to accessing health services for the poorer population groups (Zare et al., 2013; Zavras et al., 2016), and also reflects the fact that low-SES individuals tend to have lower health status and greater health care needs.

We also examine the changes in income elasticity of HHE across different household types. Contrary to the more privileged groups, lower SES households did not become more sensitive to income changes in the post-EAP period. Those households appear to be more "protective" about their health care consumption than their richer counterparts, and this intensified in the post-EAP, during which HHE became more elastic for higher socioeconomic groups, but not for less-privileged households. As described in Chapter 2, this finding reflects the different composition of HHE across household types and the fact that some categories of HHE (e.g. payments for pharmaceuticals, user charges)

cannot be easily substituted or avoided by shifting to public services during periods of economic distress. In the same vein, we find that income elasticity only increased among the households in the top quantiles of the HHE distribution, indicating that contrary to those at the bottom, high spenders are those who actually became more sensitive to income changes during the post-EAP period. In sum, our findings reveal that HHE did not become more responsive to income changes among lower SES groups and households that spend relatively less on health care.

Last, we employ additional measures to capture household welfare instead of household income. We show that HHE is more responsive to permanent income shocks compared to current income variations. In addition, by using consumption expenditure and the CWI, we present strong evidence of greater sensitivity in the post-EAP period, a finding that further validates our baseline results.

Generally speaking, although economic crisis and adjustment generally pose significant challenges to health financing, there is scant evidence regarding decision-making and the households' health care consumption responses to an economic shock. Even less is known about how HHE responds to income changes before and after large-scale economic adjustment and shocks, albeit some studies have examined the responsiveness of HHE to income changes (Chaze, 2005; Getzen, 2000; Zare et al., 2013). Using various empirical techniques, this chapter systematically studies this largely unexplored topic, and contributes to the literature in various ways. First, it contributes to a better understanding of how household spending behaviour towards health care changes in the face of an economic adjustment and the relevant health policy measures. Second, it elaborates on the heterogeneous consumption responses across different household types and socioeconomic groups, and between the low and high spenders. This is particularly important, given that households tend to have different composition of health payments, diverse needs for medical care and differ in what they can afford during periods of economic shock. Third, this study further employs various measures of current and permanent income, and identifies how HHE responds to different measures of household welfare. Fourth, although estimates of the income elasticity of HHE generally tend to ignore potential endogeneity concerns (Trivedi, 2002; Zare et al., 2013), we relax this assumption and also employ an IV approach to further test the robustness of our findings. Lastly, it also contributes to the existing literature for the Greek health system. Although OOPE has traditionally been a major financing source for the Greek health system (Economou et al., 2017; Mossialos et al., 2005), the household characteristics associated

with the probability of spending for health care and the level of HHE have not been examined from an empirical perspective. This study also fills this gap, by providing evidence for the determinants of HHE and the income elasticity across different households types.

5.1.2. Implications for financial protection among older households

Chapter 3 uncovers the potential changes and implications in terms of financial protection against health payments during the economic crisis in Greece. Given the significant household income loss and the recent health policy responses to the crisis, the extent to which the Greek population is financially protected against the risk of illness is a matter of great importance for health system performance assessment (Maresso et al., 2014; OECD, 2016). This chapter particularly concentrates on older people, many of whom can be considered as high-need, high-cost patients with complex multimorbidities. In general, older population has greater health needs and costs but fewer financial resources to cover them, struggles to face the increased financial strain during economic downturns, and is also more susceptible to health shocks and the adverse effects of the crisis (Bierman, 2014; Fenge et al., 2012; Lyberaki & Tinios, 2018). Therefore, there are significant and rising concerns for the financial protection of this group, especially in a country where the population is rapidly ageing, such as Greece (United Nations, 2017).

Our analysis indicates that the headcount and overshoot of CHE more than doubled among older households over 2007-2015. According to our baseline results, for example, the incidence of CHE increased from 5.83% to almost 14% during the study period. Controlling for various confounders, the odds of facing CHE for a household in 2015 are more than twice the odds of financial catastrophe in 2007. In addition, the overshoot of CHE also increased suggesting that the average extent by which OOPE exceeds the corresponding threshold also increased. The findings are generally robust to different thresholds of CHE, and can be explained in light of the broader household financial situation and the relevant health policy responses during the economic recession.

After splitting the sample by SES, we find that the incidence of financial catastrophe increased across all groups over the period we examined, with the low-income households being disproportionately affected. Among the poorest households, the headcount increased from 6% to almost 22% during the period of the crisis. On the contrary, the respective change among the richest group (i.e. households in the top

quintile) has been somewhat lower. Considering that the percentage of population with unmet health needs also increased over the study period (Eurostat, 2018d), the incidence of CHE could have been even greater in the absence of financial barriers to access (Moreno-Serra et al., 2011). It thus appears that a large share of the low-income older households faces a "bad trade-off"; they either encounter the risk of CHE, or face unmet medical needs and barriers to accessing health care.

Further, we find that the rate of CHE is higher among households with chronic or multimorbid patients compared to those without chronic patients. In light of this, it appears that the health system cannot adequately protect those with poor health status, especially after the onset of the economic crisis. For instance, more than one out of ten elderly households with multimorbid patients incured financial catastrophe due to health payments in 2007, with the respective figure being more than 20% in 2015. As discussed in Chapter 4, the high rate of CHE among households with chronic patients, as well as the significant increase during 2007-2015, can possibly be explained by several features of the Greek health system (e.g. weak primary care, lack of comprehensive chronic disease management), and the lack of a thorough strategy to protect chronic patients from the financial burden of OOPE.

Our analysis also focuses on the breadown of CHE by type of health expenditure. As shown in Figure 3.1, CHE was mainly due to inpatient and nursing care before the onset of the crisis, followed by outpatient care and medicines. During the period we examined, the contribution of household pharmaceutical spending to CHE substantially increased; a finding that is linked with the cost-sharing reforms and the changes in pharmaceutical pricing and reimbursement system (Economou et al., 2017; Gouvalas et al., 2016). However, the contribution of inpatient care to CHE diminished during the study period, possibly because households shifted to public services and became less willing to pay informal payments in hospitals (Economou, 2015; Souliotis et al., 2016).

Last, we employ logistic regression and selection models and examine which household types tend to incur financial catastrophe due to health payments. Our estimates show that the households in the top quintile are less likely to face CHE than their poorer counterparts, suggesting that low-income groups are less protected against the financial risk of ill health. What is interesting, however, is that although the odds of CHE do not significantly differ across consumption quintiles in 2007, we do find a clear socioeconomic differential in the probability of CHE in 2015. As discussed in Chapter 3, these findings

raise substantial distributional and equity concerns, suggesting widening inequalities in the risk of CHE across socioeconomic groups following the Greek crisis.

This chapter makes some distinct contributions to the literature about financial protection in health. First, it systematically examines the changes in financial protection for the older population during a period of economic recession. Although this group comprises of high-need, high-cost patients and is highly vulnerable during recessions, there is no comprehensive evidence for the extent to which the incidence and intensity of CHE have changed over the period of the recent economic crisis. This study fills this gap in the literature using data from Greece, which arguably has been harder hit by the recent recession in Europe. Second, we particularly focus on the implications of the crisis in terms of financial protection across different population groups, and also provide plausible interpretations for these findings. This is important, given that health policy responses to the crisis may have different impact across population groups and socioeconomic strata (Kondilis, Giannakopoulos, et al., 2013; Stuckler et al., 2017). Third, we identify which types of expenditure are the main drivers of the overall CHE among older households, and how they have changed over the period of recession. From a methodological perspective, this study also employs regression models and estimators that take into consideration potential selection issues, originating from the fact that some households may not be able to afford health payments, having financial barriers to access (S. Brown et al., 2014; Kawabata et al., 2002). This is particularly relevant for the Greek case, given that the proportion of people reporting unmet needs and barriers to accessing health care has significantly increased during the period examined (Eurostat, 2018d; Kentikelenis et al., 2014)

5.1.3. Fertility responses and implications for newborn health

Focusing on newborn health is particularly important, since it is strongly associated with various health and socioeconomic outcomes during childhood and adulthood (S. E. Black et al., 2007; Blumenshine et al., 2010). Thus, health at birth can be considered as an input in a health production function that essentially approximates the initial endowment of "human health capital". In light of these remarks, Chapter 4 examines how economic climate influences fertility decisions and responses across different population groups, and also studies the potential link between economic conditions during pregnancy and newborn health across different socioeconomic groups.

Our analysis demonstrates a strong association between economic conditions in the first and third trimesters of gestation and the BW, while showing a weaker relationship between economic climate in the second trimester and BW. In addition, the probability of LBW is countercyclical with reference to business cycle volatility in the first and third trimesters of pregnancy. We also find similar results for the length of pregnancy and the probability of preterm birth, and further validate our initial hypotheses regarding the relationship between prenatal economic conditions and birth outcomes. These results are generally robust and consistent, even after changing the measure of the economic climate and detrending technique. As discussed in Chapter 4, our results can be possibly interpreted by two main mechanisms: (a) changes in quantity and quality of maternal nutrition and (b) increased psychosocial stress and depression during periods of economic decline.

After splitting the sample by SES, we show that business cycle variation during the first and last trimesters matters for the BW and the risk of LBW in infants of low-SES households. Nonetheless, the BW of high-SES newborns is only responsive to economic conditions in the first trimester. This difference can be attributed to nutritional deprivation and dietary changes during economic recession, which mostly affects low-SES households (Bonaccio et al., 2017; Brinkman et al., 2010). On the contrary, high-SES households can smooth consumption and are not expected to suffer from food deprivation and insecurity during periods of economic decline.

Economic volatility might influence fertility decisions differently across population groups, having potential implications for the cohort composition of women who become pregnant (Chevalier & Marie, 2017). With this in mind, we find that economic downturn during the preconception period raises the probability that women who conceive are better-educated and married. These findings can be interpreted, considering that low-SES families may be unable to afford the costs of childbearing due to credit constraints and significant income loss during the crisis (Schneider & Hastings, 2015).

After accounting for potential selection into pregnancy, we find that newborns exposed to the crisis while in utero tend to be lighter, with the effect being mainly driven by the infants of low-SES parents. In particular, the estimated BW loss for the low-SES children is greater, whereas the corresponding loss for newborns of high-SES families is insignificant. Hence, in addition to the socioeconomic gradient in health at birth, there is also a socioeconomic differential on the impact of economic recession on newborn health. In other words, children born to low-SES families are hit more severely by the recent

economic downturn and bear greater health costs, resulting in a widening of the BW gap between infants of lower and higher socioeconomic groups.

In this context, this chapter contributes to the evidence on the health effects of recessions in various ways. In contrast to previous evidence, which concentrates on the relationship between unemployment and birth indicators, we also employ some "soft" economic indicators, aiming to investigate the link between economic climate and uncertainty during pregnancy and newborn health. Therefore, this analysis captures the overall economic climate, expectations and uncertainty, which are not directly reflected by standard measures of economic activity such as GDP and unemployment rate (Gelper & Croux, 2010). Second, to the best of our knowledge, this is the first paper documenting widening inequalities in newborn health during recessions, arising from a socioeconomic differential in an economic crisis' impact on newborn health. Third, we employ various detrending techniques to capture the cyclical component of the economic indicators, and test the robustness of our findings. Fourth, this study investigates how economic climate during preconception period might influence the type of women who conceive, testing for potential selection into pregnancy. Fifth, we address potential selection due to compositional changes on the type of women who conceive, and further employ various robustness checks. Lastly, our analysis relies on a large administrative dataset from Greece, a country that faced a severe and protracted economic downturn. Examining the Greek case is important, since previous evidence concentrated on shorter recessions with lesser economic and social impact.

5.2. Limitations

As discussed in the individual chapters, there are some limitations that should be taken into account when discussing and interpreting the findings of this thesis. Given that each study employs different data sources and empirical methods, the detailed limitations are fully presented in the corresponding chapters. In this section, we thus summarize the main data and methodological limitations.

The first empirical study (Chapter 2) relies on household-level data from the Greek HBS. Although HBS adequately captures some key aspects about household income and expenditure patterns, it does not include a rich set of health variables and indicators. Hence, we do not control for an indicator of health status due to data availability restrictions. This is a common limitation in studies using household data (Amuedo-

Dorantes & Pozo, 2011; Okunade et al., 2010; Zare et al., 2013), since it is difficult to approximate health status at the household level and most budget surveys do not include detailed information about respondents' health status. Instead, we control for proxies for the need for health care at the household level, focusing on the groups considered to be heavy users of health services. Furthermore, household expenditure and income data are self-reported and may thus be affected by various factors, such as the level of disaggregation, recall period and question framing (Heijink, Xu, Saksena, & Evans, 2011; Lu, Chin, Li, & Murray, 2009). However, no systematic differences in data reporting are expected, since the survey design and methodology remained unchanged over the period we examined (Hellenic Statistical Authority, 2015). Additionally, the aggregate nature of the EAP as well as the cross-sectional design of the surveys do not allow us to employ quasi-experimental approaches or estimate potential causal effects. Therefore, the interpretation of associations as causal relationships should be made with caution. Further, the impact of each of the "triple hits" cannot be disentangled and tested separately, due to lack of relevant data. Last, although our IV has been extensively tested and generally performs well, finding a perfect IV is always a challenging empirical task. It is thus important to interpret these results taking these limitations into account. It is encouraging, however, that the findings remain robust to different empirical techniques and indicators of household welfare.

Using data from SHARE, Chapter 3 focuses on financial protection in health among older households. Although SHARE follows respondents over time, it is not possible to exploit the relevant longitudinal information due to limited data availability. Therefore, we cannot identify whether OOPE persists over time, or explore how OOPE affects household spending patterns in general (WHO Regional Office for Europe, 2018b). Additionally, we only employed data from Waves 2 and 6 (before and after the onset of the crisis) to conduct this analysis, since Greece did not participate in the other waves (Börsch-Supan et al., 2013; SHARE Release Guide, 2018). We cannot thus adjust for underlying trends or other time-related factors, which could influence OOPE and the probability of CHE. Furthermore, we do not have access to information on how households finance their consumption or cope with excessive OOPE. Examining these aspects is an interesting exercise, since both have significant implications on household consumption and welfare in the long run.

In the last empirical chapter, we rely on a large administrative dataset that includes information for all births over the period 2008-2015 in Greece. Similar to most datasets of

this kind, the Greek Vital Statistics do not include information for the mode of delivery, health behaviours, and prenatal care utilization. Furthermore, in order to examine the potential heterogeneous impact by socioeconomic group, we only solely on education as a proxy for SES due to limited data availability for other socioeconomic measures. Although education is a reliable and widely employed indicator for socioeconomic status (Galobardes, Shaw, Lawlor, Lynch, & Davey Smith, 2006; Oakes & Rossi, 2003), stratifying the sample by other variables could serve as an additional robustness check. In any case, we conducted various analyses and tests, all of which confirmed our baseline findings. In addition, although we employ various indicators of newborn health, we cannot examine the potential impact of economic conditions on some additional birth outcomes, such as neonatal diseases, Apgar scores, and congenital malformations. Last, from a methodological perspective, we do not know the extent to which each mother has been exposed to the adverse effects of the crisis. This is a common limitation in studies that have examined the impact of exogenous wide-scale events on birth outcomes (Carlson, 2015; Quintana-Domeque & Ródenas-Serrano, 2017). Unlike bereavement, for example, economic crisis is not a stressor in and of itself. Therefore, we rely on various economic climate and uncertainty indicators during pregnancy to carry out our assessment.

5.3. Further research

This thesis examines policy-relevant topics regarding the impact of the Greek crisis on the health sector. However, a number of research and policy-relevant questions remain unanswered. This section elaborates on research areas worth further investigation.

First, although this thesis examines household behaviour and demand for health care during the crisis, it only focuses on HHE. Exploring trends in hospitalizations and primary care visits could significantly improve our understanding of how households modified and adjusted their health care demand and utilization during the crisis. However, a thorough analysis of this kind requires access to detailed records for patients admitted to Greek hospitals. An integrated dataset for primary care visits and hospital admissions would also allow us to examine potential substitution effects between different types of care and to identify changes in household behaviour and health care consumption responses for different types of care during the crisis.

Second, more empirical work is needed in order to improve our understanding regarding the implications of the crisis on financial protection. Currently, most available

datasets do not include information for unmet needs and barriers to access health services, although their consideration is particularly important for a comprehensive study of CHE (WHO Regional Office for Europe, 2018b). With this in mind, a comprehensive dataset that includes information on household expenditure and unmet needs would substantially improve financial protection measurement. This is important, especially when measuring CHE during periods with significant changes in the frequency of unmet health needs.

Another direction for future research relates to the mechanisms that households employ when dealing with high OOPE and financial catastrophe. In particular, household coping strategies are worth further exploration, since the ways through which health care is financed (e.g. savings, borrowing, selling assets, cutting down other types of consumption) have various implications on household consumption and welfare in the long run.

Furthermore, although we examine trends in financial protection among households with patients suffering from chronic conditions, more work is needed on this front. Investigating the extent to which patients in each disease category are protected against the financial risks of ill health could allow us to better identify those incurring excessive OOPE and to design targeted policy measures to improve equity in health financing.

Third, there are still some gaps in the literature on the health effects of the Greek – and European - crisis, since a substantial body of the existing evidence is subject to various types of bias including ecological inference fallacy and measurement error (Parmar et al., 2016). By employing micro-level data and objective health indicators, we provide evidence for the impact of the recession on health at birth and address some of these types of bias. However, there is significant ground for further research on the impact of recession on adult health status. In particular, using micro-level data for mortality and morbidity would allow us to make inferences at an individual level and control for several confounders, avoid aggregation bias, and also elaborate on potential heterogeneity in the impact of business cycle fluctuations on adult health across socioeconomic groups. Furthermore, another understudied topic worth further exploration relates to the medium- and long-term health consequences of economic conditions at birth and during early life.

Going beyond the scope of this thesis, various challenges associated with the availability and improvement of data sources need to be addressed in Greece. First, a longitudinal survey that includes variables about health status, health-related behaviours, patient satisfaction and responsiveness, insurance status and health expenditure and utilization could provide valuable data needed to address important research questions and various methodological challenges, some of which have been discussed in this thesis.

Second, an integrated administrative and clinical dataset for primary care visits and hospital admissions would allow us to further study household behaviour towards health care, and also track potential changes in some other health system performance elements, such as health service outcomes, efficiency and productivity. Third, patient-level registries, combined and integrated with other datasets, could also serve as an important source of information to examine questions about morbidity, mortality and health and clinical outcomes for specific population sub-groups and conditions in the Greek setting.

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List of Appendices

Appendix A: Supplementary Material to Chapter 2

Table A. 1: Definition of variables

Variable	Definition
Dependent variables	
Health expenditure	The total household spending for health care
Independent variables	
Income	Continuous variable for annual net household income
Economic adjustment programme	=1 if year is 2010-2015, =0 if year is 2008-2009
Male	=1 if household head is male, =0 if female
Age 15-34	=1 if age≥15 and age≤34, =0 otherwise
Age 35-44	=1 if age≥35 and age≤44, =0 otherwise
Age 45-54	=1 if age≥45 and age≤54, =0 otherwise
Age 55-64	=1 if age≥55 and age≤64, =0 otherwise
Age 65-74	=1 if age≥65 and age≤74, =0 otherwise
Age≥75	=1 if age≥75, =0 otherwise
Divorced	=1 if household head is divorced, =0 otherwise
Married	=1 if married, =0 otherwise
Never married	=1 if never married, =0 otherwise
Widowed	=1 if widowed, =0 otherwise
Insurance	=1 if beneficiary of any type of insurance (either public or private), =0 if no insurance
No formal education	=1 if household head has no formal education, =0 otherwise
Primary and lower secondary education (ISCED level 1, 2)	=1 if highest education level is primary or lower secondary education, =0 otherwise
Upper- and post-secondary education (ISCED level 3, 4)	=1 if highest education level is upper or post- secondary education, =0 otherwise
Tertiary education (ISCED level 5, 6)	=1 if highest education level is tertiary education, =0 otherwise
Worker	=1 if household head is worker, 0=otherwise
Self-employed	=1 if self-employed, 0=otherwise
Farmer	=1 if farmer, 0=otherwise
Unemployed	=1 if unemployed, 0=otherwise
Retired	=1 if retired, 0=otherwise
Other inactive	=1 if other inactive, 0=otherwise
Household size	The number of household members
Household members under 4 years old	The number of household members aged under 4 years old
Household members over 65 years old	The number of household members aged over 65 years old

Densely populated (at least 500 inhabitants/km^2)	=1 if densely populated, =0 otherwise
Intermediate (between 100 and 499 inhabitants/km^2)	=1 if intermediate, =0 otherwise
Sparsely populated (less than 100 inhabitants/km^2)	=1 if sparsely populated, =0 otherwise

Table A. 2: Summary statistics

Variables	Total sample	Non-zero expenditure	Zero expenditure
Health expenditure	1367,65 (2267,49)	1575,53 (2365,49)	0 (0)
Income	25100,40 (19771,53)	25908,57 (20394,11)	19783,65 (13924,31)
Male	0,72 (0,45)	0,72 (0,45)	0,72 (0,45)
Age 15-34	0,09 (0,29)	0,08 (0,27)	0,20 (0,40)
Age 35-44	0,15 (0,36)	0,15 (0,36)	0,19 (0,39)
Age 45-54	0,18 (0,38)	0,17 (0,37)	0,23 (0,42)
Age 55-64	0,18 (0,39)	0,18 (0,39)	0,19 (0,39)
Age 65-74	0,19 (0,39)	0,21 (0,40)	0,11 (0,31)
Age≥75	0,20 (0,40)	0,22 (0,41)	0,08 (0,27)
Divorced	0,06 (0,23)	0,05 (0,22)	0,08 (0,27)
Married	0,65 (0,48)	0,67 (0,47)	0,55 (0,50)
Never married	0,12 (0,32)	0,10 (0,29)	0,25 (0,43)
Widowed	0,18 (0,38)	0,19 (0,39)	0,12 (0,32)
Insurance	0,96 (0,19)	0,97 (0,16)	0,90 (0,30)
No formal education	0,13 (0,34)	0,14 (0,34)	0,08 (0,28)
Primary and lower secondary education	0,39 (0,49)	0,40 (0,49)	0,37 (0,48)
Upper- and post-secondary education	0,29 (0,45)	0,28 (0,45)	0,36 (0,48)
Tertiary education	0,19 (0,39)	0,19 (0,39)	0,18 (0,39)
Worker	0,29 (0,45)	0,28 (0,45)	0,40 (0,49)
Self-employed	0,11 (0,32)	0,11 (0,32)	0,11 (0,31)
Farmer	0,04 (0,20)	0,04 (0,19)	0,04 (0,21)
Unemployed	0,04 (0,20)	0,04 (0,19)	0,09 (0,29)
Retired	0,40	0,43	0,24

	(0,49)	(0,50)	(0,42)
Other inactive	0,11 (0,31)	0,11 (0,31)	0,12 (0,32)
Household size	2,47 (1,26)	2.49 (1,25)	2,35 (1,31)
Household members under 4 years old	0,11 (0,37)	0,11 (0,38)	0,08 (0,31)
Household members over 65 years old	0,64 (0,78)	0,69 (0,79)	0,32 (0,61)
Densely populated (at least 500 inhabitants/km^2)	0,45 (0,50)	0,45 (0,50)	0,52 (0,50)
Intermediate (between 100 and 499 inhabitants/km^2)	0,19 (0,39)	0,19 (0,39)	0,18 (0,38)
Sparsely populated (less than 100 inhabitants/km^2)	0,35 (0,48)	0,36 (0,48)	0,31 (0,46)

A note on the GLM specification tests, measures of goodness of fit and model performance.

Based on the existing literature (e.g. Manning et al., 2005; Jones, 2010), we employ some specification tests in order to identify the optimal distributional family, and the appropriate link function. For the identification of the family distribution, we used a modified Park test. Given that the literature on the techniques for choosing the optimal GLM link function is rather mixed, we rely on three tests (i.e. Pregibon link test, Pearson correlation test, modified Hosmer and Lemshow test) (Manning et al., 2005). Table A3 indeed confirms that Gamma distribution is the optimal distributional family, whereas log is the appropriate link function.

Table A. 3: GLM specification tests for distributional family and link function

Results of the Modified Park test		
Coefficient: 1.815		
Family	**Chi2**	**p-value**
Gamma	3.43	0.0639
Poisson	66.67	0.0000
Inverse Gaussian or Wald	140.92	0.0000
Gaussian NLLS	330.62	0.0000
Results of the GLM link tests		
Pearson correlation test	-	0.1661
Pregibon test	-	0.0561
Modified Hosmer and Lemeshow test	-	0.3999

Our analysis further presents evidence regarding measures of goodness of fit and model performance. In doing so, we rely on several measures, such as R squared, root mean squared error, mean absolute prediction error, and mean prediction error (Jones, 2000).

Table A. 4: Measures of goodness of fit and model performance

Model	Mean Squared Error ($x10^6$)	Root Mean Squared Error	Mean Absolute Prediction Error
MTPM (Gamma)	4.77	2182.94	1177.72
TPM (OLS)	4.80	2191.45	1182.86
MTPM (Poisson)	4.75	2178.69	1177.69
OLS	4.85	2201.23	1288.16
GLM (Gamma)	4.77	2184.47	1180.81
GLM (Poisson)	4.75	2179.58	1178.90

Table A. 5: Single-equation models for household health expenditure (GLM, OLS)

	(1)	(2)	(3)
	GLM (Gamma)	**OLS**	**GLM (Poisson)**
EAP	-1.373***	-0.901***	-2.258***
	(0.349)	(0.289)	(0.426)
Income	0.454***	0.405***	0.488***
	(0.031)	(0.026)	(0.036)
Interaction (EAP x Income)	0.118***	0.075***	0.208***
	(0.034)	(0.029)	(0.042)
Male	-0.085**	-0.060**	-0.062*
	(0.034)	(0.027)	(0.034)
35-44	0.028	-0.017	-0.015
	(0.050)	(0.040)	(0.052)
45-54	0.015	0.014	-0.062
	(0.050)	(0.042)	(0.054)
55-64	0.164***	0.124***	0.095*
	(0.053)	(0.044)	(0.056)
65-74	0.094	0.081	0.079
	(0.067)	(0.052)	(0.074)
75+	0.160**	0.194***	0.146*
	(0.070)	(0.055)	(0.075)
Primary/lower secondary education	-0.067**	-0.079***	-0.082***
	(0.030)	(0.024)	(0.031)
Upper and post-secondary education	0.057	0.017	0.040
	(0.038)	(0.029)	(0.039)
Higher education	0.151***	0.107***	0.084*
	(0.043)	(0.034)	(0.045)
Intermediate population density	-0.004	-0.006	-0.024

	(0.029)	(0.023)	(0.030)
Sparsely populated	0.029	0.030	0.014
	(0.027)	(0.022)	(0.029)
Household size	0.097***	0.048	0.063
	(0.037)	(0.032)	(0.039)
Household size squared	-0.011**	-0.004	-0.009*
	(0.005)	(0.005)	(0.005)
Divorced	-0.052	-0.073	-0.021
	(0.057)	(0.046)	(0.059)
Never married	-0.233***	-0.233***	-0.185***
	(0.050)	(0.039)	(0.059)
Widowed	-0.127***	-0.128***	-0.117***
	(0.043)	(0.036)	(0.041)
Members aged below 4	0.225***	0.154***	0.207***
	(0.032)	(0.027)	(0.030)
Members aged more than 65	0.152***	0.122***	0.126***
	(0.026)	(0.020)	(0.026)
Self-employed	0.243***	0.142***	0.203***
	(0.036)	(0.028)	(0.037)
Farmer	0.111**	0.037	0.112**
	(0.052)	(0.047)	(0.052)
Unemployed	0.092	0.019	0.059
	(0.068)	(0.050)	(0.072)
Retired	0.285***	0.211***	0.217***
	(0.040)	(0.030)	(0.043)
Other inactive	0.371***	0.235***	0.272***
	(0.051)	(0.037)	(0.050)
Insured	0.162**	0.026	0.130*
	(0.072)	(0.055)	(0.075)
Region FE	Yes	Yes	Yes
Constant	2.128***	2.472***	1.988***

	(0.315)	(0.266)	(0.359)
Observations	31,940	27,878	31,940
R-squared		0.113	

Table A. 6: Income elasticity of household health expenditure (without controlling for education)

	Total period	**Pre-EAP**	**Post-EAP**	**Significant difference (pre-post)**
Probability semi-elasticity				
Probability semi-elasticity	0.053	0.036	0.059	Yes
	(0.003)	(0.005)	(0.004)	
Unconditional income elasticity				
Main model TPM (logit, GLM Gamma)	0.57	0.51	0.59	Yes
	(0.02)	(0.03)	(0.02)	
TPM (logit, OLS)	0.55	0.49	0.56	Yes
	(0.02)	(0.03)	(0.02)	
TPM (logit, GLM Poisson)	0.67	0.53	0.71	Yes
	(0.03)	(0.03)	(0.03)	
GLM Gamma	0.58	0.52	0.60	Yes
	(0.02)	(0.03)	(0.02)	
OLS	0.49	0.45	0.50	Yes
	(0.02)	(0.03)	(0.02)	
GLM Poisson	0.68	0.54	0.73	Yes
	(0.03)	(0.03)	(0.03)	

Table A. 7: Income elasticity of household health expenditure (including a quadratic term for income)

	Total period	**Pre-EAP**	**Post-EAP**	**Significant difference (pre-post)**
Probability semi-elasticity				
Probability semi-elasticity	0.060	0.029	0.073	Yes
	(0.005)	(0.007)	(0.006)	
Unconditional income elasticity				
Main model TPM (logit, GLM Gamma)	0.56	0.45	0.60	Yes
	(0.02)	(0.03)	(0.02)	
TPM (logit, OLS)	0.54	0.42	0.57	Yes
	(0.02)	(0.04)	(0.02)	
TPM (logit, GLM Poisson)	0.57	0.45	0.61	Yes
	(0.03)	(0.04)	(0.03)	
GLM Gamma	0.59	0.46	0.63	Yes
	(0.02)	(0.03)	(0.03)	
OLS	0.49	0.41	0.52	Yes
	(0.02)	(0.03)	(0.02)	
GLM Poisson	0.59	0.46	0.63	Yes
	(0.02)	(0.03)	(0.03)	

Table A. 8: Modified two-part models (sensitivity analyses)

	MTPM (logit, Gamma)		**MTPM (logit, Gamma)**		**MTPM (logit, Gamma)**		**MTPM (logit, Gamma)**		**MTPM (logit, Gamma)**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Participation equation	Expenditure equation	Participation equation	Expenditure equation	Participation equation	Expenditure equation	Participation equation	Expenditure equation	Participation equation	Expenditure equation
EAP	-1.990***	-0.633**	-1.969**	-0.867***	-2.170***	-0.932***	-2.339***	-0.961***	-0.828	-0.611**
	(0.721)	(0.312)	(0.772)	(0.324)	(0.779)	(0.324)	(0.773)	(0.323)	(0.724)	(0.277)
Log income	0.478***	0.485***	0.471***	0.460***	0.387***	0.433***	0.330***	0.415***	0.513***	0.453***
	(0.066)	(0.025)	(0.071)	(0.028)	(0.073)	(0.029)	(0.073)	(0.029)	(0.070)	(0.025)
EAP x Log income	0.147**	0.057*	0.139*	0.078**	0.157**	0.084***	0.173**	0.086***	0.025	0.048*
	(0.073)	(0.031)	(0.077)	(0.032)	(0.078)	(0.032)	(0.077)	(0.032)	(0.073)	(0.028)
Male					-0.315***	-0.022	-0.311***	-0.021	-0.310***	-0.067**
					(0.064)	(0.031)	(0.064)	(0.031)	(0.060)	(0.026)
35-44					0.138*	-0.039	0.113	-0.051	0.225***	0.017
					(0.073)	(0.047)	(0.073)	(0.047)	(0.073)	(0.039)
45-54					-0.047	-0.121***	-0.066	-0.131***	0.187**	0.044
					(0.073)	(0.044)	(0.073)	(0.044)	(0.075)	(0.040)
55-64					0.130	-0.015	0.153*	-0.008	0.425***	0.143***
					(0.082)	(0.047)	(0.083)	(0.047)	(0.083)	(0.041)
65-74					0.661***	0.042	0.726***	0.063	0.627***	0.094*
					(0.102)	(0.053)	(0.105)	(0.052)	(0.130)	(0.050)
75+					1.154***	0.090*	1.240***	0.117**	1.098***	0.214***
					(0.112)	(0.053)	(0.115)	(0.053)	(0.144)	(0.052)
Intermediate population density									0.059	-0.009

									(0.057)	(0.022)
Sparsely populated									-0.123**	0.013
									(0.059)	(0.022)
Household size							0.222***	0.051	0.195***	0.035
							(0.071)	(0.035)	(0.068)	(0.031)
Household size squared							-0.019*	-0.002	-0.030***	-0.004
							(0.010)	(0.005)	(0.010)	(0.004)
Divorced					-0.361***	-0.088*	-0.204**	-0.039	-0.159	-0.076*
					(0.092)	(0.049)	(0.102)	(0.052)	(0.100)	(0.046)
Never married					-0.666***	-0.237***	-0.444***	-0.174***	-0.328***	-0.244***
					(0.062)	(0.043)	(0.081)	(0.047)	(0.081)	(0.038)
Widowed					-0.431***	-0.187***	-0.283***	-0.143***	-0.152	-0.127***
					(0.087)	(0.034)	(0.096)	(0.038)	(0.096)	(0.035)
Members aged below 4									0.624***	0.170***
									(0.071)	(0.027)
Members aged more than 65									0.297***	0.121***
									(0.065)	(0.020)
Self-employed			0.387***	0.188***	0.363***	0.186***	0.365***	0.188***	0.327***	0.130***
			(0.067)	(0.034)	(0.068)	(0.034)	(0.068)	(0.034)	(0.070)	(0.028)
Farmer			0.343***	0.110**	0.312***	0.097**	0.303***	0.089*	0.178	-0.002
			(0.105)	(0.048)	(0.106)	(0.049)	(0.106)	(0.048)	(0.111)	(0.047)

Unemployed			0.123	0.090	0.090	0.094	0.082	0.092	0.037	-0.004
			(0.090)	(0.065)	(0.089)	(0.064)	(0.090)	(0.063)	(0.090)	(0.050)
Retired			0.901***	0.286***	0.406***	0.221***	0.430***	0.234***	0.283***	0.180***
			(0.056)	(0.025)	(0.073)	(0.038)	(0.074)	(0.038)	(0.072)	(0.029)
Other inactive			1.013***	0.225***	0.697***	0.257***	0.719***	0.269***	0.423***	0.155***
			(0.085)	(0.038)	(0.098)	(0.046)	(0.099)	(0.046)	(0.080)	(0.034)
Uninsured			0.677***	-0.006	0.524***	-0.026	0.557***	-0.007	0.467***	-0.003
			(0.086)	(0.066)	(0.086)	(0.066)	(0.087)	(0.065)	(0.085)	(0.053)
Primary/lower secondary education			-0.342***	-0.051*	-0.153*	-0.048*	-0.147*	-0.046*		
			(0.078)	(0.026)	(0.081)	(0.026)	(0.081)	(0.026)		
Upper and post-secondary education			-0.445***	0.051	-0.141	0.074**	-0.121	0.083**		
			(0.083)	(0.032)	(0.088)	(0.033)	(0.089)	(0.033)		
Higher education			-0.321***	0.095***	0.041	0.129***	0.083	0.145***		
			(0.092)	(0.037)	(0.097)	(0.038)	(0.099)	(0.038)		
Constant	-2.497***	2.501***	-3.066***	2.605***	-1.988***	2.986***	-1.967***	3.001***	-4.103***	2.046***
	(0.663)	(0.258)	(0.719)	(0.284)	(0.739)	(0.292)	(0.737)	(0.293)	(0.701)	(0.257)
Observations	33,088	33,088	32,405	32,405	32,405	32,405	32,405	32,405	32,617	32,617

Table A. 9: Regression models for household health expenditure (using consumption expenditure)

	(1)		(2)		(3)		(4)	(5)	(6)
	TPM (Logit, GLM Gamma)		TPM (Logit, OLS)		TPM (Logit, GLM Poisson)		GLM Gamma	OLS	GLM Poisson
EAP	-4.030***	-1.476***	-4.030***	-1.320***	-4.030***	-2.255***	-2.180***	-1.320***	-2.678***
	(0.765)	(0.266)	(0.765)	(0.252)	(0.765)	(0.353)	(0.283)	(0.252)	(0.361)
Expenditure	0.930***	0.687***	0.930***	0.692***	0.930***	0.685***	0.792***	0.692***	0.760***
	(0.075)	(0.027)	(0.075)	(0.024)	(0.075)	(0.033)	(0.028)	(0.024)	(0.034)
Interaction (EAP x Expenditure)	0.371***	0.147***	0.371***	0.131***	0.371***	0.227***	0.211***	0.131***	0.266***
	(0.077)	(0.027)	(0.077)	(0.025)	(0.077)	(0.035)	(0.028)	(0.025)	(0.036)
Male	-0.411***	-0.065**	-0.411***	-0.103***	-0.411***	-0.068**	-0.135***	-0.103***	-0.110***
	(0.064)	(0.029)	(0.064)	(0.026)	(0.064)	(0.032)	(0.032)	(0.026)	(0.033)
35-44	0.198**	0.018	0.198**	0.019	0.198**	0.001	0.072	0.019	0.031
	(0.077)	(0.043)	(0.077)	(0.038)	(0.077)	(0.049)	(0.046)	(0.038)	(0.050)
45-54	0.169**	0.035	0.169**	0.067*	0.169**	-0.013	0.096**	0.067*	0.016
	(0.080)	(0.044)	(0.080)	(0.039)	(0.080)	(0.050)	(0.046)	(0.039)	(0.051)
55-64	0.453***	0.204***	0.453***	0.225***	0.453***	0.175***	0.307***	0.225***	0.226***
	(0.088)	(0.047)	(0.088)	(0.041)	(0.088)	(0.053)	(0.049)	(0.041)	(0.054)
65-74	0.641***	0.134**	0.641***	0.182***	0.641***	0.160**	0.245***	0.182***	0.215***
	(0.136)	(0.057)	(0.136)	(0.050)	(0.136)	(0.072)	(0.061)	(0.050)	(0.073)
75+	1.224***	0.256***	1.224***	0.372***	1.224***	0.274***	0.420***	0.372***	0.374***
	(0.153)	(0.061)	(0.153)	(0.053)	(0.153)	(0.072)	(0.065)	(0.053)	(0.074)
Primary/lower secondary education	-0.275***	-0.141***	-0.275***	-0.145***	-0.275***	-0.117***	-0.194***	-0.145***	-0.142***
	(0.084)	(0.027)	(0.084)	(0.024)	(0.084)	(0.030)	(0.031)	(0.024)	(0.031)
Upper and	-0.397***	-0.094***	-0.397***	-0.121***	-0.397***	-0.056	-0.164***	-0.121***	-0.093**

post-secondary education									
	(0.093)	(0.034)	(0.093)	(0.029)	(0.093)	(0.037)	(0.039)	(0.029)	(0.038)
Higher education	-0.363***	-0.101***	-0.363***	-0.097***	-0.363***	-0.081*	-0.165***	-0.097***	-0.114***
	(0.105)	(0.038)	(0.105)	(0.033)	(0.105)	(0.041)	(0.043)	(0.033)	(0.042)
Intermediate population density	0.011	-0.025	0.011	-0.017	0.011	-0.041	-0.016	-0.017	-0.035
	(0.059)	(0.024)	(0.059)	(0.021)	(0.059)	(0.028)	(0.026)	(0.021)	(0.029)
Sparsely populated	-0.146**	0.036	-0.146**	0.023	-0.146**	0.012	0.030	0.023	0.003
	(0.063)	(0.024)	(0.063)	(0.021)	(0.063)	(0.027)	(0.026)	(0.021)	(0.028)
Household size	-0.063	-0.090***	-0.063	-0.090***	-0.063	-0.087**	-0.079**	-0.090***	-0.082**
	(0.073)	(0.031)	(0.073)	(0.030)	(0.073)	(0.035)	(0.034)	(0.030)	(0.037)
Household size squared	-0.011	0.004	-0.011	0.005	-0.011	0.003	0.001	0.005	0.002
	(0.010)	(0.004)	(0.010)	(0.004)	(0.010)	(0.004)	(0.005)	(0.004)	(0.005)
Divorced	-0.228**	-0.067	-0.228**	-0.113**	-0.228**	-0.051	-0.092*	-0.113**	-0.076
	(0.102)	(0.048)	(0.102)	(0.044)	(0.102)	(0.053)	(0.053)	(0.044)	(0.055)
Never married	-0.328***	-0.138***	-0.328***	-0.220***	-0.328***	-0.107*	-0.218***	-0.220***	-0.169***
	(0.083)	(0.044)	(0.083)	(0.037)	(0.083)	(0.057)	(0.048)	(0.037)	(0.060)
Widowed	-0.204**	-0.096***	-0.204**	-0.122***	-0.204**	-0.106***	-0.118***	-0.122***	-0.118***
	(0.099)	(0.036)	(0.099)	(0.035)	(0.099)	(0.039)	(0.039)	(0.035)	(0.039)
Members aged below 4	0.649***	0.174***	0.649***	0.177***	0.649***	0.165***	0.264***	0.177***	0.222***
	(0.072)	(0.028)	(0.072)	(0.026)	(0.072)	(0.028)	(0.030)	(0.026)	(0.028)
Members aged more than 65	0.398***	0.187***	0.398***	0.192***	0.398***	0.165***	0.238***	0.192***	0.193***
	(0.067)	(0.022)	(0.067)	(0.019)	(0.067)	(0.024)	(0.024)	(0.019)	(0.024)

Self-employed	0.198***	0.108***	0.198***	0.065**	0.198***	0.114***	0.139***	0.065**	0.134***
	(0.070)	(0.032)	(0.070)	(0.027)	(0.070)	(0.036)	(0.034)	(0.027)	(0.036)
Farmer	0.155	0.047	0.155	-0.006	0.155	0.056	0.067	-0.006	0.068
	(0.114)	(0.047)	(0.114)	(0.046)	(0.114)	(0.049)	(0.049)	(0.046)	(0.051)
Unemployed	0.054	0.034	0.054	-0.018	0.054	0.050	0.020	-0.018	0.031
	(0.089)	(0.055)	(0.089)	(0.047)	(0.089)	(0.063)	(0.059)	(0.047)	(0.065)
Retired	0.341***	0.199***	0.341***	0.201***	0.341***	0.167***	0.266***	0.201***	0.199***
	(0.076)	(0.034)	(0.076)	(0.028)	(0.076)	(0.041)	(0.036)	(0.028)	(0.042)
Other inactive	0.645***	0.201***	0.645***	0.221***	0.645***	0.176***	0.312***	0.221***	0.231***
	(0.100)	(0.041)	(0.100)	(0.035)	(0.100)	(0.047)	(0.044)	(0.035)	(0.048)
Insured	0.389***	0.011	0.389***	0.020	0.389***	-0.011	0.181***	0.020	0.117*
	(0.086)	(0.056)	(0.086)	(0.051)	(0.086)	(0.065)	(0.063)	(0.051)	(0.069)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-7.344***	0.528**	-7.344***	-0.100	-7.344***	0.571*	-0.860***	-0.100	-0.451
	(0.741)	(0.269)	(0.741)	(0.243)	(0.741)	(0.336)	(0.285)	(0.243)	(0.342)
Observations	31,941	27,879	31,941	27,879	31,941	27,879	31,941	27,879	31,941
R-squared								0.168	

Table A. 10: Regression models for household health expenditure (using CWI)

	(1)		(2)		(3)		(4)	(5)	(6)
	TPM (Logit, GLM Gamma)		TPM (Logit, OLS)		TPM (Logit, GLM Poisson)		GLM Gamma	OLS	GLM Poisson
EAP	-5.666***	-2.524***	-5.666***	-2.425***	-5.666***	-3.592***	-3.543***	-2.425***	-4.214***
	(0.941)	(0.353)	(0.941)	(0.328)	(0.941)	(0.463)	(0.376)	(0.328)	(0.472)
CWI	0.922***	0.766***	0.922***	0.757***	0.922***	0.788***	0.864***	0.757***	0.873***
	(0.089)	(0.035)	(0.089)	(0.031)	(0.089)	(0.042)	(0.036)	(0.031)	(0.042)
Interaction (EAP x CWI)	0.520***	0.246***	0.520***	0.235***	0.520***	0.354***	0.340***	0.235***	0.411***
	(0.094)	(0.035)	(0.094)	(0.033)	(0.094)	(0.046)	(0.037)	(0.033)	(0.047)
Male	-0.398***	-0.051*	-0.398***	-0.094***	-0.398***	-0.059*	-0.121***	-0.094***	-0.101***
	(0.064)	(0.029)	(0.064)	(0.026)	(0.064)	(0.032)	(0.031)	(0.026)	(0.033)
35-44	0.165**	-0.004	0.165**	-0.008	0.165**	-0.030	0.047	-0.008	-0.005
	(0.076)	(0.044)	(0.076)	(0.039)	(0.076)	(0.049)	(0.046)	(0.039)	(0.050)
45-54	0.110	-0.015	0.110	0.017	0.110	-0.076	0.041	0.017	-0.053
	(0.079)	(0.044)	(0.079)	(0.040)	(0.079)	(0.050)	(0.046)	(0.040)	(0.051)
55-64	0.350***	0.116**	0.350***	0.141***	0.350***	0.076	0.207***	0.141***	0.115**
	(0.088)	(0.046)	(0.088)	(0.042)	(0.088)	(0.053)	(0.049)	(0.042)	(0.054)
65-74	0.510***	0.023	0.510***	0.077	0.510***	0.028	0.119*	0.077	0.066
	(0.135)	(0.058)	(0.135)	(0.051)	(0.135)	(0.071)	(0.062)	(0.051)	(0.072)
75+	1.057***	0.119*	1.057***	0.246***	1.057***	0.118	0.265***	0.246***	0.196***
	(0.150)	(0.061)	(0.150)	(0.053)	(0.150)	(0.072)	(0.066)	(0.053)	(0.074)
Primary/lower secondary education	-0.230***	-0.111***	-0.230***	-0.131***	-0.230***	-0.109***	-0.153***	-0.131***	-0.135***
	(0.084)	(0.026)	(0.084)	(0.024)	(0.084)	(0.030)	(0.030)	(0.024)	(0.031)
Upper and post-secondary	-0.316***	-0.055*	-0.316***	-0.099***	-0.316***	-0.050	-0.110***	-0.099***	-0.087**

education									
	(0.092)	(0.034)	(0.092)	(0.029)	(0.092)	(0.037)	(0.037)	(0.029)	(0.038)
Higher education	-0.269**	-0.068*	-0.269**	-0.081**	-0.269**	-0.088**	-0.115***	-0.081**	-0.123***
	(0.104)	(0.038)	(0.104)	(0.033)	(0.104)	(0.042)	(0.042)	(0.033)	(0.043)
Intermediate population density	0.027	-0.013	0.027	-0.006	0.027	-0.033	0.000	-0.006	-0.027
	(0.059)	(0.024)	(0.059)	(0.022)	(0.059)	(0.029)	(0.026)	(0.022)	(0.029)
Sparsely populated	-0.139**	0.046*	-0.139**	0.032	-0.139**	0.023	0.041	0.032	0.014
	(0.062)	(0.024)	(0.062)	(0.021)	(0.062)	(0.027)	(0.026)	(0.021)	(0.028)
Household size	-0.023	-0.086***	-0.023	-0.086***	-0.023	-0.095***	-0.068**	-0.086***	-0.091***
	(0.072)	(0.031)	(0.072)	(0.030)	(0.072)	(0.034)	(0.034)	(0.030)	(0.035)
Household size squared	-0.012	0.005	-0.012	0.006	-0.012	0.005	0.001	0.006	0.004
	(0.010)	(0.004)	(0.010)	(0.004)	(0.010)	(0.004)	(0.004)	(0.004)	(0.005)
Divorced	-0.217**	-0.045	-0.217**	-0.090**	-0.217**	-0.020	-0.070	-0.090**	-0.045
	(0.102)	(0.049)	(0.102)	(0.044)	(0.102)	(0.054)	(0.053)	(0.044)	(0.056)
Never married	-0.340***	-0.154***	-0.340***	-0.231***	-0.340***	-0.121**	-0.237***	-0.231***	-0.186***
	(0.083)	(0.044)	(0.083)	(0.038)	(0.083)	(0.056)	(0.047)	(0.038)	(0.058)
Widowed	-0.228**	-0.090**	-0.228**	-0.125***	-0.228**	-0.100**	-0.116***	-0.125***	-0.114***
	(0.099)	(0.036)	(0.099)	(0.035)	(0.099)	(0.039)	(0.039)	(0.035)	(0.040)
Members aged below 4	0.640***	0.164***	0.640***	0.172***	0.640***	0.162***	0.253***	0.172***	0.220***
	(0.072)	(0.029)	(0.072)	(0.026)	(0.072)	(0.028)	(0.031)	(0.026)	(0.028)
Members aged more than 65	0.375***	0.172***	0.375***	0.178***	0.375***	0.161***	0.219***	0.178***	0.192***
	(0.065)	(0.022)	(0.065)	(0.019)	(0.065)	(0.024)	(0.024)	(0.019)	(0.025)
Self-employed	0.243***	0.121***	0.243***	0.077***	0.243***	0.100***	0.161***	0.077***	0.118***

	(0.070)	(0.032)	(0.070)	(0.028)	(0.070)	(0.035)	(0.034)	(0.028)	(0.036)
Farmer	0.218*	0.085*	0.218*	0.024	0.218*	0.075	0.113**	0.024	0.091*
	(0.113)	(0.048)	(0.113)	(0.046)	(0.113)	(0.049)	(0.051)	(0.046)	(0.051)
Unemployed	0.129	0.088	0.129	0.030	0.129	0.093	0.085	0.030	0.075
	(0.090)	(0.057)	(0.090)	(0.048)	(0.090)	(0.063)	(0.061)	(0.048)	(0.066)
Retired	0.342***	0.212***	0.342***	0.208***	0.342***	0.174***	0.281***	0.208***	0.208***
	(0.076)	(0.035)	(0.076)	(0.029)	(0.076)	(0.041)	(0.036)	(0.029)	(0.042)
Other inactive	0.674***	0.234***	0.674***	0.238***	0.674***	0.196***	0.352***	0.238***	0.257***
	(0.100)	(0.042)	(0.100)	(0.035)	(0.100)	(0.047)	(0.046)	(0.035)	(0.048)
Insured	0.339***	-0.060	0.339***	-0.036	0.339***	-0.078	0.096	-0.036	0.048
	(0.087)	(0.058)	(0.087)	(0.052)	(0.087)	(0.066)	(0.065)	(0.052)	(0.070)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-7.363***	-0.229	-7.363***	-0.712**	-7.363***	-0.375	-1.559***	-0.712**	-1.477***
	(0.883)	(0.345)	(0.883)	(0.305)	(0.883)	(0.417)	(0.365)	(0.305)	(0.425)
Observations	31,940	27,878	31,940	31,940	31,940	31,940	31,940	27,878	31,940
R-squared								0.154	

Figure A. 1: Out-of-pocket expenditure (% of GDP) in selected European countries, 1995-2014

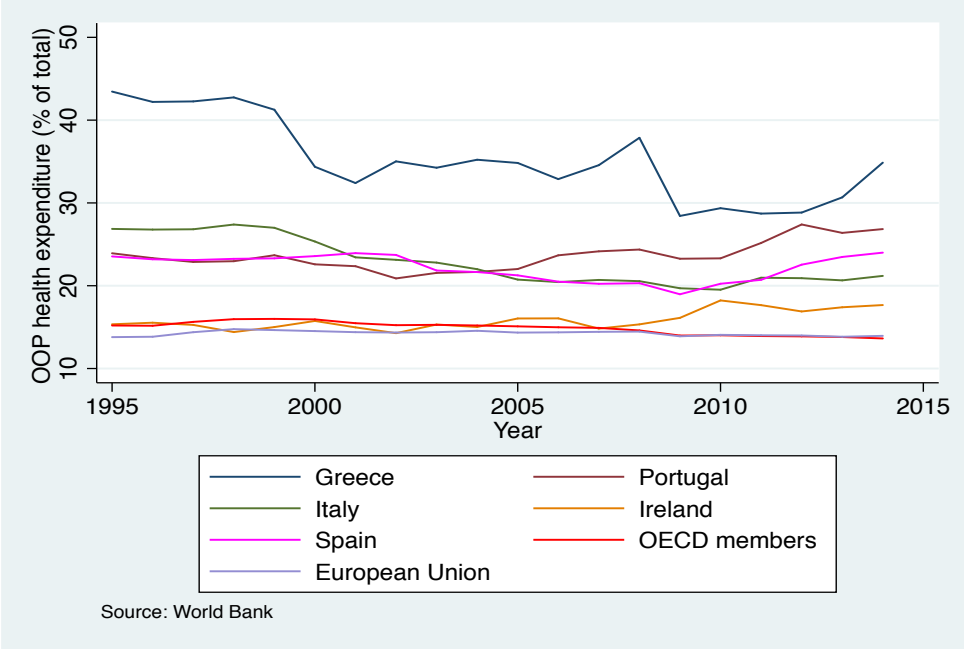
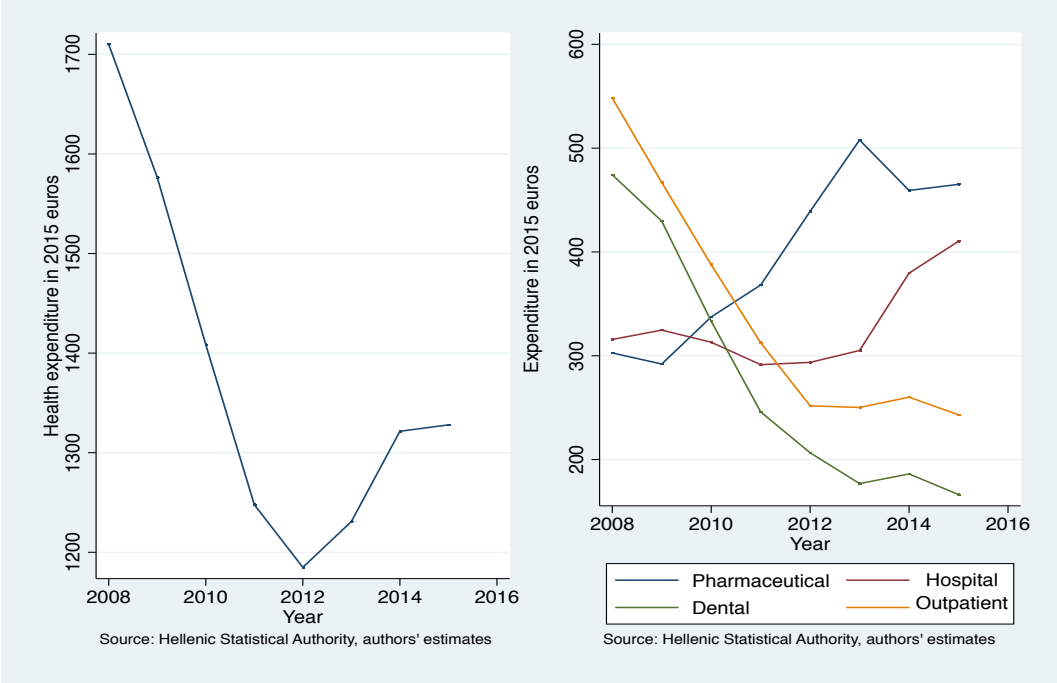


Figure A. 2: Mean household health expenditure in Greece, 2008-2015



A note on the construction of the asset index

In order to construct the wealth index, we relied on household data from the HBS. Based on the existing literature, we conducted a principal component analysis to aggregate the available household indicators into an index (Filmer & Pritchett, 2001; Vyas & Kumaranayake, 2006).

Given that Greece is a high-income country, the indicators and assets included in the wealth index are not similar to the ones used for the construction of similar indices for low- and middle-income countries (Foubert et al., 2014; E. E. Freeman et al., 2013; Nikoloski & Mossialos, 2013). Indeed, Tsakloglou and Panopoulou (1998) and Ferguson et al. (2003) have used assets as proxies for household welfare and provided relevant details for the variables that could be used for the construction of an index in Greece (Ferguson et al., 2003; Tsakloglou & Panopoulou, 1998).

The variables we used for the construction of the index were the following: house ownership without financial obligations (e.g. mortgage), hot water, central heating, car ownership, washing machine, more than two television sets, personal computer, second house ownership, and area per equivalent member (binary variables that equals 1 if the area per member is more than 30 square meters).

A note on the construction of the CWI

As pointed above, income and expenditure suffer from several drawbacks, as they cannot capture the concept of "permanent income hypothesis". Building on the existing literature, we use a latent variable approach to construct a composite welfare indicator (CWI), which essentially captures the concept of permanent income (R. H. Abul Naga & Burgess, 1997; R. M. Abul Naga, 1994). In particular, our analysis mainly relies on a previous work by Mitrakos and Tsakloglou, who estimated a composite welfare indicator, using a dataset from a previous wave Greek HBS (2004/5) (Mitrakos & Tsakloglou, 2010). In this section, we present the methodology we used for constructing this indicator.

Denote $X = (x_1, x_2, \dots., x_k)'$ as the vector of the welfare indicators in the HBS. These indicators are associated with the CWI (i.e. the proxy for permanent income y_p. If we let $b = (b_1, b_2, \dots., b_k)$ be the vector of parameters, and $U = (u_1, u_2, \dots., u_k)$ be the vector of the error terms, then the relationship between the available welfare indicators and the CWI is given by the following expression:

$$X = by_p + U \quad (1)$$

Following Mitrakos and Tsakloglou, we assume both y_p and U follow a normal distribution, such that $y_p \sim N(\mu_p, \sigma_p^2)$ and $U \sim N(0, \Omega)$. Then, X is also normally distributed, such that $X \sim N(b\mu_p, bb'\sigma_p^2 + \Omega)$ Given the relationship in (1), the conditional distribution of y_p given X is the following:

$$y_p|x \sim N\left[\mu_p + \Sigma_{y_pX}\,\Sigma_{XX}^{-1}\left(X - b\mu_p\right), \Sigma_{y_py_p} - \Sigma_{y_pX}\,\Sigma_{XX}^{-1}\,\Sigma_{Xy_p}\right] \quad (2)$$

where, $\Sigma_{y_py_p} = cov(y_p, y_p) = \sigma_p^2$, Σ_{y_pX} is the $(1xk)$ variance-covariance matrix of y_p and X, Σ_{Xy_p} is the $(kx1)$ variance-covariance matrix, and Σ_{XX} is the variance-covariance matrix of the variables of the vector X.

Based on (2) , the predictor of the CWI that minimizes the MSE is the following:

$$E(y_p|X) = \mu_p + \Sigma_{y_pX}\,\Sigma_{XX}^{-1}\left(X - b\mu_p\right) \quad (3)$$

According to (3), the CWI is a linear function of the variables included in X. In addition, the expression presented in (3) suggests that the relative weights of the variables included in X reflect the covariance between y_p and X.

Given that income and expenditure are log-normally distributed, we assume that the logarithm of income Y and the logarithm of consumption C are given by the following expressions:

$$Y = Y_p + Y_t \quad (4)$$

and,

$$C = B + Y_p + C_t \quad (5)$$

where Y_t and C_t are the residuals in (4) and (5) respectively. Last, following the arguments by Mitrakos and Tsakloglou (2010), we further assume that $cov(Y_p, Y_t) = cov(Y_p, C_t) = cov(Y_t, C_t)$.

Using (4) and (5), and taking into considerations the assumptions for the covariance, one can conclude to the following system of equations, which have 3 unknown parameters:

$$var(Y) = \sigma_p^2 + u_Y \quad (6)$$

$$var(C) = \sigma_p^2 + u_C \quad (7)$$

$$cov(Y, C) = \sigma_p^2 \quad (8)$$

Based on (1), (3), (4), and (5), the CWI of each household is given by the following expression:

$$E\left(y_p \middle| X\right) = \mu_Y + \frac{\sigma_p^2}{\left(\sigma_p^2 + u_Y\right)\left(\sigma_p^2 + u_C\right) - (\sigma_p^2)^2}\left[u_C(Y - \mu_Y) + u_Y(C - \mu_C)\right] \quad (9)$$

Appendix B: Supplementary Material to Chapter 3

Table B. 1: Distribution-sensitive measures of catastrophic health payments (defined as % of total household expenditure)

Threshold: 5%	**Pre**	**Post**
Concentration Index (HQ)	-0.113	-0.063
Rank-weighted head count	40.37	59.38
Concentration Index (O)	-0.036	-0.090
Rank-weighted overshoot	3.12	6.38
Threshold: 10%	**Pre**	**Post**
Concentration Index (HQ)	-0.142	-0.120
Rank-weighted head count	21.12	38.08
Concentration Index (O)	0.038	-0.090
Rank-weighted overshoot	1.64	4.00
Threshold: 15%	**Pre**	**Post**
Concentration Index (HQ)	-0.131	-0.156
Rank-weighted head count	11.21	23.96
Concentration Index (O)	0.154	-0.061
Rank-weighted overshoot	0.87	2.49
Threshold: 20%	**Pre**	**Post**
Concentration Index (HQ)	0.010	-0.166
Rank-weighted head count	5.77	15.79
Concentration Index (O)	0.287	-0.003
Rank-weighted overshoot	0.46	1.51

Table B. 2: Headcount and overshoot of catastrophic health expenditure, by education level

	No education/Primary education		**Secondary education**		**Tertiary education**	
Threshold: 5%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	45.28	65.92	28.70	51.40	23.71	47.20
	(1.57)	(1.42)	(1.83)	(1.72)	(2.40)	(2.15)
Overshoot	3.94	7.86	2.28	5.05	1.67	3.99
	(0.23)	(0.31)	(0.27)	(0.30)	(0.27)	(0.29)
Threshold: 10%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	24.90	43.22	13.13	29.31	9.60	27.00
	(1.36)	(1.41)	(1.35)	(1.53)	(1.61)	(1.89)
Overshoot	2.22	5.16	1.31	3.13	0.92	2.22
	(0.19)	(0.27)	(0.22)	(0.25)	(0.21)	(0.23)
Threshold: 15%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	14.10	27.86	6.00	17.51	4.76	14.70
	(1.08)	(1.24)	(0.98)	(1.28)	(1.09)	(1.42)
Overshoot	1.29	3.41	0.85	2.01	0.57	1.24
	(0.15)	(0.23)	(0.18)	(0.20)	(0.16)	(0.18)
Threshold: 20%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Head count	7.66	18.77	4.20	11.93	3.44	8.00
	(0.77)	(1.07)	(0.87)	(1.07)	(0.90)	(1.07)
Overshoot	0.78	2.25	0.60	1.26	0.38	0.72
	(0.12)	(0.19)	(0.15)	(0.17)	(0.12)	(0.14)

Table B. 3: Incidence and intensity of catastrophic health payments among households with chronic patients

Threshold	Cancer		Diabetes		Hypertension		Heart attack		Stroke		Chronic Lung disease		Alzheimer	
5%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	58.50	82.31	57.86	79.61	49.16	69.26	64.16	79.88	69.16	76.46	63.22	78.64	58.76	89.54
	(6.97)	(4.01)	(2.89)	(1.81)	(1.72)	(1.25)	(2.75)	(1.88)	(5.28)	(3.93)	(4.55)	(2.90)	(10.37)	(3.90)
O	8.81	11.51	5.80	10.08	4.05	7.78	7.14	10.84	8.32	13.09	6.77	10.83	12.33	17.42
	(1.74)	(1.10)	(0.55)	(0.48)	(0.26)	(0.29)	(0.62)	(0.55)	(1.38)	(1.32)	(0.89)	(0.88)	(3.71)	(1.91)
10%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	43.54	63.39	34.01	55.10	23.69	43.74	37.81	57.20	39.96	60.68	41.95	59.15	47.98	79.36
	(6.75)	(4.59)	(2.81)	(2.16)	(1.43)	(1.31)	(2.73)	(2.37)	(5.57)	(4.40)	(4.64)	(3.39)	(10.50)	(4.73)
O	6.43	7.90	3.47	6.73	2.29	5.03	4.59	7.45	5.47	9.67	4.14	7.47	9.48	13.22
	(1.51)	(0.99)	(0.48)	(0.43)	(0.22)	(0.25)	(0.54)	(0.49)	(1.24)	(1.20)	(0.76)	(0.79)	(3.39)	(1.81)
15%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	34.43	39.49	21.36	38.16	12.65	28.06	24.07	42.14	28.02	46.27	24.12	38.16	42.37	63.40
	(6.34)	(4.35)	(2.43)	(2.07)	(1.08)	(1.17)	(2.37)	(2.31)	(5.07)	(4.56)	(3.95)	(3.26)	(10.44)	(5.34)
O	4.47	5.39	2.15	4.43	1.43	3.28	3.03	4.94	3.82	7.02	2.55	5.10	7.16	9.80
	(1.30)	(0.85)	(0.40)	(0.36)	(0.18)	(0.21)	(0.46)	(0.41)	(1.07)	(1.05)	(0.63)	(0.68)	(3.07)	(1.68)
20%	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
HQ	24.06	29.91	10.37	24.32	8.11	18.50	15.55	28.24	19.59	32.03	13.69	28.25	29.77	44.68
	(5.67)	(4.00)	(1.70)	(1.78)	(0.87)	(1.00)	(2.03)	(2.07)	(4.49)	(4.32)	(3.15)	(3.05)	(9.75)	(5.39)
O	3.02	3.65	1.41	2.88	0.92	2.13	2.06	3.20	2.66	5.04	1.67	3.50	5.34	7.20
	(1.11)	(0.70)	(0.34)	(0.30)	(0.15)	(0.18)	(0.39)	(0.34)	(0.91)	(0.89)	(0.50)	(0.57)	(2.76)	(1.53)

*HQ: Headcount, O: Overshoot, Standard errors in parentheses

Table B. 4: Determinants of the probability of incurring catastrophic health payments (Waves 2 and 6)

	Wave 2				Wave 6			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CHE (threshold: 5%)	**CHE (threshold: 10%)**	**CHE (threshold: 15%)**	**CHE (threshold: 20%)**	**CHE (threshold: 5%)**	**CHE (threshold: 10%)**	**CHE (threshold: 15%)**	**CHE (threshold: 20%)**
	Logit	**Logit**	**Logit**	**Logit**	**Logit**	**Logit**	**Logit**	**Logit**
Unmarried	-0.210	-0.181	0.088	0.006	-0.533**	-0.258	-0.173	-0.024
	(0.268)	(0.350)	(0.455)	(0.530)	(0.213)	(0.230)	(0.250)	(0.300)
Divorced	-0.385	-0.525	-0.894	-0.594	-0.432**	-0.107	-0.058	-0.146
	(0.367)	(0.385)	(0.661)	(0.740)	(0.195)	(0.203)	(0.232)	(0.270)
Widowed	-0.247	-0.191	-0.093	-0.492	-0.205	0.009	0.005	-0.126
	(0.197)	(0.256)	(0.378)	(0.360)	(0.162)	(0.163)	(0.174)	(0.189)
Male	-0.166	-0.145	-0.213	-0.101	-0.024	-0.007	-0.070	-0.195
	(0.142)	(0.173)	(0.235)	(0.262)	(0.111)	(0.113)	(0.122)	(0.141)
Age	0.044	-0.033	-0.009	0.065	-0.028	-0.109*	-0.102	-0.114
	(0.064)	(0.072)	(0.105)	(0.121)	(0.054)	(0.055)	(0.064)	(0.076)
Age squared	-0.000	0.000	0.000	-0.000	0.000	0.001*	0.001*	0.001*
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Second quintile	-0.149	-0.067	-0.160	-0.153	-0.369**	-0.412***	-0.254	-0.446**
	(0.158)	(0.190)	(0.246)	(0.322)	(0.149)	(0.145)	(0.156)	(0.181)
Third quintile	-0.016	-0.053	0.013	0.263	-0.293*	-0.265*	-0.319**	-0.400**
	(0.174)	(0.216)	(0.283)	(0.348)	(0.154)	(0.148)	(0.161)	(0.185)
Fourth quintile	-0.260	-0.425*	-0.451	0.071	-0.683***	-0.712***	-0.607***	-0.417**
	(0.191)	(0.236)	(0.328)	(0.375)	(0.156)	(0.160)	(0.179)	(0.205)
Fifth quintile	-0.487**	-0.255	-0.065	0.597	-0.746***	-0.838***	-0.793***	-0.813***
	(0.208)	(0.254)	(0.313)	(0.388)	(0.159)	(0.167)	(0.184)	(0.207)
Primary education	-0.020	-0.368**	-0.524**	-0.610**	-0.012	-0.076	-0.055	-0.440***
	(0.174)	(0.187)	(0.223)	(0.279)	(0.135)	(0.129)	(0.138)	(0.160)

Secondary education	-0.147	-0.510**	-0.713**	-0.367	-0.042	-0.057	0.062	0.074
	(0.199)	(0.225)	(0.279)	(0.329)	(0.125)	(0.119)	(0.130)	(0.146)
Tertiary education	-0.307	-0.768***	-0.823**	-0.481	0.025	0.121	0.193	-0.029
	(0.237)	(0.294)	(0.370)	(0.407)	(0.144)	(0.140)	(0.157)	(0.193)
Employed or self-employed	-0.090	-0.145	-0.471	-0.332	-0.186	-0.388**	-0.507**	-0.517*
	(0.160)	(0.218)	(0.315)	(0.349)	(0.136)	(0.154)	(0.206)	(0.272)
Unemployed	-0.868	-0.112	0.225	0.732	-0.697***	-0.505*	0.030	0.224
	(0.665)	(0.709)	(0.869)	(1.114)	(0.244)	(0.265)	(0.280)	(0.325)
Homemaker	-0.092	-0.167	-0.166	-0.215	-0.085	-0.077	-0.061	-0.096
	(0.148)	(0.184)	(0.231)	(0.310)	(0.133)	(0.129)	(0.140)	(0.163)
Other	0.517*	1.153***	0.885**	0.927**	0.165	0.439**	0.492**	0.484**
	(0.311)	(0.315)	(0.377)	(0.431)	(0.225)	(0.206)	(0.205)	(0.211)
Household size	0.147	0.144	0.093	-0.354	-0.421*	-0.183	-0.042	-0.292
	(0.236)	(0.323)	(0.422)	(0.379)	(0.219)	(0.219)	(0.259)	(0.284)
Household size squared	-0.052	-0.059	-0.041	0.022	0.038	-0.008	-0.028	0.011
	(0.037)	(0.053)	(0.066)	(0.055)	(0.036)	(0.036)	(0.045)	(0.052)
Member with multimorbidity	0.707***	0.470***	0.487***	0.402**	0.811***	0.697***	0.638***	0.621***
	(0.099)	(0.123)	(0.143)	(0.188)	(0.077)	(0.077)	(0.088)	(0.112)
Member with long-standing activity limitation	0.686***	0.842***	0.838***	0.968***	0.795***	0.766***	0.748***	0.758***
	(0.118)	(0.153)	(0.208)	(0.273)	(0.108)	(0.103)	(0.114)	(0.136)
Hospitalized member	1.375***	1.742***	1.925***	2.199***	0.982***	0.958***	0.898***	0.957***
	(0.209)	(0.203)	(0.232)	(0.232)	(0.186)	(0.150)	(0.138)	(0.148)
Constant	-2.846	-0.770	-2.312	-6.225	1.797	3.241	1.525	1.487
	(2.303)	(2.616)	(3.793)	(4.447)	(1.909)	(2.021)	(2.377)	(2.778)

Observations	2,258	2,258	2,258	2,258	3,294	3,294	3,294	3,294

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

For binary variables, the reference category is the complementary group. The reference categories for the other variables are married, first expenditure quintile, no education, retired for marital status, total household expenditure, education and employment status respectively.

Table B. 5: Determinants of the probability of incurring catastrophic health payments (Waves 2 and 6), Sartori selection estimator

	Wave 2					Wave 6				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	CHE (threshold 20%)	CHE (threshold 5%)	CHE (threshold 10%)	CHE (threshold 15%)	CHE (threshold 20%)	CHE (threshold 20%)	CHE (threshold 5%)	CHE (threshold 10%)	CHE (threshold 15%)	CHE (threshold 20%)
	Selection	Outcome	Outcome	Outcome	Outcome	Selection	Outcome	Outcome	Outcome	Outcome
Unmarried	-0.198	-0.186	-0.131	-0.051	0.001	-0.507***	-0.165	-0.058	-0.058	-0.071
	(0.172)	(0.151)	(0.178)	(0.222)	(0.273)	(0.136)	(0.115)	(0.119)	(0.133)	(0.148)
Divorced	-0.325**	-0.390***	-0.284	-0.507*	-0.211	-0.207	-0.127	-0.008	0.016	-0.017
	(0.157)	(0.150)	(0.187)	(0.277)	(0.319)	(0.129)	(0.103)	(0.108)	(0.120)	(0.136)
Widowed	-0.161	-0.262**	-0.182	-0.190	-0.201	-0.246**	-0.099	0.022	0.005	-0.084
	(0.125)	(0.103)	(0.120)	(0.147)	(0.183)	(0.106)	(0.081)	(0.082)	(0.090)	(0.101)
Male	-0.092	-0.110	-0.096	-0.124	-0.047	-0.161**	-0.056	-0.039	-0.053	-0.095
	(0.087)	(0.075)	(0.088)	(0.108)	(0.132)	(0.076)	(0.058)	(0.059)	(0.066)	(0.074)
Age	0.077**	-0.014	-0.032	-0.003	0.015	0.027	-0.036	-0.070**	-0.066**	-0.076**
	(0.037)	(0.033)	(0.038)	(0.049)	(0.060)	(0.038)	(0.029)	(0.029)	(0.032)	(0.036)
Age squared	-0.001**	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000**	0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Second quintile	0.118	-0.156*	-0.060	-0.084	-0.092	0.059	-0.153**	-0.192***	-0.138*	-0.247***
	(0.111)	(0.092)	(0.103)	(0.124)	(0.161)	(0.095)	(0.075)	(0.074)	(0.078)	(0.088)
Third quintile	0.303**	-0.087	-0.074	-0.010	0.172	0.351***	-0.075	-0.062	-0.131	-0.187**
	(0.123)	(0.101)	(0.114)	(0.136)	(0.167)	(0.107)	(0.078)	(0.075)	(0.080)	(0.089)
Fourth quintile	0.277**	-0.203*	-0.266**	-0.279*	0.075	0.050	-0.308***	-0.356***	-0.297***	-0.172*

	(0.129)	(0.107)	(0.125)	(0.155)	(0.181)	(0.102)	(0.080)	(0.080)	(0.087)	(0.095)
Fifth quintile	0.384***	-0.364***	-0.195	-0.146	0.142	0.186*	-0.344***	-0.427***	-0.426***	-0.403***
	(0.135)	(0.114)	(0.133)	(0.165)	(0.197)	(0.107)	(0.082)	(0.083)	(0.091)	(0.102)
Primary education	0.172	-0.041	-0.276***	-0.348***	-0.334**	0.024	-0.005	-0.086	-0.069	-0.271***
	(0.128)	(0.098)	(0.102)	(0.113)	(0.135)	(0.104)	(0.076)	(0.073)	(0.077)	(0.086)
Secondary education	0.143	-0.057	-0.307***	-0.438***	-0.334**	0.014	-0.093	-0.115*	-0.051	-0.019
	(0.141)	(0.110)	(0.119)	(0.141)	(0.168)	(0.085)	(0.065)	(0.065)	(0.071)	(0.077)
Tertiary education	0.010	-0.154	-0.433***	-0.435**	-0.261	0.132	-0.022	0.016	0.110	-0.004
	(0.152)	(0.125)	(0.142)	(0.174)	(0.205)	(0.099)	(0.076)	(0.077)	(0.085)	(0.096)
Employed or self-employed	-0.106	-0.145	-0.096	-0.204	-0.162	-0.083	-0.219***	-0.217***	-0.222**	-0.248**
	(0.102)	(0.091)	(0.112)	(0.150)	(0.185)	(0.095)	(0.074)	(0.080)	(0.094)	(0.112)
Unemployed	-0.284	-0.280	0.246	0.377	0.491	-0.333**	-0.458***	-0.263*	0.068	0.045
	(0.299)	(0.309)	(0.332)	(0.405)	(0.518)	(0.151)	(0.134)	(0.142)	(0.153)	(0.174)
Homemaker	0.079	-0.107	-0.142	-0.127	-0.087	-0.091	-0.096	-0.061	-0.025	-0.055
	(0.105)	(0.083)	(0.095)	(0.116)	(0.145)	(0.096)	(0.070)	(0.070)	(0.076)	(0.084)
Other	0.015	0.438**	0.737***	0.538***	0.490**	0.179	0.140	0.302***	0.339***	0.367***
	(0.245)	(0.194)	(0.187)	(0.195)	(0.219)	(0.170)	(0.120)	(0.110)	(0.110)	(0.114)
Household size	0.005	0.000	-0.022	-0.082	-0.140	-0.244*	-0.201*	-0.147	-0.122	-0.310**
	(0.151)	(0.133)	(0.162)	(0.193)	(0.223)	(0.143)	(0.108)	(0.117)	(0.133)	(0.144)
Household size squared	-0.013	-0.018	-0.017	-0.003	0.010	0.033	0.016	0.007	0.004	0.034

	(0.023)	(0.021)	(0.026)	(0.030)	(0.033)	(0.024)	(0.017)	(0.019)	(0.022)	(0.024)
Member with multimorbidity	0.486***	0.413***	0.273***	0.266***	0.233***	0.427***	0.451***	0.420***	0.363***	0.340***
	(0.072)	(0.051)	(0.058)	(0.071)	(0.086)	(0.059)	(0.040)	(0.041)	(0.045)	(0.051)
Member with long-standing activity limitation	0.294***	0.392***	0.417***	0.394***	0.389***	0.273***	0.501***	0.499***	0.461***	0.442***
	(0.091)	(0.066)	(0.075)	(0.092)	(0.114)	(0.082)	(0.057)	(0.055)	(0.059)	(0.067)
Hospitalized member	0.354**	0.821***	1.032***	1.127***	1.209***	0.224*	0.561***	0.554***	0.546***	0.534***
	(0.159)	(0.101)	(0.097)	(0.102)	(0.113)	(0.130)	(0.092)	(0.078)	(0.076)	(0.079)
Constant	-2.047	-0.004	0.224	-1.135	-2.659	0.380	1.693	2.113**	1.171	1.389
	(1.338)	(1.185)	(1.414)	(1.808)	(2.239)	(1.318)	(1.032)	(1.052)	(1.166)	(1.307)
Observations	2,258	2,258	2,258	2,258	2,258	3,294	3,294	3,294	3,294	3,294

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

For binary variables, the reference category is the complementary group. The reference categories for the other variables are married, first expenditure quintile, no education, retired for marital status, total household expenditure, education and employment status respectively

Appendix C: Supplementary Material to Chapter 4

Table C. 1: Definition of variables

Variable	Definition
Dependent variables	
BW	Birth weight in grams
LBW	=1 if BW<2,500 =0 if BW>=2,500
Preterm birth	=1 if pregnancy length<37 =0 if pregnancy length>=37
Stillbirth	=1 if born dead =0 if born alive
Fetal growth	Birth weight divided by gestational age (in weeks)
Independent variables	
Business cycle fluctuation in the first trimester	Continuous variable for the economic fluctuations during the first trimester of pregnancy
Business cycle fluctuation in the second trimester	Continuous variable for the economic fluctuations during the second trimester of pregnancy
Business cycle fluctuation in the third trimester	Continuous variable for the economic fluctuations during the third trimester of pregnancy
Married	=1 if married or living with partner, =0 otherwise
Age 15-24	=1 if age≥15 and age≤24, =0 otherwise
Age 25-29	=1 if age≥25 and age≤29, =0 otherwise
Age 30-34	=1 if age≥30 and age≤34, =0 otherwise
Age 35-39	=1 if age≥35 and age≤39, =0 otherwise
Age≥40	=1 if age≥40, =0 otherwise
Up to primary education	=1 if highest educational level is primary education, =0 otherwise
Lower secondary education	=1 if highest educational level is lower secondary education, =0 otherwise
Upper secondary education	=1 if highest educational level is upper secondary education, =0 otherwise
University education	=1 if highest educational level is university education, =0 otherwise
Total children	Continuous variable with the total number of deliveries by the pregnant woman
Multiple birth	=1 if multiple birth, =0 otherwise
Male	=1 if male, =0 otherwise
Greek nationality	=1 if mother is Greek, =0 otherwise

Table C. 2: Summary statistics for birth outcomes and Economic Sentiment Indicator (2008-2015)

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
BW (in grams)	3147.1	3135.8	3124.5	3125.1	3123.8	3115.9	3127.2	3126.5
LBW (%)	8.61	9.13	9.60	9.30	9.37	9.61	9.59	9.49
Preterm (%)	9.83	10.51	11.44	11.22	11.02	11.69	11.78	11.54
Pregnancy length	38.21	38.20	38.17	38.18	38.14	38.10	38.09	38.10
Macrosomia	3.29	3.19	3.06	3.05	2.99	2.78	3.03	2.94
Male (%)	51.54	51.60	51.53	51.57	51.49	51.47	51.42	51.49
Stillbirth (%)	0.33	0.43	0.43	0.40	0.44	0.40	0.38	0.34
ESI	100.00	82.7	82.9	81.6	80.9	91.6	100.5	89.7

Table C. 3: Regression estimates for birth weight (sensitivity analysis)

	Total				High-SES				Low-SES			
	(1)	(2)	(3)	(4)^	(5)	(6)	(7)	(8)^	(9)	(10)	(11)	(12)^
	BW	BW	BW	BW	BW	BW	BW	BW	BW	BW	BW	BW
EC 1st trimester	115.6***	129.2***	163.7***	-16.18***	79.40*	80.01*	76.73	-19.28***	178.8***	180.5***	233.9***	-14.83***
	(20.57)	(22.22)	(26.99)	(2.432)	(40.93)	(41.20)	(58.25)	(5.395)	(28.41)	(28.35)	(35.25)	(3.266)
EC 2nd trimester	52.83***	43.48**	48.20**	-2.448	46.29	53.23	72.08	-2.175	20.72	18.68	5.447	2.875
	(18.09)	(18.09)	(21.27)	(2.718)	(42.47)	(42.53)	(54.68)	(4.345)	(27.22)	(27.45)	(34.40)	(4.205)
EC 3rd trimester	57.94***	64.33***	79.13***	-7.310***	35.56	35.26	-2.038	-1.009	110.2***	111.7***	158.4***	-15.44***
	(14.61)	(14.80)	(17.19)	(1.688)	(41.45)	(40.76)	(44.56)	(3.859)	(20.10)	(20.22)	(27.92)	(2.341)
Marital status	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Age	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Number of children	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Multiple birth	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes
Male	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Education	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No	Yes
Greek	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,045***	3,097***	3,051***	3,231***	3,103***	3,108***	3,122***	3,278***	3,100***	3,140***	3,080***	3,291***
	(6.056)	(8.223)	(7.277)	(9.952)	(18.77)	(12.59)	(17.38)	(20.81)	(13.57)	(7.378)	(17.63)	(17.10)

Observations	826,218	800,970	800,970	800,970	156,794	156,794	156,794	156,794	438,889	438,889	438,889	438,889
R-squared	0.188	0.184	0.037	0.191	0.236	0.232	0.037	0.238	0.176	0.175	0.039	0.179

^ Columns 4, 8 and 12 present the estimates for the baseline regression model, using unemployment rate as a proxy for economic conditions during pregnancy.

Table C. 4: Robustness checks using Economic Policy Uncertainty Index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	BW	**LBW**	**Pregnancy length**	**Preterm birth**	**Macrosomia**	**Stillbirth**	**Male**	**Foetal growth**
EC 1st trimester	-37.12***	0.225***	-0.205***	0.330***	-0.134***	0.445***	-0.000880	-0.644***
	(4.401)	(0.0416)	(0.0208)	(0.0381)	(0.0332)	(0.132)	(0.0133)	(0.114)
EC 2nd trimester	3.160	-0.0653**	-0.00874	0.0163	-0.00130	-0.0259	-0.00536	0.127
	(3.911)	(0.0329)	(0.0199)	(0.0474)	(0.0357)	(0.199)	(0.0149)	(0.0947)
EC 3rd trimester	-10.81**	0.0938***	-0.104***	0.149***	0.0141	0.196	0.0146	-0.148
	(4.201)	(0.0348)	(0.0204)	(0.0441)	(0.0334)	(0.186)	(0.0160)	(0.113)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,253***	-3.069***	40.05***	-4.265***	-3.324***	-7.534***	0.0353	81.64***
	(29.27)	(0.305)	(0.222)	(0.354)	(0.270)	(1.248)	(0.112)	(0.962)
Observations	800,970	800,970	805,105	805,105	800,970	810,410	807,244	799,668
R-squared	0.189		0.171					0.161

Table C. 5: Robustness checks using Economic Sentiment Indicator (without HP filter)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	BW	**LBW**	**Pregnancy length**	**Preterm birth**	**Macrosomia**	**Stillbirth**	**Male**	**Foetal growth**
EC 1st trimester	152.6***	-1.227***	0.793***	-1.157***	0.433***	-0.801	0.0388	2.883***
	(20.63)	(0.217)	(0.113)	(0.231)	(0.157)	(0.578)	(0.0564)	(0.495)
EC 2nd trimester	27.90	0.0784	0.0184	-0.0897	0.371	-1.016*	0.0732	0.428
	(17.72)	(0.190)	(0.0945)	(0.209)	(0.259)	(0.587)	(0.0818)	(0.397)
EC 3rd trimester	95.42***	-0.706***	0.758***	-0.929***	0.283	-0.682	0.00178	1.453***
	(13.44)	(0.134)	(0.0918)	(0.187)	(0.180)	(0.697)	(0.0633)	(0.314)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1,764***	6.724***	31.30***	8.100***	-8.936***	6.885**	-0.458	56.42***
	(107.0)	(0.828)	(0.692)	(1.253)	(0.922)	(3.321)	(0.294)	(2.280)
Observations	800,970	800,970	805,105	805,105	800,970	810,410	807,244	799,668
R-squared	0.189		0.172					0.161

Table C. 6: Robustness checks using Economic Sentiment Indicator (with Butterworth filter)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	BW	**LBW**	**Pregnancy length**	**Preterm birth**	**Macrosomia**	**Stillbirth**	**Male**	**Foetal growth**
EC 1st trimester	129.9***	-1.096***	0.655***	-0.822***	0.364*	-0.354	0.0519	2.547***
	(23.91)	(0.216)	(0.119)	(0.254)	(0.186)	(0.668)	(0.0645)	(0.572)
EC 2nd trimester	45.63**	-0.00888	0.122	-0.253	0.447	-1.230**	0.0740	0.718*
	(17.80)	(0.191)	(0.0947)	(0.214)	(0.262)	(0.588)	(0.0828)	(0.402)
EC 3rd trimester	59.29***	-0.500***	0.548***	-0.499***	0.113	-0.248	0.00491	0.858**
	(15.71)	(0.142)	(0.0861)	(0.182)	(0.195)	(0.741)	(0.0686)	(0.359)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,033***	-1.802***	38.51***	-1.916***	-3.938***	-4.614***	0.0625***	78.32***
	(7.943)	(0.0663)	(0.0762)	(0.0884)	(0.0689)	(0.143)	(0.0151)	(0.271)
Observations	800,970	800,970	805,105	805,105	800,970	810,410	807,244	799,668
R-squared	0.189		0.171					0.161

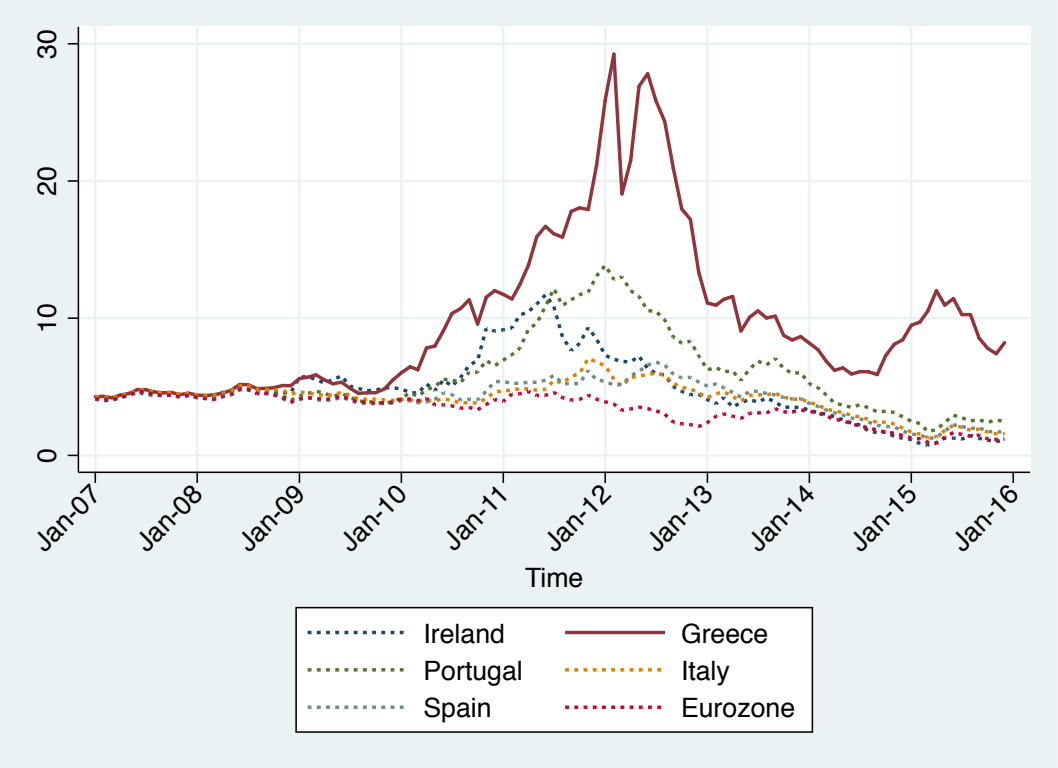
Table C. 7: Economic conditions during pregnancy and birth outcomes among low-SES families

	EPU		ESI without HP filter		ESI with Butterworth filter	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	BW	**LBW**	**BW**	**LBW**	**BW**	**LBW**
EC 1st trimester	-41.11***	0.258***	209.4***	-1.567***	182.9***	-1.385***
	(5.640)	(0.0561)	(25.53)	(0.234)	(30.46)	(0.249)
EC 2nd trimester	7.183	-0.0688	3.162	0.0864	24.71	-0.0285
	(4.352)	(0.0419)	(27.61)	(0.219)	(26.89)	(0.218)
EC 3rd trimester	-14.62**	0.107**	154.4***	-1.029***	105.9***	-0.725***
	(6.554)	(0.0531)	(18.64)	(0.209)	(21.32)	(0.224)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,340***	-3.618***	1,411***	9.408***	3,098***	-2.124***
	(43.43)	(0.440)	(167.8)	(1.299)	(13.48)	(0.0866)
Observations	438,889	438,889	438,889	438,889	438,889	438,889
R-squared	0.177		0.177		0.177	

Table C. 8: Economic conditions during pregnancy and birth outcomes among high-SES families

	EPU		**ESI without HP filter**		**ESI with Butterworth filter**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	BW	**LBW**	**BW**	**LBW**	**BW**	**LBW**
EC 1st trimester	-31.85***	0.175**	94.00**	-0.919***	86.29**	-0.882**
	(10.59)	(0.0713)	(41.03)	(0.355)	(41.18)	(0.359)
EC 2nd trimester	-5.502	-0.0161	37.59	0.185	47.06	0.150
	(9.013)	(0.0887)	(42.70)	(0.369)	(42.47)	(0.366)
EC 3rd trimester	-9.178	0.152**	50.74	-0.279	37.93	-0.233
	(5.858)	(0.0702)	(41.39)	(0.359)	(41.08)	(0.385)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes
Year of birth FE	Yes	Yes	Yes	Yes	Yes	Yes
Month of birth FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Day of week FE	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3,327***	-3.484***	2,268***	2.653	3,105***	-2.003***
	(54.54)	(0.647)	(218.9)	(1.644)	(19.10)	(0.223)
Observations	156,794	156,794	156,794	156,794	156,794	156,794
R-squared	0.236		0.236		0.236	

Figure C. 1: Long-term interest rate of government bonds maturing in 10 years



Source: OECD

Appendix D: Published papers