

# Recent Trends in Public and Private Debts: Cross Country Comparison

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**Abstract** This paper examines the evolution of government, household, and corporate debt across countries in response to the 2008 Great Recession and the extent to which these debts have been rebalanced. We examine 37 OECD countries from 2005 to 2019 classify them into 8 groups of countries that share comparable trends in debt evolution. We find that groups of countries show similar patterns of debt dynamics within each group, while the patterns are distinct across different groups. Policymakers may benefit from knowing who their peer countries are in terms of debt dynamics.

**Keywords** Public debt · Government debt · Household debt · Private debt · Recessions

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## Introduction

Examining the evolution of public debt is essential when assessing a country's economic conditions because it affects macroeconomic performance (OECD, 2012). Existing studies have demonstrated that high levels of public debt can slow economic growth to a greater extent than high but declining levels of public debt (Reinhart and Rogoff, 2011). During times of recession, governments increase spending to alleviate the economic crisis, inevitably increasing public debt (Biró and Elek, 2020), but this could be dangerous because it is difficult to cut back on public spending after the economy recovers (Savage, 2019). Not surprisingly, the status and evolution of public debt have drawn attention from researchers and policy makers.

Private debt is another crucial economic factor to diagnose economic conditions because agents with high levels of debt are likely vulnerable to negative economic shocks. For example, in 2008, the Global Financial Crisis resulted in an exponential increase in household debt in the United States, which led to a huge expansion of mortgages granted to high-risk borrowers. This caused US economic growth to plummet in the following years (Milan and Sufi, 2010). Furthermore, in 1997, the Asian Financial Crisis broke out due to the crash of the bubble economy, which made it nearly impossible for many Asian firms to renew their short-term debts (Warwick and Will, 1999).

However, relative to public debt, less attention has been given to private debt, and even when private debt has been studied, it has not been examined jointly with public debt. Thus, we aim to contribute to the literature by systematically examining how the debts of governments, households, and firms in various countries changed in response to the 2008 Great Recession and related crises, and the extent to which these debts have been rebalanced as of 2019.

The main objective of this paper is to classify countries that share similar time-series patterns in terms of their public, household, and corporate debt levels during and after the 2008 Great Recession. This paper provides descriptive analyses based on the evolution of debt levels across countries and does not aim to explain the driving forces behind these changes. This limitation is because our purpose is to find common patterns across countries in terms of evolution of public and private debts. Identifying the driving forces would naturally require country-level in-depth analysis to account for unique political, social, and historical backgrounds, which is beyond the scope of this paper.

We construct our dataset mainly based on the Global Debt Database compiled by International Monetary Fund (IMF), supplementing it with several data sources. Our dataset includes public and private debt, unemployment rates, employment rates, exchange rates from local currency to US dollars, and real GDP per capita for 37 OECD member countries from 2001 to 2019. The outcome variables of interest are public debt represented by general government debt and central government debt, and private debt represented by non-financial corporate debt and household debt. Note that we omit financial firms from our analysis because they mediate borrowing and lending among clients, making them hold sizable borrowing, and we do not have a systematic dataset that informs us of the "net" liability for them. As we are aware of the importance of financial firms in an economy, our analysis is limited but nevertheless provides more information on the evolution public, households, and non-financial corporate debt.

General government debt measures the gross debt of the general government and acts as a key indicator of the sustainability of government finance because it is a direct indicator of

government deficits. Central government debt is a subsector of general government debt along with state and local government debt. We use both general government debt and central government debt because the central government debt is more likely to be subject to “monetization,” as central banks do not generally buy or discount local government debt (Chouraqui et al., 1986). However, because financial systems vary between countries, we must be cautious about international comparison of the data, which is why we include general government debt to check for consistency. As defined in the System of National Accounts 2008, private debt, also known as private credit, includes any debt extended to private institutions or individuals, both public and private non-financial corporations, households, and non-profit institutions serving households.

**Table 1** Classification of Countries into Groups

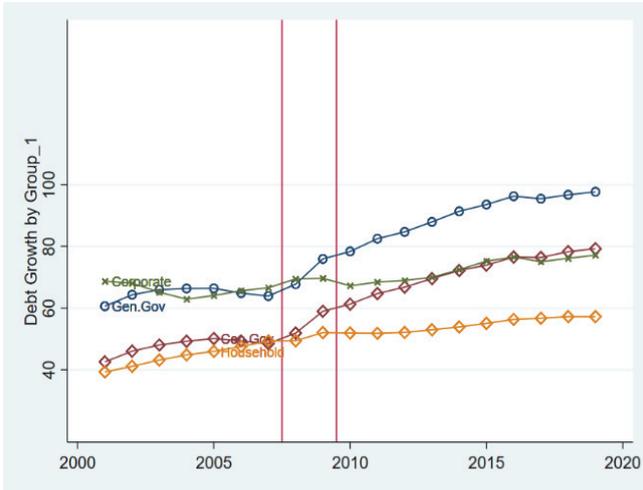
Classification	Period 1 (2008-2010)	Period 2 (2011-2019)	Countries
Group 1	Dominant increase in Government debt	Both government and private debt continues to grow	Australia, Colombia, Japan, France, Mexico
Group 2	Dominant increase in Government debt	Government debt continues to grow while private debt decreases	Greece, Portugal, Spain, United Kingdom, United States
Group 3	Dominant increase in non-financial corporate debt	Public debt settles while private debt increases	Norway, Sweden, Switzerland, Turkey
Group 4	Dominant increase in non-financial corporate debt	Public debt increases while the corporate debt remains or decreases	Estonia, Italy, Latvia, Lithuania, New Zealand, Slovenia
Group 5	Dominant increase in non-financial corporate debt	Public debt gradually increases. Private debt increases	Belgium, Chile, Finland, Luxembourg, Korea
Group 6	Dominant increase in Household debt	Private debt increases. Public debt increases but gradually recovers	Canada, Czech Republic, Poland, Slovak Republic
Group 7	Dominant increase in Private debt	Government and firm debt increase, but gradually decrease. Household debt settles	Denmark, Ireland, Netherlands
Group 8	Others: No clear dominant type, but increases in all debt types	Government and Firm debts increase Household debt decreases	Austria, Germany, Hungary, Iceland, Israel

Note: This table provides the standards for group classification. There are 37 countries, divided into 8 groups, where each group is divided by its trend changes in debt types during period 1 and period 2. We gather debt information on general government debt from the World Economic Outlook published in October 2020 by IMF and central government debt, non-financial corporate debt, and household debt data from the Global Debt Database published in 2018 and revised in 2021 by IMF. We filled in the missing data from the World Development Indicators compiled by the World Bank. Government debt includes general and central government debt.

**Panel 1.**

**Group 1 (Australia, Colombia, Japan, France, Mexico):**

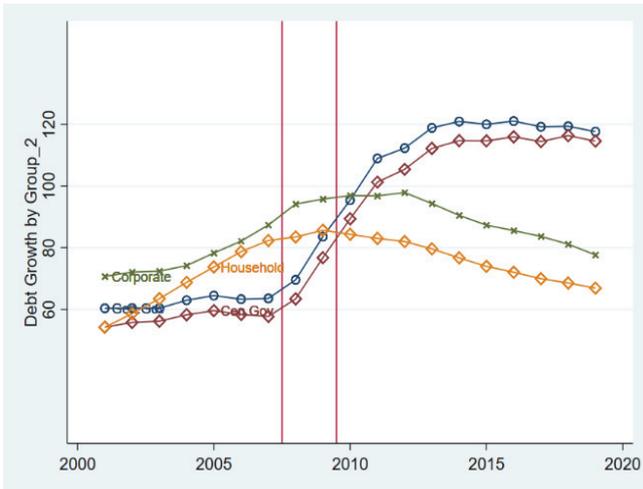
Public debt increased dominantly during the recession, and the trend is continuing.



**Panel 2.**

**Group 2 (Greece, Portugal, Spain, United Kingdom, United States):**

Public debt increased dominantly during the recession. Public debt continues rising while private debt is settling.

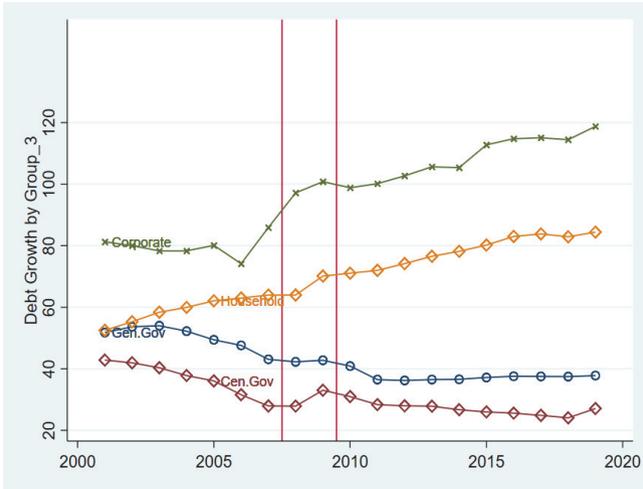


**Fig. 1** Time Series Patterns of Public and Private Debt by Group

**Panel 3.**

**Group 3 (Norway, Sweden, Switzerland, Turkey):**

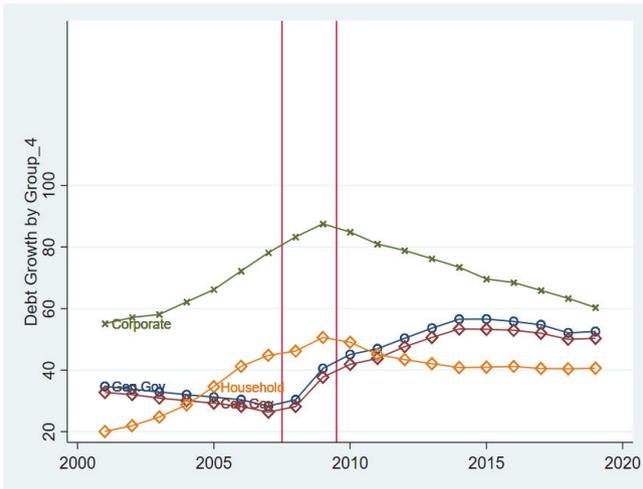
Corporate debt dominantly increased during the crisis and continues to increase along with household debt, while public debt is settling.



**Panel 4.**

**Group 4 (Estonia, Italy, Latvia, Lithuania, New Zealand, Slovenia):**

Corporate debt dominantly increased during the crisis, but private debt is decreasing while public debt is increasing.

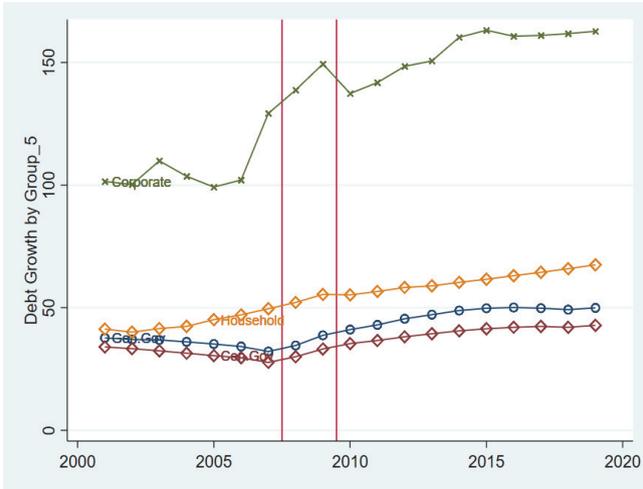


**Fig. 1** Time Series Patterns of Public and Private Debt by Group (continued)

**Panel 5.**

**Group 5 (Belgium, Chile, Finland, Luxembourg, Korea):**

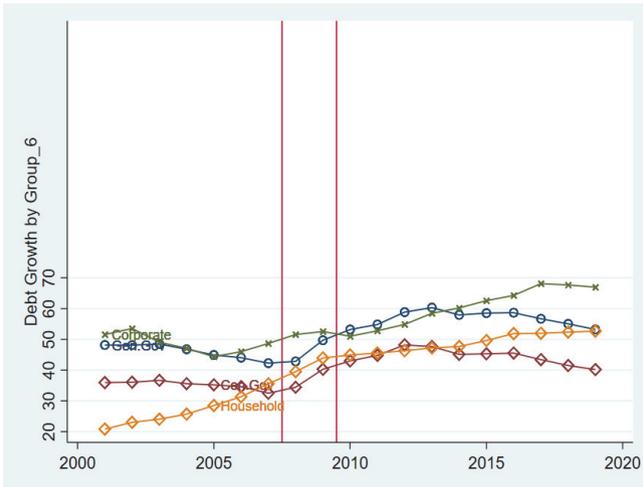
Corporate debt dominantly increased during the crisis and continues to increase. Both public and private debt also are gradually increasing.



**Panel 6.**

**Group 6 (Canada, Czech Republic, Poland, Slovak Republic):**

Household debt increased dominantly during the crisis, and both public and private debts continued to increase. However, public debt has been gradually recovering since 2015.

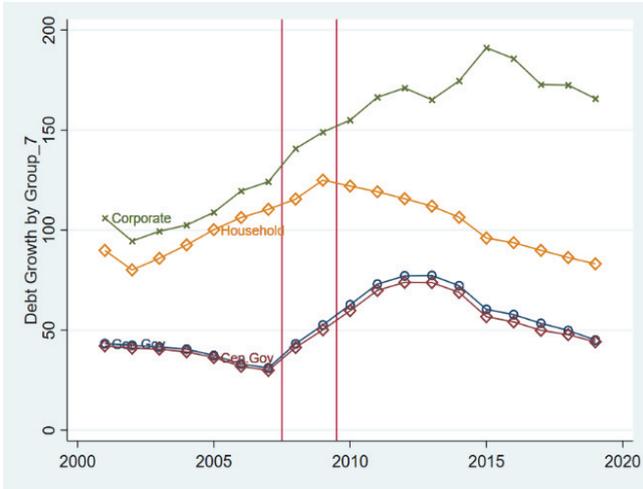


**Fig. 1** Time Series Patterns of Public and Private Debt by Group (continued)

**Panel 7.**

**Group 7 (Denmark, Ireland, Netherlands):**

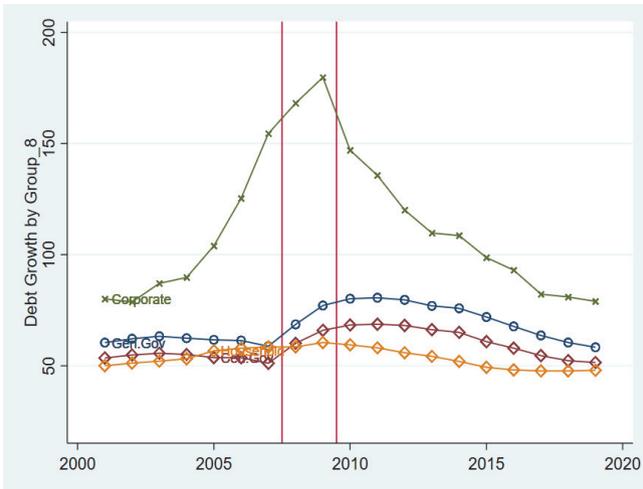
Corporate and household debt dominantly increased during the crisis, but afterward, household debt was alleviated. The government and firm debts continued to increase but gradually recovered from 2014 and 2015, respectively.



**Panel 8.**

**Group 8 (Austria, Germany, Hungary, Iceland, Israel):**

We define this group as Others. No dominant increase was clearly defined, but the recovery pattern for all debt types is similar and relatively well alleviated for all types.



**Fig. 1** Time Series Patterns of Public and Private Debt by Group (continued)

Based on time trends in public and private debt, we divide 37 OECD countries into 8 groups.<sup>1</sup> Groups 1 and 2 include countries where government debts show a dominant increase during the Global Financial Crisis. Group 1 includes countries with this trend in addition to an increase in private debt, while Group 2 includes countries with this trend and a decrease in private debt. Groups 3, 4, and 5 include countries where non-financial corporate debts show a dominant increase during the economic crisis. Group 3 includes countries that settled growing public debt trends while private debts increased; Group 4 includes countries with continued increasing public debt in combination with decreasing private debt, and Group 5 includes countries where both public and private debt rates increase. Group 6 includes countries where both private and public debt increase, but the dominant increase was in household debts between 2008 and 2010. Group 7 includes countries where both corporate and household debts show a dominant increase during the crisis, followed by a decrease in household debt and a continued increase in government and corporate debts, but these rates eventually settle. Finally, Group 8 consists of countries where no single debt type shows a clear and common dominant increase between 2008 and 2010, but where government and corporate debts increase while household debts settle or slightly increase after 2011. The panels of Figure 1 show the time-series patterns for each group.

The remainder of this paper is organized as follows. Section 2 briefly reviews existing studies on public and private debts. Section 3 describes the data and the sample we use for the study, while Section 4 presents the econometric framework. Section 5 reports our results, and Section 6 concludes.

## Related Studies

Trends in public and private debt have been widely analyzed in the literature since the outbreak of the economic crisis in 2008 (Hoffman and Lemieux, 2016). For instance, previous empirical studies have identified that job losses lead to a massive transition to disability insurance, causing social expenditures, particularly on health services, to increase (e.g., Brio and Elek, 2020, and Keegan et al., 2013). This increase in social expenditures often leads to an increase in public debt.

In addition, various studies have used the latest trends in fiscal balance and a focus on public and private debt and public spending. Among them, our paper is closely related to Isomitdinov et al. (2020), Karanikolos et al. (2016), Berkmen et al. (2012), and Engemann and Wall (2009). All four papers classify countries and examine the evolution of debts, as we do. However, different from us, their classification is based on pre-determined characteristics such as region of a country, income level, and demographics.

Another strand of literature this paper is related to is studies examining correlations among types of debts and other economic outcomes. For example, Bernardi and Forni (2020) examine

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<sup>1</sup> See details in Table 1. Group 1 includes Australia, Colombia, Japan, France and Mexico; Group 2 includes Greece, Portugal, Spain, United Kingdom, and United States; Group 3 includes Norway, Sweden, Switzerland, and Turkey; Group 4 includes Estonia, Italy, Latvia, Lithuania, New Zealand, and Slovenia; Group 5 includes; Group 6 includes Canada, Czech Republic, Poland, Slovak Republic; Group 7 includes Denmark, Ireland, and Netherlands; and Group 8 includes Austria, Germany, Hungary, Iceland, and Israel.

correlation between private and public debt during an economic recession, using data from 200 countries, from 1950 to 2015. Batini et al. (2019) examines European countries from 1980 to 2014 and finds that while high private debt leads to deeper recessions, high public debt does not necessarily do so. Chang et al. (2016) empirically reports a positive correlation between social spending and government debt in the short term, using central government debt data for 13 OECD member countries from 1980 to 2010. Our paper complements these studies by reporting groups of countries exhibiting common time-series patterns over public, household, and non-financial firms.

## Data and Sample

We use the Global Debt Database provided by IMF as our main data source. We collect a dataset that includes public and private debt, macroeconomic indicators, and social indicators for all 37 OECD member countries from 2001 to 2019. The debt data is based on the annual average rates of central government debt, household debt, and non-financial corporate debt as percentages of GDP. Unfortunately, the data disclosed by IMF is not complete and does not include all data for all countries. Therefore, we complement the missing data from the World Economic Outlook database published in October 2020, the World Development Indicators by World Bank, Eurostat, and other national sources. We merge the datasets by aggregating by country and year. Thus, the unit of observation in our analysis is country by year.

For public debt, we use both general government debt and central government debt. For private debt, we collect separate data on household and non-financial corporate debt. We additionally collect data from the Bank of International Settlements (BIS) including general government, household, and non-financial corporate debt, as well as credit to the private non-financial sector from all sectors at market value. As BIS does not cover all OECD member countries and the data is not adjusted, we use this data as a robustness check. BIS data covers the credits of 31 OECD member countries from 2001 to 2019; Estonia, Iceland, Latvia, Lithuania, Slovak Republic, and Slovenia are not included. Data is provided quarterly, so we convert the data into an annual measurement by calculating the average of four unadjusted periods.

We restrict the sample from 2005 to 2007, 2008 to 2010, and 2011 to 2019. We choose these sample periods for the following reasons. We select three years before and after the 2008 Financial Crisis, coinciding with the layoff announcements by Lehman Brothers. Panel B of Table 2 reports that the average unemployment rates of OECD countries increased in the second period in comparison to the first period, while the employment rates dropped. These trends also shifted in the third period, from 2011 to 2019. Therefore, we consider the period from 2008 to 2010 as the treatment period for the 2008 Financial Crisis. We use the period from 2005 to 2010 for our empirical analyses and compare it with the period from 2011 to 2019. Our dataset goes until 2019 because not all OECD member countries disclose adjusted debt-to-GDP ratios for the next years. Since our dataset is aggregated by year, we compile a complete dataset up to 2019. Panels A and B of Table 2 report the means for socio-economic trends across OECD member countries according to our dataset. Each column represents the trend before, during, and after the economic crisis. Table 2 reports the summary statistics of our sample depending on the stage of the economic crisis: three years before the economic crisis occurs

(column (1)), three years including and after 2008 when the economic crisis hit the global economy (column (2)), and the period from 2011 following the crisis (column (3)). We identify the latter two periods as post1 and post2.

Next, we classify the indicators into two types based on their characteristics – macroeconomic indicators and social indicators. We use aggregate data from OECD Stats and the World Bank's World Development Indicators for both macroeconomic and social indicators. Macroeconomic data include GDP per capita (real), unemployment and employment rates, and exchange rates of US dollars into local currency. We exploit data for GDP per capita and currency exchange rates (constant, USD) from World Development Indicators, and unemployment and employment rates from OECD Stats.

**Table 2** Summary Statistics

	Before (2005-2007) (1)	During (2008-2010) (2)	After (2011-2019) (3)
<b>Panel A. Debts and Expenditures (% of GDP)</b>			
<b>A1. Debt Data from IMF</b>			
General Government Debt	47.548	56.865	68.248
Central Government Debt	40.011	48.776	59.521
Household Debt	56.524	63.389	61.608
Non-financial Corporate Debt	87.073	105.79	100.796
<b>A2. Debt Data from BIS</b>			
General Government Debt	55.696	59.235	72.511
Non-financial Corporate Debt	102.494	120.494	131.322
Household Debt	63.288	73.808	74.532
<b>A3. Expenditure Data from OECD</b>			
Social Expenditure	18.211	20.16	20.66
Health Expenditure	7.888	8.556	8.735
Public Employment Spending	1.232	1.405	1.309
<b>Panel B. Macroeconomic Variables</b>			
Exchange rate <sup>1</sup>	114.05	113.353	125.372
Employment rate <sup>2</sup>	66.35	65.85	67.37
GDP per Capita <sup>3</sup>	38,010	38,193	40,846
Unemployment <sup>4</sup>	6.74	7.94	7.99
Working Population <sup>5</sup>	67.242	67.261	66.146

Note: This table provides mean values of key variables across three time periods from 2005 to 2019. The data is divided into debts and expenditures in Panel A and macroeconomic variables in Panel B. The unit of observation is country by year. We use the IMF Global Debt Database for Panel A1, BIS credit data for Panel A.2, and OECD expenditure data for Panel A3. We use OECD data for macroeconomic variables in Panel B. <sup>1</sup> The exchange rate is calculated by the total constant national currency unit/US dollars. <sup>2</sup> The employment rate is the ratio of the employed to the working population. We complement missing data for Colombia from the World Bank, Germany from the German National Statistical Bureau (Destatis), France and Switzerland from FRED, and Lithuania and Luxembourg from Eurostat. <sup>3</sup> GDP per capita is converted into US dollars, at a constant rate. <sup>4</sup> Unemployment rates: an unemployed person as a percentage of the labor force. Since each country has different measures for calculating the unemployment rate, data given by OECD depends on the data provided by LFS (Labor Force Survey). For European countries, data from LFS is not available, so data is taken from EUROSTAT. For unemployment rates, we complement missing data from the World Bank's World Development Indicators from January 2021. <sup>5</sup> Working population: population of people in the age group of 15 to 64.

**Table 2** Summary Statistics (continued)

	<b>Before (2005-2007) (1)</b>	<b>During (2008-2010) (2)</b>	<b>After (2011-2019) (3)</b>
<b>Panel C. Debt by Groups and Periods</b>			
<b><u>General Government Debt</u></b>			
Group 1	65.041	74.007	91.794
Group 2	63.767	82.848	117.579
Group 3	46.691	41.963	37.033
Group 4	29.967	38.658	53.247
Group 5	33.838	38.135	48.142
Group 6	43.74	48.578	57.112
Group 7	33.83	52.801	62.892
Group 8	60.609	75.306	70.577
<b><u>Central Government Debt</u></b>			
Group 1	49.295	57.36	73.061
Group 2	58.55	76.504	112.159
Group 3	31.855	30.621	26.479
Group 4	27.941	35.906	50.434
Group 5	29.244	32.845	40.59
Group 6	34.105	39.224	44.626
Group 7	32.672	50.394	59.877
Group 8	52.812	64.814	60.583
<b><u>Household Debt</u></b>			
Group 1	47.586	51.103	54.798
Group 2	78.259	84.473	74.743
Group 3	63.008	68.39	79.465
Group 4	40.21	48.613	41.677
Group 5	47.27	54.266	61.843
Group 6	31.797	42.785	49.463
Group 7	105.623	120.836	100.246
Group 8	57.693	59.457	51.213
<b><u>Non-financial Corporate Debt</u></b>			
Group 1	65.413	68.761	73.315
Group 2	82.583	95.606	88.314
Group 3	80.053	98.921	109.959
Group 4	72.173	85.212	70.788
Group 5	110.169	141.823	156.714
Group 6	46.342	51.705	61.763
Group 7	117.54	148.231	173.894
Group 8	127.929	164.963	100.891

Note: This table provides mean values of outcome variables in each period in Panel A1 by group. Unit of debt is the percentage of debt to the nominal GDP. See Table 1 for the classifications

For some countries, unemployment and employment rates are missing from OECD Stats. For those cases, we rely on statistics from World Bank, the Federal Reserve Bank of St. Louis, Eurostat, and the German National Bureau of Statistics (Destatis). Finally, we include social data covering spending by the government, such as social expenditure, health expenditure, and public employment spending.

We first analyze how each country's debt rates changed, narrow the analysis to debt rate change due to macroeconomic factors, and then analyze the relationship between the debt rate change and social spending by the government.

## Econometric Framework

Our paper extends the statistical framework in Lee (2018) and applies it in examining the evolution of public and private debt, while Lee (2018) divides a sample of 8 European countries into two groups based on the degree of the change in unemployment rates before and after the 2008 crisis.

Specifically, we examine the differences in the magnitude of the impact of the 2008 Global Financial Crisis on each country by estimating the following DID specification:

$$\begin{aligned} Debt_{kt} = & \alpha + \beta_1 \left( 1(\text{country}_k \in \text{group}_g) \times 1(t \in \text{post1}) \right) \\ & + \beta_2 \left( 1(\text{country}_k \in \text{group}_g) \times 1(t \in \text{post2}) \right) + \gamma X_{kt} \\ & + \theta_k + \vartheta_t + \varepsilon_{kt} \end{aligned}$$

where  $Debt_{kt}$  is the rate of debt as a percentage of GDP of country  $k$  in year  $t$ . We interact the dummies “post1” and “post2,” which are indicators covering 2008-2010 and 2011-2019, with  $\text{country}_k$  classified into  $\text{group}_g$  based on its debt evolution pattern. Therefore,  $1(\text{country}_k \in \text{group}_g) \times 1(t \in \text{post1})$  represents the evolution of public and private debt in the three years following the Great Recession, and  $1(\text{country}_k \in \text{group}_g) \times 1(t \in \text{post2})$  represents the evolution in the period after that. Parameters  $\beta_1$  and  $\beta_2$  capture the impact of the Great Recession for the countries belonging to Group  $k$ , during periods “post1” and “post2,” respectively. Variable  $X_{kt}$  includes macroeconomic and social indicators: GDP per capita, rates of employment and unemployment, and currency exchange rates in USD. See details regarding the construction of these variables in Table 2. Parameters  $\theta_k$  and  $\vartheta_t$  capture country- and year-fixed effects. Variable  $\varepsilon_{kt}$  captures unexplained random shocks.

We assume that the trends in public and private debt rates would have increased at a different magnitude and that different types of debt would have varying patterns. To test the plausibility of our assumption, we restrict our sample to 2008 to 2010 and estimate a linear regression model including the interaction effects between the two indicators: one for each country's debt-to-GDP ratio by type and one for the year 2008 to 2010. Similarly, we include the same interaction effects between debt rates and the years 2011 to 2019. If countries share the same time trends, then the interaction effects should not be different from 0, which is what we find.

## Results

Columns (1) to (3) of Table 3 present our estimates of the impact of the economic recession on each country's debt-to-GDP ratio. Conditional on time and country fixed effects, both government debt and private debt increased during the economic crisis. We classify countries into different categories based on which types of debts were dominantly affected during the Great Recession.

Next, we examine whether the impact of the economic crisis on debt rates depends on the initial macroeconomic level of each country. To test this possibility, we include control variables to narrow down the correlational influence of macroeconomic indicators, such as unemployment and employment rates, currency exchange rate, and GDP per capita, in equation (1). We regress the debt rates of country  $k$  in year  $t$  on the explanatory variables and added control variables. Table 3 reports the results of the impact of the economic crisis on the trends of public and private debt. With the controls, we find a stronger correlation of the interaction variable of country  $k$  in year  $t$  on debt rates, especially during the post2 period, which is three years after the outbreak of the economic crisis.

Table 3 shows the results for each country's debt trend in public and private debt for period 1 and period 2, which we name post1 and post2. The two types of public debt, general government debt and central government debt, reveal similar trends. Both types of debt increase and decrease in a similar pattern but differ in magnitude. During the post1 period, from 2008 to 2010, we note that the public government debt dominantly increased in 13 countries – Austria, Australia, Colombia, France, Germany, Greece, Mexico, the Netherlands, Japan, Portugal, Spain, the United Kingdom, and the United States. The result is most notable in Greece and the United Kingdom, which saw respective increases of 28.552% and 26.218% during period 1 at a statistically significant level of 1%. Private debt includes two types of debt: non-financial corporate debt and household debt. Non-financial corporate debt showed a dominant increase in 19 countries, with 5 countries, Canada, the Czech Republic, Denmark, Poland, and the Slovak Republic, seeing household debt rates increase the most. These results demonstrate that the impact was more severe for non-financial corporate debt during this period, as some countries in the former group, such as Iceland, Ireland, and Luxembourg, experienced respective increases of 156.965%, 60.910%, and 92.555%, and Canada and Denmark in the latter group experienced increases of 18.01% and 18.426%. These results are all statistically significant at the conventional level.

We then classify countries into eight groups based on the change in debt trends in each country during period 2, which we define as the period from 2011 to 2019. Table 1 presents the classification in detail. Table 4 displays our estimates of the impact of the economic crisis on public and private debt types for each group. Each column in Table 4 represents the result of a different regression. Columns (1) and (2) demonstrate the impact on public debt; columns (3) and (4) show the impact on private debt. Groups 1 and 2 include countries where government debt dominantly increased during the Global Financial Crisis. We exclude Austria, Germany, and the Netherlands from these groups because their public debt rates were relatively alleviated or increased at a moderate rate compared to increases in other debt types during period 2. Therefore, we classify the remaining 10 countries that share this trend during period 1 into Groups 1 and 2.

**Table 3** Trend Change by Country

	General Government Debt (1)	Central Government Debt (2)	Non-financial Corporate Debt (3)	Household Debt (4)
<b>Group 1</b>				
<b>1(i: Post1, 2008 - 2010)</b>				
× Australia	15.191*** (1.344)	13.037*** (1.570)	2.306 (1.988)	10.509*** (1.259)
× Colombia	10.648*** (1.586)	8.573*** (1.776)	5.336 (3.290)	9.585*** (1.190)
× France	20.314*** (1.194)	17.482*** (1.370)	12.020*** (1.677)	12.321*** (0.874)
× Japan	27.006*** (1.264)	25.594*** (1.448)	5.693*** (1.815)	5.206*** (1.016)
× Mexico	11.001*** (1.275)	11.917*** (1.433)	2.626 (1.725)	4.806*** (1.229)
<b>1(i: Post2, since 2011)</b>				
× Australia	41.247*** (2.438)	35.074*** (2.712)	-0.750 (5.075)	26.059*** (3.619)
× Colombia	24.206*** (3.861)	18.105*** (4.190)	18.874*** (6.766)	24.862*** (4.578)
× France	39.802*** (2.211)	34.101*** (2.441)	31.320*** (4.295)	24.082*** (2.875)
× Japan	70.167*** (3.105)	68.031*** (3.398)	8.623 (6.152)	12.098*** (3.578)
× Mexico	22.280*** (2.088)	22.418*** (2.261)	14.085*** (3.944)	14.522*** (2.712)
<b>Group 2</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Greece	28.552*** (1.288)	28.589*** (1.480)	15.039*** (1.792)	15.953*** (1.129)
× Portugal	24.836*** (1.331)	21.544*** (1.487)	17.919*** (1.841)	11.384*** (1.419)
× Spain	16.514*** (2.828)	16.142*** (3.084)	5.861 (5.669)	4.025 (4.042)
× United Kingdom	26.218*** (1.262)	26.269*** (1.356)	6.220*** (1.690)	7.372*** (1.294)
× United States	23.922*** (1.602)	23.036*** (1.629)	-2.625 (2.493)	0.272 (2.017)

Note: This table continues on the next page. Standard errors are clustered at the country level, reported in parentheses. \* Significant at 10%, \*\* Significant at 5%, \*\*\* Significant at 1%.

**Table 3** Trend Change by Country (continued)

	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>Group 2</b>				
<b>1(i: Post2, since 2011)</b>				
× Greece	63.055*** (3.247)	68.165*** (3.518)	-1.522 (7.102)	2.269 (5.594)
× Portugal	62.937*** (1.643)	63.536*** (1.827)	14.856*** (2.993)	2.682 (2.524)
× Spain	58.354*** (3.672)	54.679*** (4.223)	-23.850*** (8.556)	-9.413 (5.884)
× United Kingdom	54.465*** (2.249)	53.675*** (2.457)	1.497 (4.305)	7.772*** (2.799)
× United States	51.919*** (1.719)	53.559*** (1.879)	1.975 (2.966)	-0.793 (3.474)
<b>Group 3</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Norway	2.211* (1.226)	13.358*** (1.413)	31.080*** (1.822)	11.559*** (0.837)
× Sweden	1.679 (1.223)	0.236 (1.387)	26.320*** (1.638)	15.009*** (1.086)
× Switzerland	5.219*** (1.504)	6.555*** (1.774)	13.944*** (2.421)	6.942*** (1.603)
× Turkey	7.722*** (1.996)	8.056*** (2.353)	11.942*** (4.295)	9.394*** (2.162)
<b>1(i: Post2, since 2011)</b>				
× Norway	-6.699*** (1.706)	9.949*** (1.749)	30.363*** (2.937)	33.273*** (2.145)
× Sweden	11.808*** (2.918)	7.710** (3.242)	38.360*** (6.015)	35.000*** (3.748)
× Switzerland	10.530*** (2.814)	10.317*** (3.203)	30.558*** (6.030)	31.134*** (4.112)
× Turkey	14.716*** (4.967)	13.297** (5.625)	37.982*** (11.504)	26.632*** (6.140)
<b>Group 4</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Estonia	4.940** (2.217)	4.774* (2.419)	3.031 (4.101)	10.860*** (3.090)
× Italy	11.289*** (1.093)	10.325*** (1.161)	13.259*** (1.504)	8.031*** (0.828)
× Latvia	26.236*** (2.803)	26.840*** (-3.104)	6.261 (5.617)	8.087** (3.949)
× Lithuania	17.879*** (2.692)	17.696*** (2.995)	-7.626 (5.352)	11.329*** (3.746)
× New Zealand	12.103*** (1.299)	12.188*** (1.412)	4.454** (1.737)	8.629*** (1.438)
× Slovenia	16.066*** (1.380)	13.606*** (1.620)	23.932*** (2.104)	13.231*** (1.281)

Note: This table continues on the next page. Standard errors are clustered at the country level, reported in parentheses. \* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

**Table 3** Trend Change by Country (continued)

	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>Group 4</b>				
<b>1(i: Post2, since 2011)</b>				
× Estonia	20.946*** (3.528)	22.709*** (3.996)	1.218 (7.356)	12.712*** (4.367)
× Italy	26.987*** (2.189)	27.314*** (2.513)	8.838** (3.881)	7.734** (2.853)
× Latvia	45.208*** (3.548)	44.020*** (4.088)	4.054 (7.710)	2.724 (4.699)
× Lithuania	47.792*** (4.756)	44.806*** (5.480)	-10.776 (10.807)	19.718*** (6.407)
× New Zealand	29.223*** (2.397)	28.741*** (2.699)	-9.058* (5.012)	16.911*** (3.578)
× Slovenia	55.167*** (2.255)	48.417*** (2.548)	1.094 (4.557)	17.787*** (3.146)
<b>Group 5</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Belgium	14.592*** (1.219)	11.766*** (1.409)	30.590*** (1.776)	12.495*** (0.928)
× Chile	12.436*** (2.056)	11.338*** (2.446)	11.813*** (3.688)	11.738*** (2.082)
× Finland	9.502*** (1.115)	8.296*** (1.248)	18.030*** (1.514)	12.931*** (0.802)
× Luxembourg	14.703*** (1.341)	13.857*** (1.565)	92.555*** (1.956)	12.333*** (1.131)
× Korea	12.340*** (1.457)	12.162*** (1.763)	15.334*** (1.971)	15.114*** (2.088)
<b>1(i: Post2, since 2011)</b>				
× Belgium	24.254*** (2.275)	18.387*** (2.404)	42.762*** (4.396)	26.857*** (2.932)
× Chile	34.370*** (4.979)	31.649*** (5.539)	41.092*** (9.982)	29.356*** (5.796)
× Finland	28.421*** (2.056)	23.073*** (2.201)	33.948*** (3.725)	23.655*** (2.391)
× Luxembourg	24.995*** (3.007)	23.908*** (3.391)	131.661*** (5.965)	24.793*** (3.608)
× Korea	36.779*** (3.427)	30.835*** (3.827)	14.778** (7.149)	40.743*** (5.568)
<b>Group 6</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Canada	12.674*** (1.210)	12.546*** (1.339)	6.430*** (1.580)	18.010*** (1.120)
× Czech Republic	14.690*** (1.177)	15.941*** (1.342)	4.645*** (1.691)	16.009*** (1.147)
× Poland	18.199*** (1.872)	13.559*** (1.990)	21.662*** (4.070)	27.437*** (2.194)
× Slovak Republic	16.606*** (1.389)	17.827*** (1.607)	8.369*** (2.268)	19.749*** (1.731)

Note: This table continues on the next page. Standard errors are clustered at the country level, reported in parentheses. \* Significant at 10%, \*\* Significant at 5%, \*\*\* Significant at 1%.

**Table 3** Trend Change by Country (continued)

	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>Group 6</b>				
<b>1(i: Post2, since 2011)</b>				
× Canada	30.015*** (1.983)	18.492*** (2.123)	26.202*** (3.792)	35.793*** (2.854)
× Czech Republic	29.433*** (3.578)	29.699*** (3.868)	24.390*** (7.303)	28.599*** (4.272)
× Poland	32.978*** (4.388)	26.089*** (4.497)	33.996*** (9.140)	43.150*** (5.495)
× Slovak Republic	42.381*** (3.248)	41.551*** (3.418)	20.946*** (6.881)	43.783*** (4.684)
<b>Group 7</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Denmark	8.806*** (1.320)	5.591*** (1.274)	10.090*** (2.028)	18.426*** (1.426)
× Ireland	34.712*** (2.062)	36.379*** (1.974)	60.910*** (3.743)	15.021*** (3.073)
× Netherlands	22.716*** (1.806)	20.939*** (2.140)	14.824*** (3.152)	14.203*** (1.644)
<b>1(i: Post2, since 2011)</b>				
× Denmark	13.307*** (1.511)	8.243*** (1.608)	16.096*** (2.286)	14.411*** (2.807)
× Ireland	87.286*** (3.493)	90.044*** (4.128)	88.160*** (7.860)	-1.670 (6.636)
× Netherlands	30.617*** (3.233)	27.796*** (3.621)	48.429*** (6.567)	14.575*** (3.912)
<b>Group 8</b>				
<b>1(i: Post1, 2008-2010)</b>				
× Austria	20.426*** (1.563)	13.164*** (2.179)	11.412* (6.155)	8.137*** (2.201)
× Germany	18.432*** (1.659)	14.219*** (1.899)	10.651*** (3.093)	4.260*** (1.387)
× Hungary	18.730*** (1.413)	17.028*** (1.541)	14.095*** (2.039)	14.178*** (1.610)
× Iceland	53.104*** (1.752)	51.083*** (1.763)	156.965*** (2.904)	0.741 (2.254)
× Israel	3.683** (1.473)	3.011* (1.719)	0.291 (2.517)	10.958*** (1.322)

Note: This table continues on the next page. Standard errors are clustered at the country level, reported in parentheses. \* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

**Table 3** Trend Change by Country (continued)

	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>Group 8</b>				
<b>I(i: Post2, since 2011)</b>				
× Austria	28.251*** (3.307)	17.276*** (2.885)	14.863* (8.525)	12.233*** (3.040)
× Germany	26.668*** (3.891)	22.980*** (3.996)	17.492** (7.912)	11.525** (4.662)
× Hungary	27.150*** (4.392)	26.362*** (4.917)	16.991* (8.649)	10.627** (5.123)
× Iceland	47.562*** (1.963)	45.218*** (2.183)	-128.937*** (3.656)	-10.367*** (3.080)
× Israel	8.609 (5.320)	5.624 (5.837)	0.193 (10.902)	22.906*** (6.088)
Controls	YES	YES	YES	YES
Observations	554	553	554	554
R-squared	0.989	0.988	0.948	0.986
Mean dep.	61.85	53.45	99.19	61.04

Note: The unit of observation is country by year. Each column corresponds to a separate regression. We include macroeconomic controls, such as unemployment, employment rate, exchange rate, and GDP per capita (real). We also control for country and year-fixed effects. The unit of debt is the percentage of GDP. There are 37 countries. Standard errors are clustered at the country level, reported in parentheses.

\* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

**Table 4** Trend Change by Group

Dep.	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>I(i: Post1, 2008-2010)</b>				
×1(group1)	14.481*** (3.691)	13.100*** (3.554)	4.034* (2.262)	8.783*** (1.746)
×1(group2)	20.074*** (3.344)	19.269*** (3.309)	9.182** (3.502)	9.035*** (2.584)
×1(group3)	1.239 (1.609)	4.543 (3.445)	19.285*** (4.584)	11.268*** (2.056)
×1(group4)	9.932*** (3.215)	9.538*** (3.227)	7.021 (4.939)	11.328*** (1.768)
×1(group5)	10.298*** (1.841)	9.279*** (1.863)	31.956** (14.707)	12.921*** (1.163)
×1(group6)	13.591*** (2.274)	13.276*** (1.881)	9.662*** (3.298)	19.930*** (2.280)
×1(group7)	19.617*** (6.763)	18.535** (7.930)	28.980* (15.124)	16.927*** (1.872)
×1(group8)	20.374** (7.997)	17.389** (8.036)	37.908 (30.606)	7.834*** (2.571)

Note: This table shows the estimate result of the trend change of each debt pattern during the post 1 period. The unit of observation is country by year. Each column corresponds to a separate regression. Standard errors are clustered at the country level, reported in parentheses. This table continues on the next page.

Standard errors are clustered at the country level, reported in parentheses.

\* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

**Table 4** Trend Change by Group (continued)

Dep.	General Government Debt (1)	Central Government Debt (2)	Non-Financial Corporation Debt (3)	Household Debt (4)
<b>I(i: Post2, since 2011)</b>				
×1(group1)	35.450*** (8.754)	32.092*** (8.937)	5.401 (9.153)	18.483*** (4.153)
×1(group2)	51.382*** (3.715)	52.331*** (4.407)	-4.091 (7.962)	1.234 (3.392)
×1(group3)	0.966 (5.082)	4.747 (3.940)	25.146*** (7.078)	30.216*** (3.678)
×1(group4)	30.546*** (6.611)	29.643*** (5.895)	-10.730 (8.664)	11.861*** (4.126)
×1(group5)	24.712*** (3.981)	21.228*** (4.425)	42.326** (20.314)	27.075*** (4.127)
×1(group6)	28.996*** (4.364)	25.085*** (6.288)	15.824** (7.739)	35.035*** (4.686)
×1(group7)	34.738* (17.873)	33.736* (19.741)	49.510*** (17.466)	8.945** (3.357)
×1(group8)	23.593*** (7.326)	20.183** (8.114)	-30.307 (32.433)	6.599 (6.042)
Controls.	YES	YES	YES	YES
Observations	554	553	554	554
R-squared	0.972	0.966	0.868	0.977
Mean dep.	61.85	53.45	99.19	61.04

Note: This table shows the estimate result of the trend change of each debt pattern during the post 2 period. We include macroeconomic controls, such as unemployment, employment rate, exchange rate, and GDP per capita (real). We also control for country and year fixed effects. The unit of debt is the percentage of GDP. There are 37 countries. Each column corresponds to a separate regression. Standard errors are clustered at the country level, reported in parentheses.

\* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%

Groups 1 and 2 both demonstrate a dominant increase in government debt in period 1, and this trend continues into period 2. However, the key difference between the two groups is that, in period 2, Group 2 sees an alleviation in private debt relative to Group 1. For Groups 1 and 2, the trend of increasing public debt continued into period 2 because countries in these groups decided to create more government debt to help alleviate private debt rates during the economic recession. However, countries in Group 1 did not successfully alleviate private debt, especially in household debt. Instead, private debt rates were maintained or increased during period 2. While general government debt rates increased from 14.481% to 35.450%, household debt rates increased to 18.483% (both statistically significant at the conventional level), and non-financial corporate debt did not show a dramatic decrease while also not being statistically significant. On the other hand, the government debt increase in Group 2 seems to have been relatively more successful in easing the burden on private debt, as non-financial corporate and household debt rates after the three-year recession period were alleviated. Almost 30% of both general and central government debt rates increased, and private debt rates plummeted (but not

at a statistically significant level) in period 2 relative to the years before 2011.

Groups 3, 4 and 5 are groups where non-financial corporate debt dominantly increased during the economic crisis. Group 3 saw a continued growing trend in private debt while public debts relatively recovered. These results were not statistically significant, but private debt rates – both firm and household debt – increased significantly. In contrast, countries in Group 4 saw a dramatic increase in public debt, more than tripling compared to the previous period, in exchange for alleviating private debt. Group 5 demonstrates an increase in all debt types. Both public and private debt rates increased but not at a dramatic rate (except for Luxembourg, which experienced an extreme increase in corporate debt).

Group 6 consists of countries that experienced a dominant increase in household debt during the economic recession, and this trend continued during the second period, increasing from 19.930% to 35.035%, both statistically significant at the conventional level. Relative to other groups, Group 6 shows small debt rates in terms of numeric value, but this group also shows a constant increase in all debt types. Group 7, on the other hand, consists of countries that experienced the largest alleviation of household debt from 16.927% to 8.945%, statistically significant at the conventional level, while the government and corporate debt rates increased, statistically significant at the 10% level. This group has the largest standard error relative to other groups, which may be due to the outlier, Ireland. Ireland initially had a dominant increase in non-financial corporate debt, which peaked in 2015, during the global economic crisis. Although at a lesser magnitude, the other two countries in this group also show a similar pattern.

**Table 5** Robustness Check

Dep.	BIS GG Debt (1)	BIS HH Debt (2)	BIS NFC Debt (3)	Social Expenditure (4)	Health Expenditure (5)
<b>1(i: Post1, 2008-2010)</b>					
×1(group1)	11.596*** (2.830)	10.168*** (2.077)	7.548* (3.707)	2.125*** (0.475)	0.905*** (0.177)
×1(group2)	15.628*** (3.723)	9.900*** (3.251)	9.215* (5.060)	2.933*** (0.401)	1.242*** (0.200)
×1(group3)	0.167 (1.864)	11.772*** (2.460)	39.063*** (9.681)	1.316*** (0.403)	0.714*** (0.125)
×1(group4)	6.688*** (2.163)	10.954*** (1.270)	12.983** (4.981)	3.671*** (0.694)	1.158*** (0.248)
×1(group5)	9.980*** (2.084)	35.791* (18.402)	41.409** (20.206)	2.880*** (0.367)	0.995*** (0.178)
×1(group6)	12.679*** (2.478)	22.571*** (3.785)	14.911** (6.884)	2.348*** (0.436)	1.067*** (0.179)
×1(group7)	14.336** (6.218)	17.554*** (2.134)	28.209** (12.076)	2.626* (1.326)	1.581*** (0.427)
×1(group8)	9.810** (3.896)	10.660*** (2.531)	12.848** (4.779)	1.543*** (0.312)	0.427* (0.238)

Note: This table checks the robustness of the data, using BIS credit data and OECD social expenditures data during the post 1 period. Standard errors are clustered at the country level, reported in parentheses. This table continues on the next page.

Standard errors are clustered at the country level, reported in parentheses.

\* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

**Table 5** Robustness Check (Continued)

Dep.	BIS GG Debt (1)	BIS HH Debt (2)	BIS NFC Debt (3)	Social Expenditure (4)	Health Expenditure (5)
<b>I(i: Post2, since 2011)</b>					
×1(group1)	31.544*** (7.976)	20.646*** (4.775)	16.141 (11.850)	4.164*** (0.868)	1.763*** (0.617)
×1(group2)	48.343*** (4.770)	1.162 (3.879)	-1.476 (8.863)	3.515*** (0.567)	1.410** (0.531)
×1(group3)	-1.613 (5.048)	30.824*** (4.453)	86.922* (50.027)	3.223*** (0.904)	2.060*** (0.552)
×1(group4)	21.178*** (3.777)	12.784** (5.069)	2.839 (12.052)	4.272*** (0.821)	1.454*** (0.433)
×1(group5)	24.281*** (4.390)	53.270** (23.420)	62.223** (26.650)	5.074*** (1.059)	1.653** (0.717)
×1(group6)	25.469*** (4.301)	37.621*** (5.792)	29.974** (12.700)	3.881*** (0.916)	1.533*** (0.483)
×1(group7)	32.284* (18.318)	12.168*** (3.516)	50.784** (19.955)	3.259*** (1.175)	1.838*** (0.549)
×1(group8)	16.531** (6.560)	14.570** (5.387)	16.570 (15.965)	2.594*** (0.662)	0.827 (0.520)
Controls	YES	YES	YES	YES	YES
Observations	461	464	464	491	554
R-squared	0.972	0.967	0.978	0.981	0.951
Mean dep.	66.85	72.21	123.9	20.03	8.537

Note: This table checks the robustness of the data, using BIS credit data and OECD social expenditures data during the post 2 period. The unit of observation is country by year. Each column corresponds to a separate regression. We refer to nominal general government debt, non-financial corporate debt, and household debt from BIS, and the unit of debt is the percentage of GDP. BIS data covers the credits of 31 OECD member countries; Estonia, Iceland Latvia, Lithuania, Slovak Republic, and Slovenia are not included. We add social and health expenditure disclosed by OECD stat to cross-check the spending trends of each group. The unit of both debt and expenditure is the percentage of GDP. Standard errors are clustered at the country level, reported in parentheses. Each column corresponds to a separate regression. Standard errors are clustered at the country level, reported in parentheses.

\* Significant at 10%; \*\* Significant at 5%; \*\*\* Significant at 1%.

Similar to Group 7, Group 8 also contains an extreme outlier, Iceland. The IMF was called in to carry out a support program, as Iceland was hit incredibly hard by the financial crisis due to firms and households being heavily indebted, with foreign currency and inflation-indexed loans. By employing unorthodox measures, including capital controls and safeguarding the social welfare system, the IMF was able to quickly adjust and bring up the current account and budget resulting in an extreme plummet in both public and private debt. The countries in the same group as Iceland demonstrate a similar pattern of debt evolution, but of a much smaller magnitude in terms of size and extremity. During period 1, there is no clear dominant debt increase in these countries, but during period 2, the commonality becomes clear: the government and firms increased their debt rates, while household debts decreased compared to the years before 2011.

Finally, Table 5 shows the results of the robustness check for each group's debt evolution and spending trends. Using the same group classification, we utilize BIS debt data on general government debt at a nominal rate, household debt, and non-financial corporate debt to check the consistent flow of the group's evolution pattern. Columns (1) to (3) demonstrate the results. Since BIS data covers 31 OECD member countries, excluding Estonia, Iceland, Latvia, Lithuania, Slovak Republic, and Slovenia, Table 5 shows the results without Iceland's extreme case for Group 8. Additionally, we examine the government spending trends during and after the crisis. We regress the social and health expenditure rates, which are calculated as a percentage of GDP, on the explanatory variables in equation (1). Columns (4) and (5) in Table 5 report the results. Regardless of the debt evolution pattern, all groups increased both social and health expenditures during the crisis at a statistically significant rate at the conventional level. Additionally, none of the groups were able to decrease social spending following the recessionary period. Group 5 made the largest increase in social expenditure rates, from 2.880% to 5.074%, at a statistically significant level. For health expenditure, Group 3 increased its expenditure level from 0.714% during period 1 to 2.060% during period 2. These findings are in line with the argument that it is difficult for governments to cut back on spending and support the fact that government policies designed to increase social expenditures should be made cautiously.

## Conclusion

This paper examines how the debts of the government, households, and firms in each country changed in response to the 2008 Great Recession, and the extent to which these debts were rebalanced afterward. Using regression analysis, we group the countries that share a similar evolution pattern for each debt type. Our main contribution is to demonstrate these patterns and cross-compare them using the latest data related to countries' debts. We consider this group classification an additional set of information that policy makers and researchers can rely on to predict a country's economic trajectory by comparing national debt levels with other countries that share similar evolution patterns.

Although we do not focus on South Korea specifically, our result suggests an implication for South Korea. Japan has been a model country for South Koreans to catch up for several decades, and it is often used as a reference for Koreans when they try to predict what might happen to South Korea in the future. Public debt is not an exception. There have been political debates on whether the Korean economy will be sustainable even if the Korean government continues to issue more public debts because the current level is much lower than Japan's. However, our result shows that South Korea and Japan belong to groups with distinctively different debt evolution patterns. South Korea belongs to a group that experienced a dominant increase in non-financial corporate debt rates during and after the 2008 global recession, while Japan belongs to a group that experienced a dominant increase in government debt during the financial crisis. The two countries show a stark difference in terms of household debt. South Korea's household debt increased dramatically from 2011 to 2019 compared to 2008 to 2010, whereas household debt in Japan has been increasing moderately. Our finding suggests that despite similarity in many areas of society, Japan may not be a relevant reference point for South Korea when it comes to the evolution of public and private debts and their sustainability.

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