



The Impact of Private Debt on Economic Growth

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Abstract

Both theoretical and empirical evidence show that recessions are steeper in countries with high levels of private debt and/or credit booms. But do these negative effects carry over to the period where the recession is over and the economy recovers from the crisis? In this paper we look at economic recovery episodes and relate the growth performance of countries with their debt levels and debt growth before the beginning of the recession. We find that a higher level of debt before a recession is correlated with smaller economic growth after the economic slowdown has finished. In contrast, higher credit growth before a recession is associated with higher GDP growth after the crisis. The effects of debt on consumption are more negative, implying that after recessions people consume less and save more than they did in the period before the recession. However, the overall economic effects of the debt measures on GDP and consumption growth are limited.

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Non-technical summary

Several papers document that a high level of debt and/or rapid growth in the debt burden makes recessions deeper and longer. Similarly, at a corporate level, a high debt burden hampers turnover and investment growth and the recruitment of new employees. Companies with a high debt burden are forced to respond to the economic decline more quickly.

In a highly indebted economy several mechanisms may be at work in lowering economic growth. For example, **debt overhang** arises when corporate debt is so high that the profit from new investments is used for covering losses and paying back existing loans. Consequently investors are not interested in financing new, profitable investments as the returns do not generate dividends. For the economy as a whole, investment cuts lead to a deceleration in economic growth.

Debt deflation can be described as a spiral, where a drop in prices (deflation) rises the real loan burden of both households and companies. In order to reduce their high debt burden, companies and households not only reduce investments and consumption, but also sell their assets. Smaller investments and consumption expenditures and the sale of assets put a downward pressure on prices, and falling prices in turn increase the real debt burden. The higher the debt burden, the greater the risk of debt inflation and its negative effect on economic growth, although this phenomenon could also be apparent after the end of the recession, limiting demand and possibly leading to deflation.

In this paper we ask whether debt dynamics before a crisis are related to economic growth after the recession is over. We look at episodes of economic recovery and relate the growth performance of countries with their debt level and debt growth before the beginning of the recession. We identify the peaks and troughs of the business cycle using real GDP data for 31 OECD and 20 emerging market countries and collect debt, consumption, investment, and trade balance data before, during and after the recession episodes. We plot the data graphically in order to get intuition and use simple regression analysis for conditional correlation.

The paper demonstrates that the negative effects of debt level and debt change in the crisis do not necessarily need to translate into negative effects for the economic recovery. On the contrary, the countries that had high and/or growing levels of debt can even have stronger economic recoveries. In fact, a higher level of debt before the recession is negatively correlated with economic growth after the economic slowdown but higher credit growth before the recession is associated with higher growth after the crisis. Both positive and negative effects are quantitatively limited. Most of the variation in GDP growth is explained by the growth potential, which is measured by decade

dummies and the growth of the country before it entered the recession. The effects of debt on consumption growth are less positive or are strongly negative compared to its effects on GDP growth. Even if people need to reduce consumption somewhat, they tend to work and therefore the effects on GDP are limited. We also find similarly that investment growth decreases as the debt level rises, and increases together with the growth rate of private debt.

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1. Introduction

Both theoretical and empirical evidence predict that recessions are steeper in countries which have high levels of debt and/or have witnessed credit booms prior to the recession. Two examples of theoretical concepts that predict strong recessions are debt deflation and debt overhang. Several empirical papers also suggest that high debt and debt growth before recessions are related to a crisis being more severe. But do these negative effects carry over to periods when the recession is over, that is, whether debt dynamics before a crisis are related to economic growth after the recession is over.

We look at the economic recovery episodes and relate the growth performance of the countries with their debt level¹ and debt growth before the beginning of the recession. We use real GDP data for 31 OECD and 20 emerging market countries and identify the peaks and troughs of the business cycle. Then we collect debt, consumption, investment, and trade balance data before, during and after the recession episodes. We plot the data graphically in order to get intuition and use simple regression analysis for conditional correlation. Our economic approach and data are similar to the one of Claessens et al. (2008).

We find that a higher level of debt before the recession is correlated with smaller economic growth after the economic slowdown. A 50 percentage point higher debt-to-GDP ratio is associated with a 0.37 percent slower average economic growth. In contrast, higher credit growth before the recession is associated with higher growth after the crisis. A 1 percent higher credit growth before the recession is followed by a 0.05 percent higher GDP growth once the recession is over. Compared to the results on GDP growth, the effect of debt growth on consumption growth is less positive, and the impact of debt level and change in debt level on consumption is stronger negative.

We also find that the investment growth pattern after recessions is similar to that of GDP growth. Investments are positively related to credit growth, but negatively to debt level and change in the debt level before the recession. The trade balance is not affected by debt measures but correlates strongly with the level of deficit or surplus before and during the recession. For both relations the economic effect of the debt measures on the growth of the variable is limited. Most of the variation in GDP growth is explained by the growth potential, which is measured by decade dummies and the growth of the country before it entered the recession. In addition our results confirm the earlier findings that high levels of private debt and previous credit booms make economic slowdowns steeper.

¹Our proxy for debt is domestic financial sector loans to the non-financial private sector. In this paper the terms debt and credit are used interchangeably.

A high level of debt and/or rapid growth in the debt burden makes the recessions deeper and longer (for example, King (1994), Uuskula et al. (2004), Claessens et al. (2008) and Claessens et al. (2011)). Similarly, at a corporate level, a high debt burden hampers turnover and investment growth (Lang et al. (1995), Ogawa (2003a) and Martinez-Carrascal and Ferrando (2008)), and also the recruitment of new employees (Nickell and Nicolitsas (1995) and Ogawa (2003b)). Moreover, companies with a high debt burden are forced to respond to the economic decline more quickly, so that for example when sales drop, companies with a high debt burden cut investments and staff more quickly than those with a low debt burden (Cantor (1990)). The effect of the pre-recession debt growth and debt level on economic growth after the end of an economic recession has been less analysed.²

From the theoretical literature we identify two processes through which a high debt burden can negatively affect economic growth: debt overhang and debt deflation. At the corporate level, the term debt overhang is used to refer to situations where the corporate debt is so large that the profit planned from new investments will be used to service existing liabilities (Myers (1977)), so that consequently investors are not interested in financing new, profitable investments. For the economy as a whole, investment cuts lead to a deceleration in economic growth. Debt deflation can be described as a spiral, where a drop in prices (deflation) raises the real loan burden of both households and companies (Fisher (1933)). In order to reduce the high debt burden, companies and households need to invest and consume less, and sell their assets. Lower investment and consumption together with the sale of assets encourage prices to drop further; this, in turn, increases the real debt burden. The higher the debt burden, the greater the risk of debt inflation and its negative effect on economic growth. Although this phenomenon could also be relevant after the end of a recession, it is likely to be more important during the downturn.

The paper is structured as follows. Section two presents the methodology and data. In section three we discuss the main results for GDP and consumption growth. Section four gives some additional information about for the effects of debt on investment and the trade balance, and discusses some of the other properties of the data. Section five presents robustness analysis and section six concludes.

²An exception is the work by Tang and Upper (2010) who find that the costs related to the reduction in private sector debt that is typical after recessions need not be high provided that the banking sector problems that led to the crisis are fixed.

2. Methodology and Data

In this section we describe the methodology used to identify economic recessions and to date the peaks and troughs of the economic cycle. We explain how we analyse the data and describe briefly the data used.

We define an economic peak at time t to be such that GDP in constant prices is higher than in the previous quarter and the quarter before (first line of Equation 1), indicating an earlier increase in GDP. In addition, GDP has to be bigger than in the next quarter and the quarter after (second line of Equation 1), indicating a subsequent drop in GDP:

$$\begin{aligned} y_t - y_{t-1} > 0, \quad y_t - y_{t-2} > 0, \\ y_{t+1} - y_t < 0, \quad y_{t+2} - y_t < 0. \end{aligned} \tag{1}$$

Similarly we define an economic trough at time t such that GDP is smaller than in the previous quarter and the quarter before (first line of Equation 2). In addition, GDP has to be smaller than in the next quarter and the quarter after (second line of Equation 2):

$$\begin{aligned} y_t - y_{t-1} < 0, \quad y_t - y_{t-2} < 0, \\ y_{t+1} - y_t > 0, \quad y_{t+2} - y_t > 0. \end{aligned} \tag{2}$$

We use full cycles which are at least five quarters long in order to avoid problems from unaccounted seasonality in the data. The methodology allows two troughs to follow each other without a peak being reached in between. In these cases we looked at the growth episode and decided whether to drop it or to merge it into one crisis if it is directly adjacent to another crisis. The approach is generally considered to be a reliable and replicable dating algorithm and it follows closely the NBER dating method for the turning points of the business cycle of the United States of America. The approach follows very closely the definition of Claessens et al. (2008), and Claessens et al. (2011), which is based on papers by Bry and Boschan (1971) and Harding and Pagan (2002).

We collect the data for qb quarters before the peak, qd quarters during the recession and qa quarters after the trough. For the benchmark analysis we set qb at 12 and qa as quarters until the beginning of next recession, but not more than 20 quarters after the previous recession had ended. The data is for debt, GDP, investment and consumption, and trade balance. For the measure of debt we take bank credit to the non-financial sector from the IMF International Financial Statistics. Although this data does not include debt from non-banks and loans taken by domestic agents directly from foreign banks, it is the data with the widest coverage across countries.

For the analysis we first plot the cross-section of the debt before and GDP growth after the recession. The graphical approach allows us to get intuition about the economic relevance of the relation. Also we can see if there are non-linearities in the data that should be addressed separately in the regression analysis.

For the main regression analysis we use the estimation Equation 3:

$$y_{i,qa} = c + \alpha d_{i,qb} + \beta x_{i,[qb,qd]} + \epsilon_i, \quad (3)$$

where $y_{i,qa}$ refers to the average of qa quarters of economic growth after the recession i , and $d_{i,qb}$ is the average credit growth or debt level before the recession. $x_{i,[qb,qd]}$ contains all the controls included in the regression. More precisely, we use dummies for sample decades, the earlier growth of GDP in the country, and the growth rate during the economic recession. ϵ_i is the residual for the crisis i .

We use data from 31 OECD countries (Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the UK, and the USA) for the period 1960Q1–2007Q4 and 20 emerging market economies (Argentina, Brazil, Chile, China, Colombia, Egypt, India, Indonesia, Israel, Jordan, Malaysia, Morocco, Pakistan, Peru, the Philippines, Russia, South Africa, Taiwan, Thailand, Venezuela) for the period 1980Q1–2007Q4³. For the benchmark results we have data for at least one description of one full episode for a limited number of emerging market countries. We adjust all the data for seasonality with X-11 ARIMA filter in E-views. For some emerging market countries we disregarded the first years of the data if rounding meant that the series did not have any business cycle dynamics at the decimal level. We restrict the sample at the end of 2007 as the method requires a full and finished growth cycle or at least 20 quarters of growth after the recession.

Private credit is measured as domestic financial sector loans to the non-financial private sector. Debt data coverage changed during the period, resulting in large level shifts in the debt series. Some of the changes in the coverage are documented, but for some we found no explanation. Therefore we used a statistical method based on extreme quartiles to detect outliers. We calculated the distance between the middle two quartiles and extended on both sides by three times this distance to detect the outliers. For the debt growth we replaced the outliers with the medians of the growth rate of the country. To calculate

³Please see the Web Appendix for data coverage and sources: http://www.eestipank.info/pub/en/dokumendid/publikatsioonid/seeriad/uuringud/_2011/_10_2011/_wp_1011_data.pdf

the debt level we took the debt level at the end of the period and used growth rates to work the level out backwards. We carried out robustness analysis for different levels of strength of identifying the outliers. The qualitative results remain unchanged.

We employed three debt measures for the analysis. Theory suggests that the right variable to use is the difference between the debt level and the desired debt. The debt level data is the closest proxy for this. However the changes in the coverage of the data mean that the debt level suffers from several weaknesses and therefore we use two additional measures of debt growth that suffer less from the problem of the changes in the data definition. The debt growth measures can also give an indication of possible credit booms and therefore proxy the periods of excessive credit growth. We use the percentage growth of the real credit (based on the CPI deflator) and the percentage change in the debt to GDP ratio.

The list of recessions used for the benchmark results is presented in Table A1 in the appendix. There are only a few non-OECD country episodes used in the analysis. The sample is restricted by the data availability of other variables and the length of the periods we use to measure the earlier credit boom and credit level.

3. Results

In this section we present the main results for GDP and consumption growth after recessions. For preliminary analysis we present the relationship between the main variables graphically. Then we continue with the regression set-up to control for factors that may drive the data correlation as explained in the previous section. The regression models are not designed for identification, and therefore the results can be analysed as (conditional) correlations and not as causal relations. We start by presenting the results for GDP, then for consumption, and finally we compare the effects of debt measures on GDP and consumption. For each variable we look first in more detail at the relationship with the debt to GDP ratio, then at that with credit growth, and finally at that with change in the debt to GDP ratio.

We find that a higher debt level prior to a recession is related to lower GDP growth rates once the recession is over. In contrast, however, high credit growth prior to a recession is associated with higher GDP growth once the economic slowdown is over. As with GDP, we also find a negative relationship between consumption growth and the debt to GDP ratio and a positive one between consumption and credit growth. However, all the estimated effects of debt on consumption are more negative than the effects on GDP growth. That

is, the negative effects of the debt level are stronger and the positive effects of debt growth are smaller. Higher debt and debt growth before the recession mean that once the economic slowdown is over people consume less and save more than they did before the recession.

Figure 1 plots the correlation between the three debt measures, with GDP growth (annualised growth rate) after the economic slowdown on the vertical axis and debt before the recession on the horizontal axis in the following order from the upper panel: average debt to GDP ratio (ratio multiplied by 100), average debt growth (annual growth rate), and average change in the debt to GDP ratio (at annual rates).

The relation between GDP growth and debt depends on the chosen measure of debt. There is a small negative correlation between the debt to GDP ratio and GDP growth, as seen in the upper panel. There is a small positive relation between earlier credit growth and later GDP growth, as displayed in the middle panel. And finally there is no relation between the change of debt to GDP ratio and GDP growth, as can be seen in the lower panel. For all the relations, the variance of GDP growth is high, which shows that there are various factors that affect GDP growth after a crisis. The extreme observations with high positive GDP growth after the recession in the top and bottom panels are Korea in 1997Q4⁴ and Estonia in 1998Q3. The two observations with high debt levels in the top panel are from Switzerland in 1990Q2 and 2002Q1. The high debt growth countries are Argentina in 1994Q4, Estonia 1998Q3, Mexico in 1994Q4, Turkey in 1998Q4 and Portugal in 2002Q2 (see Table A1).

For the upper and lower panels of Figure 1 the crisis episodes are identical. GDP growth measures are the same, but are rearranged on the vertical axis according to the debt measures. There were 64 crises that satisfied all the criteria for the debt level. The number of crises is different for the credit growth measure because of differences in the data availability⁵.

Turning to regression analysis of GDP growth, the first column of Table 1 presents the unconditional correlation coefficient of the upper panel of the Figure 1. It confirms the visual conjecture of a negative relationship, but the effect is small and only marginally statistically significant. After controlling for the growth potential of the country (see model M4 of the table) a 50 percentage point higher level of debt is associated with a 0.37 ($-0.0073 \times 50 = 0.365$) percent slower economic growth.

⁴Dates indicate the beginning of the crisis.

⁵For a few cases (Switzerland in 1969Q3, Sweden in 1975Q2 and 1981Q3, Argentina in 1994Q4) the credit aggregate was available for a longer period than nominal GDP, therefore some crises are present in the credit growth but not in the debt level figures. On the other hand for Korea the CPI series is available only from 1980, therefore one slowdown in 1964Q4 in Korea which is present in the debt to GDP ratio calculations is missing for the credit growth.

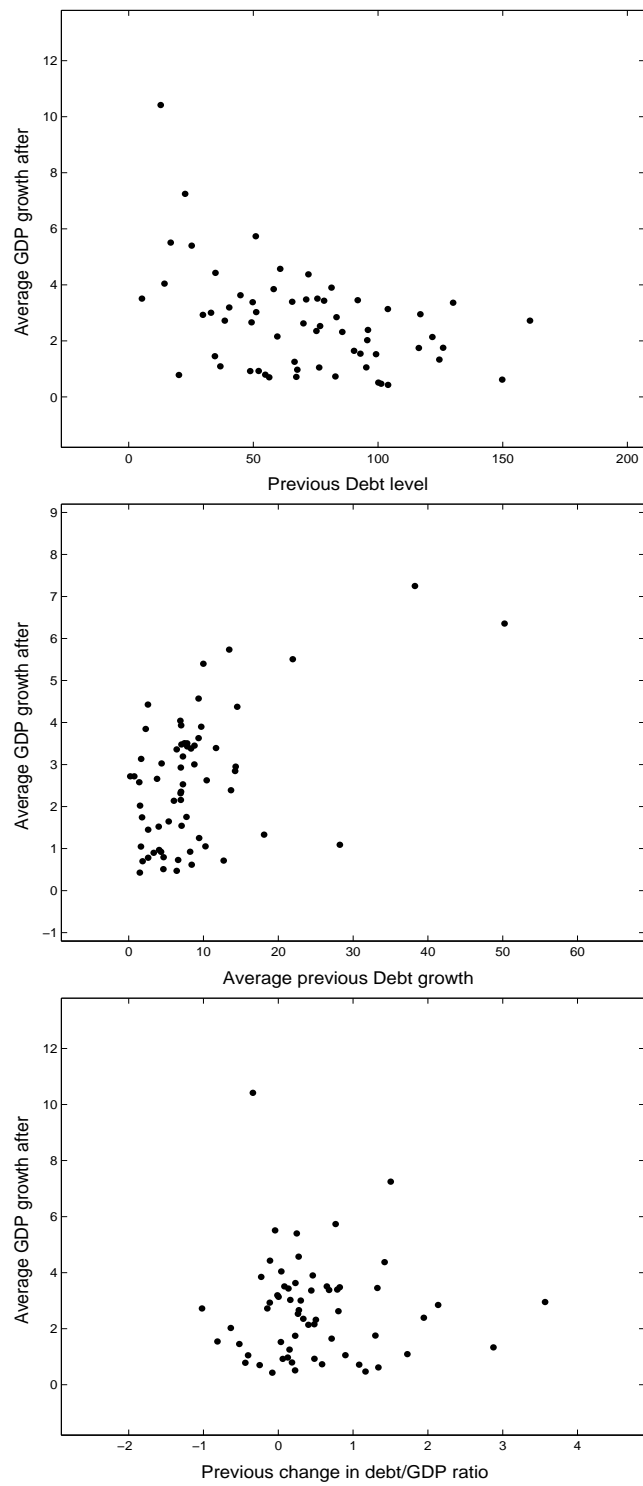


Figure 1: GDP growth and debt measures

Table 1: GDP growth and debt to GDP ratio

Variable	M1	M2	M3	M4
Debt	-0.0219 (0.0059)	-0.0173 (0.0062)	-0.0079 (0.0050)	-0.0073 (0.0051)
Growth before			0.5780 (0.0884)	0.5561 (0.0975)
Growth during				-0.0217 (0.0409)
DD 60		2.4219 (0.9583)	1.7328 (0.7424)	1.8033 (0.7526)
DD 70		-0.0606 (0.6983)	-0.1137 (0.5356)	-0.1152 (0.5344)
DD 80		0.0532 (0.6769)	0.3821 (0.5216)	0.3484 (0.5242)
DD 90		0.4326 (0.5820)	0.4314 (0.4463)	0.3971 (0.4500)
Const	4.2130 (0.4684)	3.5467 (0.7533)	0.9655 (0.6998)	0.9403 (0.6998)
N	61	61	61	61
R^2 adjusted	0.15	0.21	0.52	0.52

In order to control for the growth potential of the country, models M2, M3 and M4 include dummies for the decades (DD60, DD70, DD80, DD90), the average growth rate of the country before the recession and the growth during the recession respectively. The results show that growth in the 1960s was indeed higher than afterwards, as the parameter value for the dummy for the 1960s is the highest and positive. More growth before means more growth after the recession as GDP growth has a high level of autocorrelation. The value of the AR coefficient is higher than 0.5 even after the crisis.

The debt level is not the most important determinant of GDP growth, but it has some explanatory power. The model with only the debt level included is able to explain around 15 percent of the variance in the data. The inclusion of decade dummies and earlier growth increases the fit of the overall model substantially, showing that other factors are indeed important. However, the estimated parameter for the debt measure decreases once the growth rate of GDP before the recession is included.

Table 2 column 1 (model M1) presents the regression results for the debt growth plotted on the middle panel of Figure 1. The initial conjecture of a positive relationship is confirmed by the unconditional correlation coefficient

presented in the first column M1. Even after potential economic growth has been controlled for, the coefficient is positive and statistically significant at conventional confidence levels (see column M4 of Table 2). After potential growth rate has been controlled for, a higher credit growth of 1 percent before the recession leads to 0.05 percent higher GDP growth after.

Table 2: GDP growth and percentage change in debt

Variable	M1	M2	M3	M4
Debt	0.0952 (0.0202)	0.0915 (0.0205)	0.0514 (0.0181)	0.0520 (0.0179)
Growth before			0.4782 (0.0836)	0.4198 (0.0932)
Growth during				-0.0475 (0.0354)
DD 60		1.6484 (0.7540)	1.1304 (0.6201)	1.2075 (0.6142)
DD 70		0.4375 (0.5452)	0.1160 (0.4471)	0.0754 (0.4419)
DD 80		0.2854 (0.5563)	0.5002 (0.4541)	0.4097 (0.4529)
DD 90		0.4996 (0.4852)	0.4695 (0.3948)	0.3598 (0.3978)
Const	1.7712 (0.2395)	1.3579 (0.4211)	0.2038 (0.3976)	0.3007 (0.3987)
N	64	64	64	64
R^2 adjusted	0.23	0.24	0.49	0.49

The debt level is able to explain around 23% of the variance in GDP growth after the recession. The decade dummies are not essential, but earlier GDP growth increases the model fit considerably and decreases the value of the parameter for the effect of debt growth before the recession.

The graphical analysis above suggested that the change in the debt to GDP ratio is not related to the level of growth. The first column of Table 3 (model M1) shows a very small negative correlation, but the correlation changes to a small positive value when controls are added (models M2, M3 and M4). The estimated parameters have very high standard errors and are never close to being statistically significant at conventional levels.

In all the estimated models there is a small negative relation between growth during the recession and after the recession — the worse the crisis, the stronger the economic recovery. However, the economic effect is quite small. Point estimates suggest that a 1pp. bigger crisis brings 0.02–0.06pp. more growth

Table 3: GDP growth and change in debt to GDP ratio

Variable	M1	M2	M3	M4
Debt	-0.0557 (0.2787)	0.0388 (0.2605)	0.0338 (0.1947)	0.0257 (0.1904)
Growth before			0.6056 (0.0872)	0.5477 (0.0920)
Growth during				-0.0640 (0.0383)
DD 60		3.4355 (0.9507)	1.8662 (0.7454)	1.9794 (0.7321)
DD 70		0.6158 (0.7035)	0.0329 (0.5323)	-0.0338 (0.5221)
DD 80		0.2635 (0.7154)	0.2827 (0.5346)	0.1838 (0.5261)
DD 90		0.8736 (0.5966)	0.5543 (0.4482)	0.4114 (0.4465)
Const	2.6880 (0.2634)	1.8912 (0.5189)	0.2247 (0.4559)	0.2941 (0.4478)
N	61	61	61	61
R^2 adjusted	-0.03	0.10	0.49	0.50

after the recession. Augmenting the model with GDP growth during the recession increases the statistical fit only marginally. In addition, the percentage change in the debt level is not able to explain the variance of GDP growth, and the adjusted R^2 is even negative. Again the autocorrelation structure explains an important share in GDP growth.

Next we present the main results for consumption growth following the same scheme as we used for GDP growth. Then we compare the results with those of GDP growth. As mentioned above, the correlation between consumption and debt measures is more negative for all the debt measures used than it was for GDP growth. Figure 2 presents the relation between consumption growth and the three measures of debt. There is no positive consumption growth to compare with the relation of credit growth before and GDP growth after the recession. The correlation coefficients are more negative for the debt level and the change in the debt to GDP ratio.

There is one important difference between the GDP and consumption analysis. We identified the business cycle turning points using real GDP growth. As we use the same cut-off dates for consumption, the average consumption growth may be negative whereas GDP growth was positive by construction.

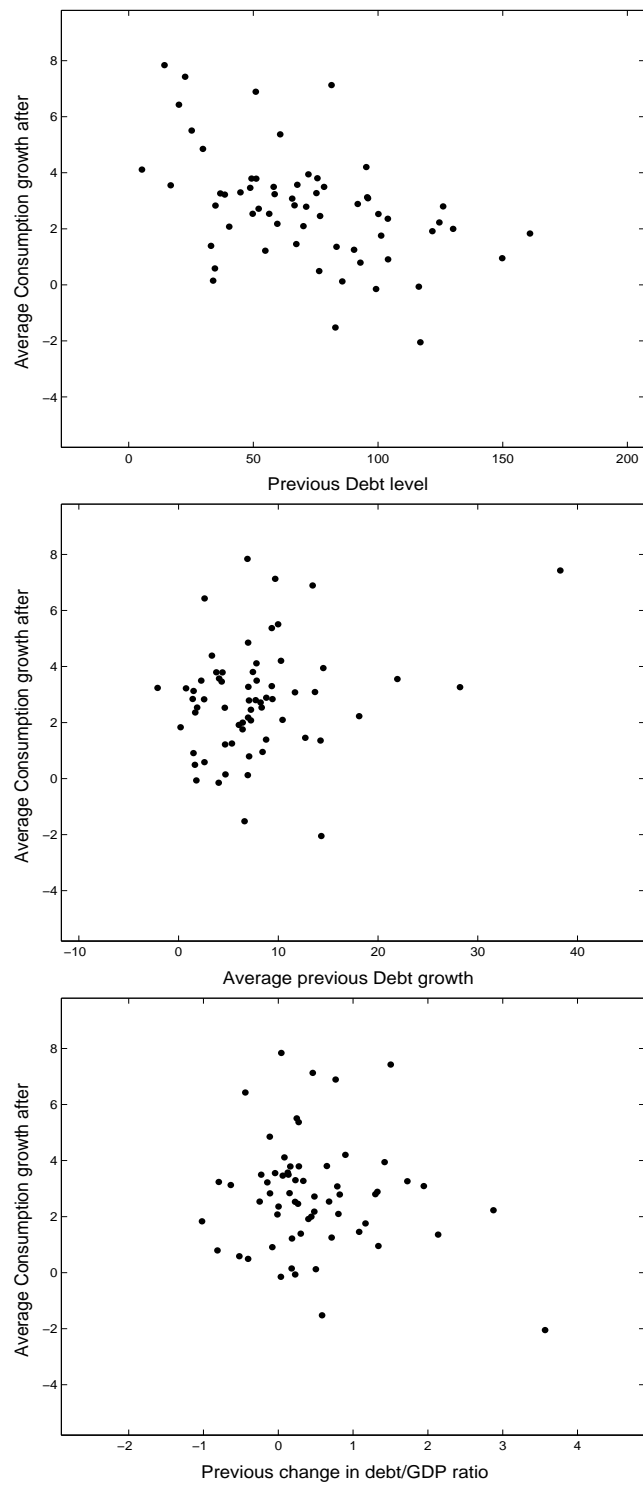


Figure 2: Consumption growth and debt measures

Equally consumption growth could have already been positive before GDP growth turned positive.

The upper panel of Figure 2 plots the relation between the debt level and consumption growth. There is a clear negative relation between the two variables, and more debt is associated with lower consumption growth after the recession (see the first column of Table 4). When we control for potential growth, a 50pp. higher debt to GDP ratio is associated with 1.2 ($0.0245 \times 50 = 1.225$) percentage points lower average consumption growth (see the last column of Table 4). The negative relation is more than three times stronger than that for GDP growth.

Table 4: Consumption growth and debt to GDP ratio

Variable	M1	M2	M3	M4
Debt	-0.0274 (0.0064)	-0.0284 (0.0070)	-0.0257 (0.0076)	-0.0245 (0.0075)
Growth before			0.1080 (0.1213)	0.0700 (0.1224)
Growth during				-0.0513 (0.0365)
DD 60		-0.2603 (1.0679)	-0.3066 (1.0624)	-0.1470 (1.0520)
DD 70		-0.6737 (0.7877)	-0.7758 (0.7911)	-0.6749 (0.7821)
DD 80		-0.7086 (0.7480)	-0.7408 (0.7441)	-0.8101 (0.7342)
DD 90		-0.1287 (0.6564)	-0.1993 (0.6571)	-0.3888 (0.6608)
Const	4.6901 (0.5061)	5.0816 (0.8503)	4.5509 (1.0338)	4.5727 (1.0178)
N	62	62	62	62
R^2 adjusted	0.20	0.16	0.16	0.17

The debt level alone can explain around 20% of the variance in consumption growth. The other controls decrease the coefficient only marginally and the adjusted R^2 even falls.

There is still some positive relation between credit growth and consumption growth, which is present in the correlation coefficient (see the first column of Table 5), but it is not easy to observe from the middle panel of Figure 2. Higher growth of 1 pp. brings 0.035 (model M4) percent more consumption growth. This is around two thirds of the impact for output. The statistical fit

of the model is poor. Debt growth can account for about 4% of the variation in consumption growth. In addition the estimated coefficient is statistically insignificant at conventional levels. Other variables add very little to the statistical fit. Decade dummies lower the adjusted measurement of fit, but the autocorrelation terms add somewhat to the fit of the model.

Table 5: Consumption growth and credit growth

Variable	M1	M2	M3	M4
Debt	0.0795 (0.0363)	0.0749 (0.0376)	0.0472 (0.0430)	0.0350 (0.0434)
Growth before			0.1735 (0.1354)	0.1421 (0.1356)
Growth during				-0.0535 (0.0398)
DD 60		1.1478 (1.0862)	0.8725 (1.0939)	0.9703 (1.0812)
DD 70		0.5204 (0.7857)	0.2187 (0.8108)	0.2772 (0.8008)
DD 80		-0.1966 (0.7858)	-0.2872 (0.7792)	-0.3704 (0.7708)
DD 90		0.2976 (0.7002)	0.1847 (0.6970)	-0.0067 (0.7019)
Const	2.1619 (0.3651)	1.9443 (0.6229)	1.6754 (0.6499)	1.8718 (0.6573)
N	64	64	64	64
R^2 adjusted	0.04	0.00	0.01	0.02

Table 6 presents the correlation between the change in the debt to GDP ratio and consumption growth. The estimated coefficient is negative as could also be conjectured from the lower panel of Figure 2. This stands in contrast with the finding for GDP growth, where the effect was close to zero. The model however does not explain the variation in the data. The adjusted R^2 is negative.

For all the estimated models, consumption growth has only a low correlation with the pre-recession growth. The autocorrelation coefficient for consumption never exceeds 0.22. The correlation is especially low compared to the results for GDP growth. The negative relation between consumption growth during and after the recession is somewhat stronger than that for GDP growth, as a 1% deeper recession brings about 0.05–0.08pp. higher growth, but again the explanatory power of the variable in consumption growth is

Table 6: Consumption growth and change in the debt to GDP ratio

Variable	M1	M2	M3	M4
Debt	-0.2970 (0.3002)	-0.3160 (0.3025)	-0.2574 (0.2946)	-0.3499 (0.2900)
Growth before			0.2235 (0.1115)	0.1617 (0.1129)
Growth during				-0.0759 (0.0392)
DD 60		1.1436 (1.1226)	0.7522 (1.1053)	0.8823 (1.0755)
DD 70		0.3071 (0.8333)	-0.1299 (0.8364)	-0.0629 (0.8130)
DD 80		-0.2871 (0.8270)	-0.4488 (0.8055)	-0.5691 (0.7847)
DD 90		0.6689 (0.7067)	0.3264 (0.7059)	0.0351 (0.7019)
Const	2.8883 (0.2828)	2.5392 (0.6141)	1.9721 (0.6590)	2.2265 (0.6534)
N	62	62	62	62
R^2 adjusted	-0.02	-0.04	0.00	0.04

rather limited. The decade dummies also play only a minor role and their importance is much smaller than it was in explaining the GDP growth rates.

The estimated coefficients for all 12 models for consumption are lower than those estimated for GDP growth. This is a strong indication that after a recession people cut consumption and save more than they did before the recession. The autocorrelation of consumption growth is also lower than that of GDP growth. It is a stylised fact often found for many economies that the autocorrelation of consumption is smaller than the autocorrelation of GDP. This result however is a challenge for standard macroeconomic models which predict that the consumption autocorrelation should be higher than the autocorrelation of the GDP series.

In addition all models for consumption have a very low fit whereas the models for GDP were often good. There is also the puzzling positive relation between debt growth before the recession and GDP growth after the recession. Countries' growth potential, measured by previous growth and decade dummies, does explain part of the positive relation, but does not undo it.

In order to control statistically the difference between the effect of debt on GDP and the effect on consumption we conducted an additional regression

analysis. We separated the common effect of the debt variable on GDP and consumption from the individual effect of the debt variable on consumption growth after the crisis. The regression results are presented in Table 7 for the same four models that were estimated before, including decade dummies and controls for the growth before and during the crisis. Control variables are allowed to have different effects on consumption and GDP growth. We only use the information from those crises where data on both GDP and consumption are available to avoid possibility that the differences could be due to the selection of the crises. Therefore the regression coefficients on GDP do not correspond one-to-one with those presented above.

Table 7: Differences of debt variable effects on GDP and consumption growth

Debt	Stat.	M1	M2	M3	M4
Level	GDP	-0.0165	-0.0148	-0.0073	-0.0065
	St.dev.	(0.0058)	(0.0062)	(0.0059)	(0.0060)
	Cons.diff.	-0.0128	-0.0142	-0.0199	-0.0194
	St.dev.	(0.0082)	(0.0087)	(0.0086)	(0.0086)
	R^2 adj.	0.1949	0.1789	0.2918	0.2971
Growth	GDP	0.0988	0.0935	0.0497	0.0513
	St.dev.	(0.0328)	(0.0329)	(0.0325)	(0.0320)
	Cons. diff.	-0.0120	-0.0121	0.0066	-0.0082
	St.dev.	(0.0464)	(0.0465)	(0.0482)	(0.0480)
	R^2 adj.	0.0920	0.0972	0.2027	0.2142
Change in level	GDP	0.1043	0.1115	0.0743	0.0706
	St.dev.	(0.2727)	(0.2696)	(0.2423)	(0.2366)
	Cons. diff.	-0.4186	-0.4015	-0.3333	-0.4125
	St.dev.	(0.3856)	(0.3813)	(0.3428)	(0.3367)
	R^2 adj.	-0.0168	0.0014	0.1790	0.2020
Obs.		120	120	120	120

We conclude that there is evidence that the debt level and growth have effects that are more negative on consumption than they are on GDP. The additional effect of the debt variable on consumption growth is negative in all but one cases (see the estimated coefficients of Cons. diff. in Table 7). A 50pp higher debt to GDP ratio leads to consumption growth after the end of the recession being an extra 1 pp. lower. The individual effect of the debt to GDP ratio on consumption growth is statistically significant when growth before and during are controlled for. For the other regressions the statistical significance of the difference is low, but given the high variance of the growth after the crisis and the small sample this is not surprising.

We did not identify any important non-linearities or threshold effects from the graphical analysis. Given the low number of observations we have chosen not to estimate any non-linearities in the regression analysis as they may be strongly influenced by outliers.

4. Investments, Trade Balance, and the Autocorrelation of GDP and Debt

In this section we look at the dynamics of investments and the trade balance after a recession and the relationship with the three debt measures. In order to give some further insights into what drives the main results we also analyse how GDP and debt changed before the recession.

The previous section suggested that the contribution of consumption to GDP growth decreases in countries which had higher levels of indebtedness. Countries where the debt level was high before the crisis face higher consumption cut than those that had lower levels of debt. The decreasing share of consumption means in accounting terms that government expenditures, investments or net exports increase. This section presents some evidence that this is indeed true, but the relationships are not strong.

Table 8 summarises the results for investment growth. The results follow a similar pattern to those for GDP and consumption growth. There is a small negative relation between levels of debt and investment growth (see the first panel of Table 8) as 50pp more debt means 1.9pp lower investment growth (model M4, $-0.0382 \times 50 = 1.91$)⁶. The effect is statistically significant at conventional statistical levels. There is also a positive relationship between earlier credit growth and investments. Debt growth that is 10 percentage points higher brings 2.2 percentage points more investment growth. The effect is again statistically significant. As with GDP and consumption growth, the change in the indebtedness has a negative relation, but the estimates are very imprecise. The results do not depend qualitatively on the controls added to the model.

However all the models explain very little in the data variance. The adjusted goodness of fit measures are very small or negative. The autocorrelation coefficient for investment growth is very small and even negative for debt growth. In broad terms the investment growth before the recession is not re-

⁶Model M1 includes a constant; M2 includes a constant and decade dummies; M3 includes a constant, decade dummies and investment growth before the recession; M4 includes all the variables in M3 and additionally investment growth during the recession. The coefficients are not reported in Table 8.

Table 8: Investment and debt measures

Debt	Obs.	Stat.	M1	M2	M3	M4
Level	62	Coef.	-0.0317	-0.0417	-0.0416	-0.0382
		St.dev.	(0.0165)	(0.0174)	(0.0176)	(0.0180)
		R^2 adj.	0.02	0.03	0.01	0.00
Growth	64	Coef.	0.1491	0.1969	0.2407	0.2220
		St.dev.	(0.0850)	(0.0862)	(0.0978)	(0.1004)
		R^2 adj.	0.01	0.02	0.02	0.01
Change in level	62	Coef.	-0.3490	-0.2842	-0.3844	-0.4465
		St.dev.	(0.7004)	(0.7064)	(0.7271)	(0.7194)
		R^2 adj.	-0.03	-0.06	-0.07	-0.06

lated to the investment growth after. This is in line with the consensus view that investments are volatile and that the decision to invest is a forward looking decision based on the expected return rather than on historical factors. The evidence does not show that a high level of indebtedness is a major obstacle to investment growth.

Table 9 summarises the effects of the three debt measures on the trade balance. The results differ from the outcomes for GDP, consumption and investment growth. The higher the level of debt before the recession, the better the trade balance after the recession. And the bigger the debt growth or change in the indebtedness, the worse the trade balance after the recession⁷.

Table 9: Trade balance and debt measures

Debt	Obs.	Stat.	M1	M2	M3	M4
Level	60	Coef.	0.0004	0.0002	-0.0001	0.0000
		St.dev.	(0.0002)	(0.0002)	(0.0001)	(0.0001)
		R^2 adj.	0.08	0.11	0.74	0.81
Growth	59	Coef.	-0.0016	-0.0016	0.0002	-0.0002
		St.dev.	(0.0008)	(0.0008)	(0.0005)	(0.0004)
		R^2 adj.	0.03	0.10	0.71	0.79
Change in level	60	Coef.	-0.0034	-0.0063	-0.0004	-0.0008
		St.dev.	(0.0067)	(0.0063)	(0.0033)	(0.0028)
		R^2 adj.	-0.03	0.09	0.75	0.81

⁷Model M1 includes a constant; M2 includes a constant and decade dummies; M3 includes a constant, decade dummies and the trade balance before the recession; M4 includes all the variables in M3 and additionally the trade balance during the recession. The coefficients are not reported in Table 9.

There is strong correlation between the trade balances before and during the recession. When the trade balance before the recession is included, the autoregressive coefficient is around 0.7. When the trade balance during the recession is also included, the sum of the coefficients is higher but is divided almost equally between the two. The goodness of fit of the analysis shows that the debt level before the recession has some explanatory power for the trade balance, explaining around 8% of the variance. As with GDP growth, earlier values for the trade balance are important determinants of the trade balance after the recession.

To give a better understanding of the main results we present some additional properties of GDP growth before, during and after the recession and debt growth before and after the recession. As discussed above there is a strong correlation between GDP growth before and after the recession and Figure 3 plots GDP growth before and after the slowdown. There is some evidence that the growth rate is slower after the recession. From Figure 3 it can be seen that at low levels of GDP growth there are countries which have increased their growth rates after a recession. In contrast, when earlier levels of growth are high there are no countries that have even higher rates of growth after a recession. On the contrary there are several countries which had high growth rates before a recession, but considerably lower growth rates afterwards. The average slowdown in the growth rates can be a product of two factors that are not directly related to the debt measures. First, as the decade dummies showed, the GDP growth rates were declining over time and therefore the growth after the recession is expected to be slower. Second, the business cycle is known to have slow starts and sharp ends. As we do not have full cycles on both sides, and as we have more sharp ends and more slow starts, the average growth rate after a recession is constructed to be lower than the growth before it.

Credit growth before a recession is positively related to GDP growth before the recession (see Figure 4). It is widely known that highly growing countries can have higher credit growth rates, and this is indeed also true in our sample. In addition there were four episodes with particularly high credit growth. These four cases were discussed briefly in the section covering the main results. Credit growth continues after the recession, but the growth rate is much smaller. Figure 5 plots the credit growth before the recession on the horizontal axis and credit growth after the recession on the vertical axis. There is a clear positive relationship between the two credit growth measures. Credit growth after the recession is on average lower than the credit growth before the recession and it is negative in several countries even though the countries have positive GDP growth rates.

We find that high credit growth is associated with deeper and longer recessions. The upper panel of Figure 6 plots earlier credit growth on the horizontal

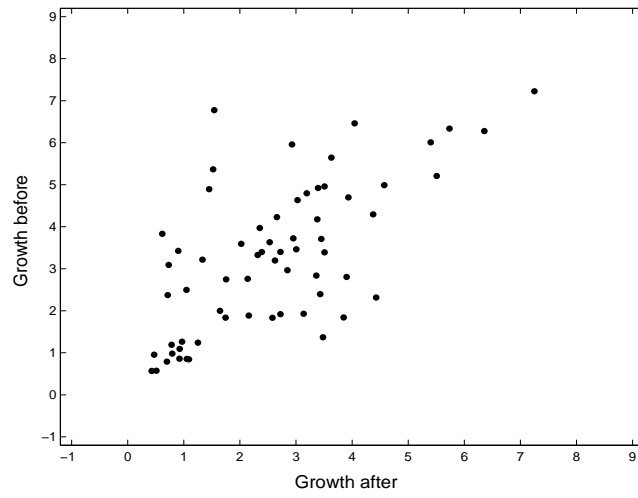


Figure 3: GDP growth before and after the recession

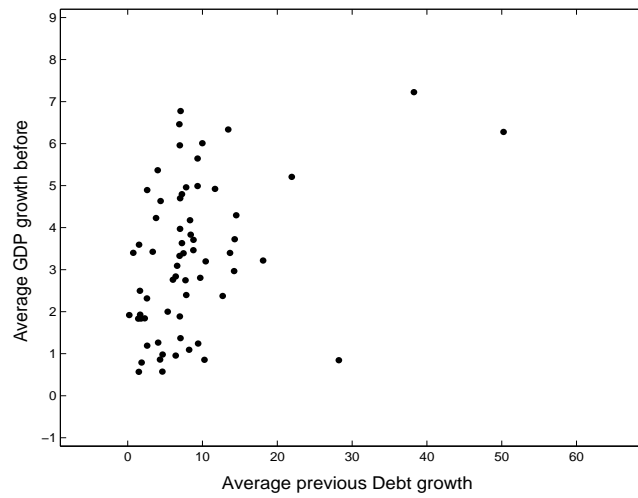


Figure 4: Credit growth and GDP growth before the recession

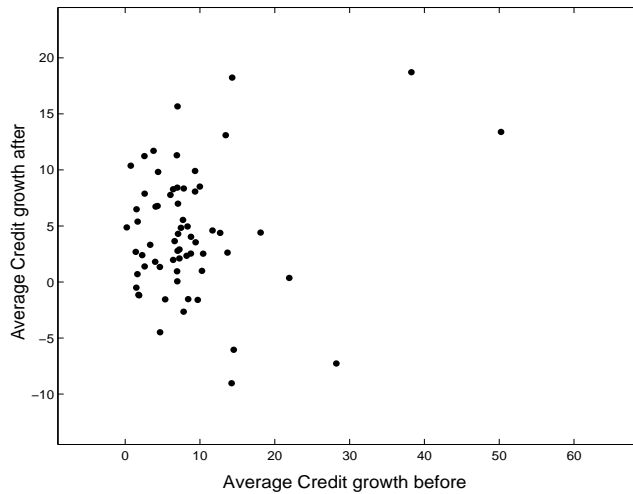


Figure 5: Credit growth before and after the recession

axis and GDP growth during the recession in the vertical axis. The relation is clearer if we exclude the outliers and concentrates on the recessions that are in the left top corner of the Figure. The lower panel of Figure 6 plots the earlier credit growth on the horizontal axis and the length of the recession in quarters on the vertical axis. The relation is weakly positive — higher debt growth before the recession is associated with longer recessions. The majority of the recessions last for two quarters and have occurred after low credit growth episodes.

The results on the strength of the recessions are in line with several previous studies. Claessens et al. (2008) use a similar sample and methodology and find a similar result. Uuskula et al. (2004) show that a financial crisis is longer and more costly in terms of lost GDP when credit growth is higher.

5. Robustness analysis

In this section we show that the results are not sensitive to the main assumptions in the set-up. We first change the data period used before the recession. Then we divide the cases between rich and poor OECD countries, different time periods, organisational memberships and levels of financial liberalisation.

Table 10 presents the results for GDP growth when we increase and decrease the period under attention by four quarters. There is no evident criterion for deciding which period before the crisis should be used. On the one hand short horizons do not allow the full dynamics before the recession to be

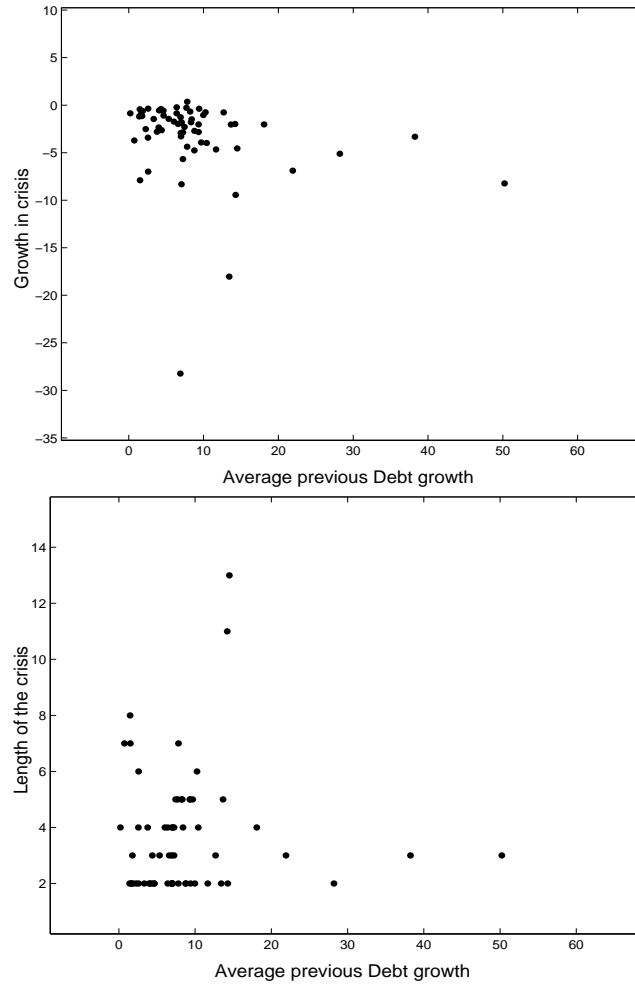


Figure 6: Credit growth and severity of the recession. GDP growth in a crisis in the upper panel and length of the crisis in quarters on the lower panel

captured as there is often a period of levelling off right before the recession so that short data would not capture credit booms. On the other hand using long periods restricts the number of cases that can be analysed. When shortening the period we gain 8 observations and lose 11 when increasing the period.

Table 10: Sensitivity to the length used for the period before the crisis

Debt	Qrt.	Obs.	Stat.	M1	M2	M3	M4
Level	8	69	Coef.	-0.0207	-0.0163	-0.0093	-0.0076
			St.dev.	(0.0054)	(0.0055)	(0.0046)	(0.0047)
			R^2 adj.	0.15	0.20	0.47	0.47
	16	50	Coef.	-0.0215	-0.0153	-0.0028	-0.0027
			St.dev.	(0.0071)	(0.0073)	(0.0058)	(0.0058)
			R^2 adj.	0.12	0.15	0.52	0.51
Growth	8	72	Coef.	0.0984	0.0932	0.0530	0.0525
			St.dev.	(0.0212)	(0.0219)	(0.0211)	(0.0204)
			R^2 adj.	0.21	0.21	0.38	0.41
	16	53	Coef.	0.1092	0.0995	0.0484	0.0495
			St.dev.	(0.0257)	(0.0270)	(0.0224)	(0.0223)
			R^2 adj.	0.22	0.20	0.52	0.51
Change in level	8	69	Coef.	0.0656	0.0584	0.0927	0.0850
			St.dev.	(0.2427)	(0.2320)	(0.1803)	(0.1776)
			R^2 adj.	-0.03	0.10	0.45	0.46
	16	50	Coef.	-0.1224	-0.0154	0.0412	0.0415
			St.dev.	(0.3290)	(0.3044)	(0.2056)	(0.2054)
			R^2 adj.	-0.04	0.07	0.57	0.56

The effect of the debt level on GDP growth remains negative for all the models while the relation between debt and GDP growth remains positive. The size of the estimated coefficient varies and is in general smaller in absolute value when longer periods are used for the time before the crisis.

Consumption growth in Table 11 follows a similar pattern. The effect of the debt level on consumption growth is negative and the debt growth is positive. The relation between the change in the debt to GDP ratio and GDP growth after the recession is negative although the explanatory power of the debt variable is marginal.

As before, the parameter estimates for consumption growth are always smaller than those for GDP growth. Again the negative effects of the debt level on consumption are bigger and the positive effects of debt growth and change in the debt to GDP ratio before the recession are smaller than those for GDP growth.

Table 11: Sensitivity to the length used or the period before the crisis

Debt	Qrt.	Obs.	Stat.	M1	M2	M3	M4
Level	8	70	Coef.	-0.0254	-0.0261	-0.0277	-0.0263
			St.dev.	(0.0057)	(0.0061)	(0.0065)	(0.0064)
			R^2 adj.	0.20	0.17	0.16	0.19
	16	51	Coef.	-0.0283	-0.0288	-0.0241	-0.0243
			St.dev.	(0.0076)	(0.0081)	(0.0090)	(0.0089)
			R^2 adj.	0.18	0.14	0.14	0.14
Growth	8	71	Coef.	0.0570	0.0498	0.0476	0.0371
			St.dev.	(0.0306)	(0.0317)	(0.0340)	(0.0337)
			R^2 adj.	0.02	0.00	-0.02	0.01
	16	52	Coef.	0.0702	0.0541	0.0357	0.0267
			St.dev.	(0.0451)	(0.0482)	(0.0468)	(0.0482)
			R^2 adj.	0.01	-0.05	0.02	0.01
Change in level	8	70	Coef.	-0.1073	-0.1935	-0.1581	-0.2431
			St.dev.	(0.2635)	(0.2709)	(0.2733)	(0.2676)
			R^2 adj.	-0.03	-0.04	-0.04	0.00
	16	51	Coef.	-0.4743	-0.5032	-0.4104	-0.5115
			St.dev.	(0.3462)	(0.3424)	(0.3355)	(0.3351)
			R^2 adj.	0.00	-0.03	0.01	0.03

The relation between debt measures and GDP could potentially be driven by whether countries are poor or rich as poor countries have usually low debt levels. Therefore we divide all the cases into growth groups: (1) rich OECD and (2) poor OECD and emerging markets⁸. The cross section is plotted on Figure 7.

The negative relation remains unchanged when we look at the relation of debt level and GDP growth in rich OECD countries. The downward trend in the upper panel for rich OECD countries is more pronounced because of the larger number of observations. However the lower panel with eight episodes does not contradict the basic finding either.

Another factor that could have an influence on the effect of credit variables on the strength of the economic recovery is the level of financial liberalisation. On the one hand financial liberalisation should allow an efficient recovery from a crisis. On the other hand low confidence and the resulting capital flight can harm the economic growth in the recovery phase.

⁸Poor OECD contains the Czech Republic, Estonia, Hungary, Korea, Mexico, Poland, Slovakia, and Turkey

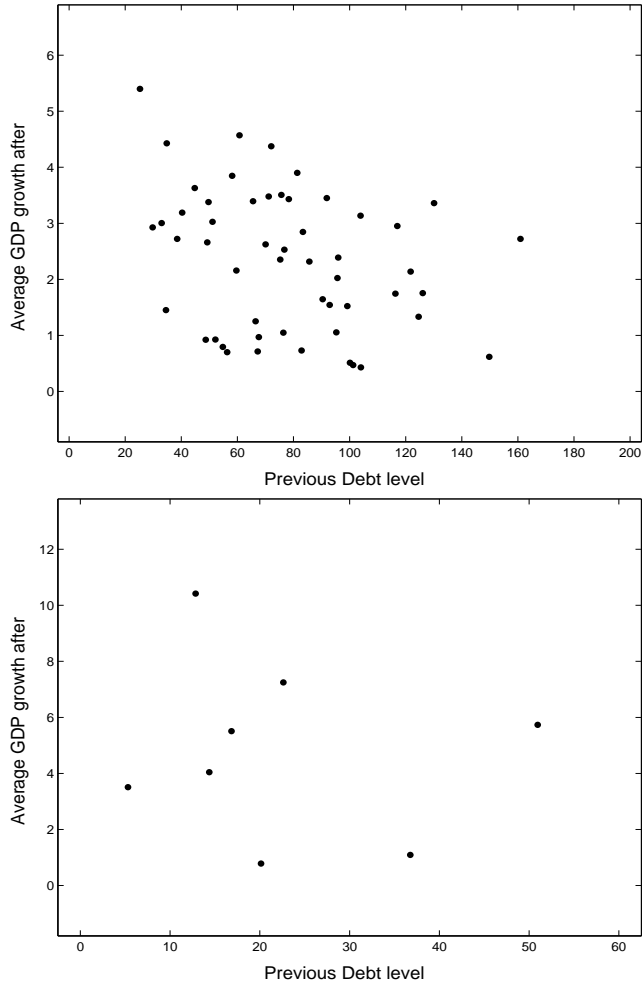


Figure 7: Debt level and GDP growth in rich OECD countries (upper panel) and poor OECD and emerging markets (lower panel)

In order to take account of the possible effects of financial liberalisation we used the classification of Abiad et al. (2008). They constructed an annual index for the countries in our sample starting in 1973. Given the availability of data we have dropped any crisis that started before 1973. We estimate the regressions of the main results, including financial liberalisation as a control and as an interaction term for the three debt measures. The regression results do not show any interaction of the debt measures with financial liberalisation either for GDP or for consumption growth⁹.

In addition we divided the crisis episodes into two groups based on the liberalisation index. We used three groups for crisis episodes setting the threshold for the index at below 10.5, and the division at 16.25 and 18 out of 21. As a rough rule the 10.5 threshold divides the episodes into cases that are less than half and more than half-liberalised. The number of crises below 10.5 was 12 out of 58. The other two thresholds correspond to the financial liberalisation in the US in 1980–1981 and 1982–1990. Germany had an index value of 17 from 1985–1992 and has been at 19 since then, but these thresholds are also convenient as they roughly divide the remaining 46 crisis episodes into three equal groups. The effect of the debt on GDP are independent from the level of financial liberalisation. This is confirmed both by looking at the cross-section plots and by regression analysis based on the interaction dummy.

As the financial liberalisation index only starts in 1973 we lose some crisis episodes. As a proxy for country openness we use a rule of thumb and divide crises where the episodes finished before 1980 from the crises that finished later. Moreover, to cover the institutional quality of the country we divided crisis episodes by the membership of the country in the European Union at the time of the crisis and by whether the country is a member now. None of the figures from any of the measures gave any serious indication of different effects, but the limitations of the paper do not allow that question to be addressed fully¹⁰.

6. Conclusions

The paper looks at recoveries from economic slowdowns and relates the growth performance to various debt measures. We show that the possible negative effects of debt levels on GDP are small. Countries which grew before recessions also grow after the recession is over. In fact, countries which had

⁹The results can be obtained from the authors on request.

¹⁰Given that the groups are of unequal size we decided to plot the crisis episodes and skip the regression analysis as regression coefficients might be heavily dependent on possible outliers.

high credit growth before the recession and had high growth are expected to grow more after the recession too. We find small negative effects of the debt level on GDP growth. The impact of debt variables on consumption growth is more negative than it is on GDP growth.

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Appendixes

Table A1: List of Recessions

Country	Beg.	End	GDP after	Debt level	Debt growth	Debt levelch.
Australia	1965Q2	1965Q4	5.40	25.26	9.98	0.25
	1971Q3	1972Q1	2.93	29.77	6.97	-0.11
	1975Q2	1975Q4	3.00	33.01	8.77	0.30
	1982Q2	1983Q2	4.43	34.81	2.57	-0.11
	1990Q1	1991Q2	3.38	49.71	8.33	0.68
Austria	1974Q1	1975Q2	3.63	44.81	9.34	0.23
	1992Q2	1993Q1	2.32	85.67	6.94	0.50
	2000Q4	2001Q2	1.52	99.18	4.02	0.03
	2004Q3	2005Q1	3.14	103.90	1.67	0.00
Belgium	1992Q1	1993Q1	2.62	70.06	10.42	0.80
Canada	1981Q2	1982Q4	1.05	95.28	10.27	0.90
	1990Q1	1991Q1	0.47	101.25	6.42	1.16
Denmark	1986Q3	1987Q1	2.95	116.99	14.31	3.57
	2000Q4	2002Q1	1.75	126.08	7.73	1.30
Estonia	1998Q3	1999Q2	7.25	22.63	38.27	1.50
Finland	1975Q2	1976Q1	3.19	40.33	7.25	-0.01
	1990Q1	1993Q2	4.38	72.06	14.51	1.42
	2001Q1	2001Q4	3.03	51.14	4.40	0.16
France	1974Q3	1975Q1	3.39	65.58	11.67	0.79
	1992Q3	1993Q2	1.64	90.39	5.35	0.71
Germany	1966Q1	1967Q2	4.57	60.75	9.34	0.27
	1974Q1	1975Q2	3.51	75.68	7.45	0.65
	1980Q1	1980Q4	0.73	82.88	6.62	0.59
	1992Q1	1993Q1	1.54	92.91	7.07	-0.81
	2002Q3	2003Q2	1.74	116.32	1.79	0.23
Italy	1992Q1	1993Q1	2.16	59.62	6.97	0.48
	2001Q1	2001Q4	0.71	67.22	12.70	1.08

Table A1: continued

Country	Beg.	End	GDP after	Debt level	Debt growth	Debt levelch.
Japan	1974Q3	1975Q1	1.25	66.49	9.41	0.15
	1981Q2	1981Q4	0.97	67.63	4.07	0.13
	1993Q1	1993Q3	0.51	100.13	4.63	0.23
	1997Q1	1999Q1	0.43	104.02	1.49	-0.08
Korea	1964Q4	1965Q2	10.42	12.84	N.A.	-0.34
	1997Q4	1998Q2	5.74	50.95	13.45	0.77
Mexico	1994Q4	1995Q2	1.09	36.76	28.22	1.73
	2000Q3	2002Q1	0.78	20.14	2.61	-0.44
The Netherland	1992Q1	1993Q4	3.43	78.33	7.83	0.13
New Zealand	1990Q4	1991Q2	3.48	71.17	7.06	0.82
	1997Q3	1998Q1	3.45	91.87	8.80	1.32
Norway	1980Q1	1980Q3	1.45	34.55	2.60	-0.52
	1991Q2	1991Q4	3.85	58.14	2.28	-0.23
	2005Q2	2005Q4	2.35	75.27	6.99	0.33
Portugal	1982Q4	1984Q1	3.90	81.33	9.69	0.46
	1992Q1	1993Q1	2.66	49.28	3.79	0.27
	2002Q2	2003Q2	1.33	124.61	18.11	2.88
Spain	1978Q3	1979Q1	1.05	76.40	1.63	-0.40
	1992Q1	1993Q1	2.53	76.74	7.25	0.26
Sweden	1975Q2	1975Q4	0.90	N.A.	3.34	N.A.
	1981Q3	1982Q1	2.58	N.A.	1.42	N.A.
	1990Q1	1992Q4	2.85	83.34	14.23	2.14
Switzerland	1969Q3	1970Q1	3.93	N.A.	7.01	N.A.
	1974Q2	1976Q1	2.02	95.66	1.51	-0.64
	1981Q2	1982Q2	2.14	121.77	6.05	0.40
	1986Q2	1986Q4	3.36	130.12	6.42	0.44
	1990Q2	1991Q2	0.62	149.78	8.42	1.34
	2002Q1	2003Q1	2.72	160.92	0.21	-1.02
Turkey	1993Q4	1994Q2	4.04	14.37	6.91	0.04
	1998Q4	1999Q3	5.51	16.85	21.93	-0.04
UK	1979Q2	1981Q1	2.72	38.54	0.74	-0.15
USA	1990Q2	1991Q3	2.39	95.96	13.68	1.95
	1969Q3	1970Q1	0.92	48.72	4.33	0.06
	1973Q4	1975Q1	0.93	52.14	8.22	0.48
	1980Q1	1980Q3	0.79	54.80	4.67	0.18
	1990Q3	1991Q1	0.70	56.36	1.86	-0.25
Argentina	1994Q4	1995Q3	6.36	N.A.	50.25	N.A.
Philippines	1997Q4	1998Q2	3.51	5.31	7.81	0.08

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