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Public Debt and Economic Growth – Economic Systems Matter

Markus Ahlborn, Rainer Schweickert

Abstract

Most studies on the relationship between public debt and economic growth implicitly assume homogeneous debt effects across their samples. We –in accordance with recent literature– challenge this view and state that there likely is a great deal of cross-country heterogeneity in that relationship. However, other than scholars assuming that all countries are different, we expect that *clusters of countries differ*. We identify three country clusters with distinct economic systems: *Liberal* (Anglo Saxon), *Continental* (Core EU members) and *Nordic* (Scandinavian). We argue that different degrees of *fiscal uncertainty* at comparable levels of public debt between those economic systems constitute a major source of heterogeneity in the debt-growth relationship. Our empirical evidence supports this assumption. *Continental* countries face more growth reducing public debt effects than especially *Liberal* countries. There, public debt apparently exerts neutral or even positive growth effects, while for *Nordic* countries a non-linear relationship is discovered, with negative debt effects kicking in at public debt values of around 60% of GDP.

Keywords: Public Debt, Economic Growth, Economic Systems, Fiscal Policy, Welfare State

JEL classification: E62, P10, P51, H10

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1. Introduction

Triggered by the now controversial paper of Reinhart and Rogoff (2010) a large and growing number of authors investigated the growth effects of high public debt levels and possible non-linearity, i.e. tipping points or thresholds in that relationship.¹ As summarized by Panizza and Presbitero (2013), the results, primarily from growth regressions, are rather inconclusive and recent studies suggest that cross-country heterogeneity has to be taken into account (Eberhardt and Presbitero 2014; Égert 2015; Gómez-Puig and Sosvilla-Rivero 2015; Lof and Malinen 2014; Puente-Avojin and Sanso-Navarro 2015). We suggest economic systems as a major determinant of such cross-country heterogeneity, i.e. clusters of countries characterized by similar production and welfare systems are likely to exhibit similar behaviour in the relationship between public debt and economic growth.

The incorporation of possible sources of heterogeneity into growth regression analyses investigating the public debt – growth relationship has only been undertaken to a limited degree so far. Caner et. al. (2011) test for differing thresholds between developing and advanced countries, finding that the public debt tipping point for advanced countries lies on a higher level than that of developing countries. One explanation could be increasing institutional quality at higher income levels, which to a certain degree alleviates the negative consequences of high public debt levels because trust in a country's institutions is higher. Kourtellos et al. (2013) investigate institutional quality itself as a possible source of heterogeneity. They identify two different growth regimes via a structural threshold regression, one of which is characterized by a framework of high and the other by one of low institutional quality. In the low-quality institutional framework, public debt is found to exert a negative influence on economic growth while it is growth neutral in a regime of high institutional quality².

However, what is lacking in all growth regressions so far is the comparison of different economic systems that are not separated by institutional quality but by different production and welfare systems, i.e. different prototypes of institutional designs. Clusters of economic systems are analysed in the literatures on *Varieties of Capitalism (VoC)* and *Worlds of Welfare State (WWS)*. This literature converged towards prototypes of liberal and coordinated economic systems (Schröder 2013), which are summarized and confirmed in our own recent contribution (Ahlborn et. al. 2016). We argue that economic systems are likely to provide an explanation for heterogeneity between clusters of countries concerning growth effects of public debt. Our argument is that – due to specific institutional characteristics – different economic systems entail different degrees of *fiscal uncertainty*, which substantially shape the investment climate at comparable levels of public debt and, hence, constitute a

¹ See, e.g., Afonso and Jalles 2013; Baum et al. 2013; Caner et al. 2011; Checherita and Rother 2012; Cecchetti et al. 2011; Kourtellos et. al. 2013; Panizza and Presbitero 2014; Teles and Mussolini 2014 and Woo and Kumar 2015.

² Further studies focus on other possible sources of heterogeneity in the public debt-growth relationship. Antonakakis (2014), Chudik et al. (2013) and Pescatori et al. (2014) focus on the trajectory and structure of public debt. Antonakakis (2014) defines “sustainable“ and “non-sustainable” debt levels for each country and accordingly finds that “sustainable” public debt has no effect while “non-sustainable” debt does impede on economic growth. Chudik et al. (2013) and Pescatori et al. (2014) discover the debt trajectory as a source of heterogeneity in the debt-growth relationship. Their findings suggest that high but reducing public debt levels are growth-neutral while high and rising debt levels are detrimental for economic activity.

source of heterogeneity in the relationship between high public debt levels and long-run economic growth.³

In order to make this point, the paper proceeds as follows. In Section 2, we present our arguments about *fiscal uncertainty* driving growth effects of public debt in clusters of countries sharing similar structural characteristics concerning *fiscal flexibility*, *fiscal effectiveness*, and *fiscal consistency*. We explain that these characteristics are constitutional elements of prototypes of economic systems in advanced OECD countries: *Liberal*, *Continental*, *Nordic*. Section 3 explains our econometric long-run growth model, which uses panel data for 111 countries over the period from 1971 to 2010 and is based on the analysis of government activity on economic growth in Beckmann et al. (2016). In order to detect homogeneous or heterogeneous thresholds we employ a *rolling threshold technique*, where we include different threshold dummies into our regressions and compare coefficient estimates and significance. The results presented in Section 4 reveal negative debt effects for low-income developing countries but no general turning point nor threshold level. However, the results on heterogeneous debt effects and thresholds for advanced OECD countries clearly suggest that countries of the *Continental* cluster indeed face negative consequences of public debt on economic growth, while these effects are neutral or even positive for *Liberal* countries. The *Nordic* countries apparently face stronger non-linearity, with negative public debt effects only kicking in at around 60% of GDP. Section 5 concludes.

³ Heterogeneity along this line of reasoning has recently also been advocated by Shelton (2012) in the context of partisan political business cycles. While we concentrate on long-run growth effects in our paper, the link between economic systems and heterogeneity of political business cycles clearly is a topic for future research.

2. Public Debt and Economic Growth: Why Economic Systems Matter

In this chapter, we proceed in three steps. First, we give an introduction into our thoughts about *fiscal uncertainty* and explain how it may shape the relationship between public debt and long-run economic growth as one source of heterogeneity. Second, we examine three groups of countries with different economic systems that differ with respect to *fiscal uncertainty* and present stylized facts that support our views. Third, we provide our hypotheses about why such economic systems and the entailing differences in *fiscal uncertainty* matter in the debt-growth relationship as one source of cross-country heterogeneity.

Theoretical Considerations - In Search of Heterogeneous Uncertainty Effects of Public Debt

Theoretical explanations for possibly negative growth effects of public debt mainly focus on fiscal deficits and argue for a trade-off between positive short-run effects (in case of an output gap and stickiness of prices and wages) and negative long-run effects. Growth impeding long-run effects are caused by changes in expectations of market participants at high levels of public debt, leading to a decrease of national savings and, consequently, to an increase of interest rates, less investment and higher risk premia. (Elemendorf and Mankiw 1999; Greiner 2014). Consequently, uncertainty rises and additionally fiscal flexibility for productive government spending is reduced with negative effects on growth (Teles and Mussolini 2014). The negative effects of public debt are likely to increase with higher public debt levels due to more uncertainty with economic actors expecting future confiscation, e.g. by increasing inflation or distortionary taxation (Cochrane 2011a; 2011b). This is also supported by papers modelling optimal levels of public debt (e.g. Checherita-Westphal et al. 2014) but rejected by other papers arguing for a monotone and negative relationship between debt and growth (Greiner 2014). Summarizing, notwithstanding differing results, the common denominator is the role of uncertainty and expectations about future fiscal policy, i.e. *fiscal uncertainty*, which determines negative long-run effects of public debt on economic growth.

Hence, even if assuming similar levels of institutional quality, countries might exhibit different public debt effects due to specific institutional characteristics if these characteristics imply different levels of *fiscal uncertainty* created by an increasing level of public debt. Three (overlapping) sources of *fiscal uncertainty* at similar debt levels, which shape the relationship between public debt and long-run growth, could be identified as potential sources of cross-country heterogeneity:

- *Lack of Fiscal Flexibility*: It is likely that a welfare state regime with a particular spending focus directly influences fiscal flexibility and consequently constitutes a source of heterogeneity in the debt-growth relationship. At similar levels of public debt, investors will demand higher risk premia in an environment of systematically higher state activity, especially if the spending focus is on transfers and subsidies that are hard to reduce such as pensions or unemployment benefits. Implicit future liabilities are higher (especially considering population ageing, Meier and Werding 2010) and successful fiscal consolidation will be harder to achieve since opposition against such consolidation efforts will likely be stronger (Tagkalakis 2009 e.g. finds that less generous unemployment benefit schemes increase the likelihood of successful consolidation). Overall, fiscal flexibility is lower at comparable public debt levels in countries favouring high

state activity and a spending focus on transfers and subsidies. This will increase *fiscal uncertainty* and will have a negative impact on the investment climate, consequently lowering long-run economic growth.

- *Lack of Fiscal Effectiveness*: According to Teles and Mussolini (2014) fiscal policy effectiveness is a major channel through which high public debt levels impede long-run economic growth. They argue that due to an increase in interest payment at high levels of public debt, governments will have lower capacity for productive spending, which ultimately lowers economic growth. Since countries with different economic systems are supposedly differing in terms of fiscal policy effectiveness in the first place this growth effect of public debt will likely differ among those country groups (e.g. Soskice (2007) argues that anticyclical fiscal policy in a liberal framework will per se produce higher fiscal multipliers). Additionally, fiscal policy effectiveness depends on how countries use debt financed funds and tax revenues. Rogerson (2007) shows that the spending mix of countries has a large influence on the effects of tax rate changes on economic activity. I.e. countries that focus spending on subsidies for work (e.g. childcare) will achieve a better market outcome by fiscal policy measures than countries favouring subsidies for leisure (e.g. pensions or unemployment benefits). Subsidizing work instead of leisure enables countries to uphold a higher level of government activity without impairing economic activity as much as countries favouring a less beneficial spending mix. In addition to these direct effects there is also an indirect growth effect of fiscal effectiveness: Market participants implicitly take fiscal policy effectiveness into account when they assess the investment climate at a given level of public debt. In countries with a less favourable spending composition and an encompassing lack of fiscal effectiveness, they will then demand higher risk premia, since they are convinced that the fiscal policy measures, which are undertaken with the debt-financed funds, will lead to a worse outcome. Ultimately, this will again increase *fiscal uncertainty* and lead to stronger negative long-run growth effects of public debt in countries with a lack of fiscal effectiveness, i.e. in countries favouring an active state and subsidies for leisure over productive spending and/or subsidies for work.
- *Lack of Fiscal Consistency*: Uncertainty about future fiscal policy may be reduced once fiscal policy is consistent with societal preferences. Iversen and Wren (1998) e.g. state that there is a trilemma with respect to achieving employment creation (i.e. economic growth), equality of income distribution and fiscal stability at the same time. Following their line of thought, any economic system can only achieve two goals simultaneously, while the other one has to be neglected. Although this trilemma does not need to be impossible to solve, there certainly is a trade-off involved that has to be solved on the basis of societal preferences. Hence, government activity – either high or low – has to be consistent with these societal preferences and the related willingness to pay taxes in the future in order to avoid *fiscal uncertainty*.⁴

⁴ Recently, uncertainty about fiscal policy in the context of political business cycles was discussed by Shelton (2012). He was able to show that right wing governments are expected to create booms in coordinated market economies and busts in liberal market economies. This nicely fits into our view about fiscal consistency. Higher spending is not seen as a problem in coordinated market economies if guided by the “right” party, while spending is seen as a problem in liberal economies especially if initiated by the “wrong” party. Overall, however, output effects are rather short lived and unlikely to show up in long-run growth, which is our focus here. In the same vein, there seem to be different political business cycles present depending on the fragmentation of government, which

Taken together, these sources of *fiscal uncertainty* constitute structural characteristics of fiscal policy in the context of overall government activity. They have been discussed in the literature to some extent as single driving forces of *fiscal uncertainty* leading to heterogeneity of growth effects on the country level. What has been neglected so far is that they are constitutional aspects of economic systems, which are homogeneously defined for clusters of countries. An economic system may possess institutional characteristics that lead to a lack of fiscal flexibility and effectiveness, causing more *fiscal uncertainty* in times of high public debt levels than in other systems, which will ultimately lead to stronger negative growth effects of public debt in such an institutional environment.

Prototypes of Economic Systems – Characteristics and Stylized Facts

The relationship between economic growth and public debt discussed above concerns two spheres of economic systems, which traditionally have been treated separately in the literature. Production systems have been analysed in the literature on *Varieties of Capitalism* inspired by the contribution of Hall and Soskice (2001) and welfare systems have been analysed in the literature on *Worlds of Welfare States* triggered by the contribution of Esping-Andersen (1990). As shown by Schröder (2013) attempts to define prototypes of economic systems in both strands of the literature lead to similar clusters due to the need for complementarity across the spheres of production and welfare as well as shared target systems based on similar societal preferences. Following this reasoning, three prototypes of economic (production and welfare) systems can be defined for advanced OECD countries (an empirical validation of these clusters is provided by Ahlborn et al. 2016):⁵

Continental: Core EU states with a *Coordinated Market Economy* and a *Conservative* welfare state, i.e. strong regulation of the economy with coordination among economic actors as the main microeconomic mechanism. Societal preferences are in favour of income equality and, therefore, an active state and a spending focus on transfers as subsidies for leisure (e.g. unemployment benefits, early pensions) are maintained.

Nordic: Nordic/Scandinavian states with a *Coordinated Market Economy* and a *Social Democratic* welfare state. These countries have an economic system with coordination between economic actors as the main mechanism and an active state. Societies favour income equality as well but the spending focus is on subsidies for work (e.g. child and elderly care). In addition, less regulative interference of the state allows for a better performance in terms of innovative capacity and economic growth.

Liberal: English-speaking countries with a *Liberal Market Economy* and *Liberal Welfare State*. I.e. deregulated economy with few government interventions and transfers. Societal preferences favour macroeconomic stability and economic growth over income equality and the spending focus lies on government consumption and productive expenditure (e.g. military).

is more likely in coordinated market economies with majority voting. However, the theory and evidence is rather mixed with respect to the directions of the effect on the local and national level (see, e.g., Geys 2007 and Huber et al. 2003). Whether or not effects prevail in the long-run should depend on the general preference for debt financed public spending as discussed in this paper.

⁵ For the discussion of the country sample and the cluster assignment, see Section 3 and Appendix. Because we concentrate on the major clusters for advanced OECD countries, we do not consider Asian, Mediterranean or Eastern European clusters here.

Figure 1 shows some stylized figures on government activity, public debt and economic growth for these clusters of countries. With respect to the structure of government activity, the *Liberal* countries feature a generally less active state and hand out fewer transfers and subsidies than the other groups. The *Continental* and *Nordic* countries both maintain an active state (high values for *Government Size* by the Economic Freedom of the World Report) as expected. Differences between those systems become apparent, however. The emphasis of the *Continental* countries on subsidies for leisure in their spending composition can be identified by the variable for transfers and subsidies, which takes on much higher values in the *Continental* group compared to the *Nordics*. Hence, the *Nordic* model provides a kind of compromise in that a high level of government activity goes along with a rather low level of transfers and subsidies. This also applies to debt dynamics indicating that a large size of government needs not to go along with high levels of public debt, which are on average even lower than in *Liberal* countries.

[Figure 1 here]

Supporting our assumption about the relevance for the debt-growth relationship, the pattern revealed when looking at the structure of government activity is also evident when looking at simple correlations between public debt levels and the 5-year average growth rate.⁶ In the *Continental* group, public debt and long-run economic growth show a strong negative correlation of -0.30, while within the *Nordic* country group this negative correlation is weaker (-0.14). The *Liberal* country group on the other hand apparently exhibits a substantially different relation between the two variables, as they are positively correlated (+0.15). While those results have to be interpreted with caution, they suggest that differing government activity in economic systems may explain heterogeneity of growth effects of public debt. In addition, the *Nordic* model seems to establish a kind of compromise in this respect.

Hypotheses – Economic Systems Matter

In our view, the combination of theoretical considerations with stylized facts about the three prototype economic systems presented above clearly supports the hypothesis of differing growth effects of public debt across clusters of countries:

Continental cluster: Since the *Continental* model favours subsidies for leisure in its government spending mix, market participants are likely to demand higher risk premia at a given level of public debt. Such spending typically entails large future obligations and is hard to reduce in case of a necessary fiscal consolidation. Therefore, market participants will question debt sustainability at lower debt levels than in other economic systems, impairing the investment climate. Consequently, these characteristics of the *Continental* spending mix lead to a strong reduction of fiscal flexibility at high levels of public debt, impairing market expectations. Furthermore, fiscal policy is less likely to be effective in *Continental* countries because of smaller fiscal multipliers in *Coordinated Market Economies* (Soskice 2007⁷) and because of the emphasis on subsidies for leisure (Rogerson 2007). Market participants take

⁶ For our whole sample of 111 countries between 1971 and 2010 there is a weak negative correlation (-0.10) between initial public debt and the 5-year average per capita growth rate. As expected, however, there are large differences between country groups in this respect. Firstly, there is a stronger negative relation between public debt and economic growth in OECD countries with a correlation coefficient of -0.24 as opposed to -0.11 in non-OECD countries. Apparently, the debt-growth relationship differs between countries at different income levels.

⁷ Soskice (2007) hypothesizes that governments of Coordinated Market Economies (CME) conduct a less effective fiscal policy than those of Liberal Market Economies (LME), which is due to the firm specific skills CME workers appropriate. These workers will react procyclically and generate more precautionary savings during a downturn

this higher *fiscal uncertainty* into account when they assess the investment climate at a given level of public debt and will demand higher risk premia. Hence, we expect that in countries with a *Continental* economic system, public debt has a more negative impact on long-term growth. In addition, *Continental* countries may risk adding to uncertainty when neglecting fiscal stability and employment creation when trying to achieve higher levels of equality by an inadequate mix of government activity.

Nordic cluster: In terms of fiscal flexibility, we also expect a negative relationship between public debt and long-run growth in the *Nordic* model. Countries with a *Nordic* economic system feature an active state and favour subsidies for work, a type of expenditure, which entails future obligations and is hard to reduce as well. This will lead to *fiscal uncertainty*, which impairs the investment climate at high levels of public debt and ultimately causes negative public debt effects on long-run growth. Considering fiscal effectiveness, *Nordic* countries put larger emphasis on subsidies for work in their spending mix. This enables them to maintain a high level of government activity at high tax rates, without harming economic activity as much as they would with another spending mix, e.g. compared to the *Continental* countries (Rogerson 2007). This might lead to a better investment climate at a given level of debt, due to more confidence of market participants in the countries' fiscal policy and it enables *Nordic* countries to maintain high levels of taxes without impairing economic activity. This might allow them to stay away from potentially growth-reducing high levels of public debt and to avoid negative trilemma effects. Hence, the expectation concerning the debt-growth relationship in a *Nordic* economic system is ambiguous: on the one hand, high state activity potentially raises *fiscal uncertainty*, while, on the other hand, a high degree of fiscal effectiveness lowers such uncertainty.

Liberal cluster: Since *Liberal* countries generally hand out less transfers and subsidies, market participants will likely expect less future obligations and that fiscal consolidation will be easier to achieve at a given debt level than in other economic systems. Hence, in this regard, we expect less negative growth effects of public debt for countries with a *Liberal* economic system, since *fiscal uncertainty* will be lower and market participants will demand smaller risk premia at a given level of public debt. *Liberal* countries generally feature a less active state with smaller tax rates and a spending mix favouring government consumption and investment. At a given level of debt, market participants will anticipate that debt generated funds are not used for potentially growth reducing measures such as large subsidies for leisure but possibly used for anticyclical fiscal policy, which additionally is more likely to be effective in *Liberal* states (Soskice 2007). This will lead to a better investment climate at a given level of debt compared to the *Continental* and *Nordic* economic systems and ultimately to less negative effects of public debt on long-run economic growth. Arguably, it is easier for *Liberal* countries to focus on the growth-debt relationship because societal preference allows neglecting income equality as a relevant target at least to some extent.

Overall, these considerations lead us to the conclusion that the relationship between public debt and long-run economic growth will substantially differ between the three country groups. At a given level of public debt, a lack of fiscal flexibility and effectiveness in the *Continental* model is likely to lead to *fiscal uncertainty* and a stronger negative effect of public debt on long-run growth especially compared to *Liberal* countries. For the *Nordic* countries, we also expect a negative relationship between public

than their LME counterparts, since –in case of unemployment– it would be harder for them to find a new job on the rigid CME labour markets. This will lead to smaller fiscal multipliers in CMEs and ultimately to a less effective anticyclical fiscal policy than in LMEs

debt and economic growth due to large future liabilities of their high level of government activity. However, their beneficial spending mix increases fiscal effectiveness and allows them to uphold high tax rates without substantially harming economic activity. This might mitigate the negative growth effects of public debt in the *Nordic* countries and otherwise allow them to uphold their high level of government interference without resorting to potentially growth reducing high levels of public debt.

3. Empirical Strategy

Econometric Methodology

As mentioned in the introduction, our goal is to test our hypothesis about economic systems detailed above by employing a growth regression, in which we investigate the effects of public debt as one determinant of long-run economic growth. We base our empirical analysis on a standard long-run growth model recently implemented by Beckmann et. al. (2016). This empirical model analysed the growth effect of overall government activity –an important control variable in order not to confuse debt with spending effects– and tested the role of economic systems in shaping this relationship by implementing group dummies. Hence, we can built on an established model, which already includes some of the features we need for our investigation and which allows comparing our findings to other results in the literature.

Our panel data is a worldwide sample of 111 developed and developing countries for the period 1971 to 2010. Because we focus on long-run growth effects, we averaged the data over 5 years, which results in eight time periods. While this reduces the number of data points considerably and, hence, limits the applicable estimation techniques (see below), it avoids that results are biased by the influence of business cycle effects. We refrain from arbitrary sample splits into developed (OECD) and developing worlds but consider differences due to the level of economic development explicitly by considering income and quality of institutions as well as corresponding interaction terms.

Our test for the stability of the regression functions over time rejects the hypothesis of no time effect. Hence, we implement time fixed effects. A Hausman test confirms the advantage of the country fixed-effects (FE) against the random-effects Pooled OLS estimation (POLS) by rejecting the hypothesis of no correlation between the regressors and the individual effects (Table 1). Therefore, we apply a FE estimation as our baseline regression, to take unobserved heterogeneity into account.

[Table 1 here]

As e.g. implied by the PVAR model of Lof and Malinen (2014) and the analyses of Panizza and Presbitero (2014) and Puente-Avojin and Sanso-Navarro (2015), reverse causality and endogeneity may be apparent in regressions testing the relationship between public debt and economic growth. In order to avoid reverse causality we use the *initial* level of public debt to analyse its impact on the 5 year average growth rate, as e.g. also done by Woo and Kumar (2015). Unfortunately, the panel data available is limited by the fact that we have to average data over 5-year-periods as is standard for growth regressions focusing on long-run relationships and excluding business cycle effects. Therefore, we refrain from GMM estimation since this small sample size – especially the limited time series dimension - significantly reduces applicability of GMM (see, e.g. Altonji and Segal 1996 or Hansen et. al. 1996).⁸ In order to deal with endogeneity, however, we furthermore employ a 2 Stage Least Squares within estimation (2SLS) of our fixed effects model, where we use lags of our public debt variable as

⁸ We are aware that similar studies, e.g. Afonso and Jalles (2013) or Woo and Kumar (2015) did implement GMM (in addition to POLS, FE and 2SLS estimations). Afonso and Jalles (2013) investigate a slightly larger sample, while the sample size of Woo and Kumar (2015) is even smaller than ours. As mentioned above, we do not undertake GMM estimation due to its limited applicability to small samples.

instruments. We also estimated all fixed effects specifications of our models with panel corrected standard errors to take possible heteroskedasticity and serial correlation into account.

Data Description and empirical approach

Basic Model - Leaning on the model in Beckmann et al. (2016), we start by estimating a basic model for determining the per capita growth rate (*gdpg*) that reads as follows:

$$gdpg = \beta_0 + \beta X' + \beta_1 gov + \beta_2 gov_squared + \beta_3 pubdebt + \beta_4 pubdebt * gdppc + u \quad [1]$$

Vector X' contains a standard set of control variables as applied in growth regressions. It is to be expected that growth decreases with higher income due to the process of catching up determined by the level of initial income (*gdppcini*, initial value of 5-year period) but increases with population growth (*pop*), investment as gross fixed capital formation (*gfcf*), and foreign direct investment (*fdi*). Openness (*open*, adjusted for country size effects) as well as democratic governance, proxied by the Polity IV index (*polity*, adjusted for income effects) are expected to exert positive effects on economic growth. Growth reducing effects are expected from macroeconomic instability, proxied by the inflation rate (*inf*) and from the financial crisis variable (*fincr*, dummy accounting for crisis within 5-year periods). An overview including a detailed description of all variables is provided in Table 2.

[Table 2 here]

In addition to these standard growth regressors, government activity (*gov*, 5 year average) has been included because – as is only partly done in some papers – results for public debt have to be controlled for stemming from government activity in order to rule out direct effects of government activity on growth. *gov* is a combined indicator of government size and regulation, two variables from the Economic Freedom of the World Index (EFW) of the Fraser Institute (Gwartney and Hall 2012). A high value for *gov* signals a high level of government activity. *gov_squared* is the squared term of the *gov* variable, which has been included to test for possible non-linearity in the growth effects of government activity. We expect an inverted u-shaped effect of government activity on growth, with decreasing growth effects at the extreme values for government activity.

Our first step in order to estimate the effect of public debt is to include our public debt variable (*pubdebt*, initial value of 5-year period) to test for possible linear growth effects of public debt. As a next step an interaction term with (logarithm of) GDP per capita (*pubdebt*gdppc*) is included in addition to *pubdebt*. Since the level of development and institutional quality are highly correlated, this allows us to follow Kourtellos et al. (2013), who argued that quality of governance may explain heterogeneous debt effects, and, at the same time, avoiding endogeneity problems of including unadjusted governance or contemporary income into the regression. We expect a positive sign for the interaction term because negative effects of public debt should decrease or vanish at higher income levels due to the close relation between income and institutional quality.

Extended Model – As the first extension of our basic model, we consider ***heterogeneity of country clusters*** according to our groups of countries⁹ with distinct economic systems. Since –as described–

⁹**Continental** country group: Austria, Belgium, France, Germany, Italy, Netherlands
Nordic country group: Denmark, Finland, Norway, Sweden

there is a vast amount of micro- and macroeconomic characteristics that shape economic systems, we do not test for those characteristics themselves but for the effects of belonging to a country cluster with a certain economic system. We use the country groups established in section 2, for countries with a *Continental*, *Liberal* or *Nordic* economic system. These groups allow us to identify particular public debt effects on economic growth in different economic systems by interacting our public debt variable with a group dummy (I_{groups}), taking on the value 1 if a country maintains a *Liberal*, *Continental* or *Nordic* economic system, respectively:

$$gdpg = \beta_0 + \beta X' + \beta_4 pubdebt + \beta_5 pubdebt * lgdppc + \beta_7 pubdebt * I_{economic\ system} \quad [2]$$

Where X' denotes the vector of controls including *gov*, *gov_squared* and *polity*.

As a second extension, we consider threshold levels by assuming **homogeneous threshold levels** of public debt, at which the debt-growth relationship possibly changes for all countries. In order to do this, we employed a *rolling threshold technique*, by including interactions between the public debt variable and a threshold dummy ($I_{threshold}$), which takes on the value 1 if public debt surpasses a certain threshold value. By this, we are able to estimate all additional effects public debt has on economic growth, if it lies above a certain value. We estimate different equations for different threshold values, substituting them in one-by-one, going from debt threshold values of 20% of GDP per capita to 105% and compare significance and coefficient of the debt-threshold estimators ($pubdebt * I_{threshold}$):

$$gdpg = \beta_0 + \beta X' + \beta_4 pubdebt + \beta_5 pubdebt * lgdppc + \beta_6 pubdebt * I_{threshold} \quad [3]$$

As a third extension, we combine thresholds and economic system effects by assuming **heterogeneous threshold levels**. We analyze public debt thresholds within the different economic systems. To achieve this, we introduce a double-interaction variable into our equation, where the public debt variable is multiplied with the debt threshold and the group dummies, which allows us to identify different growth effects at different public debt levels within the country groups:

$$gdpg = \beta_0 + \beta X' + \beta_4 pubdebt + \beta_5 pubdebt * gdppc + \beta_8 pubdebt * I_{threshold} * I_{economic\ system} \quad [4]$$

The empirical strategy, i.e. building on a standard growth model and proceeding in steps, allows us to compare our results to those of previous studies concerning: (1) the impact of public debt on economic growth and possible non-linearity in that relationship (Afonso and Jalles 2013; Baum et al. 2013; Checherita and Rother 2012; Cecchetti et al. 2011; Teles and Mussolini 2014 or Woo and Kumar 2015) and (2) possible sources of heterogeneity in that relationship such as the level of development and institutional quality (e.g. Caner et. al. 2011 or Kourtellos et. al. 2013). Hence, we are able to test the robustness of previous studies' findings and, in a second step, our own hypotheses about economic systems within a well-established empirical framework.

Liberal country group; Australia, Canada, Ireland, New Zealand, Switzerland, United Kingdom, United States
In the Appendix, there is a detailed discussion about our group assignment and its theoretical foundation.

4. Empirical Results

Baseline Regression

The regression results for the basic growth model augmented with the simple public debt variable (Equation [1]) estimated via FE and 2SLS are represented in Table 3, columns (1) and (2). The results for the control variables are generally in line with our expectations. The coefficient for our *polity* variable, which acts as a proxy for institutional quality, remains insignificant. However, this variable has been cleared from income effects so that we measure deviations from the expected pattern only. In addition, the variable measures institutional quality proxied by democratic governance. In this respect, deviations from (democratic) institutional quality, being expected given the income level of countries does not seem to play a significant role for explaining growth effects of public debt. Nonetheless, we leave this variable in our equations to avoid omitted variable bias, associated with variables related to institutional quality.

[Table 3 here]

With respect to the variables measuring government activity, our negative and significant estimators for *government activity* (*gov* and *gov_squared*) reveal the expected inverted u-shaped relationship between government activity and economic growth with lower growth at extremely high and low values of government activity. These results remain stable over all our specifications. Hence, we are confident that our estimates concerning the public debt variable do not reflect direct spending effects. Indeed, results presented in columns (1) and (2) reveal not significant results for growth effects of public debt controlling for direct spending effects. The fact that coefficients are significant when neglecting fixed effects¹⁰ can be interpreted as a first sign of heterogeneity in public debt effects. There are unobserved country characteristics, which seem to influence the debt-growth relationship and render it insignificant when controlling for unobserved heterogeneity via a fixed effects estimation. Hence, we do not find conclusive evidence for a simple homogeneous and linear relation between public debt and economic growth. This contradicts the findings of other authors, such as Afonso and Jalles (2013), Checchetti et. al. (2011) or Woo and Kumar (2015), who do find linear negative growth effects in their samples.

As expected, however, our baseline model with the inclusion of an interaction variable between public debt and initial income (*pubdebt*gdppc*) indicates heterogeneity in the debt-growth relationship with respect to income levels. As can be seen in column (3) and (4) of Table 3, the estimations arrive at a significant negative coefficient for simple public debt and a significant positive estimator for the interaction term. Hence, more developed economies exhibit no or even positive (linear) growth effects of public debt. The threshold value for GDP per capita at which the negative public debt effect is rendered neutral lies at 1,975\$ per capita, which indicates that a linear negative relation between public debt and long-run economic growth is only observable for very poor countries. As described, we understand this relationship to be shaped by institutional quality increasing with higher income levels and mitigating negative consequences of public debt. This can be interpreted as a confirmation of the results of Caner et. al (2011) and Kourtellos et al. (2013), while it contradicts the findings of Checchetti

¹⁰ Results for POLS not represented here but available upon request. Results concerning public debt are in line with the main results of the FE and 2SLS estimations.

et. al. (2011) and Woo and Kumar (2015) who found linear negative debt effects in their growth regressions for a sample of OECD countries.

As described, we will use equation [1] as the baseline regression. It takes the effects of differing levels of government activity (by including *gov* and *gov_squared*) and (deviations from expected) institutional quality (*polity*) into account as well as linear public debt effects (*pubdebt*) and heterogeneous public debt effects at differing income levels (*pubdebt*gdppc*). This will allow us an unbiased estimation of possible non-linearity in the debt-growth relationship and of public debt effects in countries with different types of institutions, i.e. different economic systems.

Heterogeneous Public Debt Effects across Economic Systems

With the previous specifications, we were able to connect our analysis to the literature on growth regressions investigating the relationship between public debt and economic growth. Now, we turn to our main analysis of heterogeneity in that relationship and economic systems as one possible source of it. To do so, we now extend our baseline model with a test for differences in growth effects of public debt between different economic systems. Columns (5) and (6) of Table 3 show the results for our baseline regression augmented with interaction variables between economic system dummies and public debt (*pubdebt*liberal*, *pubdebt*continental*, *pubdebt*nordic*). For *Liberal* and *Nordic* countries, the estimators are insignificant in the FE and 2SLS specification. Hence, the (linear) effects public debt has on long-run economic growth do not differ from the rest of the sample. We can therefore reasonably assume a neutral (or even positive) relation between the two variables, due to the positive influence of those countries' high GDP per capita over the *pubdebt*gdppc* interaction variable. As expected, however, public debt effects are fundamentally different for countries with a *Continental* economic system. The group interaction coefficient is negative and significant in all our specifications, which clearly supports our assumption that the economic system of that country group entails a negative relationship between public debt and long-run economic growth.

The positive effect of those countries' high GDP per capita (over *pubdebt*gdppc*) does not render public debt effects neutral or positive, as it does for other countries at that stage of development and institutional quality (the average GDP per capita of *Continental* countries over our time periods lies at 27,712 \$). When the negative influence of *pubdebt*continental* is considered, the GDP value from which on growth neutrality of public debt would be expected, is shifted up to 40,273 \$ (FE estimation) and 625,869 \$ (2SLS). Thus, our results clearly suggest a negative impact of public debt on long-run economic growth for countries with a *Continental* economic system, while this effect is neutral or even positive for *Liberal* or *Nordic* countries. As a robustness check, we included different *Continental* dummy-public debt interactions in the equations, where we excluded one country at a time from the group (see Table A1 in the Appendix for the 2SLS estimations). The results remain stable and, therefore, the finding of a negative relationship between public debt and long-run economic growth that exists within the *Continental* country group is apparently stable and robust. Hence, the results of the first extension strongly support our assumption of heterogeneity between groups of countries identified by

economic systems: countries with a *Continental* economic system face negative public debt effects, while *Liberal* and *Nordic* countries do not.¹¹

Homogeneous Public Debt Thresholds

The results for our second extension of the basic model, i.e. considering homogenous non-linearity in the public debt-growth relationship, are summarized in Figure 2. We employed a *rolling threshold technique* by augmenting our baseline model with interaction variables between public debt and threshold dummies that take on the value 1 if debt lies above a certain threshold value and 0 if it lies below¹² (Equation [3]). Significance and sign of the public debt effects in our baseline regression do not change (Not reported here, but available upon request). I.e. we still detect a negative linear growth impact of public debt that decreases or vanishes at higher income levels. The estimation for the threshold dummy interactions at first sight allow the conclusion of homogeneous non-linearity.

[Figure 2 here]

Figure 2 depicts coefficient estimates and significance of all (whole number) threshold dummies between 20 and 105% of GDP. It shows that from values of around 30 to 75% of GDP no significant estimators are obtained for our debt threshold estimator, while for thresholds between 76 and 86% and between 96 and 105% of GDP a significant negative influence of public debt (in addition to the negative linear effect of *pubdebt*) can be detected¹³. At first sight this might be taken as an indication of a non-linear public debt – growth relationship along the lines of Reinhart and Rogoff (2010) and the subsequent regression analyses, with negative debt effects kicking in above thresholds of around 90% of GDP. Afonso and Jalles (2013) and Woo and Kumar (2015), e.g. detected homogeneous thresholds at around 90% by adding dummies to their growth regression, while Chechetti et. al. (2011) came to similar results, using a rolling threshold technique similar to ours (based on a likelihood ratio statistic). Furthermore, Checherita and Rother (2012) used a quadratic term in their growth regression among 12 Eurozone member states and found evidence for a similar threshold at around 90%. As mentioned above, all these studies assumed homogeneous thresholds, which apply for all countries in their various samples.

[Figure 3 here]

At first sight, our analysis confirms these findings. When taking a closer look at the results, however, several problems with this interpretation arise. First, it is puzzling that no significant estimator is obtained for thresholds between 86 and 96% of GDP, which could be the result of cross-country heterogeneity in the debt-growth relationship: Some countries may face difficulties in terms of

¹¹ We did test other groups, especially developing countries. We again used our dummy variable interaction approach to test for heterogeneity in the debt-growth relationship between OECD and non-OECD countries and for regional differences (e.g. among continents). We, however, did not detect strong evidence for such heterogeneity (other than that imposed by our income interaction). These results are available upon request.

¹² E.g. if the threshold variable *debt_100* is included, the simple public debt variable measures the overall linear debt effect while the coefficient of the interaction variable measures additional growth effects of public debt levels above that threshold (in this case above 100% of GDP). We included different threshold dummies step by step into our regression and compare significance and coefficients of our estimators. The significant and negative coefficient for the *debt_100* variable for example suggests that, at public debt levels above 100% of GDP, additional negative growth effects across the whole sample can be observed.

¹³ For values greater than around 30% of GDP a positive impact of public debt on economic growth was identified by our analysis.

decreasing growth rates at public debt levels above such threshold values, while other countries are able to cope with it. Depending on the included threshold dummy, heterogeneity between countries may explain insignificant results.

Second, another problematic feature of the results for homogeneous debt thresholds is depicted in Figure 3, where the coefficient for *pubdebt* and the corresponding debt-threshold interactions are depicted. It shows that both coefficients fluctuate synchronously, meaning a high negative “additional” growth effect of public debt levels above a certain threshold (indicated by a negative coefficient of the threshold debt interaction) leads to a corresponding increase of the *pubdebt* coefficient. Therefore, the overall effect of public debt above the thresholds, i.e. the joint effect of *pubdebt* and the threshold interaction remains constant along all threshold values. This makes the standard interpretation of homogenous debt thresholds difficult, since it contradicts the notion that there is a constant linear effect of public debt on growth, which is altered once public debt surpasses a certain threshold. Hence, while we do find some evidence for homogeneous non-linearity in our growth regression, these threshold effects are not as robust as assumed and the relationship between public debt and economic growth is not straightforward and homogeneous, as already pointed out by e.g. Egert (2015) and Panizza and Presbitero (2013 and 2014).

Heterogeneous Public Debt Thresholds across Economic Systems

In line with this recent literature, the results from our first extension of the basic model using dummies for economic systems as well as the insignificance of threshold estimates over a wide range of debt levels suggests that country heterogeneity in addition to what is considered by using FE estimation matters. Hence, our third extension considers economic systems as a source of cross-country heterogeneity with respect to threshold effects. In Figure 4 our results for the estimations along the lines of equation [4] are summarized. We carried out tests for non-linearity in public debt effects on long-run growth that differs among the three different economic systems. Instead of a simple interaction between the group dummies and public debt, double interaction coefficients¹⁴ were added to the baseline regression. Figure 4 again depicts coefficient values and t-statistics of our threshold variables for all debt levels between 20 and 105% of GDP (whole numbers). This time, however, we estimated separate threshold variables for our three different country groups. One can clearly see that significance of the negative growth effects of public debt within the *Continental* country group increases from debt levels of around 70% onwards, with the most significant negative coefficient for a debt threshold of 86 or 87% percent of GDP. This can be taken as evidence for non-linear growth effects of public debt within the *Continental* country group, where an already negative effect becomes more pronounced at high public debt levels above circa 75%.

[Figure 4 here]

In contrast, no negative debt threshold was found for the *Liberal* country group. This supports our finding that in this country group, high public debt levels have no or, if any, a positive effect on long-run economic growth. Hence, this signifies a fundamental difference in the debt-growth relationship between those two country groups, the roots of which, we believe, lie in their respective economic

¹⁴ Interaction variables between public debt and the dummies for groups and thresholds, e.g. *debt_100_continental* to include debt levels above 100% in the *Continental* country group

system. The *Nordics* apparently face yet another relationship between public debt and economic growth. For most threshold values, we identified no significant growth effect of public debt within that country group. For threshold debt values between 56 and 59% of GDP, however, a significant negative growth effect of public debt was estimated. Therefore, for the *Nordic* country group, we have evidence for a non-linear relationship between public debt and long-run economic growth, with neutral growth effects that become negative at relatively high public debt levels of around 60%. The *Nordic* countries, however, have stayed below these potentially harmful public debt levels for the most years over the sample period (see descriptive statistics in Figure 1).

Hence, it is not only that very high levels of public debt with negative growth effects are observed in the *Continental* group. Growth effects of public debt also differ significantly at levels of public debt below 60 % of GDP, a level of public debt experienced by all three groups of countries. A specific feature of the *Nordic* group is that these countries are similar to the *Liberal* group for very low level of public debt up to 36 % of GDP and converge towards the *Continental* group for higher levels of public debt until they become quite similar for levels of public debt above about 55 % of GDP.

5. Conclusion and Policy Implications

We identified three clusters of countries with distinct economic systems based on a unified VoC and WWS typology and corresponding empirical studies (e.g. Ahlborn et. al. 2016):

- *Liberal* Countries (Anglo Saxons and Switzerland), with a *Liberal Market Economy* and *Welfare State* and a spending focus on government consumption
- *Continental* Countries (Core EU member states) with a *Coordinated Market Economy* and a *Conservative Welfare State*, focusing their expenditure on subsidies for leisure
- *Nordic* Countries (Core EU member states) with a *Coordinated Market Economy* and a *Social Democratic Welfare State* and a spending focus on subsidies for work.

We expected the features of these economic systems to influence the relationship between public debt and economic growth due to different degrees of *fiscal uncertainty*. *Continental* countries, mainly due to their focus on subsidies for leisure, face higher future liabilities at a given level of debt. This, together with a less effective fiscal policy, will likely impede the investment climate, leading to higher risk premia and less investment. This, in turn, will reduce long-term growth at a debt level that would not be growth reducing in a *Liberal* framework.

Overall, our empirical findings support these assumptions. They reveal that there is a great deal of heterogeneity between clusters of countries in the relationship between public debt and economic growth. Contrary to other studies (e.g. Afonso and Jalles 2013 or Woo and Kumar 2015) we found neither simple linear debt effects nor robust homogeneous debt thresholds. Our results indicate that the debt-growth relationship firstly differs between countries with different GDP per capita, i.e. at different stages of development with corresponding levels of institutional quality (confirming Caner et. al. 2011 and Kourtellis et. al. 2013). Poor, underdeveloped countries experience a linear negative influence of public debt on long-run growth, while for richer countries this effect vanishes and even turns positive. Secondly, our expectations concerning heterogeneity between different clusters of countries were clearly supported by the empirical findings, with the *Continental* country group experiencing a fundamentally different debt-growth relationship than *Liberal* and *Nordic* countries. For countries with

a *Continental* economic system, we identified a clear negative growth effect of public debt that becomes more significant at public debt levels above around 75% of GDP, a value most of these countries' debt levels surpass consistently in recent times. For *Liberal* countries, no such effect was identified. Therefore, public debt apparently affects the economy substantially different –far more positive– in a *Liberal* institutional framework. *Nordic* countries apparently face yet another relationship between public debt and economic growth with more pronounced non-linearity. Our estimations identified neutral growth effects for low public debt values that become negative from levels of around 60% of GDP on. The *Nordic* countries, however, mostly stayed below such potentially growth-reducing public debt values. Likely, because their favourable spending composition, i.e. their focus on subsidies for work, and a strong consensus on societal preferences allow them to uphold high government activity and tax levels without harming economic activity as much as in other economic systems.

Our policy implication from this analysis is connected to the intensely debated issue of austerity measures. One group of scholars and politicians (mainly from Central Europe) views fiscal consolidation as a crucial precondition of sustainable economic growth, while others (mainly from the Anglo Saxon countries) assume that high public debt is a minor issue and demand large fiscal stimuli. The contribution of our study to this debate could be a call for more caution in this debate. The effects of high public debt levels on the economy likely differ between country groups, depending on which economic system they possess. Therefore, any policy recommendation has to take the institutional framework of a country into account. It could very well be justified, that Continental European scholars and policymakers are primarily concerned with fiscal consolidation as a precondition for growth. On the other hand, it can be just as justified for Anglo Saxon policymakers and scholars to view public debt effects as negligible and to push for larger fiscal stimuli. Both views are legitimate, since – as our study suggests – the fundamental relationship between public debt and economic growth differs between fully developed economies. Economic systems matter in this respect, as the types of institutions in a country constitute a source of heterogeneity in growth effects of public debt.

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Figure 1: Descriptive Statistics¹⁵



¹⁵The graph on the top shows the group averages for the variables *Government Size* and *Transfers and Subsidies* from the Economic Freedom of the World Report (five year average 2008-2012, the scores were reversed and transformed to have 0 mean and variance 1. Values for *Government Size* and *Transfers and Subsidies* greater than 0 signify a larger government or more transfers and subsidies than the average of our 17 countries.) The scatterplots on the bottom right hand side, plot the 5-year growth averages for each country of the group on the y-axis against the public debt value (in % of GDP) of the initial year in that 5-year period. The graphs on the left hand side depict the group averages of annual public debt levels between 1971 and 2010.

Table 1: Hausman Test Fixed vs Random Effects, 1971 - 2010

	(a)	(b)	(a-b)
gdppcini	-5.020	-0.561	-4.460
pop	0.608	0.289	0.319
gfcf	0.140	0.155	-0.014
inf	-0.004	-0.004	-0.0004
open	0.019	0.008	0.012
fdi	0.142	0.138	0.004
fincr	-2.477	-2.871	0.395
gov	0.602	0.758	-0.156
gov2	-0.028	-0.037	0.009
polity	-0.034	0.011	-0.046
pubdebt	0.000	-0.003	0.003
lyears_1980	0.721	0.209	0.512
lyears_1985	-0.784	-2.065	1.282
lyears_1990	0.603	-0.631	1.233
lyears_1995	1.059	-0.587	1.646
lyears_2000	1.337	-0.506	1.842
lyears_2005	1.845	-0.370	2.215
lyears_2010	1.932	-0.730	2.662
Chi2(18): 171.32 P-Value: (=0.000)			

Note: The H_0 is that the difference in coefficients is not systematic. (a) denotes consistent under H_0 and H_a while (b) corresponds to inconsistent under H_a and efficient under H_0

Table 2: Data Description and Sources

Name	Variable	Source	Description
fdi	FDI flows and stock 5 year average	UNCTAD	Expressed in % of GDP
fin_cr	Financial crisis indicator 5 year average	Systemic Banking Crisis Database (Laeven et al. 2012)	Taking on the value 1 if banking crisis occurred
gov	“interference by government” 5 year average	EFW (Gwartney & Hall 2012)	Sum of <i>regulation</i> and <i>government size</i> High value for gov signals high interference level
gdpg	GDP per capita growth 5 year average	UNCTAD	
gfcf	Investment rate 5 year average	UNCTAD	Gross fixed capital formation in % of GDP
pubdebt	Public debt initial year of period	IMF Historical Public Debt Database	Expressed in % of GDP
Inf	Inflation 5 year average	WDI	
gdppcini	Log GDP per Capita initial year of period	UNCTAD	
continental, nordic, liberal	Country Group Dummies		
debt_100, debt_99 etc	Debt level dummies		
open	Openness 5 year average	UNCTAD	Defined as (im+ex)/GDP
polity	Democratic Governance 5 year average	Polity 4	residual of polity variable regressed on income (excluding endogenous effects)
pop	Population Growth 5 year average	UNCTAD	

Table 3: Growth Effects of Public Debt, Basic Model and Differences in Economic Systems

	(1)	(2)	(3)	(4)	(5)	(6)
	FE	2SLS	FE	2SLS	FE	2SLS
Dep. Variable	gdp	gdp	gdp	gdp	gdp	gdp
gdppcni	-5.020*** (-7.994)	-5.595*** (-11.02)	-5.377*** (-7.412)	-6.033*** (-10.86)	-5.399*** (-7.285)	-6.122*** (-10.63)
pop	0.608** (2.101)	0.613*** (5.683)	0.654** (2.331)	0.679*** (6.071)	0.669** (2.385)	0.731*** (6.298)
gfcf	0.140*** (4.487)	0.132*** (5.267)	0.148*** (4.564)	0.138*** (5.514)	0.148*** (4.59)	0.141*** (5.561)
inf	-0.00419*** (-2.722)	-0.00392*** (-3.364)	-0.00403*** (-2.715)	-0.00375*** (-3.226)	-0.00403*** (-2.701)	-0.00366*** (-3.130)
open	0.0194*** (2.885)	0.0179** (2.398)	0.0204*** (2.913)	0.0196*** (2.627)	0.0204*** (2.882)	0.0194*** (2.581)
fdi	0.142** (2.612)	0.159*** (3.361)	0.123** (2.180)	0.132*** (2.694)	0.125** (2.317)	0.140*** (2.832)
fincr	-2.477*** (-6.217)	-2.488*** (-6.213)	-2.357*** (-6.147)	-2.303*** (-5.619)	-2.338*** (-6.102)	-2.254*** (-5.434)
gov	-0.602** (2.286)	-0.610* (1.863)	-0.642** (2.449)	-0.642** (1.968)	-0.650** (2.493)	-0.681** (2.071)
gov_squared	-0.0283** (-2.412)	-0.0287** (-2.020)	-0.0289** (-2.453)	-0.0291** (-2.061)	-0.0296** (-2.526)	-0.0315** (-2.214)
polity	-0.0345 (-1.151)	-0.0373 (-1.184)	-0.0264 (-0.872)	-0.0224 (-0.696)	-0.0294 (-0.966)	-0.0287 (-0.884)
pubdebt	0.000061 (0.0159)	-0.00359 (-0.402)	-0.0387** (-2.424)	-0.0574** (-1.979)	-0.0435** (-2.302)	-0.0781** (-2.332)
pubdebt*gdppc			0.00510** (2.428)	0.00695** (2.003)	0.00580** (2.226)	0.00983** (2.351)
pubdebt*liberal					0.00324 (0.220)	0.00771 (0.243)
pubdebt*continental					-0.0180* (-1.842)	-0.0531** (-2.461)
pubdebt*nordic					-0.000762 (-0.0593)	-0.0317 (-0.836)
Constant	36.07*** (6.954)	42.76*** (8.455)	38.41*** (6,596)	45.61*** (8.636)	38.48*** (6.493)	46.22*** (8.522)
Observations	636	575	636	575	636	575
R-squared	0.453	0.469	0.462	0.475	0.464	0.473
Wald Chi2		2509.24		2536.88		2517.09
Number of countries	111	111	111	111	111	111

Note: The table provides fixed effects (Eq. 1,3 and 5, Robust t-statistics in parentheses.) and 2 stage least squares (Eq. 2, 4 and 6 z-statistics in parentheses.)

Lagged values for *pubdebt* were used as instruments (see text) in equations 2, 4 and 6

*** Indicates significance at 1% level, ** at 5% level, * at 10% level. Source: see Table 2.

Figure 2: Detailed Homogeneous Thresholds: t-statistics and coefficient (Fixed Effects)¹⁶

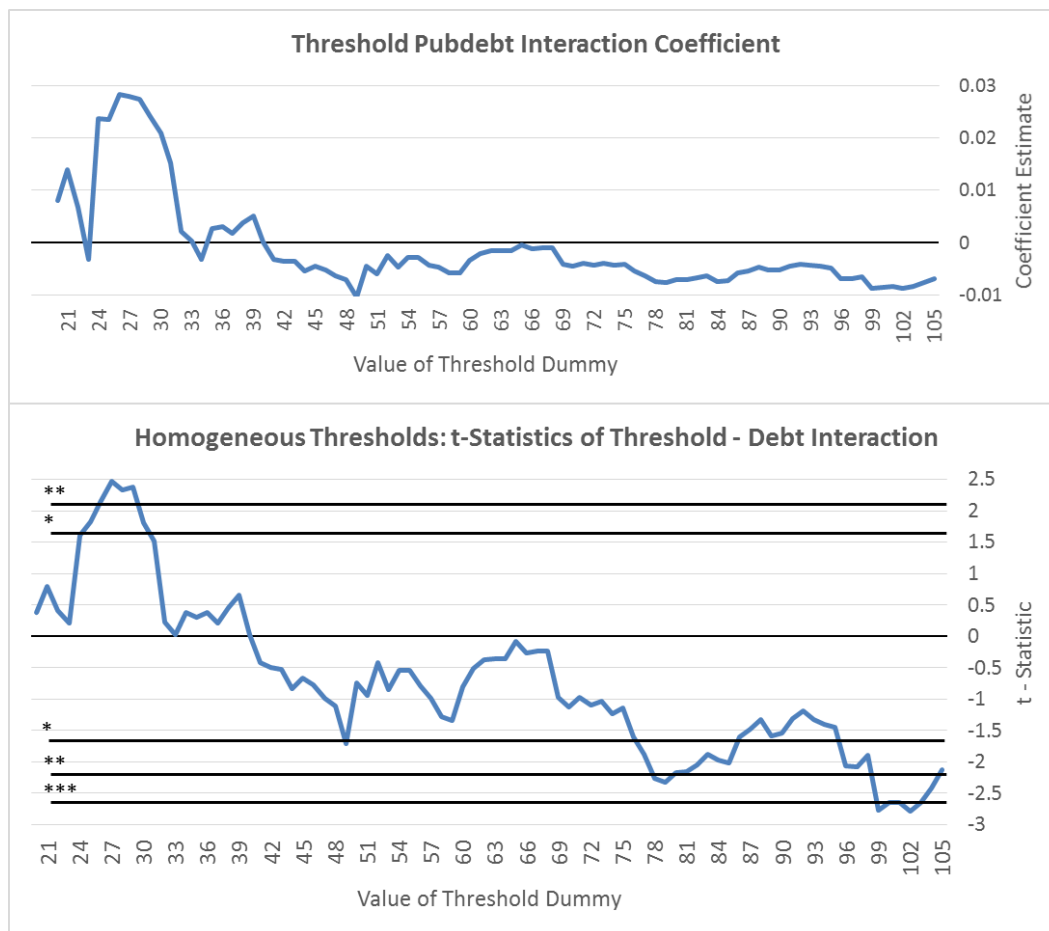
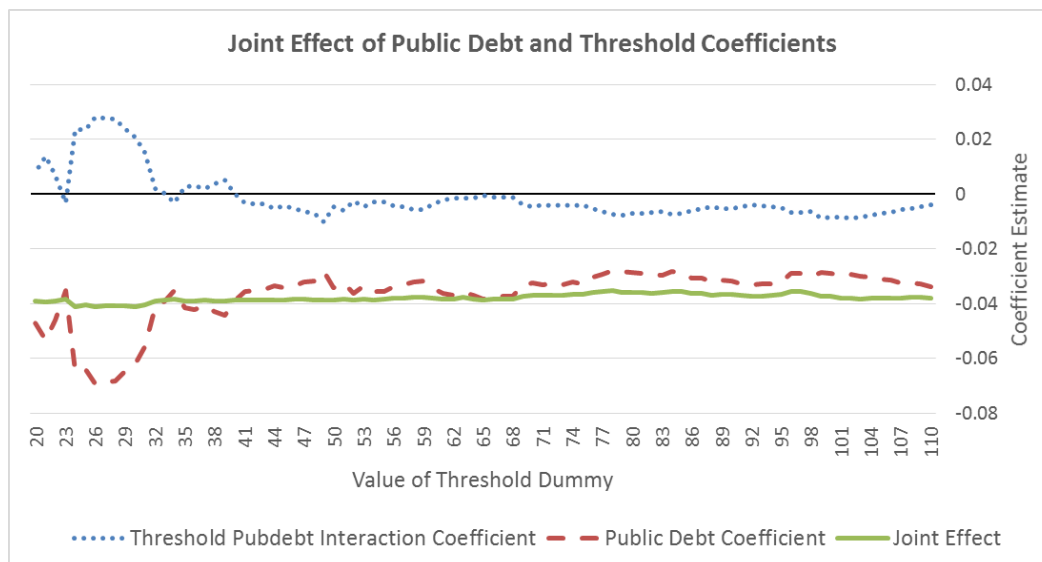


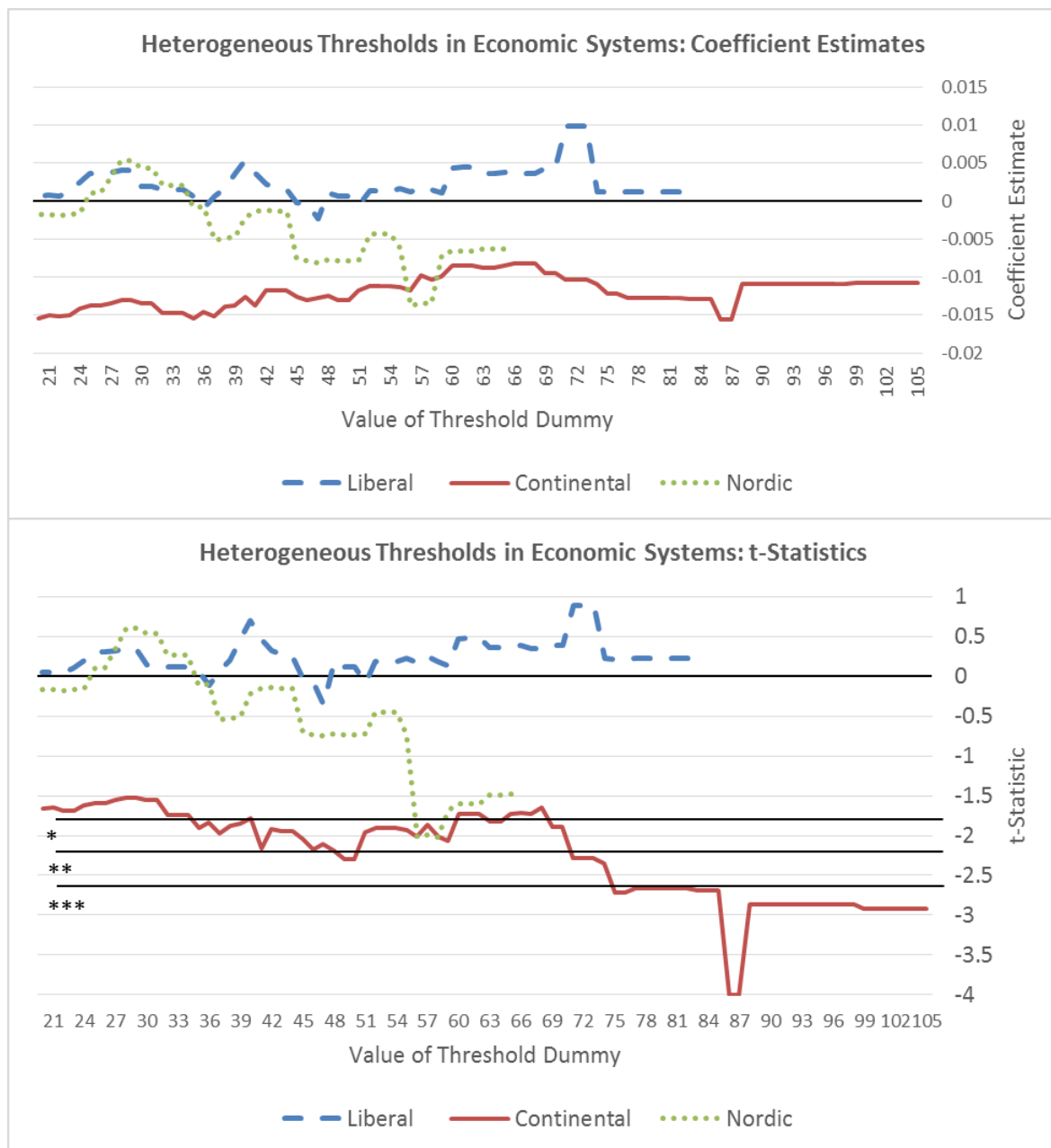
Figure 3: Homogenous Debt Thresholds: Public Debt and threshold coefficient estimates¹⁷



¹⁶ This graph depicts the coefficient estimates (upper half) and t-statistics (lower half) for the interaction term between differing threshold dummies and our public debt variable (see equation [3] in section 3.2.). Threshold values between 20 and 105% of GDP were tested.

¹⁷ This graph depicts the coefficient estimates for our public debt threshold interaction and the coefficient for our simple public debt variable, as well as the joint effect (sum of both coefficients)

Figure 4: Detailed Heterogeneous Debt Thresholds: t-Statistics and coefficients (Fixed Effects)¹⁸



¹⁸ This graph depicts the coefficient estimates (upper half) and t-statistics (lower half) for the double interaction term between differing threshold dummies, group dummies for our three economic systems and our public debt variable (see equation [4] in section 3.2.). Threshold values between 20 and 105% of GDP were tested.

Appendix Table A1: Robustness Check – Rotating Continental Group Composition¹⁹

	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Dep. Variable	gdp	gdp	gdp	gdp	gdp	gdp
gdppcni	-6.102*** (-10.62)	-6.072*** (-10.56)	-6.089*** (-10.61)	-6.105*** (-10.62)	-6.064*** (-10.57)	-6.103*** (-10.63)
pop	0.720*** (6.259)	0.713*** (6.200)	0.723*** (6.261)	0.730*** (6.295)	0.710*** (6.192)	0.727*** (6.28)
gfcf	0.140*** (5.529)	0.142*** (5.574)	0.140*** (5.522)	0.142*** (5.583)	0.140*** (5.519)	0.140*** (5.533)
inf	-0.00367*** (-3.142)	-0.00372*** (-3.184)	-0.00365*** (-3.119)	-0.00366*** (-3.128)	-0.00369*** (-3.158)	-0.00368*** (-3.152)
open	0.0191** (2.535)	0.0190** (2.53)	0.0198*** (2.634)	0.0191** (2.536)	0.0198*** (2.637)	0.0195*** (2.6)
fdi	0.142*** (2.87)	0.126** (2.523)	0.142*** (2.852)	0.141*** (2.84)	0.144*** (2.899)	0.139*** (2.8)
fincr	-2.267*** (-5.472)	-2.248*** (-5.398)	-2.292*** (-5.541)	-2.280*** (-5.507)	-2.283*** (-5.515)	-2.239*** (-5.395)
gov	0.674** (2.049)	0.647** (1.97)	0.686** (2.085)	0.679** (2.064)	0.669** (2.035)	0.674** (2.053)
gov_squared	-0.0311** (-2.184)	-0.0303** (-2.126)	-0.0312** (-2.191)	-0.0314** (-2.201)	-0.0309** (-2.166)	-0.0313** (-2.198)
polity	(0.027) (-0.832)	(0.0294) (-0.903)	(0.0269) (-0.829)	(0.0283) (-0.874)	(0.0265) (-0.816)	(0.028) (-0.863)
pubdebt	-0.0747** (-2.275)	-0.0687** (-2.118)	-0.0741** (-2.249)	-0.0769** (-2.307)	-0.0681** (-2.106)	-0.0758** (-2.285)
pubdebt*gdppc	0.00937** (2.295)	0.00845** (2.123)	0.00930** (2.269)	0.00966** (2.326)	0.00843** (2.113)	0.00953** (2.301)
pubdebt*liberal	0.00992 (0.314)	0.0141 (0.45)	0.01 (0.316)	0.00835 (0.263)	0.0134 (0.427)	0.00916 (0.289)
pubdebt*nordic	-0.0287 (-0.761)	-0.0252 (-0.672)	-0.0278 (-0.738)	-0.0309 (-0.815)	-0.0244 (-0.649)	-0.03 (-0.794)
pubdebt*conti-AT	-0.0531** (-2.394)					
pubdebt*conti-BE		-0.0485* (-1.902)				
pubdebt*conti-FR			-0.0506** (-2.251)			
pubdebt*conti-GE				-0.0528** (-2.427)		
pubdebt*conti-IT					-0.0436* (-1.885)	
pubdebt*conti-NL						-0.0512** (-2.372)
Constant	46.08*** (8.506)	46.11*** (8.476)	45.80*** (8.468)	46.05*** (8.499)	45.76*** (8.454)	46.10*** (8.517)
Observations	575	575	575	575	575	575
R-squared	0.473	0.472	0.474	0.474	0.474	0.475
Wald Chi2	2516.89	2508.22	2517.87	2517.96	2515.87	2522.81
Number of countries	111	111	111	111	111	111

Note: The table provides 2 stage least squares within estimators of our model Robust t-statistics in parentheses.

Lagged values for *pubdebt* were used as instruments (see text) in equations 2, 4 and 6

*** Indicates significance at 1% level, ** at 5% level, * at 10% level. Source: see Table 2.

¹⁹ For this robustness check, one country at a time was excluded from the Continental group. So, *pubdebt*conti-AT* e.g. signifies the interaction variable between a group dummy for our Continental group without Austria and our public debt variable

Appendix 2: Theoretical Foundation of Group Assignment: VoC, WWS and Economic Systems

In order to identify different economic systems, i.e. types of institutional frameworks that might shape expectations of market participants and by this the debt-growth relationship, we employ a joint VoC and WWS framework and compare the growth effects of public debt in different economic systems. The VoC approach, as one strand of literature on economic systems, focusses on the consistency of alternative types of institutional frameworks. Its core message (see e.g. Hall and Soskice 2001) is that different types of institutional matrices in the economy shape different market regimes or capitalist variations. These microeconomic institutional frameworks determine incentives for firms, households and policymakers and thereby influence the overall performance of the economy with respect to the societal preferences within the economic system. The VoC literature identifies two polar cases of capitalist varieties. *Liberal Market Economies* (LMEs, mainly Anglo-Saxon countries) rely primarily on markets to achieve coordination among economic actors with price signals and formal contracting as its main mechanisms. Opposite to these market-driven LMEs, *Coordinated Market Economies* (CMEs, mainly Scandinavian and Continental European countries) are identified by the VoC approach, where non-market institutions play critical roles and influence processes of strategic interaction. Countries cluster along the line of this bipolar continuum according to their institutional characteristics. As mentioned, when it comes to economic performance, consistency of the respective economic system matters. Meaning that none of the two polar cases performs better or worse by itself but that it is crucial for economic performance of a country to feature a consistent economic system where the institutions within all microeconomic spheres are complementary, i.e. produce matching incentive structures.

While the focus of VoC approach largely lies on microeconomic features of the production system with government activity playing no or only a secondary role, the literature on WWS, inspired by the seminal work of Esping-Andersen (1990) focusses on different shapes of welfare states in developed countries. The WWS literature distinguishes three different welfare state regimes: a *Liberal* (Anglo-Saxons), a *Conservative* (Continental Europe) and a *Social Democratic* (Nordic States) model. Each of these models possesses its own particular patterns of welfare state provision. The *Liberal* welfare state focusses on poverty alleviation and the provision of basic needs and otherwise relies on markets and private provision of social security. In the *Conservative* and *Social Democratic* welfare regimes on the other hand, the state plays a much more active role in providing social securities. The latter focusses on social services, i.e. subsidies for work (e.g. child care), while the emphasis of spending in a *Conservative* framework is on transfer payment like unemployment benefits and pensions, i.e. subsidies for leisure (Esping-Andersen and Myles 2009, Rogerson 2007). Following Schröder (2013) an integration of the two strands of literature is possible and useful for our investigation of economic systems. He argues that the similarity in country groupings that arises through various comparative analyses of economic systems cannot be due to coincidence but must be the result of underlying causal factors that link a *Liberal* welfare state to a *Liberal Market Economy* and *Conservative* or *Social Democratic* welfare states to a *coordinated* variety of capitalism. This link is again provided by institutional complementarities. In the same manner as institutions are complementary to each other within the production system (as postulated by the VoC approach), certain welfare state characteristics enhance the efficiency of institutions in other spheres and vice versa. A strong *Conservative* or *Social Democratic* welfare state with its strong unemployment protection e.g. encourages the appropriation of sector/firm-specific skills, a feature of a CME that is crucial for its firms to generate incremental innovation. A *Liberal* welfare

state on the other hand reinforces labour market flexibility, which is crucial for LME firms to successfully engage in sectors where radical innovation is prevalent. Apart from this link between welfare states schemes and skill creation, Schröder (2013) identifies further complementarities between the three Worlds of Welfares States and the two Varieties of Capitalism, which leads him to the identification of three economic systems, namely: *Liberal capitalism, Conservatively, and Social Democratically Coordinated Capitalism*.

In our group assignment, we basically follow Schröder's (2013) classifications by differentiating between *Liberal*, *Continental (Conservatively Coordinated Capitalism)* and *Nordic (Social Democratically Coordinated Capitalism)* economic systems. Several ambiguities had to be considered nonetheless. Switzerland is according to Schröder (2013) and other scholars a borderline case, since it mixes liberal and coordinated aspects in its economic system. Opposite to Schröder (2013) we assign it to the *Liberal* cluster, since our focus is on state activity and welfare state provision, a field where the Swiss characteristics (and descriptive statistics) clearly point in the direction of a *Liberal* configuration of state activity. This view is very much supported by our cluster analysis in Ahlborn et. al. (2016). Japan, another borderline case is left out of this analysis, since it does not match well enough one of our three models. Due to the ambiguity of group assignment of Mediterranean countries, the later developing economies Spain, Portugal and Greece are excluded from our group assignment as well, while EU founding member Italy (as supported by Schröder 2013) can justifiably be identified as a *Continental* economic system.

In addition to this classification of production systems and welfare states within economic systems, further characteristics of countries play a role in our investigation. One such factor are the underlying preferences within a society concerning different aspects of economic performance. Iversen and Wren (1998) e.g. state that there is a trilemma of the societal objectives employment creation (i.e. economic growth), equality of income distribution and fiscal stability. Following their line of thought, any economic system can only achieve two goals at the same time, while the other one has to be neglected. *Liberal* countries are then favouring employment creation and fiscal stability over equality while the coordinated countries favour equality of income distribution and either neglect fiscal stability (*Nordics*) or employment creation (*Continental*s). The analysis of economic systems in Ahlborn et. al. (2016), however, suggests, that the *Nordic* countries presumably escaped this assumed trade-off, since a low level of regulation combined with an active state and high state employment allows these states to achieve good outcomes in all three aspects of economic performance.