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Does economic growth really depend on the magnitude of debt? A threshold model approach

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Abstract

In recent economic literature it has been emphasized that across both advanced countries and emerging markets, high levels of debt-to-gross domestic product (GDP) ratio (90% and above) are associated with notably lower growth outcomes. On the other hand, much lower levels of external debt-to-GDP ratio (60% and below) are associated with adverse outcomes for emerging market growth. These findings have been broadly cited and used in practice. On the other hand, there is an opposite evidence, such that the initial level of debt-to-GDP ratio has no impact on economic growth rate. Taking both viewpoints into account, we propose to employ a time series-based nonlinear mechanism in the threshold autoregression form in order to examine the possible relationship between economic growth rate and its potential determinants included the mentioned debt-to GDP indicator. The originality of the study is that it employs threshold variables instead of exogenous variables and time-series data instead of panel data to reveal the economic instruments that have determined the business cycle in European countries for the last 2 decades —starting from 1995. The purpose of the study is to check the mechanism of growth (measured in terms of GDP growth rate and industrial production growth rate) depending on several important macroeconomic variables, such as public debt, rate of inflation, interest rate, and rate of unemployment with the level of growth itself serving as the threshold variable. We propose an efficient methodology for seeking the best specification of threshold autoregression model in terms of both goodness of fit and parsimony of parametrization. The data (quarterly and monthly) applied in the research cover the time period from the beginning of 1995 to the end of 2013. Such a long period is interesting because it allows investigation of the mechanism of growth under two different economic policy models. We identify that the exogenous monetary mechanism played an important role in diagnosing the phases of business cycle in most European economies

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which is in line with liberal economic policy dominating in the observed period. The initial level of debt-to-GDP ratio as its increase within the recession period was of no value for the economic growth pattern.

Keywords: threshold models, economic growth, public debt, economic policy, 2007—2009 recession
JEL: C24, C87, E32

1. Introduction

The relationship between economic growth and public debt has been the subject of numerous studies and publications in recent years. There is ongoing debate among economists about whether there should be specified levels of public debt in both developed and emerging economies. The academic debate even has entered the political arena, particularly in the European Union (EU), where criteria for economic convergence were established in the early 1990s. The problem is not easy to solve systematically because there is evidence that supports both positions: those who consider that public debt positively stimulates economic growth and those who consider the opposite. The recession of 2007–2009 has re-opened the debate on the limits of public debt in the economy and the impact of its magnitude on economic growth (Krugman (2012)). The recession itself as well as a long stagnation period thereafter experienced by both developed and emerging economies caused increasing debt-to-GDP ratios; this has become common knowledge and has been perceived as a way to maintain prevailing levels of growth. Economists widely discussed and evaluated this phenomenon after the recession (e.g. Saleh and Harvie (2005); Schclarek (2005); Misztal (2011)). Woo and Kumar (2015) examined the impact of high public debt on economic growth in the long run. Their analysis, based on a panel of developed and emerging economies over almost 4 decades, took into account a broad range of determinants of growth. The empirical results suggest an inverse relationship between initial debt and subsequent growth, controlling for other determinants of growth. On average, a 10-percentage point increase in the initial debt-to-GDP ratio is associated with a slowdown in annual real per capita GDP growth of around 0.2 percentage points per year, with the impact being somewhat smaller in advanced economies. Furthermore, there is some evidence of nonlinearity with higher levels of initial debt having a proportionately larger negative effect on subsequent growth. Panizza and Presbitero (2014) provided an interesting survey on the latest literature related to this topic. An analysis of the components of growth suggests that the adverse effect largely reflects a slowdown in labor productivity growth, mainly due to reduced investment and slower growth of capital stock.

Direct motivation of our research was the paper of Reinhart and Rogoff (2010a,b) who concluded that high levels of debt-to-GDP ratio (90% and above) are associated with notably lower growth outcomes. On the other hand, much lower levels of the external debt-to-GDP ratio (60%) are associated with adverse outcomes for emerging market growth. Reinhart and Rogoff's results were questioned by Herndon et al. (2014), who repeated the research and found that the GDP growth rate in countries whose debt-to-GDP ratios exceeded 90% did not differ from that in countries with lower values of the indicator. Mota et al. (2012) considered the problem of debt-to-GDP ratio dynamics in 2000–2011 across the EU countries. They applied a fixed-effect panel model for 27 EU countries and found no support for the view that when monetary policy effectiveness is constrained (when short-term interest rates reached or are close to the lower zero bound), contractionary fiscal policy is expansionary. The broad explanation of this fact is, among others, related to changes introduced in the EU labor market, such as increasing flexibility in working time, making wages and labor costs more responsive to market pressures, and weakening unemployment benefit systems. The authors rejected any association between the initial fiscal policy response to the crisis and the subsequent debt crisis. Panizza and Presbitero (2013) used a panel-data modeling approach for OECD countries in the period 1982–2008 and concluded that the case still needs to be made for a causal effect from high debt to low growth. In addition, they showed that the evidence of a common debt threshold above which growth collapses is far from being robust. Moreover, their next study (Panizza and Presbitero (2014)) revealed that negative correlation between debt and growth disappears once the model is corrected for endogeneity. On the other hand, the findings by Ilzetzki (2011) for a sample of developing countries could not reject that in most countries, inclusion of a debt feedback effect does not change the size of fiscal multipliers significantly. Eyraud and Weber (2013) examined the effect of fiscal consolidation on the debt ratio and concluded, among others, that using the debt ratio as an operational fiscal target is risky. In other words, if country authorities focus on the short-term behavior of the debt ratio, they may engage in repeated rounds of tightening in an effort to make the debt ratio converge with the official target, thereby undermining confidence and setting off a vicious circle of slow growth, deflation, and further tightening. Finally Mendieta-Muñoz (2014) showed that short-run fluctuations may affect the rate of growth. He studied 13 Latin American and 18 OECD economies during the period 1981–2011 and found evidence that business cycle fluctuations have significant impact on the rate of growth for the majority of studied economies. In addition, he stated that research on the interaction between business cycle fluctuations and economic growth requires implementation of various modeling approaches in order to describe specific mechanisms for each particular country in a more detailed way.

In this study, we are in line with the studies of Panizza and Presbitero (2013, 2014); Herndon et al. (2014); Mota et al. (2012) in that a high level of debt-to-GDP ratio does not necessarily mean a decrease in the growth rate in subsequent periods, although we do not concentrate solely on debt. We examine the dynamics of the growth rate in EU countries with respect to the level of selected economic indicators. The aim of the study is to analyze economic growth patterns within mentioned economies given different indicator variables, such as external debt-to-GDP ratio, long- and short-term interest rates, real estate cost indicators, consumer price index (CPI), exchange rate, and their first differences. The hypothesis of the research is that there are significant relationships between the indicators and economic growth dynamics. Durlauf et al. (2005) argued that modeling economic growth based on time series is limited owing to short series of data, sensitivity of growth to business cycles, and other short-run instabilities. A multi-regime approach in growth patterns was very important from their viewpoint. Thus, we propose to employ a nonlinear mechanism to reveal possible types of the mentioned relationships. Threshold models of the threshold autoregression (TAR) and self-exciting threshold autoregression (SETAR) type are to be used to distinguish among: (1) threshold variable(s) and its (their) level(s) in the state of prosperity and the state of recession, (2) the number of states of economic growth, and (3) differences in business cycle between developed and emerging European economies. The threshold model seems to be the right tool of analysis for cyclical patterns when a certain number of regimes can be distinguished. In the analyzed period of time, several phases of economic cycles were observed with the strongest recession of 2007–2009 (in Europe, 2008–2009). The data (quarterly and monthly) applied in the research cover the time period from the beginning of 1995 to the end of 2013. Such a long period is interesting from yet another viewpoint, that is, it allows investigating the mechanism of growth under two different economic policy models. From the beginning of that period up to the outbreak of the financial crisis in 2007, policies based on the Washington consensus were dominant. Starting from 2007—2008, the situation has changed and there has been a great comeback of state interventionism, although in some countries, tightening of financial policy was continuous. For this reason, an interesting problem has arisen: are the applied models able to show any differences between the two types of economic policy?

2. Classification of economies

One of the most popular perspectives of classification of economies is the criterion of initial wealth measured by GDP per inhabitant. The initial wealth is crucial for understanding the individual process of developing an economy. According to this, the group of developing EU countries consists of Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, and Slovak Republic. In the beginning of the analyzed period, that is, in 1995, the GDP per inhabitant of all these countries was far less than 10,000 USD, while at the end of this period in 2013, only Bulgaria and Romania's GDP per capita remained below this threshold. This means that the newest EU countries that entered EU in 2004 managed to make successful progress in the process of economic convergence measured by dispersion from the average level. This process was interrupted by the recession of 2007–2009 when each country had to bring its economic decisions more or less in line with EU economic policy (Osińska and Kluth (2011)). However both developed and emerging countries have suffered from the recession, and some of them, like Greece, were even forced to ask for financial assistance from international institutions.

Facing the recession and the threat of deep crisis, governments made resolutions about financing economic recovery by increasing public debt. It is worth noting that EU member states had different levels of public debt-to-GDP ratios before entering the Eurozone. For example, in the first quarter of 2000, the public debt-to-GDP ratio of the EU15 was 65.6%, while in Belgium and Italy, the values were 115.7% and 112.8%, respectively. The lowest values were observed in Luxembourg (6%) and in Norway (23.9%). During the last 14 years, the public debt-to-GDP ratio has increased and exceeded 90% in many countries. In the last quarter of 2013, in the Eurozone, the ratio was 92.6%. In Belgium, France, Italy, Portugal, Spain, and the United Kingdom, the public debt-to-GDP ratio was higher than 90% and in Austria, Germany, Hungary, the Netherlands, and Slovenia, it was close to 80%. The only exception to this trend is Sweden, where public debt significantly decreased in the analyzed period from more than 60% to 35–40% of GDP. In Luxembourg and Norway, the public debt-to-GDP ratio increased, but remained at low levels of 23.1% and 29.5%, respectively.

The common increase of public debt has resulted from the changing economic paradigm during the last great recession. When financial policy instruments failed and interest rates could not be reduced any longer due to a liquidity trap, fiscal policy instruments became more important. The paradigm of economic liberalization was replaced by the paradigm of interventionism of governments in economies. Billions of dollars or euros were pumped into EU economies, mainly into their financial sectors, in order to aid recovery from the deep recession. According to public debt-to-GDP ratio dynamics, it is possible to indicate three types of economies. The first group comprises countries where initial public debt-to-GDP ratios were low and remained relatively low (e.g., Luxembourg, Norway, and Switzerland). The second group comprises those countries where initial public debt-to-GDP ratios were very high (more than 100%), then lowered, and increased again during the crisis (e.g., Belgium and Italy). The third group comprises economies where initial public debt-to-GDP ratios were at acceptable levels of about 40% and then increased; this is the biggest group comprising most European countries (e.g., the Czech Republic, France, Germany, Poland, and the United Kingdom). In this study, we do not consider the debt-to-GDP ratio as a cause of all economic difficulties but rather as an instrument of fiscal policy that is often accompanied by worse values of other economic variables, such as GDP, long- and short-term interest rates, CPI, cost of new residential buildings index, and exchange rates (currency/USD) (Eyraud and Weber (2013)). Looking at long-term and short-term interest rates, the following features are observed.

1. Interest rates were in general lowered systematically, which was in accordance with the Washington Consensus (e.g., Austria, Belgium, Norway, and Poland)
2. In the case of Hungary and Portugal, interest rates were decreasing but increased in 2011.
3. In some cases, interest rates had an overall tendency to decrease but increased and decreased in the short run (e.g., Germany, Luxemburg, and

Norway).

These facts motivated the subsequent parts of this study, in which we check whether the mentioned variables can significantly diversify the path of the growth rate over time into separate regimes.

3. Model

The problem described in Section 2 can be modeled by a wide class of switching models, such as TAR/SETAR models Tong (1990), STR models Granger and Teräsvirta (1993), and Markov switching models Hamilton (1994). The models reveal different mechanisms of endogenous variable dynamics taking into account the way in which the dynamics change over time. As the threshold variable is to be verified and is assumed *a priori*, we found the threshold class of the models the most useful.

Let Y_t denote a k-dimensional random vector. The general model is

$$Y_t = B^{J_t} Y_t + A^{J_t} Y_{t-1} + H^{J_t} \varepsilon_t + C^{J_t} \tag{1}$$

where J_t is a random variable taking values of a finite set of natural numbers $\{1, 2, 3, ..., p\}$, B^{J_t}, A^{J_t}, H^{J_t} are $k \times k$-dimensional matrixes of the coefficients, ε_t is the k-dimensional white noise, and C^{J_t} is a constant vector, which is called a canonical form of the threshold model. This defines a wide class of the models, depending on the choice of J_t. When J_t is a function of Y_t, then we obtain a SETAR model. The TAR/SETAR$(p; k_1, k_2, \ldots, k_p)$ model is defined as follows:

$$Y_t = \alpha_0^j + \sum_{i=1}^{k_j} \alpha_i^j Y_{t-i} + h^j \varepsilon_t \tag{2}$$

conditionally on X_{t-d}, where $X_{t-d} = \{X_{i,t-d}, Y_{t-d}\} \in R_j, j = 1, ..., p$. In our research, the following economic threshold model was applied:

$$GDP_t = \begin{cases} \alpha_0^1 + \alpha_1^1 GDP_{t-1} + \ldots + \alpha_{k_1}^1 GDP_{t-k_1} + \varepsilon_t & \text{for} \quad X_{t-d} \le r_1 \\ \alpha_0^2 + \alpha_1^2 GDP_{t-1} + \ldots + \alpha_{k_2}^2 GDP_{t-k_2} + \varepsilon_t & \text{for} \quad r_1 < X_{t-d} \le r_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \ldots \quad \ldots\ldots\ldots\ldots\ldots \\ \alpha_0^p + \alpha_1^p GDP_{t-1} + \ldots + \alpha_{k_p}^p GDP_{t-k_p} + \varepsilon_t & \text{for} \quad X_{t-d} > r_p \end{cases} . \tag{3}$$

where X_{t-d} is a set of threshold variables that are described in Section 4. In SETAR model (3), the threshold variable is the lagged endogenous variable (here, GDP_t). In the case of monthly data, GDP was replaced by the industrial production index (IPI). When we consider other threshold variables from a set of lagged exogenous variables, say $\{X_t\}$, the resulting model is called a TAR model. It is interesting that these two models describe different mechanisms underlying economic phenomena. In the case of the SETAR model, an endogenous mechanism is assumed owing to the self-exciting process of switching between regimes, while in the case of the TAR model, the exogenous mechanism is described. This interpretation coincides with the endogenous and exogenous growth idea in economics. It is useful to present the two-regime model with $I(y)$ function.

$$I(y) = \begin{cases} 0 & \text{when} \quad Y_{t-d} \leq 0 \\ 1 & \text{when} \quad Y_{t-d} > 0 \end{cases}, \tag{4}$$

and the corresponding SETAR$(2, k, k)$ model

$$Y_t = (\alpha_0 + \alpha_1 Y_{t-1} + \ldots + \alpha_k Y_{t-k}) + (\beta_0 + \beta_1 Y_{t-1} + \ldots + \beta_k Y_{t-k}) \cdot I\left(Y_{t-d}\right) + \varepsilon_t \tag{5}$$

If all $\beta_0, \beta_1, ..., \beta_k$ parameters are zeros, then (5) becomes the linear autoregressive model. When the autoregressive model is considered, its stationarity becomes the crucial point. For the linear autoregressive model, the conditions of stationarity are well known and easy to satisfy (see Greene (1993)). In the case of the SETAR or TAR model, the problem is much more complicated. Even stationary models within the regimes do not guarantee stationarity of the whole system. Niglio et al. (2012) analyzed this problem, based on studies by Petruccelli and Woolford (1984) and Chan et al. (1985), among others. In the case of the two-regime SETAR model (3), when k is greater than 1, the following stationarity conditions must be satisfied An and Huang (1996); Ling (1999):

$$max_j \sum_{i=1}^{k} \left|\alpha_i^{(j)}\right| < 1$$

$$\sum_{i=1}^{k} max_j \left|\alpha_i^{(j)}\right| < 1$$

The SETAR model with more than two regimes and other cases of the TAR model are rarely the subject of analysis in the context of the whole system, because the formal conditions for SETAR(2) are difficult to generalize. Although ergodicity conditions as well as distribution stationarity are known (Chen and Tsay (1991)), formalization of the conditions for a given system is very rare. As Tong (2007) pointed out, one of the problems is the asymmetry of the probability density function in the case of threshold models, such as the skew-Gaussian and skew-t models. For further discussion, see Tong (2011). Another solution, taking into account statistical aspects, is testing for unit roots within a specified TAR/SETAR system. Kapetanios and Shin (2006) proposed and developed a test for unit roots in a three-regime SETAR model. Again, the situation is complicated when formulating a generalized procedure appropriate for any threshold model. The most popular —but not very elegant —approach applied in practice ensures stationarity, first, at the stage of standard procedure of testing a time series for a unit root and, second, within each regime of the TAR/SETAR model. This has been applied in the research reported in the remainder of the paper.

4. Data

The data in the form of time series covered the period from the beginning of 1995 to the end of 2013. Time-series data were taken from official statistics of Eurostat. The research was organized into two separate panels, that is, time series observed quarterly and monthly. Quarterly data included (short names are given in brackets): the GDP growth rate (GDP), unemployment rate (UEMP), public debt as a percentage of GDP (DEBT), interest rates (longIR and shortIR), CPI (CPI), cost of new residential buildings index (ESTATE), exchange rates denominated in USD (EXR), and their first differences. It was assumed that the GDP growth rate was the endogenous variable and the lagged remaining variables were supposed to be thresholds for regime changes. The regimes correspond to the phases of an economic cycle. In fact, what we examined was a business cycle across European countries. To eliminate non-stationarity, the original GDP series were detrended with a Hodrick—Prescott (HP) filter with $\lambda = 1600$.

Following this idea, we decided to check monthly data, which consist of industrial production index (IPI), interest rates (longIR, shortIR), CPI and first differences of CPI, exchange rates denominated in USD (EXR) and its first differences. Being in line with the previous panel we assumed that the IPI is the endogenous variable.

All the original data were seasonally adjusted and transformed into logs. Time series were filtered using the HP filter and tested for stationarity using Augmented Dickey—Fuller (ADF) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests. The number of regimes was restricted to three for the following reasons: relatively short time series and reasonable interpretation of the business cycles in the cases of prosperity, recession, and the intermediary states of increasing and decreasing GDP.

The TAR/SETAR models are originally suitable for stationary time series. The results of testing for stationarity for detrended GDP and IPI series are presented in table 1. Data from the USA and Japan were taken for comparison.

It is noticeable that all the time series of interest are stationary when the KPSS test results are considered Kwiatkowski et al. (1992). In the case of the ADF test Dickey and Fuller (1979), in five cases, the test statistics were higher than the 5% critical value, but due to the smaller power of the ADF test, the KPSS was preferred. When the threshold variables were considered, they were taken into account in both ways: non-stationary levels and stationary first differences. This was in order to examine the level or dynamics of the threshold (switching) variable.

The dynamics of the level of GDP in comparison with the level of public debt-to-GDP ratio and the cost of new residential buildings index is shown in Figures 1 and 2.

In Figure 1, the original quarterly data before transformation are shown. The compared indicators are GDP and debt-to-GDP ratio, and GDP and real estate cost index. The figures show quite different patterns of dynamics of GDP and the possible thresholds. It is somewhat difficult to conclude that the public debt-to-GDP ratio in different periods dramatically changes to a positive trend in GDP growth. This can be explained in particular for the case of the United Kingdom. When the GDP growth collapsed in 2007–2008, the debt-to-GDP ratio was far below 50%. Starting from the lowest level of GDP in 2009, debt

Variable	t_{ADF}	μ_{KPSS}	Variable	t_{ADF}	μ_{KPSS}
Austria_IPI	-3.134454	0.091254	Austria_GDP	-3.602535	0.090413
Belgium_IPI	-3.002986	0.096155	Belgium_GDP	-2.998182	0.084473
Czech_IPI	-2.860445	0.094126	Czech_GDP	-3.666064	0.084655
Denmark_IPI	-4.265872	0.057792	Denmark_GDP	-3.331706	0.073707
Finland_IPI	-3.333381	0.077884	Finland_GDP	-3.985277	0.072443
France_IPI	-3.225340	0.089785	France_GDP	-3.132938	0.092853
Germany_IPI	-3.568179	0.065706	Germany_GDP	-3.529351	0.069103
Hungary_IPI	-4.641119	0.069914	Hungary_GDP	-3.028876	0.082063
Italy_IPI	-2.537608	0.120174	Italy_GDP	-3.092656	0.067824
Latvia_IPI	-2.856016	0.122569	Japan_GDP	-3.426199,	0.098099
Lithuania_IPI	-2.165379	0.088470	Latvia_GDP	-2.717347,	0.112239
Luxembourg_IPI	-3.682101	0.067238	Lithuania_GDP	-2.425999,	0.093371
Netherlands_IPI	-3.700299	0.082195	Luxembourg_GDP	-2.814069	0.085169
Norway_IPI	-3.925349	0.083579	Netherlands_GDP	-2.703567	0.106519
Poland_IPI	-2.681694	0.104379	Norway_GDP	-4.013167	0.061905
Slovakia_IPI	-2.588174	0.156716	Poland_GDP	-3.553682	0.083245
Slovenia_IPI	-2.005931	0.128169	Slovakia_GDP	-2.496298	0.143578
Spain_IPI	-2.635801	0.114826	Slovenia_GDP	-3.309978	0.122970
Sweden_IPI	-3.601550	0.071867	Spain_GDP	-2.671723	0.187489
Switzerland_IPI	-2.386782	0.139405	Sweden_GDP	-3.731164	0.059687
UK_IPI	-3.824086	0.063443	Switzerland_GD P	-3.002516	0.099492
			UK_GDP	-2.906273	0.092184
			USA_GDP	-3.321318,	0.099664

The critical value for the ADF test at the $\alpha = 5\%$ significance level is $t_{50,5\%} = -2.0086$ The critical value for the KPSS test at the $\alpha = 5\%$ significance level is $\mu_{KPSS_{5\%}} = 0.462$

Table 1: Results of testing for unit roots

systematically increased, pulling GDP up to current levels. The case of the United States, presented in Figure 3, is similar to that of the United Kingdom.

In the case of monthly data, short-term interest rates are shown in Figure 4 together with the IPI for Spain and the United Kingdom. It can be observed that financial policy instruments are of lower efficiency in the term of recession and after, which supports the findings of Leigh et al. (2010).

5. Empirical results

The procedure of the research was organized as follows. First, the regime's number was chosen based on quantiles of threshold variables. Due to the relatively small numbers of observations, quartiles were used in computations. Minimum Bayesian information criterion (BIC) was the criterion of selection for both the number of regimes and the threshold variable. Two or three regimes were chosen in all cases. If threshold values within regimes were close, then the two-regime model was enforced instead of the three-regime model. Second, the threshold variables were analyzed and for the chosen threshold, the mod-

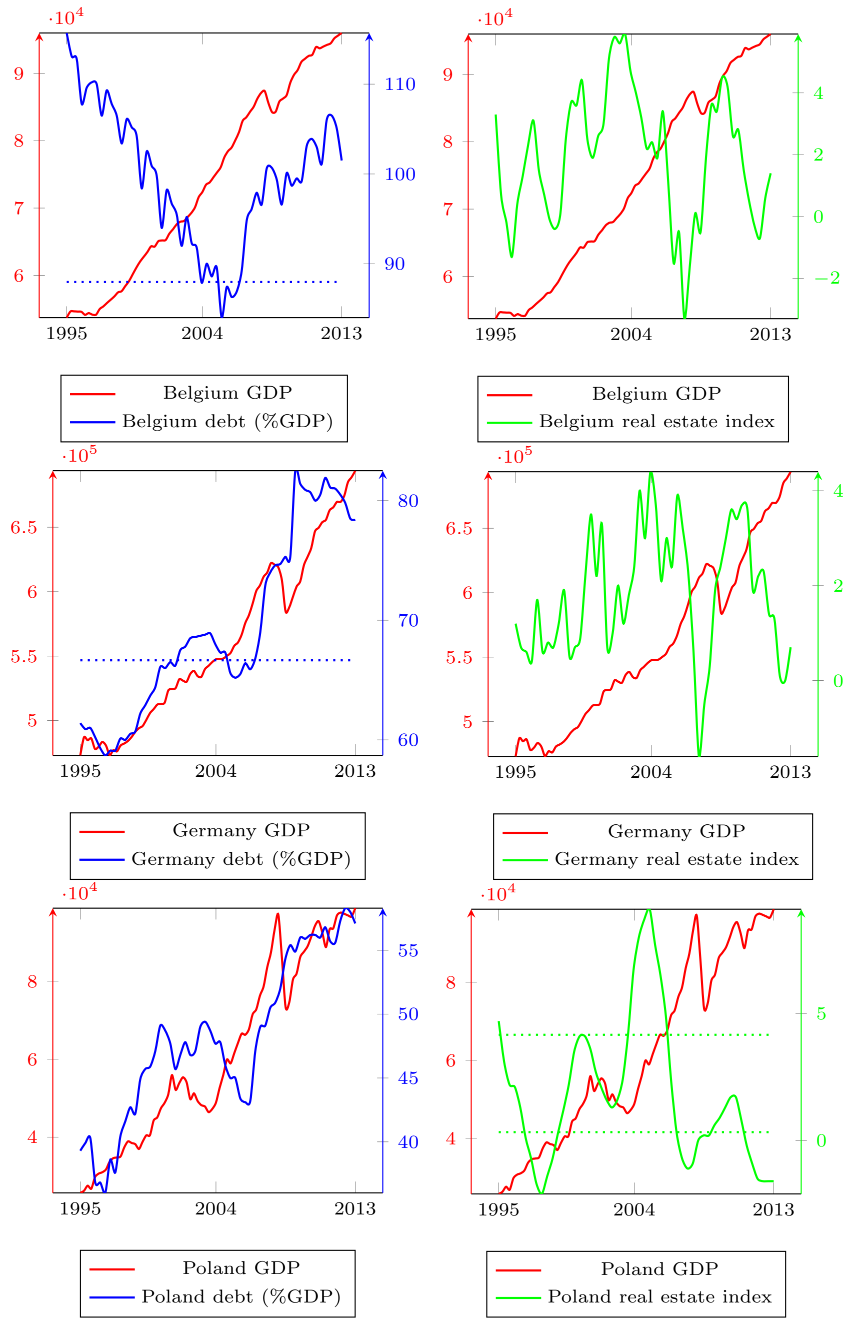

Figure 1: GDP in comparison to debt-to-GDP ratio and to real estate countries in selected European countries

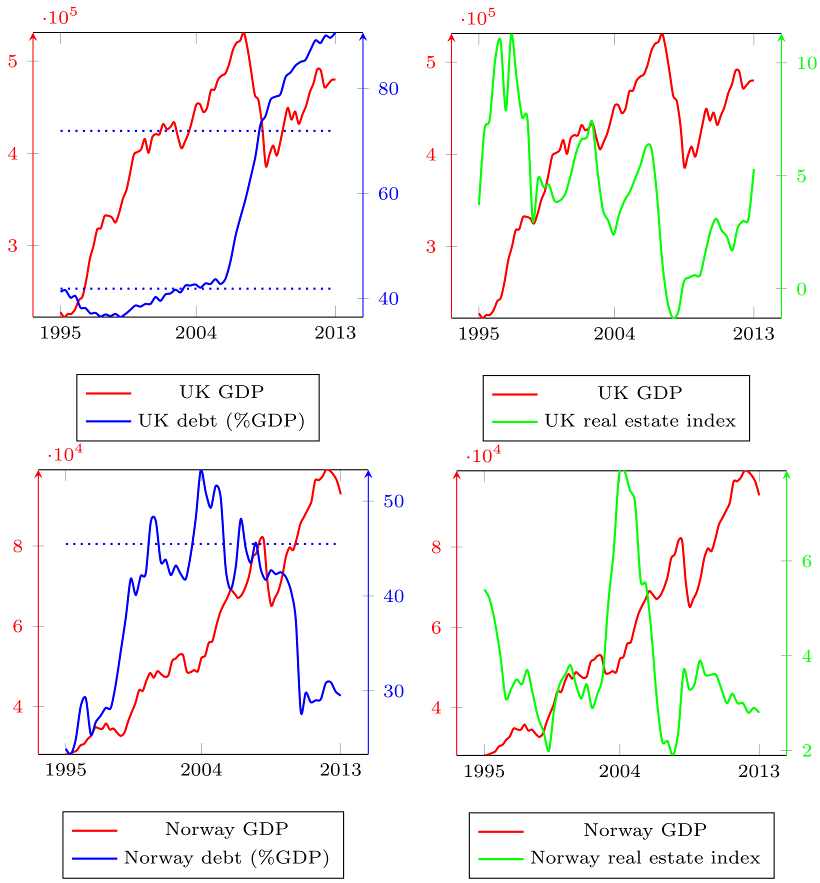

Figure 2: GDP in comparison to debt-to-GDP ratio and to real estate countries in selected European countries

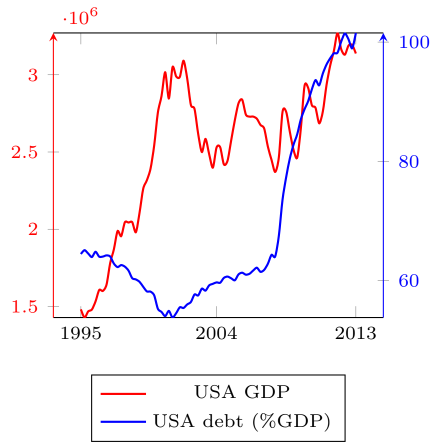

Figure 3: GDP in comparison to debt-to-GDP ratio in the USA

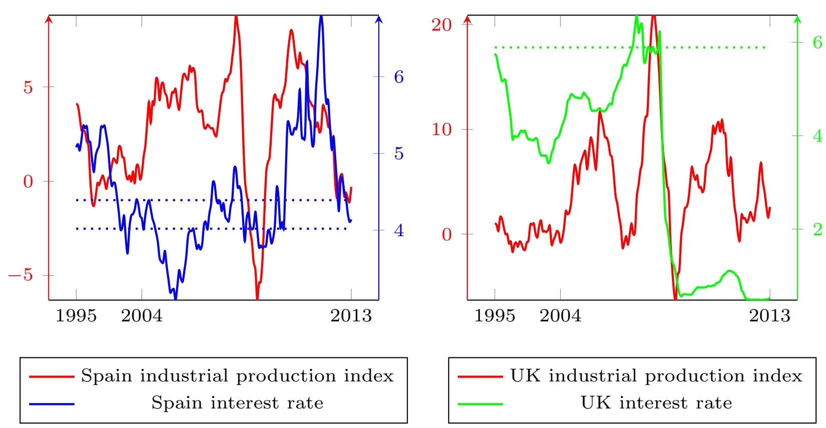

Figure 4: The industrial production index in Spain and UK in comparison to short term interest rate

els of the form (3) were estimated using the conditional ordinary least squares method Tong (1983, 1990). The values of maximum lag in regimes and maximum delay of the threshold variable were limited up to value of 6, due to the limited numbers of observations. All the methodological aspects of the threshold model construction, including testing for the number of regimes, the choice of threshold variable, parameter estimation, and testing for stability of findings, were projected and carried out using `gretl` computer package. Stationarity of the autoregressive component within regimes was ensured at the stage of estimation. The procedures of selection and estimation of the threshold models was originally written by the authors of this paper and are available in `gretl` package. The results of selection of the threshold variable and the number of regimes are presented in Tables 2, 3 (quarterly data), and 4, 5 (monthly data).

Country		GDP	UNEMP	ΔUNEMP	DEBT	ΔDEBT	ESTATE	ΔESTATE	CPI	ΔCPI	long IR	Δlong IR	short IR	Δshort IR	EXR	ΔEXR
EU28	BIC	-491.378	-335.335	-341.856			-489.313	-491.694								
	tr1	-0.010	2.152	-0.011			2.500	-0.004								
	tr2	0.007	NA	NA			0.004	NA								
	tr_lag	1	1	1			6	1								
Euro18	BIC	-563.715	-462.683	-471.180	-411.013	-396.980	-568.375	-558.191			-569.210	-557.835	-571.293	-566.913		
	tr1	-0.008	2.125	0.000	69.100	-0.006	2.600	0.000			4.440	-0.110	3.390	-0.030		
	tr2	NA	NA	NA	NA	NA	NA	NA			NA	NA	NA	0.105		
	tr_lag	2	1	1	1	1	3	1			6	1	6	2		
Czech	BIC	-330.298	-335.070	-329.250	-242.753	-231.715	-230.290	-214.012	-339.443	-333.404	-242.969	-234.251	-335.966	-324.958	-334.219	-320.899
	tr1	-0.031	1.629	-0.028	28.600	-0.008	1.200	-0.000	1.800	-0.001	4.145	-0.030	3.460	-0.345	2.985	-0.008
	tr2	0.023	NA	NA	NA	NA	3.800	NA	6.700	NA	5.090	NA	NA	0.080	NA	NA
	tr_lag	4	3	1	1	1	1	1	2	1	1	1	3	1	3	1
Hungary	BIC	-299.195	-277.731	-278.983	-204.881	-205.088	-197.825	-200.960	-298.219	-289.408	-236.536	-226.787				
	tr1	-0.030	2.022	0.000	59.300	-0.017	4.700	-0.009	6.700	-0.003	7.600	-0.070				
	tr2	NA	NA	0.017	NA	NA	6.700	NA	NA	NA	NA	0.320				
	tr_lag	5	2	1	1	1	3	2	4	1	3	2				
Poland	BIC	-254.430	-224.316	-225.165	-179.891	-171.931	-167.560	-177.354	-260.997	-246.160	-173.560	-174.157	-261.815	-257.136	-261.471	-250.886
	tr1	-0.005	2.272	-0.030	43.100	0.005	1.300	-0.001	4.100	-0.003	5.860	-0.135	4.760	-0.140	1.044	-0.040
	tr2	NA	NA	NA	47.100	NA	NA	0.006	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	6	3	1	5	1	1	2	3	2	3	1	5	1	5	1
Slovakia	BIC	-356.492	-299.877	-291.781	-269.972	-266.951	-324.293	-322.490	-357.909	-345.283	-258.906	-238.727				
	tr1	-0.028	2.573	-0.005	34.024	-0.000	2.400	0.000	4.600	-0.008	4.680	-0.110				
	tr2	0.008	NA	NA	NA	NA	NA	0.002	7.300	NA	NA	NA				
	tr_lag	4	1	5	2	1	1	1	1	1	2	2				
Slovenia	BIC	-448.753	-426.068	-428.621	-332.005	-332.057	-352.537	-354.874	-454.546	-434.160	-287.220	-287.018	-308.681	-279.833		
	tr1	-0.003	1.902	-0.028	27.500	0.004	5.300	-0.005	5.500	-0.007	4.680	-0.248	0.880	-0.020		
	tr2	NA	NA	0.000	NA	NA	NA	NA	NA	NA	NA	-0.050	4.850	NA		
	tr_lag	6	1	3	1	1	1	1	3	1	1	1	1	1		

* Values of thresholds given in nominal units.

Table 2: Threshold models selected for quarterly data

Country		GDP	UNEMP	ΔUNEMP	DEBT	ΔDEBT	ESTATE	ΔESTATE	CPI	ΔCPI	long IR	Δlong IR	short IR	Δshort IR	EXR	ΔEXR
Austria	BIC	-557.928	-553.448	-557.066	-425.762	-417.977	-553.418	-549.446	-554.165	-546.170	-551.344	-550.643	-557.792	-550.472		
	tr1	0.002	1.459	-0.024	66.800	0.006	2.600	-0.005	2.000	-0.002	4.350	-0.330	3.340	0.005		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	1	2	1	1	1	6	1	2	1	4	1	5	1		
Belgium	BIC	-526.922	-532.815	-514.278	-371.070	-363.770	-341.536	-338.758	-523.902	-514.832	-529.454	-533.741	-529.437	-519.482		
	tr1	0.001	2.001	-0.022	99.800	-0.007	0.100	-0.002	1.400	0.001	4.370	-0.315	3.270	0.000		
	tr2	0.014	NA	NA	NA	NA	NA	NA	NA	NA	NA	-0.080	NA	NA		
	tr_lag	6	5	1	1	1	1	2	5	1	5	1	4	1		
Denmark	BIC	-437.342	-438.418	-428.170	-308.252	-305.638	-412.121	-408.189	-440.143	-427.368	-434.986	-435.985	-435.614	-434.094		
	tr1	-0.000	1.482	-0.039	37.800	-0.006	2.500	0.000	1.800	-0.004	4.530	-0.365	2.190	-0.025		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	6	4	1	1	2	1	1	4	1	6	1	4	1		
Finland	BIC	-445.156	-442.629	-451.281	-324.566	-316.422	-433.826	-432.045	-449.599	-437.213	-456.570	-444.691	-448.783	-446.147		
	tr1	-0.002	2.079	-0.012	43.100	0.009	1.300	-0.005	0.800	-0.003	4.430	-0.355	3.280	-0.257		
	tr2	NA	NA	NA	NA	NA	3.100	NA	NA	NA	NA	NA	NA	0.157		
	tr_lag	1	5	1	1	1	1	1	2	2	5	2	4	3		
France	BIC	-571.138	-574.010	-562.487	-410.989	-399.150	-561.562	-555.344	-576.973	-553.523	-564.943	-561.257	-567.644	-560.145		
	tr1	-0.008	2.152	0.000	66.200	0.008	1.900	0.000	1.700	0.000	4.340	-0.105	1.640	-0.285		
	tr2	0.007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3.890	0.125		
	tr_lag	6	6	1	1	1	3	3	2	1	3	1	1	2		
Germany	BIC	-493.049	-494.935	-482.371	-347.275	-342.030	-316.426	-307.590	-488.380	-478.119	-489.765	-484.932	-487.798	-482.483		
	tr1	-0.010	2.041	-0.027	67.300	0.001	1.900	-0.008	1.600	0.000	3.580	-0.347	3.290	0.005		
	tr2	0.008	2.128	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	6	3	1	1	1	1	1	4	1	6	1	5	1		
Ireland	BIC	-259.751	-252.332	-243.906	-200.125	-201.612	-197.756	-191.889			-255.154	-245.830				
	tr1	0.003	5.100	-0.061	30.295	0.005	-0.300	-0.012			4.130	-0.310				
	tr2	NA	NA	NA	63.902	NA	NA	-0.001			NA	NA				
	tr_lag	4	1	1	1	2	1	1			2	1				
Italy	BIC	-505.011	-502.484	-503.622	-372.948	-364.789	-506.520	-508.523	-512.660	-516.382	-506.488	-496.481	-504.931	-512.647		
	tr1	-0.002	2.163	0.000	107.100	-0.009	1.900	-0.004	1.900	0.000	4.250	-0.100	3.290	-0.410		
	tr2	NA	NA	NA	NA	NA	3.200	-0.001	NA	0.002	NA	NA	NA	0.145		
	tr_lag	6	3	2	1	1	3	2	4	1	5	1	1	2		
Luxembourg	BIC	-341.727	-337.067	-333.683	-251.407	-248.454	-235.861	-230.819	-341.090	-330.662			-276.067	-274.471		
	tr1	0.003	1.386	0.000	6.100	0.000	2.200	-0.005	1.500	-0.000			2.470	-0.235		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA			NA	0.172		
	tr_lag	6	3	2	1	1	1	1	1	1			1	1		
Netherlands	BIC	-525.926	-517.685	-511.810	-372.213	-366.367	-347.249	-337.800	-528.837	-503.103	-513.803	-509.692	-512.181	-511.927		
	tr1	-0.000	1.253	-0.016	51.000	-0.014	1.900	-0.000	2.000	-0.003	3.580	-0.350	1.640	0.005		
	tr2	NA	NA	NA	NA	NA	3.700	NA	NA	NA	NA	NA	3.680	NA		
	tr_lag	6	1	1	1	1	1	1	3	2	2	1	1	1		
Norway	BIC	-285.556	-279.400	-272.972	-197.514	-202.427	-179.929	-173.772	-282.772	-273.100	-278.690	-269.086	-288.072	-270.916	-279.215	-269.812
	tr1	0.007	1.131	0.000	41.900	0.004	3.400	-0.004	1.300	-0.003	5.190	-0.390	4.750	0.030	1.815	-0.002
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	4	1	1	2	1	1	1	1	1	6	1	6	1	5	1
Spain	BIC	-559.229	-562.921	-547.491	-420.415	-410.631	-563.839	-537.168	-552.460	-548.742	-572.656	-546.620	-571.002	-562.338		
	tr1	-0.006	2.361	-0.010	43.500	-0.007	3.200	-0.007	2.900	0.000	4.080	-0.425	3.390	-0.373		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.102		
	tr_lag	2	1	1	1	1	4	1	2	1	5	1	6	1		
Sweden	BIC	-318.557	-318.611	-309.450	-223.467	-216.488	-313.373	-304.819	-313.671	-311.425	-312.832	-308.125	-318.178	-310.008		
	tr1	-0.024	1.841	-0.011	38.600	-0.003	3.700	-0.001	1.500	-0.003	3.550	-0.405	3.420	-0.255		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	5	5	2	1	1	5	1	6	1	5	2	5	1		
Switzerland	BIC	-368.409							-364.484	-370.050	-360.684	-357.429	-359.900	-356.271	-359.507	-354.471
	tr1	-0.023							0.650	0.000	2.985	-0.315	0.283	-0.010	0.118	-0.031
	tr2	NA							NA	0.004	NA	-0.060	NA	NA	NA	NA
	tr_lag	2							2	2	5	1	1	1	2	1
UK	BIC	-311.135	-302.494	-298.448	-210.825	-207.751	-303.948	-298.135	-302.549	-299.242	-304.207	-300.323	-305.425	-303.764	-304.531	-294.855
	tr1	-0.032	1.775	-0.020	38.925	0.011	2.600	-0.007	1.900	-0.003	4.755	-0.350	3.618	-0.230	-0.478	-0.019
	tr2	0.042	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.163	NA	NA	NA
	tr_lag	4	4	1	1	1	2	1	2	2	3	1	4	1	1	1
Japan	BIC	-216.818	-224.591	-211.900	-181.781	-178.928			-215.673	-213.441	-216.292	-216.887	-124.726	-132.335	-213.191	-212.838
	tr1	-0.051	1.380	0.000	109.128	0.015			-0.200	-0.003	1.420	-0.050	0.330	-0.020	4.689	-0.027
	tr2	NA	NA	0.026	NA	NA			NA	0.004	NA	NA	NA	0.010	NA	NA
	tr_lag	6	2	2	1	1			2	3	1	1	1	1	1	2
USA	BIC	-275.434	-271.344	-260.972	-271.348	-258.960			-275.147	-259.386	-274.648	-258.552				
	tr1	0.001	1.526	-0.011	59.166	0.004			1.700	-0.000	4.720	-0.425				
	tr2	NA	NA	NA	NA	NA			3.100	NA	NA	NA				
	tr_lag	1	1	1	3	1			3	1	5	1				

* Values of thresholds given in nominal units.

Table 3: Threshold models selected for quarterly data

Country		IPI	ΔIPI	CPI	ΔCPI	long IR	Δlong IR	short IR	Δshort IR	EXR	ΔEXR
EU28	BIC	-1489.581	-1484.786								
	tr1	-0.022	-0.500								
	tr2	NA	0.000								
	tr_lag	1	1								
Euro18	BIC	-1574.131	-1570.849								
	tr1	-0.023	-0.800								
	tr2	NA	NA								
	tr_lag	1	2								
Czech	BIC	-1338.090	-1340.275	-1348.358	-1344.171	-1091.712	-1079.383	-1354.049	-1351.206	-1354.785	-1341.122
	tr1	-0.033	-0.400	1.600	0.003	4.700	0.152	5.374	0.000	2.887	-0.028
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	1	1	6	5	1	1	2	6	6	1
Hungary	BIC	-1052.596	-1049.970	-1062.222	-1064.249	-1054.622	-1044.366				
	tr1	-0.040	-1.910	7.600	0.003	6.373	-0.130				
	tr2	NA	NA	NA	NA	NA	NA				
	tr_lag	1	1	2	1	1	1				
Poland	BIC	-1055.589	-1047.625	-1066.535	-1065.694	-1049.599	-1042.445	-1067.917	-1064.313	-1064.457	-1063.005
	tr1	-0.014	-0.050	7.819	-0.001	5.986	0.070	15.966	0.045	1.075	0.000
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	1	1	5	3	1	1	2	3	4	4
Slovakia	BIC	-769.737	-773.249	-789.112	-789.956	-788.415	-789.049				
	tr1	0.013	0.200	5.000	-0.003	5.030	0.100				
	tr2	NA	NA	NA	NA	NA	NA				
	tr_lag	1	1	1	4	3	5				
Slovenia	BIC	-1400.831	-1400.017	-1418.661	-1415.935	-1111.021	-1090.173	-1125.699	-1112.443		
	tr1	0.014	-0.200	7.860	0.004	5.237	-0.310	5.038	-0.020		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	1	1	6	1	2	1	1	1		

* Values of thresholds given in nominal units.

Table 4: Threshold models selected for monthly data

Country		IPI	ΔIPI	CPI	ΔCPI	long IR	Δlong IR	short IR	Δshort IR	EXR	ΔEXR
Austria	BIC	-1532.815	-1534.789	-1559.263	-1549.269	-1558.289	-1548.718	-1550.020	-1551.264		
	tr1	0.012	0.100	2.400	-0.004	4.082	0.140	0.728	-0.190		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	1	1	6	5	4	3	5	3		
Belgium	BIC	-781.771	-788.792	-803.301	-797.760	-823.304	-803.278	-803.132	-803.955		
	tr1	-0.051	-1.700	0.900	-0.005	4.114	0.010	2.140	-0.120		
	tr2	NA	-0.300	3.400	-0.003	5.126	NA	4.780	NA		
	tr_lag	1	1	5	1	6	1	6	2		
Denmark	BIC	-1206.650	-1207.243	-1222.996	-1193.908	-1209.580	-1219.061	-1223.001	-1197.747		
	tr1	0.025	0.600	1.700	0.001	4.100	-0.050	2.200	-0.126		
	tr2	NA	0.900	2.900	NA	NA	NA	5.372	0.153		
	tr_lag	1	2	6	1	5	1	2	1		
Finland	BIC	-1346.309	-1343.721	-1370.249	-1358.757	-1370.662	-1367.329	-1367.827	-1380.644		
	tr1	0.025	0.700	0.300	0.001	5.484	0.000	4.360	-0.110		
	tr2	NA	NA	2.800	NA	NA	NA	NA	0.123		
	tr_lag	1	1	5	3	4	1	5	1		
France	BIC	-1642.153	-1640.425	-1662.444	-1674.289	-1679.549	-1666.143	-1668.051	-1666.015		
	tr1	0.008	0.400	1.800	-0.003	3.654	0.122	1.380	-0.120		
	tr2	NA	NA	2.000	NA	5.858	NA	4.876	NA		
	tr_lag	1	1	1	3	1	4	3	3		
Germany	BIC	-1421.540	-1425.249	-1434.478	-1435.375	-1464.613	-1441.082	-1445.154	-1441.129		
	tr1	0.005	-0.400	0.680	0.001	5.214	0.130	3.340	-0.050		
	tr2	NA	0.100	NA	NA	NA	NA	4.680	NA		
	tr_lag	1	3	3	1	2	6	1	2		
Ireland	BIC	-564.183	-557.170	-452.016	-453.068	-569.021	-552.717				
	tr1	0.052	-0.118	-99.393	-0.001	4.930	-0.030				
	tr2	NA	NA	NA	NA	NA	NA				
	tr_lag	2	1	1	1	4	1				
Italy	BIC	-1141.608	-1143.634	-1167.681	-1162.117	-1162.481	-1165.371	-1165.929	-1165.827		
	tr1	-0.013	-0.760	1.400	-0.003	5.400	0.140	3.876	-0.020		
	tr2	NA	NA	NA	NA	NA	NA	4.686	NA		
	tr_lag	1	2	4	4	4	4	6	5		
Luxembourg	BIC	-1337.385	-1325.910	-1345.304	-1334.361			-1023.546	-1027.257		
	tr1	-0.002	-0.700	2.000	0.002			0.002	0.649		
	tr2	NA	NA	NA	NA			NA	NA		
	tr_lag	6	2	2	1			2	1		
Netherlands	BIC	-1301.404	-1291.103	-1309.729	-1286.129	-1297.850	-1291.942	-1307.003	-1294.635		
	tr1	-0.031	-1.800	1.500	-0.001	3.732	0.010	3.080	-0.116		
	tr2	NA	NA	2.600	NA	NA	NA	NA	NA		
	tr_lag	6	2	1	1	4	2	6	1		
Norway	BIC	-799.573	-792.876	-798.460	-786.597	-796.383	-795.705	-802.994	-786.072	-793.748	-788.601
	tr1	-0.070	-0.050	2.500	0.003	6.258	0.146	2.690	0.130	1.774	0.001
	tr2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	1	1	3	1	5	1	5	1	1	1
Spain	BIC	-1079.327	-1074.063	-1093.861	-1101.611	-1097.477	-1094.103	-1097.399	-1100.909		
	tr1	0.006	-0.600	3.800	-0.004	4.740	0.150	4.850	-0.040		
	tr2	NA	NA	NA	NA	NA	NA	NA	NA		
	tr_lag	1	1	1	4	3	3	1	6		
Sweden	BIC	-1526.594	-1520.914	-1521.238	-1517.772	-1526.257	-1511.731				
	tr1	0.005	0.200	1.500	-0.002	4.430	0.080				
	tr2	NA	NA	NA	NA	NA	NA				
	tr_lag	6	1	1	2	4	1				
Switzerland	BIC	-937.953	-935.604	-957.692	-954.645	-957.378		-953.467		-962.134	-954.246
	tr1	0.005	-0.300	-0.400	-0.002	2.560		0.250		0.184	0.008
	tr2	NA	NA	1.800	NA	NA		NA		NA	NA
	tr_lag	1	1	3	4	1		6		6	5
UK	BIC	-1232.795	-1227.570	-1252.058	-1258.453	-1262.727	-1247.432	-1243.056	-1246.548	-1266.388	-1244.845
	tr1	0.010	-1.400	2.000	-0.002	4.984	0.070	5.410	0.020	-0.446	-0.015
	tr2	NA	0.300	NA	NA	NA	NA	NA	NA	NA	NA
	tr_lag	1	1	1	3	5	4	2	6	6	2

* Values of thresholds given in nominal units.

Table 5: Threshold models selected for monthly data

The results can be considered within two groups of countries, that is, developed and emerging EU countries. In the case of emerging EU countries, the CPI (or ΔCPI) was the most important switching variable for both quarterly and monthly data. The CPI became a switching variable for GDP in the Czech Republic, Hungary, Slovakia, and Slovenia. For the variable IPI, CPI (or ΔCPI) was a threshold variable in Hungary, Slovakia, and Slovenia. The reason is quite simple. In 2004, when emerging countries entered the EU, one of the formal requirements was to do with inflation. In addition, all countries that transformed from centrally planned to market economies exhibited inflation. Therefore, the lagged price index became the threshold for the observed period of 1995–2013. In two other emerging countries, the thresholds were different. In Poland, for quarterly and monthly data, the threshold was the short-term interest rate —a linkage between monetary policy and the real economy. In addition, in the Czech Republic, the exchange rate of the Czech koruna and euro was the threshold when monthly data are considered.

As this study considered developed countries, the situation is even more diversified. When quarterly data were considered, CPI (or ΔCPI) and the short-term interest rate (or Δshort-term interest rate) occurred in five cases, the long-term interest rate and its first differences occurred in two cases (Belgium and Finland), while lagged GDP was the threshold for itself in six cases (Austria, Ireland, Luxembourg, Sweden, the United Kingdom, and the United States). In two cases, namely, Germany and Japan, the economic cycle was sensitive for the level of unemployment rate, which was a significant threshold. For the EU28 as a whole and also for the United States, the difference for the real estate cost index was the switching variable, but this case is special in terms of comparability and availability of the data. The obtained results show that solvency of the economy and monetary policy was still of great importance in many developed European countries. Furthermore, in strong and innovative economies, the hypothesis of endogenous growth could be analyzed. However, it is worth noting that the debt-to-GDP ratio was never chosen as a threshold variable and furthermore, the BIC levels were for the models in which there were the worst (the maximum) for the debt-to-GDP ratio, which was supposed to be a threshold. This finding supports our initial hypothesis: that a high level of debt-to-GDP ratio does not necessarily mean a decrease in the growth rate.

In the case of monthly data, the most frequent threshold variables were CPI and ΔCPI (in the cases of Austria, Italy, Luxembourg, the Netherlands, and Spain), long-term interest rate (for Belgium, France, Germany, and Ireland) and short-term interest rate (in the cases of Denmark, Finland, and Norway, which are outside the EU but are members of the European Free Trade Association). For Switzerland and the United Kingdom, the exchange rate was of great importance, which is in line with the decision of the National Bank of Switzerland in January 2015 to discontinue its exchange rate ceiling. For Sweden, the endogenous growth hypothesis was fulfilled.

The general remark is that for both types of data, the set of threshold variables consists of CPI, long- and short-term interest rates, and their first differences. For countries that do not have the common currency (the Czech

Republic, Switzerland, and the United Kingdom), the exchange rate was of great importance. Only in four cases for quarterly data and in one case for monthly data was the endogenous growth hypothesis supported by the data. These findings show that the exogenous monetary mechanism played an important role in diagnosing the phases of business cycle in most European economies that were in line with the Washington consensus. Thus, the debt-to-GDP ratio might have a contractionary impact in the short run that in the longer run was not observed. The initial debt-to-GDP ratio level is of no value for the economic growth pattern and was not a significant economic factor for countries with high public debt-to-GDP ratios, like Belgium and Italy. The same was indicated in Leigh et al. (2010) and Mota et al. (2012), among others. The mostly exogenous impact on economic growth within examined economies was due to institutional regulations, openness of the economies (particularly, financial markets and export/GDP ratio), and the subprime crisis (real estate index). The levels of thresholds were reasonable and depended on the range of data.

Referring back to the classification of the economies presented in Section 2, it can be stated that the intuition directly from the results of Reinhart and Rogoff (2010b) was not confirmed by the empirical findings. The increasing debt-to-GDP ratio as a consequence of quantitative easing and decisions generated by central banks did not become a symbol of the defense against the recession in Europe, the United States, or Japan. It is difficult to state whether applying this tool has brought a satisfactory result in practice. As the echo of recession is still present in different economies, it confirms the viewpoint of Krugman (2012), who states that the decisions were too late and not effective.

The estimated models exhibit an important characteristic. In some cases, like in the case of GDP in Germany and IPI in the United Kingdom, the autoregressive models in regimes differ significantly.

Dependent variable Germany_GDP with switching variable Germany_UNEMP

	coeff.	std. err	t-stat.	p-value	
r1	0.000284779	0.001406	0.2024	0.8396	
Y_{t-1}	0.966909	0.116809	8.278	1.26E-016	***
Y_{t-2}	-0.291217	0.153358	-1.899	0.0576	*
Y_{t-3}	0.246799	0.124955	1.975	0.0483	**
r2	0.00331058	0.001840	1.799	0.0721	*
Y_{t-1}	0.568713	0.170633	3.333	0.0009	***
Y_{t-2}	-0.43414	0.152602	-2.845	0.0044	***
r3	-0.000367187	0.001060	-0.3464	0.7291	
Y_{t-1}	1.10479	0.152421	7.248	4.22E-013	***
Y_{t-2}	0.43326	0.227152	1.907	0.0565	*
Y_{t-3}	-0.749527	0.154409	-4.854	0.000001	***

Threshold 1	7.699
Threshold 2	8.399
R^2	86.98%
BIC	-494.935
Doornik–Hansen test for normality pval	0.053159
LMF test for serial correlation pval	0.443753
ARCH test pval	0.486271
White's test for heteroskedasticity pval	0.396804
Ramsey's RESET23 test pval	0.350606

Dependent variable UK_IPI with switching variable UK_EXR

	coeff.	std. err	t-stat.	p-value	
r1	0.00035982	0.0007600	0.4734	0.6359	
Y_{t-1}	1.19049	0.0673711	17.67	7.06E-070	***
Y_{t-2}	-0.308325	0.095939	-3.214	0.0013	***
Y_{t-3}	0.191819	0.0870041	2.205	0.0275	**
Y_{t-4}	-0.185667	0.0869336	-2.136	0.0327	**
Y_{t-5}	0.316894	0.0883744	3.586	0.0003	***
Y_{t-6}	-0.374759	0.0618303	-6.061	1.35E-009	***
r2	-0.00102756	0.0015321	-0.6707	0.5024	
Y_{t-1}	1.24123	0.0948352	13.09	3.84E-039	***
Y_{t-2}	-0.372546	0.0938886	-3.968	0.0000725	***

Threshold 1	0.640
R^2	92.68%
BIC	-1266.39
Doornik–Hansen test for normality pval	0.004372
LMF test for serial correlation pval	0.000003
ARCH test pval	0.083521
White's test for heteroskedasticity pval	0.282642
Ramsey's RESET23 test pval	0.768930

Threshold values were put in nominal units and refer to 7.699–8.399% of the unemployment rate in the case of Germany and 0.64 USD/GBP in the case of the United Kingdom. In other cases, for example, IPI in Sweden, very similar values of significant parameter estimates can be observed across the regimes. The test statistics of the estimated models are usually satisfactory, concerning high levels of R^2, lack of heteroskedasticity, and the functional form of the model. The results of normality and serial correlation are more diversified, which results from the numbers of observations. As the parameter estimates are beyond the scope of this study, we decided not to present them here but they are available on request from the authors.

6. Conclusions

Although nominal convergence criteria were the same for all the EU member countries, the ways to fulfill them were different and in many case very difficult. The level of unionization of the EU is far from 100%. Therefore, the findings obtained in our study depend on the period of observation —short when the number of observations is considered but long when economic changes are studied. From 1995 until 2013, developed EU economies experienced intense economic growth, which was interrupted in 2008 by the financial and economic recession. Thereafter, economic development divergence processes were exposed. The recession revealed complicated economic and social situations in many countries, even stable and well-established economies, like German and the United Kingdom. The weakest developed EU countries, namely, Portugal, Italy, Ireland, Greece, and Spain, suffered greatly due to their lack or unsatisfactory levels of reforms and economic divisions, causing the crisis in Eurozone. Within this group, only the government in Ireland managed to improve its situation significantly after 2010. On the other hand, the East and Central European countries can be considered. At the moment of entering the EU, these countries optimistically developed their economies, but the gaps with other EU economies were significant. During the last 20 years, they lowered inflation, improved economic efficiency, and developed many economic institutions. Slovenia and Estonia became the leaders of institutional changes in Central European countries. The results of this study show the difficulties these countries had to endure in order to became part of European capitalism.

In the study, we demonstrated the results of the assumed association between threshold variables and economic cycles, measured by the GDP growth rate (or IPI) in the EU economies via the threshold models TAR or SETAR). Following the latest disclosures about public debt dynamics and its influence on the growth rate, we assumed that the public debt-to-GDP ratio might serve as an important indicator for policy change. Different policy regimes were observed over quite a long time period but liberal policy was the dominant case from the early 1990s. We took into account the following threshold variables: the unemployment rate, debt-to-GDP ratio, real estate cost index, CPI, long- and short-term interest rate, the exchange rate, and their first differences. All the data were seasonally adjusted, transformed into logs, and detrended. The analysis was undertaken using two panels of data, that is, time series observed quarterly and monthly.

The general remark is that for both types of data, the CPI, long- and short-term interest rates, and their first differences were significantly associated with the economic cycles. For countries that do not have the common currency (the Czech Republic, Switzerland, and the United Kingdom), the exchange rate was of great importance as a channel for economic stimulation (exports and imports). Only in four cases for quarterly data ((Austria, Luxembourg, Sweden, and the United Kingdom) and in one case for monthly data (Sweden) was the endogenous growth hypothesis supported by the data. These findings imply that the exogenous monetary mechanism played an important role in diagnosing the phases of business cycle in most European economies that were in line with the dominant liberal economic policy in the observed period. Thus, the debt-to-GDP ratio might have a contractionary impact only in the short run, which was omitted while the relatively long run was observed. The initial debt-to-GDP ratio level was of no value for the economic growth pattern. The mostly exogenous impact on economic growth within the examined economies was caused by institutional regulations, openness of the economies (particularly financial markets and export/GDP ratio), and the subprime crisis (real estate index). The levels of thresholds were reasonable and depended on the range of data.

In the study, we set up the hypothesis that macroeconomic indicators can properly divide the business cycle in the EU countries according to specified economic policy regimes in the years 1995–2013. Considering this in the broader context, the institutional order in these countries must be taken into account together with the level of economic development and the position of a given economy in the global system (core or peripheral). Looking back on the classification of the economies according to debt to GDP ratio provided in Section 2, we cannot indicate any similarities concerning threshold factors within the groups of countries, but rather, we can indicate country-specific factors. In the group comprising countries with low ratios of public debt to GDP, it is noticeable that the business cycle in Norway is dependent on the short-term interest rate for both quarterly and monthly data, that in Luxembourg on the CPI level, and that in Switzerland on first differences of CPI when quarterly data were used and on the exchange rate level in the case of monthly data. On the other hand, in the case of the highest level of debt-to-GDP ratio indicator, the economic cycle in Belgium depended on the long-term interest rate and in the case of Italy, on the levels and changes of CPI for quarterly and monthly observations, respectively. In the case of the middle group, the results were more diversified, covering almost all indicators considered apart from the debt-to-GDP ratio. These findings can be generalized in such a way that "country-specific" factors were indicated as the thresholds that support specific institutional structures across the countries, specific economic policy, as well as the position of the economy in the global system.

Although many analyses have been undertaken in the last few years on the monetary and fiscal policy instruments corresponding to different phases of the economic cycle, a proper diagnosis is still an open issue. The quality of institutions, state integrity, the position of the economy (core or peripheral), and the middle-income trap are some examples of states that might affect the economic growth pattern in different countries, including EU members.

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