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RIGOROUS THESIS

Fiscal Rules in the European Union

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature.

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Signature

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All remaining errors are mine.

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ABSTRACTS

PART I – The EMU and its Fiscal Rules

This paper treats the fiscal rules of the European Economic and Monetary Union. It begins by introducing this union's inception and by discussing its set of fiscal rules – the Stability and Growth Pact, including its reform. The rationale for policy coordination and the need for fiscal rules in a monetary union are then investigated. The Stability and Growth Pact is then assessed from this point of view. The most important part of the paper is devoted to the analysis of whether the Stability and Growth Pact could be substituted by the disciplining effect of the financial markets. Our findings suggest that there is certain interaction between the financial markets and the governments' decisions on the fiscal policies and that this reaction has become stronger after the beginning of the latest financial and economic crisis. However, the institutional setup and market conditions in the European Union are such that this interaction is biased and thus we conclude that the Union needs to have fiscal rules.

JEL Classification: C23, E44, E61, E62, H62, H87

Keywords: European Economic and Monetary Union, Stability and Growth Pact, Financial markets, Fiscal rules, Policy coordination

ČÁST I – Evropská hospodářská a měnová unie a její fiskální pravidla

Tato práce se zabývá fiskálními pravidly Evropské hospodářské a měnové unie. Nejdříve popisujeme vznik této unie a její fiskální pravidla, tedy Pakt stability a růstu, včetně jeho reformy. Dále se zabýváme důvody, proč by měnová unie měla koordinovat hospodářské politiky svých členů a proč by měla mít fiskální pravidla. Z tohoto hlediska poté Pakt zhodnocujeme. Nejdůležitější část této práce se zabývá analýzou toho, zda by pravidla daná Paktem stability a růstu mohla být nahrazena disciplinujícím efektem finančních trhů. Naše zjištění naznačují, že skutečně existuje jistá interakce mezi finančními trhy a rozhodnutími vlád o hospodářské politice a že tato reakce zesílila od začátku nedávné finanční a ekonomické krize. Nicméně, vzhledem k tomu, jaké jsou v Evropské Unii institucionální uspořádání a podmínky na trhu, náš závěr je takový, že ona interakce je tímto zkreslená a že tudíž Unie potřebuje fiskální pravidla.

JEL klasifikace: C23, E44, E61, E62

Klíčová slova: Evropská hospodářská a měnová unie, Pakt stability a růstu, Finanční trhy, Fiskální pravidla, Koordinace politik

PART II – The Golden Rule of Public Finance and Productivity of Public Capital

This paper concentrates on the golden rule of public finance. It reviews the main advantages and disadvantages of the potential implementation of this rule in the European Union. Often the question of the productivity of public capital is at the heart of the rule's discussions. As this issue has mostly been investigated for the United States, we try to estimate the productivity of public capital using data on the current member states of the European Union. Working both with data on net capital stocks and gross capital formation, we come to the conclusion that there is a cointegrating relationship between capital and output and that this relationship is in most cases positive. However, as there are also other expenditures classified as current spending that have a positive effect on the output in the long run, we argue that the golden rule should not be introduced in the European Union if the current definition of public capital investment does not change for the rule's purposes.

JEL Classification: C23, E22, E62, H52, H62

Keywords: Golden rule of public finance, European Union, Cointegration, Productivity of capital, Cobb-Douglas production function

ČÁST II – Zlaté pravidlo veřejných financí a produktivita veřejného kapitálu

Tato práce se zaměřuje na zlaté pravidlo veřejných financí. Nejprve diskutujeme základní výhody a nevýhody zavedení tohoto pravidla v Evropské Unii. Otázka produktivity veřejného kapitálu je často základem diskusí o tomto pravidle. Protože se však většina studií na toto téma soustředila na Spojené státy americké, tato práce se zabývá touto otázkou s použitím dat pro dnešní členské státy Evropské unie. Využívajíce jak data o kapitálu, tak i data o hrubých investicích, docházíme k závěru, že existuje vztah kointegrace mezi kapitálem a důchodem a že tento vztah je většinou kladný. Nicméně protože existují i takové výdaje, které jsou klasifikované jako běžné, avšak mají na důchod také pozitivní vliv v dlouhém období, argumentujeme, že zlaté pravidlo veřejných financí by nemělo být v Evropské Unii zavedeno, pokud se současná definice veřejných kapitálových investic pro tyto účely nezmění.

JEL klasifikace: C23, E22, E62, H52, H62

Klíčová slova: Zlaté pravidlo veřejných financí, Evropská Unie, Kointegrace, Produktivita kapitálu, Cobb-Douglasova produkční funkce

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ABBREVIATIONS

2SLS – Two-Stage Least Squares

CTBOIS – Close to Balance or in Surplus

DM – Deutsche Mark

EC – European Commission

ECB – European Central Bank

ECJ – European Court of Justice

ECOFIN – Economic and Financial Affairs (Council)

EDP – Excessive Deficit Procedure

EESC – European Economic and Social Committee

EMU – European Economic and Monetary Union

ERM II – Exchange Rate Mechanism II

ESA – European System of Accounts

EU – European Union

EUR – euro

FE – Fixed Effects

FED – Federal Reserve System

GDP – Gross Domestic Product

GLS – Generalized Least Squares

IMF – International Monetary Fund

ln, log – natural logarithm

MTO – Medium-Term Objective

OECD – Organization for Economic Co-operation and Development

OLS – Ordinary Least Squares

R&D – Research and Development

SGP – Stability and Growth Pact

TEU – Treaty on the European Union

UK – United Kingdom

US, USA – United States of America

VAR – Vector Autoregression

INTRODUCTION

This rigorous thesis is a collection of two essays. Although the two essays are independent of each other, they have a unifying theme: the fiscal rules in the European Union.

Part I investigates the Stability and Growth Pact. After introducing the inception of the European Economic and Monetary Union (EMU) it describes the development of the Pact, including its reform. It also concentrates on the reasons for the need for policy coordination and the existence of fiscal rules in a monetary union. The Pact is then assessed from this point of view. The most important part of the paper is devoted to the analysis of whether the Stability and Growth Pact could be substituted by the disciplining effect of the financial markets, which is one of the arguments against the existence of fiscal rules in the EMU. Our findings suggest that there is certain interaction between the financial markets and the governments' decisions on the fiscal policies and that this reaction has become stronger after the beginning of the latest financial and economic crisis. However, the institutional setup and market conditions in the European Union are such that this interaction is biased and thus we conclude that the Union needs to have fiscal rules.

Part II concentrates on the golden rule of public finance. It reviews the main advantages and disadvantages of the potential implementation of this rule in the European Union, both from the conceptual and practical point of view. Often the question of the productivity of public capital is at the heart of the rule's discussions. As this issue has mostly been investigated for the United States, we try to estimate the productivity of public capital using data on the current member states of the European Union. Working both with data on net capital stocks and gross capital formation, we come to the conclusion that there is a cointegrating relationship between capital and output and that this relationship is in most cases positive. However, as there are also other expenditures classified as current spending that have a positive effect on the output in the long run, we argue that the golden rule should not be introduced in the European Union if the current definition of public capital investment does not change at least for the rule's purposes.

As a requirement for the rigorous thesis, the remarks made by the referees of the Master thesis have to be incorporated. Here is the excerpt from the referee report by PhDr. Kamila Koprnická: *My rather editorial note concerns the form of graphs and tables. These were not fully unified and in some cases clear. This problem could be solved by adjustment of graphics to one style. Very final note concerns the decimal points – "commas" should be replaced by*

"dots" where appropriate. No other suggestions for improvement were made by the two referees.

The remarks were incorporated as follows: first, as decimal commas only appeared in the first three tables in Annex 1, we have substituted the decimal commas by decimal points in these three tables. Second, tables and figures were graphically unified. Third, the last part of Section 4.3.1 was erased to remove possible ambiguities.

Two IES working papers have been published based on the Master thesis, mainly consisting of the empirical parts of both essays. These are IES Working Paper no. 30/2010 and IES Working Paper no. 3/2011 and they are enclosed in the Appendix of the thesis.

PART I –

THE EMU AND THE STABILITY AND GROWTH PACT

1 Introduction

The European Economic and Monetary Union (EMU) is a very unique project, both from the political and economic point of view. It is the result of the strong European integration efforts in the late 1980's and early 1990's which are very often identified with the personality of Jacques Delors, president of the European Commission at that time. As it is actually the first project of its kind in modern history, its creators could not gain inspiration and know-how from any previous projects of similar nature. Given the speed of its creation, there was not enough time to develop theories on which the monetary union's functioning could be firmly founded.

The EMU's functioning was based on the Maastricht Treaty, but later its fiscal provisions were completed and made more precise by the Stability and Growth Pact (SGP). Ever since its adoption this set of rules has been quite controversial. This was caused by the fact that researchers have not always been able to agree on the design of the Pact, but one of the causes was also the dissatisfaction with the Pact by different member states and even representatives of European Union's (EU's) institutions. The SGP was reformed in 2005. Its amendment was significant, but certainly not revolutionary. However, due to the latest financial problems of Greece and the fear of other states also getting into financial troubles, suggestions have appeared that the fiscal constraints imposed on the member states should become much stricter. It remains to be seen whether because of this the EMU's fiscal rules will undergo a revolutionary change.

One reason for criticisms of the Pact may be the fact that researchers have not been able to reach a common standpoint concerning the need for fiscal rules in the monetary union. Nevertheless, it seems that reasons for fiscal rules are much more frequent than arguments against them. An example of the latter is the argument that fiscal rules are not necessary as the financial markets are able to impose sufficient discipline on the monetary union's members. Researchers have opposing views on this issue, so we examine it, too.

We investigate the question of the substitutability of the SGP by the financial markets in more details analysing three different issues: first, whether the financial markets react to changing

fiscal behaviour of the states; second, whether the governments improve their fiscal behaviour when the markets increase their costs of borrowing; and, third, whether the market conditions and institutional setting in the EMU do not hamper these reactions or do not make them biased and inefficient.

The paper is organized as follows: in Section 2 we describe briefly the inception of the EMU and we analyse the historical development of the SGP, concentrating especially on the fiscal rules that are included within the Pact and the Maastricht Treaty. In Section 3 we analyse, on the basis of current literature, what the reasons for a monetary union to coordinate the member states' economic and fiscal policies and to have fiscal rules or constraints are. We then assess the SGP in the light of these considerations. In Section 4 we test whether the SGP could be substituted by the financial markets and in Section 5 we conclude.

2 The EMU and the Stability and Growth Pact

The establishment of the EMU was very demanding and necessitated a lot of changes, such as new institutions (e.g. the European Central Bank) and new rules for the good working of the monetary union, namely the Stability and Growth Pact (SGP). However, the establishment of the EMU brought also many economic policy problems. One of the reasons for this was the design of the monetary union itself: the EMU is based on a maximalist monetary approach, which means that there is a common monetary policy for all its members, but the fiscal approach is minimalist, i.e. all the union's members pursue their own fiscal policies.

Buti (2006) reminds that while the Maastricht Treaty provided the EU member states with criteria whose fulfilment was necessary for entrance to the EMU, the SGP should ensure that budgetary discipline of the member states does not disappear after they join the monetary union. Because of this, the SGP should be considered as a 'major building block of EMU's architecture'. He also recalls opinions of several experts involved in the Pact's design in the 1990's: the Pact (its Excessive Deficit Procedure (EDP), more precisely) should protect the EMU from gross fiscal policy errors of individual member states. It should identify excessive deficits arising from such errors and enforce their correction. However, the EDP should not be mechanistic, as it is hard to define an excessive deficit based only on numerical criteria, and should not be initiated frequently.

This Section will describe the establishment of the European Economic and Monetary Union and then will analyse the historical evolution of the Stability and Growth Pact. Special attention will be paid to the fiscal provisions that the Maastricht Treaty and the Stability and Growth Pact include.

2.1 Establishment of the Economic and Monetary Union

In 1992 the "common market stage" of European integration was declared to had been achieved. The Treaty on European Union (TEU) [1] which was signed in Maastricht had as one of its most important goals the establishment of an economic and monetary union.

For the purpose of this paper, the following issues are important: for economic policy it was set that the member states have to coordinate their economic policies and ensure multilateral surveillance for this coordination. Furthermore, they should be subject to financial and budgetary discipline. For monetary policy it was set that a single currency would be created and its stability should be ensured by the European Central Bank (ECB) through a stable price level. The ECB ought to be independent of the national and Community political authorities and is prohibited from providing any type of credit to the member states' governments or Community institutions.

We shall now look in more detail on the economic policy provisions. Based on Articles 102a and 103 of the TEU,[2] member states shall conduct their economic policies so as to contribute to the 'achievement of the objectives of the Community'[3] and in the context of broad guidelines of economic policies which shall be approved by the Council. The member states' economic policies should be considered a 'matter of common concern' and should be coordinated within the Council. The Council should also monitor both the economic developments in the Community and the consistency of the member states' economic policies with the broad economic policy guidelines.

Article 104b of the TEU[4] provides for a non-bail-out clause: neither the Community, nor any of its members should be liable for the commitments of a member state's government or other

[1] This treaty, also referred to as Maastricht Treaty, came into force on 1 November 1993.

[2] In original version; Articles 120 and 121 of the Lisbon Treaty.

[3] As defined in Article 2 of TEU: 'to promote throughout the Community a harmonious and balanced development of economic activities, sustainable and non-inflationarygrowth respecting the environment, a high degree of convergence of economic performance, a high level of employment and of social protection, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States.'

[4] In original version; Article 125 of the Lisbon Treaty.

public authorities. Article 104c[5] states that the governments should avoid excessive deficits and then provides for what the member states, the Commission and the Council should do when monitoring, evaluating and possibly correcting a member state's budgetary situation. Budgetary discipline should be assessed based on whether the ratio of government deficit to GDP and the ratio of government debt to GDP exceed some reference values. These were set by the Maastricht Treaty in the following way: 3% for the government deficit ratio and 60% for the government debt ratio. These two values have already been discussed a lot. It is often claimed that they were set in such way because they reflected the reality of the EU. In any case, they are completely arbitrary. As explained by Baldwin & Wyplosz (2006), assuming that inflation is 2%, a 3% budget deficit is only sustainable under two conditions: when nominal potential GDP grows at least at 5% annually and the debt-to-GDP ratio is lower than 60%. However, from 1995 to 2009 nominal GDP has not grown so much on average neither in the EU, nor in the EMU (it was less than 4% in both groups of countries) and many countries' debts were higher than 60% of GDP.

It seems that the member states did not consider the provisions of the Maastricht Treaty sufficient to ensure fiscal discipline after the accession of the member states to the EMU, as they later concluded the Stability and Growth Pact (SGP). The rest of this Section treats the Pact in more details.

2.2 The Stability and Growth Pact

This Subsection describes the historical evolution of the Stability and Growth Pact, concentrating mainly on the fiscal rules it includes. It depicts its 2005 reform and deals with the problems of the Pact and its criticisms, both before and after the reform.

To have an overview of the development of the budget deficits and public debts of EU countries in the period that we are interested in, tables showing the EU countries' deficit and debt to GDP ratios together with real GDP growth rates are included in Annex 1 (Tables 1.1-3).[6] It may be useful to have these at hand when pondering on the individual member states' behaviour and actions dealt with in this paper.

[5] In original version; Article 126 of the Lisbon Treaty.

[6] In the tables we have first listed EMU countries, then old MSs that are outside the EMU and finally the new MSs that are outside the EMU.

2.2.1 Original shape of the Stability and Growth Pact

Since the initial proposal submitted by the German Minister of finance Theo Waigel in the second half of 1995, it took the EU two years of very tough negotiations to reach an agreement about the fiscal rules that should be imposed on the union and especially the EMU. The two most important actors were Germany and France. While Germany was a big proponent of fiscal discipline in the EMU, France wanted to emphasize economic growth, probably because at that time it faced high unemployment (more than 10% since 1992, according to Eurostat), and did not want the fiscal rules set by the Maastricht Treaty to become stricter.

Finally, the Stability and Growth Pact was agreed upon. The European Council held on 17 June 1997 in Amsterdam passed a resolution on the SGP which should provide political guidance to all parties involved in the implementation of the Pact. Rules of the SGP were further specified in two regulations of 7th July 1997: Council Regulation (EC) no. 1466/97 on the strengthening of the surveillance of budgetary positions and the surveillance and coordination of economic policies (so called preventive arm of the Pact) and Council Regulation (EC) no. 1467/97 on speeding up and clarifying the implementation of the excessive deficit procedure (so called corrective arm of the Pact). The former should help to prevent the occurrence of excessive government deficits and to promote multilateral supervision and coordination of economic policies, while the latter should further the correction of an excessive government deficit in case it occurs, also by imposing sanctions.

The guidelines included in the European Council resolution of 17 June 1997 have set what the member states, the Commission and the Council commit themselves to do under the SGP. Concerning the fiscal rules included in the guidelines, we should stress the following: first, the member states committed themselves to do their best to have, in the medium term, their budget close to balance or in surplus (CTBOIS). Second, the reference value of excessive deficit was set to 3% of GDP, in line with the Maastricht convergence criteria. Third, since it would be possible to treat an excessive deficit as exceptional (see below), the benchmark for assessing an economic downturn to be severe was set to a fall in real GDP of no less than 0.75%).

In both regulations specifying the rules of the SGP, a distinction is made between the ‘participating member states’, i.e. members of the Eurozone, and the ‘non-participating member states’, i.e. those that have not adopted the euro. In Regulation no. 1466/97 the difference is rather formal: it is set that the participating member states have to prepare

Stability programmes and the non-participating member states have to prepare Convergence programmes. These shall both be submitted to the Council and the Commission to be assessed, which should ensure multilateral surveillance over the member states' economic policies. The regulation mainly specifies what kind of information the programmes should contain. On the other hand, the distinction between the two groups of member states is much more significant in Regulation no. 1467/97: if a deficit is found to be excessive, certain procedures, and especially the sanctions, can only be applied to the participating member states.

Concerning the fiscal rules, the following issues should be stressed from the two regulations: first, in the introductory part of both regulations we read that if the member states' medium-term objective (MTO) of budgetary positions CTBOIS is observed, this should enable them to deal with normal cyclical fluctuations without exceeding the 3% reference value for the budget deficit ratio. It thus appears that the policymakers responsible for the design of the SGP were aware of the economic cycle and its consequences for public deficits.

Second, Regulation no. 1467/97 specifies the provisions of the Maastricht Treaty on the compliance with budgetary discipline. The Treaty is very general about the compliance with budgetary discipline: it is breached if (a) 'the ratio of the planned or actual government deficit to gross domestic product exceeds a reference value, unless either the ratio has declined substantially and continuously and reached a level that comes close to the reference value; or, alternatively, the excess over the reference value is only exceptional and temporary and the ratio remains close to the reference value', (b) 'the ratio of government debt to gross domestic product exceeds a reference value, unless the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace'.[7] Regulation no. 1467/97 specifies when an excess of the deficit over the reference value of 3% should be considered exceptional and temporary: 'when resulting from an unusual event outside the control of the member state concerned and which has a major impact on the financial position of the general government, or when resulting from a severe economic downturn.' In addition, it should be considered temporary if, according to the European Commission's predictions, the budget deficit would get below the reference value after the end of the unusual event or the economic downturn. It is also set that an excess over the reference value caused by an economic downturn would, usually, be considered exceptional only if the annual fall in real GDP was higher than 2%. In case the fall

[7] It should, however, be noted that the EDP has never been launched for the breach of the second rule. This may be surprising given that many MSs have their debts higher than 60% of GDP and not decreasing.

in real GDP is between 0.75% and 2% it us upon the Council to decide whether it is exceptional or not.

It is actually very interesting how the two reference values – 0.75% and 2% were set. The 2% value was somehow acceptable among the member states, but there was a big debate about the first reference value. France wanted to set it at 0.5%, while Germany wanted to have this value at 1%. Setting the value at 0.75% was therefore a compromise in the true sense of the word.

Third, Article 104c(3) of the TEU[8] says that when a member state breaches one of the reference values or when the Commission considers that there is a risk of an excessive deficit, the Commission should prepare a report. This report should take into account two things: 1) whether the government deficit exceeds the investment expenditures made by the state and 2) all other relevant factors. However, no further details are provided for this provision. Regulation no. 1467/97 sets what should happen, within given deadlines, if an excessive deficit occurs, which is called Excessive Deficit Procedure (EDP): based on the Commission's report, if the Council decides that a deficit is excessive, it shall give recommendations to the given member state for the correction of such deficit. If the member state does not act accordingly, the Council can make its recommendations public. It can also take a decision on what steps the member state should take to correct the excessive deficit. If the member state does not abide by such decision, it may face sanctions imposed by the Council: these can range, as specified in Article 104c (11) of the TEU,[9] from asking the European Investment Bank to review its lending policies to the given member state to imposing a fine. This is initially only a non-interest bearing deposit that cannot exceed 0.5% of GDP and it should usually be converted by the Council into a fine if in its view the excessive deficit is not corrected within two years from the time when the deposit was made. The time-frame of the EDP is outlined in Table I.1.

The fact that it is the Council which decides about the imposition of the sanctions can be considered as a victory of France in the SGP's negotiations because Germany was a big supporter of the sanctions being imposed automatically. In this context it should, however, be noted that, paradoxically, Germany was the second country (after Portugal) against which the Commission initiated the EDP. This happened in November 2002 because according to the

[8] In original version; Article 126 (3) of the Lisbon Treaty.

[9] In original version; Article 126 (11) of the Lisbon Treaty.

Commission's projections the German deficit-to-GDP ratio was expected to reach 3.8% for year 2002. Germany was closely followed by France against which the Commission initiated the EDP in June 2003 for its 2002 government budget deficit of 3.1% of GDP.[10]

Table I.1 – Time scale for the application of the Excessive Deficit Procedure

Time (ultimate dates)	**Action**
1 March (year t) or 1 September (year t)	Member states submit data on their public finances to the Commission
1 June (year t) or 1 December (year t)	The Council decides on the existence of an excessive deficit on the basis of a report by the Commission and issues recommendations to the member states concerned
1 October (year t) or 1 April (year t+1)	The Council considers whether effective action has been taken and whether recommendations should be made public
1 November (year t) or 1 May (year t+1)	The Council decides on measures to be taken by the member states concerned to correct the excessive deficit
1 January (year t+1) or 1 July (year t+1)	The Council imposes sanctions on the member states concerned
1 May (year t+1) or 1 November (year t+1)	The Council decides on an intensification of the sanctions or abrogation of the excessive deficit

Source: Eijffinger & de Haan (2000)

2.2.2 Problems and criticisms of the original Stability and Growth Pact

A good overview of what followed the above mentioned EDPs is provided by Ardy et al. (2006), Catenaro & Morris (2008) and Sychra (2007). While Portugal took appropriate steps to correct its excessive deficit, Germany and France did not do enough to carry out all the Council's recommendations and continued having budget deficits higher than 3% of GDP in the following years. When the deadlines for correction of the excessive deficits expired, the Council was expected to take further steps within the EDP, but this did not happen. At the 2546th Council meeting held in November 2003 too few member states were willing to vote for taking stricter measures against Germany and France. Instead, the Council adopted

[10] Actually, the first country against which the EDP should have been applied was Greece, but it was discovered much later that this country was creatively improving its statistics since 1997 and thus should not have been admitted to the EMU at all. For more details on such practices of Greece, Italy and Portugal see Koen & Noord (2005).

'conclusions' in which it decided to hold the EDPs in abeyance and gave the two countries its own recommendations that were very similar to those of the Commission. The countries were asked to correct their excessive deficits by the end of year 2005. It is interesting that in this issue the countries in their voting were not divided into the 'fiscally prudent' North and 'fiscally irresponsible' South: Spain together with e.g. the Netherlands were for a standard continuation of the EDPs, while Germany and France, major proponents of the SGP, voted against this, together with countries such as Italy or Greece. According to Buti (2006), this was a '*de facto* suspension of the excessive deficit procedure' and it contributed to the Pact's loss of credibility.

The Commission strongly disagreed with the Council's conclusions and was also dissatisfied by the fact that the Council did not accept its recommendations. Because of this, it brought an action for annulment against the Council by the European Court of Justice (ECJ).[11] The ruling of the ECJ was such that both parties of this case could claim that they won: according to the Court, the Council had the right to decide not to accept the Commission's recommendations. However, it did not have the right to change its previous recommendations without the Commission's initiative and to put the EDPs into abeyance as neither France, nor Germany had abided by the initial Council's recommendations. Given all these circumstances, it is questionable whether the Pact remained credible for all the stakeholders. Nevertheless, as Talani (2008) notes, there was no adverse reaction of the financial markets to this development.

Since its inception the Stability and Growth Pact had opponents and its changes were being discussed. Many considered its rules to be too strict and in 2002 the President of the Commission at that time, Romano Prodi, even said during his speech to the European Parliament that to enforce the Pact inflexibly and dogmatically would be stupid (Prodi, 2002).

Wyplosz (2006) reviews what economists usually perceive as problematic concerning the SGP. First, the government budget deficit which is used as a measure of fiscal discipline is not cyclically adjusted. This is not very good because the governments cannot influence the business cycle. Second, it may be short-sighted to base fiscal discipline on annual measures. A long-term measure, such as the public debt, may be better. Third, the Pact is only suspended when the GDP falls by 2% (or 0.75%, as already explained), but a longer period of very slow GDP growth may be as dangerous for the government budget deficit as a fall in

[11] The lawsuit was filed on 27 January 2004 under case no. C-27/04.

GDP. Fourth, the SGP does not take into account that some kinds of public expenditure are productive. It may therefore be reasonable to take such expenditure out of the budget balance for considerations of an EDP.[12] Fifth, there is the problem of the built-in asymmetry of the Pact: in economically worse years governments have to tighten their deficits, but in better years they have no incentive to make any improvements to their budgets. This results in pro-cyclical policies.[13] Nevertheless, Catenaro & Morris (2008) note that this may rather be a problem of the Pact's implementation than of its design.

Ardy et al. (2006) mention also the following problems: all countries, irrespective of their specific economic and fiscal positions, are subject to the same rules. On the other hand, bigger countries, such as Germany and France, are treated differently than the small ones, such as Portugal (a good example could be the events of 2003). This undermines the credibility of the Pact. Finally, the authors also see as a problem that the SGP is too much concentrated on stability and not sufficiently on growth and employment.

Often the SGP was criticised for not leaving the governments enough room for reaction to adverse shocks (due to the limit on deficit-to-GDP ratio). However, Artis & Onorante (2008) seem to confirm the assertion that if the budgetary position of CTBOIS is met, it should be sufficient for the 3% reference value not being breached. These authors simulate a model for 11 EMU countries and calculate for each of them such deficit to GDP ratio that the country would have a sustainable position (i.e. its debt would be approaching either 60% or 40% of GDP – the simulation was done for both cases) and, with 90% probability, the country would not breach the 3% reference value.[14]

According to Kopits (2001) who reminds that based on historical estimations of fiscal parameters a 1% fall in GDP causes a 0.6% rise in budget deficit on average, the 3% limit on government deficits would seem to be sufficient: if countries have budgetary positions CTBOIS, they should not breach the 3% reference value even if GDP falls by 5%. Such fall in

[12] Another argument for such treatment of the public investment would be intergenerational equity, like under the UK's Golden Rule. It says that while there is not reason why future generations should pay for the consumption of the current generation, they should contribute to the investments done by the current generation as they will also profit from them.

[13] Ardy et al. (2006) mention this as a problem of the SGP, too, and Woods (2008) shows that on average fiscal policies of the Eurozone countries were certainly not strongly counter-cyclical in recent years and that in 2000-2002 they were rather pro-cyclical. However, Wyplosz's own model results suggest that fiscal policies stopped to be pro-cyclical after the Pact was introduced.

[14] The authors chose the 90% probability because in the new version of the SGP a severe economic downturn is defined as any fall in GDP, which in reality happens in around 10% of the cases.

GDP does not happen often: even in the global crisis year 2008, none of the countries encountered such slowdown. However, in 2009 the situation worsened: when we look at Table A1.3 in Annex 1, we can see that a decline in GDP of 5% or more occurred in eleven EU countries. Only five EU countries did not breach the 3% reference value.[15] Of these, Finland's GDP fell most (by 7.8%) and it was only able to avoid breaching the limit on budget deficit because in the previous years it had budget surpluses. Concerning the countries that breached the 3% reference value, fourteen of them experienced a fall in GDP lower than 5% and eight of them an even higher fall. However, nine of the former saw their deficit-to-GDP ratio decrease by more than 3 percentage points, which would suggest that in a situation like the current global economic crisis this ratio reacts more strongly to a 1% fall in GDP than in usual downswings. On average, budget deficit ratios deepened by 1 percentage point more than we would expect based on the historical estimates of fiscal parameters, as it is reminded by Kopits (2001).

What we all were able to follow since 2003 was the issue of problematic enforcement of the SGP. This is something that the Pact was also reproached for by academics. Given that the imposition of sanctions was not made automatic and it is at the discretion of the Council to decide about the procedures under the EDP, the outcome is not surprising: those that design national fiscal policies should vote in the Council about them. In some stages of the EDP the member state concerned does not vote, but then often mentioned 'horse-trading' can occur: country X does not vote against country Y if later country Y does not vote against country X. This actually happened in 2003, when neither France, nor Germany voted against each other when deciding about furthering the EDP...

How the reform of the SGP addressed the above mentioned issues will be discussed later in this Section. Nevertheless, it should be admitted that the Pact, with all its problems, also had some positive effects. Catenaro & Morris (2008) remind that the Stability and Growth Pact had a good influence on public finances: there were several countries that achieved compliance with the rules (the best example is Finland that started to run high budget surpluses) and the Eurozone deficit ratios reached lower levels than before Maastricht. This can be seen in the Table A1.1 in Annex 1, with only few exceptions, mainly in the crisis year 2008 and then in 2009. However, when Wyplosz (2006) compares the fiscal consolidation of EMU countries with that of the rest of the OECD countries, he does not find a big difference

[15] These countries were Finland, Luxembourg, Denmark, Sweden and Bulgaria.

in the performance of these two groupings. It is therefore questionable whether fiscal consolidation in the EMU should be attributed especially to the Pact or to some exogenous factors.

2.2.3 Reform of the Stability and Growth Pact

As political commitment to the SGP was lessening and its criticism was growing, it became apparent that a reform of the Pact was inevitable. Nevertheless, as Buti (2006) reminds, radical changes to the SGP were not politically feasible. The European Council at its meeting held on 17-18 June 2004 asked the Commission and the member states to come up with proposals on changes of the SGP that would strengthen and clarify its implementation. The Commission released its proposals in September 2004. In the following months the SGP was discussed at all levels, but the cornerstone of the discussions was that the Pact had proved to be useful in principle and that it only needed to be made more effective.

The European Council held on 22 and 23 March 2005 in Brussels endorsed an ECOFIN Council report entitled 'Improving the implementation of the Stability and Growth Pact'. This report confirmed that the member states were still committed to the Lisbon strategy and that therefore the fiscal policies should reflect this. It also stressed the importance of bigger focus on long-term sustainability (i.e. debt ratios should really converge to prudent levels), emphasised that it would be necessary to promote the growth oriented character of the Pact and called for a better governance of its rules.

The proposals included in the report were then translated by the Commission into two regulations of 27th June 2005: Council Regulation (EC) no. 1055/2005 and Council Regulation (EC) no. 1056/2005 that amended the two regulations that previously had set the SGP rules. The reform provided the Pact with much more political discretion.

Some of the fiscal rules outlined in the previous Subsection were changed. First, the 3% and 60% reference values remained the same, but it was set by Regulation no. 1055/2006 that the MTOs should be country-specific and not necessarily CTBOIS. They should be based on the current debt ratio and potential growth of the given country, of course preserving a sufficient margin to the 3% reference value. For Eurozone countries and those being part of ERM II the possible MTOs were set to range between -1% of GDP and balance or surplus (cyclically adjusted, net of one-off measures).[16] The revision of the MTOs is possible in case of

[16] The cyclical adjustment of the deficit to GDP ratio is an important change – in the original SGP there was no such adjustment.

implementation of a major structural reform. As the Council mentioned, in the future MTOs should also reflect implicit liabilities of the states (after a feasible methodology for the calculation is devised).

Second, for Eurozone and ERM II countries an adjustment path to the MTO was specified: if a country does not observe its MTO yet, it should improve its cyclically-adjusted budgetary position by 0.5% of GDP annually, as a benchmark (this means that in good economic times the effort should be higher while in bad times it can be lower).[17] The expected dates when the budget deficit should become CTBOIS should be included in the Stability programmes. To foster economic growth when defining the adjustment path to the MTO, major structural, cost saving reforms, and especially pension reforms introducing a multi-pillar system,[18] should be taken into account. This means that countries implementing such reforms can temporarily deviate from the objective, but their budget deficit must not breach the 3% reference value anyway.[19] Furthermore, as Regulation no. 1056/2005 sets, the Council and the Commission should take the aforementioned pension reform into account when doing any budgetary assessment under the EDP.

Third, Regulation no. 1056/2005 changed the definition of a 'severe economic downturn'. The former definition being considered too strict, it was set that an economic downturn is severe when the annual GDP growth rate is negative or if a given member state faces an accumulated loss of GDP during a long period of very low GDP growth relative to its potential.

Fourth, Regulation no. 1056/2005 specifies what 'relevant factors' the Commission's report should 'appropriately reflect' when assessing whether a budget deficit is excessive, based on Article 104c(3) of TEU:[20] it is especially the evolution of the medium-term economic position (such as potential growth, cyclical conditions, the implementation of Lisbon agenda or R&D and innovation policies) and evolution of the medium-term budgetary position (especially fiscal consolidation efforts in "good times", sustainability of debt, public investment expenditures and the overall quality of public finances), but also 'any other factors which, in

[17] Good economic times are defined as times when actual GDP is above potential GDP.
Such requirement was first agreed by the Eurogroup in 2002, but the provision of the reformed SGP was slightly different.

[18] A mandatory, fully funded pillar has to be included.

[19] The deviation can only reflect the costs of the reform.

[20] Article 126(3) of the Lisbon Treaty.

the opinion of the member state concerned, are relevant in order to comprehensively assess in qualitative terms the excess over the reference value'.

Interestingly, the regulation states that 'special consideration shall be given to budgetary efforts towards increasing or maintaining at a high level financial contributions to fostering international solidarity and to achieving European policy goals, notably the unification of Europe if it has a detrimental effect on the growth and fiscal burden of a member state.' It seems that nearly any expenditure could be classified as such special factor. However, in any case the excess of the 3% reference value has to be considered temporary.

Sixth, when a country's budget deficit is found to be excessive, the Council should request the given country to improve its fiscal stance annually by at least 0.5% of GDP in cyclically adjusted terms, net of one-off temporary measures, as a benchmark.

Finally, it should also be noted that in 2005 most of the deadlines connected with the EDP were extended by at least one month. However, very often the words 'as a rule' were added to the setting of the deadlines, which means that these have in fact become much less strict.

To provide a good overview of the main changes in the provisions of the SGP, Table I.2 was prepared.

Table I.2 – Main changes in provisions of the SGP

Provision	**Original SGP**	**SGP after 2005 reform**
Reference values	- Budget deficit: 3% of GDP - Government debt: 60% of GDP	- Budget deficit: 3% of GDP - Government debt: 60% of GDP
MTO	- MTOs close to balance or in surplus for all member states	- Country-specific MTOs, can diverge from close to balance or in surplus requirement, but there has to be sufficient buffer with respect to the 3% budget deficit reference value. - Eurozone member states + ERM II members: MTO can vary from -1% of GDP to balance or surplus (cyclically adjusted, net of one-off measures)
Adjustment path (for Member States that are in the eurozone or in ERM II)	No concrete specification	- Improvement of cyclically-adjusted balance towards the MTO of 0.5% of GDP annually (net of one-off and other temporary measures), as a benchmark. For the definition of the adjustment path special attention to: major structural and pension reforms, as mentioned in this Subsection. During their implementation, a Member State's budget

		deficit can deviate from the objective; the deviation can reflect the costs of the reform.
Severe economic downturn	When the fall in real GDP is higher than 2%. An economic downturn can be considered as severe if real GDP falls by at least by 0.75%.	When annual GDP growth rate is negative or if the given Member State faces an accumulated loss of GDP during a long period of very low GDP growth relative to its potential.
Other relevant factors	No concrete specification	Very concrete specification. Enumeration of the relevant factors can be found in this Subsection.
Minimum adjustment when deficit is excessive	No concrete specification	When a member state's budget deficit is declared being excessive, the member state has to decrease it by 0.5% of GDP annually in cyclically adjusted terms and net of one-off measures, as a benchmark.

Source: Maastricht Treaty, Regulation no. 1466/97, Regulation no. 1467/97, Regulation no. 1055/2005, Regulation no. 1056/2005.

2.2.4 Evaluation of the reformed Stability and Growth Pact

The reform of the Stability and Growth Pact addressed several of the problems described in Subsection 1.2.2. First, it was decided that the measures of fiscal discipline would be partly cyclically adjusted. The 3% reference value should still hold of an unadjusted budget deficit, but the MTOs for Eurozone and ERM II countries were set in cyclically adjusted terms. Second, it partly addressed the asymmetry of the Pact by giving the Eurozone and ERM II countries an 'incentive' to improve their budgets by setting an adjustment path to their specific MTOs expressed in cyclically adjusted terms and net of one-off measures. Third, the EMU countries would no longer be subject to the same rules, as their MTOs can differ based on their debt ratio and potential growth. These provisions may help to make fiscal policies less pro-cyclical.

According to Catenaro & Morris (2008), the MTOs are consistent with the rules of the new SGP, but only a few Eurozone member states have already achieved them and many countries do not intend to achieve them in this decade. The authors therefore doubt the relevance of so distant targets. Also, they point to the fact that planned adjustments are smaller in the post-reform stability programmes than in the previous ones – only 1% of GDP in three years instead of 1.5% of GDP. They, nevertheless, claim that this could be interpreted as a more realistic setting of targets by the member states.

Fourth, the fact that a long period of slow GDP growth can be devastating for public budgets was taken into account: a severe economic downturn was defined not only as any fall in GDP, but also a protracted period of very low GDP growth. Fifth, given the introduction of very

many ‘relevant factors’ that should be taken into account when assessing the countries’ budget deficits, one of them being the implementation of the Lisbon agenda, it may be claimed that the Pact has become more oriented to growth and employment. Nevertheless, many researchers share the view that given the inclusion of the wide variety of relevant factors and so many exceptions to the 3% rule, the Pact has in fact become powerless.[21]

However, some of the Pact’s possible problems persist: first, as was already mentioned, some economists are of the view that for judgments on fiscal sustainability the public debt should be used rather than the budget deficit. Also the European Council stressed the importance of a bigger focus on long-term sustainability. However, the regulations covering the SGP were actually not changed much in this sense. Furthermore, when we look at the data we see very well that the EMU’s average debt-to-GDP ratio has not yet got below the 60% reference value. This is likely to be problematic given the expected demographic developments in the EU. E.g. Woods (2008) reminds that public debts in the EU are not decreasing sufficiently to enable the member states to cope well with the costs of ageing populations.

Second, public investment was not taken out of the budget balance for EDP considerations under the new Pact. The inter-generational equity argument holds, but it is questionable whether it is possible to find an item in the European System of Accounts (ESA) for which it can be shown by statistical testing that it really is productive and then take such item out of the budget balance. As far as we know, there is no study on this issue performed on data for all the EU’s member states.

Finally, there is the problem of a different treatment by the Council of large and small member states: it is not really a question of the design of the SGP as it heavily depends on the willingness of the Council to be as strict towards larger countries as to the smaller ones.

Buti (2006) discusses the transparency of the SGP rules. First, he notes that both the indicators used are constructed in such a way under the ESA 95 accounting rules that they do not reflect fully the states’ situations in terms of deficit and debt. Second, he claims that the reform of the SGP both increased and decreased transparency: he sees positively the cyclical adjustment of the MTOs and the adjustment path to them, but he reminds that in the new version of the Pact the member states are provided many ‘easy escape routes’ that may weaken the Pact.

[21] Buti (2006) cites Buiter (2005) and Calmfors (2005).

Also, as there were no important changes concerning the enforcement of the SGP, Buti (2006) notes that the new Pact will only be implemented successfully if there is sufficient political will. When comparing the old SGP with the new one, he assumes two possibilities concerning its enforcement: either the member states collude and the Pact becomes void, or they adhere to its rules properly and in such case the outcomes may be better then under the old SGP. Catenaro & Morris (2008) are also of the view that it is very important whether after the reform political commitment to the SGP will be strengthened: in such case, even if the new rules are more flexible and lenient, the reformed Pact may work better than the old one.

Ardy et al. (2006) claim that greater political discretion that the new Pact provides should make the EDP being triggered less often, reducing also the political tensions. On the other hand, Catenaro & Morris (2008) note that as far as they know, since the Pact was reformed, all deficits higher than 3% of GDP were considered excessive and the procedures under the EDP were taken without controversy. However, several countries (such as Germany, Portugal or Italy) have profited from higher flexibility of the new Pact, especially concerning the extension of the deadlines under the EDP. The new Pact allows an extension by one year, but in reality deadlines were extended by two years for Germany (and for Portugal, too).

After the reform some rules have become more automatic – such as the adjustment of 0.5% of GDP annually in the case of an excessive deficit. However, when in 2005 Germany had a deficit of 3.3% of GDP, the Council decided that it should improve its fiscal position by 0.5% in two years, instead of one year. According to Catenaro & Morris (2008) these facts support doubts about the implementation and enforcement of the new Pact and according to Eijffinger & de Haan (2000) the Pact's restrictions are not credible simply because the sanctions are not deterrent enough for the member states to stop breaching the Pact.

2.2.5 Recent fiscal developments in the EMU

The fact that in the last several years basically all deficits higher than 3% of GDP were considered excessive is very positive. However, the Pact was not able to ensure that the countries really abide by its rules, such as fulfilling the MTOs.

Therefore, when the financial and economic crisis hit the EU, most states' budgets were quite far from balance and it was not very surprising that many of these countries had suddenly fallen into deep budget deficits.

In November 2009 a new Greek government's budget draft revealed that the country's deficit would be twice as high as expected – nearly 13% of GDP. By the end of 2009 rating agencies

downgraded the country's rating and since that time the Greek government bond spreads have been rising. The Greek government started to implement measures that should decrease its spending but it encountered a very negative reaction from the public – since the beginning of the year there have already been many, sometimes quite violent demonstrations. Also the reaction of the financial markets to all these events was not positive. Furthermore, there have been fears of contagion from the Greek crisis to start spreading over other EMU countries, such as Spain and Ireland. At the beginning of May 2010 a rescue package of around 100 billion EUR was approved by the EU and the IMF. To what extent this package is compatible with the Lisbon treaty where bailout is banned, that is questionable.

Maybe in connection with all this the European Commission proposed that national budgets and policy planning should be aligned through the establishment of a "European Semester" for economic policy coordination. Thus the member states may benefit from early coordination at European level when preparing their national budgets or reform programmes. This proposal was very often interpreted by the media in the sense that the EU wants to approve the member states' national budgets.

We could see in the discussion in the previous Subsections that EU policy-makers have not been willing or able to do revolutionary changes to the SPG. However, this may change after the recent problems of Greece. In any case, a significant change to the EU'S fiscal rules seems to be more likely now than ever before.

3 Fiscal Coordination in the European Economic and Monetary Union

Fiscal policies are much more important in countries forming a monetary union than for those being outside such union, because the former have lost the possibility of reacting to asymmetric shocks by movements in the exchange rate or by adjustment of interest rates.

Much research has already been devoted to the question whether in a monetary union economic and fiscal policies should be coordinated and whether fiscal rules (or constraints) should be imposed on a union's members. This Section should provide an overview of the basic arguments, both in general for an economy and for a set of countries forming a monetary union. First, coordination of economic (fiscal) policies in a monetary union will be treated. Second, the imposition of fiscal rules or constraints will be discussed.

3.1 Coordination of economic policies in a monetary union

In recent literature many reasons for the coordination of economic or fiscal policies can be found. Less often, it is also possible to find arguments why such coordination may not be optimal. This section should provide an overview of different opinions on the coordination of fiscal and economic policies in a monetary union.

Beetsma et al. (2001) note that ex-ante and ex-post coordination of economic policies should be distinguished. Ex-ante coordination is ensured through multilateral agreements, such as the Maastricht Treaty and the Stability and Growth Pact in the case of the EMU, and can only deal with enduring problems, such as a possible deficit bias. Ex-post coordination, on the other hand, takes place when necessitated by actual economic development. As an example of such coordination in the EMU the authors recall the Eurogroup where fiscal policy of the euro area countries is discussed in an informal way.

Any economic policy which generates cross-border spillovers could be to some extent coordinated or even centralized in a monetary union. In the EMU it is especially the case of structural policies, taxation and reaction to external shocks.[22] However, researchers have differing opinions about the existence, size and direction of the spillovers.

Wyplosz (2006) claims that the spillovers are poorly known, adding that it is also extremely difficult to quantify the costs of coordination. Nonetheless, he considers these not to be negligible. Lindbeck & Niepelt (2006) also remind that there is no consensus about the importance of direct spillovers of fiscal policies. They, nevertheless, assume that forming a monetary union would make them more significant because common currency encourages cross-border market integration, promoting international interdependence.

Beetsma et al. (2001) remind that many authors assume that in a monetary union the total cross-border effect of an autonomous fiscal impulse is so small that coordination would in fact be much more costly. Nevertheless, in their opinion the size of the union-wide spillovers depends crucially on the central bank's reaction to the fiscal impulse, which means that spillovers are endogenous. Because of this they consider it reasonable to assume important and positive spillovers of fiscal policy, but at the same time they admit that the theoretical

[22] As Beetsma et al. (2001) notice, if taxation (especially of mobile factors) was not coordinated in the EMU, tax rates would be inefficiently low due to competition among the member states.

literature is inconclusive about the sign of the spillovers:[23] while the classic analyses of policy coordination assume positive demand spillovers, more recent studies assume negative spillovers. Fitoussi & Saraceno (2007) contributed to the debate by suggesting that from the theoretical point of view there is no reason why the negative externalities should be larger than the positive ones.

Ardy et al. (2006) discuss the coordination of policies from the point of view of social costs: these occur when in a monetary union its members implement their fiscal or supply-side policies in an uncoordinated fashion and thus adversely affect growth prospects or stability of the other countries.

Another issue in economic policy coordination in a monetary union is the existence of many fiscal authorities and only one monetary policy maker (in the EMU it is the ECB which is independent and committed to price stability). Catenaro & Morris (2008) are of the view that in a monetary union a coordination mechanism is necessary to assure that fiscal policies are not mutually inconsistent and that they do not jeopardize the union's macroeconomic stability and cohesion.

Beetsma et al. (2001) do not provide such a clear conclusion: they admit that because of the large number of players in a monetary union such as the EMU the risk of inadequately coordinated policy mix is higher than in individual countries, but they argue that given the narrow mandate of the ECB, coordination of fiscal policies may magnify the discrepancy between how a given economic development is perceived by the ECB at the aggregate level and how fiscal authorities see it in the individual countries. They furthermore claim that coordination of fiscal policies increases the strategic weight of fiscal authorities in comparison with the ECB which could have adverse effects on the expansionary bias of the macroeconomic policies. Finally, they remark that based on existing literature, fiscal coordination may be counterproductive in the EMU when it provokes an enough strong adverse reaction of the ECB.[24] Therefore, intuitively fiscal coordination will probably be more beneficial when the central bank's reaction to a disturbance is weaker, which could be the case of an asymmetric shock (as such shock has a smaller union-wide impact and the probability of the central bank reacting is lower).

[23] The authors note that according to the sign of the spillovers the fiscal policy reaction should be either expansive or restrictive.

[24] Such a reaction is more likely when there is significant inconsistency between the goals of monetary and fiscal authorities and also when governments have the possibility to put pressure on the central bank.

3.2 Fiscal rules in a monetary union

In the last decades, researchers have identified many different reasons why countries should have fiscal rules. Nevertheless, it has to be admitted that differing opinions exist about certain issues. When countries form a monetary union, many of the problems become more pronounced, which is often taken as a case for fiscal rules or constraints in monetary unions. Woods (2008) begins the discussion of the reasons for existence of fiscal rules by stating that in a monetary union they are needed to protect the member states from the consequences of unsustainable policies in a member state. This Subsection shall provide an overview of the different channels through which this can happen.

3.2.1 Credibility of the monetary authority and its commitment

One stream of reasoning is connected with endangered central bank's commitment to price stability or its credibility. Lindbeck & Niepelt (2006), Buiter (2006) and Chari & Kehoe (1998) claim that if, in a monetary union, the central bank can commit to price stability, free-riding and inflationary bias are not a problem. However, Lindbeck & Niepelt (2006) also note that when the central bank is not credibly committed to price stability, countries may be induced to accumulate higher debts because they expect that the central bank would adjust its monetary policy to depreciate the debt.[25] Furthermore, governments may also tend to accumulate higher debts if they expect the central bank to become the lender of last resort. This all may be a good reason for the introduction of some constraint on the government debt.

In the EMU this was forbidden already by the Maastricht Treaty (Article 104[26]); nevertheless, for instance Eijffinger & de Haan (2000) are persuaded that in some situations the ECB may find it very difficult to avoid being involved in bail-out. Fitoussi & Saraceno (2007) support this view, claiming that the credibility of the ECB is another reason for having fiscal rules in the EMU: as it is impossible to exclude the eventuality of bail-out, a limit on public debt helps to maintain the credibility of the central bank. On the other hand, Buiter (2006) considers arguments for the possibility of a bail-out to be unconvincing.

According to Wyplosz (2006) there is strong evidence that when debt becomes so high that it is problematic to finance it through market borrowing, large inflation occurs. As the EMU considers price stability being so important, it was necessary to ensure that the ECB would

[25] Buti et al. (2001) support this view by reminding that according to several papers by Dixit and Lambertini fiscal discretion seems to be harmful for monetary commitment and thus fiscal rules may be appropriate.

[26] In original version; Article 123 of the Lisbon Treaty.

not be under pressure to inflate the EU. Ardy et al. (2006) and Eijffinger & de Haan (2000) also confirm the need to spare the ECB the potential pressure to allow higher inflation in the union.

Beetsma et al. (2001) confirm that large accumulated debts are a source of danger to the credibility of the monetary authority, also because they can induce the central bank to raise the common interest rate.

Ardy et al. (2006) remind that another source of threat to the credibility of the central bank in a monetary union could be the possibility of free-riding: some of its members will pursue unsound fiscal policies relying on the prudence of the other states, enjoying the benefits of credibility. Nevertheless, if too many countries behave in such way, at the aggregate level their policies may become inconsistent with the monetary policy, which could endanger the credibility of the central bank.

3.2.2 Deficit bias

Another stream of reasoning concerns a possible deficit bias. Kopits (2001) considers that the strongest reason for having fiscal rules is that rational policymakers run policies with a deficit bias. Bean (1992) and Beetsma & Uhlig (1999) also support this view: given the governments' short time horizons determined by the electorate cycle, they tend to borrow to finance expenditure.

Wyplosz (2006) claims that unquestionably, based on the evolution of public debt in the last thirty years, governments are subject to a deficit bias. He is, however, not sure whether this should not be solved domestically (by introducing domestic political institutions) rather than at the union level.[27] He, nonetheless, notes that arguments such as 'macroeconomic discipline is a necessary attribute of Euro area members', or Stark's (2001) statement that the 'deficit bias is incompatible with the general stability culture that must lie at the basis of the monetary union' (pp. 227), are clearly not sufficient for justification of rules like those imposed by the SGP.

Catenaro & Morris (2008) claim that the deficit bias is higher in a monetary union than without it, as the effect of exchange rates that may potentially discipline the government is not in place any more. Eijffinger & de Haan (2000) support the view that members of a monetary

[27] Nevertheless, Woods (2008) notes that without the SGP most EU countries would have no fiscal framework at all and thus it may not be reasonable to expect the introduction of some domestic fiscal rules in all of the EU countries.

union will tend to borrow more than non-members. They presume that countries outside a monetary union are limited in their borrowing by their domestic capital market and when they want to borrow more, they suddenly face the exchange rate risk, which may limit their willingness to borrow. The opposite holds for the union's members.

3.2.3 Effect on interest rates

Many researchers are concerned about the effect of unsound fiscal policies on the interest rates. Catenaro & Morris (2008) claim that when a government borrows excessively, it can have an adverse effect on the price level and the interest rates, which would crowd out private investment.

Lindbeck & Niepelt (2006) explain that expansionary fiscal policy can make the ECB increase interest rates for the euro area. They describe a situation when after a cost-push shock the ECB reacts by increasing the interest rates and the member states, trying to moderate its effect, come up with an expansionary fiscal policy, which may force the ECB to increase the interest rates even further. Another case could simply be when a member state runs an expansionary fiscal policy that causes a rise in inflation, to which the ECB reacts by increasing the euro area interest rates.

These authors also point out the externalities from additional borrowing by a government in Euro bonds. According to them, it influences bond interest rates of other euro area governments much more than if all such countries had their own currencies.[28] This effect can be exacerbated if investors do not properly differentiate between individual euro debtors.

The argumentation of Ardy et al. (2006) is similar: if one member of a monetary union runs a deficit, it will not face an increased real exchange rate with respect to the other countries, as they share a common currency, but the deficit will cause a union-wide rise in interest rates, the costs of crowding-out thus being spread to all the union's members.

Feldstein (2005) emphasizes the danger of cumulative public debts because these can have a negative influence on the long-term interest rates and also on the value of the euro. Eijffinger & de Haan (2000) note that if a sufficiently large member of the EMU has an unsustainable fiscal position, it may affect the euro's exchange rate. The Delors Report (1989) also claims that fiscal indiscipline could endanger the stability of the new currency.

[28] The effect of excessive borrowing on the interest rates is also referred to in the literature as weak fiscal dominance, in which case the central bank cannot do much against the rising interest rates.

However, several authors have an opposing view to the issue of the adverse effect on the interest rates. Wyplosz (2006) argues that claiming that a country's budget deficit increases interest rates in the whole monetary union is a 'serious analytical mistake'. He argues that this claim is based on crowding-out effects derived for a closed economy (public borrowing competes with private borrowing for savings), but in an open economy world savings are concerned and none of the EMU countries is big enough to have an influence on world interest rates. Furthermore, if deficits are regarded as a sign of possible default, it is not the euro-area interest rate that should rise, but only the interest rate applied to the given country's debt.

Fitoussi & Saraceno (2007) remind a paper by Detken et al. (2004) who explain why deficits do not have a large impact on union-wide interest rates by the fact that bond substitutability broadens the savings pool from which governments can borrow. Thus there exists a possibility to free-ride, which should be limited by a fiscal rule.

3.2.4 Other explanations

Another issue is that high debt might limit the policy-makers in their reaction to shocks and may divert resources from their optimal use. Catenaro & Morris (2008) remind that high deficits and debts can limit the government's ability to cope with domestic demand stabilization, because with a high level of debt a country is more likely to default on the debt and has to behave in such way so as not to raise fears of default, i.e. it cannot additionally borrow too much. The authors furthermore point out that when a country has a high debt it spends a lot of resources on interest payments. These resources thus cannot be applied for more productive uses. Fitoussi & Saraceno (2007) provide an example of countries for which high interest payments are detrimental. According to them, because of high interest payments Germany, France and Italy do not have effective fiscal policies due to the lack of room for the automatic stabilizers.

An alternative explanation for why there should be fiscal rules in a monetary union is provided by Wyplosz (2006). He argues that from a political economy point of view, in a monetary union there is a clear risk of free-riding on the common pool of financial resources: a country can be accumulating its debt until it is impossible to avoid default and then extort help from the other member states. Such bail-out is ruled out by the Maastricht Treaty (the already mentioned Article 104b), but, as Wyplosz notes, maybe the policy-makers imposed a

restriction on the height of the public debt because they doubt the 100% enforceability of such provision.

This may be connected with the assertion by several researchers that the imposition of fiscal rules in the EMU was driven by some member states' fear of other, irresponsible governments. Woods (2008) claims that the most important aim of the SGP was to protect fiscally disciplined states from those fiscally irresponsible. Bean (2001) directly affirms that Germany feared that Italy's membership in the EMU would be destabilizing so it ensured that fiscal rules would be imposed. The opinion of Buiter (2006) goes even further: according to him, the drafters of the Maastricht criteria (mainly Germany and the Netherlands) wanted to keep, in this way, Italy and maybe also Spain and Portugal out of the EMU. This author also notes that the imposition of fiscal rules can be explained by paternalistic reasons, as some members of the EMU may not be viewed as being able to act in their best interest without the imposition of some external constraints.

Kopits (2001) suggests that reputation which a country acquires for a wise management of fiscal policies can induce it to continue behaving wisely. Obviously, the converse would also hold. Thus, from this perspective it would be reasonable to constrain the members of a monetary union by fiscal rules because certain countries may never start behaving fiscally wisely without such a constraint.

Another argument for the need of fiscal rules in a monetary union is presented by Lindbeck & Niepelt (2006). These authors claim that becoming part of a monetary union is dangerous for the soundness of domestic fiscal policies because the government thus loses two 'watchdogs': the domestic central bank, as the monetary union has its own and only one central bank, and foreign exchange markets, as the country has to give up its currency (the authors assume that irresponsible fiscal policies were discouraged by possible depreciation of the currency). On the other hand, they also note that possibly the fiscal authorities could be made more sensible by the fact that contrary to their own central bank, the union's central bank will less probably react to their own domestic crisis.

3.2.5 Role of financial markets

There is also the issue of the role of the financial markets. The literature is quite inconclusive about the ability of the financial markets to behave as some kind of restrainers to the governments' fiscal policies. Fitoussi & Saraceno (2007) recall two papers (by Alesina et al. (1992) and Bernoth (2004)) which conclude that markets are able to monitor fiscal

performance and put pressure on governments through the spreads and that they have not lost this ability after the introduction of the EMU. However, many researchers have an opposing opinion.

Eijffinger & de Haan (2000) claim that markets may not be disciplining enough. They explain that the markets migth not make a difference between interest rates applied to a fiscally disciplined and undisciplined country within a monetary union because they may expect that even if, in the case of the EMU, the Maastricht Treaty provided for a no-bail-out clause, the Union would help a member state in troubles for political reasons. Furthermore, according to these authors, markets tend to react slowly to an unsustainable fiscal position and sometimes, when they react, it can have contagion consequences. This can be very well illustrated by the article 'Eastern Europe: Argentina on the Danube' published in the Economist in February 2009 where both Poland and the Czech Republic were claimed to have harmed their households by decreasing interest rates and thus depreciating their currencies, as these were highly indebted in foreign currency. However, while Polish households had a foreign currency debt amounting to around 30% of GDP, this figure was virtually zero in the Czech Republic. In spite of this, the two countries were put in one basket.

Woods (2008) agrees that markets have not been differentiating significantly among different euro government bonds. He reminds that we can expect that the markets may not reflect the individual countries' situation properly, but also that their reactions might be 'abrupt and potentially very disruptive'.

Kopits (2001) argues that well designed fiscal rules could have the same effects as markets on governments' fiscal behaviour, but in a quicker and more efficient way and without their reactions' adverse consequences such as high risk premium or an abrupt outflow of capital.

3.2.6 Negative aspects of fiscal rules

Having fiscal constraints in a monetary union (but also in a state outside such grouping) has, of course, also some negative aspects. If the constraints on deficit or on debt are imposed, governments may have limited scope for reaction to a shock (given that in a monetary union when one country is hit by a shock it cannot face the problems by movements in the exchange or interest rates, constraints e.g. on deficit might be too restrictive for the government's intended reaction). However, as Eijffinger & de Haan (2000) mention, according to Buti and Sapir (1998) over the period that they investigated (1961-1996, i.e. before the introduction of the SGP) EU member states on average did not tend to loosen their fiscal policy during severe

recessions (these were defined as a decline in GDP by at least 0.75%). It seems that the above described problem depends crucially on the design of a concrete fiscal rule and may be avoidable: as was mentioned in the previous Section, if the EMU countries observe their medium-term objectives of a fiscal stance close to balance or in surplus, they should have enough room for reactions to shocks without breaching the limit on the budget deficit.

Several researchers (e.g. Woods (2008), Kopits (2001)) emphasize the potential negative effect of constraints, especially that on the budget deficit, to the level of public capital expenditures. If the assumption that public investment has a positive effect on economic growth is correct, then this would be a very important thing to consider when designing a fiscal rule.

Another issue is the one highlighted by Kopits (2001) and Beetsma et al. (2001). They mention that fiscal rules can cause that states bound by them resort to creative accounting. The best example is Greece that was hiding its deficit by stock-flow adjustments to meet the Maastricht criteria and be allowed to enter the EMU.

3.3 Evaluation of the Stability and Growth Pact

3.3.1 Stability and Growth Pact and the coordination of economic policies in the EMU

Given that based on the Maastricht Treaty the member states should follow the broad guidelines of economic policies (these are mainly based on the Lisbon strategy) and that there exist processes aiming to coordinate the macroeconomic, structural and employment policies, together with coordination of taxation (such as minimal rates for VAT or the excise tax), we may claim that the ex-ante coordination of economic policies is important for the EMU. For example employment policies are coordinated and monitored within the Luxembourg process, structural reforms are monitored under the Cardiff process and the macroeconomic policies are dealt with under the Cologne process.

Also concerning the reaction to external shocks we can claim that the current setting provides for coordination of the Member States' actions. An example can be the EU's reaction to the crisis which first hit it in 2008: The European Economic Recovery Plan was put forward by the European Commission in November 2008 and approved by the Council already in December 2008. Its key aspects were, first, an injection of 200 billion euro (1.5% of GDP) to

the economy, without breaking the SGP, and, second, the plan of implementation in the short run of measures that should be beneficial for the EU economy in the long run, such as increase in competitiveness etc. Its strategic goals were to stimulate demand and increase the confidence of consumers, limit the consequences of the crisis to the citizens' lives and help them to get back to the labour market, prepare the economy so that it can profit from all opportunities after it starts growing again, and to prepare the EU for a transition to a low-carbon economy.

However, it has to be noted that the intention not to break the SGP was not observed by many EMU members. While in 2008 only five of them breached the 3% value (France, Greece, Ireland, Malta and Spain, according to Eurostat data), in 2009 only five of them managed *not* to breach it. This is not very surprising given the fact that in 2009 GDP fell by 4.2% on average in the EU, while in 2008 it grew by 0.8%.

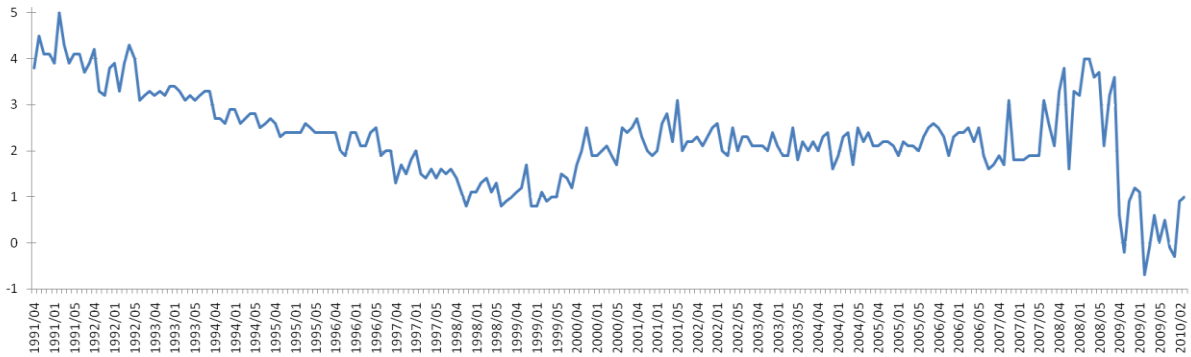
Concerning the coordination of fiscal policies and the monetary policy, it is questionable whether the coordination is performed to the extent that the fiscal policies of all the member states are really mutually consistent and also consistent with the goal of the monetary policy. Nevertheless, if this coordination really is not perfect, then we may also claim that it is not sufficiently strong to jeopardize the commitment and credibility of the ECB.

3.3.2 Stability and Growth Pact and the need for fiscal rules in the EMU

The fact that the Maastricht Treaty provided for the independence of the ECB and ruled out the possibility of bail-out is a good basis for the central bank's strong commitment to price stability.

When we look at the data on inflation (in Figure I.1), we can see that most of the time of its existence the ECB was able to keep inflation close to the target.

Figure I.1 – Inflation in the EU / EMU from 1991 to 2009 (in %)

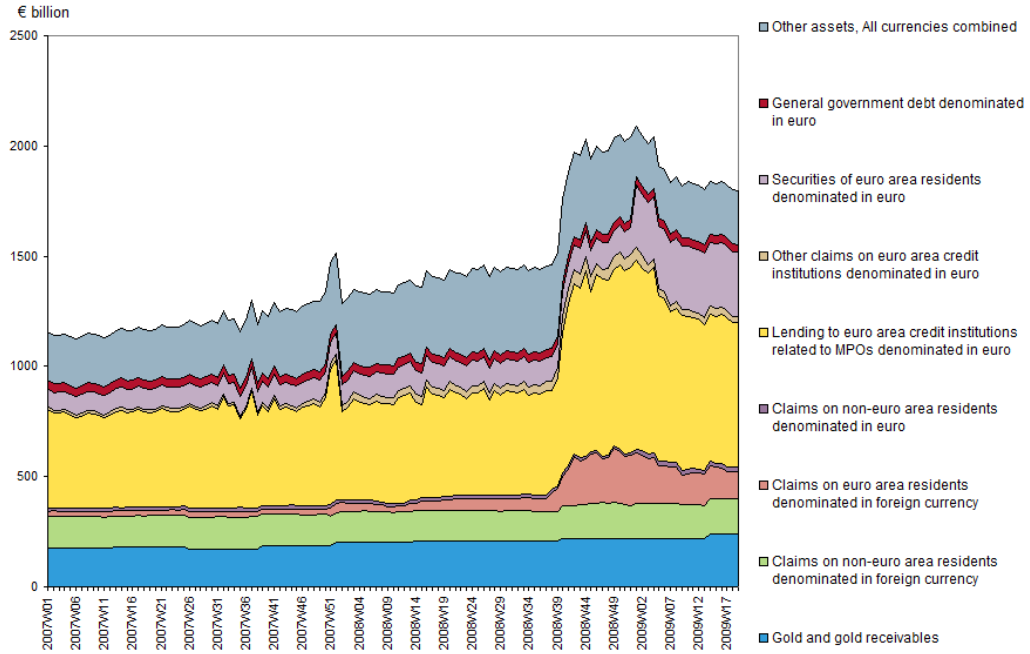


Source: European Central Bank

In 2008, mainly in connection with the global financial and economic crisis, the inflation rose to 4% but decreased very quickly to even negative numbers in 2009.

However, we also have to point out that the balance sheet of the ECB has significantly increased, as shown in Figure I.2. Nevertheless, in comparison with the expansion in assets of the FED or the Bank of England, it is relatively small. The change of the balance sheet of the ECB can be attributed to the bank's effort to pump liquidity into the economy (we can see from Figure I.2 that in 2008 lending to euro area credit institutions increased most significantly of all the bank's assets). What the ECB's exit strategy will be, that is still a question. The issue of the expansion of the ECB's assets may be seen as a supporting argument for those researchers who claim that the possibility of bail-out cannot be excluded.

Figure I.2 – ECB balance sheet: assets



Source: European Central Bank

The EU's fiscal provisions seem to deal well with the possible deficit bias, as there is a limit set to the deficit-to-GDP ratio.[29] If we trace this in the data, we may see that on average fiscal discipline improved, at least before the start of the global crisis. Nevertheless, in connection with the deficit constraint, we should also discuss issues that are considered problematic.

First, there may be a negative effect of the deficit constraint on public investment. The SGP does not provide for an exclusion of public investment expenditures from the calculation of

[29] This should also limit the negative effect of excessive borrowing's on inflation and interest rates in the EMU.

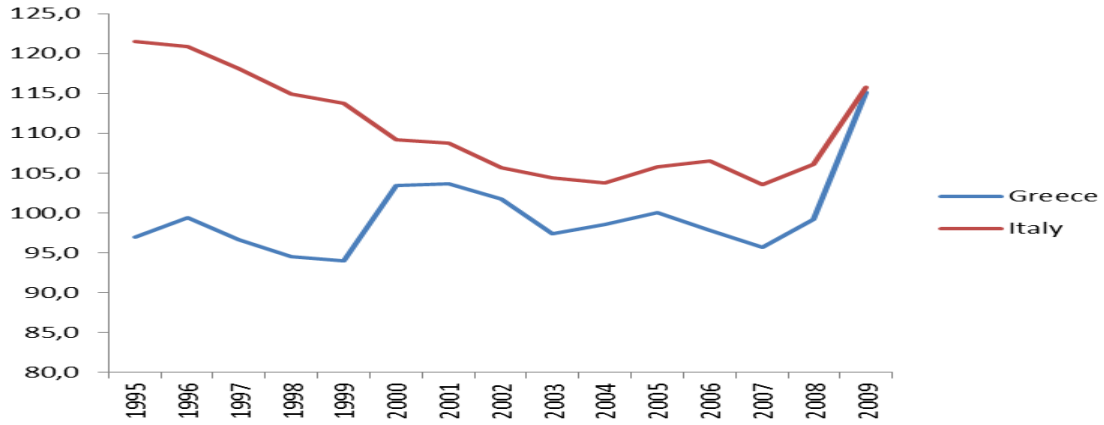
the deficit for the Excessive Deficit Procedure purposes and thus it is possible that the governments rather cut investment than current expenditures when they need to avoid breaching the Pact. In this respect, maybe the SGP should take inspiration in the UK's Golden rule.

Second, there is the issue of the limitation of the governments' scope for reaction to shocks. However, as already mentioned in the previous Section, several researchers confirm that if the budgetary position of close to balance or in surplus is observed, there should be enough room for reaction to a shock without breaching the 3% reference value. Of course, during extreme events such as a fall in GDP by several percent, as is now the case of the EU, the reference value is usually breached.

Third, we can again confirm that the SGP has led several countries to be very creative when calculating their deficits. Greece, Italy and Portugal are considered to be the worst culprits.

Concerning the issue of bail-out of one member state by some other member states, it is questionable whether the Maastricht Treaty's provision forbidding such behaviour will really be observed: countries that have got to financing problems, such as Latvia and Hungary, were already provided loans - by the IMF, but also by the EU and some individual member states and it is not certain whether these loans will be fully repaid. It now remains to be seen how the EU member states will deal with Greece that had a tremendous deficit of 12.7% of GDP in 2009, and whose debt was 99.2% of GDP in 2008 and then reached 115% of GDP in 2009. While until 2009 it seemed that the Greek debt would soon outreach that of Italy, the two countries in the end had nearly the same public debt in 2009, the only difference being that the Greek debt underwent a much steeper growth. This can be seen in Figure I.3.

Figure I.3 – Comparison of Greek and Italian public debts



Source: Eurostat

4 The Stability and Growth Pact and the Financial Markets

In the discussions of monetary unions and fiscal rules the question whether European Union's Stability and Growth Pact could be substituted by the disciplining effect of the financial markets has often been raised. However, as we already shown in the previous Section, researchers have not reached a common opinion on this issue.

In this Section we investigate this question by distinguishing three issues: first, the institutional setup and conditions influencing the markets' and the governments' behaviour; second, the reaction of the financial markets to the governments' fiscal behaviour; and third, the reaction of the governments to changing costs of borrowing. Therefore we test whether the government bond yield spreads change in reaction to increasing budget deficits and public debts, and then we test whether the governments improve the structural primary balance when the spreads of their bonds increase.

The structure of the Section is the following: we first review recent literature dealing with our research question and also discuss briefly the institutional conditions in the EMU that may significantly influence our conclusions. We then describe and review the data that we use for the investigation of the behaviour of the financial markets and of the governments, performing also tests of the statistical properties of the data. Then we outline the method that we use for the estimation. We continue by presenting the results of our estimation and then we conclude.

4.1 Related literature

To tackle the question whether the Stability and Growth Pact could be substituted by the financial markets requires investigating three issues: first, whether the institutional setup and market conditions in the EMU enable an efficient working of the financial markets and a responsible behaviour of the governments; second, whether the financial markets react to a worsening fiscal stance of a government, i.e. if a country's government bond yields increase when its fiscal stance deteriorates; and third, whether governments change their fiscal behaviour appropriately to the market signals, i.e. if a country's government corrects the budget deficit when the costs of borrowing increase. While many researchers have studied what drives yields (or spreads) of government bonds, only a few have explored the reaction of the governments to the market signals.

4.1.1 Institutional setup and market conditions

At the beginning of their paper, Balassone et al. (2004) remind that there are many prerequisites for the financial markets to be effective. They mention eight important, partly overlapping conditions that were outlined by Bishop et al. (1989) and Lane (1993). These can be summarized as follows: First, there is free movement of capital. Second, governments do not have privileged access to the market. Third, markets have access to all necessary information on sovereign borrowers. Fourth, bail-out is not allowed, there is no external guarantee and debts cannot be monetized. Fifth, the financial system can absorb the bankruptcy of a sovereign borrower. Finally, borrowing governments do respond to market signals.

Balassone et al. (2004) argue that many of these conditions have already been fulfilled in the EMU, but several remain problematic. This can be confirmed today: first, information necessary for evaluating the financial reliability of governments is available to the markets with delay (e.g. Eurostat will only release a lot of data for the first quarter of 2010 in July 2010, i.e. four months after the end of the given period). Furthermore, we have to remind that it is not 100% reliable - for example in the case of Greece it has become doubtful when this country's creativity in producing statistics was discovered and statistics had to be reviewed several years backwards.

Second, it is unsure whether the markets would be able to absorb the bankruptcy of a sovereign borrower. For example the debt of Greece is mostly owned by French and German banks and in case Greece defaulted on its obligations, the banking systems of these two countries may be significantly harmed. Third, the borrowers' response to market signals is uncertain but this is something that we can test for. The greatest problem, however, seems to be the issue of (non-)bail-out. Bail-out is prohibited in the EMU[30] but the credibility of this ban has become more doubtful than ever, given the situation in Greece and the loans that have been granted to it by other EU countries and the IMF.

We have to bear all this in mind when drawing conclusions from our estimation results.

4.1.2 The markets' reaction

Researchers generally agree that government bond yield spreads are determined by several factors: default risk, exchange rate risk and liquidity premiums, and factors such as

[30] It was already banned by the Maastricht Treaty.

transaction costs and differences in tax treatment or different sensitivities to common shocks. To this Lemmen & Goodhart (1999) note that in a monetary union the default risk is higher as the countries cannot inflate their debts or devalue their currencies. However, as we can see these days, higher probability of bail-out in a monetary union goes in the opposite direction as far as the default risk is concerned.

There are two main lines of research in the current literature that are connected with the issue of the reaction of the financial markets to the fiscal stance of governments. While the first one investigates the effect of fiscal variables on the government bond yields, the second one tries to assess their effect on government bond yield spreads.

The first line of research is much less widespread than the second one. For us the most relevant paper is that by Ardagna et al. (2004).[31] These authors worked with a panel of 16 OECD countries and a time period of more than 40 years, using annual data. They did the estimation on two different periods, one using OLS estimation with country specific fixed effects and one using the GLS estimator. They concluded that the effect of fiscal deficits and public debt on interest rates is very significant.

However, as Gale & Orszag (2002) note, the overall level of long-term bond yields is affected by many factors and not only the fiscal policy. It may therefore be better to investigate the bond yield spreads if we want to trace the effect of fiscal policy on the markets' pricing of the costs of borrowing. This was confirmed by the recent development of the government bond yields that is illustrated in Figure A2.1 in Annex 2. We can see that after an increase in the bond yields of all governments between 2005 and 2007, many government bonds yields started to decrease in 2008, but the spreads among them have increased significantly and this is what we are interested in.

The literature aiming to explain the government bond yield spreads is very wide and usually Germany is used as the benchmark. It is generally accepted that the spreads in a monetary union are caused by differences in credit and liquidity risk premiums. Many researchers have also found that government bond spreads are driven by a common factor, usually referred to as *international risk aversion.* Manganelli & Wolswijk (2009) tried to find what drives this

[31] Other papers are e.g. Laubach (2003), Pesani and Strauch (2003), Tavares and Valkanov (2001).

international risk aversion and they claimed that it was related to the level of short-term interest rates.[32]

Codogno et al. (2003) worked with monthly data for 10 EMU countries between 1995 and 2002. Because of the period chosen, the authors took into account the exchange rate risk components of the government bond yield spreads in the regression. They also included to their model two variables that should approximate risk premiums. These were both related to the US economy (spreads between interest rates on US swaps and the federal government bond yields and between the yields on AAA US corporate bonds and the federal government bond yields). The authors came to the conclusion that government bond spreads in the Eurozone are mainly driven by credit risk and international factors and not so much by liquidity factors.

Bernoth et al. (2006) used data on yield-at-issue spreads for 14 EU countries and the US federal government in the period from 1993 to 2005, taking into account only DM, then EUR issues and US$ issues to avoid the influence of exchange rate risk on the yields. They used the 2SLS estimation technique adding both country- and time-specific fixed effects. The authors also included investors' risk aversion into the regression. They proxied for it using the spread between BBB US corporate bonds yields and the US government bonds yields. The authors concluded that yield spreads do respond to government indebtedness but that after the start of the EMU the markets' attention moved from government debts and deficits to debt-service ratios.

Paesani et al. (2006) investigated the period between 1983 and 2003 for the USA, Germany and Italy, estimating a VAR model. They came to the conclusion that fiscal developments have influenced significantly the long-term interest rates.

Schuknecht et al. (2008) investigated the government bond risk premiums for the EMU and Canada using data on bond yields spreads at issue from 1999 to 2005. Then, in Schuknecht et al. (2010), they reviewed their previous findings for the EMU, extending the period until May 2009 and thus taking into account also the impact of the financial crisis. In both papers they estimated an OLS model with time fixed effects, including into the regression also two proxies for international risk aversion: the BBB US corporate bond yields spreads and also the short-term interest rates (3-month EURIBOR concretely). Their conclusion in 2008 was that

[32] For a detailed description of how the interest rates affect the government bond spreads see Manganelli & Wolswijk (2009).

yields spreads over an appropriate benchmark do respond to indicators of fiscal performance. In 2010 they added to this that the markets' reaction to fiscal imbalances has become stronger after the fall of the Lehman Brothers. However, they did not account for the effect of the crisis itself (their crisis dummy was only included in the regression in interaction with other variables).

Alexopoulou et al. (2009) used monthly data for 8 new EU member states from 2001 to 2009 and did the estimation using the pooled mean group technique.[33] They also took into account the global financial conditions and proxied for them using the stock market volatility of the Dow Jones Eurostoxx 50 index. These authors' conclusion was that for most of the countries government bond yield spreads responded significantly to fiscal fundamentals.

Haugh et al. (2009) estimated a simple panel model for 10 EMU countries over the period from December 2005 to June 2009, using quarterly data. These authors also included in their regression a proxy for risk in the form of spreads between high yield corporate bonds and government bonds. They concluded that differing fiscal policies have an important impact on government bond yield spreads. They, however, note that this was not so evident in the pre-crisis times when the general risk aversion was very low.

4.1.3 The governments' reaction

Literature dealing with our second research question is rather limited. The only paper that we were able to find is the already mentioned paper by Balassone et al. (2004). These authors test for different time periods how the governments change their structural primary budget balance in response to a change in the market price of public borrowing and come to the conclusion that the governments tend to react with a delay to changing market conditions.

4.2 Data and method

4.2.1 The markets' reaction

To answer the question of the financial markets' reaction we used quarterly data from 1999 to 2009[34] for 16 EMU countries. We decided that the beginning of the period investigated will be year 1999 when the euro was introduced. It was shown e.g. by Blanco (2001) that the

[33] Quarterly or annual observations were linearly interpolated.

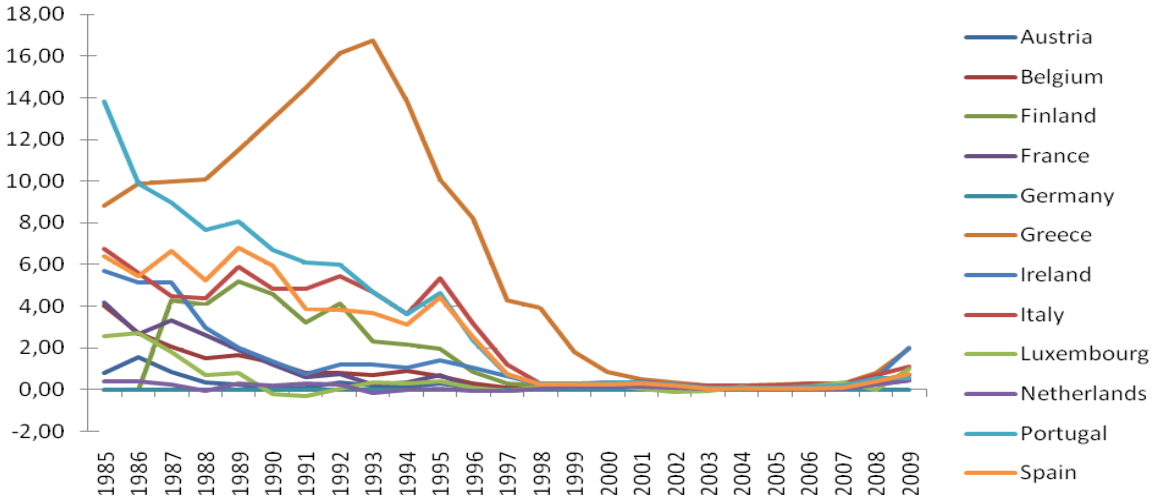
[34] Working also with data for the first quarter of 2010 would be very interesting but Eurostat will only release most of the data for this period in July 2010.

influence of the exchange rate risk on the yield spreads in the pre-EMU era was very significant. This is illustrated by Figure I.4 where we can see that after the elimination of national currencies the government bond yield spreads decreased to very low numbers. The exchange rate risk is therefore something that has to be taken into account. Some researchers, such as Codogno et al. (2003), have treated the exchange rate risk component of the yield spreads using interest rates on swap contracts, but we do not have access to such data. Therefore our estimation begins in 1999 and thus we do not need to proxy for the exchange rate risk.

Several countries from our sample, namely Greece, Cyprus, Malta, Slovenia and Slovakia, did not join the EMU already in 1999. These countries were only comprised in our estimation from their entrance into the EMU onwards.

While many researchers work with data on bond yields at issue, we used data on long-term government bond yields provided by the IMF (International Financial Statistics), as the former were not available to us. The rest of our data comes from the Eurostat except data on US spreads that are also taken from the IMF.

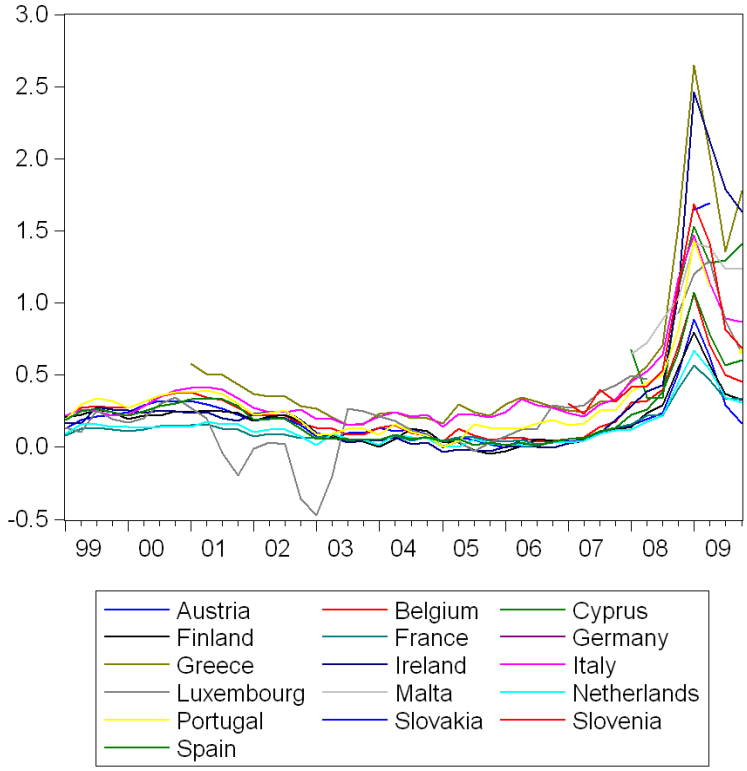
Figure I.4 – Government bond yield spreads of chosen EMU countries in 1985 – 2009 (in %)



Source: IMF, International financial statistics.

Looking at Figure I.5, we can see that while until 2006 EMU government bond yield spreads were very low, in 2007 they started to rise quite significantly. In Annex 2 we included the spread figures for each country separately (Figure A2.2).

Figure I.5 – Government bond yield spreads of EMU countries in 1999 - 2009 (in %)



Source: IMF, International financial statistics.

As we have already mentioned, researchers generally agree that spreads are mainly influenced by the default risk, exchange rate risk and liquidity premiums, and factors such as transaction costs and differences in tax treatment or different sensitivities to common shocks. We assume that transaction costs and tax treatment are similar in the EMU and that exchange rate risk is not relevant any more. We therefore proxy for the default risk by using different fiscal indicators and we proxy for liquidity premiums and different sensitivities to shocks using other variables. Our regression is the following:

$$spread_{i,t} = \alpha + \beta(fiscal.indicators)_{i,t} + \gamma(other.factors)_{i,t} + \varepsilon_{i,t}$$

Our dependent variable, *Spread*, is the difference between a country's long-term government bond yield and the German long-term government bond yield, both being expressed in %.

Our key indicators of fiscal performance refer to the general government and are the following: budget balance or net lending as share on GDP expressed relative to Germany

(*NetLending*),[35] gross public debt as share on GDP expressed relative to Germany (*GrossDebt*), external balance of goods and services as share on GDP (*ExtBal*), share of interest payable on governmental revenues (*Int/Rev*), all expressed in %.

Based on Bernoth et al. (2006) we use as proxy for liquidity of a government's debt the share of this debt on the sum of debts of all EMU countries (*DebtShare*).[36] To proxy for international risk aversion we use two variables: the short-run interest rates in the EMU - 3-month EURIBOR (*SR_IntRate*) and the spread between the US bank prime loan rate and the US 10-year government bond yield (*US_spread*). We wanted to follow previous research using the US corporate bond yields instead of the bank prime loan rate, but such data was not available to us. We also controlled for changes in GDP using the variable *GDPgrowth,* expressed in %.

We used several time dummy variables: *turmoil* having the value of 1 from the third quarter of 2007 to the second quarter of 2008 and 0 otherwise; *crisis* having the value of 1 from the third quarter of 2008 until the end of 2009 and 0 otherwise; and *turmcris* having the value of 1 from the third quarter of 2007 on and 0 otherwise.

We also used dummy variable *South* for southern EMU states[37] and dummy variable *HighDebt* for those EMU states whose gross public debt in the period under investigation was higher than 60% of their GDP on average.[38]

During our estimation we tried to include into the regression the squared terms of *NetLending* and *GrossDebt* and different interactions of the variables that we used.[39]

The descriptive statistics of the key variables are in Annex 2, Table A2.1.

We then looked at the statistical properties of the key variables. We tested *Spread, NetLending* and *GrossDebt* for stationarity. We examined these time series using the Fisher-ADF panel unit root test. While for *NetLending* and *GrossDebt* we rejected the null

[35] I.e. it is expressed as difference from the German figure. A positive number means that the country's net lending as share on GDP is higher than Germany's.

[36] Some authors use data on bid-ask spreads to proxy for the liquidity risk, but such data were not available to us.

[37] Namely Cyprus, Greece, Italy, Malta, Portugal, Spain.

[38] Namely Austria, Belgium, France, Germany, Greece, Italy, Malta.

[39] E.g. the interaction of crisis (or turmoil) and different fiscal or liquidity indicators; the interaction of country dummies and different fiscal or liquidity indicators; the interaction of crisis and country dummies and different fiscal or liquidity indicators; the interaction of proxies for international risk aversion and different fiscal indicators.

hypothesis of unit root, in the case of *Spread* we could not reject this null hypothesis. The results are shown in Annex 1, Table A2.2. Looking back to Figure I.5 where we can see a clear rise in the spreads, this is not surprising. However, we suppose that such result of the test is mainly due to the possible presence of a structural break in the data connected with the latest financial and economic crisis.

We therefore estimate an OLS model, checking whether the inclusion of the country-specific fixed effects is appropriate.

4.2.2 The governments' reaction

To answer the question of the governments' reaction we used annual data from 1999 to 2009 for 16 EMU countries. We could not use quarterly data because the variable that we decided to use as dependent variable is only available on an annual basis.

Data on government bond yield spreads were taken from the IMF (International Financial Statistics) and all other variables were taken from the AMECO database of the European Commission.

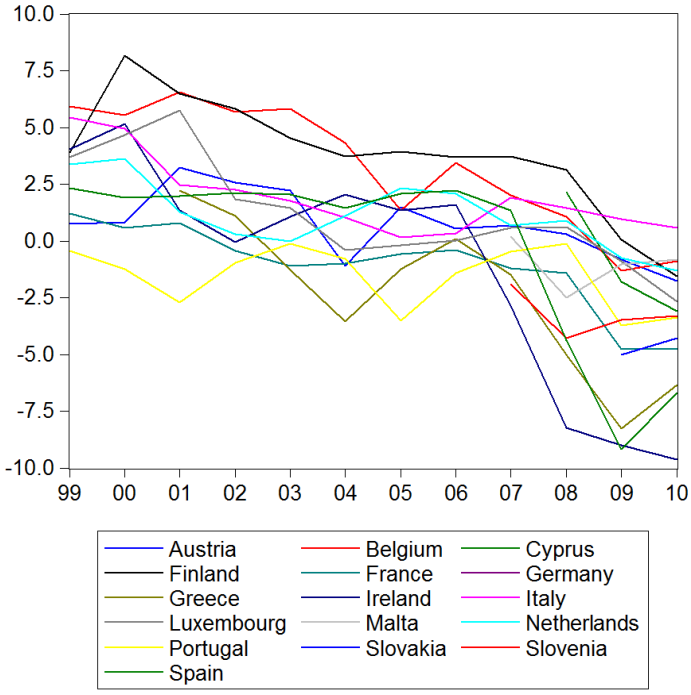
Based on the paper by Balassone et al. (2004) we estimated a regression showing whether governments adjust their fiscal policies in reaction to rising spreads. However, we tried to capture the effect of the latest crisis on the governments' behaviour.

Our regression was the following:

$$StrPrBal_{i,t} = \alpha + \beta StrPrBal_{i,t-1} + \gamma Spread_{i,t-1} + \delta(other.factors)_{i,t-1} + \theta crisis_{i,t} + \varepsilon_{i,t}$$

Our dependent variable which should capture the fiscal behaviour of governments is *StrPrBal* (the structural primary balance, defined as net lending excluding interest, cyclically adjusted based on trend GDP, as share on GDP). We decided to use cyclically adjusted figures because these should reflect governments' fiscal behaviour better than not adjusted figures, as the governments clearly cannot influence the economic cycle (or events such as the latest crisis which caused a great economic slowdown in most countries). The development of this variable in the period under investigation is shown in Figure I.6.

Figure I.6 – Structural primary balance of EMU countries in 1999 – 2010 (in % of GDP)



Source: IMF, International financial statistics.

Our key explanatory variable is *Spread*, i.e. the difference between a country's long-term government bond yield and the German long-term government bond yield (both being expressed in %), which shows how the markets value the given country's government bonds. As other factors that are likely to have an effect on a country's structural primary balance we used the lagged value of the dependent variable, the gross public debt as share on GDP (*GrossDebt*), external balance of goods and services as share on GDP (*ExtBal*), all expressed in %.

We again used several time dummy variables: *turmoil* having the value of 1 in 2007 and 0 otherwise; *crisis* having the value of 1 from 2008 on and 0 otherwise; and *turmcris* having the value of 1 from 2007 on and 0 otherwise. During our estimation we tried to include different interactions of the variables that we used.

The descriptive statistics of the key variables are in Annex 2, Table A2.3.

We then looked at the statistical properties of our key variables. We tested *StrPrBal*, *Spread* and *GrossDebt* for stationarity. We examined these time series using the Fisher-ADF panel unit root test. While for *StrPrBal* we rejected the null hypothesis of unit root, in the case of

Spread and *GrossDebt* we could not reject this null hypothesis. The results are shown in Annex 2, Table A2.4. However, as we work with very short time series, we have to bear in mind that we cannot draw strong conclusions from the tests.

Given that we use the lagged value of the dependent variable as one of the explanatory variables, we applied the Arellano-Bond estimator.

4.3 Estimation results

4.3.1 The markets' reaction

Table I.3 presents our estimation results. In all the models the coefficients have the expected signs. We begin our estimation by the inclusion of *NetLending* and *GrossDebt* only in Model 1. We can see that the effect of both these variables on *Spread* is relatively high. However, the coefficient on *NetLending* diminishes by one half when we include also the *turmoil* and *crisis* dummies which can be seen in Model 2. When we add also other variables, mainly interactions of different variables with the *crisis* dummy, it gets even closer to 0.

Table I.3 – Estimation results 1

Dependent variable: ***Spread***	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Const	0.3626 ***	0.2372 ***	0.2197 ***	0.0614 *	0.1956 ***
NetLending	-0.0285 ***	-0.0102 **	-0.0045 ***	-0.0029	-0.0036 **
GrossDebt	0.0109 *	0.0129 ***	0.0102 ***	0.0088 ***	0.0106 ***
Turmoil		0.1373 ***	0.1365 ***	0.0668 *	0.1263 ***
Crisis		0.7561 ***	0.7188 ***	0.7896 ***	0.7431 ***
Crisis*NetLending			-0.0329 ***	-0.0349 ***	-0.0334 ***
Crisis*DebtShare			-0.0205 ***	-0.0225 ***	-0.0205 ***
Crisis*GDPgrowth			-0.0178 ***	-0.0171 ***	-0.0175 ***
South*crisis*GrossDebt			0.0129 ***	0.0134 ***	0.0129 ***
SR_IntRate				0.0471 ***	
US_Spread					0.0153 ***
Adjusted R2	0.4246	0.7828	0.8526	0.8651	0.8548
Akaike criterion	207.09	-239.05	-413.64	-453.36	-419.76
Test statistic for common intercept	6.9252 ***	19.4176 ***	20.3802 ***	20.1988 ***	21.1285 ***
Test statistic for normality of residuals	229.55 ***	229.36 ***	278.06 ***	343.85 ***	265.68 ***
Number of observations	460	460	460	460	460

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

GrossDebt has a positive effect on *Spread*: when a country's gross debt increases by 1 percentage point relative to Germany, its spread increases by 0.01 percentage point. The turmoil period had a significant effect on the spreads of government bond yields relative to Germany: in this period, according to our estimation, spreads increased by 0.07 – 0.14 percentage points, depending on the model. Nevertheless, the effect of the crisis was even stronger: it caused an increase in spreads by at least 0.7 percentage points.

During the crisis, the importance of the height of the budget deficit increased significantly: an increase in *NetLending* resulted in a 0.03 percentage point decrease in Spread. Other two factors have also become important during the crisis: *DebtShare*, proxying for the liquidity risk premium, and *GDPgrowth*. In the time of crisis, the markets valued better bonds of countries with higher GDP growth (with a 1 percentage point increase in *GDPgrowth, Spread* decreased by nearly 0.02 percentage points) and also of those countries whose debt had a higher share on the whole euro-area debt (with a 1 percentage point increase in *DebtShare Spread* decreased by 0.02 percentage points). Finally, in the time of crisis the importance of *GrossDebt* increased for southern EMU members. For these a 1 percentage point increase in the gross debt relative to Germany meant an additional 0.01 percentage point increase in the bond yield spread.

Based on previous research papers we also tried to proxy for international risk aversion. In Model 4 we used the short-run interest rate (*SR_IntRate*) and in Model 5 we used *US_Spread*. Mostly the inclusion of these variables did not change much the coefficients of the other explanatory variables. This holds especially for Model 5 where the fit of the model increased only slightly. Nevertheless, in Model 4 the fit increased significantly, the biggest change in coefficients or their significance appearing in the case of *NetLending* and *turmoil*.

For all three models we have checked that neither pooled OLS, nor a random-effects model would be more adequate than the fixed-effects model: the test statistic for common intercept is highly significant in all cases (see Table I.3) and according to the Hausman test GLS estimators were not consistent.

Many variables that we expected to be important were not significant in our estimation. These were first, the squared terms of *NetLending* and *GrossDebt*. Second, the external balance of goods and services, *ExtBal,* and the share of interest payable on the revenues, *Int/Rev*. These two variables were not significant even in interaction with *crisis* or *South* dummies. Third, variables such as *DebtShare* and *GDPgrowth* were not significant when included by

themselves, but in interaction with the *crisis* dummy they turned out to be significant. Fourth, variable *GrossDebt* was not significant in interaction with *crisis*, but when these two were interacted also with the dummy variable *South*, the term was significant. Fifth, when we included interactions of different fiscal indicators with proxies for international risk aversion, these did not turn out to be significant. Finally, the dummy variable *HighDebt* was not significant, even in interaction with fiscal indicators or with fiscal indicators and the *crisis* dummy, which would suggest that the markets do not perceive high-debt countries disproportionately differently from the low-debt countries.

Comparing our results with the previous research we note that our coefficients are mostly lower. This may, especially in the case of *NetLending*, be caused by the fact that we have included the *crisis* dummy variable also separately into the regression.

As we can see in Table I.3, in none of the models the residuals have a normal distribution. However, we show in Figure A2.3 in Annex 2 that their main problem is probably too high kurtosis for having a normal distribution.

Our estimation suggests that financial markets do change their pricing of a government's bonds when its fiscal stance deteriorates. While before the start of the crisis government bond spreads basically responded to the level of gross public debt only (the budget deficits affected the spreads only very slightly or not at all), when the crisis began the importance of the budget deficits increased. Furthermore, southern states started to be penalized by the markets for the size of their public debt more than other Eurozone countries. This is very likely due to the fact that these states are often perceived as having relatively worse fundamentals.

4.3.2 The governments' reaction

Table I.4 presents our estimation results. Of the three models the first one has the best statistical properties as at the 5% level of significance it is not over-identified and the errors are neither AR(1), nor AR(2).

All coefficients except *GrossDebt* have the expected sign. However, *GrossDebt* is not significant in any of the models.

We can see that *StrPrBal* is strongly influenced by its past value and by *crisis* which had a significant negative effect on the dependent variable: this event caused a decrease in the structural primary balance relative to GDP by at least 0.7 percentage points. Model 1 suggests

that governments do react to the bond yield spreads: with a 1 percentage point increase in *Spread*, *StrPrBal* increases by 1.2 percentage points relative to GDP in the following period. We included into Model 2 the interaction of *crisis* and *Spread* instead of *Spread* only. The effect of this term was greater than the effect of only *Spread* itself: during the crisis a 1 percentage point increase in *Spread* made the governments improve the structural primary budget balance by 1.5 percentage points relative to GDP in the following period. When in Model 3 both *Spread* and *crisis*Spread* were included in the estimation, they both turned out to be insignificant while the coefficient of *crisis* decreased to nearly -1.

Table I.4 – Estimation results 2

dependent variable: StrPrBal	**Model 1**	**Model 2**	**Model 3**
Const	-0.558 **	-0.516 **	-0.590 **
StrPrBal(-1)	0.4458 ***	0.489 ***	0.444 ***
Spread(-1)	1.179 ***		0.679
GrossDebt(-1)	0.001	0.004	0.003
crisis	-0.721 ***	-0.726 *	-0.996 ***
crisis*Spread(-1)		1.462 **	1.092
SSR	350.57	360.99	346.66
Test for AR(1) errors	-1.86 *	-2.14 **	-2.00 **
Test for AR(2) errors	-0.86	-0.74	-0.79
Sargan over-identification test	49.71	48.96	52.41 *
Wald (joint) test	98.50 ***	100.54 ***	123.65 ***
Test for normality of residuals	3.29	3.04	2.65
Number of observations	112	112	112

Note: ***, **, * indicate 1%, 5% and 10% level of significance, respectively

However, when we tested the hypothesis that the coefficient on *Spread* was the same before and during the crisis, i.e. that coeff(Spread_1)=1.462 and coeff(crisis*Spread_1)=1.179, in neither of the two cases we could reject the null hypothesis that the reaction of governments to increasing costs of borrowing did not change after the start of the crisis. The results of this test are reported in Annex 2, Table A2.5.

Comparing our estimation results with the previous research we find that the effect of the past value on the dependent variable is very similar. Our coefficient on *GrossDebt* is significantly lower, while that on *Spread* is much higher. This is, however, connected with the inclusion of the crisis dummy into the regression.

Our estimation suggests that governments do react to increasing costs of borrowing. However, given that spreads were mostly quite low after the inception of the EMU (in terms of tenths of percentage points, or tens of basis points before the start of the crisis, as we could see in Figure I.4), an increase by 0.5 percentage points is already very big – such a thing happened e.g. to Greece between 2007 and 2008 (during this time its budget deficit increased from nearly 4% to 7.8% of GDP, i.e. it nearly doubled) or to Italy between 2008 and 2009 (during this time its budget deficit increased from nearly 2.7% to 5.2% of GDP) – and this would only trigger, according to our model, a 0.5 - 0.7 percentage point improvement in the structural primary balance in the following period. Given that such big increase in spreads only happened when budget deficits decreased a lot, such governments' reaction may simply not be sufficient to maintain fiscal discipline.

4.4 Conclusions

Our results suggest that the markets do react to fiscal indicators but that this reaction was much weaker before the start of the latest financial and economic crisis than in the last two years. Before the crisis, government bond spreads reacted mainly to the gross public debt. However, the crisis has brought, apart an overall increase in the level of spreads, a reaction of the financial markets to budget deficits and, in the case of southern EMU states, an even stronger reaction to the height of the gross public debt. Whether the reaction of the markets will remain as strong as it was in the last two years or whether it will become weaker again, that is a question.

Concerning the governments' reaction to the change in financial markets' pricing of their bonds, our results suggest that the governments do react to increasing spreads of their bond yields relative to Germany by improving their structural primary budget balance but that the reaction is not very strong. Also, we have found that this reaction was not affected significantly by the latest crisis.

Our conclusion could thus be that the financial markets could potentially have a disciplining effect on the governments. However, reminding the importance of the institutional setup and market conditions in the EMU, we have to note that there are many obstacles to the effectiveness of this setting. First, official data on government finance are released with a significant delay. Until official data are published, only estimates are available to all the stakeholders and sometimes even backward reviews of the data are necessary. Second,

although bail-out is prohibited by the Treaty, these days we cannot deny that the reaction of the financial markets is biased because of the behaviour of the EMU towards its members that are in financial troubles: the loan granted to Greece is extremely similar to a bail-out.

Given all the problems mentioned above our conclusion therefore is that the Stability and Growth Pact cannot be effectively substituted by the financial markets and the EMU thus needs to have fiscal rules.

5 Conclusion

In this paper we described and discussed the evolution of the main fiscal rule of the EMU – the Stability and Growth Pact. We also investigated why a monetary union needs to have fiscal rules and then we tested whether the SGP could be substituted by the financial markets.

Since its inception the SGP has been subject to a lot of criticism. After eight years of its existence it underwent an important reform. This amendment of the Pact, however, did not address all the criticisms and certainly did not tackle all its problems. Also, when the latest financial and economic crisis hit Europe, many EMU member states suddenly found themselves in deep budget deficits. This may be at least partly attributed to the fact that most of these states did not actually observe the rules of the Pact, especially the medium-term objectives set for the budgets.

The financial problems of Greece have triggered a discussion about how it would be possible to ensure that the member states really observe the rules of the Pact, as obviously the current sanctions have not been deterrent enough. It remains to be seen whether the policy-makers will change the EMU's fiscal rules in a way that would make the states become really fiscally disciplined.

Having analysed the need for coordination of economic policies and for fiscal rules in monetary unions, we come to the conclusion that these are necessary in the EMU. There are many more reasons why members of a monetary union should be constrained by fiscal rules than reasons why fiscal rules should not constrain the states.

One of the arguments against fiscal rules is that these are not necessary because the financial markets are able to impose fiscal discipline on the states. We investigated the issue of the substitutability of the SGP by the financial markets in more details in the last part of the paper. Our estimation results suggest that the financial markets do react to changes in

governments' deficits and debts, especially since the beginning of the crisis. Interestingly, we found that the markets' reaction to gross debt has become higher for southern member states with the start of the crisis. Our estimation results also suggest that the governments do adjust their structural primary balances when their bond spreads increase. However, given the market conditions and institutional setting in the EMU, both these reactions are potentially biased and thus we affirm that the SGP could really not be substituted by the financial markets.

Our conclusion is thus that the EMU needs fiscal rules. We are aware of the fact that the Stability and Growth Pact has not been powerful enough to keep the states fiscally disciplined but we suppose that without this set of fiscal rules the member states' situation would probably be even worse.

ANNEX 1

Table A1.1 – Deficit-to-GDP ratios of EU countries from 1995 to 2009 (in %)

geo/time	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	*-5.8*	*-4.0*	-1.8	-2.4	-2.3	-1.7	0.0	-0.7	-1.4	-4.4	-1.6	-1.6	-0.6	-0.4	-4.3
Belgium	*-4.5*	*-4.0*	-2.3	-0.9	-0.6	0.0	0.4	-0.1	-0.1	-0.3	-2.7	0.3	-0.2	-1.2	-5.9
Finland	*-6.2*	*-3.5*	-1.3	1.6	1.6	6.9	5.0	4.1	2.6	2.4	2.8	4.0	5.2	4.5	-2.8
France	*-5.5*	*-4.0*	*-3.3*	-2.6	-1.8	-1.5	-1.5	-3.1	-4.1	-3.6	-2.9	-2.3	-2.7	-3.4	-8.3
Germany	:	*-3.3*	-2.6	-2.2	-1.5	1.3	-2.8	-3.7	-4	-3.8	-3.3	-1.6	0.2	0.0	-3.4
Greece	:	:	:	:	:	-3.7	-4.5	-4.8	-5.6	-7.5	-5.2	-2.9	-3.7	-7.7	-12.7
Ireland	-2.1	-0.1	1.1	2.4	2.7	4.8	0.9	-0.4	0.4	1.4	1.7	3.0	0.3	-7.2	-12.5
Italy	*-7.4*	*-7.0*	-2.7	-2.8	-1.7	-0.8	-3.1	-2.9	-3.5	-3.5	-4.3	-3.3	-1.5	-2.7	-5.3
Luxembourg	2.4	1.2	3.7	3.4	3.4	6.0	6.1	2.1	0.5	-1.1	0.0	1.3	3.7	2.5	-2.2
Netherlands	:	-1.9	-1.2	-0.9	0.4	2.0	-0.2	-2.1	-3.1	-1.7	-0.3	0.5	0.2	0.7	-4.7
Portugal	*-5.0*	*-4.5*	*-3.5*	*-3.4*	-2.8	-2.9	-4.3	-2.8	-2.9	-3.4	-6.1	-3.9	-2.6	-2.7	-8.0
Spain	-6.5	-4.8	-3.4	-3.2	-1.4	-1.0	-0.6	-0.5	-0.2	-0.3	1.0	2.0	1.9	-4.1	-11.2
Slovenia	-8.4	-1.1	-2.4	-2.4	-3.0	-3.7	-4.0	-2.5	-2.7	-2.2	-1.4	-1.3	0.0	-1.8	-6.3
Cyprus	-0.8	-3.2	-5.0	-4.1	-4.3	-2.3	-2.2	-4.4	-6.5	-4.1	-2.4	-1.2	3.4	0.9	-3.5
Malta	-4.2	-8.0	-7.7	-9.9	-7.7	-6.2	-6.4	-5.5	-9.9	-4.7	-2.9	-2.6	-2.2	-4.7	-4.5
Slovakia	-3.4	-9.9	-6.3	-5.3	-7.4	-12.3	-6.5	-8.2	-2.8	-2.4	-2.8	-3.5	-1.9	-2.3	-6.3
Denmark	-2.9	-1.9	-0.5	0.1	1.5	2.4	1.5	0.3	0.1	2.0	5.2	5.2	4.5	3.4	-2.0
Sweden	-7.4	-3.2	-1.5	1.1	1.3	3.7	1.6	-1.2	-0.9	0.8	2.3	2.5	3.8	2.5	-2.1
UK	-5.9	-4.3	-2.2	-0.1	0.9	3.6	0.5	-2.0	-3.3	-3.4	-3.4	-2.7	-2.7	-5.0	-12.1
Bulgaria	:	:	:	:	0.2	-0.3	0.6	-0.8	-0.3	1.6	1.9	3.0	0.1	1.8	-0.8
Czech Republic	-13.4	-3.3	-3.8	-5.0	-3.7	-3.7	-5.6	-6.8	-6.6	-3.0	-3.6	-2.6	-0.7	-2.1	-6.6
Estonia	1.1	-0.3	2.2	-0.7	-3.5	-0.2	-0.1	0.3	1.7	1.6	1.6	2.3	2.6	-2.7	-3.0
Latvia	-1.6	-0.4	1.2	0.0	-3.9	-2.8	-2.1	-2.3	-1.6	-1.0	-0.4	-0.5	-0.3	-4.1	-9.0
Lithuania	-1.6	-3.3	-11.9	-3.1	-2.8	-3.2	-3.6	-1.9	-1.3	-1.5	-0.5	-0.4	-1.0	-3.2	-9.8
Hungary	-8.7	-4.3	-5.9	-7.8	-5.4	-3.0	-4.0	-8.9	-7.2	-6.4	-7.9	-9.3	-5.0	-3.8	-4.1
Poland	-4.4	-4.9	-4.6	-4.3	-2.3	-3.0	-5.1	-5.0	-6.3	-5.7	-4.1	-3.6	-1.9	-3.6	-6.4
Romania	-2.1	-3.7	-4.5	-3.2	-4.4	-4.7	-3.5	-2.0	-1.5	-1.2	-1.2	-2.2	-2.5	-5.5	-7.8
European Union (27 countries)	:	:	-2.6	-1.9	-1.0	0.6	-1.4	-2.5	-3.1	-2.9	-2.4	-1.4	-0.8	-2.3	-6.9
European Union (25 countries)	-5.2	-4.2	-2.6	-1.9	-0.9	0.6	-1.4	-2.5	-3.1	-2.9	-2.5	-1.4	-0.8	-2.3	:
European Union (15 countries)	-5.1	-4.2	-2.6	-1.8	-0.8	0.8	-1.2	-2.3	-3	-2.8	-2.4	-1.3	-0.8	:	-7.0
Euro area (11-2000, 12-2006, 13-2007, 15-2008)	-4.9	-4.2	-2.7	-2.2	-1.3	0.1	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6	-2.0	:
Euro area (16 countries)	-5.0	-4.2	-2.7	-2.3	-1.4	0.0	-1.9	-2.6	-3.1	-2.9	-2.5	-1.3	-0.6	-2.0	-6.4
Euro area (15 countries)	-5.0	-4.2	-2.7	-2.3	-1.4	0.0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6	-2.0	:
Euro area (13 countries)	-5.0	-4.2	-2.7	-2.3	-1.4	0.0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6	-2.0	:
Euro area (12 countries)	-5.0	-4.2	-2.7	-2.3	-1.4	0.0	-1.8	-2.5	-3.1	-2.9	-2.5	-1.3	-0.6	-2.0	-6.4

Source: Eurostat, AMECO database for year 2009

Table A1.2 – Debt-to-GDP ratios of EU countries from 1995 to 2009 (in %)

geo/time	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	68.3	68.3	64.4	64.8	67.2	66.5	67.1	66.5	65.5	64.8	63.9	62.2	59.5	62.6	66.5
Belgium	130.4	127.3	122.7	117.4	113.7	107.9	106.6	103.5	98.5	94.2	92.1	88.1	84.2	89.8	96.7
Finland	56.6	57.0	53.9	48.4	45.7	43.8	42.5	41.5	44.5	44.4	41.7	39.7	35.2	34.2	44.0
France	55.5	58.0	59.2	59.4	58.9	57.3	56.9	58.8	62.9	64.9	66.4	63.7	63.8	67.5	77.6
Germany	55.6	58.4	59.7	60.3	60.9	59.7	58.8	60.4	63.9	65.8	68.0	67.6	65.0	66.0	73.2
Greece	97.0	99.4	96.6	94.5	94.0	103.4	103.7	101.7	97.4	98.6	100	97.8	95.7	99.2	115.1
Ireland	82.1	73.5	64.3	53.6	48.5	37.8	35.6	32.2	31.0	29.7	27.4	24.9	25.0	43.9	64.0
Italy	121.5	120.9	118.1	114.9	113.7	109.2	108.8	105.7	104.4	103.8	105.8	106.5	103.5	106.1	115.8
Luxembourg	7.4	7.4	7.4	7.1	6.4	6.2	6.3	6.3	6.1	6.3	6.1	6.5	6.7	13.7	14.5
Netherlands	76.1	74.1	68.2	65.7	61.1	53.8	50.7	50.5	52.0	52.4	51.8	47.4	45.5	58.2	60.9
Portugal	61.0	59.9	56.1	52.1	51.4	50.5	52.9	55.6	56.9	58.3	63.6	64.7	63.6	66.3	76.8
Spain	63.3	67.4	66.1	64.1	62.3	59.3	55.5	52.5	48.7	46.2	43.0	39.6	36.2	39.7	53.2
Slovenia	:	:	:	:	:	:	26.8	28.0	27.5	27.2	27.0	26.7	23.4	22.6	35.9
Cyprus	40.6	42.8	46.7	51.2	51.8	48.7	52.1	64.6	68.9	70.2	69.1	64.6	58.3	48.4	56.2
Malta	35.3	40.1	48.4	53.4	57.1	55.9	62.1	60.1	69.3	72.3	70.1	63.7	61.9	63.7	69.1
Slovakia	22.1	31.1	33.8	34.5	47.9	50.3	48.9	43.4	42.4	41.5	34.2	30.5	29.3	27.7	35.7
Denmark	72.6	69.4	65.4	61.4	58.1	52.4	49.6	49.5	47.2	45.1	37.8	32.1	27.4	34.2	41.6
Sweden	72.2	73	71	69.1	64.8	53.6	54.4	52.6	52.3	51.1	50.8	45.7	40.8	38.3	42.3
UK	51.2	51.3	49.8	46.7	43.7	41.0	37.7	37.5	39.0	40.9	42.5	43.5	44.7	52.0	68.1
Bulgaria	:	:	105.1	79.6	79.3	74.3	67.3	53.6	45.9	37.9	29.2	22.7	18.2	14.1	14.8
Czech Republic	14.6	12.5	13.1	15.0	16.4	18.5	24.9	28.2	29.8	30.1	29.7	29.4	29.0	30.0	35.4
Estonia	9.0	7.4	6.2	5.5	6.0	5.1	4.8	5.7	5.6	5.0	4.6	4.5	3.8	4.6	7.2
Latvia	15.1	13.9	11.1	9.6	12.5	12.3	14.0	13.5	14.6	14.9	12.4	10.7	9.0	19.5	36.1
Lithuania	11.9	14.3	15.6	16.6	22.8	23.7	23.1	22.3	21.1	19.4	18.4	18.0	16.9	15.6	29.3
Hungary	85.2	71.4	62.0	59.9	59.8	55.0	52.0	55.6	58.4	59.1	61.8	65.6	65.9	72.9	78.3
Poland	49.0	43.4	42.9	38.9	39.6	36.8	37.6	42.2	47.1	45.7	47.1	47.7	45.0	47.2	51.0
Romania	7.0	11.1	15.2	16.6	21.7	22.5	25.7	24.9	21.5	18.7	15.8	12.4	12.6	13.3	23.7
European Union (27 countries)	:	:	68.3	66.4	65.8	61.9	61.0	60.4	61.9	62.2	62.8	61.4	58.8	61.6	73.6
European Union (25 countries)	68.7	70.3	68.5	66.7	66.0	62.1	61.2	60.6	62.1	62.5	63.2	61.9	59.4	62.3	74.3
European Union (15 countries)	69.7	71.6	69.8	68.0	67.1	63.2	62.3	61.6	63.1	63.4	64.3	62.8	60.4	:	:
Euro area (EA11-2000, EA12-2006, EA13-2007, EA15-2008)	72.1	73.7	73.2	72.8	71.5	68.8	68.4	68.2	69.4	69.8	70.4	68.7	66.2	69.7	78.7
Euro area (16 countries)	72.2	73.8	73.3	72.9	71.7	69.2	68.2	68.0	69.1	69.5	70.1	68.3	66.0	69.4	78.7
Euro area (15 countries)	72.3	74.0	73.4	73.1	71.8	69.3	68.3	68.1	69.2	69.6	70.3	68.5	66.2	69.7	79.0
Euro area (13 countries)	72.4	74.0	73.5	73.1	71.8	69.3	68.3	68.1	69.2	69.6	70.3	68.5	66.2	69.7	79.0
Euro area (12 countries)	72.5	74.1	73.6	73.2	72.0	69.5	68.4	68.2	69.4	69.8	70.4	68.7	66.4	69.9	79.2

Source: Eurostat

Table A1.3 – Real GDP growth in EU countries from 1995 to 2009 (in %)

geo/time	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Austria	:	1.4	3.7	1.9	3.5	3.7	0.8	1.4	0.8	3.2	1.8	2.8	2.9	1.0	-3.0
Belgium	4.0	3.6	6.2	5.0	3.9	5.3	2.3	1.8	2.0	4.1	2.9	4.4	4.9	1.2	-7.8
Finland	2.1	1.1	2.2	3.5	3.3	3.9	1.9	1.0	1.1	2.5	1.9	2.2	2.3	0.4	-2.6
France	1.9	1.0	1.8	2.0	2.0	3.2	1.2	0.0	-0.2	1.2	0.8	3.2	2.5	1.3	-4.9
Germany	:	2.4	3.6	3.4	3.4	4.5	4.2	3.4	5.9	4.6	2.2	4.5	4.5	2.0	-2.0
Greece	:	8.1	11.5	8.4	10.7	9.4	5.7	6.5	4.4	4.6	6.2	5.4	6.0	-3.0	-7.1
Ireland	2.8	1.1	1.9	1.4	1.5	3.7	1.8	0.5	0.0	1.5	0.7	2.0	1.6	-1.0	-5.0
Italy	:	1.5	5.9	6.5	8.4	8.4	2.5	4.1	1.5	4.4	5.4	5.6	6.5	0.0	-3.4
Luxembourg	3.1	3.4	4.3	3.9	4.7	3.9	1.9	0.1	0.3	2.2	2.0	3.4	3.6	2.0	-4.0
Netherlands	:	3.6	4.2	4.9	3.8	3.9	2.0	0.8	-0.8	1.5	0.9	1.4	1.9	0.0	-2.6
Portugal	5.0	2.4	3.9	4.5	4.7	5.0	3.6	2.7	3.1	3.3	3.6	4.0	3.6	0.9	-3.6
Spain	6.8	3.6	4.9	3.6	5.4	4.4	2.8	4.0	2.8	4.3	4.5	5.8	6.8	3.5	-7.8
Slovenia	:	1.8	2.3	5.0	4.8	5.0	4.0	2.1	1.9	4.2	3.9	4.1	5.1	3.6	-1.7
Cyprus	:	:	:	:	:	:	-1.6	2.6	-0.3	0.7	4.0	3.5	4.0	2.1	-1.5
Malta	7.9	6.9	4.4	4.4	0.0	1.4	3.5	4.6	4.8	5.0	6.7	8.5	10.6	6.2	-4.7
Slovakia	3.1	2.8	3.2	2.2	2.6	3.5	0.7	0.5	0.4	2.3	2.4	3.4	1.7	-0.9	-4.9
Denmark	4.0	1.5	2.5	3.8	4.6	4.4	1.1	2.4	1.9	4.1	3.3	4.2	2.5	-0.2	-5.1
Sweden	3.1	2.9	3.3	3.6	3.5	3.9	2.5	2.1	2.8	3.0	2.2	2.9	2.6	0.5	-4.9
UK	:	-9.4	-5.6	4.0	2.3	5.4	4.1	4.5	5.0	6.6	6.2	6.3	6.2	6.0	-5.0
Bulgaria	:	4.0	-0.7	-0.8	1.3	3.6	2.5	1.9	3.6	4.5	6.3	6.8	6.1	2.5	-4.1
Czech Republic	2.8	5.7	11.7	6.7	-0.3	10	7.5	7.9	7.6	7.2	9.4	10	7.2	-3.6	-14.1
Estonia	0.5	3.6	8.3	4.8	3.3	6.9	8.0	6.5	7.2	8.7	10.6	12.2	10.0	-4.6	-18.0
Latvia	:	5.2	7.5	7.6	-1.1	3.3	6.7	6.9	10.2	7.4	7.8	7.8	9.8	2.8	-14.8
Lithuania	:	1.0	4.3	5.2	4.2	4.9	4.1	4.4	4.3	4.9	3.5	4.0	1.0	0.6	-6.3
Hungary	:	6.2	7.1	5.0	4.5	4.3	1.2	1.4	3.9	5.3	3.6	6.2	6.8	5.0	1.7
Poland	:	:	:	:	-1.2	2.4	5.7	5.1	5.2	8.5	4.2	7.9	6.3	7.3	-7.1
Romania	:	1.8	2.7	3.0	3.0	3.9	2.0	1.2	1.3	2.5	2.0	3.2	2.9	0.8	-4.2
European Union (27 countries)	:	1.8	2.8	3.0	3.1	3.9	2.0	1.2	1.3	2.5	2.0	3.1	2.8	0.7	-4.2
European Union (25 countries)	:	1.7	2.7	3.0	3.0	3.9	1.9	1.2	1.2	2.3	1.8	3.0	2.7	0.5	-4.3
European Union (15 countries)	:	1.5	2.6	2.8	2.9	3.9	1.9	0.9	0.8	2.1	1.7	2.9	2.7	0.6	-4.1
Euro area (EA11-2000, EA12-2006, EA13-2007, EA15-2008)	:	1.6	2.6	2.8	2.9	3.9	1.9	0.9	0.8	2.2	1.7	3.0	2.8	0.6	-4.1
Euro area (16 countries)	:	1.5	2.6	2.8	2.9	3.9	1.9	0.9	0.8	2.2	1.7	3.0	2.7	0.6	-4.1
Euro area (15 countries)	:	1.5	2.6	2.8	2.9	3.9	1.9	0.9	0.8	2.2	1.7	3.0	2.7	0.6	-4.1
Euro area (13 countries)	:	1.5	2.6	2.8	2.9	3.9	1.9	0.9	0.8	2.1	1.7	2.9	2.7	0.6	-4.1
Euro area (12 countries)	:	1.4	3.7	1.9	3.5	3.7	0.8	1.4	0.8	3.2	1.8	2.8	2.9	1.0	-3.0

Source: Eurostat

ANNEX 2

Figure A2.1 – Government bond yields of EMU countries from 1999 to 2009 (in %)

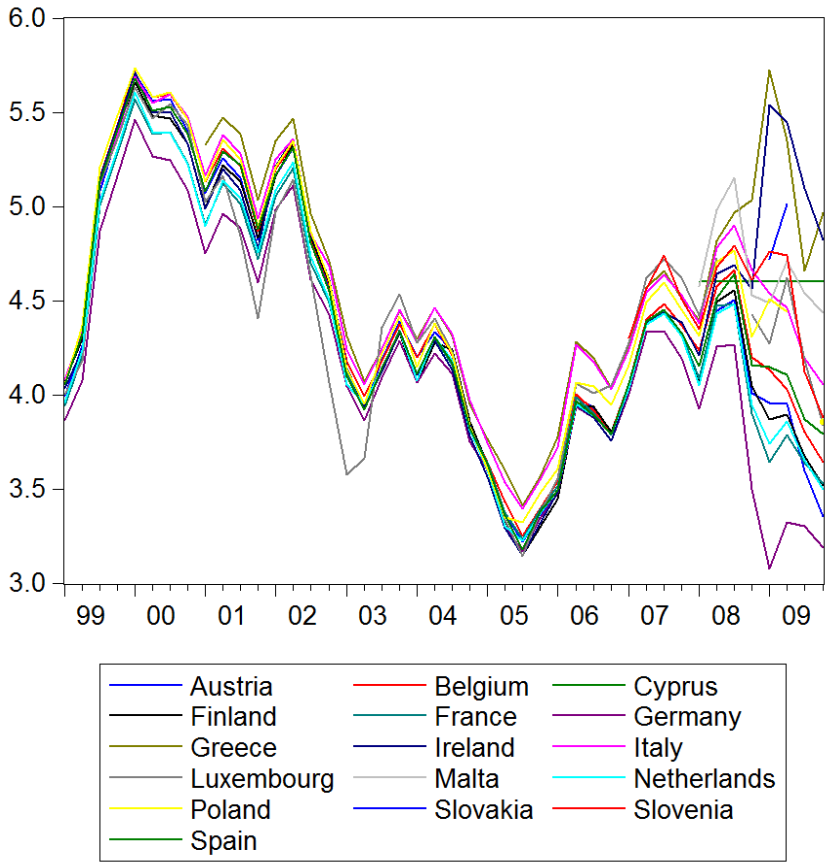


Figure A2.2 - Government bond yield spreads of EMU countries from 1999 to 2009 (in %)

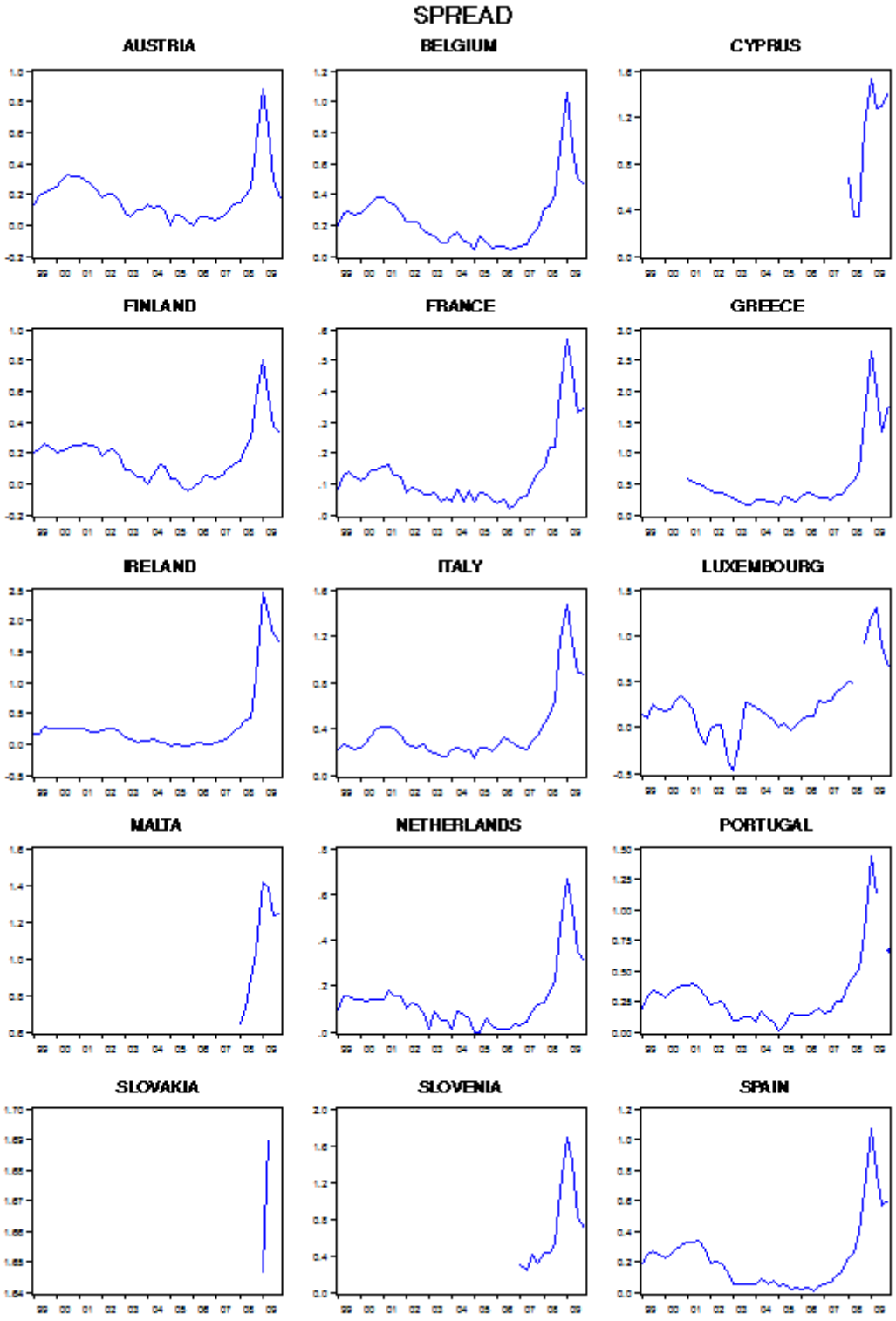
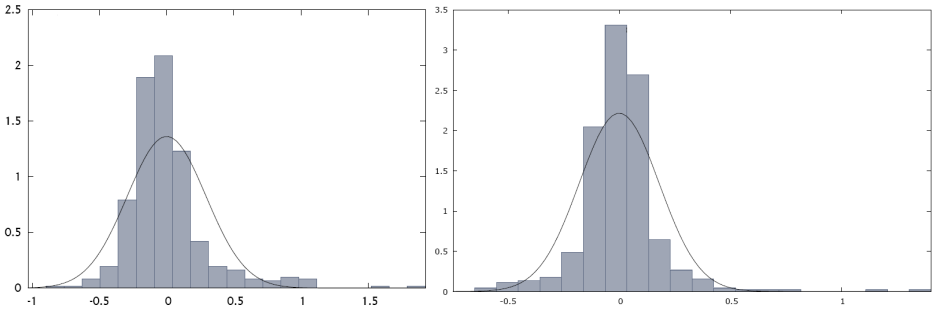


Figure A2.3 – Test for normality of residuals

Model 1 Model 2



Model 3 Model 4 Model 5

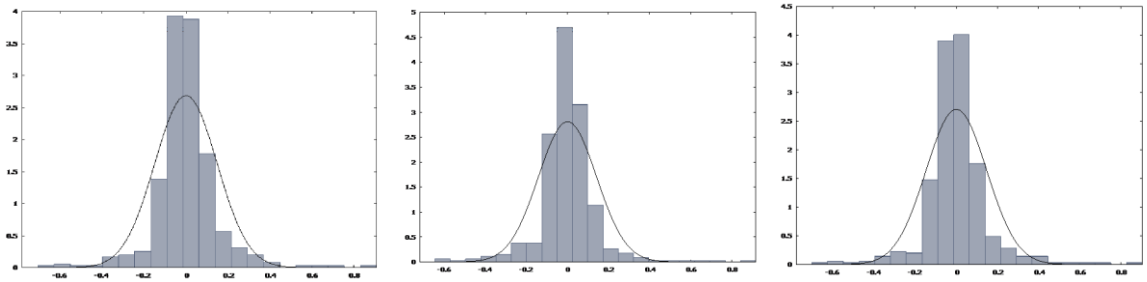


Table A2.1 – Descriptive statistics of the key variables

	Average	**Median**	**Minimum**	**Maximum**
Spread	0.30	0.20	-0.47	2.65
NetLending	0.50	0.52	-18.88	12.64
GrossDebt	-4.43	-5.35	-62.30	54.90
ExtBal	1.97	1.09	-19.95	38.53
Int/Rev	6.94	6.34	0.32	31.29
DebtShare	6.30	2.21	0.03	28.89
SR_IntRate	3.15	3.20	0.72	5.03
IntRiskAv	1.60	1.67	-0.60	3.93
GDPgrowth	1.36	1.41	-13.48	17.72

Table A2.2 – Panel integration and cointegration tests

Integration test			
	NetLending	**GrossDebt**	**Spread**
ADF – Fisher chi-square	46.6**	52.3***	32.5

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) for all tests the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) We assumed individual unit root processes.

Table A2.3 – Descriptive statistics of the key variables

	Average	**Median**	**Minimum**	**Maximum**
StrPrBal	0.37	0.59	-9.63	8.17
Spread	0.28	0.21	-0.08	2.00
GrossDebt	61.94	59.36	6.07	124.93
ExtBal	-0.86	-0.46	-17.98	13.22
GDPgrowth	3.44	3.57	-10.09	14.48

Table A2.4 - Panel integration test

Integration test			
	StrPrBal	**Spread**	**GrossDebt**
ADF – Fisher chi-square	40.8**	20.2	18.3

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) for the test the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) We assumed individual unit root processes.

Table A2.5 – Hypothesis testing

Null hypothesis	**Test statistic**	**P-value**
coeff[spread_1] = 1.462	1.57304	0.2098
coeff[crisis*spread_1] = 1.179	0.233236	0.6291

REFERENCES

Alexopoulou, I.; Bunda, I. & Ferrando, A. (2009). 'Determinants of Government Bond Spreads in New EU Countries', ECB working paper no. 1093.

Ardagna, S.; Caselli, F. & Lane, T. (2004). 'Fiscal Discipline and the Cost of Public Debt Service - Some Estimates for OECD Countries', ECB working paper no. 411.

Ardy, B.; Begg, I.; Hodson, D.; Maher, I. & Mayes, D. G. (2006). 'Adjusting to EMU', Palgrave Macmillan, New York.

Artis, M. J. & Onorante, L. (2008). 'The revision of the Stability and Growth Pact: the Medium-Term Objective', in Talani, L. S. & Casey, B., ed. Between growth and stability - The demise and reform of the European Union's Stability and Growth Pact. Edward Elgar Publishing Limited, Massachusetts, pp. 170-190.

Balassone, F.; Franco, D. & Giordano, R. (2004). 'Market-induced fiscal discipline: Is there a fall-back solution for rule failure?', Banca d'Italia - conference research paper, pp. 389-426.

Baldwin, R. E. & Wyplosz, C. (2006). 'The Economics of European Integration', McGraw Hill Companies.

Bean, C. R. (1992). 'Economic and monetary union in Europe', The Journal of Economic Perspectives vol. 6, issue 4, pp. 31-52.

Beetsma, R.; Debrun, X. & Klaassen, F. (2001). 'Is fiscal policy coordination in EMU desirable?', Swedish Economic Policy Review vol. 8, pp. 57-98.

Beetsma, R. & Uhlig, H. (1999). 'An analysis of the Stability and Growth Pact', The Economic Journal vol. 109 (458), pp. 546-571.

Bernoth, K.; von Hagen, J. & Schuknecht, L. (2006). 'Sovereign Risk Premiums in the European Government Bond Market', Discussion Papers 151, SFB/TR 15 Governance and the Efficiency of Economic Systems, Free University of Berlin, Humboldt University of Berlin, University of Bonn, University of Mannheim, University of Munich.

Blanco, R. (2001). 'The Euro-Area Government Securities Markets. Recent Developments and Implications for Market Functioning', Paper prepared for the BIS Autumn Central Bank Economist's Meeting, Banco de Espaňa.

Buiter, W. H. (2006). 'The 'Sense and Nonsense of Maastricht' Revisited: What Have We Learnt about Stabilization in EMU?', Journal of Common Market Studies vol. 44 (4), pp. 687-710.

Buti, M. (2006). 'Will the New Stability and Growth Pact Succeed? An Economic and Political Perspective', European Economy, Economic paper no. 241.

Buti, M.; Roeger, W. & Veld, J. i. (2001). 'Monetary and fiscal policy interactions under a stability pact', Economics Working Papers ECO2001/08, European University Institute..

Catenaro, M. & Morris, R. (2008). 'Fiscal policy and implementation in EMU', in Farina, F. & Tamborini, R., ed. Macroeconomic Policy in the European Monetary Union. Routledge, New York. pp. 19-44.

Chari, V. V. & Kehoe, P. J. (1998). 'On the need for fiscal constraints in a monetary union', Federal Reserve Bank of Minneapolis Research Department working paper no. 589.

Codogno, L.; Favero, C. & Missale, A. (2003). 'Yield Spreads on EMU Government Bonds', Economic Policy, CEPR, CES, MSH vol. 18(37), pp. 503-532.

Council of the European Union (2005). 'Brussels European Council 22 and 23 March 2005 - Presidency conclusions.', document no. 7619/1/05.

Council of the European Union (1997). 'Resolution of the European Council on the Stability and Growth Pact. Amsterdam, 17 June 1997', OJ C 236, 2.8.1997, pp. 1-2.

Delors, J. (1989). 'Report on economic and monetary union in the European Community ('Delors report')', Office for Official Publications of the European Communities, Luxembourg.

Eijffinger, S. C. W. & de Haan, J. (2000). 'European monetary and fiscal policy', Oxford University Press.

European Commission (2008). 'Communication from the Commission to the European Council – A European Economic Recovery Plan', COM(2008) 800 final, Brussels.

European Commission (2002). 'Report from the Commission - Excessive deficit in Germany', http://ec.europa.eu/economy_finance/sgp/deficit/countries/germany_en.htm, accessed on 6 January 2010.

Feldstein, M. (2005). 'The euro and the stability pact', NBER working paper no. 11249.

Fitoussi, J.-P. & Saraceno, F. (2007). 'Fiscal discipline as a social norm: The European stability pact', Documents de Travail de l'OFCE 2007-22, Observatoire Francais des Conjonctures Economiques (OFCE).

Gale, W. G. & Orszag, P. R. (2002). 'The Economic Effects of Long-Term Fiscal Discipline', Urban-Brookings Tax Policy Center Discussion Paper.

Haugh, D.; Ollivaud, P. & Turner, D. (2009). 'What Drives Sovereign Risk Premiums? - an Analysis of Recent Evidence from the Euro Area', OECD Economics Department Working Paper no. 718.

Koen, V. & Noord, P. v. d. (2005). 'Fiscal Gimmickry in Europe: One-off measures and creative accounting', OECD working paper no. 417.

Kopits, G. (2001). 'Fiscal rules: Useful policy framework or unnecessary ornament?', IFM working paper no. 01/145.

Laubach, T. (2003). 'New Evidence on the Interest Rate Effects of Budget Deficits and Debt', Federal Reserve Board Finance and Economics Discussion Series, Vol. 12.

Lemmen, J. J. & Goodhart, C. A. (1999). 'Credit Risks and European Government Bond Markets: A Panel Data Econometric Analysis', Eastern Economic Journal vol. 25 (1), pp. 77-107.

Lindbeck, A. & Niepelt, D. (2006). 'The Stability Pact - Rationales, problems, alternatives', KYKLOS 59, no. 4, pp. 579-600.

Manganelli, S. & Wolswijk, G. (2009). 'What Drives Spreads in the Euro Area Government Bond Market?', Economic Policy, CEPR, CES, MSH vol. 24, pp. 191-240.

Paesani, P. & Strauch, R. (2003). 'Public Finances and Long-term interest rates: Linkages between Europe and the USA', European Central Bank.

Paesani, P.; Strauch, R. & Kremer, M. (2006). 'Public Debt and Long-term Interest Rates - The Case of Germany, Italy and the USA', ECB working paper no. 656.

Pagano, M. & von Thadden, E.-L. (2004). 'The European Bond Markets under EMU', Oxford Review of Economic Policy vol. 20 (4), pp. 531-554.

Prodi, R. (2002). 'Speech to the European Parliament: A Stronger, Better Stability and Growth Pact, on 21 October 2002.'.

Schuknecht, L.; von Hagen, J. & Wolswijk, G. (2010). 'Government Bond Risk Premiums in the EU Revisited - The Impact of the Financial Crisis', ECB working paper no. 1152.

Schuknecht, L.; von Hagen, J. & Wolswijk, G. (2008). 'Government Risk Premiums in the Bond Market - EMU and CAnada', ECB working paper no. 879.

Stark, J. (2001). 'Genesis of a Pact' in Brunila, A.; Buti, M. & Franco, D., ed. The Stability and Growth Pact. Palgrave, New York, pp. 77-105.

Sychra, Z. (2007). 'Realizace Hospodářské a měnové unie v EU: implementace, přístupy, důsledky', dissertation thesis, Masarykova Univerzita.

Talani, L. S. (2008). 'A Dead Stabiilty and Growth Pact and a strong Euro: There Must Be a Mistake!' in Talani, L. S. & Casey, B., ed. Between growth and stability - The demise and reform of the European Union's Stability and Growth Pact. Edward Elgar Publishing Limited, Massachusetts, pp. 85-108.

Tavares, J. & Valkanov, R. (2001). 'The Neglected Effect of Fiscal Policy on Stock and Bond Returns', FEUNL Working Paper Series wp413, Universidade Nova de Lisboa.

The Economist (2009). 'Eastern Europe: Argentina on the Danube?', The Economist, 19th February 2009, pp. 14.

Woods, R. (2008). 'Notes on the reformed SGP: creating and implementing effective macroeconomic frameworks' in Talani, L. S. & Casey, B., ed. Between growth and stability - The demise and reform of the European Union's Stability and Growth Pact. Edward Elgar Publishing Limited, Massachusetts, pp. 129-169.

Wyplosz, C. (2006). 'European Monetary Union - The dark sides of a major success', Economic Policy April 2006, pp. 207-261.

LEGISLATION

'Council Regulation (EC) No 1056/2005 of 27 June 2005 amending Regulation (EC) No 1467/97 on speeding up and clarifying the implementation of the excessive deficit procedure.', OJ L 174, 7.7.2005, pp. 5-9.

'Council Regulation (EC) No 1055/2005 of 27 June 2005 amending Regulation (EC) No 1466/97 on the strengthening of the surveillance of budgetary positions and the surveillance and coordination of economic policies', OJ L 174, 7.7.2005, pp. 1-4.

'Council Regulation (EC) No 1467/97 of 7 July 1997 on speeding up and clarifying the implementation of the excessive deficit procedure', OJ L 209, 2.8.1997, pp. 6-11.

'Council Regulation (EC) No 1466/97 of 7 July 1997 on the strengthening of the surveillance of budgetary positions and the surveillance and coordination of economic policies', OJ L 209, 2.8.1997, pp. 1-5.

'Treaty on European Union', Official Journal C 191, 29 July 1992.

'Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community', Official Journal C 306 of 17 December 2007.

PART II –
THE GOLDEN RULE OF PUBLIC FINANCE AND THE PRODUCTIVITY OF PUBLIC CAPITAL

1 Introduction

Reforms of the Stability and Growth Pact (SGP), the fiscal rule of the European Economic and Monetary Union (EMU), have been discussed since its inception. One of the proposals has been that the EMU's fiscal rule should be closer to the 'golden rule of public finance'. Basically, such rule says that current public expenditures should be financed by taxes while public capital investment may be financed by borrowing.

The level of public capital spending has decreased in the European Union (EU) since the 1970's, which is often attributed to the SGP. The golden rule is expected to be able to change this trend and to induce an increase in public capital investment. It thus appears that the public capital is perceived to be at a suboptimally low level in the EU.

One important assumption underlying the debates about the golden rule is the productivity of public capital. This issue has already been explored by many researchers, however, these concentrated mostly on the United States (US) or members of the Organization for Economic Co-operation and Development (OECD). As we discuss the possible introduction of the golden rule in the EU, we also investigate the productivity of the public capital for the EU countries.

We first introduce the golden rule as such, providing also examples of countries where such rule has already been implemented. Second, we discuss the possible implementation of the golden rule in the EU, both from the conceptual and the practical points of view. Third, and foremost, we investigate the productivity of public capital in the EU, using both data on net capital stocks and on (cumulative totals) of gross capital formation. Most importantly, we detect cointegration, i.e. a long-run relationship, both between net capital stock and gross capital formation and GDP. We find that at the aggregate level the public capital is productive. However, we identify also such kinds of public investment that seem to have a negative effect on the output and, on the other hand, current expenditures whose effect on the output is positive in the long run.

The paper is organized as follows: in Section 2 we introduce and discuss the golden rule of public finance. In Section 3 we investigate the productivity of public capital in the EU. In Section 4 we conclude.

2 The Golden Rule of Public Finance

The golden rule of public finance basically says that current expenses by the state should be covered by current revenues and that governments can only borrow to invest. Such description is, however, rather vague. Many research papers operate with the golden rule without actually stating the definition of the rule how exactly it is perceived and used. Nevertheless, several authors provide such definition.

Kellermann (2007) states that according to the 'golden rule of public borrowing', 'government deficit is accepted if accompanied by an increase in assets so that the government's net asset position does not deteriorate. Thus current expenditures must be covered by current receipts while for investment expenditure recourse to debt is allowed' (pp. 1089). This is in line with the definition of the golden rule as Creel (2003) uses it: 'over the cycle, government borrowing should not exceed net government capital formation; hence current expenditures should be financed by current receipts' (pp. 14).

It is well known that the golden rule was introduced in the United Kingdom (UK) in 1997. We can read in HM Treasury (1997) that 'over the economic cycle, the Government will only borrow to invest – public consumption (including the consumption of capital) will be paid for by taxation'. However, as, according to the HM Treasury, this rule would not guarantee the sustainability of public finances as a lot of public investment yields social returns but not necessarily taxable economic output, the sustainable investment rule also applies: 'over the economic cycle, the Government will ensure the level of public debt as a proportion of national income is held at a stable and prudent level'. In the UK the net debt of 40% of GDP is perceived to be prudent.[40]

Balassone & Franco (2000) recall that a kind of gulden rule is also in place in Germany: according to article 115 of the Constitution, 'borrowing cannot exceed the total investment

[40] The rule operates with net debt because this should ensure that current taxpayers pay for the maintanance of capital stock.

expenditure in the budget; exceptions are only allowed to avoid disturbances to the overall economic equilibrium'.

Researchers have very differing views on the potential implementation of a golden rule in the EU – it seems that there are as many proponents of this rule as its opponents. This Section will present the most debated issues underlying the introduction of the golden rule.

2.1 Fiscal consolidation and public investment

The view that during fiscal consolidation public investment is cut more than current spending is commonly shared in the literature.[41] It is thus not surprising that the fiscal consolidation in the EU due to the introduction of the Stability and Growth Pact is often blamed for the decrease in public investment spending. Kellermann (2007) argues that one of the reasons for cuts in investment during fiscal consolidation is that lowering investment is politically more feasible than lowering current expenditures. Woods (2008) claims that this bias against investment was the reason why the golden rule had been introduced in the UK.

Balassone & Franco (2000) argue that as under the SGP the budgets should be close to balance or in surplus, most capital investments have to be financed by taxes. This brings a disincentive to invest into large projects. The authors remind one of their models where they show that a policymaker with a finite horizon decreases public investment when a deficit ceiling is put in place. However, they remind that it has already been shown that even under a benevolent planner total welfare is lower when a ceiling on investment is applied because when a project is indivisible, it needs to be financed by higher (distorionary) taxes which then are not smoothed over time. Also, very realistically, they note that when a deficit limit is introduced, voters would prefer a cut in investment to a cut in current spending.

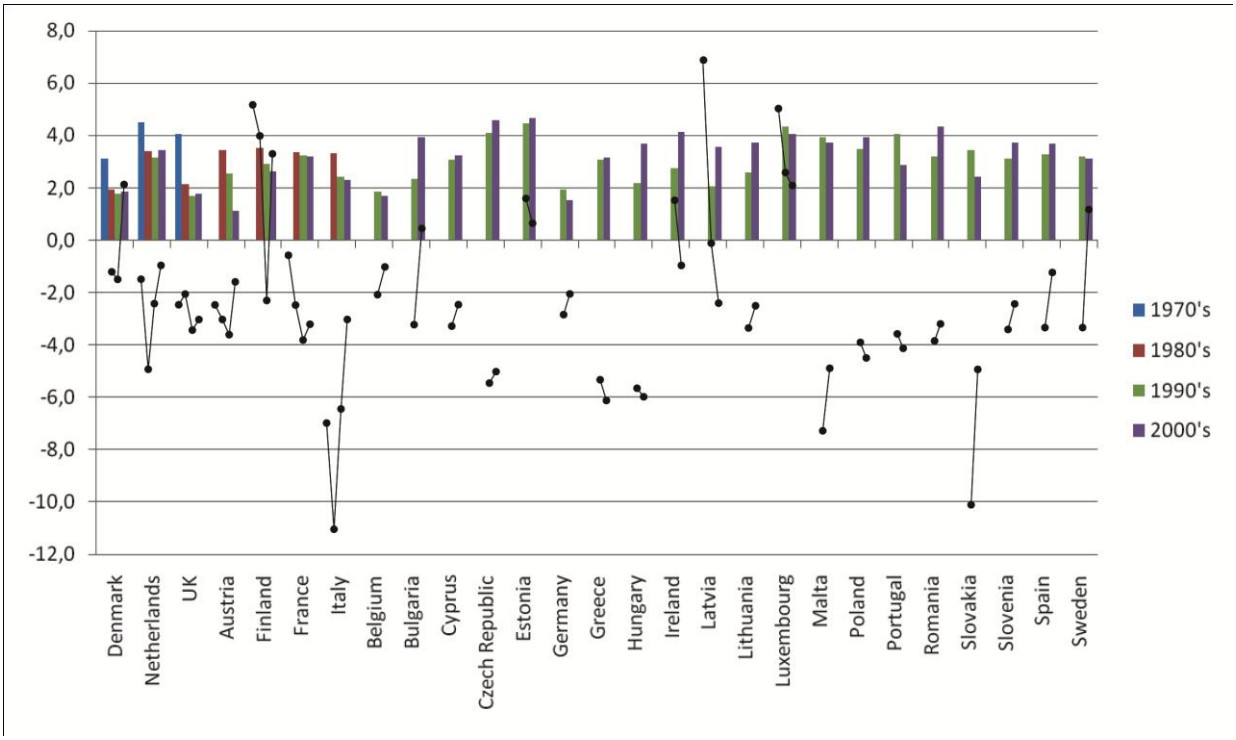
We begin our investigation of the relationship between fiscal consolidation and gross capital formation by plotting these into one figure for all the 27 EU countries. Figure II.1 shows decennary averages of gross capital formation performed by the general governments and decennary averages of public budget balances. Unfortunately, for most countries only data for the last two decades were available.

What we can see is that in all countries for which we have the data, between the 1970's and the 1990's gross public investment really decreased. Such development has partly changed, as

[41] See Blanchard & Giavazzi (2003), Buti et al. (2002), Balassone and Franco (2000) or de Haan et al. (1996).

in more than half of the EU member states in the last decade the public investment was higher than in the 1990's. This may, however, be caused by the fact that most of these countries were new member states together with Spain, Greece and Ireland that could be claimed to be still catching up, also in terms of public investment, with the other old member states.

Figure II.1 – Public gross capital formation and public budget balance (in % of GDP)



Note: the black line depicts the development in public budget balance; usually only two of four figures were available
Source: Eurostat

We can only compare the 1980's and the 1990's for seven countries. While in all of them public investment decreased between the two decades, only two of them (Italy and the Netherlands) experienced fiscal consolidation. It thus seems that public investment decreased independently of the fiscal developments. This would confirm the view of Kellermann (2007) who claims that governmental borrowing is not always connected with higher public capital spending.

Looking at the last decade, we can see that in seventeen countries the average budget deficit improved and in eleven of them the public gross investment actually increased. As only four of the countries that consolidated their fiscal stance and still had higher public investment are old member states, such development may be caused by the fact that the new member states made use of resources from the structural EU funds for their public investments. The other

seven old member states that were able to consolidate their fiscal stance decreased their public investment. The remaining four old member states raised their deficits, half of them increasing public investment spending and half of them decreasing it.

It thus seems that at least in the case of the old member states whose public investment spending has been less influenced by the access to the EU's funds, fiscal consolidation has been connected with a decrease in public spending.

The European Commission (2003), however, looks at the development of the public capital formation in aggregate for the whole EMU and compares the data with those for Japan and the US. The drop in public capital formation in the EU, especially in comparison with the other two countries, is much more pronounced and the data furthermore suggest that this drop coincides with the run up to the SGP. Kamps (2005) notes that the EC saw this problem even before – in 2001 in the Broad Economic Policy guidelines it appealed to the member states to ensure an appropriate balance between public investment and decrease in public debt and taxes.

In this context, Blanchard & Giavazzi (2003) reproach to the SGP that it does not push the member states to decrease current spending, cut taxes and increase investment spending, as it does not matter how exactly a state succeeds in meeting the deficit limit.

2.2 Assumptions underlying the desired increase in public investment

It is usually supposed that the introduction of a golden rule would increase public investment. However, this seems to have two implicit assumptions: that the level of capital in the EU is suboptimally low and that public investment is productive.

As for the first assumption, it is not sure whether this holds, especially in the case of the more developed EU member states. Kamps (2005) shows using a simple model of endogenous growth that in most EU countries the level of public capital stock is not suboptimally low.

Concerning the productivity of public capital, a lot of researchers have already investigated this topic and they have often come to different conclusions – some even found that the productivity of public capital is negative. Most of the studies are done for the United States and we do not know of any that would work with data for all the current EU member states. Therefore, we devote most of this paper to the issue of the productivity of public capital in the EU.

2.3 Intergenerational equity

One of the HM Treasury's[42] basic arguments supporting the introduction of the golden rule is that such rule promotes fairness between generations: current spending basically benefits only today's taxpayers, so the burden of such spending should not be passed on to future generations. On the other hand, when an investment is made, today's but also future taxpayers profit from such expenditure so they can also share the costs of the investment. This view is supported by many researchers; however, it is strongly opposed e.g. by Buiter (1998).

He admits that the golden rules allows for a smoothing of consumption and distortionary taxes over time (this view is supported e.g. by Buti et al. (2002)) and let households and firms borrow under better conditions than in the market (thanks to the tax and transfers system). However, he argues that the effect of public investment on intergenerational fairness may be captured by generational accounts and that it is only possible to assess a project in the context of the complete accounts and not by evaluating it separately as this would probably omit many other linkages. Doing such evaluation thus becomes extremely complex, if not impossible.

He furthermore argues that even the picture provided by the generational accounts might only be partial and misleading and that the distribution of the tax burden may differ from the distribution of public consumption benefits. He also notes that the effects of changes in the labour market, private saving or private capital formation on the general equilibrium and intergenerational equity may be very unpredictable.

Buti et al. (2002) in fact agree with Buiter's view, claiming that it is unclear whether a combination of lower investment and lower public debt would not be preferable to higher investment and higher public debt.

The underlying uncertainty of the future benefits of many projects supports the view that it is very difficult to quantify these benefits when trying to assess whether to finance an investment from taxes or debt to ensure intergenerational equity.

2.4 Optimal level of public debt

Blanchard & Giavazzi (2003) note that as under the SGP the budget deficit (including interest) should be balanced over the cycle, the public debt should eventually approach zero.

[42] HM Treasury (1998).

However, according to them, there are many reasons why the public debt should be higher than zero – such as intergenerational transfers or public investment projects with a large social rate of return. This view is supported e.g. by Creel (2003).

On the other hand, Kellermann (2007), using a simple growth model with public capital, shows that debt financing of investment may not be optimal because it might negatively affect social welfare and the stock of public and private debt.

Somewhere between the two opposing views is that of Buiter (1998) who claims that the optimal strategy for financing of public investment can only be determined when both the current and all the future revenues and spending of the government are taken into account, which is, of course, not really possible.

2.5 Definition of public capital investment

There is also the issue of the definition of public capital investment for the purposes of a golden rule. Buiter (1998) stresses the importance of the distinction between current and capital expenditure. He defines public consumption as spending whose 'benefits are exhausted within the accounting or reporting period', while public capital expenditure as spending that 'yields an (uncertain) stream of future returns beyond the current accounting or reporting period' (pp. 7). The (pecuniary) returns can be both direct and indirect. However, he also claims that public investment should be done if future social returns are higher than social opportunity cost, i.e. these do not necessarily have to be pecuniary.

Sawyer (1997) outlines two possible notions of capital: the first one relates to gross capital formation, i.e. to fixed assets, and the other one is such expenditure that yields a stream a future benefits. These may, but do not have to be appropriated by the state and need not be tangible. Kellermann (2007) notes that it is very difficult to distinguish between productive and 'consumptive' public capital investment. To this he adds that certain types of expenditures, such as those on education, could also be considered as enhancing growth. Already the EESC (2006) mentioned the possibility of defining R&D and education expenditure as investment. Blanchard & Giavazzi (2003) and Creel (2003) agree on the fact that should a golden rule be introduced in the EU, the definition of the public investment would have to be broadened.

This would prevent the potential bias towards physical assets and against expenditure on growth enhancing intangible assets, such as human capital. This bias is also one of the

arguments of Buti et al. (2002) against the introduction of the golden rule using the current definition of public capital.

Sawyer (1997) argues that as public capital investment often does not yield any cash revenues to the government, no distinction should be made between current and capital expenditures. However, when discussing the rationales for the golden rule he admits that it may be reasonable to make a difference between capital spending that yields a stream of cash revenues and other public spending, be it consumption spending or capital expenditures, that will bring no cash to the state.

There is also the question whether gross or net public investment should be used under the golden rule. Most authors agree that net investment should be used as current generations should pay for the depreciation of public capital. However, many of them also acknowledge that this is very problematic – e.g. Creel (2003) reminds that the depreciation rate of public capital is very difficult to set and thus it is problematic to calculate the net public investment.

2.6 Golden rule and sustainability of public finances

Many argue that the introduction of the golden rule would lead to the unsustainability of public finances.[43] Buti et al. (2002) argue that if the golden rule is applied to net investment, this problem would probably not occur as, according to them, the level of net investment done by the state and not by entities being excluded from the general government accounts, is not very high. However, they claim that if the golden rule is applied to gross investment, it will lead to unsustainable public finances. Balassone & Franco (2000) support this view by claiming that the golden rule would lead to a fall in primary surpluses which would not be good at all in the times when the problem of ageing populations in the EU is so close.

Nevertheless, certain authors disagree with this view: Creel (2003) argues that increased borrowing also means increased interest payments. Whenever there is a limit on the budget deficit including interest, governments would not borrow excessively because too high interest payments would force them to cut current expenditures.

2.7 Other practical issues

There are also many practical issues connected with the introduction of the golden rule in the European Union.

[43] As we already mentioned, this is why the sustainable investment rule was introduced in the UK.

First, there is the question whether a significant change to the EU's fiscal rules is possible at all. Blanchard & Giavazzi (2003) are aware of the fact that a large change to the SGP that would require the Treaty to be changed would be very difficult to push through. They, however, think that changing the way the public investment is accounted for in public budgeting would be possible without a modification to the Treaty.

Second, there is the problem of the flexibility under the golden rule. Balassone & Franco (2000) argue that the golden rule is not helpful during downswings as capital investment expenditures take place with a significant delay. On the other hand, Ardy et al. (2006) argue that the golden rule allows sufficient flexibility to the governments as the length of the cycle is unknown and also because the definition of investment may be debated.[44]

Third, there are opposing views on whether the golden rule would improve transparency of the fiscal rules. While Blanchard & Giavazzi (2003) claim that the golden rule would introduce more transparency to the budgets,[45] Buti et al. (2002) and Balassone & Franco (2000) claim that the introduction of the golden rule would lead to opportunistic behaviour because of the incentive to classify current expenditures as capital expenditures, and that the multilateral surveillance would become even more complex and difficult. In this context, however, Balassone & Franco (2000) claim that if the states self-impose the golden rule, like e.g. the UK has done it, there would be no problem of multilateral surveillance.

Finally, the transition to the golden rule is also perceived as problematic. Both Buti et al. (2002) and Balassone & Franco (2000) agree that an excessive burden would be placed on the current generations as they would not only have to pay the interest on previously made debts, but they would also have to fund new investments.

[44] They provide a very good example of this, reminding that the British Labour government referred to all public expenditure as to investment in public services. This may, however, count against the golden rule as this only shows how the rule can be vague.

[45] They use Italy as example: in this country the government performs investments through a special agency that borrows money on the market and whose balance is not consolidated in the government accounts.

3 Empirical evidence on the productivity of public capital in the EU

As we already discussed in the previous Section, one important assumption underlying the desired increase in public capital investment is that public capital is productive. Many studies have been devoted to this question but the majority of them was performed for the US. For our discussion of the EU's fiscal rules we investigate this issue for all 27 EU countries.

This Section first, reviews the literature treating the productivity of public capital. Second, we describe and discuss the data and the method that we use. Third, we present our estimation results and in the end, we provide a brief summary of our findings.

3.1 Related literature

The question whether investment into public capital enhances economic growth has been investigated since the 1970's. Several approaches to this issue have been taken, varying from estimation of a production function, a translog production function, a profit or cost function to estimation of different kinds of VAR models.

Batina & Ihori (2005) provide a large overview of research on public investment's effect on economic growth, mainly in the US. The first important paper, which evoked a lot of reactions, was that of Aschauer (1989). He estimated a Cobb-Douglas production function (adding a time trend into it and assuming constant returns to scale) and concluded that the elasticity of private output with respect to public capital was 0.39, public capital being more productive than labour or private capital. He also found that infrastructure, such as motorways, mass transit, airports, electrical and gas facilities and sewers, has an output elasticity of 0.24. On the other hand, the output elasticity of hospitals was estimated to be 0.04 and that of educational buildings even negative (-0.01). Nevertheless, this all was done for aggregated data, i.e. for the whole USA. When in Aschauer (1990) disaggregated and time averaged data were used (i.e. data for individual US states were averaged over time), the output elasticities were estimated to be much lower than in the previous paper.

Most other research classified as 'early studies' by Batina & Ihori (2005) also found that public capital is productive. These studies took a production function, cost function and profit function approaches. However, they were criticised very soon, mainly from the statistical point of view.

Further studies used both aggregated and disaggregated data for the US. We especially focus on those using disaggregated data because we do not want to ignore differences among the EU countries' economies. Studies using disaggregated data that are reviewed by Batina & Ihori (2005) used more approaches than the 'early studies' – system estimation or VAR models can also be found there. These papers reach various conclusions on the productivity of public capital; some even claim that state public capital has a negative impact on the output.

Munell (1990) estimated panel data for the US and her result was that public capital had a positive effect on the state output, the coefficient being 0.15. However, when constant returns to scale were imposed on all the inputs, the estimate was only 0.06.

The results of Holtz-Eakin (1994) were different. He estimated a production function where the error term was composed of a random variable, a state-specific and a time-specific effect. He estimated his data using several approaches and in most cases the effect of public capital on private output was negative.

Garcia-Mila et al. (1996) estimated a production function using panel data for the US and as proxy for public capital stock they included different kinds of infrastructure. Their estimates of the effect of public capital on private output were positive, irrespective of whether random or fixed effects were used. However, the authors came to the conclusion that the estimation should be done in first differences, based on different specification issues, and when this approach was used, the estimates were negative and insignificant. Therefore the conclusion of the authors is that 'there is no evidence of a positive linkage between public capital and private output' (pp. 180).

When comparing the results of estimation of aggregated and disaggregated data, Batina & Ihori (2005) note that cross section may dominate in panel data analysis and public capital can thus appear less productive. This is the reason why the use of aggregated data usually yields higher estimates of the public capital productivity. As already noted above, this was in fact confirmed by Aschauer's 1989 and 1990 papers.

Batina & Ihori (2005) also review studies on other countries than the US. However, only three of them treat panel data for (several) OECD countries. The authors have many reservations to the paper by Ford & Poret (1991), the main problem being seen in the small sample size for an 'effective time series analysis' (on average they have slightly more than 20 observations for each country). Having figures on net capital stock usually for 40 years, we do not expect to face such problem.

Sturm et al. (1998) and De Haan & Romp (2005) provide an overview of research into the relation of public capital and economic growth in a more 'problem-based' manner than Batina & Ihori (2005). They point out several issues that may be important for our own estimation, which is discussed below.

First, there is the issue of how public capital should be defined. If we think of core infrastructure, such as roads, rails, power stations etc., we need to take into account that not all these are provided by the state (e.g. the power stations). Another problem is that public investment can be put into roads, hospitals or schools, but also into equipment such as a swimming pool, which is usually not considered to be productive. Therefore, not all government's expenditures on capital are productive. Also, if we take government spending on capital as a regressor, we have to take into account that the height of current investment very likely depends on the current level of capital.

Second, there is the problem of the kind of production function we estimate. One issue is how the public capital (G) enters the production function. Let us have the following production function:

$$Y_t=A_t(G_t).f(K_t,L_t,G_t) \qquad (1)$$

where A stands for technology, K for private capital, L for labour and G for public capital.

Very often we can see that public capital enters it in the same way as e.g. private capital or labour. However, De Haan & Romp (2005) suggest that it may be more reasonable to insert it into the production function as something that influences productivity (A). This problem was in fact solved by Sturm et al. (1998) who came to the conclusion that when a Cobb-Douglas production function is estimated in log levels, both approaches lead to similar equations to be estimated.

Other issues that we should take into account during the estimation are the following: it seems to be very important to do the estimation with country specific effects – otherwise the estimates could be biased and inconsistent. Also, it may be important whether public and private capitals are complements or substitutes because of possible crowding-out effects.

Third, there is the issue of possible problems with the data. Most cited is the non-stationarity of data, which may be a problem even for panel data sets. In some cases this may be solved by first differencing the given variables, but, as explained by Munnell (1992), this may deprive us from the possibility to estimate any long-run relationship between inputs and the output,

because in such estimation the output in a given year depends only on inputs from that year. This was also confirmed by Garcia-Mila et al. (1996), as already described above.

Furthermore, Sturm et al. (1998) note that researchers should also investigate whether variables are cointegrated (i.e. whether they grow together and converge to their long-run relationship).

Fourth, there is the problem of reverse causation or simultaneity bias. Usually the causality is expected to be the following: public capital determines output. But it is also possible that there is a feedback from output to the capital stock, as higher output can have a positive effect on the demand for infrastructure. De Haan & Romp (2005) mention several possibilities of dealing with this problem. Those that are out of the scope of this paper are estimation using the generalized method of moments, estimation of simultaneous equations or a VAR model, or the use of instrumental variables.

Calderon & Serven (2002) estimate panel data and solve the problem of reverse causation by using the instrumental variables approach. They use demographic variables as instruments and supplement these with the lagged values of explanatory variables as weakly exogenous instruments. However, as the result of such estimation is very similar to the outcome of their pooled OLS model which they consider to be misspecified, they seem to be rather disappointed by the results of the instrumental variables approach.

Actually, it is possible that the bias of estimates caused by the reverse causation is not very significant: Cadot et al. (1999), working with data on French regions, took a simultaneous equations approach to the modeling and then compared their estimate of the elasticity of output with respect to public capital (0.101 for the whole of France) with that made by simple OLS (0.099). We can see that the difference between these two estimates is very small.

3.2 Data and Method

Our analysis is based on the Cobb-Douglas production function. As already noted earlier, when such production function is estimated in log levels, it does not matter how the public capital enters the function. Therefore let us have a production function in the following form:

$$Y_t = A_t K_t^{\alpha} G_t^{\beta} L_t^{\gamma} \qquad (2)$$

where *Y* stands for output, *A* for technology, *K* for private capital, *G* for public capital, *L* for labour (i.e. the number of workers) and *t* is a subscript for time. Assuming constant returns to scale, i.e. $\alpha+\beta+\gamma=1$, we can express the equation in per worker terms:

$$\frac{Y_t}{L_t} = A_t\left(\frac{K_t}{L_t}\right)^{\alpha}\left(\frac{G_t}{L_t}\right)^{\beta} \qquad (3)$$

Expressing the variables per capita by lower case letters and taking the natural logarithm, we get the following equation:

$$\ln y_t = \ln A_t + \alpha \ln k_t + \beta \ln g_t \qquad (4)$$

Basically, we should estimate the following equation:

$$\ln y_{i,t} = \tau + \alpha \ln k_{i,t} + \beta \ln g_{i,t} + u_{i,t} \quad (5)$$

In the estimation of this equation the constant τ will approximate the logarithm of technology. Based on previous research, we expect that a simple pooled OLS would very likely yield misspecified estimates, due to e.g. differences in production technology across countries. Therefore we do our estimation also with country-specific effects. This leads us to suppose that the error term has the following form:

$$u_{i,t} = \mu_i + \upsilon_t + \varepsilon_{i,t} \qquad (6)$$

where we suppose that μ_i is the country-specific component, υ_t is the time-specific component and $\varepsilon_{i,t}$ is an i.i.d. error with a zero mean. Either we may take the approach of a fixed-effects model (FE model) where we suppose that μ_i captures the unobserved differences among the countries, or the approach of a random-effects model (RE model) where we suppose that μ_i has zero mean and is uncorrelated with the explanatory variables (Wooldridge, 2006).

We suppose that the public capital does not crowd out private capital. This is not refuted in the literature: de Haan et al. (1996) investigated this issue and concluded that public and private investment are complements. The results of the European Commission (2003) were rather inconclusive.

We work with a panel of annual data for 27 EU countries in the period 1960 – 2009. Nevertheless, for many countries a lot of observations are missing, especially for certain variables.

Our data were mostly retrieved from the Eurostat database. However, several important variables were taken from other sources.

1) data on gross domestic product, employment and net capital stock (for the whole economy) were retrieved from the Ameco database of the European Commission. Data on GDP were more complete and available for a longer time period in Ameco than in Eurostat database.

2) data on net capital stock, both for the general government and the private sector, were provided by the Kiel Institute for World Economy (estimates were done by Christophe Kamps in 2004). The estimates of capital stocks exist from 1960 to 2001 for 22 OECD countries, of which only 14 are EU members.

3) data on gross capital formation, both for the general government and the private sector, were retrieved from Eurostat. They are available for all the 27 EU countries but usually only from the 1990's on.

All our variables are expressed in EUR per person employed and in natural logarithms, if not stated otherwise.

Our key variables are the following: gross domestic product (*GDP*) as the dependent variable, and net governmental capital stock (*NGCS*) and net private non-residential capital stock (*NPCS*) as explanatory variables. The descriptive statistics for these variables are included in Annex 1, Table A1.1. As the net capital stock variables are only available for 14 EU countries that are also OECD countries, we suppose that the countries are sufficiently homogenous so that there is no problem with poolability of the data. Following Aschauer (1993), we add a time[46] (and time squared) variable to proxy for the technological progress.

We first look at the statistical properties of the key variables. In Annex 1 we included three figures showing the key variables (Figures A1.1-3 in Annex 1). Given these figures we do not expect the variables to be stationary. This was confirmed by the unit root tests that we performed on all the variables: we could not reject the null hypothesis of unit root at any of the usual levels of significance. The results are presented in Annex 1, Table A1.2.

As the variables are all integrated of order 1, we investigate whether there is a cointegrating relationship among them, i.e. whether it is possible to find a linear combination of them that would yield disturbances that are integrated of order 0, which would mean that the difference among them is stable and they thus grow at roughly the same rate (Greene, 2002).

[46] The variable *time* ranges from 1 to 50.

Therefore, we apply the Pedroni residual cointegration test to find whether there is panel cointegration between the two capital stock variables and GDP. As shown in Annex 1, Table A1.3, the null hypothesis of no cointegration was rejected at the 1% level of significance using the Augmented Dickey-Fuller test statistic and at 10% level of significance using the Phillips-Peron test statistic.[47]

To quantify the long-term relationship between capital stock and GDP we estimate an OLS model and then we try whether the inclusion of fixed or random effects is appropriate. Granger (1981) and Engle & Granger (1987) showed that due to the cointegrating relationship between GDP and the capital stock variables, the coefficients that we obtain are super consistent, i.e. they converge to their true values faster than a usual OLS estimator with stationary variables, but the standard errors are not consistent.

To account for the possible simultaneity bias, we also do the estimation using first lags of our explanatory variables. We are aware of the fact that this method is very simplistic and has many limitations, but the simultaneous equations approach or instrumental variables method are out of the scope of this paper, especially due to the lack of data available for such procedures.

Data on net public capital stock are not available in a more detailed breakdown. As we assume that different kinds of capital have different productivity, we also work with data on gross capital formation that exist for several categories.[48] To be able to use these as stock variables, we compute their cumulative totals per person employed and express these in natural logarithms.

Data on gross capital formation are available aggregated for the private and public sector (*PGCF* and *GGCF*, respectively) and also in different functional categories for the public sector (the Classification of Functions of Government in ESA 95). Following Kappeler & Välilä (2007) we sort those that we assume could be productive into three groups: infrastructure (economic affairs – *GGCF_IN*), health and education (health, education – *GGCF_HE*) and public goods (defence, general public services, environment, public order and safety – *GGCF_PG*). The descriptive statistics of these variables are shown in Annex 1, Table A1.4. For illustration we also show the graphs of *GGCF* and *PGCF* in Annex 1, Figure

[47] Anytime we tested for cointegrating relationship among given variables, we ensured that this relationship does not disappear when time trend and time^2 are included. To save space, the results of these are not presented.

[48] Net figures are not available.

A1.4. We can see that the variables are not stationary, which was also confirmed by statistical tests: in the case of *PGCF* we could not reject the null hypothesis of unit root on any of the usual levels of significance and in the case of *GGCF* we could not reject it at the 1% level of significance. The results are presented in Annex 1, Table A1.5.

Therefore, we test whether there is a cointegrating relationship between *GDP* and *PGCF* and *GGCF*. The result of the test is in Annex 1, Table A1.6. We can see that the null hypothesis of no cointegration is strongly rejected. We continue by replacing *GGCF* with the three different kinds of this variable. We test these and *PGCF* for cointegration with *GDP*. The result of this test is presented in the same table in Annex 1. We can see that again the null hypothesis of no cointegration is rejected at 1% level of significance. We thus assume that from OLS estimation in all the cases we should get super consistent coefficients.

Nevertheless, there are also other types of governmental expenditure that are considered to be very important for economic growth. These are especially money spent on research and development (*R&D_G*) and on education (*EXP_E_G*), which can be considered as a kind of investment into human capital, both being expressed in logarithms of their cumulative totals. Their graphs are shown in Annex 1, Figure A1.5. These variables are not stationary, which was confirmed by the unit root tests: in the case of *EXP_E_G* we could not reject the null hypothesis of unit root at any of the usual levels of significance and in the case of *R&D_G* we did not reject this hypothesis at the 5% level of significance (see Table A1.7 in Annex 1)

We tested for cointegration between *GDP* and *PGCF, GGCF, R&D_G,* and *EXP_E_G.* The results of the test are in Annex 1, Table A1.8. We did reject the null hypothesis of no cointegration among the variables. We thus expect our estimators to be super consistent.

3.3 Estimation results

3.3.1 Net capital stocks

We begin with the estimation of net capital stock variables as determinants of GDP. Table II.1 presents the results. In all models presented in the table the coefficients have the expected sign. We begin with the pooled OLS in Model 1. Its result is that public capital is only slightly less productive than private capital. However, when fixed effects are included in Model 2, the productivity of the public capital decreases significantly, to 0.34. On the other hand, the productivity of private capital increases and is nearly twice as high as the productivity of the public capital (0.64). When we add two variables proxying for the technological progress,

time and $time^2$, in Model 3, we can see that the coefficients on both capital stocks decrease but that the productivity of private capital remains double that of private capital. Furthermore, the fit of Model 3 is much better than the fit of Model 2.

When we exclude the proxies for technological progress but add to the estimation the time fixed effects that can account for common factors such as the business cycle, we can see in Model 4 that in comparison with Model 3 the fit did not improve and that the coefficients remained nearly the same.[49] In all models where fixed effects were used the tests for common intercept suggests that the use of this kind of model is more appropriate than the use of pooled OLS.

We then proceed by estimating the basic model using random effects. The results of Model 5 are very similar to the results of Model 2 and both types of capital are very productive. However, when we include the two time variables in Model 6, we can see that the coefficients decrease to levels similar to Models 3 and 4. We can see from the test statistic for consistence of GLS estimates that the use of random effects is appropriate.

All models where either the time variables or time fixed effects were included predict an elasticity of GDP with respect to the public capital stock to be at least 0.22, i.e. when *NPCS* increases by 1%, GDP increases by 0.22%. When these time specific effects are not included, the productivity of public capital is predicted to be more than 0.33. Also the elasticity of GDP with respect to the private (non-residential) capital stock is predicted to be higher by models without time specific effects (up to 0.64) and lower when these effects are included (around 0.46). In none of the models we could accept the null hypothesis of normally distributed residuals. As there is cointegrating relationship among the variables, the estimators should be super consistent, while the standard errors are inconsistent and thus not decisive.

Our results suggest that both capital stocks are highly productive, although not as much as e.g. in Aschauer (1989) who also uses figures on net public capital stock. This is not surprising because Aschauer uses aggregated data while we use disaggregated (country-level) data and, as we have already noted, the productivity of capital is usually estimated to be lower when disaggregated data are used.

[49] We note that when both the time variables and time fixed effects were included into the regression, logically the coefficients were the same as in Model 4, except for the constant.

Table II.1 – Estimation results – net capital stocks

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Const	0.2501 **	0.1199	0.2004 ***	0.2598 ***	0.1255 ***	0.2061 ***
NGCS	0.4284 ***	0.3380 ***	0.2293 ***	0.2213 ***	0.3432 ***	0.2371 ***
NPCS	0.5376 ***	0.6439 ***	0.4679 ***	0.4561 ***	0.6385 ***	0.4649 ***
time			0.0359 ***			0.0353 ***
time^2			-0.0020 *			-0.0002 ***
fixed effects (cross-section)	no	yes	yes	yes	no	no
fixed effects (time)	no	no	no	yes	no	no
random effects	no	no	no	no	yes	yes
Adjusted R2	0.9778	0.9933	0.9959	0.9958		
Akaike criterion	-444.6	-1127.9	-1416.1	-1362.8	-412.6	-395.9
F statistic	12882.9 ***	5734.8 ***	8330.3 ***	2456.9 ***		
Test statistic for common intercept		103.360 ***	154.940 ***	150.097 ***		
Test statistic for consistence of GLS estimates					2.8188	5.4454
Test statistic for normality of residuals	36.137 ***	72.840 ***	66.220 ***	67.205 ***	37.651 ***	52.393 ***
Number of observations	585	585	585	585	585	585

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

To account for the possible problem of reverse causation, we run the estimation again but including the first lag of the explanatory variables, as current level of GDP can hardly have a backwards influence on the past period level of capital stock. As can be seen in Table II.2, the coefficients did not change much: in the case of NGCS the decrease was never greater than by 0.03 and in the case of NPCS the decrease was by 0.04 at most. The private capital has remained twice as much productive as public capital. As in the previous estimation, GLS estimators seem to be consistent.

The finding that the coefficients were nearly the same as in the previous estimation suggests that the simultaneity bias might really be rather small.

Table II.2 – Estimation results – lagged values of net capital stocks

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
const	0.3853 ***	0.2570 **	0.2497 ***	1.5794 ***	0.2644 ***	0.2597 ***
NGCS (-1)	0.4271 ***	0.3369 ***	0.1987 **	0.2010 **	0.3437 ***	0.2115 ***
NPCS (-1)	0.5183 ***	0.6239 ***	0.4287 ***	0.4262 ***	0.6168 ***	0.4246 ***
time			0.0493 ***			0.0479 ***
time2			-0.0004 ***			-0.0004 ***
fixed effects (cross-section)	no	yes	yes	yes	no	no
fixed effects (time)	no	no	no	yes	no	no
random effects	no	no	no	no	yes	yes
Adjusted R2	0.9755	0.9909	0.9941	0.9943		
Akaike criterion	-409.9	-974.7	-1225.5	-1208.9	-381.2	-306.3
F statistic	11643.4 ***	4232.7 ***	5771.5 ***	1813.3 ***		
Test statistic for common intercept		76.382 ***	111.843 ***	113.525 ***		
Test statistic for consistence of GLS estimates					2.7387	8.1177 *
Test statistic for normality of residuals	32.77 ***	58.85 ***	51.09 ***	57.06 ***	30.96 ***	89.16 ***
Number of observations	585	585	585	585	585	585

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

3.3.2 Gross capital formation

To be able to account for differences in productivity of different kinds of capital, we continue by estimating the effect on GDP of the cumulative totals of public and private gross capital formation, as these data are available for several categories. We begin by including into the estimation the private and public gross capital formation in the aggregate form. The results of this estimation are shown in Table II.3.

In all models the coefficients have the expected sign, except for the proxies for technological progress. However, we can see that in the pooled model (Model 1) both coefficients on gross capital formation, but especially that on *PGCF*, are higher than in the other models where fixed effects were included. Model 4 seems to be best specified. According to it, public gross

capital formation is nearly three times more productive than public gross capital formation. Again, given the cointegrating relationship among the variables, our estimators should be super consistent.

Table II.3 – Estimation results – cumulative gross capital formation

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**
const	1.7564 ***	2.6467 ***	6.0412 ***	2.4948 ***
PGCF	0.4407 ***	0.2045 ***	0.2089 **	0.2325 **
GGCF	0.0999	0.0697	0.0693	0.0859
time			-0.1665 ***	
time2			0.0020 ***	
fixed effects (cross-section)	no	yes	yes	yes
fixed effects (time)	no	no	no	yes
Adjusted R2	0.7342	0.9695	0.9738	0.9751
Akaike criterion	-429.769	-444.240	-504.86	-510.26
F statistic	572.9 ***	471.6 ***	513.8 ***	345.5 ***
Test statistic for common intercept		123.407 ***	55.432 ***	50.98 ***
Test statistic for normality of residuals	9.568 ***	50.683 ***	48.964 ***	47.882 ***
Number of observations	415	415	415	415

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust
3) GLS estimates were not consistent.

As for the negative coefficient on time, it seems that this variable has become a strange proxy for technological progress. It is not very realistic that technologies would face such a downward sloping trend. This finding also seems to be at odds with all growth theories claiming that economic growth is based on technological progress.

Not surprisingly, our estimators are significantly lower than those presented in Table II.1. This is probably caused by the fact that at the beginning we worked with net figures while now gross figures are used. It is logical that the effect of variables expressed in gross terms on GDP is lower because they were not netted of depreciation etc. Nevertheless, this is what is usually best available and what we can work with when discussing fiscal rules.

To be able to see the effects of different kinds of the public gross capital formation, we include into the regression the three categories of public gross capital formation. The results of this estimation are in Table II.4. We can see that in comparison with fixed effects models and also in comparison with the fixed effects models presented in Table II.3, the pooled OLS model strongly overestimates the coefficient on *PGCF*. In the current three fixed effects models the coefficients on *PGCF* are very similar, ranging from 0.087 to 0.112, but they are significantly lower than in fixed effects models shown in Table II.3.

Table II.4 – Estimation results – subcategories of cumulative gross capital formation

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**
const	1.8188 ***	3.1327 ***	6.9366 ***	3.0409 ***
PGCF	0.4650 ***	0.0877	0.0948	0.1119 ***
GGCF_IN	0.0913	0.1125	0.0521	0.0699
GGCF_HE	0.0426	0.1154	0.1522	0.1527
GCCF_PG	-0.0563	-0.0485	-0.0366	-0.0332
time			-0.1889 ***	
time2			0.0023 ***	
fixed effects (cross-section)	no	yes	yes	yes
fixed effects (time)	no	no	no	yes
Adjusted R2	0.7363	0.9719	0.9768	0.9773
Akaike criterion	-201.94	-445.89	-518.94	-513.56
F statistic	276.08 ***	455.44 ***	518.52 ***	347.49 ***
Test statistic for common intercept		126.803 ***	61.125 ***	55.648 ***
Test statistic for normality of residuals	10.971 ***	56.069 ***	46.868 ***	52.030 ***
Number of observations	395	395	395	395

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust
3) GLS estimates were not consistent.

In Model 2, where no account was taken of the time (or technological progress), the effect of infrastructure gross capital formation seems to be overstated, as it is by 0.5 – 0.6 higher than in Models 3 and 4. On the other hand, Model 2 seems to underestimate the effect of investment into health and schooling: in Models 3 and 4 the coefficients on this kind of investment are by approximately 0.04 higher. In all the models, the coefficient on gross pubic capital formation in the field of public goods is relatively small, but negative, which would suggest that money spent like this is not invested in a financially productive way. As in the previous estimation, the coefficient on *time* is negative.

Again, given the cointegrating relationship among the variables, we should obtain super consistent estimators.

However, as we already mentioned in the previous Section, there are also other public expenditures that are not capital investments but which are considered to be important for economic growth, such as expenditures on R&D or education.

To find what their effect on GDP is, we used their cumulative totals as explanatory variables, together with the gross capital formation variables. The results of the estimation are shown in Table II.5. In Models 1 to 3, all variables were included. In Models 4 and 5, apart gross capital formation only R&D expenditures were included and in Models 6 and 7, apart gross capital formation only expenditures on education were included.

As we can see, the effect of the private gross capital formation increased only slightly in comparison with the previous estimation, but it remained lower than in models presented in Table II.3. We can, however, see that expenditures on R&D have a much higher effect on GDP than any public gross capital formation (the coefficient is around 0.17 in all fixed effects models) and that the effect of expenditures on education on GDP is nearly as high as that of public gross capital formation in the field of education and health in the previous table (the coefficient ranges from 0.087 to 0.118 in all the fixed effects models in Table II.5 and the coefficient on GGCF_HE ranged from 0.115 to 0.153 in fixed effects models in Table II.4).

As in the previous estimations the coefficient on *time* is negative and again our estimates should be super consistent given the cointegrating relationship among the variables.

Table II.5 – cumulative gross capital formation and other expenditures

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
const	8.8141 ***	5.8332 ***	2.9167 ***	5.3027 ***	2.6714 ***	6.7446 ***	2.6037 ***
PGCF	0.0338	0.0712	0.1037	0.1435 *	0.1731 **	0.1248	0.1357
GGCF	0.0898	0.0006	0.0098	0.0039	0.0094	0.0549	0.0674
R&D_G	0.1364 ***	0.1689 ***	0.1631 ***	0.1818 ***	0.1732 ***		
EXP_E_G	0.3599 ***	0.0955	0.0875			0.0949	0.1182
time	-0.2693 ***	-0.1471		-0.1247		-0.1984 ***	
time2	0.0027 ***	0.0018 *		0.0016 *		0.0024 ***	
fixed effects (cross-section)	no	yes	yes	yes	yes	yes	yes
fixed effects (time)	no	no	yes	no	yes	no	yes
Adjusted R2	0.9284	0.9779	0.9787	0.9784	0.9786	0.9762	0.9768
Akaike criterion	-64.55	-423.11	-408.89	-421.23	-409.09	-509.8	-505.67
F statistic	681.75 ***	452.82 ***	301.63 ***	462.66 ***	301.43 ***	521.48 ***	346.79 ***
Test statistic for common intercept		29.023 ***	26.001 ***	38.581 ***	35.006 ***	43.042 ***	38.597 ***
Test statistic for normality of residuals	20.551 ***	49.245 ***	58.147 ***	59.006 ***	72.619 ***	47.132 ***	49.679 ***
Number of observations	316	316	316	316	316	316	316

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust
3) GLS estimates were not consistent.

3.4 Brief summary

Our results suggest that there is a long-run positive relationship between GDP and capital, both private and public. We came to this conclusion working with net and gross figures, depending on their availability. We found that both the net capital stocks and the cumulative totals of the gross capital formation are cointegrated with GDP. In most estimations private capital was more productive than public capital. From different kinds of public gross capital formation, investment into health and education was usually most productive. However, we found that expenditures on R&D and education also have a positive effect on GDP.

Given that we did our estimation with gross capital formation, we can assume that if net figures were available, the effect of public investment on GDP would be higher at least in

those areas where depreciation is relatively high. Investment into public goods does not seem to be productive, maybe because this type of investment does not offset the distortionary impact of taxation, at least in monetary terms.

From the technical point of view, we can say that the pooled OLS model was every time misspecified. Concerning the nature of the country-specific effects, when we worked with capital stock variables, GLS estimators were consistent, i.e. the use of random effects was appropriate. However, when working with the cumulative totals of gross capital formation, GLS estimators were inconsistent, i.e. the use of fixed effects was appropriate. This may be caused by the fact that as we used cumulative totals of the gross capital formation, the unobserved country-specific effects reflected the previously accumulated gross capital stock for which we did not have data, and thus this error component could not have a zero mean and was correlated with the explanatory variables.

4 Conclusion

In this paper we investigated the productivity of public capital from the point of view of the golden rule. We first introduced the golden rule as such, providing also examples of countries where this kind of rule has already been introduced.

We then discussed the possible implementation of the golden rule in the EU. There are many problematic issues connected with the golden rule, both conceptual and practical. One of the important assumptions underlying the introduction of the golden rule, which is supposed to induce a rise in public capital investment, is that public capital is productive. As most studies treating this topic have been performed for the US and not for the EU, we devote most of the paper to this question.

Using data for the EU (all 27 member states when possible) we investigated the issue of the productivity of public capital. The most important thing is that we found that there is a cointegrating relationship between both the net capital stocks and the cumulative totals of the gross capital formation and GDP. Apart data on net capital stocks we also worked with data on gross capital formation because there were available also disaggregated into several categories.

This long-run relationship among the variables proved to be positive in most cases. In the case of the net capital stocks the productivity was found to be lower than in the case of the

cumulative totals of the gross capital formation, which we attribute to the fact that gross capital formation is not netted of depreciation.

Concerning the different kinds of gross public capital formation, we have found that investments into infrastructure and health and education are productive. On the other hand, investments into public goods do not seem to have a positive effect on output, as they probably do not offset, in monetary terms, the distortive effects of taxation. However, we have found that also current expenditures on R&D or education have a significant positive effect on GDP.

This all leads us to the conclusion that at the aggregate level public capital is productive. However, there are many kinds of public capital which is likely to be unproductive and as there also are many kinds of current expenditures that have a positive effect on output in the long run. Therefore, we are of the following view concerning the assumption of productivity of the public capital that usually underlies the discussions of the golden rule: supposing that the introduction of the golden rule in the EU should promote public capital investment, it would not be reasonable to introduce such rule if the definition of public capital investment does not change.

It may be helpful to add growth-enhancing current expenditures to the category of public investment for this purpose and maybe to exclude unproductive investments from it. It would, however, be very difficult to determine which kinds of public investment should be treated as unproductive, also taking into account that not all benefits stemming from an investment can be expressed in monetary terms and thus have a significant effect on the output.

Furthermore, as the sub-optimality of the level of public capital is debatable and the need for more public investment is thus uncertain, we are not proponents of the introduction of a golden rule in the EU in today's conditions.

ANNEX

Table A1.1 – Descriptive statistics of key variables of GDP and net capital stock variables

	Mean	Median	Minimum	Maximum
GDP	2.59	2.83	-0.35	4.20
NGCS	11.36	8.53	0.22	33.20
NPCS	27.65	22.63	0.69	88.73

Figure A1.1– ln GDP per person employed over the period 1960 – 2009

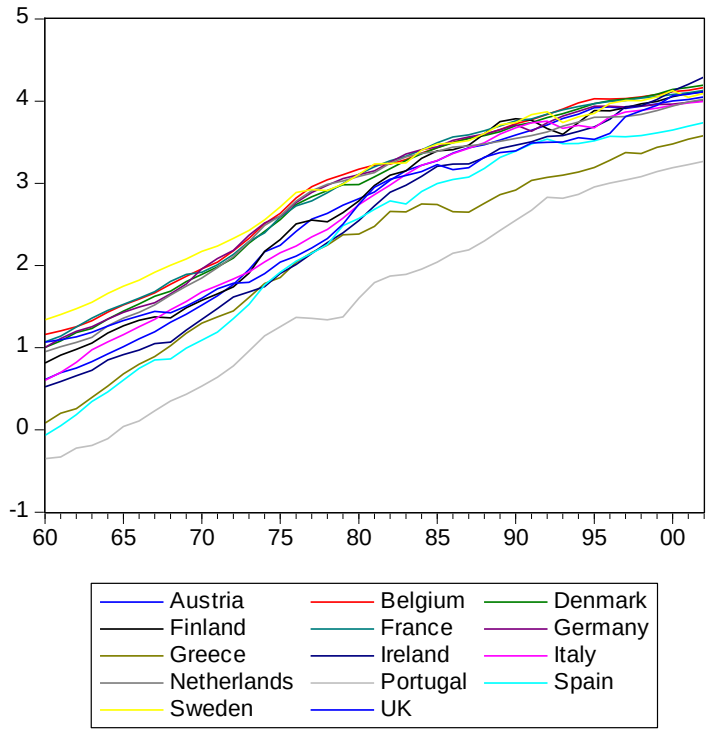


Figure A1.2 – ln net government capital stock per person employed over the period 1960 – 2009

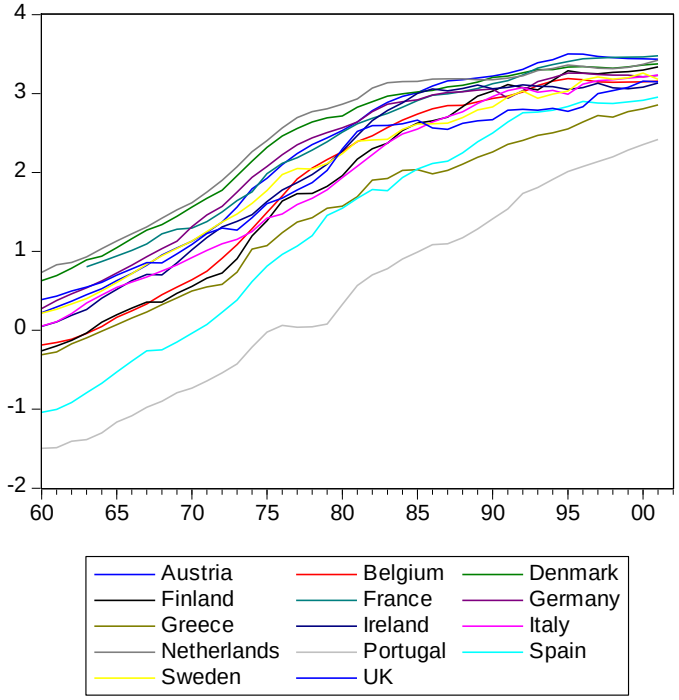


Figure A1.3 – ln net private non-residential capital stock per person employed over the period 1960 – 2009

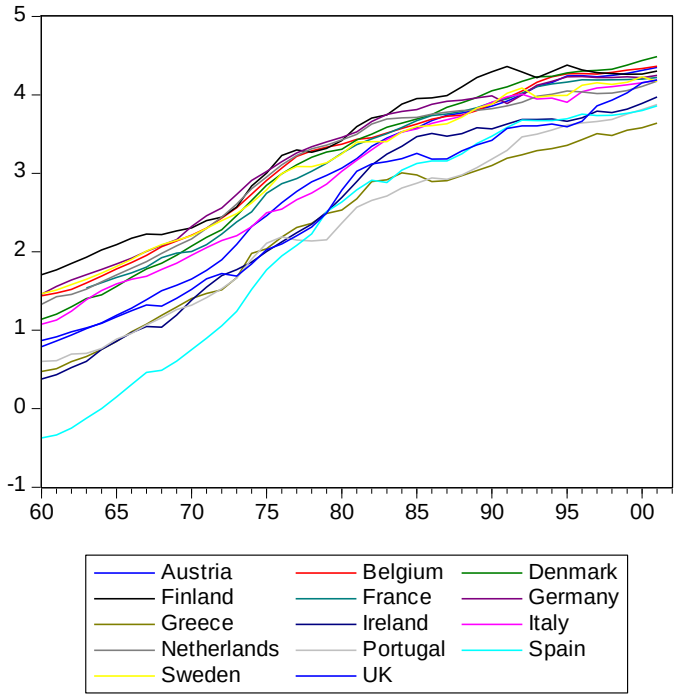


Table A1.2 – Panel integration test – GDP and net capital stocks

	GDP	NGCS	NPCS
ADF – Statistic	47.045	8.468	2.419

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

Table A1.3 – Panel cointegration test – net capital stocks

	GDP with NGCS and NPCS
ADF – Statistic	-5.4998 ***
PP – Statistic	-1.8316 *

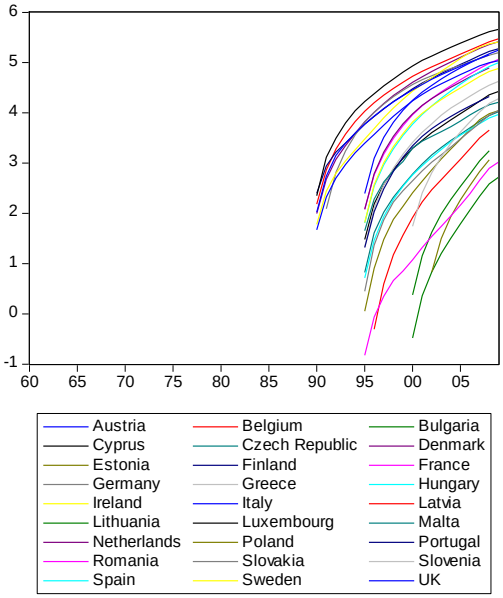
Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) we assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% and 5% level of significance, respectively.
4) the null hypothesis was also rejected when time and time^2 were added to the net capital stock variables.

Table A1.4 – Descriptive statistics of gross capital formation variables

	Mean	Median	Minimum	Maximum
PGCF	3.56	3.78	-0.82	5.66
GGCF	1.65	1.89	-4.56	4.19
GGCF_HE	-0.04	0.18	-4.46	2.32
GGCF_IN	0.49	0.68	-3.72	3.20
GGCF_PG	0.27	0.47	-4.26	2.86

Figure A1.4 – ln private and governmental gross capital formation over the period 1960 – 2009

PGCF



GGCF

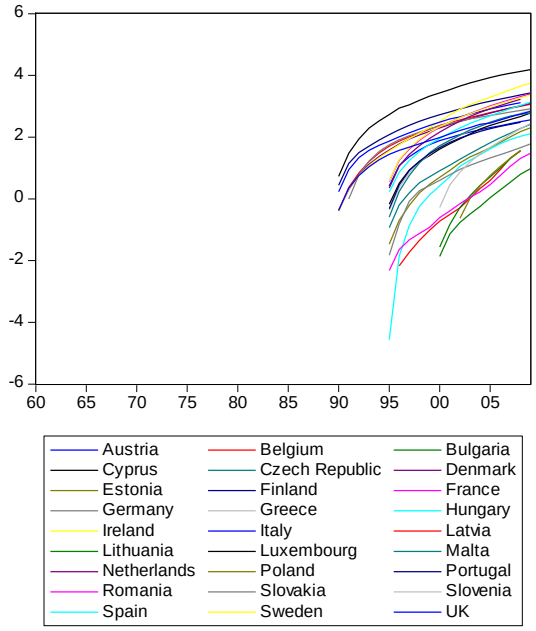


Table A1.5 – Panel integration test – gross capital formation

	PGCF	**GGCF**
ADF – Statistic	8.468	63.15 **

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

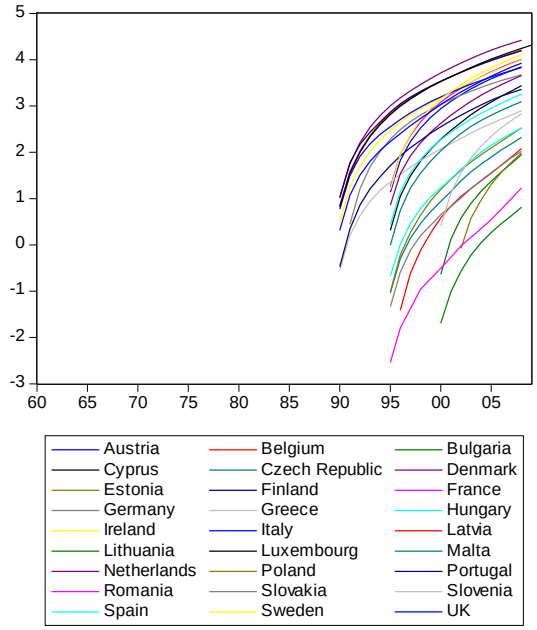
Table A1.6 – Panel cointegration test – gross capital formation

	GDP with GGCF and PGCF	**GDP with PGCF, GGCF_HE, GGCF_IN and GGCF_PG**
ADF – Statistic	-4.6725 ***	-4.4660 ***
PP – Statistic	- 2.9143 ***	-4.4241 ***

Notes: 1) *** indicates 1% level of significance.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) se assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% level of significance.
4) the null hypothesis was also rejected when time and time^2 were added to the gross capital formation variables

Figure A1.5 – ln public expenditures on education and ln public expenses on R&D over the period 1960 – 2009

EXP_E_G



R&D_G

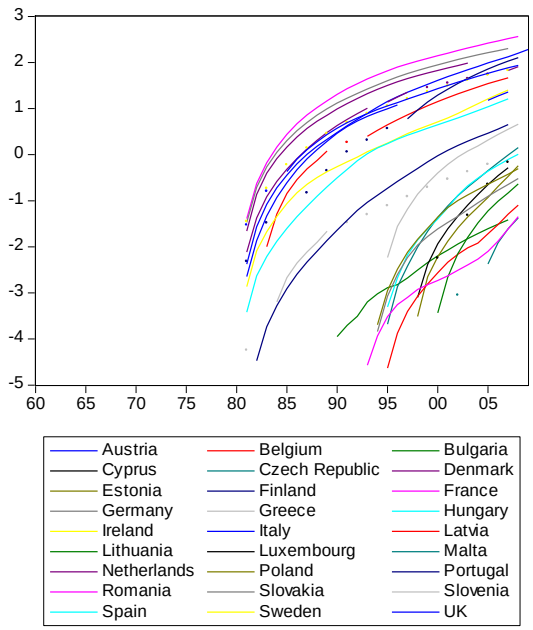


Table A1.7 – Panel integration test – expenditures on R&D and education

	R&D	**EXP_E_G**
ADF – Statistic	59.056 *	52.754

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

Table A1.8 – Panel cointegration test – expenditures on R&D and education

	GDP with PGCF, GGCF, R&D_G and EXP_E_G	**GDP with PGCF, GGCF, and EXP_E_G**	**GDP with PGCF, GGCF, R&D_G, time and time2**
ADF - Statistic	-5.5707 ***	-5.8552 ***	-8.1524 ***
PP - Statistic	-13.4088 ***	-4.0470 ***	-31.8443 ***

Notes: 1) *** indicates 1% level of significance.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) we assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% level of significance, except for the first column.
4) when in the third column the time variables were not included, we could not reject the null hypothesis of no cointegration. However, in the case of the first two columns, the inclusion of the time variables did not change our conclusion.

REFERENCES

Aschauer, D. A. (1989). 'Is Public Expenditure Productive?', Journal of Monetary Economics vol. 23, pp. 177-200.

Aschauer, D. A. (1990). 'Why Is Infrastructure Important?', Conference Series of the Federal Reserve Bank of Boston, pp. 21-68.

Aschauer, D. A. (1993). 'Public Capital and Economic Growth. In Public Policy Brief no. 4/1993 – Public Infrastructure Investment: A Bridge to Productivity Growth', The Jerome Levy Economics Institute of Bard College, pp. 9-30.

Balassone, F. & Franco, D. (2000). 'Public Investment, the Stability Pact and the 'Golden Rule'', Fiscal Studies vol. 21 (2), pp. 207-229.

Batina, R. G. & Ihori, T. (2005). 'Public Goods - Theories and Evidence', Springer, Germany.

Blanchard, O. & Giavazzi, F. (2003). 'Improving the SGP Through a Proper Accounting of Public Investment', CEPR discussion paper no. 4220.

Buiter, W. H. (1998). 'Notes on 'A Code for Fiscal Stability'', NBER working paper no. 6522.

Buti, M.; Eijffinger, S. & Franco, D. (2002). 'Revisiting the Stability and Growth Pact: Grand Design or Internal Adjustment? ', CEPR discussion paper no. 3692.

Cadot, O.; Röller, L.-H. & Stephan, A. (1999). 'A Political Economy Model of Infrastructure Allocation: An Empirical Assessment', FS IV 99 - 15, Wissenschaftszentrum Berlin.

Calderon, C. & Serven, L. (2002). 'The Output Cost of Latin America's Infrastructure Gap', Central Bank of Chile Working Paper no. 186.

Creel, J. (2003). 'Ranking Fiscal Policy Rules: the Golden Rule of Public Finance vs. the Stability and Growth Pact', OFCE working paper no. 2003-04. Available at: http://ssrn.com/abstract=826285

De Haan, J.; Sturm, J. E. & Sikken, B. J. (1996). 'Government Capital Formation: Explaining the Decline', Review of World Economics, vol. 132, pp. 55-74.

De Haan, J. & Romp, W. (2005). 'Public Capital and Economic Growth: A Critical Survey', European Investment Bank Papers vol. 10, pp. 41-70.

Engle, R. F. & Granger, C. W. J. (1987). 'Co-Integration and Error Correction: Representation, Estimation, and Testing', Econometrica, vol. 55 (2), pp. 251-276.

European Commission (2001). '2001 Broad Economic Policy Guidelines', European Economy 72/2001.

European Commission (2003). 'Public Finances in EMU 2003', European Economy 3/2003.

European Commission (2009). 'Public Finances in EMU 2009', European Economy 5/2009.

European Economic and Social Committe (2006). 'Opinion of the European Economic and Social Committee on Strengthening economic governance — The reform of the Stability and Growth Pact', Official Journal C 88/15.

Ford, R. & Poret, P. (1991). 'Infrastructure and Private-Sector Productivity', Economic Studies no. 17, pp. 64-89.

Garcia-Mila, T.; McGuire, T. J. & Porter, R. H. (1996). 'The Effect of Public Capital in State-Level Production Functions Reconsidered', The Review of Economics and Statistics vol. 78, no. 1, pp. 177-180.

Granger, C. W. J. (1981). 'Some Properties of Time Series Data and Their Use in Econometric Model Specification', Journal of Econometrics, vol. 16 (1), pp. 121-130.

Greene, W. H. (2002). 'Econometric Analysis', Pearson Education, Inc., New Jersey. Fifth edition.

HM Treasury (1997). 'A Code for Fiscal Stability', London. Available at: http://archive.treasury.gov.uk/pub/html/docs/fpp/code/code.pdf , accessed on 20 May 2010.

HM Treasury (1998). 'Fiscal Policy: Current and capital spending', London. Available at: http://archive.treasury.gov.uk/pub/html/fpccs.pdf , accessed on 20 May 2010.

Holtz-Eakin, D. (1994). 'Public-Sector Capital and the Productivity Puzzle', The Review of Economics and Statistics vol. 76 (1), pp. 12-21.

Kamps, C. (2005). 'Is There a Lack of Capital in the European Union? ' EIB working paper no. 3/2005.

Kappeler, A. & Välilä, T. (2007). 'Composition of Public Investment and Fiscal Federalism: Panel Data Evidence from Europe', European Investment Bank, Economic and Financial Report 2007/02.

Kellermann, K. (2007). 'Debt Financing of Public Investment. On a Popular Misinterpretation of 'the Golden Rule of Public Sector Borrowing'', European Journal of Political Economy vol. 23, pp. 1088-1104.

Munnell, A. H. (1990). 'How Does Public Infrastructure Affect Regional Economic Performance?', Federal Reserve Bank of Boston - Conference Series 34, pp. 69-112.

Sawyer, M. (1997). 'On Budget Deficits and Capital Expenditure', Macroeconomics 9802012, EconWPA.

Sturm, J.-E.; De Haan, J. & Kuper, G. (1998). 'Market Behaviour and Macroeconomic Modelling', MacMillan, chapter Modelling Government Investment and Economic Growth on a Macro Level: A Review, pp. 359-406.

Wooldridge, J. M. (2006). 'Introductory Econometrics - A Modern Approach', Thomson South-Western, USA. Third edition.

APPENDIX

Could the Stability and Growth Pact Be Substituted by the Financial Markets?

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Abstract:
In the discussions of the need for fiscal rules and their usefulness in a monetary union researchers have not agreed on whether the financial markets have a sufficiently disciplining effect on the governments, which would mean that the fiscal rules are not necessary. This paper investigates whether the European Union's main fiscal rule, the Stability and Growth Pact, could be substituted by the financial markets, taking into account also the effects of the latest financial and economic crisis. Our findings suggest that there is certain interaction between the financial markets and the governments' decisions on the fiscal policies and that this reaction has become stronger after the beginning of the crisis. However, the institutional setup and market conditions in the European Union are such that this interaction is biased and thus we conclude that the Union needs to have fiscal rules.

Keywords:
European Economic and Monetary Union, Stability and Growth Pact, Financial markets, Fiscal rules

JEL: C23, E44, E62, H62, H74, H87

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1 Introduction

The European Economic and Monetary Union (EMU) is a very unique project, both from the political and economic point of view. Its functioning was based on the Maastricht Treaty where, *inter alia*, the well-known limits on government deficit and debt ratios to GDP were set (3% and 60%, respectively).[50] It, however, seems that the member states did not consider the provisions of the Maastricht Treaty sufficient to ensure fiscal discipline after the accession of the member states to the EMU, as they later concluded the Stability and Growth Pact (SGP).

The establishment of the EMU necessitated a lot of changes, such as a new currency, new institutions (especially the European Central Bank[51]) and the already mentioned new set of fiscal rules that should ensure a good working of the monetary union, the SGP. Ever since its adoption the SGP has been quite controversial. One reason for criticisms of the Pact is the fact that certain economists questioned the need for fiscal rules in the EMU at all. In their work researchers have identified several reasons for the application or non-application of fiscal rules in a monetary union.

First, there is the issue of the credibility of the central bank and its commitment to price stability. Researchers dealing with this, such as Eijffinger & de Haan (2000), Beetsma et al. (2001), Buiter (2006), Lindbeck & Niepelt (2006), Ardy et al. (2006) or Fitoussi & Saraceno (2007), mostly share the opinion that the absence of fiscal rules and thus the existence of expansive fiscal policies could hamper the credibility of the monetary authority and weaken its commitment to keeping the price level stable.

Second, there is the tendency of governments to run budget deficits. Researchers generally agree that this is a legitimate reason for the existence of fiscal rules (see e.g. Eijffinger & de Haan (2000), Kopits (2001), Stark (2001), Schneider & Hedbavny (2003), Wyplosz (2006), Catenaro & Morris (2008)).

Third, the impact of unsound fiscal policies on union-wide interest rates is often discussed. Most of the researchers treating this issue are of the opinion that this effect may be dangerous (see e.g. Feldstein (2005), Ardy et al. (2006), Lindbeck & Niepelt (2006), Catenaro & Morris (2008)). However, certain authors disagree, such as Wyplosz (2006) or Fitoussi & Saraceno (2007).

Many arguments why fiscal rules should not be used in a monetary union also exist. These are mentioned e.g. by Beetsma et al. (2001), Kopits (2001) and Woods (2008). They cover effects

[50] One of the clauses of the Maastricht Treaty that is very important for our analysis is Article 104b of the TEU (in original version) that provides for a non-bailout clause: neither the Community, nor any of its members should be liable for the commitments of a member state's government or other public authorities.

[51] Its main task was set to ensure the stability of the new currency through a stable price level. Furthermore it was decided that the ECB ought to be independent of the national and Community political authorities and is prohibited from providing any type of credit to the member states' governments or Community institutions.

of fiscal rules like the governments' limited scope for reaction to shocks or their resort to creative accounting.

Another one is the claim that fiscal rules are actually not needed because they can be substituted by the disciplining effect of the financial markets. Fitoussi & Saraceno (2007) recall two papers (by Alesina et al. (1992) and Bernoth (2004)) which conclude that markets are able to monitor fiscal performance and put pressure on governments through the spreads between different bonds and that they have not lost this ability after the introduction of the EMU.

Eijffinger & de Haan (2000) claim that markets may not be disciplining enough. They explain that the markets might not differentiate between a fiscally disciplined and undisciplined country within a monetary union by demanding different yields on their government bonds because they may expect that even if, in the case of the EMU, the Maastricht Treaty provided for a no-bail-out clause, the Union would help a member state in troubles for political reasons. This view is supported by Hedbavny et al. (2004) who, when comparing the EU with the US, claim that the markets have a higher probability of expecting a bail-out in the EU because this union has fewer member states than the US and thus all countries have a greater influence on all important decisions. This view is, however, opposed by Schucknecht et al. (2008) who claim that based on their findings the no-bailout clause in the Maastricht Treaty seems to be credible.

Furthermore, according to Eijffinger & de Haan (2000), markets tend to react slowly to an unsustainable fiscal position and then, when they finally (and often very strongly) react, such event can have contagion consequences. This was in fact confirmed in 2010 when we saw a sudden significant increase in spreads of Greece and then also of certain other countries (especially Ireland and Portugal).

Woods (2008) agrees that until 2008 the markets have not been differentiating significantly among different euro government bonds. He reminds that we can expect that the markets may not reflect the individual countries' situation properly, but also that their reactions might be 'abrupt and potentially very disruptive'. This is very well in line with the conclusions of Eijffinger & de Haan (2000) and also with the findings of Schucknecht et al. (2010) according to whom markets reacted 3-4 times more strongly to deficit differentials and 7-8 times more strongly to debt differentials after the beginning of the financial crisis.

Kopits (2001) argues that well designed fiscal rules could have the same effect as the markets on the governments' fiscal behaviour, but in a quicker and more efficient way and without their reactions' adverse consequences such as high risk premiums or abrupt outflows of capital.

We investigate the question of the substitutability of the SGP by the financial markets by analysing three different issues: first, the financial markets' reaction to changing fiscal behaviour of the states; second, the governments' response in terms of fiscal behaviour to the markets increasing their costs of borrowing; and, third, the question whether the market conditions and institutional setting in the EMU do not hamper these reactions or do not make

them biased and inefficient. Therefore we test whether the government bond yield spreads change in reaction to increasing budget deficits and public debts, assuming that when a state's fiscal stance starts to deteriorate, financial markets begin to ask a higher risk premium and thus the country's government bond yields (and therefore also the spread relative to a benchmark) increase. Then we test whether the governments improve the structural primary balance when the spreads of their bonds increase, assuming that when the yields on government bonds increase, the costs of borrowing for a given country also grow and such country's government reacts to this by increasing its structural primary balance, trying to reverse the trend. To do this we use data until the end of year 2009 to see what the impact of the recent crisis was.

The paper is organized as follows: in Section 2 we provide an overview of the related literature and also discuss the institutional conditions in the EMU that may significantly influence our conclusions. In Section 3 we present the data used for the investigation of the financial markets' and the governments' behaviour, performing also tests of statistical properties of the data. We then outline the method used for the estimation. In Section 4 we show our estimation results and in Section 5 we conclude.

2 Related literature

To tackle the question whether the Stability and Growth Pact could be substituted by the financial markets requires investigating three issues: first, whether the institutional setup and market conditions in the EMU enable an efficient working of the financial markets and a responsible behaviour of the governments; second, whether the financial markets react to a worsening fiscal stance of a government; and third, whether governments change their fiscal behaviour appropriately to the market signals. While many researchers have studied what drives yields (or spreads) of government bonds, only a few have explored the reaction of the governments to the market signals.

2.1 Institutional setup and market conditions

At the beginning of their paper, Balassone et al. (2004) remind that there are many prerequisites for the financial markets to be effective in disciplining the fiscal behaviour of the governments. They mention eight important, partly overlapping conditions that were outlined by Bishop et al. (1989) and Lane (1993). These can be summarized as follows: first, there is free movement of capital. Second, governments do not have privileged access to the market. Third, markets have access to all necessary information on sovereign borrowers. Fourth, bail-out is not allowed, there is no external guarantee and debts cannot be monetized. Fifth, the financial system can absorb the bankruptcy of a sovereign borrower. Finally, borrowing governments do respond to market signals.

Balassone et al. (2004) argue that many of these conditions have already been fulfilled in the EMU, but several remain problematic. This can be confirmed today: first, information necessary for evaluating the financial reliability of governments is available to the markets

with delay (e.g. in 2010 Eurostat released a lot of important statistics from the first quarter of the year with a four months lag, i.e. in July). Furthermore, we have to remind that the data are not 100% reliable - for example in the case of Greece they have become doubtful when this country's creativity in producing statistics was discovered and these had to be reviewed several years backwards.

Second, it is unsure whether the markets would be able to absorb the bankruptcy of a sovereign borrower. Blundell-Wignall & Slovnik (2010) showed that nearly 60% of the foreign-owned part of the Greek public debt was held by German and French banks and in case Greece defaulted on its obligations, the banking systems of these two countries may be significantly weakened because the Greek debt represented 12% and 6% of the banks' Tier 1 capital, respectively.

Third, the borrowers' response to market signals is uncertain but this is something that we can test for. Finally, the greatest problem seems to be the issue of (non-)bail-out and non-existence of external guarantee. Bail-out is prohibited in the EMU[52] but the credibility of this ban has become more doubtful than ever, given the situation in Greece and Ireland and the loans that have been granted to them by other EU countries and the IMF, which is seen by many to be very close to a bail-out. This example would support the claim of Eijffinger & de Haan (2000) that fiscal rules in a monetary union are necessary.[53]

We have to bear all this in mind when drawing conclusions from our estimation results.

2.2 The markets' reaction

Researchers generally agree that government bond yield spreads are determined by several factors: default risk, exchange rate risk and liquidity premiums, and factors such as transaction costs and differences in tax treatment or different sensitivities to common shocks. To this Lemmen & Goodhart (1999) note that in a monetary union the default risk is higher as the countries cannot inflate their debts or devalue their currencies. However, as we could see after the inception of the EMU, higher probability of bail-out in a monetary union may go in the opposite direction as far as the default risk is concerned.

There are two main lines of research in the current literature that are connected with the issue of the reaction of the financial markets to the fiscal stance of governments. While the first one investigates the effect of fiscal variables on the government bond yields, the second one tries to assess their effect on government bond yield spreads.

[52] It was already banned by the Maastricht Treaty.

[53] However, recently we have seen discussions about the possible introduction of the 'bail-in' of creditors which may be able to prevent investors from considering placing their money into the banks as risk free (expecting that governments will always bail the banks out). This would be done e.g. in the way that when a bank gets into financial problems its debt held by third parties would automatically be converted into common equity. See European Commission (2010).

The first line of research is much less widespread than the second one. For this analysis the most relevant paper is that by Ardagna et al. (2004).[54] These authors worked with a panel of 16 OECD countries and a time period of more than 40 years, using annual data. They did the estimation for two different periods, one using OLS estimation with country specific fixed effects and one using the GLS estimator. The effect of both the primary deficit as share on GDP and the gross public debt as share on GDP on the 10-year government bond yields was significant in most specifications and was estimated to be around 0.1 and 0.01, respectively. However, as Gale & Orszag (2002) note, the overall level of long-term bond yields is affected by many factors and not only the fiscal policy. It may therefore be better to investigate the bond yield spreads relative to another country if we want to trace the effect of fiscal policy on the markets' pricing of the costs of borrowing. This was confirmed by the recent development of the government bond yields that is illustrated in Figure A1 in the Annex. We can see that after an increase in the bond yields of all governments between 2005 and 2007, many government bonds yields started to decrease in 2008, but the spreads among them have increased and this is what we are interested in.

The literature aiming to explain the government bond yield spreads is very wide and usually Germany is used as the benchmark. It is generally accepted that the spreads in a monetary union are caused by differences in credit and liquidity risk premiums. Many researchers have also found that government bond spreads are driven by a common factor, usually referred to as *international risk aversion.* Manganelli & Wolswijk (2009) tried to find what drives this international risk aversion and they claimed that it was related to the level of short-term interest rates.[55]

Codogno et al. (2003) worked with monthly data for 10 EMU countries between 1995 and 2002. Because of the period chosen, the authors took into account the exchange rate risk components of the government bond yield spreads in the regression. They also included in their model two variables that should approximate risk premiums. These were both related to the US economy (spreads between interest rates on US swaps and the federal government bond yields and between the yields on AAA US corporate bonds and the federal government bond yields). The authors came to the conclusion that government bond spreads in the Eurozone are mainly driven by credit risk and international factors and not so much by liquidity factors.

Bernoth et al. (2006) used yield-at-issue data on spreads for 14 EU countries and the US federal government in the period from 1993 to 2005, taking into account only DM, then EUR issues and USD issues to avoid the influence of exchange rate risk on the yields. They used the 2SLS estimation technique adding both country- and time-specific fixed effects. The authors also included investors' risk aversion into the regression. They proxied for it using the spread between BBB US corporate bond yields and the US government bond yields. The

[54] Other papers are e.g. Laubach (2003), Pesani and Strauch (2003), Tavares and Valkanov (2001).

[55] For a detailed description of how the interest rates affect the government bond spreads see Manganelli & Wolswijk (2009).

authors concluded that yield spreads do respond to government indebtedness but that after the start of the EMU the markets' attention moved from government debts and deficits to debt service-to-GDP ratios.

Paesani et al. (2006) investigated the period between 1983 and 2003 for the USA, Germany and Italy, estimating a VAR model. They came to the conclusion that fiscal developments have influenced significantly the long-term interest rates.

Schuknecht et al. (2008) investigated the government bond risk premiums for the EMU and Canada using data on bond yield spreads at issue from 1999 to 2005. Then, in Schuknecht et al. (2010), they reviewed their previous findings for the EMU, extending the period until May 2009 and thus taking into account also the impact of the financial crisis. In both papers they estimated an OLS model with time fixed effects, including into the regression also two proxies for international risk aversion: the BBB US corporate bond yield spreads and also the short-term interest rates (3-month EURIBOR concretely). Their conclusion in 2008 was that yield spreads over an appropriate benchmark do respond to indicators of fiscal performance. In 2010 they added to this that the markets' reaction to fiscal imbalances has become stronger after the fall of the Lehman Brothers. However, they did not account for the effect of the crisis itself (their crisis dummy was only included in the regression in interaction with other variables), which would very likely have an impact on their results.

Alexopoulou et al. (2009) used monthly data for 8 new EU member states from 2001 to 2009 and did the estimation using the pooled mean group technique.[56] They also took into account the global financial conditions and proxied for them using the stock market volatility of the Dow Jones Eurostoxx 50 index. These authors' conclusion was that for most of the countries government bond yield spreads responded significantly to fiscal fundamentals.

Haugh et al. (2009) estimated a simple panel model for 10 EMU countries over the period from December 2005 to June 2009, using quarterly data. These authors also included in their regression a proxy for risk in the form of spreads between high yield corporate bonds and government bonds. They concluded that differing fiscal policies have an important impact on government bond yield spreads. They, however, noted that this was not so evident in the pre-crisis times when the general risk aversion was very low.

2.3 The governments' reaction

Literature dealing with our second research question is rather limited. The only paper that we were able to find is the already mentioned work by Balassone et al. (2004). These authors test for different time periods (1981 – 2003, 1981 – 1991, 1992 – 1998 and 1999 – 2003) using the Arellano-Bond estimation technique how the governments change their structural primary budget balance in response to a change in the market price of public borrowing and come to the conclusion that the governments tend to react with a delay to changing market conditions and that the spreads have a different impact on the fiscal behaviour of the state depending on the chosen time period (the effect being the strongest after the introduction of the EMU).

[56] Quarterly or annual observations were linearly interpolated.

3 Data and method

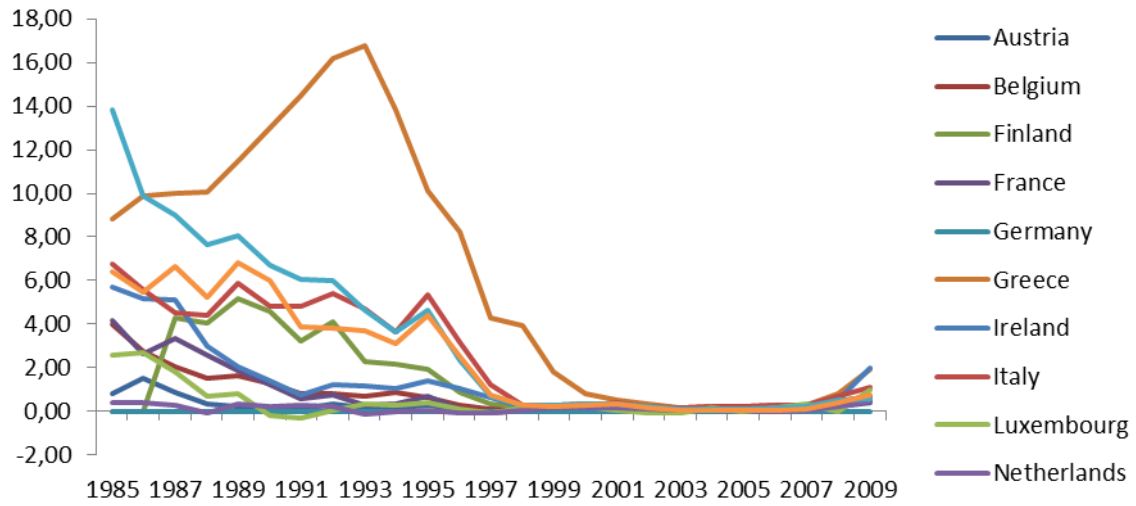
3.1 The markets' reaction

To investigate the issue of the financial markets' reaction we used quarterly data from 1999 until the end of 2009[57] for 16 EMU countries.

While many researchers work with data on bond yields at issue, we used data on (long-term) government bond yields provided by the IMF (International Financial Statistics), as the former were not available to us.[58] The rest of our data comes from the Eurostat except for data on US spreads that are also taken from the IMF.

We decided that the beginning of the period investigated would be year 1999 when the euro was introduced. It was shown e.g. by Blanco (2001) that the influence of the exchange rate risk on the yield spreads in the pre-EMU era was very significant. This is illustrated by Figure 1 where we can see that after the elimination of national currencies the long-term government

Figure 1 – Long-term government bond yield spreads of chosen EMU countries in 1985 – 2009 (in %)



Source: IMF, International Financial Statistics.

bond yield spreads, i.e. the difference between the long-term government bond yields of a given country and of Germany, decreased to very low numbers. The exchange rate risk is therefore something that has to be taken into account. Some researchers, such as Codogno et al. (2003), have treated the exchange rate risk component of the yield spreads using data on

[57] Working also with data for the first quarter of 2010 would have been very interesting but they were not available when the empirical part of this paper was written.

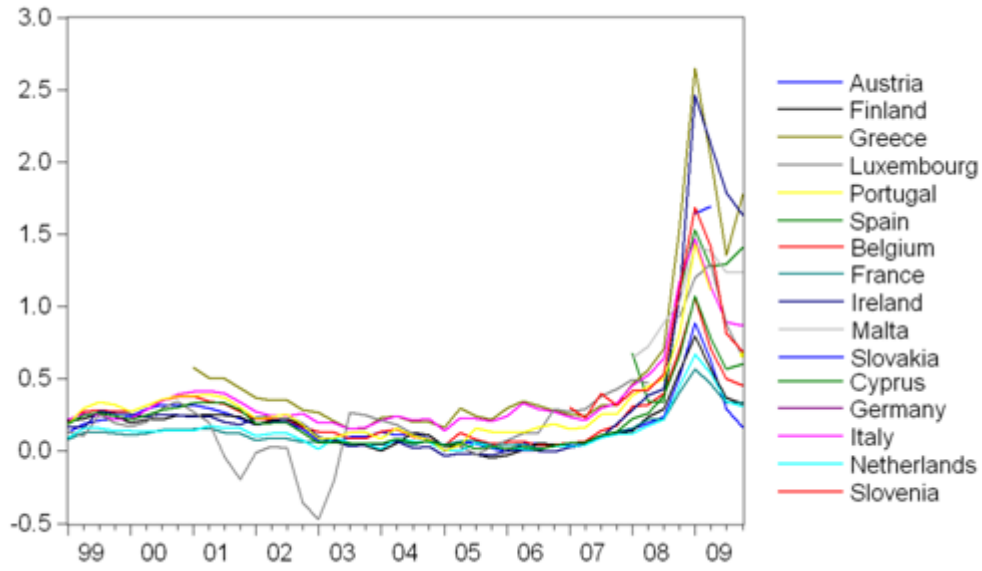
[58] Note that in the International Financial Statistics database the IMF does not do a precise distinction between different maturities of government bonds. It explains that 'Government Bond Yield refers to one or more series representing yields to maturity of government bonds or other bonds that would indicate longer term rates' – see http://www.imfstatistics.org/imf/IFSIntRa.htm .

swap contracts denominated in different currencies, but we do not have access to such data. As our estimation begins in 1999, we do not need to proxy for the exchange rate risk

Several countries from our sample, namely Greece, Cyprus, Malta, Slovenia and Slovakia, did not join the EMU already in 1999. These countries were only comprised in the estimation from their entrance into the EMU onwards.

Looking at Figure 2, we can see that while until 2007 EMU long-term government bond yield spreads were very low, in 2008 they started to rise quite significantly. In the Annex we included the spread figures for each country separately (Figure A2).

Figure 2 – Long-term government bond yield spreads of EMU countries in 1999 - 2009 (in %)



Source: IMF, International Financial Statistics.

As we have already mentioned, researchers generally agree that spreads are mainly influenced by the default risk, exchange rate risk and liquidity premiums, and factors such as transaction costs and differences in tax treatment or different sensitivities to common shocks. We assume that transaction costs and tax treatment are similar in the EMU and that exchange rate risk is not relevant any more. We therefore proxy for the default risk by using different fiscal indicators and we proxy for liquidity premiums and different sensitivities to shocks using other variables. Our regression is the following:

$$spread_{i,t} = \alpha + \beta(fiscal.indicators)_{i,t} + \gamma(other.factors)_{i,t} + \varepsilon_{i,t}$$

Our dependent variable, *Spread*, is the difference between a country's long-term government bond yield and the German long-term government bond yield, both expressed in percentage points.

All our indicators of fiscal performance refer to the general government. The key fiscal indicators that we use in our estimation are the following: budget balance (or net lending) as

share on GDP, expressed in percentage points, relative to Germany[59] (*NetLending*) that is expected to have a negative effect on the dependent variable, gross public debt as share on GDP relative to Germany (*GrossDebt*) that is expressed in percentage points and is expected to have a positive effect on the dependent variable, and the share of interest payable on governmental revenues (*Int/Rev*) that is expressed in percent and is also expected to have a positive effect on the dependent variable.

To take into account the external position of the given countries, we also include in our estimation the current account as share on GDP (*CA*), expressed in percent.

Based on Bernoth et al. (2006) we use as proxy for liquidity of a government's debt the share of this debt on the sum of debts of all EMU countries (*DebtShare*), expressed in percent.[60] To proxy for international risk aversion we use two variables: the short-run interest rates in the EMU - 3-month EURIBOR (*SR_IntRate*) and the spread between the US bank prime loan rate and the US 10-year government bond yield (*US_spread*), as defined by the IMF.[61] We also controlled for changes in GDP using the variable *GDPgrowth*, expressed in percent.

We use several time dummy variables. *crisis* has the value of 0 until the second quarter of 2008 and 1 from the fall of the Lehman Brothers on, i.e. from the third quarter of 2008 until the end of 2009, which is also the end of our dataset. To be also able to distinguish the period of the crisis from the preceding period of turmoil when we could already observe some signs of the upcoming crisis, we use the variable *turmoil* which has the value of 1 from the third quarter of 2007 to the second quarter of 2008 and 0 otherwise. To make sure that it is correct to suppose that it is important to differentiate between the period of turmoil and the crisis period, we also try to do our estimation with variable *turmcris* which does not take the difference into account, having the value of 1 from the third quarter of 2007 on and 0 otherwise.

We also used dummy variable *South* for southern EMU states[62] and dummy variable *HighDebt* for those EMU states whose gross public debt in the period under investigation was higher than 60% of their GDP on average.[63]

During our estimation we tried to include into the regression the squared terms of *NetLending* and *GrossDebt* and different interactions of the explanatory variables .[64]

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[59] I.e. the variables are expressed as difference from the German figures. This is because in our dependent variable we also compare the countries' yields to those of Germany that has historically been considered as a benchmark. To provide an example: a positive figure, such as 0.5, means that a country's net lending as share on GDP is higher than Germany's by 0.5 percentage points.

[60] Some authors use data on bid-ask spreads to proxy for the liquidity risk, but such data were not available to us.

[61] We wanted to follow previous research using the US corporate bond yields instead of the bank prime loan rate, but such data was not available to us.

[62] Namely Cyprus, Greece, Italy, Malta, Portugal, Spain.

[63] Namely Austria, Belgium, France, Germany, Greece, Italy, Malta.

[64] E.g. the interaction of crisis (or turmoil) and different fiscal or liquidity indicators; the interaction of country dummies and different fiscal or liquidity indicators; the interaction of crisis and country dummies and different

We also looked at the statistical properties of the key variables. We tested *Spread*, *NetLending* and *GrossDebt* for stationarity. We examined these time series using the Fisher-ADF panel unit root test. While for *NetLending* and *GrossDebt* we rejected the null hypothesis of unit root, in the case of *Spread* we could not reject this null hypothesis. The results are shown in the Annex, Table A1. Looking back to Figure 2 where we can see a clear rise in the spreads, this is not surprising. However, we suppose that such result of the test is mainly due to the possible presence of a structural break in the data connected with the latest financial and economic crisis.

We therefore estimate an OLS model, checking whether the inclusion of the country-specific fixed effects is appropriate.

3.2 The governments' reaction

To investigate the issue of the governments' reaction to the financial markets we used annual data from 1999 to 2009 for 16 EMU countries. We could not use quarterly data because the variable that we decided to use as dependent variable is only available on an annual basis.

Data on government bond yield spreads were taken from the IMF (International Financial Statistics) and all other variables were taken from the AMECO database of the European Commission.

Based on Balassone et al. (2004) we estimate a regression showing how governments adjust their fiscal policies in reaction to rising spreads. However, we also try to capture the effect of the latest crisis on the governments' behaviour.

Our regression is the following:

$$StrPrBal_{i,t} = \alpha + \beta StrPrBal_{i,t-1} + \gamma Spread_{i,t-1} + \delta(other.factors)_{i,t-1} + \theta crisis_{i,t} + \varepsilon_{i,t}$$

Our dependent variable which should capture the fiscal behaviour of governments is *StrPrBal* (the structural primary balance, defined by Eurostat as net lending excluding interest, cyclically adjusted based on trend GDP, expressed as share on GDP in percent. We use cyclically adjusted figures because these should reflect governments' fiscal behaviour better than not adjusted figures, as the governments clearly cannot influence the economic cycle (or events such as the latest crisis which caused a great economic slowdown in most countries). The development of this variable in the period under investigation is shown in Figure 3.

Our key explanatory variable is *Spread,* i.e. the difference between a country's long-term government bond yield and the German long-term government bond yield which is expressed in percentage points and which shows how the markets value the given country's government bonds. We expect that as *Spread* increases, the government starts reducing its borrowing to make the markets decrease the yields and thus lower its costs of borrowing.

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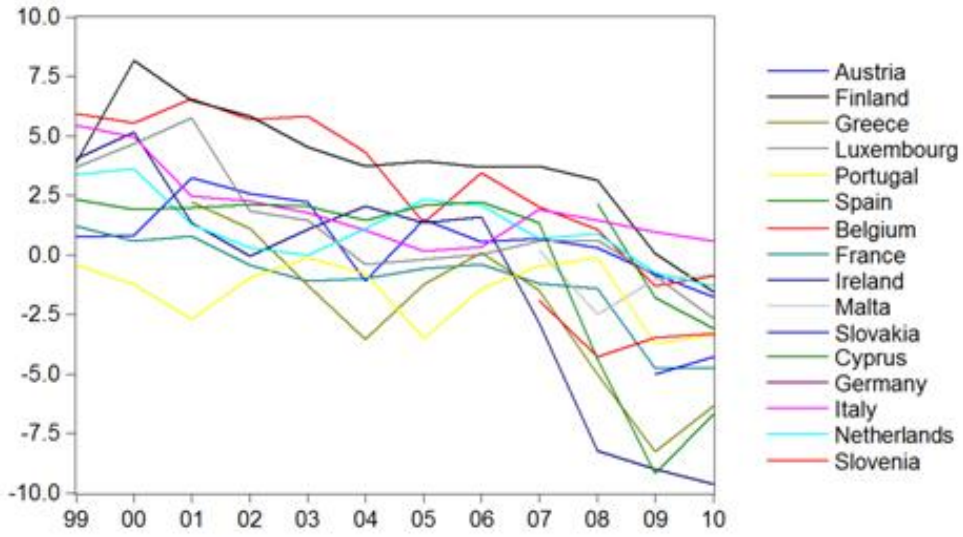
fiscal or liquidity indicators; the interaction of proxies for international risk aversion and different fiscal indicators.

As other factors that are likely to have an impact on a country's structural primary balance we use the lagged value of the dependent variable because the speed at which governments can increase revenues or decrease expenses is rather limited and thus the structural primary balance usually does not change very quickly; the gross public debt as share on GDP (*GrossDebt*) that is expected to have a positive effect on the dependent variable (we assume that a higher stock of debt induces the government to start pursuing more responsible fiscal policies) and the current account as share on GDP (*CA*) that is expected to have a negative effect on the dependent variable (we expect that lower current account balance will make the government decrease its net lending). All these variables are expressed in percent.

We again include into the estimation the dummy variable *HighDebt* in interaction with other explanatory variables to see whether high debt countries are adjusting their fiscal policies in a different way than countries with low public debts.

Figure 3 – Structural primary balance of EMU countries in 1999 – 2010 (in % of GDP)



Source: IMF, International financial statistics.

We use several time dummy variables that theoretically should be the same as in the previous estimation where quarterly data were used. However, as this time we use annual data, we need to simplify these variables: *turmoil* thus has the value of 1 in 2007 and 0 otherwise; *crisis* has the value of 1 in 2008 and 2009 and 0 otherwise; and *turmcris* has the value of 1 from 2007 on and 0 otherwise. In our estimation we try to include different interactions of the explanatory variables.

We also looked at the statistical properties of our key variables. We tested *StrPrBal*, *Spread* and *GrossDebt* for stationarity. We examined these time series using the Fisher-ADF panel unit root test. While for *StrPrBal* we rejected the null hypothesis of unit root, in the case of *Spread* and *GrossDebt* we could not reject this null hypothesis. The results are shown in the Annex, Table A2. However, as we work with very short time series, we have to bear in mind

that we cannot draw strong conclusions from the tests, also given that the end of our sample is strongly influenced by the crisis.

As we use the lagged value of the dependent variable as one of the explanatory variables which could give rise to autocorrelation, we apply the Arellano-Bond estimator (a dynamic panel data estimation technique, taking a partial adjustment based approach).[65] This is also consistent with the approach of Balassone et al. (2004).

4 Estimation results

4.1 The markets' reaction

Table 1 presents our estimation results. In all the models the coefficients have the expected signs.

We begin our estimation by the inclusion of *NetLending* and *GrossDebt* only in Model 1. We can see that the effect of both these variables on *Spread* is relatively high. However, the coefficient on *NetLending* diminishes by one half when we include also the *turmoil* and *crisis* dummies which can be seen in Model 2.[66] By doing this we try to estimate how the spreads were affected by the recent crisis. When we add also other variables, mainly interactions of different variables with the *crisis* dummy, the coefficient on *NetLending* gets even closer to 0. This suggests that in normal times the markets do not price the government bonds based on the states' deficits.

GrossDebt has a positive effect on *Spread*: when a country's gross debt increases by 1 percentage point relative to Germany, the spread of this government's bond yields relative to Germany increases by 0.009 - 0.01 percentage point, depending on the model. According to our estimation, the turmoil period had a significant effect on the spreads of government bond yields relative to Germany: in this period, spreads increased by 0.07 – 0.14 percentage points, depending on the model. Nevertheless, the effect of the crisis was even stronger: it caused an increase in spreads by at least 0.7 percentage points.

During the crisis, the importance of the height of the budget deficit increased significantly: an increase in *NetLending* by 1 percentage point resulted in a 0.03 percentage point decrease in *Spread*. Other two factors have also become important during the crisis: *DebtShare*, proxying for the liquidity premium, and *GDPgrowth*. In the time of crisis, the markets valued better bonds of countries with higher GDP growth (with a 1 percentage point increase in *GDPgrowth*, *Spread* decreased by nearly 0.02 percentage points) and also of those countries whose debt had a higher share on the whole euro-area debt (with a 1 percentage point increase in *DebtShare*, *Spread* decreased by 0.02 percentage points). This would suggest that the

[65] For more details on this method see Arellano & Bond (1991).

[66] The inclusion of these two dummy variables proved to be better than the inclusion of only one of them or the inclusion of *turmcris*.

largest Eurozone economies, such as Germany or France, were perceived as relatively safer borrowers.

Table 1 – Estimation results 1

Dependent variable: ***Spread***	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Const	0.3626 ***	0.2372 ***	0.2197 ***	0.0614 *	0.1956 ***
NetLending	-0.0285 ***	-0.0102 **	-0.0045 ***	-0.0029	-0.0036 **
GrossDebt	0.0109 *	0.0129 ***	0.0102 ***	0.0088 ***	0.0106 ***
Turmoil		0.1373 ***	0.1365 ***	0.0668 *	0.1263 ***
Crisis		0.7561 ***	0.7188 ***	0.7896 ***	0.7431 ***
Crisis*NetLending			-0.0329 ***	-0.0349 ***	-0.0334 ***
Crisis*DebtShare			-0.0205 ***	-0.0225 ***	-0.0205 ***
Crisis*GDPgrowth			-0.0178 ***	-0.0171 ***	-0.0175 ***
South*crisis*GrossDebt			0.0129 ***	0.0134 ***	0.0129 ***
SR_IntRate				0.0471 ***	
US_Spread					0.0153 ***
Adjusted R2	0.4246	0.7828	0.8526	0.8651	0.8548
Akaike criterion	207.09	-239.05	-413.64	-453.36	-419.76
DW statistic	0.6876	0.9516	1.1996	1.3465	1.2187
Test statistic for common intercept	6.9252 ***	19.4176 ***	20.3802 ***	20.1988 ***	21.1285 ***
Test statistic for normality of residuals	229.55 ***	229.36 ***	278.06 ***	343.85 ***	265.68 ***
Number of observations	460	460	460	460	460

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

In the time of crisis the importance of *GrossDebt* increased especially for southern EMU members. For these a 1 percentage point increase in the gross debt relative to Germany meant an additional 0.01 percentage point increase in the bond yield spread. It thus seems that during the crisis the financial markets started to be sensitive to many more factors than in the previous times.

Based on previous research papers we also tried to proxy for international risk aversion. In Model 4 we used the short-term interest rate (*SR_IntRate*) and in Model 5 we used *US_Spread*. Mostly the inclusion of these variables did not change much the coefficients of the other explanatory variables. This holds especially for Model 5 where the fit of the model increased only slightly. Nevertheless, in Model 4 the fit increased significantly, the biggest change in coefficients or their significance appearing in the case of *NetLending* and *turmoil*. It thus seems that the inclusion of the proxies for international risk aversion is relevant. An interesting finding is that in Model 4 the significance of *turmoil* has decreased with the inclusion of the proxy for international risk aversion. This would suggest that these two

variables are somehow interconnected. The same cannot, however, be said about variable *crisis*.

Many variables that we expected to be important were not significant in our estimations. These were first, the squared terms of *NetLending* and *GrossDebt*. Second, the current account, *CA*, and the share of interest payable on the revenues, *Int/Rev*. These two variables were not significant even in interaction with *crisis* or *South* dummies. Third, variables such as *DebtShare* and *GDPgrowth* were not significant when included by themselves, but in interaction with the *crisis* dummy they turned out to be significant. Fourth, variable *GrossDebt* was not significant in interaction with *crisis*, but when these two were interacted also with the dummy variable *South*, the term was significant. Fifth, when we included interactions of different fiscal indicators with proxies for international risk aversion, these terms did not turn out to be significant.

Finally, the dummy variable *HighDebt* was not significant, neither in interaction with fiscal indicators, nor with fiscal indicators and the *crisis* dummy, which would suggest that the markets did not perceive high-debt countries disproportionately differently from the low-debt countries. However, this would probably be different if we could have included data for year 2010 as spreads of many high-debt countries (such as Greece, Portugal) have risen significantly.

For all the models we have checked that neither pooled OLS, nor a random-effects model would be more adequate than the fixed-effects model: the test statistic for common intercept is highly significant in all cases (see Table 1) and according to the Hausman test GLS estimators would not be consistent.

Comparing our results with the previous research we note that our coefficients are mostly lower. Taking e.g. Schuknecht et al. (2010), we can see that our coefficients both on *NetLending* and *GrossDebt* are significantly lower and the same holds for the interaction of these variables with the *crisis* dummy. We attribute this especially to the fact that we have included the *turmoil* and *crisis* dummy variables also separately into the regression, not only in interaction with other variables. It thus seems that due to this we estimated the reaction of the markets to fiscal developments both before and during the crisis to be significantly lower than in the above mentioned paper, which would weaken the conclusions of its authors.

As we can see in Table 1, in none of the models the residuals have a normal distribution. We show in Figure A3 in the Annex that their main problem is probably too high kurtosis for having a normal distribution.

Our estimation suggests that financial markets do change their pricing of a government's bonds when its fiscal stance deteriorates. While before the start of the crisis government bond spreads basically responded to the level of gross public debt only (the budget deficits affected the spreads only very slightly or not at all), when the crisis began the importance of the budget deficits increased. Furthermore, southern states started to be penalized by the markets for the size of their public debt more than other Eurozone countries. This is very likely due to the fact that these states are often perceived as having relatively worse fundamentals.

4.2 The governments' reaction

Table 2 presents our estimation results. Of the four models, Model 2 seems to be the most appropriate: it has the best statistical properties as at the 5% level of significance it is not over-identified and the errors are not AR(2). All coefficients have the expected sign. However, *GrossDebt* is not significant in any of the models.

Table 2 – Estimation results 2

dependent variable: StrPrBal	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Const	-0.550 ***	-0.558 **	-0.516 **	-0.590 **
StrPrBal(-1)	0.512 ***	0.446 ***	0.489 ***	0.444 ***
Spread(-1)	0.522 *	1.179 ***		0.679
GrossDebt(-1)	0.002	0.001	0.004	0.003
crisis		-0.721 ***	-0.726 *	-0.996 ***
crisis*Spread(-1)			1.462 **	1.092
Safedef*Spread(-1)				
SSR	369.08	350.57	360.99	346.66
Test for AR(1) errors	-1.97 **	-1.86 *	-2.14 **	-2.00 **
Test for AR(2) errors	-0.81	-0.86	-0.74	-0.79
Sargan over-identification test	49.83	49.71	48.96	52.41 *
Wald (joint) test	48.51 ***	98.50 ***	100.54 ***	123.65 ***
Test for normality of residuals	2.59	3.29	3.04	2.65
Number of observations	112	112	112	112

Note: ***, **, * indicate 1%, 5% and 10% level of significance, respectively

We can see that *StrPrBal* is strongly influenced by its past value. Furthermore, in Model 1 we can see that with a 1 percentage point increase in *Spread*, *StrPrBal* increases by 0.5 percentage points but only at the 10% level of significance. This would suggest that the structural primary balance is strongly influenced by its height in the previous period but that it is independent of the financial markets' signals.

In all the other models we also take into account the effect of the crisis: variable *crisis* has a significant negative effect on the dependent variable. This event caused a decrease in the structural primary balance relative to GDP by 0.7 – 1 percentage points. Model 2 suggests that governments react to the bond yield spreads even at the 1% level of significance: with a 1 percentage point increase in *Spread*, *StrPrBal* increases by 1.2 percentage points relative to GDP in the following period.

We included into Model 3 the interaction of *crisis* and *Spread* instead of *Spread* only. The effect of this term was greater than the effect of only *Spread* itself: during the crisis a 1 percentage point increase in *Spread* made the governments improve the structural primary budget balance by 1.5 percentage points relative to GDP in the following period. The

coefficient was, however, slightly less significant. When in Model 4 both *Spread* and *crisis*Spread* were included in the estimation, they both turned out to be insignificant while the coefficient of *crisis* decreased to nearly -1.

However, when we tested the hypothesis that the coefficient on *Spread* was the same before and during the crisis, i.e. that coeff(Spread_1)=1.462 and coeff(crisis*Spread_1)=1.179, in neither of the two cases we could reject the null hypothesis that the reaction of governments to increasing costs of borrowing did not change after the start of the crisis. The result of this test is reported in the Annex, Table A3.

When we included into our estimation an interaction of *HighDebt* and *Spread*, and also *HighDebt* and *GrossDebt*, they both turned out to be insignificant.

Comparing our estimation results with Balassone et al. (2004) for the period 1999 – 2003 in their paper, we note the following: in our Model 1, which is the closest one to theirs, the estimate of the effect of the past value of the dependent variable is slightly higher in our estimation (0.51 compared to 0.45) and the effect of *Spread* is slightly lower (0.52 compared to 0.67). Unlike Balassone et al. (2004) our effect of *GrossDebt* is not significant.

However, when we take into account the effect of the crisis, the impact on the past value of the dependent variable is very similar to theirs (also 0.45) and the effect of *Spread* very significantly increases (the coefficient rises to 1.18 compared to 0.67 in their estimation).

As we only did our estimation for the period of time when the EMU was already in place, it is impossible for us to distinguish whether the governments improved the structural primary balance in response to the financial markets' signals or whether they did so because according to the SGP their deficits must not exceed 3% of GDP.

In this respect we may base our conclusions on the results of Balassone et al. (2004) who did their estimation for several time periods and in each of them they obtained different results: in the period 1992 – 1998 (which can be considered a time of a run up to EMU), the reaction of the structural primary balance to the spreads was significantly lower than for the period 1999 – 2003 when the SGP was already in place (0.16 compared to 0.67). This difference was even more significant for the period 1981 – 1991 (the coefficient on the spread was only 0.05) when EU countries were not bound by any supra-national fiscal rule and the introduction of such rule was not even planned.

Our estimation suggests that governments do react to increasing costs of borrowing (or spreads). However, given that spreads were mostly quite low after the inception of the EMU (in terms of tenths of percentage points, or tens of basis points, before the start of the crisis as we could see in Figure 2), an increase by 0.5 percentage points is already very big – such a thing happened e.g. to Greece between 2007 and 2008 (during this time its budget deficit increased from below 4% to 7.8% of GDP, i.e. it nearly doubled) or to Italy between 2008 and 2009 (during this time its budget deficit increased from below 2.7% to 5.2% of GDP) – and this would only trigger, according to Models 2 and 5, a 0.5 - 0.6 percentage point improvement in the structural primary balance in the following period. Given that such big

increase in spreads only happened when budget deficits increased a lot, such governments' reaction may simply not be sufficient to maintain fiscal discipline.

Therefore it seems that even if the SGP very likely contributed to a more responsible fiscal behaviour of the governments, it was not powerful enough and did not keep Eurozone countries from having excessive deficits. This can be documented by the fact that most countries whose spreads increased significantly in 2008 often corrected their deficits only slightly in 2009 and continued breaching the Pact.

5 Conclusion

The aim of this paper is to answer the question whether in the case of a monetary union the financial markets have a sufficiently disciplining effect on the governments' fiscal behaviour and whether thus fiscal rules are redundant. To do this we needed to investigate three issues: the institutional setup and market conditions in the EMU, the reaction of the markets to changing fiscal stances of governments and the reaction of governments to a change in the markets' pricing of their bonds.

Our results suggest that the markets do react to fiscal indicators but that this reaction was much weaker before the start of the latest financial and economic crisis than at the end of 2008 and in 2009. Before the crisis, government bond spreads reacted mainly to the gross public debt. However, the crisis has brought, apart an overall increase in the level of spreads, a reaction of the financial markets to budget deficits and, in the case of southern EMU states, an even stronger reaction to the height of the gross public debt. We expect that if 2010 data were included to the estimation, both these effects would probably become even stronger.

Concerning the governments' reaction to the change in financial markets' pricing of their bonds, our results suggest that the governments do react to increasing spreads of their bond yields relative to Germany by improving their structural primary budget balance but that the reaction is not very strong and we assume that before the introduction of the EMU it was even weaker. Also, we have found that this reaction was not affected significantly by the latest crisis.

Our conclusion could thus be that the financial markets could potentially have a disciplining effect on the governments. This is, however, spoiled by the rather weak reaction of the governments to changing market conditions. Furthermore, reminding the importance of the institutional setup and market conditions in the EMU, we have to note that there are many obstacles to the effectiveness of this setting. First, official data on government finance are released with a significant delay. Second, although bail-out is prohibited by the Treaty, these days we may suppose that the reaction both of the financial markets and of the governments is biased because of the behaviour of the EMU towards its members that got in financial troubles: the loans granted to Greece and Ireland are considered by many to be very close to a bail-out.

We are aware of the fact that the Stability and Growth Pact has not been powerful enough to keep the states fiscally disciplined even before the crisis, but we suppose that without this set of fiscal rules the member states' situation would probably be even worse. Given all the problems mentioned above our conclusion therefore is that the Stability and Growth Pact cannot be effectively substituted by the financial markets and the EMU thus needs to have fiscal rules, probably even stricter than the SGP itself.

ANNEX

Figure A1 – Government bond yields of EMU countries from 1999 to 2009 (in %)

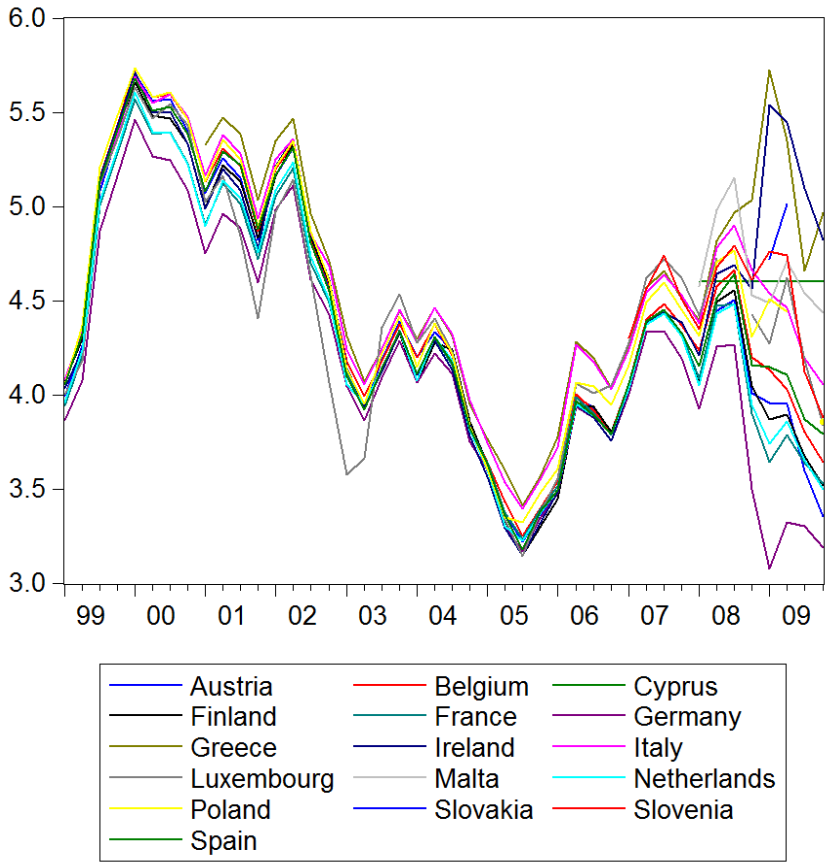


Figure A2 - Government bond yield spreads of EMU countries from 1999 to 2009 (in %)

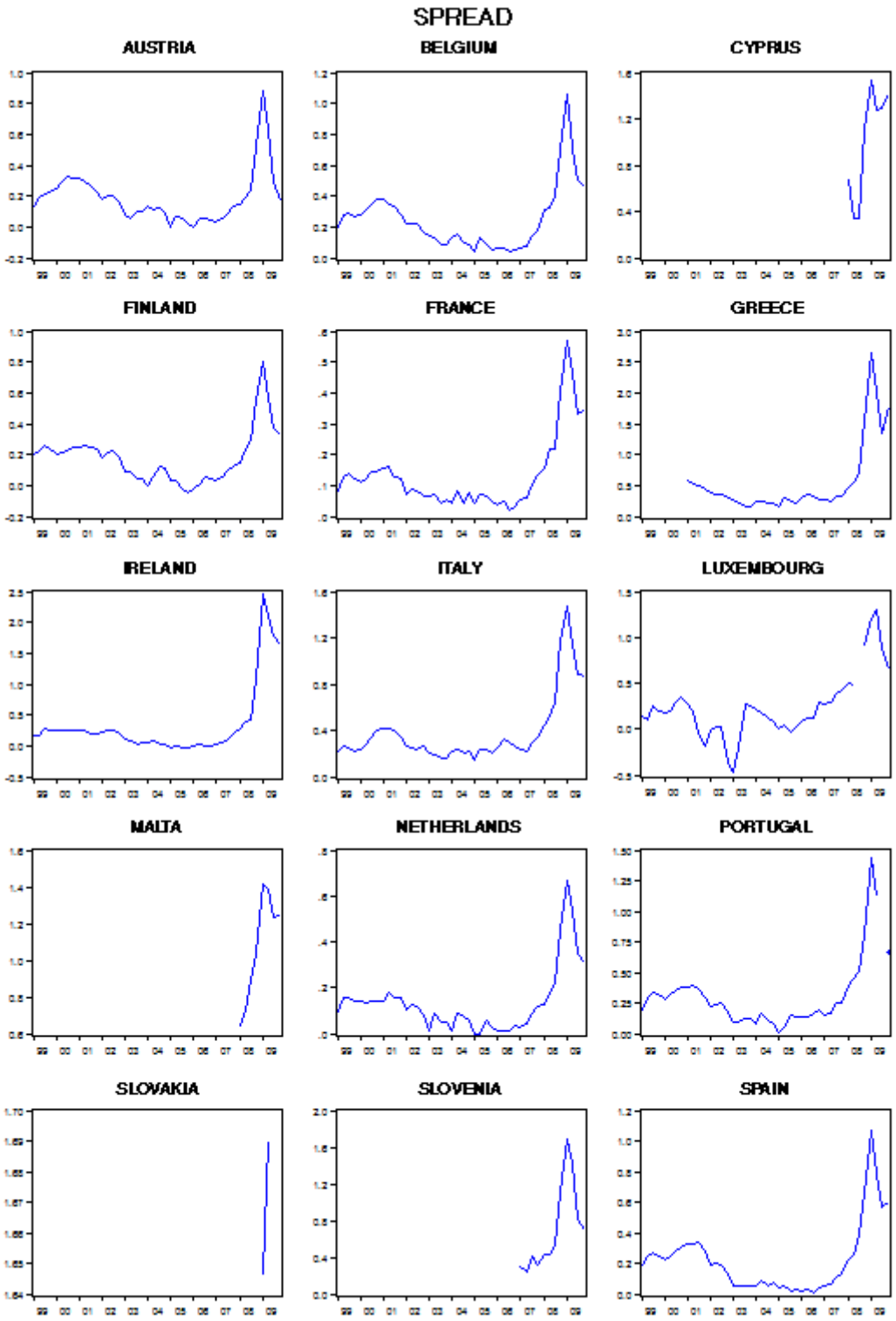
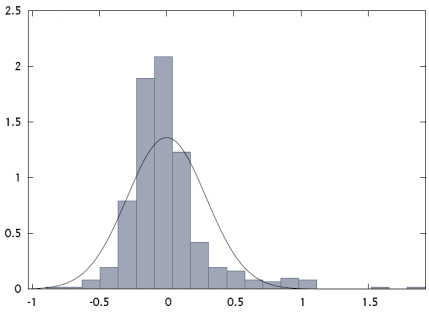
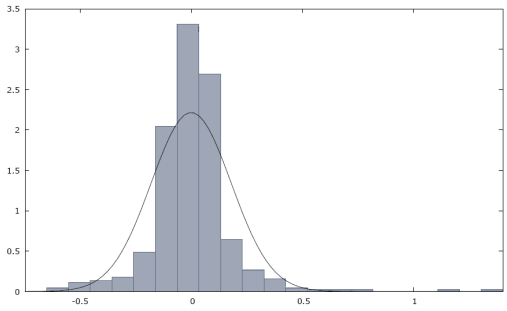


Figure A3 – Test for normality of residuals

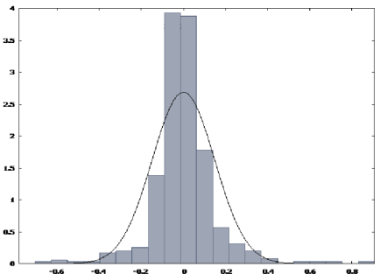
Model 1



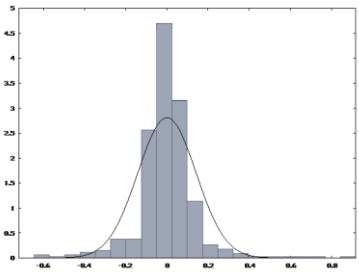
Model 2



Model 3



Model 4



Model 5

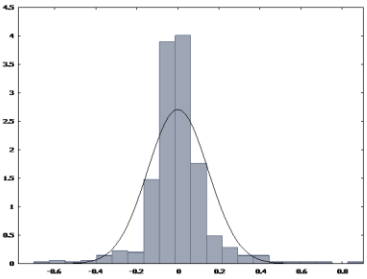


Table A1 – Panel integration and cointegration tests

Integration test			
	NetLending	GrossDebt	Spread
ADF – Fisher chi-square	46.6**	52.3***	32.5

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) for all tests the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) We assumed individual unit root processes.

Table A2 - Panel integration test

Integration test			
	StrPrBal	Spread	GrossDebt
ADF – Fisher chi-square	40.8**	20.2	18.3

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) for the test the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) We assumed individual unit root processes.

Table A3 – Hypothesis testing

Null hypothesis	**Test statistic**	**P-value**
coeff[spread_1] = 1.462	1.57304	0.2098
coeff[crisis*spread_1] = 1.179	0.233236	0.6291

REFERENCES

Alexopoulou, I.; Bunda, I. & Ferrando, A. (2009). 'Determinants of Government Bond Spreads in New EU Countries', ECB working paper no. 1093.

Ardagna, S.; Caselli, F. & Lane, T. (2004). 'Fiscal Discipline and the Cost of Public Debt Service - Some Estimates for OECD Countries', ECB working paper no. 411.

Ardy, B.; Begg, I.; Hodson, D.; Maher, I. & Mayes, D. G. (2006). 'Adjusting to EMU', Palgrave Macmillan, New York.

Arellano, M. & Bond, S. (1991). 'Some tests of specification for panel data', The Review of Economic Studies, vol. 58, no. 2, pp. 277-297.

Balassone, F.; Franco, D. & Giordano, R. (2004). 'Market-induced fiscal discipline: Is there a fall-back solution for rule failure?', Banca d'Italia - conference research paper, pp. 389-426.

Beetsma, R.; Debrun, X. & Klaassen, F. (2001). 'Is fiscal policy coordination in EMU desirable?', Swedish Economic Policy Review vol. 8, pp. 57-98.

Bernoth, K.; von Hagen, J. & Schuknecht, L. (2006). 'Sovereign Risk Premiums in the European Government Bond Market', Discussion Papers 151, SFB/TR 15 Governance and the Efficiency of Economic Systems, Free University of Berlin, Humboldt University of Berlin, University of Bonn, University of Mannheim, University of Munich.

Blanco, R. (2001). 'The Euro-Area Government Securities Markets. Recent Developments and Implications for Market Functioning', Paper prepared for the BIS Autumn Central Bank Economist's Meeting, Banco de Espaňa.

Blundell-Wignall, A. & P. Slovik (2010). 'The EU Stress Test and Sovereign Debt Exposures', OECD Working Papers on Finance, Insurance and Private Pensions, no. 4, OECD Financial Affairs Division.

Buiter, W. H. (2006). 'The 'Sense and Nonsense of Maastricht' Revisited: What Have We Learnt about Stabilization in EMU?', Journal of Common Market Studies vol. 44 (4), pp. 687-710.

Catenaro, M. & Morris, R. (2008). 'Fiscal policy and implementation in EMU', in Farina, F. & Tamborini, R., ed. Macroeconomic Policy in the European Monetary Union. Routledge, New York. pp. 19-44.

Codogno, L.; Favero, C. & Missale, A. (2003). 'Yield Spreads on EMU Government Bonds', Economic Policy, CEPR, CES, MSH vol. 18(37), pp. 503-532.

Eijffinger, S. C. W. & de Haan, J. (2000). 'European monetary and fiscal policy', Oxford University Press.

European Commission (2010). Memo/10/506 (20 October 2010) – An EU framework for Crisis Management in the Financial Sector – Frequently Asked Questions. http://europa.eu/press_room/index_en.htm

Feldstein, M. (2005). 'The euro and the stability pact', NBER working paper no. 11249.

Fitoussi, J.-P. & Saraceno, F. (2007). 'Fiscal discipline as a social norm: The European stability pact', Documents de Travail de l'OFCE 2007-22, Observatoire Francais des Conjonctures Economiques (OFCE).

Gale, W. G. & Orszag, P. R. (2002). 'The Economic Effects of Long-Term Fiscal Discipline', Urban-Brookings Tax Policy Center Discussion Paper.

Haugh, D.; Ollivaud, P. & Turner, D. (2009). 'What Drives Sovereign Risk Premiums? - an Analysis of Recent Evidence from the Euro Area', OECD Economics Department Working Paper no. 718.

Hedbavny, P.; Schneider, O. & Zápal, J. (2004). 'Does the Enlarged European Union Need a Better Fiscal Pact? ', UK FSV – IES Working Paper no. 55.

Kopits, G. (2001). 'Fiscal rules: Useful policy framework or unnecessary ornament?', IFM working paper no. 01/145.

Lemmen, J. J. & Goodhart, C. A. (1999). 'Credit Risks and European Government Bond Markets: A Panel Data Econometric Analysis', Eastern Economic Journal vol. 25 (1), pp. 77-107.

Lindbeck, A. & Niepelt, D. (2006). 'The Stability Pact - Rationales, problems, alternatives', KYKLOS 59, no. 4, pp. 579-600.

Manganelli, S. & Wolswijk, G. (2009). 'What Drives Spreads in the Euro Area Government Bond Market?', Economic Policy, CEPR, CES, MSH vol. 24, pp. 191-240.

Paesani, P.; Strauch, R. & Kremer, M. (2006). 'Public Debt and Long-term Interest Rates - The Case of Germany, Italy and the USA', ECB working paper no. 656.

Schneider, O. & Hedbavny, P. (2003). 'Fiscal Policy: Too Political', UK FSV – IES Working Paper no. 37.

Schuknecht, L.; von Hagen, J. & Wolswijk, G. (2010). 'Government Bond Risk Premiums in the EU Revisited - The Impact of the Financial Crisis', ECB working paper no. 1152.

Schuknecht, L.; von Hagen, J. & Wolswijk, G. (2008). 'Government Risk Premiums in the Bond Market - EMU and CAnada', ECB working paper no. 879.

Stark, J. (2001). 'Genesis of a Pact' in Brunila, A.; Buti, M. & Franco, D., ed. The Stability and Growth Pact. Palgrave, New York, pp. 77-105.

Woods, R. (2008). 'Notes on the reformed SGP: creating and implementing effective macroeconomic frameworks' in Talani, L. S. & Casey, B., ed. Between growth and stability -

The demise and reform of the European Union's Stability and Growth Pact. Edward Elgar Publishing Limited, Massachusetts, pp. 129-169.

Wyplosz, C. (2006). 'European Monetary Union - The dark sides of a major success', Economic Policy April 2006, pp. 207-261.

LEGISLATION

'Treaty on European Union', Official Journal C 191, 29 July 1992.

'Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community', Official Journal C 306 of 17 December 2007.

The Golden Rule of Public Finance and the Productivity of Public Capital

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Abstract:
This paper concentrates on the golden rule of public finance. It reviews the main advantages and disadvantages of the potential implementation of this rule in the European Union. Often the question of the productivity of public capital is at the heart of the rule's discussions. As this issue has mostly been investigated for the United States, we try to estimate the productivity of public capital using data on the current member states of the European Union. Working both with data on net capital stocks and gross capital formation, we come to the conclusion that there is a cointegrating relationship between capital and output and that this relationship is in most cases positive. However, as there are also other expenditures classified as current spending that have a positive effect on the output in the long run, we argue that the golden rule should not be introduced in the European Union if the current definition of public capital investment does not change for the rule's purposes.

Keywords:
Golden rule of public finance, European Union, Cointegration, Productivity of capital, Cobb-Douglas production function

JEL: C23, E22, E62, H52, H62

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1 Introduction

Reforms of the Stability and Growth Pact (SGP), the main fiscal rule of the European Economic and Monetary Union (EMU), have been discussed since its inception and many suggestions how to improve it have emerged. One of the proposals has been that the EMU's fiscal rule should get closer to the 'golden rule of public finance'. Basically, such rule says that current public expenditures should be financed by taxes while public capital investment may be financed by borrowing.

The level of public capital spending has decreased in the European Union (EU) since the 1970's, which is often attributed also to the SGP. The golden rule is expected to be able to change this trend and to induce an increase in public capital investment. It thus appears that public capital is perceived to be at a suboptimally low level in the EU.

One important assumption underlying the debates about the golden rule is the productivity of public capital. This issue has already been explored by many researchers. However, these concentrated mostly on the United States (US) or Organization for Economic Co-operation and Development (OECD) members. As we discuss the possible introduction of the golden rule in the EU, we investigate the productivity of the public capital for the EU countries.

We first introduce the golden rule as such, providing also examples of countries where such rule has already been implemented. Second, we discuss the possible implementation of the golden rule in the EU, both from the conceptual and the practical points of view. Third, and foremost, we investigate the productivity of public capital in the EU, using both data on net capital stocks and on (cumulative totals of) gross capital formation. Most importantly, we detect cointegration, i.e. a long-run relationship, both between net capital stock and GDP and gross capital formation and GDP. We find that at the aggregate level public capital is productive. However, we identify also such kinds of public capital that seem to have a negative effect on the output and, on the other hand, current expenditures whose effect on the output is positive in the long run.

The paper is organized as follows: in Section 2 we introduce and discuss the golden rule of public finance. In Section 3 we investigate the productivity of public capital in the EU. In Section 4 we conclude.

2 The Golden Rule of Public Finance

The golden rule of public finance basically says that current expenses by the state should be covered by current revenues and that governments can only borrow to invest. Such

description is, however, rather vague. Furthermore, many research papers operate with the golden rule without actually stating the definition of the rule – how exactly it is perceived and used. Nevertheless, several authors provide such definition.

Kellermann (2007) states that according to the 'golden rule of public borrowing', 'government deficit is accepted if accompanied by an increase in assets so that the government's net asset position does not deteriorate. Thus current expenditures must be covered by current receipts while for investment expenditure recourse to debt is allowed' (pp. 1089). This is in line with the definition of the golden rule as Creel (2003) uses it: 'over the cycle, government borrowing should not exceed net government capital formation; hence current expenditures should be financed by current receipts' (pp. 14).

It is well known that the golden rule was introduced in the United Kingdom (UK) in 1997. We can read in HM Treasury (1997) that 'over the economic cycle, the Government will only borrow to invest – public consumption (including the consumption of capital) will be paid for by taxation' (pp. 1). However, as, according to the HM Treasury, this rule would not guarantee the sustainability of public finances because a lot of public investment yields social returns but not necessarily taxable economic output, the sustainable investment rule also applies: 'over the economic cycle, the Government will ensure the level of public debt as a proportion of national income is held at a stable and prudent level' (pp. 1). In the UK the net debt of 40% of GDP is considered to be prudent.[67]

Balassone & Franco (2000) recall that a kind of golden rule is also in place in Germany: according to article 115 of the Constitution, 'borrowing cannot exceed the total investment expenditure in the budget; exceptions are only allowed to avoid disturbances to the overall economic equilibrium'.

Researchers have very differing views on the potential implementation of a golden rule in the EU – it seems that there are as many proponents of this rule as its opponents. This Section will present the most debated issues underlying the introduction of the golden rule.

2.1 Fiscal consolidation and public investment

The view that during fiscal consolidation public investment is cut more than current spending is commonly shared in the literature.[68] It is thus not surprising that the fiscal consolidation in the EU due to the introduction of the Stability and Growth Pact is often blamed for the decrease in public investment spending. Kellermann (2007) argues that one of the reasons for cuts in investment during fiscal consolidation is that lowering investment is politically more

[67] The rule operates with net debt because this should ensure that current taxpayers pay for the maintanance of capital stock.

[68] See Blanchard & Giavazzi (2003), Buti et al. (2002), Balassone and Franco (2000) or de Haan et al. (1996).

feasible than lowering current expenditures. Woods (2008) claims that this bias against investment was the reason why the golden rule was introduced in the UK.

Balassone & Franco (2000) argue that as under the SGP the budgets should be close to balance or in surplus, most capital investments have to be financed by taxes. This brings a disincentive to invest into large projects. The authors remind one of their models where they show that a policymaker with a finite horizon decreases public investment when a deficit ceiling is put in place. However, they remind that it has already been shown that even under a benevolent planner total welfare is lower when a ceiling on investment is applied because when a project is indivisible, it needs to be financed by higher (distortionary) taxes which then are not smoothed over time. Also, very realistically, they note that when a deficit limit is introduced, voters would prefer a cut in investment to a cut in current spending.

The European Commission (EC) (2003) looks at the development of the public capital formation in aggregate for the whole EU and compares the data with those for Japan and the US. The drop in public capital formation in the EU, especially in comparison with the other two countries, is much more pronounced, and the data furthermore suggest that this drop coincides with the run up to the SGP. Kamps (2005) notes that the EC saw this problem even before – in 2001 in the Broad Economic Policy guidelines it appealed to the member states to ensure an appropriate balance between public investment and decrease in public debt and taxes.

2.2 Assumptions underlying the desired increase in public investment

It is usually supposed that the introduction of the golden rule would increase public investment. However, this seems to have two implicit assumptions: first, that the level of capital in the EU is suboptimally low, and, second, that public investment is productive (and thus has a positive impact on the economy).

As for the first assumption, it is not sure whether this holds, especially in the case of the more developed EU member states. Kamps (2005) shows, using a simple model of endogenous growth, that in most EU countries the level of public capital stock is not suboptimally low.

Concerning the productivity of public capital, a lot of researchers have already investigated this topic and they have often come to different conclusions, some even finding that the productivity of public capital is negative. Most of the studies have been done for the United States and we do not know of any that would work with data for all the current EU member states. Therefore, we devote most of this paper to the issue of the productivity of public capital in the EU.

2.3 Intergenerational equity

One of the HM Treasury's[69] basic arguments supporting the introduction of the golden rule is that such rule promotes fairness between generations: current spending basically benefits only today's taxpayers, so the burden of such spending should not be passed on to future generations. On the other hand, when an investment is made, today's but also future taxpayers profit from such expenditure so they can also share the costs of the investment. This view is supported by many researchers; however, it is strongly opposed e.g. by Buiter (1998) and Buti et al. (2002).

The former admits that the golden rule allows for a smoothing of consumption and distortionary taxes over time and let households and firms borrow under better conditions than in the market (thanks to the tax and transfers system). However, he argues that the effect of public investment on intergenerational fairness may only be comprehensively captured by generational accounts and that even this picture may be partial and misleading . Doing such evaluation thus becomes extremely complex, if not impossible.

The underlying uncertainty of the future benefits of many projects supports the view that it is very difficult to quantify these benefits when trying to assess whether to finance an investment from taxes or debt to ensure intergenerational equity.

2.4 Optimal level of public debt

Blanchard & Giavazzi (2003) note that as under the SGP the budget deficit (including interest) should be balanced over the cycle, the public debt should eventually approach zero. However, according to them, there are many reasons why the public debt should be higher than zero – such as intergenerational transfers or public investment projects with a large social rate of return. This view is supported e.g. by Creel (2003).

On the other hand, Kellermann (2007), using a simple growth model with public capital, shows that debt financing of investment may not be optimal because it might negatively affect social welfare and the stock of public and private debt.

2.5 Definition of public capital investment

There is also the issue of the definition of public capital investment for the purposes of the golden rule. Buiter (1998) stresses the importance of the distinction between current and capital expenditure. He defines public consumption as spending whose 'benefits are exhausted within the accounting or reporting period', while public capital expenditure as spending that 'yields an (uncertain) stream of future returns beyond the current accounting or reporting period' (pp. 7). The (pecuniary) returns can be both direct and indirect. However, he

[69] HM Treasury (1998).

also claims that public investment should be done if future social returns are higher than social opportunity cost, i.e. these do not necessarily have to be pecuniary.

Sawyer (1997) outlines two possible notions of capital: the first one relates to gross capital formation, i.e. to fixed assets, and the other one is such expenditure that yields a stream a future benefits. These may, but do not have to be appropriated by the state and need not be tangible. Kellermann (2007) notes that it is very difficult to distinguish between productive and 'consumptive' public capital investment. To this he adds that certain types of expenditure, such as that on education, could also be considered as enhancing growth. Already the EESC (2006) mentioned the possibility of defining R&D and education expenditure as investment. Blanchard & Giavazzi (2003) and Creel (2003) agree on the fact that should a golden rule be introduced in the EU, the definition of the public investment would have to be broadened.

This would prevent the potential bias towards physical assets and against expenditure on growth enhancing intangible assets, such as human capital. This bias is also one of the arguments of Buti et al. (2002) against the introduction of the golden rule using the current definition of public capital.

2.6 Other practical issues

There are also many practical issues connected with the introduction of the golden rule in the European Union.

First, there is the question whether a significant change to the EU's fiscal rules is possible at all. Blanchard & Giavazzi (2003) note that a large change to the SGP which would require a modification of the Treaty would be very difficult to push through. They, however, think that changing the way public investment is accounted for in public budgeting would be possible without a modification to the Treaty.

Second, there is the problem of flexibility under the golden rule. Balassone & Franco (2000) argue that the golden rule is not helpful during downswings as capital investment expenditures take place with a significant delay. On the other hand, Ardy et al. (2006) argue that the golden rule allows sufficient flexibility to the governments as the length of the cycle is unknown and also because the definition of investment may be debated.[70]

Third, there are opposing views on whether the golden rule would improve transparency of the fiscal rules. While Blanchard & Giavazzi (2003) claim that the golden rule would introduce more transparency to the budgets,[71] Buti et al. (2002) and Balassone & Franco

[70] They provide a very good example of this, reminding that the British Labour government referred to all public expenditure as to investment in public services. This may, however, count against the golden rule: it only shows that it may happen that nothing changes with the rule's introduction if the definition of investment is cleverly made.

[71] They use Italy as example: in this country the government performs investments through a special agency that borrows money on the market and whose balance is not consolidated in the government accounts.

(2000) claim that the introduction of the golden rule would lead to opportunistic behaviour because of the incentive to classify current expenditures as capital expenditures, and that the multilateral surveillance would become even more complex and difficult. In this context, however, Balassone & Franco (2000) claim that if the governments self-impose the golden rule, like e.g. in the UK, there would be no problem of multilateral surveillance.

Finally, the transition to the golden rule is also perceived as problematic. Both Buti et al. (2002) and Balassone & Franco (2000) agree that an excessive burden would be placed on the current generations as they would not only have to pay the interest on previously made debts, but they would also have to fund new investments.

3 Empirical evidence on the productivity of public capital in the EU

As we already discussed in the previous Section, one important assumption underlying the desired increase in public capital investment is that public capital is productive. Many studies have been devoted to this question but the majority of them were performed for the US. For the needs of our discussion of the introduction of the golden rule in the EU, we investigate this issue for all 27 EU member states.

In this section we first review the literature treating the productivity of public capital. Second, we describe and discuss the data and the method used. Third, we present our estimation results and, at the end, we provide a brief summary of our findings.

3.1 Related literature

The question whether investment into public capital enhances economic growth has been investigated since the 1970's. Several approaches to this issue have been taken, varying from estimation of a production function, a translog production function, a profit or cost function to estimation of different kinds of VAR models.

Batina & Ihori (2005) provide a large overview of research on public investment's effect on economic growth, mainly in the US. The first important paper, which evoked a lot of reactions, was that of Aschauer (1989). He estimated a Cobb-Douglas production function (adding a time trend into it and assuming constant returns to scale) and concluded that the elasticity of private output with respect to public capital was 0.39, public capital being more productive than labour or private capital. He also found that infrastructure, such as motorways, mass transit, airports, electrical and gas facilities and sewers, has an output elasticity of 0.24. On the other hand, the output elasticity of hospitals was estimated to be 0.04 and that of educational buildings even negative (-0.01). Nevertheless, this all was done for

aggregated data, i.e. for the whole USA. When in Aschauer (1990) disaggregated and time averaged data were used (i.e. data for individual US states were averaged over time), the output elasticities were estimated to be much lower than in the previous paper.

Most other research classified as 'early studies' by Batina & Ihori (2005) also found that public capital is productive. These studies took a production function, cost function and profit function approaches. However, they were criticised very soon, mainly from the statistical point of view.

Further studies used both aggregated and disaggregated data for the US. We especially focus on those using disaggregated data because we do not want to ignore differences among the EU countries' economies. Studies using disaggregated data that are reviewed by Batina & Ihori (2005) used more approaches than the 'early studies': system estimation or VAR models can also be found there. These papers reach various conclusions on the productivity of public capital; some even claim that state public capital has a negative impact on the output.

Munell (1990) estimated panel data for the US and her result was that public capital had a positive effect on the state output, the coefficient being 0.15. However, when constant returns to scale were imposed on all the inputs, the estimate was only 0.06.

The results of Holtz-Eakin (1994) were different. He estimated a production function where the error term was composed of a random variable, a state-specific and a time-specific effect. He estimated his data using several approaches and in most cases the effect of public capital on private output was negative.

Garcia-Mila et al. (1996) estimated a production function using panel data for the US and as proxy for public capital stock they included different kinds of infrastructure. Their estimates of the effect of public capital on private output were positive, irrespective of whether random or fixed effects were used. However, the authors came to the conclusion that the estimation should be done in first differences, based on different specification issues, and when this approach was used, the estimates were negative and insignificant. Therefore the conclusion of the authors is that 'there is no evidence of a positive linkage between public capital and private output' (pp. 180).

When comparing the results of estimation of aggregated and disaggregated data, Batina & Ihori (2005) note that cross section may dominate in panel data analysis and public capital can thus appear less productive. This is the reason why the use of aggregated data usually yields higher estimates of the public capital productivity. As already noted above, this was in fact confirmed by Aschauer's 1989 and 1990 papers.

Sturm et al. (1998) and De Haan & Romp (2005) provide an overview of research into the relation of public capital and economic growth in a more 'problem-based' manner than Batina

& Ihori (2005). They point out several issues that may be important for our own estimation, which is discussed below.

First, there is the issue of how public capital should be defined. If we think of core infrastructure, such as roads, rails, power stations etc., we need to take into account that not all these are provided by the state (e.g. the power stations). Another problem is that public investment can be put into roads, hospitals or schools, but also into equipment such as a swimming pool, which is usually not considered to be productive. Therefore, not all government's expenditures on capital are productive. Furthermore, if we take government spending on capital as a regressor, we have to take into account that the height of current investment very likely depends on the current level of capital.

Second, there is the problem of the kind of production function we estimate. One issue is how public capital (G) enters the production function. Let us have the following production function:

$$Y_t=A_t(G_t).f(K_t,L_t,G_t) \qquad (1)$$

where *A* stands for technology, *K* for private capital, *L* for labour and *G* for public capital.

Very often we can see that public capital enters it in the same way as e.g. private capital or labour. However, De Haan & Romp (2005) suggest that it may be more reasonable to insert it into the production function as something that influences productivity (*A*). This problem was in fact solved by Sturm et al. (1998) who came to the conclusion that when a Cobb-Douglas production function is estimated in log levels, both approaches lead to similar equations to be estimated.

Other issues that we should take into account during the estimation are the following: it seems to be very important to do the estimation with country specific effects – otherwise the estimates could be biased and inconsistent. Also, it may be important to find whether public and private capitals are complements or substitutes because of possible crowding-out effects.

Third, there is the issue of possible problems with the data. Most cited is the non-stationarity of data, which may be a problem even for panel data sets. In some cases this may be solved by first differencing the given variables, but, as explained e.g. by Munnell (1992), this may deprive us from the possibility to estimate any long-run relationship between inputs and the output, because in such estimation the output in a given year depends only on inputs from that year. This was confirmed by Garcia-Mila et al. (1996), as already described above.

Furthermore, Sturm et al. (1998) note that researchers should also investigate whether the variables are cointegrated (i.e. whether they grow together and converge to their long-run relationship).

Fourth, there is the problem of reverse causation or simultaneity bias. Usually the causality is expected to be the following: public capital determines output. But it is also possible that

there is a feedback from output to the capital stock, as higher output can have a positive effect on the demand for infrastructure. De Haan & Romp (2005) mention several possibilities of dealing with this problem. Those that are out of the scope of this paper are estimation using the generalized method of moments, estimation of simultaneous equations, a VAR model, or the use of instrumental variables.

Calderon & Serven (2002) estimate panel data and solve the problem of reverse causation by using the instrumental variables approach. They use demographic variables as instruments and supplement these with the lagged values of explanatory variables as weakly exogenous instruments. However, as the result of such estimation is very similar to the outcome of their pooled OLS model which they consider to be misspecified, they seem to be rather disappointed by the results of the instrumental variables approach.

Actually, it is possible that the bias of estimates caused by the reverse causation is not very significant: Cadot et al. (1999), working with data on French regions, took a simultaneous equations approach to the modeling and then compared their estimate of the elasticity of output with respect to public capital (0.101 for the whole of France) with that made by simple OLS (0.099). We can see that the difference between these two estimates is very small.

3.2 Data and Method

Our analysis is based on the Cobb-Douglas production function. As already noted earlier, when such production function is estimated in log levels, it does not matter how the public capital enters the function. Therefore let us have a production function in the following form:

$$Y_t = A_t K_t^{\alpha} G_t^{\beta} L_t^{\gamma} \qquad (2)$$

where *Y* stands for output, *A* for technology, *K* for private capital, *G* for public capital, *L* for labour (i.e. the number of workers) and *t* is a subscript for time. Assuming constant returns to scale, i.e. $\alpha+\beta+\gamma=1$, we can express the equation in per worker terms:

$$\frac{Y_t}{L_t} = A_t \left(\frac{K_t}{L_t}\right)^{\alpha} \left(\frac{G_t}{L_t}\right)^{\beta} \qquad (3)$$

Expressing the variables per worker by lower case letters and taking the natural logarithm, we get the following equation:

$$\ln y_t = \ln A_t + \alpha \ln k_t + \beta \ln g_t \qquad (4)$$

Basically, we should estimate the following equation:

$$\ln y_{i,t} = \tau + \alpha \ln k_{i,t} + \beta \ln g_{i,t} + u_{i,t} \quad (5)$$

In the estimation of this equation the constant τ will approximate the logarithm of technology. Based on previous research, we expect that a simple pooled OLS would very likely yield

misspecified estimates, due to e.g. differences in production technology across countries. Therefore we do our estimation with country-specific and time-specific effects. This leads us to suppose that the error term has the following form:

$$u_{i,t} = \mu_i + \upsilon_t + \varepsilon_{i,t} \qquad (6)$$

where we suppose that μ_i is the country-specific component, υ_t is the time-specific component and $\varepsilon_{i,t}$ is an i.i.d. error with a zero mean. Either we may take the approach of a fixed-effects model (FE model) where we suppose that μ_i captures the unobserved differences among the countries, or the approach of a random-effects model (RE model) where we suppose that μ_i has zero mean and is uncorrelated with the explanatory variables (Wooldridge, 2006).

We suppose that the public capital does not crowd out private capital. This is not refuted in the literature: de Haan et al. (1996) investigated this issue and concluded that public and private investment are complements. The results of the European Commission (2003) were rather inconclusive.

We work with a panel of annual data for 27 EU countries in the period 1960 – 2009. Nevertheless, for many countries a lot of observations are missing, especially for certain variables.

Our data were mostly retrieved from the Eurostat database. However, several important variables were taken from other sources.

Data on gross domestic product and employment were retrieved from the Ameco database of the European Commission. In this database, figures on GDP were more complete and available for a longer time period than in the Eurostat database).

Data on net capital stock, both for the general government and the private sector, were provided by the Kiel Institute for World Economy (estimates were done by Christophe Kamps in 2004). The estimates of capital stocks exist from 1960 to 2001 for 22 OECD countries, of which only 14 are EU members. Figures on gross capital formation, both for the general government and the private sector, were retrieved from Eurostat. They are available since the 1970's, although for some of the countries since the 1990's only. Figures on different kinds of gross capital formation are usually available from the 1990's on.

All our variables are expressed in EUR per person employed and in natural logarithms, if not stated otherwise.

Our key variables are the following: gross domestic product (*GDP*) as the dependent variable, and net public capital stock (*NGCS*) and net private non-residential capital stock (*NPCS*) as explanatory variables. As the net capital stock variables are only available for 14 EU countries that are also OECD members, we suppose that the countries are sufficiently homogenous so

that there is no problem with poolability of the data. Following Aschauer (1993), we add a time[72] (and time squared) variable to proxy for the technological progress.

We first look at the statistical properties of the key variables. In the Annex we included three figures showing the key variables (Figures A1-3). Given these figures we did not expect the variables to be stationary. This was confirmed by the unit root tests that we performed on all the variables: we could not reject the null hypothesis of unit root at any of the usual levels of significance. The results are presented in the Annex, Table A1.

As the variables are all integrated of order 1, we investigate whether there is a cointegrating relationship among them, i.e. whether it is possible to find a linear combination of them that would yield disturbances that are integrated of order 0, which would mean that the difference among them is stable and they thus grow at roughly the same rate (Greene, 2002).

Therefore, we apply the Pedroni residual cointegration test to find whether there is panel cointegration between the two capital stock variables and GDP. As shown in the Annex, Table A2, the null hypothesis of no cointegration was rejected at the 1% level of significance using the Augmented Dickey-Fuller test statistic and at 10% level of significance using the Phillips-Peron test statistic.[73]

To quantify the long-term relationship between capital stock and GDP we estimate an OLS model and then we try whether the inclusion of fixed or random effects is appropriate. Granger (1981) and Engle & Granger (1987) showed that due to a cointegrating relationship between given variables, the coefficients that we obtain are super consistent, i.e. they converge to their true values faster than a usual OLS estimator with stationary variables. However, the standard errors are not consistent.

To account for the possible simultaneity bias, we also do the estimation using first lags of our explanatory variables. We are aware of the fact that this method is very simplistic and has many limitations, but the simultaneous equations approach or instrumental variables method are out of the scope of this paper, especially due to the lack of data available for such procedures.

Data on net public capital stock are not available in a more detailed breakdown. As we assume that different kinds of capital have different productivity, we also work with data on gross capital formation that exist for several categories.[74] To be able to use these as stock variables, we compute their cumulative totals per person employed and express these in natural logarithms.

[72] The variable *time* ranges from 1 to 50.

[73] Anytime we tested for cointegrating relationship among given variables, we ensured that this relationship does not disappear when time trend and time^2 were included. To save space, the results of these are not presented.

[74] Net figures are not available.

Data on gross capital formation are available aggregated for the private and public sector (*PGCF* and *GGCF*, respectively) and also in different functional categories for the public sector (the Classification of Functions of Government in ESA 95). Following Kappeler & Välilä (2007) we sort those that we assume could be productive into three groups: infrastructure (economic affairs – *GGCF_IN*), health and education (health, education – *GGCF_HE*) and public goods (defence, general public services, environment, public order and safety – *GGCF_PG*). For illustration we also show the graphs of *GGCF* and *PGCF* in the Annex, Figure A4. We can see that these two variables do not seem to be stationary, which was also confirmed by statistical tests: in the case of *PGCF* we could not reject the null hypothesis of unit root on any of the usual levels of significance and in the case of *GGCF* we could not reject it at the 1% level of significance. We, however, bear in mind that the results of the tests are not 100% reliable as the length of the time series varies only between 15 and 39 observations. The results are presented in the Annex, Table A3.

Therefore, we test whether there is a cointegrating relationship between *GDP* and *PGCF* and *GGCF*. The result of the test is in the Annex, Table A4. We can see that the null hypothesis of no cointegration is strongly rejected. We continue by replacing *GGCF* with the three different kinds of this variable. We test these three variables and *PGCF* for cointegration with *GDP*. The result of this test is presented in the same table in the Annex. We can see that the null hypothesis of no cointegration is rejected at the 1% level of significance. We again note that as the number of observations does not exceed 20 for any of the countries, the result of the test is not 100% conclusive. However, it remains useful for having a picture on the roles of the different kinds of public expenditures. Thus, based on the tests, we assume that from OLS estimation in all the cases we should get consistent coefficients.

Nevertheless, there are also other types of government's expenditure that are considered to be very important for economic growth. These are especially resources spent on research and development (*R&D_G*) and on education (*EXP_E_G*), which can be considered as a kind of investment into human capital, both being expressed in logarithms of their cumulative totals. Their graphs are shown in the Annex, Figure A5. These variables do not seem to be stationary, which was confirmed by the unit root tests: in the case of *EXP_E_G* we could not reject the null hypothesis of unit root at any of the usual levels of significance and in the case of *R&D_G* we did not reject this hypothesis both at the 1% and 5% level of significance (see Table A5 in the Annex). Like in the previous unit root testing, we note that as the length of the time series is limited, so are the test's results, which will also hold for the following cointegration testing.

We tested for cointegration between *GDP* and *PGCF, GGCF, R&D_G,* and *EXP_E_G.* The results of the test are in the Annex, Table A6. We did reject the null hypothesis of no cointegration among the variables. We thus expect our estimators to be consistent.

3.3 Estimation results

3.3.1 Net capital stocks

We begin with the estimation of net capital stock variables as determinants of GDP. Table 1 presents the results. In all models presented in the table the coefficients have the expected sign. We begin with the pooled OLS in Model 1. Its result is that public capital is only slightly less productive than private capital. However, when country-specific fixed effects are included in Model 2, the productivity of the public capital decreases significantly, to 0.34.

Table 1 – Estimation results – net capital stocks

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Const	0.2501 **	0.1199	0.2004 ***	0.2598 ***	0.1255 ***	0.2061 ***
NGCS	0.4284 ***	0.3380 ***	0.2293 ***	0.2213 ***	0.3432 ***	0.2371 ***
NPCS	0.5376 ***	0.6439 ***	0.4679 ***	0.4561 ***	0.6385 ***	0.4649 ***
time			0.0359 ***			0.0353 ***
time^2			-0.0020 *			-0.0002 ***
fixed effects (cross-section)	no	yes	yes	yes	no	no
fixed effects (time)	no	no	no	yes	no	no
random effects	no	no	no	no	yes	yes
Adjusted R2	0.9778	0.9933	0.9959	0.9958		
Akaike criterion	-444.6	-1127.9	-1416.1	-1362.8	-412.6	-395.9
F statistic	12882.9 ***	5734.8 ***	8330.3 ***	2456.9 ***		
Test statistic for common intercept		103.360 ***	154.940 ***	150.097 ***		
Test statistic for consistence of GLS estimates					2.8188	5.4454
Test statistic for normality of residuals	36.137 ***	72.840 ***	66.220 ***	67.205 ***	37.651 ***	52.393 ***
Number of observations	585	585	585	585	585	585

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

On the other hand, the productivity of private capital increases and gets nearly twice as high as the productivity of the public capital (0.64). When we add two variables proxying for the technological progress, *time* and $time^2$, in Model 3, we can see that the coefficients on both capital stocks decrease but that the productivity of private capital remains double that of private capital. Furthermore, the fit of Model 3 is much better than the fit of Model 2.

When we exclude the proxies for technological progress but add to the estimation the time fixed effects that can account for common factors such as the business cycle, we can see in Model 4 that in comparison with Model 3 the fit did not improve and that the coefficients remained nearly the same.[75] In all models where fixed effects were used the tests for common intercept suggest that the use of this kind of model is more appropriate than the use of pooled OLS.

We then proceed by estimating the basic model with the inclusion of the random effects. The results of Model 5 are very similar to the results of Model 2 and both types of capital are very productive. However, when we include the two time variables in Model 6, we can see that the coefficients decrease to levels similar to Models 3 and 4. We can see from the test statistic for consistence of GLS estimates that the use of random effects is appropriate.

All models where either the time variables or time fixed effects were included predict an elasticity of GDP with respect to the public capital stock to be at least 0.22, i.e. when *NGCS* increases by 1%, *GDP* increases by 0.22%. When these time specific effects are not included, the productivity of public capital is predicted to be more than 0.33. Also the elasticity of *GDP* with respect to the private (non-residential) capital stock is predicted to be higher by models without time specific effects (up to 0.64) and lower when these effects are included (around 0.46). As there is a cointegrating relationship among the variables, the estimators should be super consistent, while the standard errors are inconsistent and thus not decisive. In none of the models we could accept the null hypothesis of normally distributed residuals.

Our results suggest that both capital stocks are highly productive, although not as much as e.g. in Aschauer (1989) who also uses figures on net public capital stock. This is not surprising because Aschauer uses aggregated data while we use disaggregated (country-level) data and, as we have already noted, the productivity of capital is usually estimated to be lower when disaggregated data are used.

To account for the possible problem of reverse causation, we run the estimation again but including the first lag of the explanatory variables, as current level of GDP can hardly have a backwards influence on the past period level of capital stock. As can be seen in Table 2, the

[75] We note that when both the time variables and time fixed effects were included into the regression, logically the coefficients were the same as in Model 4, except for the constant.

coefficients did not change much: in the case of NGCS the decrease was never greater than by 0.03 and in the case of NPCS the decrease was by 0.04 at most. The private capital has remained twice as much productive as public capital. As in the previous estimation, GLS estimators seem to be consistent.

The finding that the coefficients were nearly the same as in the previous estimation suggests that the simultaneity bias might really be rather small.

Table 2 – Estimation results – lagged values of net capital stocks

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
const	0.3853 ***	0.2570 **	0.2497 ***	1.5794 ***	0.2644 ***	0.2597 ***
NGCS (-1)	0.4271 ***	0.3369 ***	0.1987 **	0.2010 **	0.3437 ***	0.2115 ***
NPCS (-1)	0.5183 ***	0.6239 ***	0.4287 ***	0.4262 ***	0.6168 ***	0.4246 ***
time			0.0493 ***			0.0479 ***
time2			-0.0004 ***			-0.0004 ***
fixed effects (cross-section)	no	yes	yes	yes	no	no
fixed effects (time)	no	no	no	yes	no	no
random effects	no	no	no	no	yes	yes
Adjusted R2	0.9755	0.9909	0.9941	0.9943		
Akaike criterion	-409.9	-974.7	-1225.5	-1208.9	-381.2	-306.3
F statistic	11643.4 ***	4232.7 ***	5771.5 ***	1813.3 ***		
Test statistic for common intercept		76.382 ***	111.843 ***	113.525 ***		
Test statistic for consistence of GLS estimates					2.7387	8.1177 *
Test statistic for normality of residuals	32.77 ***	58.85 ***	51.09 ***	57.06 ***	30.96 ***	89.16 ***
Number of observations	585	585	585	585	585	585

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

3.3.2 Gross capital formation

To be able to account for differences in productivity of different kinds of capital, we continue by estimating the effect on GDP of the cumulative totals of public and private gross capital formation, as these data are available for several categories. We begin by including into the estimation the private and public gross capital formation in aggregate form. The results of this estimation are shown in Table 3.

In all models the coefficients have the expected sign, except for the proxies for technological progress. Like in the previous estimation, we can see that in the pooled model (Model 1) both coefficients on gross capital formation, but especially that on *PGCF*, are higher than in the other models where fixed effects were included.

Model 4, where both the country-specific and time-specific fixed effects are included, seems to be best specified. According to it, private gross capital formation is nearly three times more productive than public gross capital formation. Again, given the cointegrating relationship among the variables, our estimators should be consistent. GLS estimates, on the other hand, were not consistent in any model, as indicated by the test statistics.

As for the negative coefficient on time, it seems that this variable has become a strange proxy for technological progress. It is not very realistic that technologies would face such a downward sloping trend. This finding also seems to be at odds with all growth theories claiming that economic growth is based on technological progress.

Table 3 – Estimation results – cumulative gross capital formation

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**
const	1.7564 ***	2.6467 ***	6.0412 ***	2.4948 ***
PGCF	0.4407 ***	0.2045 ***	0.2089 **	0.2325 **
GGCF	0.0999	0.0697	0.0693	0.0859
time			-0.1665 ***	
time2			0.0020 ***	
fixed effects (cross-section)	no	yes	yes	yes
fixed effects (time)	no	no	no	yes
Adjusted R2	0.7342	0.9695	0.9738	0.9751
Akaike criterion	429.769	-444.240	-504.86	-510.26
F statistic	572.9 ***	471.6 ***	513.8 ***	345.5 ***
Test statistic for common intercept		123.407 ***	55.432 ***	50.98 ***
Test statistic for consistence of GLS estimates		232.262 ***	207.313 ***	220.549 ***
Test statistic for normality of residuals	9.568 ***	50.683 ***	48.964 ***	47.882 ***
Number of observations	415	415	415	415

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

Not surprisingly, our estimators are significantly lower than those presented in Table 1. This is probably caused by the fact that at the beginning we worked with net figures while now

gross figures are used. It is logical that the effect of variables expressed in gross terms on GDP is lower because they were not netted of depreciation etc. Nevertheless, this is what is usually best available and what we can work with when discussing fiscal rules.

To be able to see the effects of different kinds of the public gross capital formation, we include into the regression the three categories of this variable. The results of this estimation are in Table 4. We can see that the pooled OLS model, in comparison with the fixed effects models and also in comparison with the fixed effects models presented in Table 3, strongly overestimates the coefficient on *PGCF*. In the current three fixed effects models the coefficients on *PGCF* are very similar, ranging from 0.087 to 0.112, but they are significantly lower than in fixed effects models shown in Table 3.

Table 4 – Estimation results – subcategories of cumulative gross capital formation

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**
const	1.8188 ***	3.1327 ***	6.9366 ***	3.0409 ***
PGCF	0.4650 ***	0.0877	0.0948	0.1119 ***
GGCF_IN	0.0913	0.1125	0.0521	0.0699
GGCF_HE	0.0426	0.1154	0.1522	0.1527
GCCF_PG	-0.0563	-0.0485	-0.0366	-0.0332
time			-0.1889 ***	
time2			0.0023 ***	
fixed effects (cross-section)	no	yes	yes	yes
fixed effects (time)	no	no	no	yes
Adjusted R2	0.7363	0.9719	0.9768	0.9773
Akaike criterion	-201.94	-445.89	-518.94	-513.56
F statistic	276.08 ***	455.44 ***	518.52 ***	347.49 ***
Test statistic for common intercept		126.803 ***	61.125 ***	55.648 ***
Test statistic for consistence of GLS estimates		211.904 ***	243.464 ***	220.44 ***
Test statistic for normality of residuals	10.971 ***	56.069 ***	46.868 ***	52.030 ***
Number of observations	395	395	395	395

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

In Model 2, where no account was taken of the time (or technology), the effect of infrastructure gross capital formation seems to be overstated, as it is by 0.5 – 0.6 higher than in Models 3 and 4. On the other hand, Model 2 seems to underestimate the effect of investment into health and schooling: in Models 3 and 4 the coefficients on this kind of investment are by approximately 0.04 higher. In all the models, the coefficient on gross pubic capital formation in the field of public goods is relatively small, but negative, which would suggest that money spent like this is not invested in a financially productive way. As in the previous estimation, the coefficient on *time* is negative. GLS estimates were not consistent in any of the models, as indicated by the test statistics.

Again, given the cointegrating relationship among the variables, we suppose that we have obtained consistent estimators.

However, as we already mentioned, there are also other public expenditures that are not capital investments but which are considered to be important for economic growth, such as expenditures on R&D or education.

Table 5 – cumulative gross capital formation and other expenditures

Dependent variable: GDP	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**
const	8.8141 ***	5.8332 ***	2.9167 ***	5.3027 ***	2.6714 ***	6.7446 ***	2.6037 ***
PGCF	0.0338	0.0712	0.1037	0.1435 *	0.1731 **	0.1248	0.1357
GGCF	0.0898	0.0006	0.0098	0.0039	0.0094	0.0549	0.0674
R&D_G	0.1364 ***	0.1689 ***	0.1631 ***	0.1818 ***	0.1732 ***		
EXP_E_G	0.3599 ***	0.0955	0.0875			0.0949	0.1182
time	-0.2693 ***	-0.1471		-0.1247		-0.1984 ***	
time2	0.0027 ***	0.0018 *		0.0016 *		0.0024 ***	
fixed effects (cross-section)	no	yes	yes	yes	yes	yes	yes
fixed effects (time)	no	no	yes	no	yes	no	yes
Adjusted R2	0.9284	0.9779	0.9787	0.9784	0.9786	0.9762	0.9768
Akaike criterion	-64.55	-423.11	-408.89	-421.23	-409.09	-509.8	-505.67
F statistic	681.75 ***	452.82 ***	301.63 ***	462.66 ***	301.43 ***	521.48 ***	346.79 ***
Test statistic for common intercept		29.023 ***	26.001 ***	38.581 ***	35.006 ***	43.042 ***	38.597 ***
Test statistic for consistence of GLS estimates		104.913 ***	138.157 ***	116.881 ***	156.736 ***	248.228 ***	191.600 ***
Test statistic for normality of residuals	20.551 ***	49.245 ***	58.147 ***	59.006 ***	72.619 ***	47.132 ***	49.679 ***
Number of observations	316	316	316	316	316	316	316

Note: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) standard errors are HAC robust

To find what their effect on GDP is, we used their cumulative totals as explanatory variables, together with the gross capital formation variables. The results of the estimation are shown in Table 5. In Models 1 to 3, all variables were included. In Models 4 and 5, apart gross capital

formation, only R&D expenditures were included and in Models 6 and 7, apart gross capital formation, only expenditures on education were included.

As we can see, the effect of the private gross capital formation increased only slightly in comparison with the previous estimation, but it remained lower than in models presented in Table 3. We can, however, see that expenditures on R&D have a much higher effect on GDP than any public gross capital formation (the coefficient is around 0.17 in all fixed effects models) and that the effect of expenditures on education on GDP is nearly as high as that of public gross capital formation in the field of education and health in the previous table (the coefficient ranges from 0.087 to 0.118 in all the fixed effects models in Table 5 and the coefficient on GGCF_HE ranged from 0.115 to 0.153 in fixed effects models in Table 4). GLS estimates were not consistent in any of the models, which can be seen from the test statistics.

As in the previous estimations the coefficient on *time* is negative and again our estimates should be consistent given the cointegrating relationship among the variables.

3.4 Brief summary

Our results suggest that there is a positive long-run relationship between GDP and capital, both private and public. We came to this conclusion working with net and gross figures, depending on their availability. We found that both the net capital stocks and the cumulative totals of the gross capital formation are cointegrated with GDP. In most estimations private capital was more productive than public capital. From different kinds of public gross capital formation, investment into health and education was usually the most productive. However, we found that expenditures on R&D and education also have a positive effect on GDP.

Given that we did our estimation with gross capital formation, we can assume that if net figures were available, the effect of public investment on GDP would be higher at least in those areas where depreciation is relatively high. Investment into public goods does not seem to be productive, maybe because this type of investment does not offset the distortionary impact of taxation, at least in monetary terms.

From the technical point of view, we can say that the pooled OLS model was every time misspecified. Concerning the nature of the country-specific effects, when we worked with capital stock variables, GLS estimators were consistent, i.e. the use of random effects was appropriate. However, when working with the cumulative totals of gross capital formation, GLS estimators were inconsistent, i.e. the use of fixed effects was appropriate. This may be caused by the fact that as we used cumulative totals of the gross capital formation, the unobserved country-specific effects reflected the previously accumulated gross capital stock

for which we did not have data, and thus this error component could not have a zero mean and was correlated with the explanatory variables.

4 Conclusion

In this paper we investigated the productivity of public capital from the point of view of the golden rule. We first introduced the golden rule as such, providing also examples of countries where this kind of rule has already been introduced.

We then discussed the possible implementation of the golden rule in the EU. There are many problematic issues connected with the golden rule, both conceptual and practical. One of the important assumptions underlying the introduction of the golden rule, which is supposed to induce a rise in public capital investment, is that public capital is productive. As most studies treating this topic have been performed for the US and not for the EU, we devote most of the paper to this question.

Using data for the EU (all 27 member states when possible) we investigated the issue of the productivity of public capital. The most important finding is the existence of a cointegrating relationship between both the net capital stocks and the cumulative totals of the gross capital formation and GDP. Apart data on net capital stocks we also worked with data on gross capital formation because these were available also disaggregated into several categories.

This long-run relationship among the variables proved to be positive in most cases. In the case of the net capital stocks the productivity was found to be higher than in the case of the cumulative totals of the gross capital formation, which we attribute to the fact that gross capital formation is not netted of depreciation and thus has a lower effect on GDP.

Concerning the different kinds of gross public capital formation, we have found that investments into infrastructure and health and education are productive. On the other hand, investments into public goods do not seem to have a positive effect on output, as they probably do not offset, in monetary terms, the distortive effects of taxation. However, we have found that also current expenditures on R&D or education have a significant positive effect on GDP.

This all leads us to the conclusion that at the aggregate level public capital is productive. However, there are many kinds of public capital which are likely to be unproductive and there also are many kinds of current expenditures that have a positive effect on output in the long run. Therefore, we are of the following view concerning the assumption of productivity of the public capital that usually underlies the discussions of the golden rule: supposing that the introduction of the golden rule in the EU should promote public capital investment, it would

not be reasonable to introduce such rule if the definition of public capital investment does not change.

It may be helpful to add growth-enhancing current expenditures to the category of public investment for this purpose and maybe to exclude unproductive investments from it. It would, however, be very difficult to determine which kinds of public investment should be treated as unproductive, also taking into account that not all benefits stemming from an investment can be expressed in monetary terms and thus have a significant positive effect on the output.

Furthermore, as the sub-optimality of the level of public capital is debatable and the need for more public investment in many EU countries is thus uncertain, we are not proponents of the introduction of a golden rule in the EU in today's conditions.

ANNEX

Figure A1– ln GDP per person employed over the period 1960 – 2009

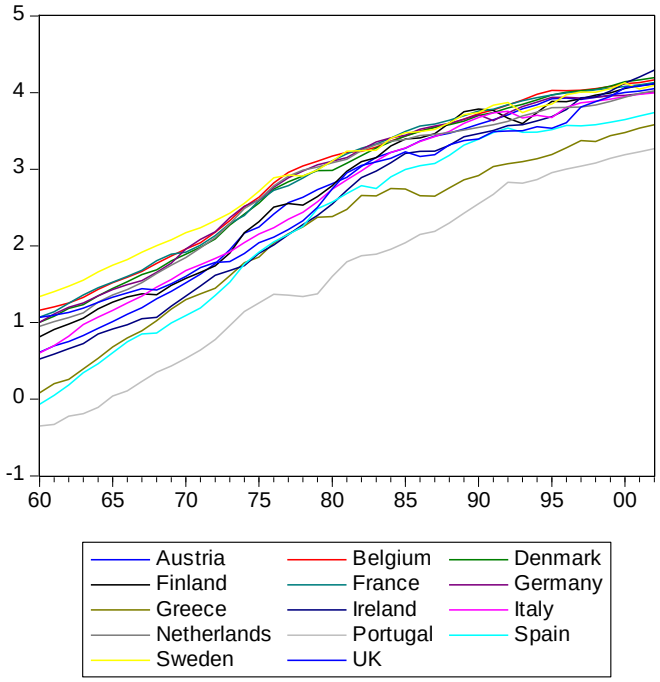


Figure A2 – ln net public capital stock per person employed over the period 1960 – 2009

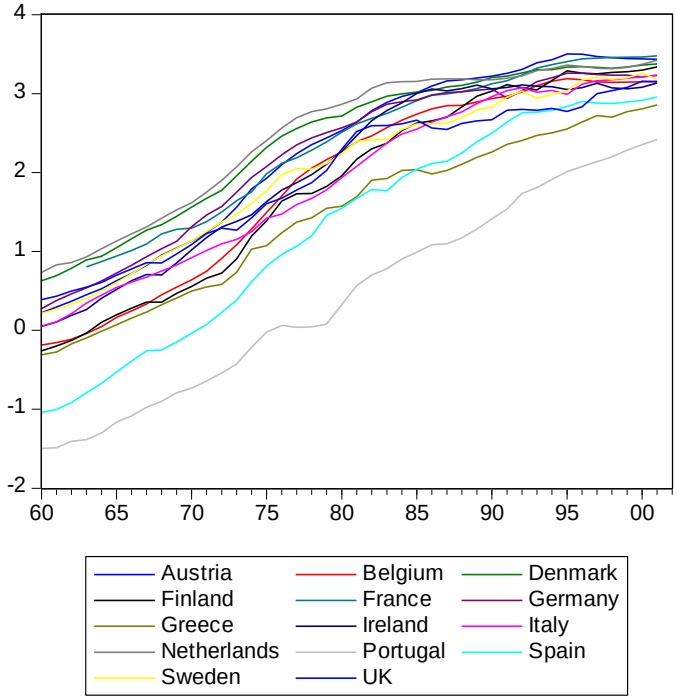


Figure A3 – ln net private non-residential capital stock per person employed over the period 1960 – 2009

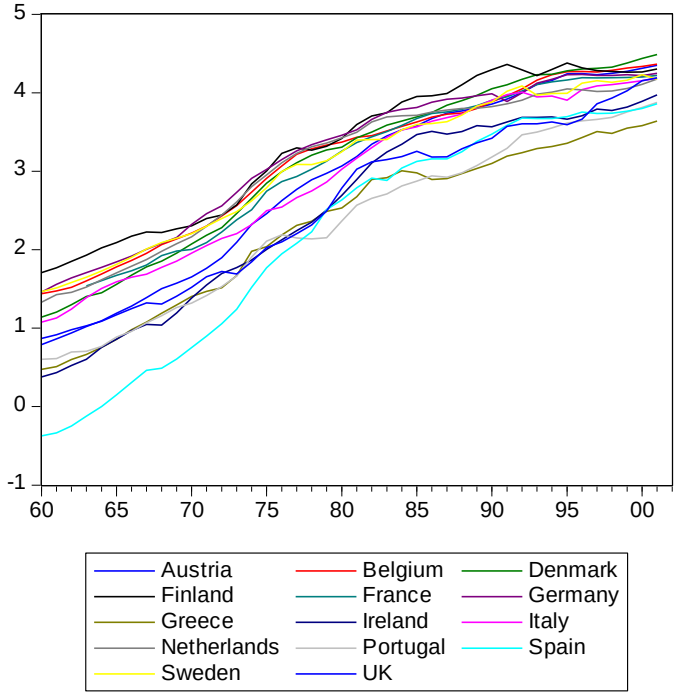


Table A1 – Panel integration test – GDP and net capital stocks

	GDP	**NGCS**	**NPCS**
ADF – Statistic	47.045	8.468	2.419

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

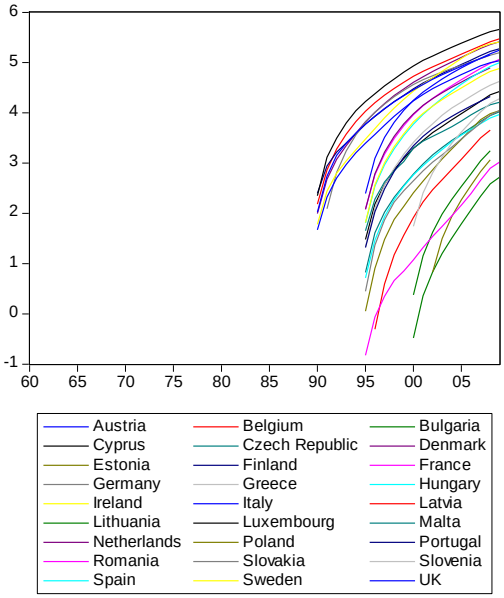
Table A2 – Panel cointegration test – net capital stocks

	GDP with NGCS and NPCS
ADF – Statistic	-5.4998 ***
PP – Statistic	-1.8316 *

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) we assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% and 5% level of significance, respectively.
4) the null hypothesis was also rejected when time and time^2 were added to the net capital stock variables.

Figure A4 – ln private and governmental gross capital formation over the period 1960 – 2009

PGCF



GGCF

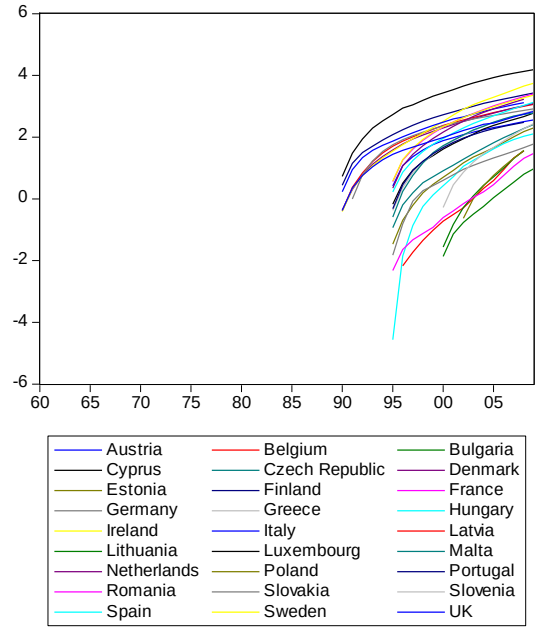


Table A3 – Panel integration test – gross capital formation

	PGCF	**GGCF**
ADF – Statistic	8.468	63.15 **

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

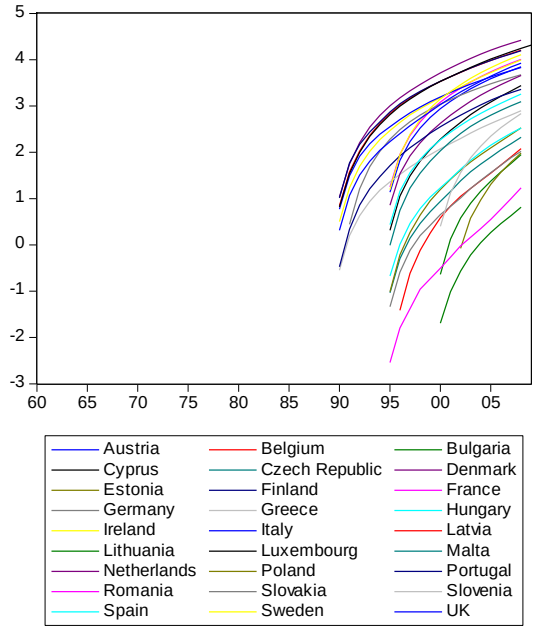
Table A4 – Panel cointegration test – gross capital formation

	GDP with GGCF and PGCF	**GDP with PGCF, GGCF_HE, GGCF_IN and GGCF_PG**
ADF – Statistic	-4.6725 ***	-4.4660 ***
PP – Statistic	- 2.9143 ***	-4.4241 ***

Notes: 1) *** indicates 1% level of significance.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) se assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% level of significance.
4) the null hypothesis was also rejected when time and time^2 were added to the gross capital formation variables

Figure A5 – ln public expenditures on education and ln public expenses on R&D over the period 1960 – 2009

EXP_E_G



R&D_G

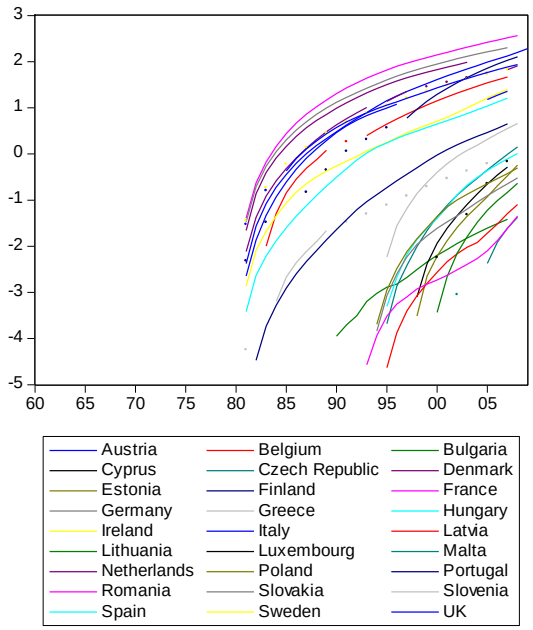


Table A5 – Panel integration test – expenditures on R&D and education

	R&D	**EXP_E_G**
ADF – Statistic	59.056 *	52.754

Notes: 1) ***, **, * indicate 1%, 5% and 10% level of significance, respectively
2) individual intercepts and trends were included in the test equation; the number of lags was chosen automatically using the Hannan-Quinn information criterion
3) we assumed individual unit root processes.

Table A6 – Panel cointegration test – expenditures on R&D and education

	GDP with PGCF, GGCF, R&D_G and EXP_E_G	**GDP with PGCF, GGCF, and EXP_E_G**	**GDP with PGCF, GGCF, R&D_G, time and time2**
ADF - Statistic	-5.5707 ***	-5.8552 ***	-8.1524 ***
PP - Statistic	-13.4088 ***	-4.0470 ***	-31.8443 ***

Notes: 1) *** indicates 1% level of significance.
2) the number of lags was chosen automatically using the Hannan-Quinn information criterion and individual intercepts were included in the test equation.
3) we assumed individual AR coefficients, but when common AR coefficients were considered, the ADF statistic and PP statistic were also significant at 1% level of significance, except for the first column.
4) when in the third column the time variables were not included, we could not reject the null hypothesis of no cointegration. However, in the case of the first two columns, the inclusion of the time variables did not change our conclusion.

REFERENCES

Aschauer, D. A. (1989). 'Is Public Expenditure Productive?', Journal of Monetary Economics vol. 23, pp. 177-200.

Aschauer, D. A. (1990). 'Why Is Infrastructure Important?', Conference Series of the Federal Reserve Bank of Boston, pp. 21-68.

Aschauer, D. A. (1993). 'Public Capital and Economic Growth. In Public Policy Brief no. 4/1993 – Public Infrastructure Investment: A Bridge to Productivity Growth', The Jerome Levy Economics Institute of Bard College, pp. 9-30.

Balassone, F. & Franco, D. (2000). 'Public Investment, the Stability Pact and the 'Golden Rule'', Fiscal Studies vol. 21 (2), pp. 207-229.

Batina, R. G. & Ihori, T. (2005). 'Public Goods - Theories and Evidence', Springer, Germany.

Blanchard, O. & Giavazzi, F. (2003). 'Improving the SGP Through a Proper Accounting of Public Investment', CEPR discussion paper no. 4220.

Buiter, W. H. (1998). 'Notes on 'A Code for Fiscal Stability'', NBER working paper no. 6522.

Buti, M.; Eijffinger, S. & Franco, D. (2002). 'Revisiting the Stability and Growth Pact: Grand Design or Internal Adjustment? ', CEPR discussion paper no. 3692.

Cadot, O.; Röller, L.-H. & Stephan, A. (1999). 'A Political Economy Model of Infrastructure Allocation: An Empirical Assessment', FS IV 99 - 15, Wissenschaftszentrum Berlin.

Calderon, C. & Serven, L. (2002). 'The Output Cost of Latin America's Infrastructure Gap', Central Bank of Chile Working Paper no. 186.

Creel, J. (2003). 'Ranking Fiscal Policy Rules: the Golden Rule of Public Finance vs. the Stability and Growth Pact', OFCE working paper no. 2003-04. Available at: http://ssrn.com/abstract=826285

De Haan, J.; Sturm, J. E. & Sikken, B. J. (1996). 'Government Capital Formation: Explaining the Decline', Review of World Economics, vol. 132, pp. 55-74.

De Haan, J. & Romp, W. (2005). 'Public Capital and Economic Growth: A Critical Survey', European Investment Bank Papers vol. 10, pp. 41-70.

Engle, R. F. & Granger, C. W. J. (1987). 'Co-Integration and Error Correction: Representation, Estimation, and Testing', Econometrica, vol. 55 (2), pp. 251-276.

European Commission (2001). '2001 Broad Economic Policy Guidelines', European Economy 72/2001.

European Commission (2003). 'Public Finances in EMU 2003', European Economy 3/2003.

European Commission (2009). 'Public Finances in EMU 2009', European Economy 5/2009.

European Economic and Social Committe (2006). 'Opinion of the European Economic and Social Committee on Strengthening economic governance — The reform of the Stability and Growth Pact', Official Journal C 88/15.

Garcia-Mila, T.; McGuire, T. J. & Porter, R. H. (1996). 'The Effect of Public Capital in State-Level Production Functions Reconsidered', The Review of Economics and Statistics vol. 78, no. 1, pp. 177-180.

Granger, C. W. J. (1981). 'Some Properties of Time Series Data and Their Use in Econometric Model Specification', Journal of Econometrics, vol. 16 (1), pp. 121-130.

Greene, W. H. (2002). 'Econometric Analysis', Pearson Education, Inc., New Jersey. Fifth edition.

HM Treasury (1997). 'A Code for Fiscal Stability', London. Available at: http://archive.treasury.gov.uk/pub/html/docs/fpp/code/code.pdf , accessed on 20 May 2010.

HM Treasury (1998). 'Fiscal Policy: Current and capital spending', London. Available at: http://archive.treasury.gov.uk/pub/html/fpccs.pdf , accessed on 20 May 2010.

Holtz-Eakin, D. (1994). 'Public-Sector Capital and the Productivity Puzzle', The Review of Economics and Statistics vol. 76 (1), pp. 12-21.

Kamps, C. (2005). 'Is There a Lack of Capital in the European Union? ' EIB working paper no. 3/2005.

Kappeler, A. & Välilä, T. (2007). 'Composition of Public Investment and Fiscal Federalism: Panel Data Evidence from Europe', European Investment Bank, Economic and Financial Report 2007/02.

Kellermann, K. (2007). 'Debt Financing of Public Investment. On a Popular Misinterpretation of 'the Golden Rule of Public Sector Borrowing'', European Journal of Political Economy vol. 23, pp. 1088-1104.

Munnell, A. H. (1990). 'How Does Public Infrastructure Affect Regional Economic Performance?', Federal Reserve Bank of Boston - Conference Series 34, pp. 69-112.

Sawyer, M. (1997). 'On Budget Deficits and Capital Expenditure', Macroeconomics 9802012, EconWPA.

Sturm, J.-E.; De Haan, J. & Kuper, G. (1998). 'Market Behaviour and Macroeconomic Modelling', MacMillan, chapter Modelling Government Investment and Economic Growth on a Macro Level: A Review, pp. 359-406.

Wooldridge, J. M. (2006). 'Introductory Econometrics - A Modern Approach', Thomson South-Western, USA. Third edition.