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A Synthesis of Empirical Research in the Sustainability of Fiscal Policy

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Abstract. In the last twenty years many developed countries have faced significant public deficits, while the ability of government authorities to deal with public deficits has been receiving rising awareness from economists and policy makers. This is an imperative topic, in provisions of economics and public policy, and it is a central subject for the EMU area; hence, they are the main motivations of this paper. Theoretically, equilibrium growth paths have to be supported by adequate fiscal policy. The risk of a default on Greek sovereign debt during the last years has worried the Euro into its first serious crisis and raised the issue of debt sustainability in Europe. There is no universally accepted definition for sustainable fiscal policy. However, economists agree that expanding public debt is not sustainable. Budget policy is constrained by the need to finance the deficit. In this paper we provide a synthesis of empirical research in the validity of the Sustainability of Fiscal Policy of the existing literature for the period 1986-2012. These studies used both time series and panel data sets and empirically examined the Sustainability of fiscal policy for a single country and for a group of countries (multi-country studies). Furthermore, there are studies using data on government expenditure at the provincial or state level. Existing studies in this topic vary in the country selection. They used data for developed, developing countries or group of both, while most of them examined developed or industrial countries. All these studies found different empirical results: support, no support or mixed results.
Keywords. Fiscal policy sustainability; Budget deficits; Government debt; cointegration; structural breaks.
JEL. E62, H62, H63.

1. Introduction

In There is no universally accepted definition for sustainable fiscal policy. However, economists [1] agree that expanding public debt is not sustainable. Budget policy is constrained by the need to finance the deficit. If, in some way, it was possible for a government to borrow without limit and to finance the interest on debt by additional borrowing, any pattern of deficits would be sustainable. However, governments meet limits of how much they can borrow from the markets. Governments face a present-value borrowing constraint, so they have to balance their budgets by setting the current market value of debt equal to the discounted sum of expected future surpluses. A violation of inter temporal budget restriction would mean that the fiscal policy cannot be sustainable forever, because

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[1] Quintos(1995), Cuddicton(1997), Afonso (2000), Chalk and Hemming (2000) and Collignon(2010)

the value of debt would explode over time at a rate faster than the growth rate of the economy in the near future. Collignon (2010) claimed that a sustainable fiscal policy must respect the present-value borrowing constraint, causing thereby the discounted value of debt to go to 0 at the limit (Quintos, 1995). This is the common idea behind all modern models of debt sustainability.

The issue of sustainable deficits has recently come again to a public debate, with regards to the proposed reforms of the Budget Stability Pact. Greece is an interesting economy to study the sustainability hypothesis, since the country's macroeconomic performance during the post-war period has been significantly influenced by a change in the conduct of fiscal policy. After 1974, successive Greek governments begun to favour a continuing shift toward deficit finance in response to the public's demand for a greater share in the country's then rapidly increasing GDP. The negative implications of this policy shift did not become evident until 1979. Following the second oil price shock, the rapid growth rates of the 1950s, 1960s and 1970s were replaced by stagnation, since then the inclination of the fiscal authorities for deficit finance was not reversed. This persistence to deficit finance resulted in the almost constant deterioration of Greek public finances over the last 18 years.

Sustainability is probably the most frequently used word in economic policy after 1990's: sustainable development, sustainable environment, sustainable debt and sustainable deficit levels. Most economists across the world are involved in a query: are the current levels of fiscal deficits and public debt sustainable? In recent years we face an increased concern about the sustainability of government budget, on whether the general government can continue operate under its current fiscal policy for an indefinite period. In the last two decades several European countries (Greece, Ireland and Portugal) have faced enormous budget deficits, while the capacity of government to manage with public deficits has been receiving growing interest from economists. This is an important topic both in terms of economics and public policy.

In this debate, which is at this time in progress, importance appears to shift from the level of public deficits to the level of public debt, mainly in relation to heavily indebted countries like Greece and Portugal. Collignon (2010) stated that there is still a lively debate about the usefulness of Europe's fiscal rules. These rules have been criticized for being too tight and creating a pro-cyclical and low-growth bias for fiscal policy. They were also critiqued for being too loose since they did not prevent countries like Greece and Portugal to accumulate excessive deficits.

During the last decade a large number of authors examined the issue of sustainability. Several studies (Wilcox, 1989; Hakkio & Rush, 1991; Tanner & Liu 1994; Quintos, 1995; Makrydakis, 1999; Jayawickrama, 2006) concluded that the intertemporal budget constraint is violated. However, these results may be biased, as they do not take into account possible structural changes in tested variables. Another reason is that public debt and deficits present a non-linear behaviour which is not taken into account in previous studies.

Various studies have individually examined the issue of non-linearity (Bohn, 1998; Argyrou, 2004), or take into account structural changes (Quintos, 1995; Makrydakis, 1999). However, addressing only structural changes or non-linearity may again lead to incorrect results.

2. Literature review

2.1. Previous theoretical work

Fiscal deficit has attracted extensive attention to public policy and macroeconomic theory due to its impact on macroeconomic performance and the

proceeding debt dynamics. According to Kustepeli & Onel (2005) budget deficit sustainability becomes an important factor that attract the attention of economists and policy makers. Budget deficit take place when government spending exceed government revenues and there is a need of financing them by net lending.

Government authorities in order to succeed in their targets, have to increase their revenues or lending money and increase the national debt. The Keynesian theoretical framework suggests that the finance of increased deficits will increase economic growth and decrease unemployment through a rise in aggregate demand. The Keynesians suggest that changes in spending and revenues can be used by the authorities to alter aggregate demand. Budget deficits play a crucial role in economic stability of a country through poverty reduction, income redistribution, decreased unemployment and sustainable growth. Hence, many developed and developing countries use deficits to increase aggregate demand and achieve their targets[2]. Thus, budget deficits do not necessarily mean that it is a bad policy.

Kustepeli & Onel (2005) summarized the major effects of deficits in the economy. Firstly, fiscal deficits can change the incentive mechanisms in the economy of a country. Economic agents have different expectations due to increased or decreased deficits and markets will be faced with speculation which may affect financial markets. Secondly, deficits may change the monetary policy of a country and according to Ozatay (1997) the control of monetary policy requires coordination between fiscal and monetary policy. If Fiscal policy is not sustainable it is very difficult for a monetary authority to succeed on their targets. Thirdly, the increased budget deficits might lead to instability in the economy through the expectations about the way of financing them. According to Kustepeli & Onel (2005) "the real sector will suffer from the crowding out effect of budget deficits, leading to reduced output growth. This will push prices up, resulting in inflation" (Kustepeli & Onel, 2005, pp. 1). Finally, the increased budget deficits will lead to increased future deficits, since an amount of future revenues will be used in order to pay the interest rates of government debt.

Jacobs et al. (2002) supported the view that each of the deficit definitions illustrated in Table 1emphasize a particular characteristic of fiscal exposure and can be used as a valuable tool in terms of policy making and investment. Comparisons between the definitions show that they do not differ so much in magnitude. Jacobs et al. (2002) implied that "In fiscal analysis it is common practice to use the operational deficit to measure fiscal sustainability, which seems to be a good choice especially in view of the fact that the other definitions only differ marginally in terms of their relationships to GDP" (Jacobs, Schoeman & Heerden, 2002, pp. 5).

Table 1. *Alternative definitions of budget deficit (adopted by Jacobs et al. (2002))*

	Fiscal Indicator	Definition
1	Conventional budget balance	Expenditure-Income
2	Total budget balance without grants	Conventional balance(1)-grants
3	External budget balance	Expenditure-Receipts(externally financed)
4	Domestic budget balance	Total balance-External balance
5	Primary budget balance	Total balance-Interest payments
6	Operational budget balance	Primary balance+ Real Interest payments
7	Current budget balance	Current revenue-Current expenditure
8	Consolidated budget balance	Central+ Decentralized government balances
9	Cyclically budget balance	Expenditures-Cyclically adjusted revenue
10	Cyclically adg. Budget balance	Total balance-Cyclically neutral balance

[2]In other words, they run deficits in the short run in order to increase the economic growth of the country in the long run.

11	Benchmark budget balance	Normative year balance (as pre-determined)
12	Structural budget balance	Cyclical Effect of budget+ benchmark balance
13	Full employment budget balance	Full employment expenditure-Full employment revenue
14	Liquidity budget balance	Total balance-net loans
15	Weightened budget balance	Weights allocated according to the importance of operational variables

As we mentioned budget deficits occurred when the government spending exceeds the revenues and thus the accumulated deficit of previous years create higher public debt. In many countries including Greece, the political parties that govern the country promote frequent changes. More specifically, the party in power usually increases spending before the elections and decrease the taxation in order to win the elections. According to Sachs & Larrain (1993) these ad hoc policies tend to increase the total budget deficit and the level of national debt. Other reasons for increased budget deficits relate to periods of high inflation or cyclical behaviour of the economy, where there is an impact on spending and revenues. For instance, during a recession there might be increased deficits since the national output and direct taxes are decreasing.

One of the most important effects of increased deficits is the impact on interest rates and investment. When a government is running budget deficits, it has to finance them by borrowing, thus, there is created a completion in markets between state, households and firms. Consequently, there is an increase of interest rates and decrease on capital formation (investment). However, in some markets, the demand for investment is not considerably affected from changes in interest rates. Greece is an economy in deep recession during the last 2 years and there was a need of increased borrowing from external markets, resulting to an extra pressure on interest rates and decreased investment.

A very insightful argument of Meade (1958) is the following: "The view is sometimes expressed that a domestic national debt means merely that citizens as potential taxpayers are indebted to themselves as holders of government debt, and that it can, therefore, have little effect upon the economy […]. It is my purpose to refute this argument [and] to show that, quite apart from any distributional effects, a domestic debt may have far-reaching effects upon incentives to work, save, and to take risks" (Meade, 1958, pp. 163).

Another negative impact of increased deficits is the debt crisis that is being created in the country. The increased borrowing from markets leads to high interest payments which constructs obstacles on the economic growth of the country. There is higher unemployment, less investment, less national output and less future revenues. Many economists, such as Krugman (1988), Clements et al. (2003), Adam & Bevan (2005) claimed that national debt growth forces the government to target higher economic growth and increased revenue in order to finance the rising debt obligations.

Modigliani (1961) implied that "if the government operation is of sizable proportions it may significantly drive up interest rates since the reduction of private capital will tend to increase its marginal product" (Modigliani, 1961, pp. 739). Additionally, "in spite of the easiest possible monetary policy with the whole structure of interest rates reduced to its lowest feasible level" (Modigliani ,1961, pp. 753).

3. What is sustainability?

In the beginning of the 20's, when France faced problems involving public debt, Keynes (1923) argued that the French government needed to perform a sustainable

fiscal policy in order to comply with the budget constraint. He implied that the absence of sustainable public accounts would be evident when "the State's contractual liabilities have reached an excessive proportion of the national income" (Keynes, 1923, pp. 55).

Nowadays sustainability is threatened when public debt as a share of GDP achieves an extreme value. There is a problem of sustainability when the public receipts are not sufficient to continue funding the costs related to new issuance of public debt or, in Keynes's words, when "it has become clear that the claims of the bond-holders are more than the tax payers can support" (Keynes, 1923, pp. 55).

Quintos (1995) argued that fiscal policy is constrained by the requirement to finance the public deficits, and any pattern of deficit will be sustainable, if it is possible to have access to borrowing without control and finance the interest payments on debt by additional borrowing. However, economies face the difficulty of limits to borrowing and face present value borrowing constraint, so the government balances its budget intertemporally by setting the current market value of debt equal to the discounted summary of expected future surpluses. A violation of intertemporal budget balance would point out that fiscal policy cannot be sustainable evermore because the value of public debt will explode over time, at a rate faster than the economic growth of the economy. He stated that "thus the fiscal policy is one that would cause the discounted value of debt to go to 0 at the limit so that the present value borrowing constraint would hold" (Quintos, 1995, pp. 409).

Cuddicton (1997) suggests two different approaches to test public deficit sustainability, the accounting and the present value constraint approach. The accounting approach centres on steady states and makes the assumption that a public deficit (or surpluses) that have as a result an unchanged debt as a share of GDP over time is sustainable. The data requirements to deploy this approach are rather modest. The present value constraint approach has the principle that fiscal policy is sustainable if the level of deficit can be financed so as a result it depends on the behaviour of lenders[3].

Additionally, Bravo & Silvestre (2002) implied that the present value budget constraint has been a central issue in the study of the sustainability of public finance in the long run. If the present value budget constraint is not satisfied, then public spending is not sustainable in the long run. Hence, if there has been a deficit for some years, a government is expected to run surpluses in the future.

A new definition of sustainability was provided by Marin (2002). He implied that sustainability means that the government can apply its pre-announced fiscal policy in equilibrium, so the fiscal policy followed by the government is compatible with the behaviour of the others agents in the economy. He concluded that "consistency requires that fiscal policy variables satisfy both a period-by-period or flow budget constraint and an intertemporal or solvency budget constraint. The first is always satisfied when the variables are correctly defined, while the second one is only fulfilled when the decisions of all the agents in the economy are mutually consistent" (Marin, 2002, pp. 7).

Furthermore, Bohn (2005) delivered another definition of sustainability: "A fiscal policy satisfies ad hoc sustainability, if it is on a trajectory such that the expected present value of future primary surpluses equals the initial debt" (Bohn, 2005, pp. 7). Polito & Wickens (2005) claimed that a fiscal stance is sustainable if it satisfies the government's intertemporal budget constraint. In practice, this does not solve the problem, as the intertemporal budget constraint is forward-looking over an infinite horizon.

[3]Which in turn is influenced by the level of debt.

On the other side, Collignon (2010) claimed that sustainability refers to a dynamic equilibrium, which does not require any significant change in fiscal policy (government spending and taxation) but it requires a long term financial stability, where markets provide funds to cover borrowing requirements. He stated that sustainability does not mean that budgets have to be balanced at all times, provided temporary deviations from the sustainable rate are corrected. However, when deficits become excessive and debt explodes, a government's solvency is threatened. He mentioned that borrowers are considered solvent as long as they can repay their debt and interest out of future revenue. Economists have a clearly defined criterion for solvency, namely respect for the intertemporal budget constraint.

However, uncertainty about the fulfilment of this condition can undermine the confidence that markets have about a government's solvency and, as a result, dry out the liquidity necessary for refinancing a new debt (higher interest rates). The rising risk of default due to a liquidity crisis may then force a government to change policy (fiscal policy), even if it is solvent and its debt is fundamentally sustainable. Furthermore, he explained that debt sustainability requires that deviations from the long run equilibrium are systematically corrected, which requires that fiscal behaviour of the government follows certain rules that can ensure this.

4. Previous empirical work

During the last 4 decades many developed and developing countries have faced noteworthy budget deficits, while the capacity of government to deal with public deficits has been attacting growing interest from economists and policy makers. This is an imperative topic both in terms of economics and public policy, especially for the European Union countries that encountered serious problems with public economics. A vast number of studies examined the sustainability of fiscal policy in many countries. In Table 2 we summarise the most important studies that examined this topic and contains information about: name of author, year of publication, tested period, type of analysis, type of methodology and main conclusion for the validity of the law. In the next section we will analyse the different methodologies, analysis and results obtained.

Table 2. *Survey in previous studies examined Sustainability of fiscal policy*

No	Author	Country	Time period	Type of Analysis	Methodology	Main results
1	Hamilton & Flavin (1986)	U.S.A.	1962-1984	Time-Series	Stationarity tests for deficit and debt	Sustainable
2	Trehan & Walsh (1988)	U.S.A.	1890-1983	Time-Series	Stationarity tests for deficit	Sustainable
3	Kremers (1988)	U.S.A.	1920-1985	Time-Series	Stationarity tests for debt	Sustainable until 1981
4	Elliot & Keamey (1988)	Australia	1953-1987	Time-Series	Stationarity tests	Sustainable
5	Wilcox (1989)	U.S.A.	1960-1984	Time-Series	Stationarity tests for debt	Unsustainable
6	Trehan & Walsh (1991)	U.S.A.	1960-1984	Time-Series	Stationarity tests for deficit	Sustainable
7	Hakkio & Rush (1991)	U.S.A.	1950-1988	Time-Series	Cointegration tests between spending and revenues	Unsustainable
8	Haug (1991)	U.S.A.	1960-1987	Time-Series	Stationarity tests, Cointegration tests	Sustainable
9	Smith & Zin (1991)	Canada	1946-1984	Time-Series	Cointegrating tests for deficit and debt	Unsustainable
10	Baglioni & Cherubini (1993)	Italy	1979-1991	Time-Series	Cointegration tests	Unsustainable

11	Tanner & Liu (1994)	U.S.A.	1950-1989	Time-Series	Cointegration tests between spending and revenues	Sustainable with a break on 1982
12	Quintos (1995)	U.S.A.	1947-1992	Time-Series	Cointegration tests between spending and revenues	Sustainable until 1980
13	Caporale (1995)	10 EU countries	1960-1991	Time-Series	Stationarity tests for deficit and debt	Mixed results
14	Vanhorebeek & Rompuy (1995)	8 EU countries	1970-2004	Time-Series	Stationarity tests for deficit and debt	Mixed results
15	Fountas & Wu (1996)	Greece	1958-1992	Time-Series	Cointegration tests between spending and revenues with breaks	Unsustainable
16	Payne (1997)	G-7 countries	1949-1994	Time-Series	Cointegration tests between spending and revenues	Mixed results
17	Artis & Marcellino (1998)	E.M.U	1963-1994	Time-Series	Stationarity tests for debt	Mixed results
18	Wu (1998)	Taiwan	1955-1994	Time-Series	Stationarity tests, Cointegration tests	Sustainable
19	Bohn (1998)	U.S.A.	1916-1995	Time-Series	Bohn test(relationship between surpluses and debt)	Sustainable
20	Papadopoulos & Sidiropoulos (1999)	5 EU countries	1961-1975	Time-Series	Cointegration tests between spending and revenues	Mixed results
21	Makrydakis (1999)	Greece	1958-1995	Time-Series	Cointegration tests between spending and revenues with breaks	Unsustainable
22	Afonso (2000)	E.M.U	1968-1997	Time-Series	Stationarity tests for debt, Cointegration tests between spending and revenues	Mixed results
23	Olekalns (2000)	Australia	1900-1997	Time-Series	Cointegration tests between spending and revenues	Unsustainable
24	Feve & Henin (2000)	G-7 countries	1940-2000	Time-Series	Stationarity tests for debt	Mixed results
25	Martin (2000)	U.S.A.	1947-1992	Time-Series	Cointegration tests with breaks	Sustainable
26	Issler & Lima (2000)	Brazil	1947-1992	Time-Series	Stationarity tests, Cointegration tests	Sustainable
27	Jha & Sharman (2004)	India	1871-1921,1950-1997	Time-Series	Stationarity tests with breaks	Unsustainable
28	Cippolini (2001)	U.K.	1963-1997	Time-Series	Cointegration tests between spending and revenues with breaks	Sustainable
29	Green et al. (2001)	Poland	1989-1997	Time-Series	Stationarity tests, Cointegration tests	Sustainable
30	Bravo & Silvestre (2002)	11 EU countries	1960-2000	Time-Series	Cointegration tests between spending and revenues	Mixed results
31	Cunado et al. (2004)	U.S.A.	1947-1992	Time-Series	Stationarity tests, Cointegration tests between spending and revenues	Sustainable
32	Hatemi-J (2002)	Sweden	1963-2000	Time-Series	Cointegration tests	
33	De Castro et al. (2004)	Spain	1964-1998	Time-Series	Cointegration tests between debt and deficits with breaks	Sustainable
34	Koo (2002)	Korea	1970-1999	Time-Series	Stationarity tests	Sustainable
35	Bajo-Rubio et al. (2004)	Spain	1964-2001	Time-Series	Stationarity tests, Cointegration tests	Unsustainable
36	Radulesku (2003)	Roumania	1992-1999	Time-	Cointegrating tests	Unsustainable

				Series		
37	Archibald & Greenidge (2003)	Barbados	1966-2001	Time-Series	Stationarity tests, Cointegration tests	Sustainable
38	Goyal et al. (2004)	India	1952-1998	Time-Series	Cointegration tests between spending and revenues with breaks	Unsustainable
39	Arghyrou (2004)	Greece	1970-2000	Time-Series	Stationarity tests for debt	Sustainable
40	Greiner et al. (2004)	4 European countries and U.S.A	1960-2003	Time-Series	Cointegration tests and Bohn test	Sustainable
41	Afonso (2005)	EU countries	1970-2003	Time-Series	Cointegration tests between spending and revenues with breaks	Mixed results
42	Westerlund & Prohl (2010)	8 OECD countries	1977-2005	Panel data	Cointegration tests between spending and revenues with breaks	Sustainable
43	Davig (2005)	U.S.A	1960-1999	Time-Series	Markov-switching stochastic process	Sustainable
44	Bohn (2005)	U.S.A	1792-2003	Time-Series	Cointegration tests between debt and deficits with breaks	Sustainable
45	Kustepeli & Onel (2005)	Turkey	1970-2003	Time-Series	Stationarity and Cointegration tests between spending and revenues with breaks	Sustainable
46	Prazmowski (2005)	Dominicain Republic	1970-2000	Time-Series	Stationarity tests and cointegration test using the Kalman filter	Unsustainable
47	Qin et al. (2006)	Phillipines	1993-2004	Time-Series	Stationarity tests	Unsustainable
48	Kalyoncu (2005)	South Korea,Mexico, the Philippines, South Africa and Turkey	1970-2003	Time-Series	Cointegrating tests between spending and revenues	Mixed results
49	Marinheiro (2006)	Portugal	1903-2003	Time-Series	Stationarity tests, Cointegration tests between spending and revenues	Sustainable
50	Prohl & Schneider (2006)	EU15	1970-2004	Panel data	Cointegration tests between debt and deficits with breaks	Sustainable
51	Kirchgaessner & Prohl (2006)	Sweden	1900-2002	Time-Series	Stationarity and Cointegration tests between spending and revenues with breaks	Sustainable
52	Jayawickrama & Abeysinghe(2006)	U.S.A.	1929-2004	Time-Series	Cointegration tests with breaks	Sustainable
53	Reddy (2006)	Fiji islands	1970-2004	Time-Series	Cointegration tests between spending and revenues with breaks	Unsustainable
54	Tshiswaka-Kashalala (2006)	South Africa	1990-2005	Time-Series	Stationarity tests, Cointegration tests	Sustainable
55	Argyrou & Luintel (2007)	Greece, Ireland, Italy and the Netherlands	1957-1998	Time-Series	DOLS and DGLS	Sustainable
56	Baharumshah & Lau (2007)	East Asian Countries	1975-2003	Time-Series	Stationarity tests, Cointegration tests and DOLS	Mixed results
57	Chortareas et al. (2008)	Latin American and Caribbean	1960-2000	Time-Series	Stationarity tests for debt	Sustainable

		countries				
58	Correia et al. (2008)	Portugal	1852-2004	Time-Series	Trace test, Breitung's non-parametric test and Bohn test	Sustainable only for some periods
59	Llorca & Redzepagic (2008)	EU new members	1995-2006	Panel data	Stationarity tests, Cointegration tests	Sustainable
60	Ehrhart & Llorca (2008)	six South-Mediterranean countries	1978-1999	Panel data	Stationarity tests, Cointegration tests	Sustainable
61	Araoz et al. (2009)	Argentina	1865-2002	Time-Series	Stationarity tests, Cointegration tests between spending and revenues	Unsustainable
62	Koumparoulis (2010)	Greece	1960-2005	Time-Series	Cointegration tests between spending and revenues, Dynamic Ordinary Least squares	Sustainable
63	Gabriel & Sabgduan (2010)	Several developed and developing countries	1975-2005	Time-Series	Stationarity test and Horvath and Watson test	Sustainable
64	Holmes et al. (2010)	EU countries	1971-2006	Panel data	Hadri tests	Sustainable
65	Puah et al. (2011)	Sarawak (State of Malaysia)	1970-2008	Time-Series	Stationarity tests, Cointegration tests	Sustainable
66	Burger et al. (2011)	South Africa	1946-2008	Time-Series	OLS, VAR, GMM, TAR, State-Space modelling and VECM	Sustainable

5. Type of Analysis

There are two types of analysis used to examine the Sustainability of fiscal policy; time series and panel data analysis. Studies implementing time series analysis examine the long run relationship between government spending and revenues for a particular country over time. The panel data analysis investigates the relationship between revenues and spending across different countries at the same point in time (year).

According to our review of the existing literature in this topic, the majority of previous studies have applied time series analysis. We can see in the following table (Table 3) that 61 out of 66 studies used time series analysis and accounted for almost 92.5% of the total studies. The studies that deployed panel data analysis are only 5 and accounted for only 7.5%.

Table 3. *Type of analysis used from previous studies*

Type of analysis	Number of studies
Panel data	5
Time series	61
Total number of studies	66

5.1. Time series analysis

As mentioned we identified that 61 out of 66 empirical studies in the literature applied time series analysis in order to examine the sustainability of fiscal policy. The majority of these studies have tested the law for a single country, while only a few have examined a group of countries. Furthermore, while some of the studies used time series data and examined developing countries, most have focused on developed countries. The results obtained from these studies, which will discussed below, are highly assorted.

Acknowledging the importance of fiscal sustainability in guaranteeing stable growth of the economy, numerous studies with different approaches have been developed to examine whether or not a country's public finances follow a sustainable path. Hamilton & Flavin (1986) adopted an intertemporal budget constraint framework and tested the case of the United States for the period 1962-1984. They used stationarity tests for public deficit and public debt. They suggested a new alternative measure of government deficits that takes into account revenues from monetization and capital gains on gold, but excludes interest payments. They propose a framework for analysing whether governments can run a Ponzi scheme or not and found sustainability of fiscal policy in the US.

Trehan & Walsh (1988) used data for the U.S. economy for the period 1890-1983 and performed stationarity tests for public deficits. They extended the work of Hamilton & Flavin (1986) by showing that satisfying the intertemproral budget constraint is equivalent to the condition that government expenditures inclusive of interest and tax revenues are cointegrated. At 1991 they re-tested the US economy for a different sample period (1960-1984). They performed stationarity test for deficit and debt and found again that the fiscal economy is sustainable for the new tested period.

The tests in the previous studies have been the subject of considerable criticisms made by Bohn (1995; 1998) because they made suppositions about future states of nature that are not easy to assess from a single set of observed time series data. Bohn (1998) proposes a new test that is not open to this criticism. He used annual data for the USA economy for the period 1916-1995 and performed a new test on the relationship of budget surpluses and debt ratio. Firstly he showed that the USA government has historically responded to the debt as a share of GDP by reducing the primary deficit or increases the primary surpluses. He stated that "in univariate regressions this positive response is obscured by war-time spending and by cyclical fluctuations, but it is highly significant if one corrects for fluctuations in government spending and in aggregate income" (Bohn, 1998, pp. 962). Secondly, he showed that the tests of previous studies are not consistent and ambiguous because they do not properly adjust for fluctuations in GDP and in public expenditures. Finally, he concluded that his empirical results obtained from his test indicates that the fiscal policy of the USA during the test period is sustainable.

5.2. Panel data Analysis

In our review of the existing literature we found that only 5 studies applied panel data analysis and used it to test a group of countries. Noticeably, this analysis covers a much wider range of countries in contrast to time series analysis. While time series analysis is mostly used in developed countries, this type of analysis is used mostly in groups of developing countries. In the introduction of this paper we mentioned that the reason why this occurs is the unavailability of long data series of developing countries. Several studies using panel analysis, which are analysed below, have produced noteworthy results. However, we have to mention that the studies (Table 4) which used panel data analysis found evidence of sustainable policy in all tested countries, while the time series analysis had mixed results.

Table 4. *Studies used Panel data analysis*

No	Author	Country	Time period	Type of Analysis	Main results
1	Westerlund & Prohl (2005)	8 OECD countries	1977-2005	Panel data	Sustainable
2	Prohlans & Schneider (2006)	EU15	1970-2004	Panel data	Sustainable

3	Llorca & Redzepagic (2008)	EU new members	1995-2006	Panel data	Sustainable
4	Ehrhart & Llorca (2008)	six South-Mediterranean countries	1978-1999	Panel data	Sustainable
5	Holmes et al (2010)	EU countries	1971-2006	Panel data	Sustainable

Prohl & Schneider (2006) analysed the sustainability of the European Union members by using a panel data analysis. They applied panel unit root and cointegration tests and found evidence that there is a long run relationship between deficits and public debt, thus fiscal policy for the 15 countries is sustainable and are consistent with the intertemporal budget constraint for the tested period of 1970-2004. Later, they tested for a structural break in the panel cointegration relationship and showed that there was a break at 1992.

On the other hand, Ehrhart & Llorca (2008) investigated the sustainability of fiscal policy in a panel of the following six South-Mediterranean countries: Egypt, Israel, Lebanon, Morocco, Tunisia and Turkey during 1978-1999. They deployed panel unit root and cointegration tests and found that while spending and revenue are not stationary, they were cointegrated. Thus, their findings are consistent with the intertemporal budget balance, and fiscal policy is sustainable during the test period. Table 5 illustrates a number of studies that examined the sustainability of Greek fiscal policy. The majority of the studies applied time series analysis in order to examine the relationship between government spending and expenditures, or between deficits and debt in the country. As mentioned in the introduction,Greece is a heavily-indebted European Monetary Union country with high debt-level and has driven the European Commission to think about special fiscal rules, different to those deploying to the remaining European Monetary Union countries, with regards to which Greece should stay on target of a structurally balanced budget.Furthermore, the risk of a default on Greek sovereign debt during the last year has worried the Euro into its first serious crisis and raised the issue of debt sustainability in Europe.

Table 5. *Studies examined the sustainability of fiscal policy in Greece*

No	Author	Country	Time period	Methodology	Main results
1	Fountas & Wu (1996)	Greece	1958-1992	Cointegration tests between spending and revenues with breaks	Unsustainable
2	Caporale (1995)	10 EU countries	1960-1991	Stationarity tests for deficit and debt	Unsustainable
3	Papadopoulos & Sidiropoulos (1999)	5 EU countries	1961-1975	Cointegration tests between spending and revenues	Sustainable
4	Makrydakis (1999)	Greece	1958-1995	Cointegration tests between spending and revenues with breaks	Unsustainable
5	Arghyrou (2004)	Greece	1970-2000	Stationarity tests for debt	Sustainable
6	Argyrou & Luintel (2007)	Greece, Ireland, Italy and the Netherlands	1957-1998	DOLS and DGLS	Sustainable
7	Koumparoulis (2010)	Greece	1960-2005	Cointegration tests between spending and revenues, Dynamic Ordinary Least	Sustainable

squares

Fountas & Wu (1996) tested the Greek economy for the period 1958-1992. They used a residual based cointegration test suggested by Gregory and Hansen that allows for a determination of a structural break in the cointegration vector to test the sustainability of Greek deficits. The results from this approach are different from the results obtained using the Engle-granger cointegration tests. They found that Greek budget deficits policy is not sustainable.

Likewise, Koumparoulis (2010) tested the sustainability of fiscal policy in Greece during 1960-2005 by using cointegration tests between government spending and revenues. He followed the approach of Quintos (1995) and applied a DOLS approach (Dynamic Ordinary Least Squares). His results indicated a structural break on 1981 and concluded that the fiscal policy in Greece during the test period is sustainable for both approaches.

5.3. Time span

The majority of previous studies used post World-War II data and tested periods less than 50 years. However, there are 8 studies (Table 6) that examined long data sets for single countries or group of countries. Focusing on the empirical results of these studies that used long series we realise that results are mixed and do not follow any common pattern.

Table 6. *Studies examined the sustainability of fiscal policy by using long data series*

No	Author	Country	Time period	Type of Analysis	Main results
1	Trehan & Walsh (1988)	U.S.A.	1890-1983	Time-Series	Sustainable
2	Okelans (2000)	Australia	1900-1997	Time-Series	Unsustainable
3	Jha & Sharma (2004)	India	1871-1921,1950-1997	Time-Series	Unsustainable
4	Bohn (2005)	U.S.A	1792-2003	Time-Series	Sustainable
5	Marinheiro (2006)	Portugal	1903-2003	Time-Series	Sustainable
6	Kirchgaessner & Prohl (2006)	Sweden	1900-2002	Time-Series	Sustainable
7	Correia et al. (2008)	Portugal	1852-2004	Time-Series	Sustainable only for some periods
8	Araoz et al. (2009)	Argentina	1865-2002	Time-Series	Unsustainable

Olekalns (2000) examined if Australian Fiscal policy has been consistent with a intertemporal budget constraint and if it is possible to identify structural changes in the conduct of fiscal policy. He used annual (1900-1995) and quarterly (1978-1997) data and performed cointegration tests between government revenues and spending. The empirical results indicate that Australian fiscal policy has not been sustainable, but the recent moves to budget surpluses may represent an attempt to incorporate the implications of intertemporal solvency into the setting of fiscal policy instruments. Moreover, he found evidence of possible structural changes in the conduct of fiscal policy, the first at the end of World War II and the second in the 1980's.

Marinheiro (2006) tested the sustainability of Portuguese Fiscal policy from 1903 to 2003. He used unit roots and cointegration tests between government spending and revenues. He found evidence that fiscal policy in Portugal is

sustainable for the whole test period but not for the most recent period of 1975-2003. This period was characterised by the largest GDP deficit ratios and indicated a shift to an unsustainable path in fiscal policy in Portugal.

Similarly, the study of Correia et al. (2008) conducted an empirical investigation of the sustainability of the public deficit in Portugal from 1852-2004. They performed the Trace test, Breitung's non-parametric test and Bohn test. They identified several structural breaks and conclude that the Breitung's and Bohn tests performed better than the Trace test. Their empirical results indicate that in some periods the deficit is sustainable while in others it is not. They stated that "usually after a period of unsustainable deficits a new regime takes over" (Correia, Neck, Panagiotidis & Richter, 2008, pp. 209).

5.4. State level

In our examination of previous empirical examinations of this topic we identify one study that examined the sustainability of budget deficits of one state. Puah et al. (2011) investigated the sustainability of budget stance of Sarawak, the biggest state in Malaysia, for the period 1970-2008. They used the intertemporal borrowing constraint in order to examine the long run relationship between government revenue and spending. There was evidence of long run equilibrium between the tested variables and their cointegration test results suggested that the Sarawak state fiscal stance satisfies the weak sustainability condition.

Furthermore, the Granger causality test results supported the view that there is a bi-direction relationship between government revenue and expenditure. Consequently, fiscal authorities made simultaneous decisions on expenditure and revenue, and these variables will mutually reinforce each other. They concluded that "however, these would put further pressure on the state government financial performance. Whilst the gap between expenditure and revenue has not exploded, we caution that Sarawak should adopt a more ambitious fiscal framework (consolidation) to rebalance its financial structure. Careful implementation of fiscal consolidation would provide some buffer to the economy especially with the uneven recovery in the global economy" (Puah, Lau & Teo, 2011, pp. 1037).

6. Empirical Results

A large volume of literature examined the sustainability of fiscal policy, but no clear pattern on the empirical results (Table 7) has been presented. A group of studies advocated supportive evidence of sustainable fiscal policy, while another group of empirical studies found that the fiscal policy is not sustainable. Finally, there are a number of studies which obtained mixed results.

Table 7. *Results of previous studies*

Results	Number of studies
Mixed results	14
Unsustainable	15
Sustainable	37
Total	66

However, these results may be biased since most of these studies do not take possible structural changes in tested variables into account. Additionally, as mentioned in the introduction, government spending and revenues are the most important fiscal instruments, and the measurements of previous data play a crucial role.

6.1. Sustainable

Artis & Marcellino (1998) analysed two features of concern in the countries of the prospective European Monetary Union; firstly, the solvency of their governments finances and secondly the accuracy of fiscal forecasts for the period 1963-1994. By using stationarity tests of public debt, they concluded that fiscal policy is sustainable only for the UK, Netherlands and Austria.

Similarly, Kustepeli & Onel (2005) tested the sustainability of budget deficits in Turkey for the period 1970-2003. They used the intertemporal budget constraint (IBC) approach initiated by Hamilton & Flavin (1986). Their empirical analysis without structural breaks show that budget deficits in Turkey are weakly sustainable.

Another article, consistent to these results was developed by Chortareas et al. (2008), who examined the sustainability of fiscal policy in several Latin American and Caribbean countries for the period of 1960-2000. They applied unit root tests with breaks and threshold nonlinearities and found supporting evidence of sustainability in the tested countries and had an improvement when nonlinear reversion was taken into account.

6.2. Unsustainable

Various studies found that a violation of intertemporal budget balance exists, thus fiscal policy cannot be sustainable evermore, since the value of public debt will increase over time at a rate faster than the growth of the economy. Wilcox (1991) followed the work of Hamilton and Flavin (1986) (HF), by performing a new test that allows for stochastic real interest rates. HF supposed a fixed real interest rate, which permits for non-stationarity in the non-interest surplus and required the surplus to be stationary. Finally, while the HF tests supposed that any violation of the borrowing constraint would be non-stochastic, his tests have power against stochastic violations of the borrowing constrain. He found a significant evidence of a shift in the structure of the US fiscal policy in the tested period (1960-1984). He used stationarity tests of public debt and found that fiscal policy during this period was un-sustainable.

Likewise, Hakkio & Rush (1991) used quarterly data for the case of the US and performed cointegration methods on government spending and revenues. They followed the studies of Smith & Zin (1988) and Trehan & Walsh (1988) where they directly focused on government spending and revenue, but they used new tests for cointegration. Secondly, they used several sample periods to test if deficits became a problem in the US economy. Additionally, they extend the work of McCallum (1984) and normalised the variables using real GNP and population. They found that government spending increased more rapidly than government revenue, so fiscal policy of the US in the test period (1950-1988) is not sustainable.

Qin et al. (2006) used the No Ponzi game criterion in order to examine the sustainability and feasibility of government debt in Phillipines for the period 1993-2004. They applied historical data and forecasts that were obtained by their macro econometric model. Their empirical results indicate that the debt was not sustainable until 2010, but weakly feasible. They implied that “the feasibility is vulnerable to major adverse shocks, and that simple budgetary deficit control policy is inadequate for achieving debt sustainability or strengthening feasibility” (Qin, Cagas, Ducanes, Magtibay-Ramos & Quising, 2006, pp. 1). Furthermore, their model simulation supported the view that the simple fiscal policy of medium-term budget deficit control alone is inadequate for reversing the unsustainable debt situation in the country.

6.3. Mixed results

A different strand of the literature found mixed results in the sustainability of fiscal policy in a single country or a group of countries. These studies used data from different countries and found evidence indicating sustainability for some of these countries and different results for other ones, or they found evidence of sustainability for a country but for a specific period.

Table 8. *Studies with mixed results about the sustainability of fiscal policy*

No	Author	Country	Time period	Main results
1	Kremers (1988)	U.S.A.	1920-1985	Sustainable until 1981
2	Caporale (1995)	10 EU countries	1960-1991	Mixed results across different countries
3	Quintos (1995)	U.S.A.	1947-1992	Sustainable until 1980
4	Vanhorebeek et al. (1995)	8 EU countries	1970-2004	Mixed results across different countries
5	Payne (1997)	G-7 countries	1949-1994	Mixed results across different countries
6	Artis & Marcellino (1998)	E.M.U	1963-1994	Mixed results across different countries
7	Papadopoulos & Sidiropoulos (1999)	5 EU countries	1961-1975	Mixed results across different countries
8	Afonso (2000)	E.M.U	1968-1997	Mixed results across different countries
9	Feve & Henin (2000)	G-7 countries	1940-2000	Mixed results across different countries
10	Bravo & Silvestre (2002)	11 EU countries	1960-2000	Mixed results across different countries
11	Afonso (2005)	EU countries	1970-2003	Mixed results across different countries
12	Kalyoncou (2005)	South Korea, Mexico, the Philippines, South Africa and Turkey	1970-2003	Mixed results across different countries
13	Baharumshah & Lau (2007)	East Asian Countries	1975-2003	Mixed results across different countries
14	Correia et al. (2008)	Portugal	1852-2004	Sustainable only for some periods

Kremers (1988) used annual data for the U.S. during the period 1920-1985 and performed stationarity tests on public debt. He found that U.S fiscal policy was sustainable until 1981 but not afterwards. Quintos (1995) extended the empirical literature on deficit sustainability in two ways; firstly, he introduced the "strong" and "weak" conditions for deficit sustainability. The strong condition corresponds to Hamilton and Flavin's necessary and sufficient condition that the debt process is stationary for the bubble term to go to 0; this "strong" condition also corresponds to Trehan and Walsh's necessary and sufficient condition that government spending and revenues be cointegrated. The "weaker" condition that introduced allows the bubble term to 0 at a rate slower than the "stronger" version.

Moreover, some studies tested the case of European Union countries. The first attempt was made by Caporale (1995) who tested a number of European Union countries (Germany, France, the U.K, Italy, Belgium, Netherlands, Denmark, Ireland, Spain and Greece) during 1960-1991. He tested whether the government's

budget is intertemporally balanced by applying a method that was first developed to detect speculative bubbles in financial markets. The aim of his test was to establish whether the government can engage in bubble finance. He used stationarity tests on deficit and public debt. His results are mixed; for Greece, Denmark, Germany and Italy the results implied that the government is not intertemporally solvent in these countries, while all the other countries appear to be on a sustainable path.

Finally, Feve & Henin (2000) investigated the sustainability of fiscal policy for the G7 countries. They performed stationarity tests of public debt and found evidence of sustainable fiscal policy for the case of the UK, Japan and the USA. Their approach departs from previous studies in the definition of sustainability and in the econometric approach. They retain a notion of effective sustainability, which imposes the stationarity of public debt expressed in terms of GDP as a (necessary, but not sufficient) condition for sustainability. Finally, they reformulated the unit root and cointegration tests in order to increase power (they purpose a Feedback Unit root test statistics).

6.4. Methods

Acknowledging the importance of fiscal sustainability in guaranteeing stable growth of the economy, numerous studies with different approaches have examined whether or not a country's public finances follow a sustainable path. Firstly, some studies applied stanionarity tests on deficits (Trehan & Walsh, 1988; Trehan & Walsh, 1991), or debt (Kremers, 1988; Wilcox, 1989). Secondly, another strand of literature deployed cointegration tests between government spending and revenues (Fountas & Wu, 1996; Payne, 1997; Olekalns, 2000; Hatemi-J, 2002), or cointegration tests between deficits and debt (Bohn, 2005; Prohl & Schneider, 2006). Thirdly, Markov-switching stochastic process was applied by Davig (2005). Fourthly, Argyrou & Luintel (2007) applied Dynamic Ordinary Least Squares (DOLS). Trace test, Breitung's non-parametric test applied by Correia et al. (2008). Finally, other studies such as Bohn (1998), Greiner et al. (2004) and Correia et al. (2008) used the Bohn test.

7. Conclusion

In this paper we try to provide a synthesis of previous empirical work in in the Sustainability of Fiscal Policy. We provide analysis of the year of publication, tested period, type of analysis, type of methodology and main conclusion about the sustainability of fiscal policy. Our findings are:

- According to our review of the existing literature in this topic, the majority of previous studies have applied time series analysis. We can see in the following table (Table 3) that 61 out of 66 studies used time series analysis and accounted for almost 92.5% of the total studies. The studies that deployed panel data analysis are only 5 and accounted for only 7.5%.
- In our review of the existing literature we found that only 5 studies applied panel data analysis and used it to test a group of countries. Noticeably, this analysis covers a much wider range of countries in contrast to time series analysis. While time series analysis is mostly used in developed countries, this type of analysis is used mostly in groups of developing countries. Studies that used panel data analysis found evidence of sustainable policy in all tested countries, while the time series analysis had mixed results.
- The majority of previous studies used post World-War II data and tested periods less than 50 years. However, there are 8 studies that examined long data sets for single countries or group of countries. Focusing on the empirical results of these

studies that used long series we realise that results are mixed and do not follow any common pattern.

- A large volume of literature examined the sustainability of fiscal policy, but no clear pattern on the empirical results has been presented. A group of studies advocated supportive evidence of sustainable fiscal policy 56% of the tested studies, while another group of empirical studies found that the fiscal policy is not sustainable (22% of the examined papers). Finally, there are a number of studies which obtained mixed results, which accounted for 22% of the tested studies.
- A large number of studies used different approaches in order to examine whether or not a country's public finances follow a sustainable path. Firstly, some studies applied stanionarity tests on deficits (Trehan & Walsh, 1988; Trehan & Walsh, 1991), or debt (Kremers, 1988; Wilcox, 1989). Secondly, another strand of literature deployed cointegration tests between government spending and revenues (Fountas & Wu, 1996; Payne, 1997; Olekalns, 2000; Hatemi-J, 2002), or cointegration tests between deficits and debt (Bohn, 2005; Prohl & Schneider, 2006). Thirdly, Markov-switching stochastic process was applied by Davig (2005). Fourthly, Argyrou & Luintel (2007) applied Dynamic Ordinary Least Squares (DOLS). Trace test, Breitung's non-parametric test applied by Correia et al. (2008). Finally, other studies such as Bohn (1998), Greiner et al. (2004) and Correia et al. (2008) used the Bohn test.

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