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A Race for Growth and Convergence

Greece's Economic Performance: 1960-2013

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Summary

This report offers a quantitative assessment of Greece's economic performance from the early 60s until 2013. During this period, real per capita GDP in Greece increased by a factor of 3.59. This performance corresponds to an annual average growth rate equal to 2.41%. At the same time, the ratio of Greek real per capita GDP over the respective figure of other developed market economies was far from constant. In fact, an examination of the data reveals long periods of continuous convergence (e.g. 1960-1979) followed by long periods of continuous divergence (e.g. 1979-1995). We focus on the supply side of the economy and use standard economic theory (a technique which is known as growth accounting) to quantify the sources (contributing factors) of growth. Using a framework that is based on neoclassical growth theory, we decompose the growth rate of real per capita GDP into three factors. These are: the total factor productivity (TFP) factor (a measure of aggregate efficiency), the capital factor (capital deepening) and the labor factor (labor hours per capita).

Our growth accounting exercise shows that from the mid-70s (especially after 1979) until 1995 and from 2007 until 2013, a persistent deterioration in what we define as the productivity factor (which is the detrended component of the TFP factor), along with a continuous fall of labor hours per capita, have driven the Greek economy to follow a flatter growth path (divergence) compared to that which other developed market economies (USA, Japan and EU-15) have followed during the last 40 years (1974-2013). The not negligible contribution of the capital factor only partially managed to offset this weak growth behavior. Things were more successful during the periods 1960-1973, 1974-1979 and 1995-2007.

This analysis can be thought to be as a primary step (a diagnostic tool) in revealing the factors (supply side) that lie behind the periods of convergence and divergence between Greece and other developed market economies. Our results point out the important role played by the TFP factor. Hence, given the current debate on the future growth prospects and consequently the sustainability of the Greek public debt, we believe that, as in the past, the Greek economy can potentially achieve the desirable growth rates by following policies that increase its productivity factor (for example promote efficiency through structural reforms and create commitment mechanisms that guarantee (credibility) the implementation of these policies). Government policies that focus only to the maintenance of demand and employment, without any monitoring on productivity, cannot be reliable means of achieving high and sustainable growth rates of real per capita GDP. What is needed is an optimal mix of supply side (productivity) and demand side (exports and investment) policy.

Key Words: Convergence, Growth Accounting, Total Factor Productivity, Neoclassical Growth Model, Greece.

1. Introduction

In 1960, real per capita GDP in Greece was 6.06 thousands of euros.[1] In the end of 2013, the same figure has reached a value of 21.73 thousands of euros.[2] Hence, during the last five decades the Greek economy has increased its domestic per capita production of goods and services by a factor of 3.59. This performance corresponds to an annual average growth rate of real per capita GDP equal to 2.41%.[3] In addition, during the same period, the ratio of the Greek real per capita GDP over the respective figure of the EU-15 group of countries increased from 53.38% to 65.08.

What lies behind this seemingly good economic performance? Was this growth path a smooth one or it was characterized by long-short periods of intensive expansion and severe contraction? Did this rate lead the Greek economy to converge towards the "standards of living" (measured in terms of real per capita GDP) of other developed countries?[4] Which were the supply side contributing factors to this economic performance? Can this analysis offer policy recommendations for the current Greek depression? In this report we try to shed some light on these questions.[5]

Doing this work requires the use of standard techniques from economic theory. More specifically, we conduct a growth accounting exercise by decomposing the growth rate of real per capita GDP into three factors. These are the TFP factor (a measure of aggregate efficiency), the capital factor (capital deepening) and the labor factor (labor hours per capita). In addition, the TFP factor is divided in two components. These are the trend factor and the productivity factor.[6] The former is not country specific and according to Kehoe and Prescott (2002) represents the world stock of useable production knowledge which grows smoothly overtime.[7] The latter is country specific, and although there is no broadly accepted theory for it, Kehoe (2003) points out the crucial role played by a country's institutions (e.g. a country's openness to foreign competition, the strength of monopoly rights, the prevalence of labor unions, government regulation of industry, and price controls).[8]

Hence, in analyzing Greece's aggregate economic performance (in terms of real per capita GDP), we examine the data from a supply-

[1] *In this report all variables are converted into real values using the GDP deflator (the base year is 2005). We do that because the theoretical framework that we adopt to conduct the growth accounting exercise follows from a one sector model economy (an economy that produces a homogeneous good). As a result, consistency requires a uniform price level. Furthermore, aggregate real macroeconomic variables are transformed into per capita terms using population in terms of working age persons, that is, persons who are 15-64 years old. Again, it is our theoretical framework that motivates this decision. In our model economy the entire population is capable of working at as a result consistency requires the use of the age-group from total population with this characteristic. Our main results (growth rates) do not considerably change, if instead of working age persons we use total population. In Greece, during the period 1960 to 2013, the average of the ratio of working age persons over total population was 65.94% (with a standard deviation equal to 0.014).*

[2] *If instead of working age persons we use total population (to obtained per capita values) then these figures become 3.98 and 14.33 thousands of euros respectively.*

[3] *Growth rates, that is, proportional changes, are computed by taking annual differences of natural logarithms of the respective variables. Hence, the growth rate of a variable* X_t *for the year* t *is computed as* $\ln X_t - \ln X_{t-1}$. *In addition, when we take the average for the growth rate of a variable* X_t *for the years* t *to* $t+n$, *we computed it as* $\frac{\ln X_{t+n} - \ln X_t}{n}$. *This means that the growth rate of year* t *is not included in this average. For example, when we say that over the period 1960-2013 the average growth rate of real per capita GDP in Greece was 2.41%, this number does not include the growth rate for the year 1960, only these of 1961 to 2013.*

[4] We compare the Greek case with these of USA, Japan and EU-15 group of countries (as a whole and individually).

[5] *The Greek economic performance from a long term perspective is well analyzed in the following studies: Alogoskoufis (1996), Dimeli et al. (1997), Bosworth and Kollintzas (2001), Kollintzas et al. (2012) and Gogos et al. (2014).*

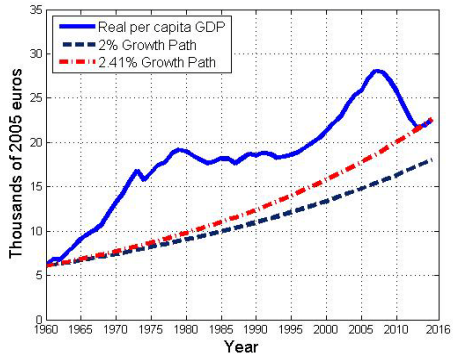
[6] *The methodology that we adopt to quantify the sources of growth is based on the neoclassical "Great Depressions" literature developed by Cole and Ohanian (1999) and Kehoe and Prescott (2002). For the case of Greece, a full implementation of this methodology is examined in Gogos et al. (2014). See Appendix A for an extended presentation of the theoretical underpinnings that underlie the growth accounting exercise.*

[7] *More specifically, Prescott (1998) points out: "One factor contributing to the growth of total factor productivity is increases in what Kuznets (1966) calls useable knowledge. This factor explains why total factor productivity in the United States is four times greater today than it was in 1850. This factor does not explain why total factor productivity in the United States is about four times greater today than it is in India. Make no mistake, knowledge used in the United States is there to be used by the Indians to increase their total factor productivity. The reason that Indian workers are less productive after correcting for stocks of tangible and intangible capital is that this useable knowledge is not as fully exploited there as it is in the United States. A successful theory of international income differences must explain why this is the case."*

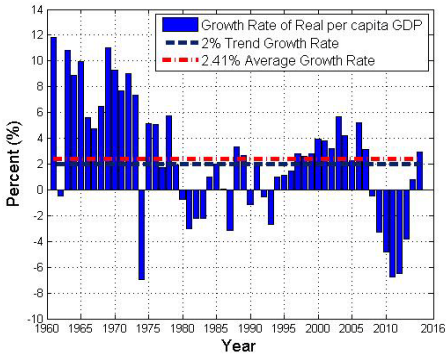
[8] *Prescott (1998) calls upon for a theory which should incorporate the following characteristic: "the strength of the resistance to the adoption of new technologies and to the efficient use of currently operating technologies, and this resistance should depend upon the policy arrangement a society employs...In every society, there are stabilizing forces that protect the status quo. Some of these forces protect entrenched vested interests that might incur losses if innovations were introduced, others are simply don't-rock-the-boat kinds of forces. Technological creativity needs to overcome these forces".*

Figure 1: Greek Economic Performance (1960-2013)

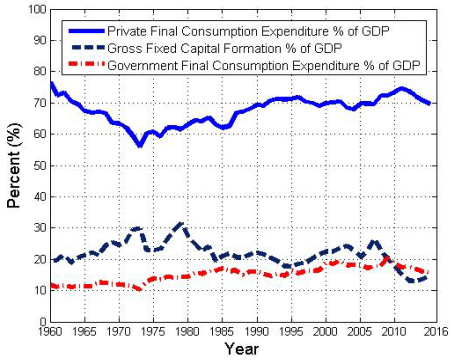
(a) Real per Capita GDP



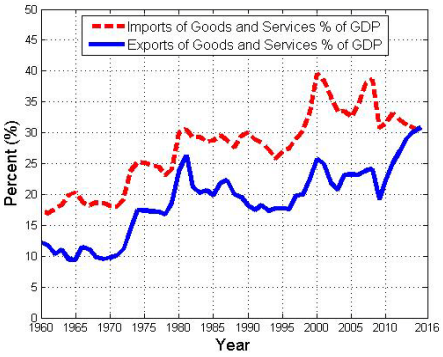
(b) Growth Rate of Real per Capita GDP



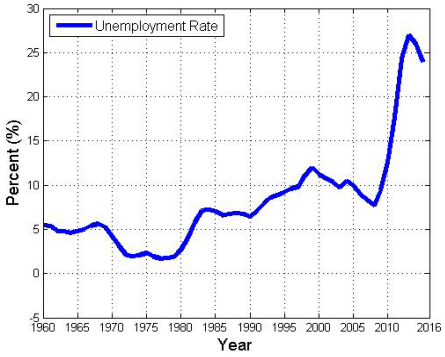
(c) Domestic Demand Components (% of GDP)



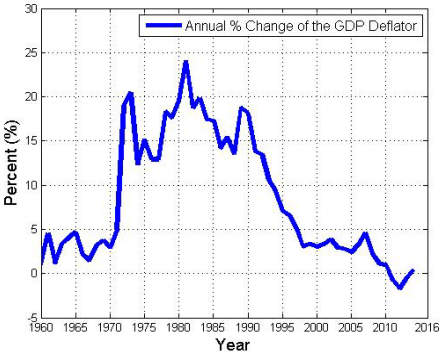
(d) Trade Balance Components (% of GDP)



(e) Unemployment Rate



(f) Annual % Change of the GDP Deflator



Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).

side perspective and quantify the contribution to real per capita GDP growth of productivity and the inputs of production.

Our growth accounting exercise reveals that from the mid-70s (especially after 1979) until 1995 and from 2007 until 2013, a persistent deterioration in the productivity factor (-3.34% during 1979-1995 and -7.54% during 2007-2013), along with a continuous fall of labor hours per capita (-0.86% during 1960-1995 and -3.05% during 2007-2013), have driven the Greek economy to follow a flatter growth path (divergence) compared to that which other developed market economies have followed during the last 40 years (1974-2013). The not negligible contribution of the capital factor (1.26% average contribution during the period 1974-2013) only partially managed to offset this poor growth behavior. The latter result comes as no surprise since Greece in the early 60s had a low level of real per capita capital stock (investment opportunities due to high returns) and as result this could trigger increases in investment expenditures and consequently accumulation of capital stock.

Things were more successful during the periods 1960-1973, 1974-1979 and 1995-2007. Again, as in the former two periods, it was the growth of its productivity factor that had the major contribution for Greece's economic performance. More specifically, during these periods, this factor expanded (on average) with rates of 6.53%, 2.04% and 1.69% respectively.

The structure of the report has as follows: In section 2 we present key stylized facts for the Greek economy and we compare its long-run growth performance with these of USA, Japan and EU-15 group of countries (aggregate and individually). Section 3 presents in a brief way the basic tools of economic theory that we use to perform our growth accounting analysis and in section 4 we display our results. Finally, section 5 concludes.

2. The Greek Growth Performance: 1960-2013

According to Prescott (2002) prosperity and depression are relative concepts. To be able to assess Greece's economic performance over the period 1960-2013 we need a "yardstick". Our choice is not a trivial one. We use economic theory to guide our view of economic data. Since real per capita GDP is an aggregate macroeconomic variable that has a tendency to grow, economists usually use as a measure of comparison a constant trend growth rate.[9] In the literature, this rate is common to be identified as the long-run growth rate of the industrial leader of the world economy. During the 20th century the United States of America had that role with an average growth rate of real per capita GDP equal to 2%.[10] As a result, from a perspective of long-run performance, the Greek economy followed a steeper growth path compared to that of a 2% trend growth rate. This fact is clearly depicted in Figure 1(a).[11] There, the blue solid line displays the Greek real per capita GDP and the two dotted lines are constant growth paths of, 2% (dotted blue black) and 2.41% (dash dotted red) respectively. Panel (b) reproduces (a) in growth rates.

If instead of growing with an average growth rate equal to 2.41% the Greek economy had grown (on average) in a rate equal to 2%, then in 2013 the level of real per capita GDP would have been equal to 17.31 thousands of euros. In other words, in 2013 the Greek real per capita GDP was 25.55% (21.73÷17.31 - 1 = 25.55%) above its 1960 constant 2% growth path. This is a clear exhibition of how, apparently small differentials in growth rates, when compounded over long periods of time magnify real per capita GDP (see Barro and Sala-I-Martin (2004)).

An interesting feature of Greece's economic performance during the last 50 years is its far from smooth, growth path trajectory. We identify three periods of continuous expansion (1960-1973, 1974-1979, 1995-2007), with growth rates (on average) well above 2%, as well as two periods of contraction (1979-1995, 2007-2013) with negative growth rates.[12] We choose to separate the period 1974-1979 from the period 1960-1973, since the annual average growth rate of real per capita GDP during the former (3.94%) was almost half relative to that during the latter (7.87%). Furthermore, the year 1974 marked a major structural break for the Greek economy. In addition, its respective growth rate (-6.96%) is not included in our analysis (only for the 1960-2013 period as a whole). More specifically, this year was characterized by a huge political turmoil in Greece, and given the negative effects of the oil shock of October 1973, reproduced a huge contraction in economic activity which did not reflect the fundamentals of the Greek economy. Nevertheless, the Greek economy during the mid-70s settled on a lower growth path compared to that which it had followed during the period 1960-1973.

In what concerns the expenditures (demand) components as shares of GDP, these are displayed in panels (c) and (d) of Figure 1. In panel (c), the blue solid line is private final consumption expenditures (nominal) as a share of GDP (nominal) and the two dotted lines, are gross fixed capital formation expenditures (dotted blue black) and government final consumption expenditures (dash dotted red) as shares of GDP. These expenditures components, along with changes in inventories and acquisitions less disposals of valuables, constitute the domestic demand in the national accounts. Finally, in panel (d), the blue solid line displays the exports of goods and services, while the red dotted line shows the expenditures for imports of goods and services.

Looking at Figure 1 (panels (c) and (d)) the following things are worth pointing out: 1st the big drop of investment expenditures, from 31.4% as a share of GDP in 1979 to 13.04% in 2013.[13] This decreased was accompanied by a huge increase in private consumption expenditures from 55.97% as a share of GDP in 1973 to 74.6% in 2011, 2nd the doubling of government consumption expenditures, from 10.37% as a share of GDP in 1973 to 20.54% in 2009, 3rd the permanent existence of high deficits in the external balance of goods and services (especially after 1981).

Finally, the last row of Figure 1 (panels (e) and (f)) presents Greece's economic performance in terms of the level of the unemployment rate and the annual percentage change of the GDP deflator (a measure of the proportional change in prices, i.e. inflation). The unemployment rate reached a trough of 1.7% in 1977 and a first peak of 12% in 1999. After falling for nine years, it reached a level of 7.7% in 2008 and then it skyrocketed to a level of 27% in 2013. Meanwhile, the prices of the domestically produced goods and services, proportionally increased in an average rate of 4.16%, 17.44%, 13.39%, 3.08% and 0.83% during

[9] *The tendency of real per capita GDP to grow is one (the 1st) of the six well known stylized facts that characterize the process of economic growth according to the work of Nicholas Kaldor (1963).*

[10] *According to Kehoe and Prescott (2002) this trend growth stems from the world stock of useable production knowledge which grows smoothly over time and is not country specific. For details see Appendix A.*

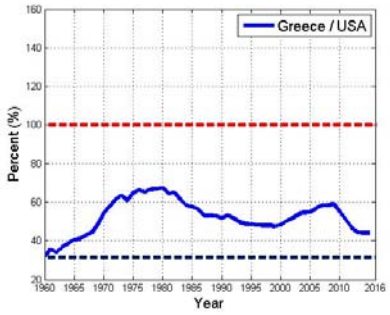
[11] *For all the variables in this report, the years 2014 and 2015 are projections from AMECO database.*

[12] *It remains to be seen whether the end of 2013 marks the beginning of a new expansion period for the Greek economy.*

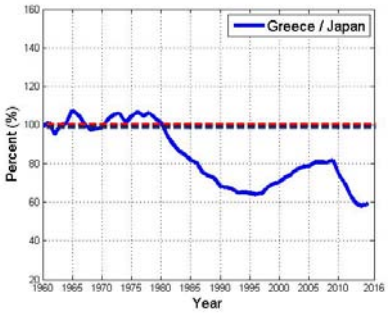
[13] *This decrease was not a continuous one. During the period 1995 to 2007, gross fixed capital formation as a share of GDP increased from 17.69% to 26.6%.*

Figure 2: Ratio of Real per Capita GDP (Greece Relative to Other Countries, %)

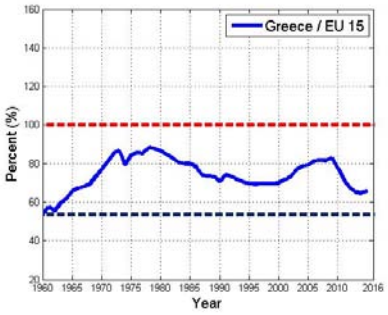
(a) USA



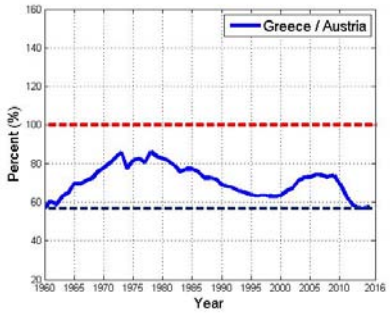
(b) Japan



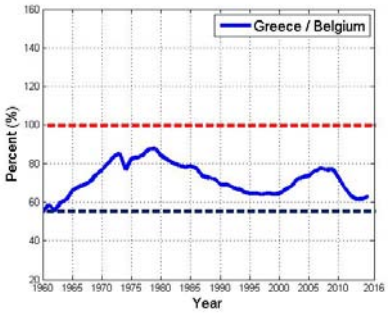
(c) EU-15



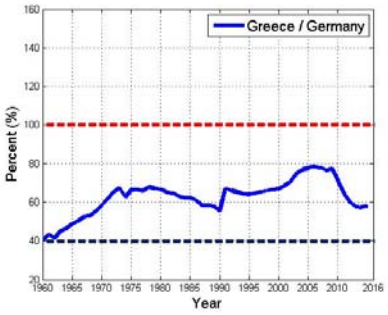
(d) Austria



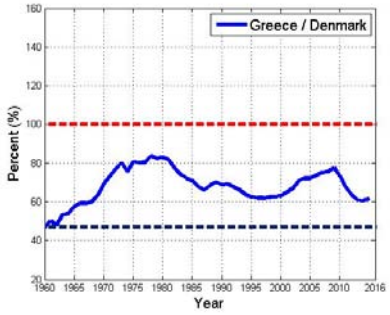
(e) Belgium



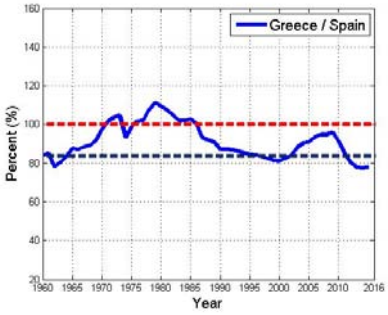
(f) Germany



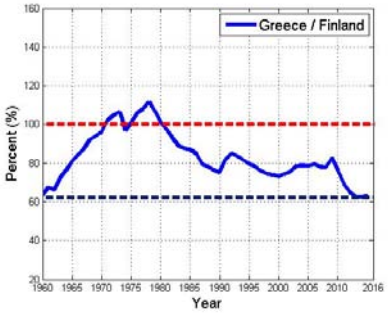
(g) Denmark



(h) Spain



(i) Finland



Source: *1. OECD (2010), "Aggregate National Accounts: Gross Domestic Product," OECD National Account Statistics (Database).*
2. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).

Note: *1. Real per capita GDP is measured in 2005 dollars (constant purchasing power parities, PPPs).*
2. The red dotted line is the level where the Greek real per capita GDP is equal to the respective figure of the other economies. The blue black dotted line presents the ratio of Greek real per capita GDP over that of the other countries in the year 1960, while the blue solid line shows its path during the period 1960-2015.

the periods of 1960-1973, 1974-1979, 1979-1995, 1995-2007 and 2007-2013 respectively.

After presenting key stylized facts for the Greek economy, it is also interesting to examine how the economies in our sample (USA, Japan, EU-15) behaved during this time period. Did the Greek economy converge towards the standards of living of these countries? If the answer is yes, had that path a clear trend? Finally, how did Greece perform compared to countries with similar characteristics (for example Spain, Portugal and Ireland)? This is done in the next subsection.

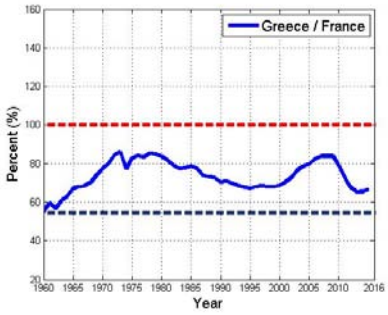
2.1 Convergence or Divergence?

Generally speaking, the Greek economy in 2013, although it experienced a 6 years of tremendous downsizing in its economic activity, stands on a better position (in terms of real per capita GDP) relative to the other economies in our sample, compared to the year 1960.[14] Only Japan, Spain, Finland, Ireland, Luxembourg and Portugal managed to grow (on average) with rates higher than that of Greece. Things are quite different if we compare the position of the Greek economy in 2013 with respect to the year

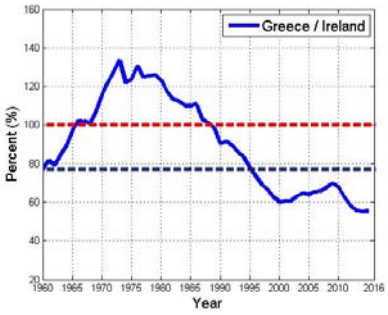
[14] *This fact is mostly attributed to the Greek growth performance during the period 1960-1973 (see Figure 2).*

Figure 2 (continued): Ratio of Real per Capita GDP (Greece Relative to Other Countries, %)

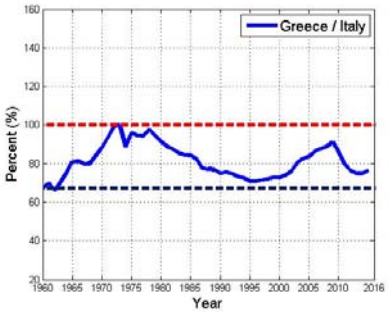
(j) France



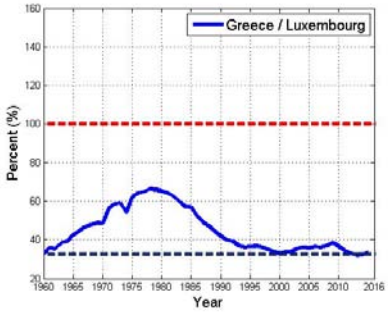
(k) Ireland



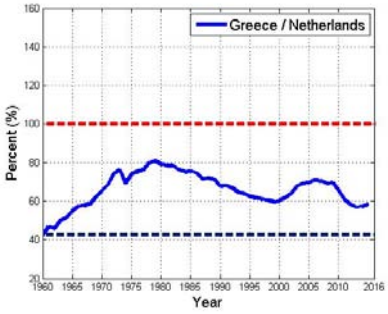
(l) Italy



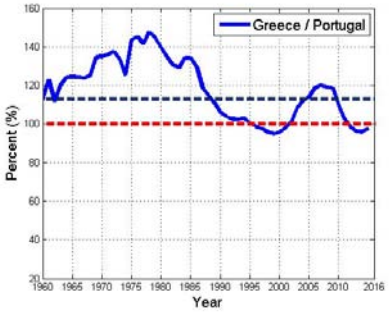
(m) Luxembourg



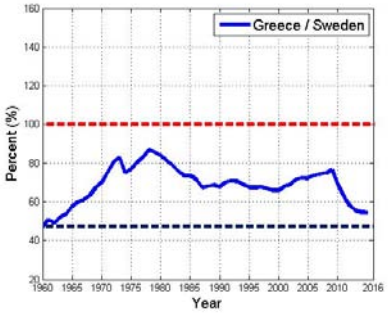
(n) Netherlands



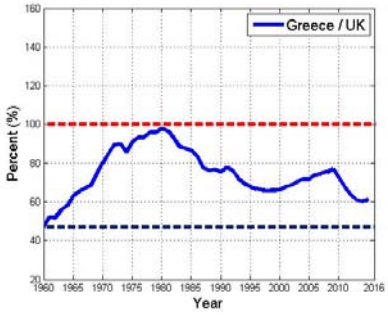
(o) Portugal



(p) Sweden



(q) UK



1974 or 1979. During this time period, Greece grew with the lowest rate (0.83% for the period 1974-2013) among our sample economies.

2.1.1 The Boom: 1960-1973

From 1960 to 1973 the Greek economy was expanding in a rate of growth of 7.87%.[15] This rate ranked Greece in the first place among our sample of economies, followed by the economy of Japan with an average growth rate of 7.38%. Furthermore, countries like these of Spain and Portugal, which had similar characteristics with Greece in the early 60s, were also expanding with high rates of growth. More specifically, Spain was growing in a rate of 6.14%, while the respective figure for Portugal was 6.53%. In addition, as the "1960-1973" column of Table 1 (panel (a)) depicts, the 60s were not a "success story" only for Greece, Japan, Spain and Portugal. Economic activity was increasing in all Western market economies in rates well above the 2% trend (for example in EU-15 the growth rate was 4.14%).

Nevertheless, the Greek growth performance, guaranteed a quick catch up towards the standards of living of the other economies. This is clearly depicted in Table 1 (panel (b)) and Figure 2. There we present the ratio of real per capita GDP in Greece over the respective figure for the other countries.[16]

[15] *Under this rate, the Greek economy could double its real per capita GDP every (approximately) 8.8 years.*

[16] *The abbreviation for the countries has as follows: US refers to the United States of America, JP to Japan, EU-15 to the European Union member countries until 2004, AT to Austria (1995), BE to Belgium (1957), DE to Germany (1957), DK to Denmark (1973), EL to Greece (1981), ES to Spain (1986), FI to Finland (1995), FR to France (1957), IE to Ireland (1973), IT to Italy (1957), LU to Luxembourg (1957), NL to Netherlands* (1957), PT to

Table 1: Convergence and Divergence (Greek Growth Performance Relative to that of Other Economies)

Growth rates, that is, proportional changes, are computed by taking annual differences of natural logarithms of the respective variables. Hence, the growth rate of a variable X_t for the year t is computed as $\ln X_t - \ln X_{t-1}$. In addition, when we take the average for the growth rate of a variable X_t for the years t to $t+n$, we computed it as $\left(\ln X_{t+n} - \ln X_t\right)/n$.

Panel (a): Annual Average Growth Rate of Real per Capita GDP (%)

Period / Country	1960-2013	1974-2013	1960-1973	1974-1979	1979-1995	1995-2007	2007-2013	2013-2015 (Projections)
US	1.79	1.64	2.57	1.95	1.83	1.91	0.3	2.05
JP	3.39	2.2	7.38	3.45	2.76	1.58	0.92	2.12
EU-15	2.04	1.34	4.14	1.97	1.26	2.08	-0.47	1.46
AT	2.41	1.62	4.68	2.36	1.53	2.17	0.12	1.31
BE	2.2	1.4	4.48	1.3	1.74	1.91	-0.43	0.63
DE	1.72	1.03	3.88	2.54	0.12	1.78	0.73	1.67
DK	1.91	1.38	3.74	2.19	1.55	1.92	-0.8	1.67
EL	**2.41**	**0.83**	**7.87**	**3.94**	**-0.17**	**3.42**	**-4.27**	**1.88**
ES	2.54	1.29	6.14	0.4	1.55	2.46	-0.97	1.91
FI	2.44	1.95	3.9	2.02	1.66	3.57	-0.6	1.52
FR	2.09	1.26	4.43	2.06	1.28	1.6	-0.12	0.91
IE	3.01	2.84	3.58	3.27	2.83	4.82	-1.46	2.04
IT	2.2	1.27	4.78	2.7	1.62	1.64	-1.62	0.94
LU	2.46	2.17	3.35	-0.05	3.55	3.51	-2.35	-0.19
NL	1.85	1.33	3.31	0.79	1.44	2.43	-0.68	0.46
PT	2.7	1.51	6.53	1.1	2.11	1.94	-0.59	1.18
SE	2.11	1.61	3.52	1.32	1.31	2.62	0.6	2.71
UK	1.93	1.71	2.87	1.66	1.99	2.63	-0.85	1.76

Panel (b): Ratio of Real per Capita GDP (Greece Relative to Other Countries, %)

Year / Country	1960	1973	1979	1995	2007	2013	2015 (Projections)
US	31.9	63.55	66.98	48.6	58.24	44.28	44.13
JP	99.38	105.96	103.44	64.73	80.75	59.15	58.86
EU-15	53.38	86.68	87.59	69.64	81.76	65.08	65.63
AT	56.77	85.88	83.73	63.77	74.05	56.89	57.54
BE	54.92	85.32	87.77	64.58	77.38	61.46	63.01
DE	40.1	67.38	67.06	64.04	77.97	57.78	58.02
DK	46.85	80.15	82.54	62.63	75.03	60.94	61.19
ES	83.45	104.51	111.22	84.46	94.82	77.79	77.74
FI	63.55	106.4	106.61	79.47	78.09	62.66	63.1
FR	55.05	86.03	84.89	67.33	83.82	65.34	66.62
IE	76.55	133.6	125.94	77.85	65.85	55.65	55.47
IT	66.92	99.98	94.41	70.84	87.72	74.81	76.23
LU	32.89	59.16	65.98	36.38	35.98	32.06	33.41
NL	42.24	76.36	81.02	62.64	70.53	56.85	58.49
PT	112.24	133.55	144.63	100.35	119.84	96.09	97.43
SE	47.2	83.07	85.47	67.4	74.23	55.41	54.49
UK	47.07	90.13	95.86	67.83	74.58	60.76	60.9

Source: 1. OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Account Statistics (Database).
2. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).

Note: 1. Real per capita GDP is measured in 2005 dollars (constant purchasing power parities, PPPs).
2. The growth rate of the starting year of each period is not included on the average value (see Footnote 3).

2.1.2 The First Signals: 1974-1979

After the big political turmoil of the year 1974, the Greek economy continued to have the first place, in terms of growth performance, among our sample economies. However, during the period 1974-1979, the pace of expansion slowed down.[17]

Most important of all, this period signaled the beginning of a major turn in Greek economic policy (see Alogoskoufis (1995) and Bosworth and Kollintzas (2001)) towards intensive redistributive policies, nationalizations, increases in government expenditures and budget deficits and allowances for labor unions to gain more power. The Year 1979 marked the peak of convergence with the majority of our sample economies. This does not hold only for Japan, Austria, France and Italy. For these countries the peak was in the year 1973, while for Germany it was in the year 2007.

2.1.3 The First Depression: 1979-1995

After almost twenty years (1960-1979) of continuous expansion (well above trend), the Greek economy fell into a sixteen years severe recession.[18] From 1979 to 1995, the annual average growth rate of real per capita GDP in Greece was -0.17%. The Greek economic policy followed a similar pattern like that in the mid-70s, however, this time the scale for an increasing role for the state was magnified. Inflation, budget deficits, debt and deficits in the trade balance started to soar. The most striking fact about this stagnation episode was its country specific characteristic. In column "1979-1995" of Table 1 (panel (a)), we observe that only Greece turned to negative growth rates during the 80s and until the mid-90s. As a result, during this time period, the Greek economy entered into a persistent divergence path. This is well depicted in columns "1979", "1995" of Table 1 (panel (b)) and in almost all subplots of Figure 2.

2.1.4 The Recovery and the New Depression: 1995-2007, 2007-2013

For the Greek economy the end of the year 1995 marked the beginning of an entrance into a recovery trajectory which would last for twelve years. The correction of many of the distortions that were introduced during the last twenty years (1975-1995), the liberalization of competition in the financial sector, along with the challenging commitment of entering into the European Monetary Union (and the organization of the Olympic Games in 2004) led the Greek economy to expand with one of the highest growth rates (3.42%) among our sample economies. As a result, especially in the end of the 90s, the divergence path of the 80s and the mid-90s turned to a convergence path.

This path was abruptly ended in the end of 2007. The more recently updated macroeconomic data reveal a picture of "shock and awe" for Greece's economic performance during the period 2007-2013. In the end of 2013, real per capita GDP was already 22.6% below its value in 2007 and the unemployment rate skyrocketed to a level of approximately 27%. These magnitudes are comparable to the depression episodes that the Western developed market economies (USA, Germany, France, UK, Italy and Canada) experienced during the interwar period of the late 20s until the mid-30s.

Finally, it is interesting to note, that the two depression episodes of 1979-1995 and of 2007-2013, have driven the Greek economy back to levels of relative real per capita GDP similar with that in the mid-60s (see Figure 2).

2.1.5 What Lies Behind This Economic Performance? A Supply-Side Analysis

The above analysis gives rise to an interesting question: Which were the most important (quantitatively) contributing factors (supply-side) for Greece's economic performance during the last fifty years? Why during the period 1974 to 2013 the Greek economy had the lowest growth rate compared to USA, Japan and EU-15 (aggregate and individual)? Did we work less? Did we accumulate less capital? Did we reduce our efficiency in the production of goods and services? To answer these questions we perform a growth accounting exercise. This is done in the next two sections.

3. Growth Accounting

The growth accounting technique has its origins to the seminal works of Solow (1957), Kendrick (1961), Denison (1962) and Jorgenson and Griliches (1967). This methodology serves as a starting point for exploring the determinants of growth. This means that we only try to quantify the sources of growth, we do not (at least not in this report) reveal what lies behind the movement of these sources. Doing this exercise requires more theory along with advanced computational methods.

3.1 The Basic Equation

Using a standard aggregate neoclassical production function, making some basic assumptions about the path of TFP and applying some basic mathematical properties (for details see

Portugal (1986), SE to Sweden (1995) and UK to the United Kingdom (1973). The year inside the parentheses refers to the time of entrance of the specific country to the European Union. For Germany, the data until 1990 refer to West Germany.

[17] The mid-70s slow down (compared to 60s) was not exclusively a Greek phenomenon. Looking at Table 1 (panel (a)), we observe a worldwide reduction in the pace of economic growth. In the literature this episode is known as "the productivity slowdown".

[18] In Gogos et al. (2014), the period 1979-2001 is characterized as a Great Depression. This definition is consistent with specific criteria (for a period to be named as a great depression) set by Kehoe and Prescott (2002).

Appendix A), we decompose real per capita GDP into four components. These are displayed in Table 2.

Table 2. Decomposition of Real per Capita GDP
(In Natural Logarithms)

Real per capita GDP, $\ln \frac{Y_t}{N_t}$, is equal to the sum of:

1. *Trend Factor:* $g_{Tr}t$
2. *Productivity Factor:* $\frac{1}{1-a}\ln \tilde{A}_t$
3. *Capital Factor:* $\frac{a}{1-a}\ln \frac{K_t}{Y_t}$
4. *Labor Factor:* $\ln \frac{L_t}{N_t}$

Note: The TFP Factor is equal to the sum of the trend factor (not country specific, i.e. common across developed market economies) and the productivity factor (country specific and according to Prescott (2002) mostly affected by government policy).

The specification of the symbols in Table 2 has as follows: Y_t is real output (in our data real GDP) in year t, g_{Tr} is trend growth rate (2%) of the TFP factor, $\tilde{A}_t$ is the productivity variable in year t, K_t is real capital stock (net accumulated past investment) in year t, L_t is labor effort (in our data labor hours) in year t, N_t is population (in our data working age population) in year t and α is the capital share parameter (the ratio of capital income over total income). Hence, the basic equation of our growth accounting exercise takes the following form:

$$\ln \frac{Y_t}{N_t} = g_{Tr}t + \frac{1}{1-a}\ln \tilde{A}_t + \frac{a}{1-a}\ln \frac{K_t}{Y_t} + \ln \frac{L_t}{N_t} \qquad (1)$$

Prescott (2002), by using a similar mathematical expression like equation (1), performed a level accounting exercise for USA, France, Japan and UK. His main accounting findings (for the year 1998) were the following: The French real per capita GDP was 31% lower than that of the USA because the labor factor in France was 37% lower compared to that in USA (differences in the productivity and in the capital factor were very small, e.g. 6% and 1% higher for France). For the case of Japan the story was quite different. The Japanese real per capita GDP was 31% lower than that of the USA because the productivity factor in Japan was 33% lower compared to that in USA (differences in the capital factor and in the labor factor were very small, e.g. 3% higher for Japan and 1% higher for the USA). For the economy of UK, both the productivity factor and the labor factor contributed to the 41% lower real per capita GDP relative to the respective figure in USA. More specifically, the former factor was 29% lower compared to that in USA, while the latter factor was 13% lower relative to that in USA (the capital factor was slightly higher in UK, 2%). Finally, it is interesting to note that the productivity factor and the labor factor had the lion's share in accounting for per capita income differences across these countries. Prescott (2002), supports the idea that this fact also holds for most of the OECD countries were data are available.

Taking annual differences of equation (1), which is a good approximation of relative small annual percentage changes (i.e. growth rates), we extract the four sources of growth of real per capita GDP. These are displayed in equation (2):

$$g_{\frac{Y_t}{N_t}} = g_{Tr} + \frac{1}{1-\alpha}g_{\tilde{A}_t} + \frac{\alpha}{1-\alpha}g_{\frac{K_t}{Y_t}} + g_{\frac{L_t}{N_t}} \qquad (2)$$

As a result, the growth rate of real per capita GDP, is driven exclusively by the sum of proportional changes in the trend factor (1st component), the productivity factor (2nd component), the capital factor (3rd component) and the labor factor (4th component).[19]

Looking at equation (2), we observe that in order to conduct our growth accounting exercise we need to have at our disposal the following time series and parameter values:

1. Time series for real GDP.
2. Times series for population.
3. Time series for labor hours.
4. Times series for real capital stock
5. Times series for Productivity
6. A value for the capital share parameter α which we assume that is always constant.
7. A value for the depreciation rate parameter δ.

Time series (1), (2), and (3) are taken from the databases, while (4) and (5) are constructed (see Appendix A). In addition, we compute a capital share parameter (it is taken residually by computing a labor share parameter, for details see Appendix A) and a

[19] *Our growth accounting framework differs from conventional approaches, since it measures the contribution to real per capita GDP growth of the capital input in terms of capital deepening (capital – output ratio) and not in capital per capita or capital per worker. As already mentioned, this growth accounting framework follows from the neoclassical "Great Depressions" methodology (for the rationale of this choice, see Kehoe and Meza (2011)).*

depreciation rate parameter (it is needed for the construction of the real capital stock series) for each country.

3.2 Presentation of Results

The results from our growth accounting exercise are presented in Table 3 (panels (a) to (h)) as well as in Figure 3 (panels 1 to 17). More specifically, Table 3 displays the annual average growth rate of real per capita GDP $\frac{Y_t}{N_t}$, of the TFP factor $A_t^{\frac{1}{1-\alpha}}$ (trend and productivity), of the capital factor $\left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}}$ and of the labor factor $\frac{L_t}{N_t}$, over the periods 1960-2013 (panel (a)), 1974-2013 (panel (b)), 1960-1973 (panel (c)), 1974-1979 (panel (d)), 1979-1995 (panel (e)), 1995-2007 (panel (f)), 2007-2013 (panel (g)) and 2013-2015 (panel (h)). Figure 3 depicts the index values (1960 = 100) for the respective variables (in detrended terms for real per capita GDP and the TFP factor) over the entire period 1960-2015. In all Figures, the blue dotted line refers to Greece and the blue black solid line refers to the sample economies.

For detrended real per capita GDP, the index values were computed using the following equation:

$$\tilde{y}_t = \frac{y_t}{\left(1+g_{Tr}\right)^{t-1960} y_{1960}} 100 \quad (3)$$

where $\tilde{y}_t$ is detrended real per capita GDP in year t, y_t is real per capita GDP in year t, y_{1960} is real per capita GDP in year 1960 and g_{Tr} is trend growth rate (2%) of the TFP factor. In addition, for detrended TFP factor (which is the productivity factor), the index values were computed using the same formula as in equation (3). Finally, for the capital factor and the labor factor, the index values were computed using the following two equations:

$$\left(\frac{K_t}{Y_t}\frac{Y_{1960}}{K_{1960}}\right)^{\frac{\alpha}{1-\alpha}} 100 \quad (4)$$

and

$$\frac{L_t}{N_t}\frac{N_{1960}}{L_{1960}} 100 \quad (5)$$

4. Analysis of Results

In this section we try to decode (at a first level) the data presented in Table 1 and Figure 2.[20] We give answers to the following questions: Why Greece, during the period 1960-1979, was converging at such high speed towards the standards of living of most of our sample economies? Why things reversed during the period 1979-1995? Why there was an improvement during the period 1995-2007? Our analysis points out the important role played by the productivity factor.

4.1 General Comments – Periods: 1960-2013, 1974-2013

As already mentioned, during the period 1960-2013 the Greek economy grew with an annual average rate of 2.41%. According to our growth accounting exercise this rate was driven by a decrease in the productivity factor of -0.1% (see Table 3 panel (a)), by an increase in the capital factor of 1.29%, by a decrease in the labor factor of -0.79% and by a steady exogenous increase in the "world stock of useable knowledge" of 2%. Why Greece had such a weak performance (0.83% or -1.17% below trend) from 1974 to 2013? The most important contributing factor was the -1.77% decrease in the productivity factor, followed by a decrease in the labor factor of -0.66%. The positive contribution of the capital factor (1.26%) only partially managed to offset this poor growth behavior.[21]

Looking more closely to Table 3 (panel (b)), we observe that other countries as well experienced a decrease in their productivity factor during the period 1974 to 2013. More specifically, Italy and Spain performed very poorly (-1.36% and -0.81%) while Japan, Finland and Ireland, were the only economies from our sample that managed to achieve an increasing path for this variable (0.15%, 0.21% and 1.1%).[22]

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[20] *We say at a first level because quantifying the sources of growth does not gives answers to what lies behind the proportional changes in the factors of production or TFP. For example, in France, over the period 1960-2013, a not negligible continuous fall in labor hours per capita has driven the economy to follow a near trend growth path, despite the increase in the productivity factor and the capital factor. Our analysis stops at this point. That is, we do not give answers about the factors that lie behind to this drop in labor hours per capita in France. Doing that requires more theory. The use of Dynamic Stochastic General Equilibrium Models (DSGE), which is the modern approach of doing macroeconomics, can help us to investigate such questions. Prescott (2002), for the case of France and by using the neoclassical growth model, points out the important role played by the tax rates on consumption expenditures and labor income.*

[21] *Since we measure economic performance relative to a 2% trend growth path, our main focus of analysis will be on the behavior of the productivity factor, the capital factor and the labor factor.*

[22] *For Japan this seemingly good economic performance is mostly attributed to the period 1974-1990. Its "lost decade" of the 90s is well analyzed in Hayashi and Prescott (2002). More specifically, the authors support the idea*

Table 3: Accounting For Growth – Annual Average % Changes

In all panels the column "Growth" refers to the growth rate of real per capita GDP and is always equal to the sum of columns (1), (2), (3) and (4). This follows from the growth accounting equation (2). The series for real per capita GDP and labor hours were taken from the databases, while the series for real capital stock and TFP were constructed (see Appendix A).

Period	(a) 1960-2013					(b) 1974-2013				
	Growth	Factors				Growth	Factors			
	(1)+(2)+(3)+(4)	TFP		Capital	Labor	(1)+(2)+(3)+(4)	TFP		Capital	Labor
Country		Trend	Productivity	Deepening			Trend	Productivity	Deepening	
		(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
US	1.79	2	-0.4	0.24	-0.05	1.64	2	-0.58	0.2	0.02
JP	3.39	2	1.35	0.5	-0.46	2.2	2	0.15	0.39	-0.34
EU-15	2.04	2	0.4	0.26	-0.63	1.34	2	-0.56	0.31	-0.41
AT	2.41	2	0.86	0.18	-0.64	1.62	2	-0.24	0.27	-0.41
BE	2.2	2	0.65	0.2	-0.65	1.41	2	-0.51	0.2	-0.34
DE	1.72	2	0.27	0.1	-0.65	1.03	2	-0.67	0.11	-0.4
DK	1.91	2	0.23	0.21	-0.53	1.38	2	-0.21	0.12	-0.53
EL	**2.41**	**2**	**-0.1**	**1.3**	**-0.79**	**0.83**	**2**	**-1.77**	**1.26**	**-0.66**
ES	2.54	2	0.26	0.79	-0.51	1.29	2	-0.81	0.86	-0.75
FI	2.44	2	1	0.07	-0.63	1.95	2	0.21	0.15	-0.42
FR	2.09	2	0.56	0.39	-0.87	1.26	2	-0.51	0.48	-0.7
IE	3.01	2	1.47	0.36	-0.82	2.84	2	1.1	0.34	-0.61
IT	2.2	2	0.39	0.51	-0.7	1.27	2	-1.36	0.68	-0.06
LU	2.46	2	0.37	-0.01	0.1	2.17	2	-0.54	0.15	-0.56
NL	1.85	2	0.38	0.13	-0.67	1.33	2	-0.74	0.18	-0.11
PT	2.7	2	0.62	0.47	-0.38	1.51	2	-0.36	0.53	-0.65
SE	2.11	2	0.06	0.1	-0.05	1.61	2	-0.66	0.07	0.19
UK	1.93	2	0.31	0.05	-0.44	1.71	2	0	0.02	-0.32

Period	(c) 1960-1973					(d) 1974-1979				
	Growth	Factors				Growth	Factors			
	(1)+(2)+(3)+(4)	TFP		Capital	Labor	(1)+(2)+(3)+(4)	TFP		Capital	Labor
Country		Trend	Productivity	Deepening			Trend	Productivity	Deepening	
		(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
US	2.57	2	0.55	0.16	-0.14	1.95	2	-0.62	0.1	0.47
JP	7.38	2	5.5	0.41	-0.53	3.45	2	0.77	0.93	-0.25
EU-15	4.14	2	3.34	0.03	-1.23	1.97	2	0.63	0.66	-1.32
AT	4.68	2	4.07	-0.14	-1.24	2.36	2	0.93	0.76	-1.33
BE	4.48	2	4.04	0	-1.56	1.3	2	-0.12	1.13	-1.71
DE	3.88	2	3.09	-0.04	-1.17	2.54	2	1.72	-0.09	-1.09
DK	3.74	2	1.88	0.3	-0.44	2.19	2	1.19	0.28	-1.29
EL	**7.87**	**2**	**6.53**	**0.53**	**-1.19**	**3.94**	**2**	**2.04**	**1.23**	**-1.32**
ES	6.14	2	3.38	0.54	0.21	0.4	2	-0.84	2.63	-3.39
FI	3.9	2	3.48	-0.32	-1.26	2.02	2	-0.1	1.34	-1.22
FR	4.43	2	3.63	0.12	-1.32	2.06	2	0.07	1.06	-1.06
IE	3.58	2	2.63	0.3	-1.35	3.27	2	1.64	0.65	-0.95
IT	4.78	2	5.42	0.01	-2.65	2.7	2	0.43	0.91	-0.72
LU	3.35	2	3.08	-0.53	-1.19	-0.05	2	-2.34	1.61	-1.32
NL	3.31	2	3.41	0.01	-2.11	0.79	2	0.39	0.45	-2.05
PT	6.53	2	4.76	0.03	-0.26	1.1	2	0.01	1.52	-2.54
SE	3.52	2	2.11	0.18	-0.77	1.32	2	-2.22	0.72	0.84
UK	2.87	2	1.6	-0.04	-0.69	1.66	2	0.21	0.43	-1.02

Source: *1. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).*
2. Groningen Growth Development Center database (GGDC)
3. OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Account Statistics (Database).

Table 3 (continued): Accounting For Growth – Annual Average % Changes

In all panels the column "Growth" refers to the growth rate of real per capita GDP and is always equal to the sum of columns (1), (2), (3) and (4). This follows from the growth accounting equation (2). The series for real per capita GDP and labor hours were taken from the databases, while the series for real capital stock and TFP were constructed (see Appendix A).

Period	(e) 1979-1995					(f) 1995-2007				
	Growth	TFP		Capital	Labor	Growth	TFP		Capital	Labor
Country	(1)+(2)+(3)+(4)	Trend (1)	Productivity (2)	Deepening (3)	(4)	(1)+(2)+(3)+(4)	Trend (1)	Productivity (2)	Deepening (3)	(4)
US	1.83	2	-0.88	0.24	0.47	1.91	2	0.1	0.11	-0.3
JP	2.76	2	0.81	0.54	-0.58	1.58	2	-0.35	0.14	-0.21
EU-15	1.26	2	-0.32	0.26	-0.68	2.08	2	-0.32	-0.13	0.54
AT	1.53	2	-0.14	0.29	-0.62	2.17	2	-0.03	-0.12	0.32
BE	1.74	2	0.38	-0.01	-0.65	1.91	2	-0.69	-0.04	0.65
DE	0.12	2	-1.24	0.2	-0.84	1.78	2	-0.26	0.01	0.03
DK	1.55	2	0.46	-0.17	-0.74	1.92	2	-1.04	0.07	0.89
EL	**-0.17**	**2**	**-3.4**	**1.67**	**-0.45**	**3.42**	**2**	**1.69**	**-0.81**	**0.54**
ES	1.55	2	0.32	0.37	-1.14	2.46	2	-1.71	0.19	1.98
FI	1.66	2	0.65	0.37	-1.35	3.57	2	1.96	-1.4	1
FR	1.28	2	0.04	0.45	-1.21	1.6	2	-0.3	-0.05	-0.05
IE	2.83	2	2.09	-0.32	-0.94	4.82	2	1.64	-0.04	1.22
IT	1.62	2	-0.66	0.53	-0.25	1.64	2	-1.69	0.21	1.12
LU	3.55	2	1.45	-0.71	0.82	3.51	2	0.08	-0.21	1.64
NL	1.44	2	-0.62	0.08	-0.03	2.43	2	-0.15	-0.2	0.78
PT	2.11	2	0.14	0.42	-0.45	1.94	2	-0.81	0.2	0.56
SE	1.31	2	-0.96	0.25	0.03	2.62	2	1.31	-0.75	0.06
UK	1.99	2	0.48	-0.08	-0.42	2.63	2	0.92	-0.42	0.13

Period	(g) 2007-2013					(h) 2013-2015 (Projections)				
	Growth	TFP		Capital	Labor	Growth	TFP		Capital	Labor
Country	(1)+(2)+(3)+(4)	Trend (1)	Productivity (2)	Deepening (3)	(4)	(1)+(2)+(3)+(4)	Trend (1)	Productivity (2)	Deepening (3)	(4)
US	0.3	2	-1.11	0.36	-0.95	2.05	2	-0.75	-0.66	1.46
JP	0.92	2	-1.09	0.04	-0.04	2.12	2	-0.57	-0.49	1.18
EU-15	-0.47	2	-2.68	1.03	-0.82	1.46	2	-0.75	-0.45	0.65
AT	0.12	2	-1.91	0.61	-0.57	1.31	2	-1.42	-0.14	0.86
BE	-0.43	2	-2.89	0.83	-0.38	0.63	2	-1.75	-0.02	0.4
DE	0.73	2	-1.96	0.23	0.46	1.67	2	-0.59	-0.44	0.71
DK	-0.8	2	-1.51	0.88	-2.17	1.67	2	-1.54	-0.63	1.85
EL	**-4.27**	**2**	**-7.54**	**4.32**	**-3.05**	**1.88**	**2**	**-1.03**	**-1.77**	**2.68**
ES	-0.97	2	-2.01	2.01	-2.97	1.91	2	-0.14	-0.94	0.99
FI	-0.6	2	-4.19	1.67	-0.09	1.52	2	-1.29	0.15	0.66
FR	-0.12	2	-2.87	1.11	-0.36	0.91	2	-1.21	0.13	0
IE	-1.46	2	-3	2.6	-3.07	2.04	2	-0.14	-1.54	1.73
IT	-1.62	2	-4.03	1.77	-1.36	0.94	2	-0.85	-0.67	0.46
LU	-2.35	2	-5.55	1.95	-0.74	-0.19	2	-2.11	0.19	-0.27
NL	-0.68	2	-3.16	0.96	-0.48	0.46	2	-1.23	-0.26	-0.05
PT	-0.59	2	-1.22	0.65	-2.02	1.18	2	0.9	-1.72	0
SE	0.6	2	-2.45	0.69	0.37	2.71	2	-0.25	-0.53	1.49
UK	-0.85	2	-3.34	0.83	-0.35	1.76	2	-0.23	-0.61	0.67

Source: 1. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).
2. Groningen Growth Development Center database (GGDC)
3. OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Account Statistics (Database).

Furthermore, an interesting feature, which is clearly displayed in Figure 3 (panels 3-17, (b)), is the persistent decrease in the productivity factor for most of the EU-15 countries from the mid-90s (or end of 90s) until today. Finally, for the US economy, the decrease in its productivity factor is mostly attributed to the 2005-2013 period (which includes the 2007-2009 recession).

In what concerns the capital factor, as Table 3 and Figure 3 (panels 1-17, (c)) display, there is a considerable increase for the case of Greece. As Gogos et al. (2014) point out, this increase was mainly driven by the private sector of the economy and it was accompanied by a big decrease in the rental rate of capital.[23] In addition, for the majority of our sample economies, the contribution of the capital factor was a very small one. This does not hold for Japan, France, Italy, Portugal and Spain.

Finally, with respect to the contribution of the labor factor, the Greek economy followed a rather similar decreasing path, like the one that most of the EU-15 group of countries followed during the last 50 years. On the other hand, only USA, Luxembourg and Sweden managed to have a positive contribution of the labor factor in their growth rate of real per capita GDP (see Figure 3 (panels 1, 13 and 16, (d)).

4.2 Period: 1960-1973

During the period 1960-1973, the Greek productivity factor was expanding with an annual average rate of 6.53%. This rate was the highest among our sample economies. The economy of Japan was in the second place with a rate of 5.5%, followed by Italy (5.42%), Portugal (4.76%), Austria (4.07%), Belgium (4.04%), France (3.63%), Finland (3.48%), Netherlands (3.41%) and Spain (3.38%). The economies of UK and USA experienced the lowest rates in terms of productivity growth, with rates of 1.6% and 0.55% respectively.[24] Generally speaking, the 60s and the early 70s were characterized by strong growth in productivity for most of the economies in our sample.

In what concerns the behavior of the capital factor, Greece had the second highest rate of growth (0.53%). In the first place we find Spain with a rate of growth equal to 0.54%. In economies like these of Austria, Germany, Finland, Luxembourg and UK, the capital factor contributed negatively to real per capita GDP growth rate. Finally, looking more closely to Table 3 (panel (c)), we observe that the contribution (in absolute terms) of the capital factor in real per capita GDP growth, was much smaller than that of the productivity factor or that of the labor factor. This holds for most of the countries in our sample and in most of the periods under concern (the case of Greece is an exception).

In terms of the pattern of the labor factor, for almost all countries it had a negative contribution to real per capita GDP growth. The only economy were this factor had a positive contribution was Spain with a rate equal to 0.21%. In Greece, the respective figure was similar with that in EU-15 group of countries, in Germany and Luxembourg (-1.19% (EL), -1.23% (EU-15), -1.17% (DE) and -1.19% (LU)). Finally, Italy and Netherlands had the highest decrease in the contribution of the labor factor, with rates of -2.65% and -2.11% respectively.

4.3 Period: 1974-1979

As already mentioned in subsection 2.1.2, the period 1974-1979 signaled the beginning of a major change in Greece's economic performance. The fall of real per capita GDP growth from 7.87% (during the period 1960-1973) to 3.94% (1.94% in detrended terms) was mainly driven by a reduction of the productivity factor from 6.53% to 2.04%. The negative contribution of the labor factor slightly increased from -1.19% to -1.32% while the positive contribution of the capital factor over doubled from 0.53% to 1.23%.

In what concerns our sample economies, only Ireland managed to keep a similar pace of real per capita GDP growth relative with that in the 60s. For all the other economies we observe a slowdown (compared to the 60s) in their economic activity. Luxembourg, Spain and the Netherlands had the worst performance with average growth rates of -0.05%, 0.4% and 0.79% respectively. The contraction in Luxembourg's economy was mainly driven by a decrease in its productivity factor (-2.34%) followed by a reduction in labor hours per capita (-1.32%). For Spain and the Netherlands the primary cause for their weak growth performance was the labor factor (see Figure 3 (panels 8, 14, (d)). Conesa and Kehoe (2007) point out that the evolution of the Spanish tax rates (marginal effective tax rates) on consumption expenditures, on labor and capital income, can account rather well for the decline in labor hours per capita. Dalton (2012) ends up with a similar result for the case of Austria.[25]

that the slowdown in economic activity had as its primary cause not a lack of funding for the exploitation of profitable investment but rather a low productivity growth which was driven (partly at least) by government policy towards subsidizing inefficient firms and declining industries. Another factor was that of an institutional change in the labor market.

[23] The fact that Greece has a relative low depreciation rate parameter and a relative high capital share parameter magnifies the contribution of the capital factor in its growth rate.

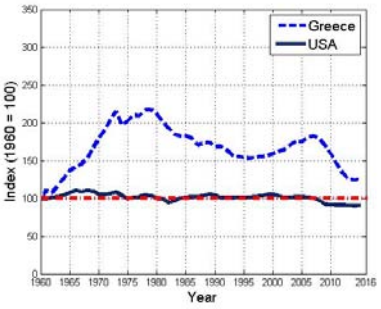
[24] This fact does not mean that in 1973 the typical working age person in UK and USA was less productive than the typical working age person in the rest of our sample economies. It means that during the period 1960-1973 their productivity increased proportionally less compared to the other countries.

[25] For a similar analysis for the case of Greece see Gogos et al. (2013).

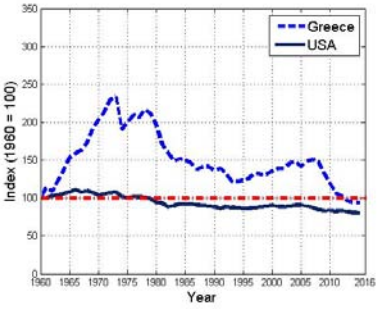
Figure 3: Accounting for Growth

Panel 1: Greece and USA

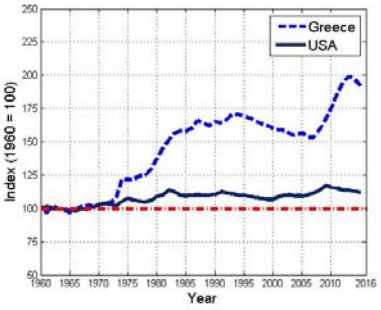
(a) Detrended Real per Capita GDP



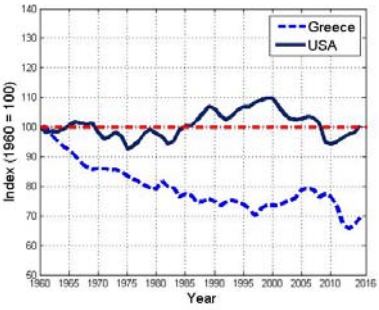
(b) Productivity Factor



(c) Capital Factor

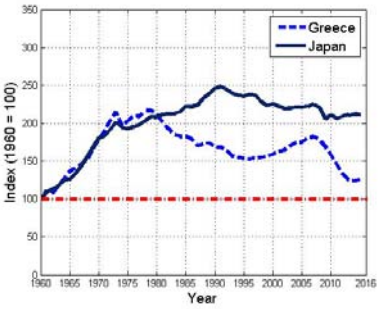


(d) Labor Factor

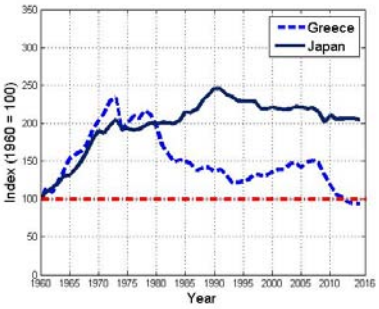


Panel 2: Greece and Japan

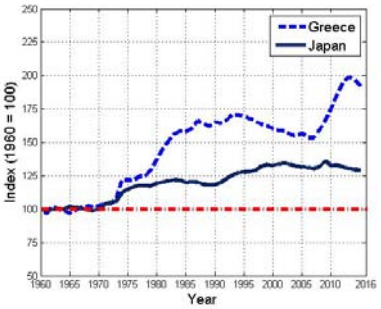
(a) Detrended Real per Capita GDP



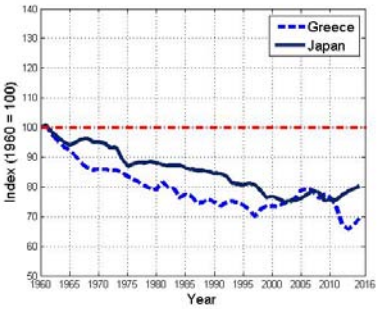
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



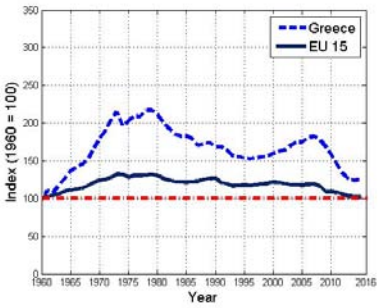
Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
1. *In all panels the respective variables are expressed as multiples of their values in 1960.*
2. *The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.*
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

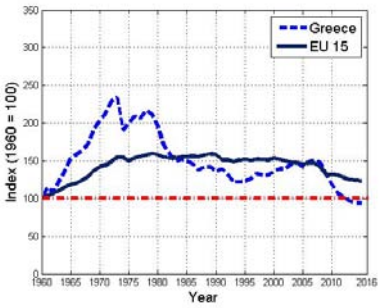
Figure 3 (continued): Accounting for Growth

Panel 3: Greece and EU-15

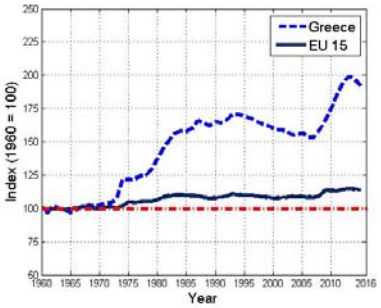
(a) Detrended Real per Capita GDP



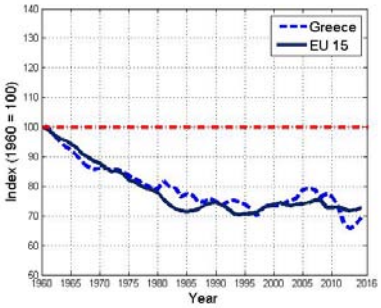
(b) Productivity Factor



(c) Capital Factor

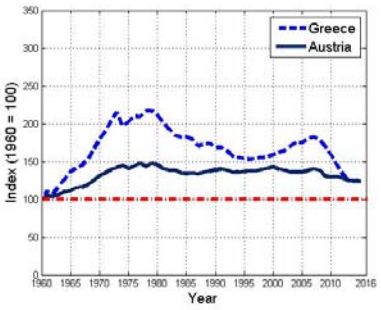


(d) Labor Factor

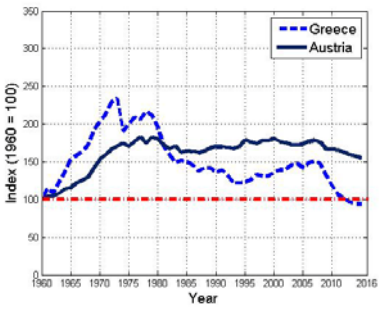


Panel 4: Greece and Austria

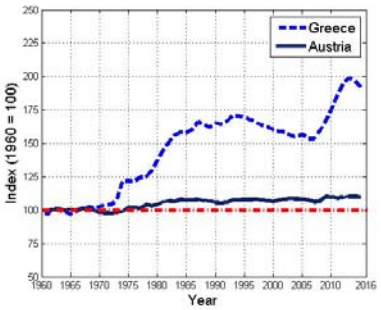
(a) Detrended Real per Capita GDP



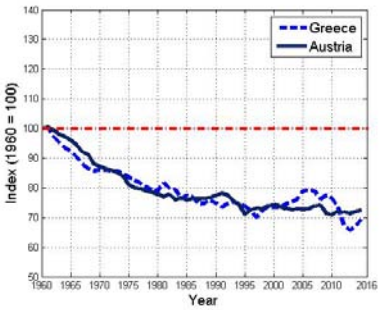
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



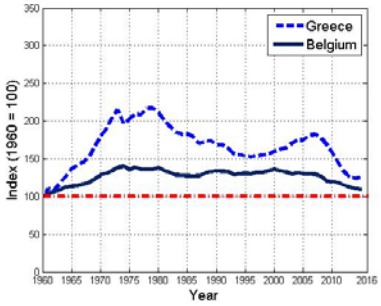
Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
1. *In all panels the respective variables are expressed as multiples of their values in 1960.*
2. *The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.*
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

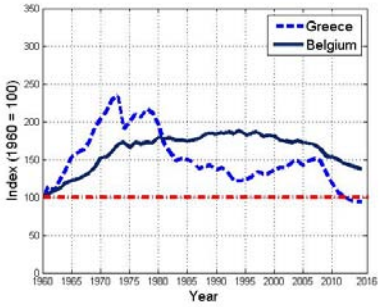
Figure 3 (continued): Accounting for Growth

Panel 5: Greece and Belgium

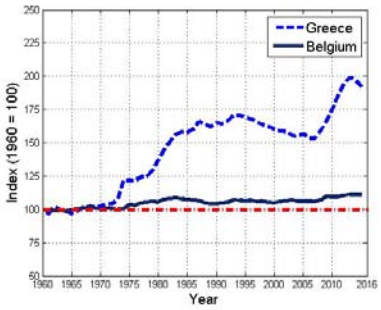
(a) Detrended Real per Capita GDP



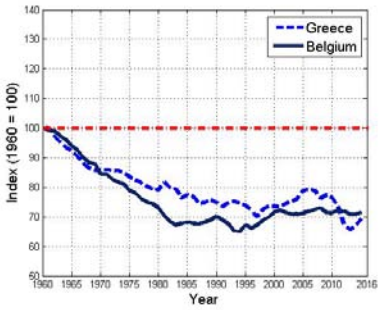
(b) Productivity Factor



(c) Capital Factor

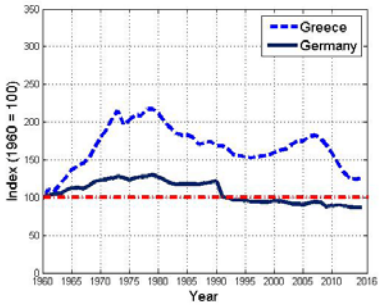


(d) Labor Factor

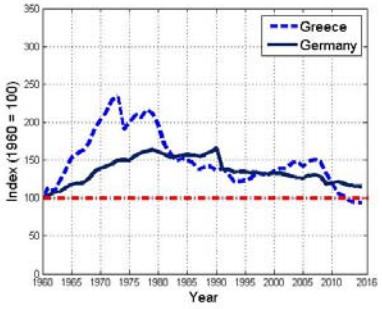


Panel 6: Greece and Germany

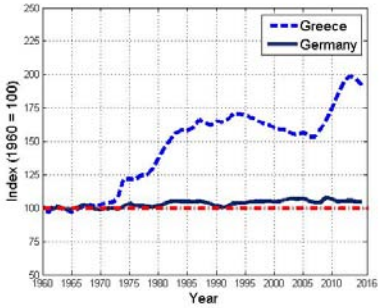
(a) Detrended Real per Capita GDP



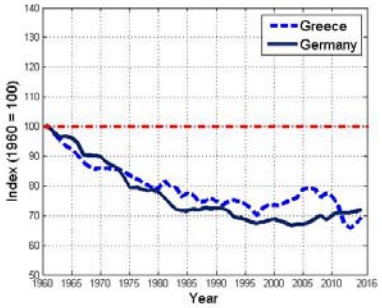
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



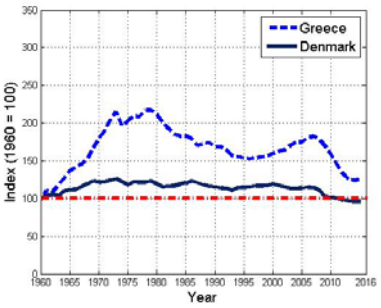
Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
1. *In all panels the respective variables are expressed as multiples of their values in 1960.*
2. *The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.*
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

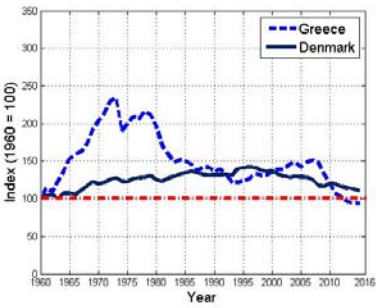
Figure 3 (continued): Accounting for Growth

Panel 7: Greece and Denmark

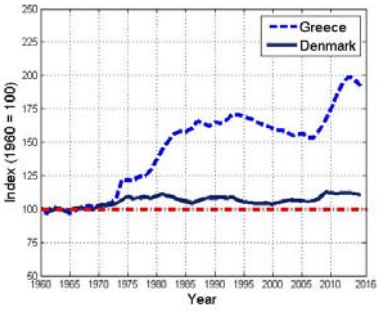
(a) Detrended Real per Capita GDP



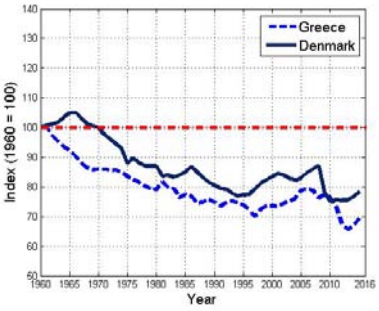
(b) Productivity Factor



(c) Capital Factor

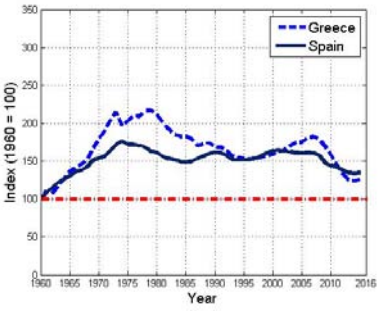


(d) Labor Factor

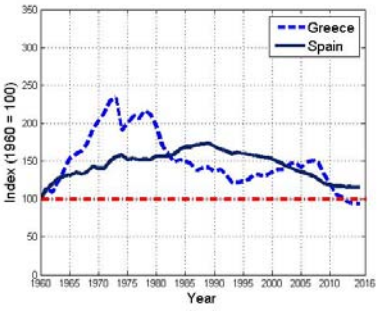


Panel 8: Greece and Spain

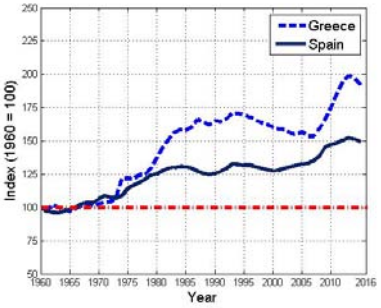
(a) Detrended Real per Capita GDP



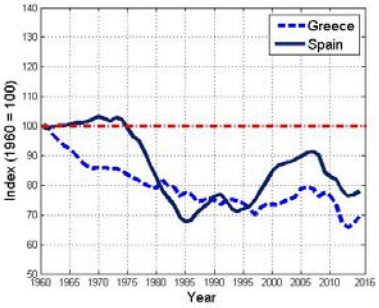
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note: 1. In all panels the respective variables are expressed as multiples of their values in 1960.

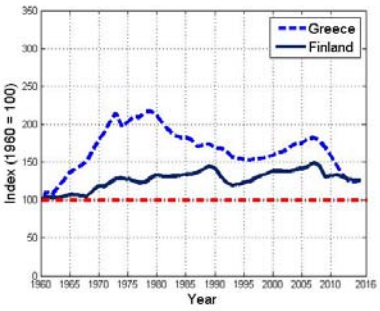
2. The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.

3. In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.

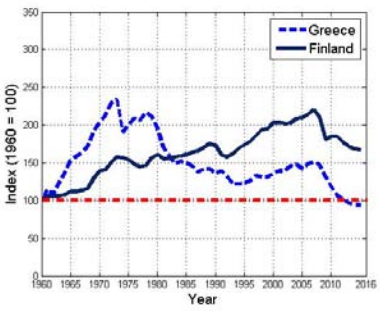
Figure 3 (continued): Accounting for Growth

Panel 9: Greece and Finland

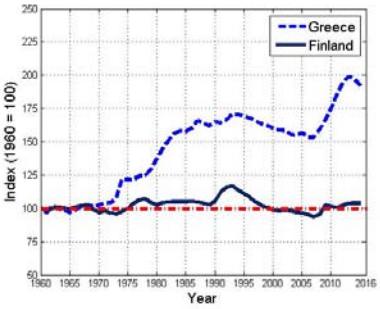
(a) Detrended Real per Capita GDP



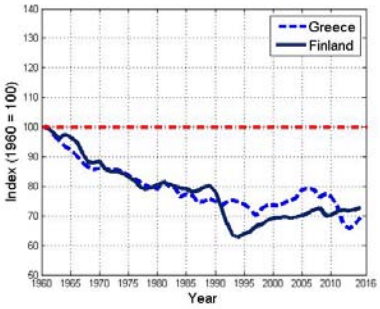
(b) Productivity Factor



(c) Capital Factor

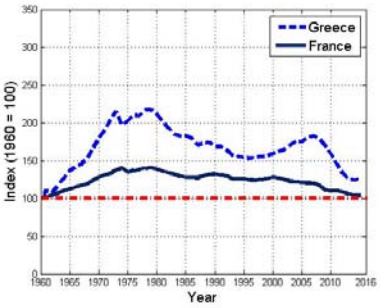


(d) Labor Factor

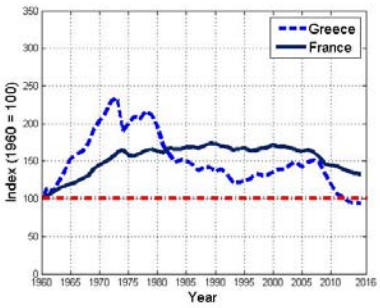


Panel 10: Greece and France

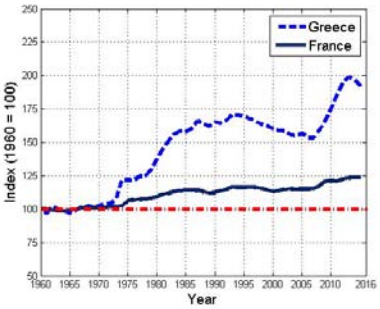
(a) Detrended Real per Capita GDP



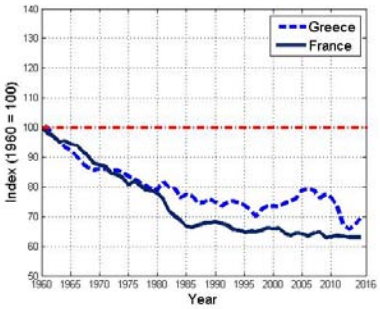
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



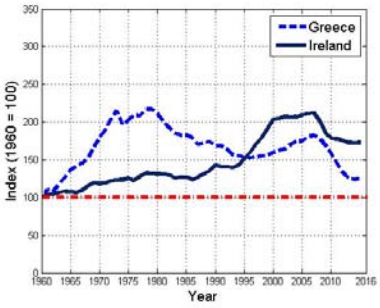
Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
1. *In all panels the respective variables are expressed as multiples of their values in 1960.*
2. *The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.*
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

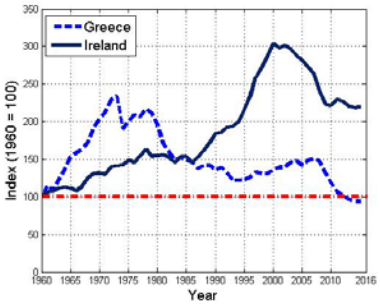
Figure 3 (continued): Accounting for Growth

Panel 11: Greece and Ireland

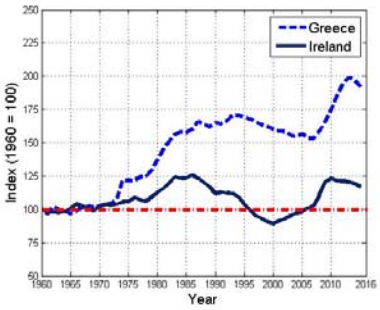
(a) Detrended Real per Capita GDP



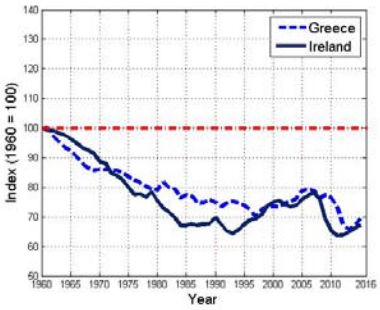
(b) Productivity Factor



(c) Capital Factor

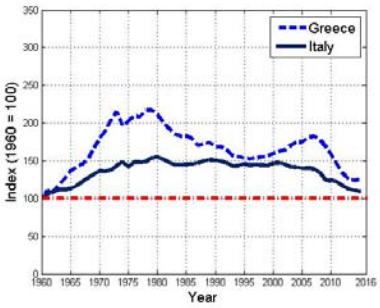


(d) Labor Factor

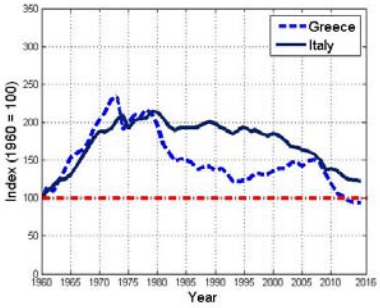


Panel 12: Greece and Italy

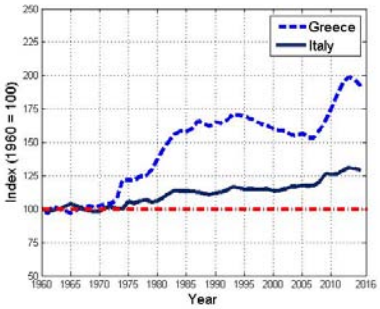
(a) Detrended Real per Capita GDP



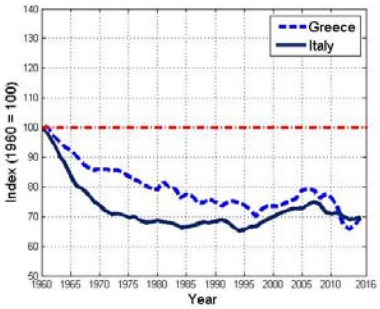
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
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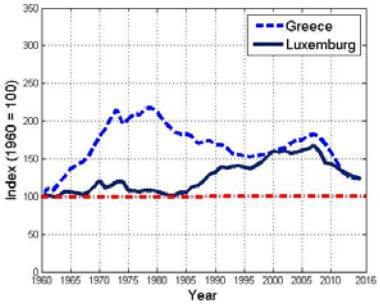
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

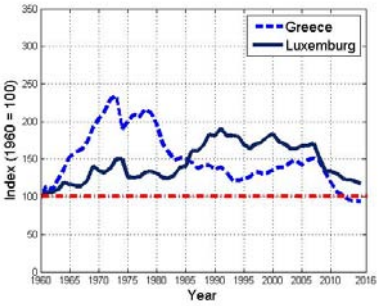
Figure 3 (continued): Accounting for Growth

Panel 13: Greece and Luxembourg

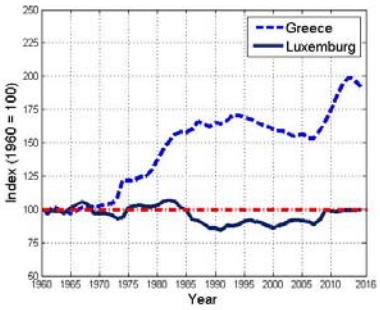
(a) Detrended Real per Capita GDP



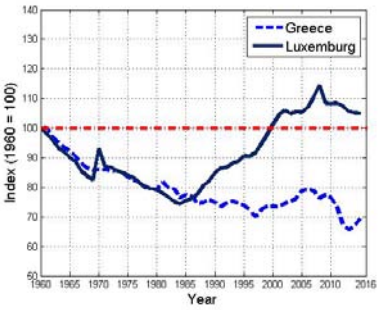
(b) Productivity Factor



(c) Capital Factor

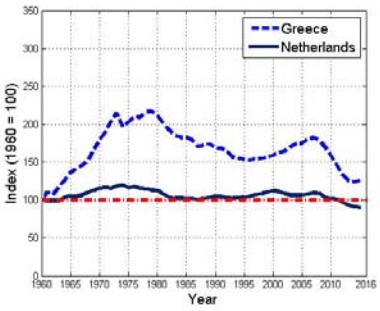


(d) Labor Factor

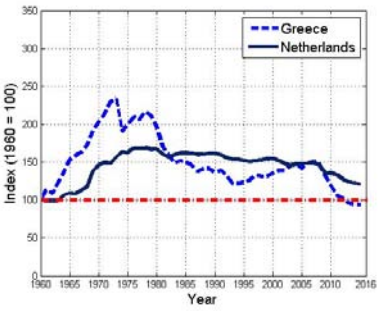


Panel 14: Greece and Netherlands

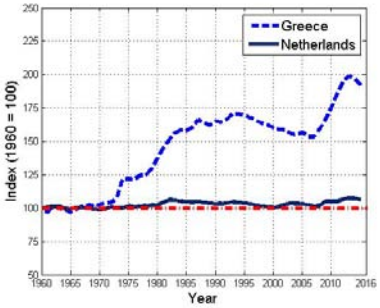
(a) Detrended Real per Capita GDP



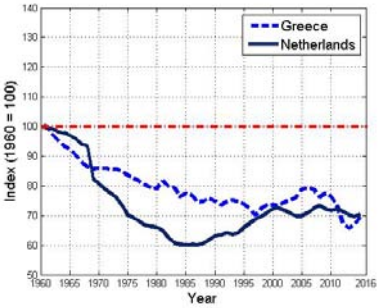
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



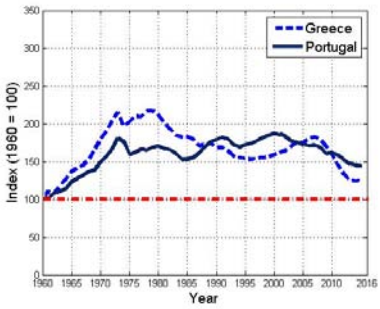
Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note:
1. *In all panels the respective variables are expressed as multiples of their values in 1960.*
2. *The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.*
3. *In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.*

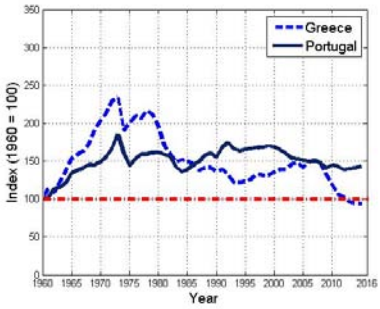
Figure 3 (continued): Accoutning for Growth

Panel 15: Greece and Portugal

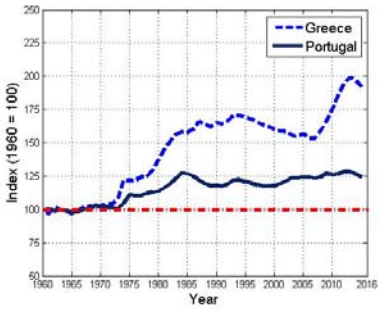
(a) Detrended Real per Capita GDP



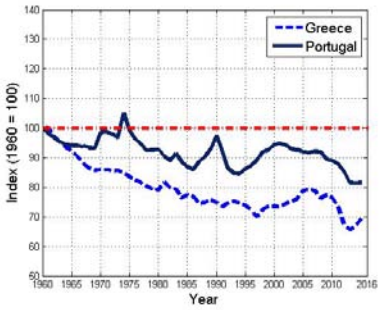
(b) Productivity Factor



(c) Capital Factor

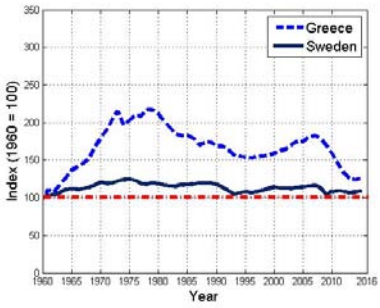


(d) Labor Factor

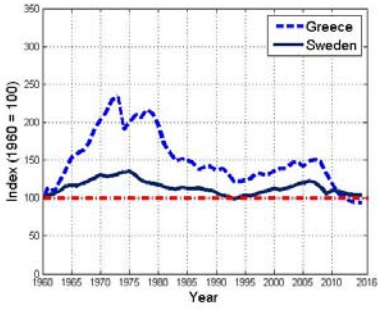


Panel 16: Greece and Sweden

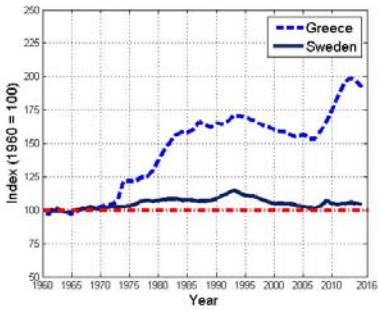
(a) Detrended Real per Capita GDP



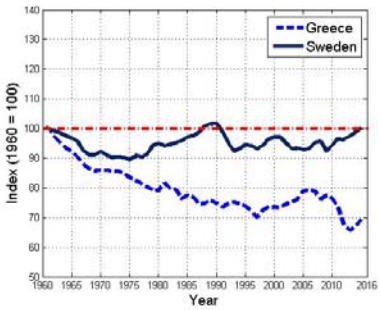
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

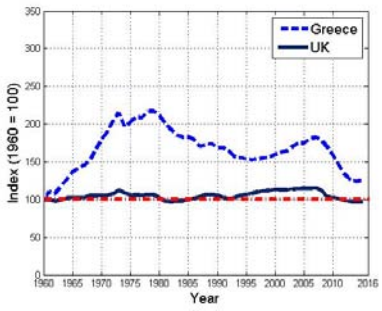
Note: *1. In all panels the respective variables are expressed as multiples of their values in 1960.*

2. The blue dotted line refers to Greece, while the blue black solid line refers to the other economies.

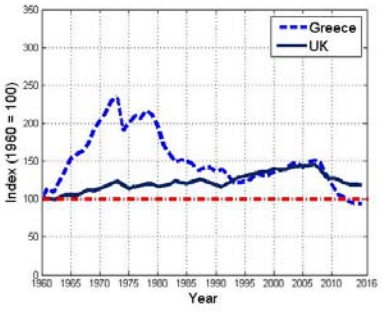
3. In panel (a), real per capita GDP is expressed relative to its 1960 constant 2% growth path. A positive slope indicates a higher than 2% growth rate, a negative slope indicates a lower than 2% growth rate, while a horizontal slope indicates a 2% growth rate. If the Greek economy, from 1960 until 2015, had grown in a constant rate of 2%, then the blue dotted line would coincide with the red one.

Figure 3 (continued): Accounting for Growth
Panel 17: Greece and UK

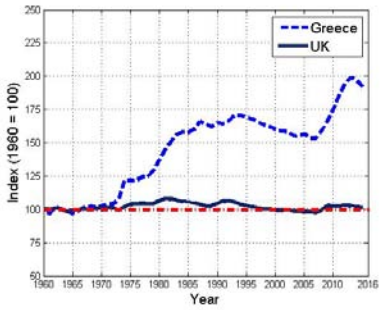
(a) Detrended Real per Capita GDP



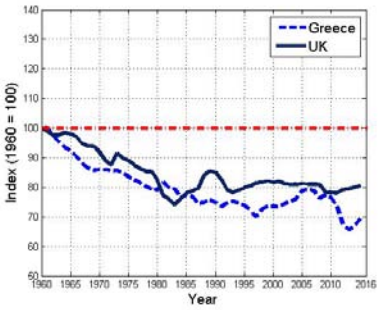
(b) Productivity Factor



(c) Capital Factor



(d) Labor Factor



Source: AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs), Groningen Growth Development Center database and OECD (2010), "Aggregate National Accounts: Gross Domestic Product", OECD National Accounts.

Note: 1. In all panels the respective variables are expressed as multiples of their values in 1960.
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4.4 Period: 1979-1995

For the Greek economy, the year 1979 marked the beginning of a 16 years period of stagnation. From the leading position, in terms of growth performance, during the 60s and 70s, it ranked to the last place during the 80s and mid-90s. The primary cause for this very weak growth performance was the big and persistent decline in its productivity factor (-3.4%). The labor factor also contributed negatively, with a rate equal to -0.45%, while the capital factor contributed positively with a rate equal to 1.67%.

Looking at Figures 3 (panels 1-17, (b)) we observe that all the economies in our sample experienced a decrease in their productivity factor from the end of the 70s until the early 80s. The oil shock of 1979, which was an external shock for the Greek economy, stands as a good candidate in explaining this decline. The rationale for this argument has as follows: the increase in the price of oil leads to an increase in the energy cost and as a result this creates an incentive for firms to reduce the utilization rate of their productive capital stock. In our growth accounting framework this reduction in the utilization rate shows up as a decrease in the productivity factor (see Appendix A. (A.2.3)). Nevertheless, this supply-side shock stands as a poor candidate in explaining the persistent decline in Greek productivity growth from 1979-1995. It is our belief that only internal structural factors which are mostly affected by government policy could cause such a high and persistent decline.

Another interesting feature during the period 1979-1995 was the poor growth performance of Germany, especially after the unification of 1991. This was driven by a decrease in the labor factor and the productivity factor of -0.84% and -1.24% respectively. Analyzing the economic performance of Germany for periods before and after the unification hides many risks since it requires merging data of two different countries. However, our attempt (risky or not) shows that after the unification the economy of Germany performed very poorly in terms of productivity.[26] This was the main contributing factor for the below trend growth performance of Germany during the last 20 years (see Figure 3 (panel 6, (a) and (b)).

[26] *The decline of productivity in Germany is well analyzed in Eicher and Roehn (2007). For the case of Italy (especially after 1995) see Daveri and Jona-Lasinio (2005) and Orsi and Turino (2010).*

Furthermore, in the mid-80s Ireland entered into a spectacular growth path, Finland experienced a severe recession during the period 1989-1993, while the early 90s marked the beginning of Japan's persistent slowdown.[27]

4.5 Period: 1995-2007

Generally speaking, during the period 1995-2007 all the economies in our sample grew with rates higher than those in the period 1979-1995. Only Japan and Portugal grew less compared to the 80s – mid-90s (2.76% vs 1.58% and 2.11% vs 1.94%). This was a result of poor productivity growth (0.81% vs -0.35% and 0.14% vs -0.81%) and low growth of the capital factor (0.53% vs 0.14% and 0.42% vs 0.2%).

The Greek economy recovered and managed to achieve the fourth highest growth rate (3.42% or 1.42% in detrended terms). This was driven by an increase in the productivity factor (1.69%) and for the first time in the last 35 years the labor factor contributed positively with a rate equal to 0.54%.The highest growth rate (4.82%) was achieved by Ireland due to the increase of its labor factor (1.22%) and its productivity factor (1.8%). Finland and Luxembourg followed, with rates of 3.57% and 3.51% respectively. For the former country the engine of growth was the productivity factor (1.96%), while for the latter was the labor factor (1.64%). Moreover, the increase in labor hours per capita was not only a Greek phenomenon. Looking at Figure 3 (panels 1, 3-11, (d)) we observe that the mid-90s where a turning point for the behavior of the labor factor for most of our sample economies. Only in USA, Japan and France labor hours per capita contributed negatively to real per capita GDP Growth (-0.3%, -0.21% and -0.05%).[28]

4.6 Period: 2007-2013

The end of the first decade of the new millennium is characterized by many economists as the "Great Recession" in post war history of the world's market economies. A quick look to Table 3 (panel (g)) and Figure 3 (panels 1-17, (a)) confirms this characterization. In most of the countries, real per capita GDP growth turned to negative values while for the other economies, growth was very weak, that is below 2% trend (USA, Japan, Austria, Germany and Sweden).

For the case of Greece, we observe a collapse of the productivity factor (-7.54%) followed by a major reduction in labor hours per capita (-3.05%). As a result the Greek economy experienced a cumulative reduction in real per capita GDP equal to 22.6% or 32.19% in detrended terms. In addition, for most of the countries, the decline in their productivity was the major factor that led them to a lower, than 2% trend, growth behavior. Only in Spain, Portugal, Ireland and Denmark the reduction of labor hours per capita was higher (in absolute terms) than the reduction in their productivity (-2.97% vs -2.01%, -2.o2% vs -1.22% and -3.07% vs -3% and -2.17% vs -1.51%).

4.7 Country Specific Productivity: Possible Explanations

Our growth accounting exercise points out the significant role played by productivity factor in accounting for the path of detrended real per capita GDP for most of our sample economies. For the case of Greece, this result is also reinforced (theoretical underpinning) by the work of Gogos et al. (2014). These authors proved that the standard neoclassical growth model, given the observed series of TFP, can account rather well for Greece's economic performance.[29] This means that the path of TFP can explain quite well the path of the capital factor, of the labor factor and that of real per capita GDP in a dynamic general equilibrium theoretical framework. As a result, we conclude that explaining the convergence and the divergence path between Greece and the majority of our sample economies requires an in depth investigation for the factors that lie behind the path of TFP.

Although there is no broadly accepted theory of TFP (see Prescott (1998) and Kehoe (2003)) the neoclassical "Great Depressions" literature, provides a guidance in focusing our attention towards the following factors (with an emphasis on a country's institutions):

- Degree of constraints imposed on entrepreneurial activity.
- Obstacles to the incorporation of new technology.
- Labor market organization.
- Strength of labor unions.
- Institutional barriers to labor mobility.
- A country's openness to foreign competition.
- Government regulation of industry.
- Price controls and subsidies to unproductive sectors or firms.
- Tax system and tax collection mechanisms.
- Degree of nationalizations and or privatizations.
- Operation of the banking sector.
- Bankruptcy and legal systems.

[27] *During the 80s, the Irish Government carried out two major budget deficit reduction programs. The first one which started in 1982 was based mostly on tax increases (unsuccessful program) while the second (started in 1987) was based on cuts in government spending (successful program). This fiscal reform proved to be one of the vital factors that helped the Irish* economy to *explode during the next 20 years (see Figure 3 (panel 12, (a))). For the case of Finland see Conesa et al. (2007).*

[28] *For the US economy, the labor factor had a major contribution to growth, especially from the mid-80s until to the late 90s.*

[29] *Our growth accounting results are slightly different from those in Gogos et al. (2014) due to the use of different databases for working age population and different (slightly) values in the calibrated parameters of the depreciation rate and the labor share (see Appendix A).*

According to Kehoe (2007), one of the central premises of the neoclassical "Great Depressions" methodology is that explaining movements in TFP involves identifying the changing institutions. Thus, for the case of Greece we ask if we observe changes in the above institutional factors especially during the years 1973, 1979, 1995 and 2007 (these years mark the turning points in the path of the Greek TFP during the last 53). According to Gogos et al. (2014) the answer is affirmative (at least for the period until 2001). All these years marked crucial turning points with respect to changes in Greece's social-economic institutions. To investigate in more depth the impact of these institutional changes in Greece's economic performance is a challenging field for future research.

5. Concluding Remarks

In this report we assessed Greece's economic performance from a long term perspective. We examined the data from a supply-side point of view, using as our theoretical vehicle the neoclassical growth model. Our growth accounting exercise showed that from the mid-70s (especially after 1979) until 2013, a persistent deterioration, in what we define as productivity factor (1979-1995 and 2007-2013), along with a continuous fall of labor hours per capita, have driven the Greek economy to follow a flatter growth path (divergence) compared to that which other developed market economies have followed during the last 40 years (1974-2013). The not negligible contribution of the capital factor only partially managed to offset this poor growth behavior. Things were more successful during the periods 1960-1973, 1974-1979 and 1995-2007.

Consequently, our analysis gives rise to the following question: What lies behind the booms and busts in productivity growth in the case of Greece? We use economic theory to guide our thinking and searching. According to the neoclassical "Great Depressions" methodology literature, break points in productivity growth are closely related with major changes in a country's social-economic institutions. Do we observe such institutional changes in the case of Greece? And most importantly, if we do observe such changes, was their timing close to the break points of productivity growth which we observe in the data (1973, 1979, 1995 and 2007)? The answer is yes. All these years mark crucial turning points with respect to changes in Greece's social-economic institutions.

This analysis can be thought to be as a primary step (a diagnostic tool) in revealing the factors (supply side) that lie behind the periods of convergence and divergence between Greece and other developed market economies. Our results point out the important role played by the TFP factor. As a result, given the current debate on the future growth prospects and consequently the sustainability of the Greek public debt we believe that, as in the past, the Greek economy can potentially achieve the desirable growth rates by following policies that increase its productivity factor (for example promote efficiency through structural reforms and create commitment mechanisms that guarantee (credibility) the implementation of these policies). Government policies that focus only to the maintenance of demand and employment, without any monitoring on productivity, cannot be reliable means of achieving high and sustainable growth rates of real per capita GDP. What is needed is an optimal mix of supply side (productivity) and demand side (exports and investment) policy.

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Appendix A

In this section we present the basic techniques that we follow for conducting the growth accounting exercise. More specifically, our framework follows from the neoclassical "Great Depressions" methodology developed by Cole and Ohanian (1999) and Kehoe and Prescott (2002).

A.1

To perform the growth accounting exercise we use a standard neoclassical production function (Cobb-Douglas):[30]

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \quad \text{(A.1)}$$

or in per capita terms (intensive form):

$$\frac{Y_t}{N_t} = A_t \left(\frac{K_t}{N_t}\right)^{\alpha} \left(\frac{L_t}{N_t}\right)^{1-\alpha} \quad \text{(A.2)}$$

where Y_t is real output (in our data real GDP) in year t, A_t is total factor productivity (TFP) in year t, K_t is real capital stock (accumulated past investment) in year t, L_t is labor effort (in our data labor hours) in year t, N_t is population (in our data working age population) in year t and α is the capital share parameter (it follows that $1-\alpha$ is the labor share parameter).[31] Following the neoclassical "Great Depressions" methodology (see Kehoe and Prescott (2002)), we rewrite the production function in the following equivalent form:

$$\frac{Y_t}{N_t} = A_t^{\frac{1}{1-\alpha}} \left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}} \frac{L_t}{N_t} \quad \text{(A.3)}$$

or in natural logarithms:

$$\ln\frac{Y_t}{N_t} = \frac{1}{1-a}\ln A_t + \frac{a}{1-a}\ln\frac{K_t}{Y_t} + \ln\frac{L_t}{N_t} \quad \text{(A.4)}$$

Making the assumption that TFP grows according to the following rule:

$$A_t = \tilde{A}_t \left(1+g_{Tr}\right)^{t(1-\alpha)} \quad \text{(A.5)}$$

where $\tilde{A}_t$ is the exogenous productivity variable (country specific) and $\left(1+g_{Tr}\right)^{1-\alpha} = 1.02^{1-\alpha}$ is the trend gross growth rate of TFP (which is not country specific), then equation (A.4) can be written as:[32]

$$\ln\frac{Y_t}{N_t} = g_{Tr}t + \frac{1}{1-a}\ln\tilde{A}_t + \frac{a}{1-a}\ln\frac{K_t}{Y_t} + \ln\frac{L_t}{N_t} \quad \text{(A.6)}$$

Hence, the natural logarithm of real per capita GDP is decomposed into four factors. These are: the trend factor $g_{Tr}t$, the exogenous productivity factor $\frac{1}{1-a}\ln\tilde{A}_t$, the capital factor $\frac{a}{1-a}\ln\frac{K_t}{Y_t}$ and the labor factor $\ln\frac{L_t}{N_t}$. By taking annual differences, that is $t-1$ to t, of equation (A.6) we extract the four sources of real per capita GDP growth rate during the year t. These are the growth rates of the above contributing factors:

$$g_{\frac{Y_t}{N_t}} = g_{Tr} + \frac{1}{1-\alpha}g_{\tilde{A}_t} + \frac{\alpha}{1-\alpha}g_{\frac{K_t}{Y_t}} + g_{\frac{L_t}{N_t}} \quad \text{(A.7)}$$

where $g_{\frac{Y_t}{N_t}} = \ln\frac{Y_t}{N_t} - \ln\frac{Y_{t-1}}{N_{t-1}}$, $g_{\tilde{A}_t} = \ln\tilde{A}_t - \ln\tilde{A}_{t-1}$, $g_{\frac{K_t}{Y_t}} = \ln\frac{K_t}{Y_t} - \ln\frac{K_{t-1}}{Y_{t-1}}$ and $g_{\frac{L_t}{N_t}} = \ln\frac{L_t}{N_t} - \ln\frac{L_{t-1}}{N_{t-1}}$

[30] *The neoclassical production function (one of the cornerstones of neoclassical growth theory) has four basic properties. First, it exhibits constant returns to scale with respect to its private (rival) inputs (capital and labor). That is, doubling the quantities of capital and labor doubles the amount of output produced. Second, it exhibits positive and diminishing marginal products with respect to its private inputs. Third, the marginal product of capital (or labor) approaches infinity as capital (or labor) goes to 0 and approaches 0 as capital (or labor) goes to infinity. Fourth, all inputs are essential during the production process (an input is essential if a strictly positive amount of it is needed to produce a positive amount of output).*

[31] *A perfect competitive market environment and a Cobb-Douglas production function imply constant input income shares (α and $1-\alpha$). This is the 5th of the six stylized facts that characterize the process of economic growth according to the work of Nicholas Kaldor (1963).*

[32] *The quality of a country's institutions is mostly reflected in the level of the productivity variable $\tilde{A}_t$. A change in government policy towards policies that promote more efficiency in the market (competition policy, reduction of the power of labor unions, reduction on the restrictions of adopting more efficient technologies, bankruptcy systems and the legal system) will be captured by an increase in $\tilde{A}_t$. Things are reversed when government policies promote inefficiency in the market. In what concerns the trend growth rate of the TFP factor, is defined as the stock of useable production knowledge. As a result, we can interpret (partially at least) the productivity variable $\tilde{A}_t$ as a measure of how efficient a country is in adopting and implementing new "technologies" in the production of goods and services.*

Equation (A.7) constitutes the basic tool for our growth accounting exercise. According to that, the growth rate of real per capita GDP is driven exclusively by the sum of the growth rates of: the trend factor g_{Tr}, the productivity factor $\frac{1}{1-\alpha} g_{\tilde{A}_{t+1}}$, the capital factor $\frac{\alpha}{1-\alpha} g_{\frac{K_{t+1}}{Y_{t+1}}}$ and the labor factor $g_{\frac{L_{t+1}}{N_{t+1}}}$.

A.1.1 Defining Trend: A Neoclassical Growth Theory Approach

According to neoclassical growth theory, in the long run, with constant population and TFP growth, and in the absence of policy changes or external shocks that affect the incentives of agents to work, to consume and to invest, market economies (given specific preferences and possibilities) converge to a balanced growth path (which is unique, feasible and desirable (optimizing behavior)) were output, consumption, investment and capital stock grow at the same rate. At the same time labor hours per capita converge to a path of zero growth behavior.[33] Taking this theory into account, then equation (A.7) attributes along a balanced growth path the growth rate of real per capita GDP exclusively to the trend component of the TFP factor $A_t^{\frac{1}{1-\alpha}}$ which is $g_{Tr} = 2\%$. In Section 4, where we present our growth accounting results by applying equation (A.7), trend, with respect to real per capita GDP, the TFP factor, the capital factor and the labor factor, is defined according to a balanced growth path behavior. This means, that the trend path for the TFP factor is to grow with a 2% rate (i.e. the productivity factor remains constant), the trend for the capital factor is to remain constant and this also holds for the labor factor. Thus, the trend path for real per capita GDP is to grow with a 2% rate. Here lies the rationale of choosing as our "yardstick" a 2% trend growth rate (see Footnote 10 in Section 2).

A.2 Data and Model

To take equation (A.7) to the data, we follow a three step methodological procedure. First, given series for real investment expenditures I_t, a value for the depreciation rate parameter δ (calibrated) and a value for the initial real capital stock (the starting year of our analysis is 1960), we construct real capital stock series by employing the perpetual inventory method. Second, we calibrate a value for the labor share parameter $1-\alpha$. Third, given series for real GDP, for real capital stock, for labor hours, values for the capital share and the labor share parameters and by employing the production function of equation (A.1) we compute series for TFP.

A.2.1 Real Capital Stock

The perpetual inventory method has as its cornerstone the following equation (law of motion of real capital stock):

$$K_{t+1} = (1-\delta) K_t + I_t \qquad \text{(A.8)}$$

which states that the real capital stock in year $t+1$ consists of undepreciated capital from the previous year plus net investment during year t.

To construct series for real capital stock (given series for real investment expenditures) we must assign values to the depreciation rate parameter and to the initial real capital stock.[34] We do that by imposing two restrictions on our choice. First, the average (in our case 1960-2013) of the ratio of consumption of fixed capital over GDP must be equal to the respective ratio which we observe in the data, that is:

$$\frac{1}{54}\sum_{t=1960}^{2013}\frac{\delta K_t}{Y_t} = \frac{1}{54}\sum_{t=1960}^{2013}\frac{\delta K_t}{Y_t}_{Data} \qquad \text{(A.9)}$$

where $\frac{\delta K_t}{Y_t}_{Data}$ is the ratio of consumption of fixed capital over GDP that we observe in the data. Second, the ratio of the capital-output ratio in the initial year must be equal with its average value over a specific time period (in our case 1961-1970):

$$\frac{K_{1960}}{Y_{1960}} = \frac{1}{10}\sum_{t=1961}^{1970}\frac{K_t}{Y_t} \qquad \text{(A.10)}$$

The law of motion of real capital stock (A.8) along with the two restrictions (eq. A.9 and A.10), imply the following values for the depreciation rate parameter for each country[35]. These are displayed in Table A.1.

[33] *This means that* $\frac{\alpha}{1-\alpha} g_{\frac{K_{t+1}}{Y_{t+1}}} = 0$ *and* $g_{\frac{L_{t+1}}{N_{t+1}}} = 0$. *Furthermore, if we assume that* $\tilde{A}_t$ *is determined by government policy (this follows from Prescott (2002)), then in the absence of policy changes* $g_{\tilde{A}_{t+1}} = 0 \Rightarrow \frac{1}{1-\alpha} g_{\tilde{A}_{t+1}} = 0$. *Consequently, along a balanced growth path, it holds that* $g_{\frac{Y_{t+1}}{N_{t+1}}} = g_{Tr} = 2\%$.

[34] *As real investment expenditures* I_t *we use the series of Gross Fixed Capital Formation from national accounts. These series were converted into real terms using the GDP deflator.*

[35] *These two restrictions are the most commonly used rules for the constructions of real capital stock series in the neoclassical "Great Depressions" literature.*

Table A.1: Calibration for the Depreciation Rate

Country	EU-15	US	JP	AT
δ	4.37%	6.51%	6.15%	4.63%
Country	BE	DE	DK	**EL**
δ	5.7%	3.69%	6.16%	**3.74%**
Country	ES	FI	FR	IE
δ	5.37%	5.36%	4.15%	4.1%
Country	IT	LU	NL	PT
δ	4.79%	8.56%	4.65%	7.51%
Country	SE	UK		
δ	3.42%	4.11		

Source: 1. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).
2. OECD (2010), "Aggregate National Accounts: Gross Domestic Product, OECD National Account Statistics (Database).

Table A.2: Calibration for the Labor Share

Country	EU-15	US	JP	AT
$1-\alpha$	65.18%	63.31%	65.41%	64.46%
Country	BE	DE	DK	**EL**
$1-\alpha$	67.54%	64.73%	67.7%	**58.43%**
Country	ES	FI	FR	IE
$1-\alpha$	62.05%	61.85%	65.48%	56.96%
Country	IT	LU	NL	PT
$1-\alpha$	59.08%	56.56%	65.47%	65.79%
Country	SE	UK		
$1-\alpha$	66.93%	69.21%		

Source: 1. AMECO – The annual macroeconomic database (European Commission, Economic and Financial Affairs).
2. OECD (2013), "OECD Economic Outlook No. 94", OECD Economic Outlook: Statistics and Projections (database).
3. OECD, "Revenue Statistics: Greece", OECD Tax Statistics (database), 2010.

A.2.2 Labor Share

To obtain a value for the labor share parameter we adopt the methodology proposed by Gollin (2002). First, we impute an income for the self-employed (for details with respect to the case of Greece see Gogos et al. (2014)) and we add this to the income of employees that belong to dependent employment (compensation of employees in the data). This sum gives us the total income for the labor factor in the economy. Second, we take the ratio of total labor income over real GDP in factor prices (real GDP at market prices minus net indirect taxes) and we obtain the labor share parameter, that is:

$$LIS_t = \frac{TLI_t}{Y_t - NIT_t} \quad \text{(A.11)}$$

where LIS_t denotes the labor income share in year t, TLI_t denotes total labor income in year t, Y_t is real GDP in year t and NIT_t is net indirect taxes in year t. Taking the average of equation (A.11) over the period 1995-2011 (cross country data availability), we compute the following labor share parameter for each country. These are displayed in Table A.2.

A.2.3 TFP

Given series for real GDP Y_t, real capital stock K_t, labor hours L_t and values for the capital and labor share parameters α and $1-\alpha$, we compute series for TFP using the following formula:

$$A_t = \frac{Y_t}{K_t^{\alpha} L_t^{1-\alpha}} \quad \text{(A.12)}$$

By employing for our growth accounting analysis a production function like the one in equation (A.7), that is, $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$, we have implicitly assumed a constant utilization rate (equal to 100%) for capital and labor.[36] According to equation (A.12), this means that unobservable (in the data) changes in the utilization rate of the factors of production will show up as changes in TFP (through the productivity component, since the trend component grows with a constant rate of 2%). According to Bergoeing et al. (2002), shifts in utilization rates may be important for short-run fluctuations in productivity, however, they argue, it is farfetched that they can account for large differences in productivity movements between countries over a period of decade or more (our main focus of analysis is for periods of a decade or more). Finally, growth in human capital also shows up as growth in TFP in this production function specification.

[36] *For example we could model the production function as* $Y_t = A_t (u_t K_t)^{\alpha} (e_t L_t)^{1-\alpha}$, *where* $u_t = 1$ *and* $e_t = 1$.

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