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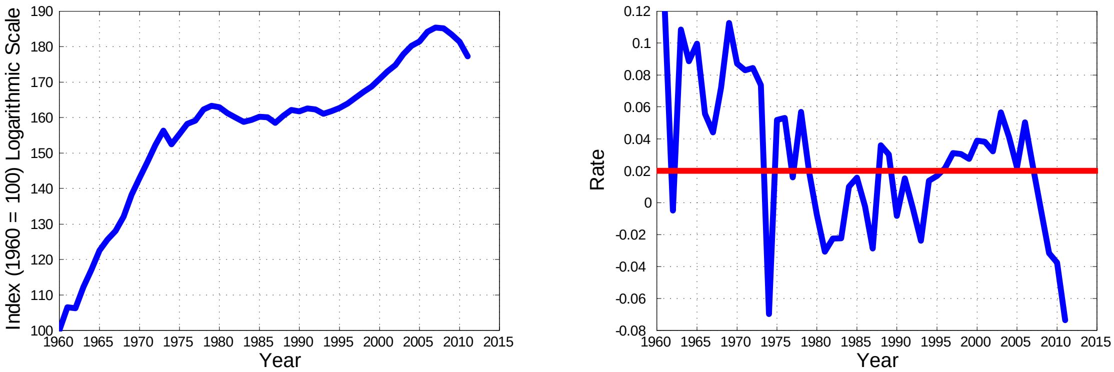
Abstract

This paper focuses on the performance of the Greek economy during the period 1979-2001. Following the work of Cole and Ohanian (1999) and Kehoe and Prescott (2002, 2007) this twenty years episode can be characterized as a Great Depression. We use this methodology and ask whether, given the observed exogenous path of total factor productivity, the basic RBC model can generate an equilibrium behavior that has growth accounting characteristics similar to those in the data. The answer is affirmative: Changes in TFP are crucial in accounting for the Greek great depression. Our model economy predicts a big decline of economic activity during the 80's and until the mid 90's and a strong recovery for the period 1995-2001. This is exactly what happened in Greece. In terms of timing, both with respect to peaks - troughs , as well as the paths as a whole for most key macroeconomic variables, our model economy moves synchronously with the data. However, puzzles between theory's predictions and the observed data are not missing. For instance, things are (not surprisingly for the RBC model) less successful when it comes to the labour factor.

Keywords: Depression, Growth Accounting, Total Factor Productivity, Dynamic General Equilibrium.
JEL Classification: E32, N10, O40.

1 Introduction

During the last five decades (1960-2011) the average annual growth rate of real per capita GDP in Greece was 2.76 percent. However, this seemingly good performance is misleading in that it fails to reveal a far from smooth trajectory. If we divide the period between 1960 to 2011 into four subperiods we identify sharp differences. During the period 1960-1979 the Greek economy was in a boom. The average annual growth rate of real per capita GDP was 6.06 %. In the next subperiod, that is 1979-1995, the Greek economy stagnated and the average annual growth rate of real per capita GDP fell to -0.07 %. During the period 1995-2007 the Greek economy recovered and the average annual growth rate of real per capita GDP rose to 3.44 %.[1] Finally, since 2008 the Greek economy experiences a dramatic downturn with the average annual growth rate of real per capita GDP being -3.69% (2007-2011). In this paper we focus in the period 1979 - 2001.



(a) Real per Capita GDP (b) Real per Capita GDP Growth Rate

Figure 1: Greece 1960-2011 Stylized Facts

Let us first define detrended real per capita GDP in period t, $\widetilde{y}_t$, as the ratio of real per capita GDP, y_t, over trend real per capita GDP, $g^{t-T_0}y_{T_0}$,

$$\widetilde{y}_t = \frac{y_t}{(g^{t-T_0}y_{T_0})} \tag{1}$$

where g is the gross trend growth rate and T_0 is the starting year of the detrending period.

Following Kehoe and Prescott (2002) we define the trend growth rate as the average annual real per capita GDP growth rate of the industrial leader of the world economy.[2] In the 20th century this was the United States of America with an average annual growth rate of real per capita GDP of 2 %. Hence, in our case, trend real per capita GDP is assumed to grow at this 2% rate, taking 1979 as the starting year T_0.

Table 1.
Average Annual Real per Capita Growth Rates (%)[3]

Period	1960-2011	1960-1979	1979-1995	1995-2001	2001-2007	2007-2011
g_y	2.76	6.06	-0.07	3.13	3.75	-3.69
g_c	2.77	5.22	0.8	2.75	3.61	-2.26
g_i	2.06	8.45	-3.66	7.12	4.85	-17.24

As Figure 1 and Tables 1 and 2 reveal, during 1979-2001, the Greek economy experienced a substantial business cycle. Based upon the work of Cole and Ohanian (1999) and Kehoe and Prescott (2002, 2007) we characterize this period as a great depression. From 1979 to 1995 the Greek economy fell into a persistent recession. At the trough of the recession, which was the year 1995, real per capita GDP was 28% below its trend value, real per capita consumption expenditure was 17.15% below its trend value, and real per capita investment expenditure was 59.42% below its trend value.[4] The recovery phase started at 1996 and lasted until 2001. At the end of the recovery phase real per capita GDP was 77.16% relative to its trend, real per capita consumption expenditure was 86.76% relative to its trend, and real per capita investment expenditure was 55.23% relative to its trend. After 2001 Greece entered a period of growth rates well above trend which

[1] For a review of the performance of the Greek economy during the last half century, see Alogoskoufis (1996) and Bosworth and Kollintzas (2001).

[2] Since our methodology follows the neoclassical growth model, we define the trend growth rate as the exogenous long run growth rate of technological progress.

[4] That is $\widetilde{y}_{1995} = \frac{y_{1995}}{((1.02)^{1995-1979}y_{1979})} = 72\%$.

abruptly ends in the end of 2007.[5] Our purpose in this paper is to examine this two decades event from the perspective of neoclassical growth theory.

Table 2.
Detrended Values, Index (1979=100)

Year	1979	1995	2001	2007	2011
y	100	72	77.16	85.81	68.41
c	100	82.85	86.76	95.67	80.73
i	100	40.58	55.23	65.59	30.41

The research agenda opened up during the last ten years by the above authors, the "Great Depressions Methodology", is built upon two pillars.[6] The first one is growth accounting, a technique which has its origins in the seminal work of Robert Solow in the late 1950's, and the second one is dynamic general equilibrium models which is now the modern approach of doing macroeconomics. As a first step, we choose the basic RBC model as the workhorse of our analysis. The way we work is as follows:

First, using the criteria set by Kehoe and Prescott (2002, 2007), we identify and date the great depression incident. Second, using a standard constant returns to scale production function (Cobb-Douglas) we compute the implied series of total factor productivity for the period under consideration. Third, we set up the RBC model, calibrate it to the Greek economy, and solve for the competitive equilibrium. We then feed the actual TFP series into the model and generate artificial data for the main aggregate economic variables. Finally, we compare the growth accounting characteristics of the actual data to those of the artificial economy.

We find that the basic RBC model can account rather well for the great depression in Greece during the 80's and 90's. Given the exogenous paths of TFP and population, our model economy predicts a big decline of economic activity during the 80's and mid 90's and a strong recovery for the period 1995 - 2001. This is exactly what happened in the Greek economy during this twenty year period. In terms of timing, both with respect to peaks - troughs , as well as the paths as a whole for most key macroeconomic variables our model economy moves synchronously with the data. However, puzzles between theory's predictions and the observed data are not missing. For instance, things are (not surprisingly for the RBC model) less successful when it comes to the labour factor.

The paper is organized as follows: Section 2 presents the definition of great depressions according to Kehoe and Prescott (2002, 2007), and checks whether the Greek economy meets the required criteria. Section 3 presents the model and section 4 describes the data. Section 5 presents the growth accounting analysis. Section 6 discusses calibration and transition dynamics. Section 7 presents the main results. Finally, section 8 concludes.

2 The Definition of Great Depressions

If output is significantly above trend, then the economy is in a boom. If it is significantly below trend, then the economy is in a depression. According to Kehoe and Prescott (2002, 2007), to be a great depression, a negative deviation of real per capita GDP from trend over the time period $D = [T_0, T_1]$ must satisfy three conditions:

1. It must be a sufficiently large negative deviation (20% or larger). That is, there is some year t in D such that:

$$\left(\frac{y_t}{(g^{t-T_0} y_{T_0})}\right) \leq 80\% \tag{2}$$

2. The deviation must occur rapidly (with a negative deviation of 15% in the first decade). That is, there is some year $t \leq T_0 + 10$ such that:

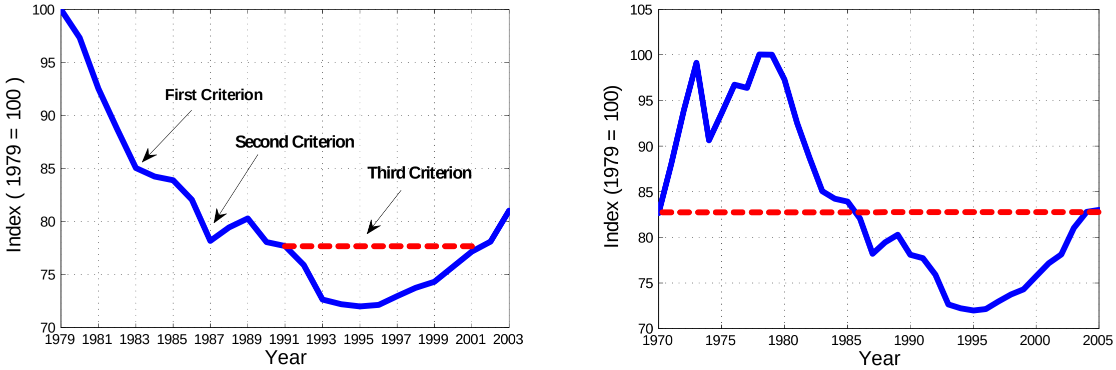
$$\left(\frac{y_t}{(g^{t-T_0} y_{T_0})}\right) \leq 85\% \tag{3}$$

3. The deviation must be sustained, in the sense that real per capita GDP cannot return to trend for a decade. That is, there are no T'',T' in D , $T'' \geq T' + 10$,such that:

$$\left(\frac{y_{T''}}{(g^{T''-T'} y_{T'})}\right) \geq 100\% \tag{4}$$

[5]The end of 2007 marks the beginning of a new negative business cycle incident which can potentially lead to a second great depression. See section 7.2 for a discussion.

[6]In 2002 the Review of Economic Dynamics published a series of papers examining great depressions episodes for different countries using the same methodology, that is growth accounting and DGE (Dynamic General Equilibrium) models.



(a) Detrended Real per Capita GDP (b) Detrended Real per Capita GDP

Figure 2: Greece's (First) Great Depression Episode

As shown above, the Greek economy, for the period 1979-2001, strictly meets all of the above criteria. The year 1979 is identified as the starting year of the depression, so $T_0 = 1979$, while the great depression incident ends in 2001, therefore $D = [1979,\ 2001]$. As Figure 2 (a) depicts, real per capita GDP is characterized by a sharp and large fall following 1979. By 1983, real per capita GDP was already 15% below trend, and in 1987 it fell to a level 22% below trend. So both the first and second criteria are met.

The third criterion requires that real per capita GDP should not grow at the trend growth rate of 2 percent during any decade during the depression. Looking at Figure 2 (a) confirms that this criterion is also met. More specifically, until 2001 there was no period of ten years or more during which real per capita GDP grew at an average rate of 2% (observe that an horizontal line denotes a 2% trend growth path).

Consequently, the Greek economy for the period 1979-2001 meets all the Kehoe and Prescott (2002, 2007) criteria, and we can define this period as a great depression. Figure 2 (b) can help us grasp the severity of this prolonged recession episode: By 2005 Greece had reached the path it would have followed if real per capita GDP grew since 1970 at the 2% trend growth rate.

3 The Model

Our model is the basic RBC model. The artificial economy consists of a large number of infinitively live identical households and a large number of identical firms. There is no uncertainty (we assume perfect foresight) and all markets operate under perfect competition. We focus on the behaviour of the representative household and the representative firm. The representative household supplies labour and capital to firms and receives a real wage rate, a gross real rental rate for capital and a share of profits in return. Utility is a function of consumption and leisure. The representative firm hires labour and capital, and given, the available technology, uses these inputs in order to produce a homogeneous good that can be used either for consumption or investment. That is, the resource constraint of the economy is $Y_t \geq C_t + I_t$.

3.1 Households

Each period of time t there are N_t identical households ($h = 1, 2, 3 ... N_t$). Their population grows at a constant rate $\frac{N_{t+1}}{N_t} = n$. The representative household, h, chooses paths of consumption, hours of work, and capital, in order to maximize the present discounted value of its lifetime utility function:

$$\sum_{t=T_0}^{\infty} (\beta^*)^t \, U(C_t^h, H_t^h) \tag{5}$$

subject to its budget Constraint, the time Constraint, and the law of motion of capital stock:[7]

$$C_t^h + I_t^h \leq w_t L_t^h + r_t K_t^h + \Pi_t^h \tag{6}$$

$$\overline{h} = H_t^h + L_t^h \tag{7}$$

$$K_{t+1}^h = I_t^h + (1-\delta)\, K_t^h \tag{8}$$

$$C_t^h, I_t^h, K_t^h, L_t^h, H_t^h > 0 \tag{9}$$

$$K_{T_0}^h > 0 \ \text{ given} \tag{10}$$

[7] Since the utility function is strictly increasing in its arguments, maximization behaviour requires the budget constraint to hold with equality.

where C_t^h is real consumption expenditure of the representative household h in period t, I_t^h is real investment expenditure, w_t is the real wage rate, r_t is the gross real rental rate of capital, L_t^h is hours of work, H_t^h is hours of leisure, $\overline{h}$ is the total number of hours available for work per year, K_t^h is real capital stock, Π_t^h is the share of profits, $K_{T_0}^h$ is the initial real capital stock which we take as given, δ is the constant depreciation rate, β^* is the time discount factor, $0 < \delta < 1$ and $0 < \beta < 1$.[8]

Solving equation (8) for investment we get:

$$I_t^h = K_{t+1}^h - (1-\delta) K_t^h \tag{11}$$

Then we substitute equation (11) into the budget constraint (6), and solve for consumption:

$$C_t^h = w_t L_t^h + (1 + r_t - \delta) K_t^h - K_{t+1}^h + \Pi_t^h \tag{12}$$

We also solve equation (7) for leisure time:

$$H_t^h = \overline{h} - L_t^h \tag{13}$$

Substituting equations (12) and (13) into equation (5) the problem of the representative household can be equivalently rewritten as:

$$\max_{\left\{K_{t+1}^h, L_t^h\right\}_{t=T_0}^{\infty}} \sum_{t=T_o}^{\infty} (\beta^*)^t \, U\left(w_t L_t^h + (1+r_t-\delta) K_t^h - K_{t+1}^h + \Pi_t^h), (\overline{h} - L_t^h)\right) \tag{14}$$

subject to:

$$C_t^h, I_t^h, K_t^h, H_t^h, L_t^h, K_{T_0}^h > 0$$

$$K_{T_0}^h > 0 \ \text{ given}$$

Taking the first order necessary conditions with respect to H_t^h and K_{t+1}^h we get:

$$w_t U_{C_t^h}\left(C_t^h, H_t^h\right) = U_{H_t^h}(C_t^h, H_t^h) \tag{15}$$

and

$$U_{C_t^h}\left(C_t^h, H_t^h\right) = (\beta^*) \, U_{C_{t+1}^h}\left(C_{t+1}^h, H_{t+1}^h\right)(1 + r_{t+1} - \delta) \tag{16}$$

The optimality conditions are completed with the transvesality condition for the one asset of our economy which is capital:

$$\lim_{t\to\infty} (\beta^t)\left(U_{C_t^h}\left(C_t^h, H_t^h\right)\right)(K_{t+1}) = 0 \tag{17}$$

Assuming a loglinear type instantaneous utility function

$$U(C_t^h, H_t^h; \gamma) = \gamma \log(C_t^h) + (1-\gamma)\log(H_t^h) \ , \ 0 < \gamma < 1 \tag{18}$$

where γ is the consumption share parameter, equations (15), (16), and (17) become:

$$w_t\left(\overline{h} - L_t^h\right) = \left(\frac{(1-\gamma)}{\gamma}\right) C_t^h \tag{19}$$

$$\frac{C_{t+1}^h}{C_t^h} = (\beta^*)(1 + r_{t+1} - \delta) \tag{20}$$

$$\lim_{t\to\infty} (\beta^t)\left(\frac{\gamma}{C_t^h}\right)(K_{t+1}^h) = 0 \tag{21}$$

3.2 Firms

Each period of time t there are M_t identical firms ($f = 1, 2, 3...M_t$). Firms produce a homogeneous good using a Cobb-Douglas constant returns to scale technology:

$$Y_t^f = A_t\left(K_t^f\right)^{\alpha}\left(L_t^f\right)^{1-\alpha} \tag{22}$$

where Y_t^f is the output of the representative firm f, $0 < \alpha < 1$ is the capital share and A_t is total factor productivity (TFP) which grows at an exogenously given rate $\frac{A_{t+1}}{A_t} = g^{1-\alpha}$.

[8] Here we make the following assumption: Each day the household has 14 hours available for market activities. Then each year the available hours for market activities for each household are 14*7*52=5096.

The representative firm f chooses, in each period t, the quantity of labour, L_t^f, and capital, K_t^f, in order to maximize profits, Π_t^f:

$$\max_{L_t^f\ ,\ K_t^f} \Pi_t^f = Y_t^f - w_t L_t^f - r_t K_t^f \tag{23}$$

subject to:

$$Y_t^f = A_t \left(K_t^f\right)^{\alpha} \left(L_t^f\right)^{1-\alpha}$$

Taking the first order necessary conditions with respect to L_t^f and K_t^f we get the following two optimality conditions:

$$w_t = (1-a) A_t \left(K_t^f\right)^{\alpha} \left(L_t^f\right)^{-\alpha} \tag{24}$$

and

$$r_t = a A_t \left(K_t^f\right)^{\alpha-1} \left(L_t^f\right)^{1-\alpha} \tag{25}$$

3.3 The Decentralized Competitive Equilibrium (DCE)

The DCE consists of a vector of quantities for the representative household,$\{Y_t^h, C_t^h, I_t^h, H_t^h, \Pi_t^h, K_{t+1}^h, L_t^h\}_{t=T_0}^{\infty}$, a vector of quantities for the representative firm $\{Y_t^f, L_t^f, K_t^f, \Pi_t^f\}_{t=T_0}^{\infty}$ and a vector of prices $\{w_t, r_t\}_{t=T_0}^{\infty}$, such that, given sequences for the exogenous variables $\{A_t, N_t\}_{t=T_0}^{\infty}$and the initial real capital stock $K_{T_0}^h$:

(a) Given prices $\{w_t, r_t\}_{t=T_0}^{\infty}$, the vector of quantities for the household,$\{Y_t^h, C_t^h, I_t^h, H_t^h, \Pi_t^h, K_{t+1}^h, L_t^h\}_{t=T_0}^{\infty}$ solves the household's maximization problem.

(b) Given prices $\{w_t, r_t\}_{t=T_0}^{\infty}$, the vector of quantities for the firm $\{Y_t^f, L_t^f, K_t^f, \Pi_t^f\}_{t=T_0}^{\infty}$ solves the firm's maximization problem.

(c) Given the vectors of quantities for households and firms, $\{Y_t^h, C_t^h, I_t^h, H_t^h, \Pi_t^h, K_{t+1}^h, L_t^h\}_{t=T_0}^{\infty}$, $\{Y_t^f, L_t^f, K_t^f, \Pi_t^f\}_{t=T_0}^{\infty}$, the vector of prices $\{w_t, r_t\}_{t=T_0}^{\infty}$ is such that all markets clear.

Thus, in each period t, the market clearing conditions for the goods and services market, the labour market, the capital market, and profits, are respectively:

$$\sum_{f=1}^{M_t} \left(Y_t^f\right) = \sum_{h=1}^{N_t} \left(Y_t^h\right) \tag{26}$$

$$\sum_{f=1}^{M_t} \left(L_t^f\right) = \sum_{h=1}^{N_t} \left(L_t^h\right) \tag{27}$$

$$\sum_{f=1}^{M_t} \left(K_t^f\right) = \sum_{h=1}^{N_t} \left(K_t^h\right) \tag{28}$$

$$\sum_{f=1}^{M_t} \left(\Pi_t^f\right) = \sum_{h=1}^{N_t} \left(\Pi_t^h\right) = 0 \tag{29}$$

Hence, the decentralized competitive equilibrium is summarized by equations (6), (7), (8), (19), (20) and (22) to (29). This is a system of thirteen equations in thirteen unknowns, in each period t.

In terms of aggregate quantities, the DCE consists of the following equations:

$$C_t + K_{t+1} - (1-\delta) K_t = w_t L_t + r_t K_t \tag{30}$$

$$w_t \left(\overline{h} N_t - L_t\right) = \left(\frac{(1-\gamma)}{\gamma}\right) C_t \tag{31}$$

$$\frac{C_{t+1}}{C_t} = \beta \left(1 + r_{t+1} - \delta\right) \tag{32}$$

where $\beta = (\beta^*) n$.

$$Y_t = A_t \left(K_t\right)^{\alpha} \left(L_t\right)^{1-\alpha} \tag{33}$$

$$w_t = (1-a) A_t \left(K_t\right)^{\alpha} \left(L_t\right)^{-\alpha} \tag{34}$$

$$r_t = a A_t \left(K_t\right)^{\alpha-1} \left(L_t\right)^{1-\alpha} \tag{35}$$

This is a system of six equations ((30) to (35)) in six unknowns (Y_t, C_t, K_{t+1}, L_t, w_t, r_t), in each period t.[9]

[9] For details see Appendix 1.

4 Data

Before applying the great depressions methodology, we must first ensure that the variables in the proposed model match up with the data. All data have been extracted from the OECD and Groningen Growth Development Center databases.[10] As already mentioned, our model is the basic RBC model where the implied national income identity is $Y_t = C_t + I_t$. Following Conesa et al. (2007), we define Y_t to be real gross domestic product. We then allocate government consumption and net exports to consumption. In other words, we make the assumption that, given data for real investment I_t, consumption is obtained residually as $C_t = Y_t - I_t$.[11]

4.1 Real Capital Stock

In order to obtain a time series for the real capital stock, K_t, we follow the same procedure as in Conesa et al. (2007), based on the perpetual inventory method.[12] The law of motion of real capital stock is:

$$K_{t+1} = I_t + (1 - \delta) K_t \tag{36}$$

This, along with data on real investment expenditure, I_t, also requires a value for the depreciation rate, δ, which we assume to be constant, and an initial value for the real capital stock, K_0. The value of δ is chosen to be consistent with the average consumption of fixed capital to GDP ratio observed in the data. This number over the period 1970-2011 in Greece is 11%, that is:

$$\frac{1}{42} \sum_{t=1970}^{2011} \frac{\delta K_t}{Y_t} = 11\% \tag{37}$$

The capital - output ratio in the initial period is chosen so as to be equal to the average capital - output ratio over some reference period, in our case 1961 - 1970. That is:

$$\frac{K_{1960}}{Y_{1960}} = \frac{1}{10} \sum_{t=1961}^{1970} \frac{K_t}{Y_t} \tag{38}$$

By choosing 1960 as our initial period, and given that our analysis will focus on the 1979 - 2001 period, we minimize the effects of the choice of K_0 on the constructed series of real capital stock. Equations (36), (37), and (38) constitute a system of 53 equations in 53 uknowns(K_0, K_1,...K_{2011}, and δ). The solution of this system, along with the real capital stock series, implies $\delta = 3.55\%$ and $\frac{K_{1960}}{Y_{1960}} = 1.74$.[13]

4.2 Input Shares

In the case of the Greek economy, self employment is a considerable proportion of total employment. As Figure 3 reveals, during the last 40 years the ratio of self employment to total employment was well above 30%. So, computing the labour share as the ratio of total compensation of employees to GDP minus net indirect taxes, would be downwards biased and misleading.[14] To amend this, in order to compute the labour share we add an

[10] For details see Appendix 4.

[11] According to Conesa et al. (2007) there are several alternative procedures for matching up objects in the model with those in the data. One way is to ignore the government and the foreign sector. Following this path, consistency requires that C_t equals private consumption in the national accounts and I_t equals private investment. One of the disadvantages of this approach is that it leaves a sizable fraction of GDP out of the analysis. Another set of procedures start by defining Y_t to be gross domestic product, and then allocate the categories that are not explicitly considered in the analysis, government consumption and net exports, to either consumption or investment. As we have mentioned, we shall follow the most frequently followed technique in Kehoe and Prescott (2002, 2007), that is we shall allocate both categories (government consumption and net exports) to consumption.

[12] The series for real investment we use in order to construct the real capital stock series, is nominal Gross Fixed Capital Formation, converted in real terms with the use of the GDP deflator. Note that, in our model, one homogeneous good is produced and can be used either for consumption or investment. That is consumption and capital goods share the same price. Note, also, that the series for nominal Gross Fixed Capital Formation and Private Consumption Expenditure in OECD database are converted in real terms using their own deflator (for details see Conesa et al. (2007)).

[13] These values are obtained with Gross Fixed Capital Formation used as real investment. If Gross Capital Formation is used instead, the depreciation rate and the initial capital stock ratio are $\delta = 2.73\%$ and $\frac{K_{1960}}{Y_{1960}} = 2.12$. Note that, the difference between GCF and GFCF equals inventory investment. By choosing GCF as real investment, inventories are treated as real investment, while in the GFCF case, inventories are treated as current consumption. We conducted growth accounting and simulations using GCF as well. The results are very close both quantitatively and qualitatively and are available upon request.

[14] The account Compensation of Employees in OECD database, shows the income that was earned from employees that belong to dependent employment (total employment minus self employment).

imputed income of the self-employed to the available OECD data on total compensation of employees.

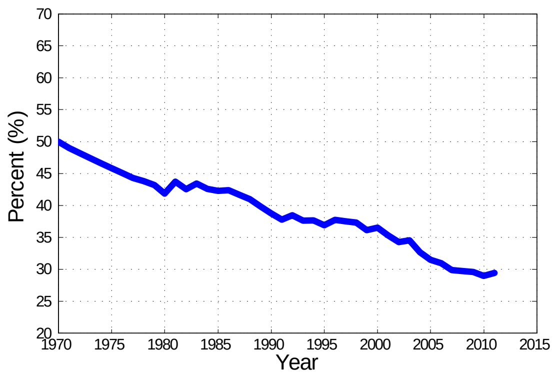


Figure 3: Self Employment to Total Employment Ratio

In order to get a proxy for the labour income of the self-employed we work as follows: First, we construct an annual compensation rate per employee by dividing total compensation of employees (net of employer's contributions to social security) with total dependent employment. We then multiply this with total self employment. The result is a constructed annual rate for total compensation of the self-employed. To compute the labour share in output, we add total compensation of self-employed to total compensation of employees and then divide this number with GDP at factor prices (that is GDP minus net indirect taxes).[15] Hence:

$$\text{Labour Share} = \frac{TCE_t^{DE} + TCE_t^{SE}}{Y_t - NIT_t} \tag{39}$$

where TCE^{DE} is total compensation of employees that belong to dependent employment, TCE^{SE} is the imputed total compensation of the self-employed, and NIT is net indirect taxes, i.e. indirect taxes less subsidies on production and imports. Taking the average of equation (37) over the period 1970-2009, we estimate a value for the labour share parameter equal to 57.13%.[16]

4.3 TFP

In order to obtain a series for TFP, we need an aggregate production function, data on the inputs of production, and a value for the parameter of the inputs shares. In our analysis, we use a Cobb-Douglas aggregate production function:

$$Y_t = A_t K_t^a L_t^{1-a} \tag{40}$$

Given data on real GDP, Y_t, real capital stock, K_t, hours of work, L_t, and a value for the capital share parameter, α, we compute the series for TFP using the following equation:

$$A_t = \frac{Y_t}{K_t^a L_t^{1-a}} \tag{41}$$

5 Growth Accounting

For our growth accounting analysis we follow the approach adopted by the "Great Depressions Methodology" literature (see e.g. Conesa et al. (2007)). More specifically the aggregate production function can be equivalently written:

$$\frac{Y_t}{N_t} = A_t^{\left(\frac{1}{1-a}\right)} \left(\frac{K_t}{Y_t}\right)^{\left(\frac{a}{1-a}\right)} \frac{L_t}{N_t} \tag{42}$$

or in natural logarithms:

$$\ln\left(\frac{Y_t}{N_t}\right) = \left(\frac{1}{1-a}\right)\ln\left(A_t\right) + \left(\frac{a}{1-a}\right)\ln\left(\frac{K_t}{Y_t}\right) + \ln\left(\frac{L_t}{N_t}\right) \tag{43}$$

Thus, we decompose real per capita GDP into three factors: The TFP factor, $A^{1/(1-\alpha)}$, the capital factor, $\left(\frac{K_t}{Y_t}\right)^{\left(\frac{\alpha}{1-\alpha}\right)}$, and the labour factor, $\frac{L_t}{N_t}$.[17] Recall that $\frac{N_{t+1}}{N_t} = n$ and TFP, A_t, grows at a constant rate.

[15] This method has been proposed by Gollin (2002).

[16] Similar values can also be found in Papageorgiou (2012). Furthermore, the Groningen Growth and Development Center database, for the period 1990-2009, provides an average for the labour share parameter equal to 57.25%.

[17] Other authors (e.g. Kydland and Zarazaga (2002)) use the terms capital intensity factor and employment intensity factor respectively. Our terminology is taken from Prescott (2002).

It is well known that our model converges. If g denotes the growth rate of real per capita GDP, then, along this balanced growth path:

$$\frac{A_{t+1}}{A_t} = g^{1-\alpha} \tag{44}$$

Hence, the TFP factor, $A^{1/(1-\alpha)}$, grows at the rate g. The above decomposition can clearly reveal whether an economy moves along its balanced growth path or not. Specifically, along the balanced growth path the capital factor and the labour factor do not grow. As a result, the growth rate of real per capita GDP is driven exclusively by the growth rate of the TFP factor, i.e. g.[18]

Table 3 and Figure 4 show the results of our growth accounting exercise:

Table 3.
Accounting for Growth - Average Annual Changes (%)

Period	Boom	Before Depression	Crisis	Recovery	Post Depression	New Crisis
	1960-1970	1970-1979	1979-1995	1995-2001	2001-2007	2007-2011
Component						
Real per Capita GDP	7.83	4.09	-0.07	3.13	3.75	-3.69
TFP Factor	9.09	1.87	-1.31	3.47	2.9	-5.67
Capital Factor	0.24	2.75	1.81	-1.09	-0.49	4.42
Labour Factor	-1.5	-0.53	-0.57	0.75	1.34	-2.44

During the period 1960-1970, real per capita GDP grew at an average annual rate of 7.83%. This was mostly driven by the contribution of the TFP factor which grew at a rate of 9.09%. The steep increase of real per capita GDP was partially offset by the behavior of the labour factor, which declined at an average annual rate of growth of -1.5%. The contribution of the capital factor was anemic with a rate of growth of 0.24%.

The 70's are characterized by a sharp decline in the growth rates of both real per capita GDP and the TFP factor, relative to the 60's. The Greek economy continued to grow at the still high rate of 4.09% (although almost half the rate of the 60's) but the TFP factor grew at nearly five times lower rate, 1.87%. On the other hand, the contribution of the capital factor increased considerably, with a rate of growth of 2.75%. The labour factor continued to decline, but at a smaller rate of -0.53%.[19]

After 20 years of continuous high growth, the Greek economy during the 80's and until the mid 90's fell into a sixteen years period of recession. Between 1979 and 1995 real per capita GDP remained practically stagnant, with an average rate of growth equal to -0.07%. The contribution of the TFP factor now became negative (-1.31%) and the labour factor was still declining (-0.57%). On the other hand, the contribution of the capital factor remained positive (1.81%) although at a lower rate relative to 70's.

Recovery for the Greek economy started in the mid 90's. During the period 1995 to 2001, real per capita GDP grew at a rate of 3.13%. The TFP factor was the workhorse of this recovery, growing at a 3.47% growth rate. The recovery pace was partially offset by a decline in the growth rate of the capital factor by -1.09%, but, on the other hand, was partially boosted by the increase of the labour factor by 0.75%.[20]

During the period 2001-2007, real per capita GDP grew at a rate of 3.75%. Once again, it is TFP, with a 2.9% growth rate, that lies behind this boost. The capital factor continued to have a negative, but at smaller rate, contribution on growth (-0.49%) while the labour factor had a positive contribution to real per capita GDP growth of 1.34%.

Finally, starting from 2008, after 13 years of continuous above trend growth and 7 years after recovering from the great depression incident of the 80's and 90's, the Greek economy is experiencing a deep recession which can potentially end up being a second great depression.[21] From 2007 to 2011, the annual average growth rate of real per capita GDP was -3.69%. This negative growth rate is driven mainly by the major fall of the TFP factor (-5.67%) as well as the fall in the labour factor (-2.44%), and is partially offset by a positive contribution of the capital factor (4.42%).

[18] See Appendix 2 for details.

[19] Note that, the Greek economy during the 70's was hit by major shocks, namely the two oil shocks as well as the mid seventies political turmoil on a national level (Cyprus invasion by Turkey and the subsequent fall of the military regime and restoration of democracy). All these are reflected in TFP.

[20] As analyzed in appendix 4 the source for labor hours data we use is OECD. This database provides data for labor hours starting from 1970. To restore data for the period 1960-1969 we use the labor hours series provided by Groningen Growth Development Center (GGDC) database. More specifically we use the growth rate of the GGDC labor hour series in order to extrapolate the OECD data backwards. The two series are very similar with the exception of the recovery period. Where, while OECD labor hours increase the opposite holds for GGDC labor hours. This obviously affect the TFP series. We conducted growth accounting and simulations for both cases. The results are very close both qualitatively and quantitatively with the exception of the recovery phase. The analysis for the GGDC labor hours are available upon request.

[21] See Kehoe (2003) and Kydland and Zarazaga (2002) for Argentina's two Great Depression episodes during the period 1974-2002.

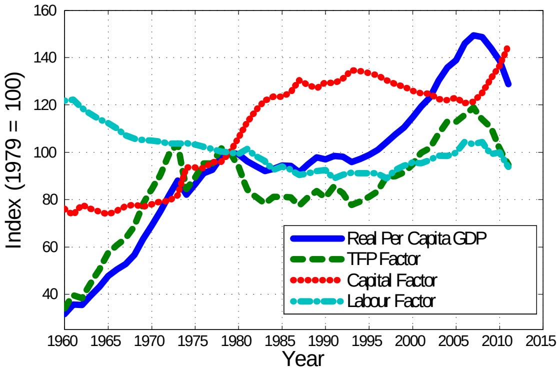


Figure 4: Growth Accounting For Greece 1960-2011

The above analysis, depicted in Figure 4, summarizes the growth accounting facts for the Greek economy for the last 50 years. The next step is to test the ability of the basic RBC model to reproduce these facts, given the exogenous paths of TFP and population. We will focus on the period 1979 - 2001 which is Greece's (first) great depression episode in the post war period.

6 Solving for the DCE Path

Equations (30) to (35) summarize the DCE of our artificial economy in terms of aggregate quantities. Our aim is to obtain the series for K_t, L_t, and Y_t along the DCE path of the artificial economy and then compare them with the actual data. To do this we work as follows: First we insert equations (34) and (35) into equations (30), (31), and (32). This gives:

$$C_t + K_{t+1} - (1-\delta)K_t = A_t\,(K_t)^{\alpha}\,(L_t)^{1-\alpha} \tag{45}$$

$$(1-a)A_t\,(K_t)^{\alpha}\,(L_t)^{-\alpha}\left(\overline{h}N_t - L_t\right) = \left(\frac{(1-\gamma)}{\gamma}\right)C_t \tag{46}$$

$$\frac{C_{t+1}}{C_t} = \beta\left(1 + aA_{t+1}\,(K_{t+1})^{\alpha-1}\,(L_{t+1})^{1-\alpha} - \delta\right) \tag{47}$$

Then we solve equation (45) for C_t and then we substitute it into equations (46) and (47). Thus, we obtain:

$$(1-a)A_tK_t^aL_t^{-a}\left(\overline{h}N_t - L_t\right) = \left(\frac{(1-\gamma)}{\gamma}\right)\left(A_tK_t^aL_t^{1-a} - K_{t+1} + (1-\delta)\,K_t\right) \tag{48}$$

and

$$\frac{A_{t+1}K_{t+1}^aL_{t+1}^{1-a} - K_{t+2} + (1-\delta)\,K_{t+1}}{A_tK_t^aL_t^{1-a} - K_{t+1} + (1-\delta)\,K_t} = \beta\left(1-\delta + aA_{t+1}K_{t+1}^{a-1}L_{t+1}^{1-a}\right) \tag{49}$$

Solving for the DCE equilibrium path involves choosing sequences of K_t and L_t,such that, the above system (eq. 48 and 49) has a unique solution, given sequences of TFP, A_t, working age persons, N_t, $t = T_0, T_0+1, ...$, the initial capital stock, K_{T_0}, and the transversality condition (eq. 21).

In order to convert the above system of infinite equations with infinite unknowns into a tractable dynamic system, we follow Conesa et al. (2007) and assume that our economy converges to the balanced growth path at some finite date T_1. Our system is thus reduced to:

$$(1-a)A_tK_t^aL_t^{-a}\left(\overline{h}N_t - L_t\right) = \left(\frac{(1-\gamma)}{\gamma}\right)\left(A_tK_t^aL_t^{1-a} - K_{t+1} + (1-\delta)\,K_t\right) \tag{50}$$

$$t = T_0, T_0+1, ...T_1$$

$$\frac{A_{t+1}K_{t+1}^aL_{t+1}^{1-a} - K_{t+2} + (1-\delta)\,K_{t+1}}{A_tK_t^aL_t^{1-a} - K_{t+1} + (1-\delta)\,K_t} = \beta\left(1-\delta + aA_{t+1}K_{t+1}^{a-1}L_{t+1}^{1-a}\right) \tag{51}$$

$$t = T_0, T_0+1, ...T_1 - 1$$

and

$$K_{T_1+1} = (g)(n)(K_{T_1}) \tag{52}$$

This is a system of $2(T_1 - T_0 + 1)$ equations, in $2(T_1 - T_0 + 1)$ uknowns (the respective capital and labour sequences).

It remains to choose T_0 and T_1, that is the period over which we are going to solve the above system. We choose $T_0 = 1970$ and assume that our economy converges to a balanced growth path after 69 years, that is $T_1 = 2039$.[22] So we solve the system over the period $T_0 = 1970$ to $T_1 = 2039$.

We assume that households have perfect foresight over the evolution of the exogenous variables, A_t and N_t. Since data are available until 2011, we need to make an assumption for the years thereafter.[23] In particular, for 2012-2013 we assume that TFP follows a proportionally similar path to the respective OECD projections for real per capita GDP. After 2013 we assume that the growth rate of TFP increases smoothly until 2020 when it reaches its trend gross growth rate $\frac{A_{t+1}}{A_t} = (1.02)^{1-\alpha}$, and continues thus thereafter. In what concerns population, we assume that after 2011, it grows at the the average annual gross growth rate of working age persons over the period 1970-2011, $n = 1.0065$. When presenting our results, we label this solution as "perfect foresight".

As in Conesa et al. (2007), we also conduct an additional numerical experiment labeled "myopic". In this case we assume that, every year, households expect future TFP to grow at the average rate that it grew over the previous 10 years. The same condition is imposed on expectations after 2011. As for population we make the same assumption as above.[24] This solution requires us to solve the model 42 times, once for each year, from 1970 to 2011.

6.1 Calibration of β and γ

Parameters γ and β are calibrated from equations (53) and (54). These equations are obtained after solving household's optimality conditions (31) and (32) for γ and β, respectively:

$$\gamma = \frac{C_t L_t}{Y_t \left(\overline{h} N_t - L_t\right)(1-\alpha) + C_t L_t} \tag{53}$$

and

$$\beta = \frac{C_{t+1}}{C_t \left(1 - \delta + a \frac{Y_{t+1}}{K_{t+1}}\right)} \tag{54}$$

Given data on Y_t, C_t, K_t, L_t, N_t, and values for α, δ, and $\overline{h}$, we take the averages of the above equations over the period 1970-2010, and obtain $\gamma = 0.3$ and $\beta = 0.93$. Our model's calibrated parameter values are summarized in Table 4:

Table 4.
Calibration

Parameters	δ	α	γ	β	g	n	$\overline{h}$
	3.55%	42.87%	0.3	0.93	1.02	1.0065	5096

Now, having values for the paths of the exogenous variables A_t, N_t (for 1970 to 2039), the initial real capital stock, K_0, and the model parameters $\overline{h}$, α, β, γ, and δ, we can solve for the DCE path of our economy. To do so, we must solve the dynamic system of equations (50), (51), and (52) over the period 1970 - 2039. The details are in appendix 3.

7 Numerical Experiments

7.1 A (First) Great Depression

In this section, we compare the growth accounting from the data with that from our artificial economy. The results are presented in Table 5 (growth rates) and Table 6 (levels) as well as Figures 5 to 8. Our analysis distinguishes between four subperiods: 1970-1979, 1979-1995, 1995-2001, and 2001-2007. As mentioned before, these subperiods are labeled, "before depression", "crisis", "recovery" and "post depression", respectively. Table 6 presents the index values corresponding to the growth accounting exercise. Specifically, it shows the

[22] Our choice for T_0 conforms to the timing chosen by Conesa et al. (2007), i.e. 10 years before the start of the crisis phase. In what concerns T_1 we make the same assumption as the above authors.

[23] Note that the Finnish crisis episode analyzed by Conesa et al. (2007) ended in 1993 and until 2005 (where their available data end) Finland was growing at a healthy rate. Thereafter, they assume that TFP grows at its annual average rate over the period 1980-2005. This assumption is not compatible with our case, since, as already mentioned, starting from 2008 Greece is in a state of ongoing and escalating depression. Nevertheless, we simulated our model following the Conesa et al. (2007) assumption as well. The findings are qualitatively and quantitatively similar with those in our paper. More substantial differences, if any, appear only after 2011. The results are available upon request.

[24] As in Conesa et al. (2007) we assume that households have perfect foresight over the evolution of working age persons because they can observe birth rates and project them into the future.

index values of detrended real per capita GDP, of detrended TFP factor, of capital factor, and of labour factor, relative to their respective values in the beginning of each of the four subperiods.

As Tables 5 and 6 and Figures 5 to 8 reveal, the basic RBC model can account rather well for the performance of the Greek economy through the 80's and 90's. In other words, the observed TFP shocks are crucial in accounting for the Greek great depression. Both solutions of our model economy (perfect foresight and myopic) predict a big decline of economic activity during the 80's and until the mid 90's, and a strong recovery (above trend growth rates) for the period 1995-2001. This is exactly what happened in Greece during this twenty year period. Furthermore, in terms of timing, both with respect to peaks - troughs , as well as the paths as a whole , our model economy moves synchronously with the data. Things are less successful when it comes to the labour factor.

7.1.1 Before Depression: 1970 - 1979

For the subperiod 1970-1979, both solutions of our model perform qualitatively relatively well. Quantitatively, the myopic solution clearly outperforms the perfect foresight one. The latter, overestimates the increase of the capital factor (3.57% relative to 2.75% in the data, in terms of growth rates and 37.95% relative to 28.12% in the data, in terms of levels) and the decrease of the labour factor (-0.76% relative to -0.53% in the data, in terms of growth rates and -6.61% relative to -4.67% in the data, in terms of levels). As a result, it overestimates the increase of real per capita GDP (4.68% relative to 4.09 in the data, in terms of growth rates).[25] On the other hand the myopic solution underestimates the increase of the capital factor (2.46% relative to 2.75% in the data, in terms of growth rates) and the decrease of the labour factor (-0.37% relative to -0.53% in the data, in terms of growth rates). Consequently, it slightly underestimates the growth rate of real per capita GDP (3.96% relative to 4.09% in the data, in terms of growth rates).

7.1.2 Crisis: 1979 - 1995

Our model is consistent with the substantial fall of real per capita GDP observed in the data. This can be seen both in terms of levels and growth rates.[26] Again the myopic solution clearly scores better here. Given an average fall of -1.31% of the TFP factor, the equilibrium response of this solution slightly underestimates the decrease of the labour factor (-0.5% relative to -0.57%) and the increase of the capital factor (1.66% relative to 1.81%). As a result, it produces a path for detrended real per capita GDP which is very similar to that in the data, that is -28.92% relative to -28% in the data, in terms of levels. This is clearly depicted in Figure 6 (a).

On the other hand, the perfect foresight solution overestimates the fall of detrended real per capita GDP (-1.08% relative to -0.07%) since it overestimates the decrease of the labour factor (-0.98% relative to -0.07%) and underestimates the increase of the capital factor (1.21% relative to 1.81%).

Overall, our model succeeds very well in reproducing the qualitative features of the detrended real per capita GDP path. It thus predicts accurately the timing of peaks, trougs and turning points. Equally successful is the behavior of the capital factor. However the same does not hold when it comes to the labour factor. All these can be seen in Figure 6.

7.1.3 Recovery: 1995 - 2001

Our model predicts well the recovery path of detrended real per capita GDP observed in the data. Here, neither the perfect foresight solution nor the myopic dominates. Quantitatively, both solutions overestimate the fall in the capital factor with the myopic solution being more successful. In what concerns the labour factor, the perfect foresight solution overestimates the increase observed in the data (1.14% relative to 0.75%) while the myopic solution underestimates this increase (0.26% relative to 0.75%). Finally, the myopic solution underestimates the increase in real per capita GDP (2.53% relative to 3.13%) while the perfect foresight solution fully matches its behavior.

7.1.4 Post Depression: 2001 - 2007

After 2001 and until 2007 our model reproduces the continuation of the, well above trend, real per capita GDP growth rates observed in the data. Here, the perfect foresight solution clearly dominates. The myopic solution does well in reproducing the behavior of the capital factor (-0.59% relative to -0.49%) but fails when it comes to the labour factor(0.01% relative to 1.34%). Consequently it underestimates the increase in real per capita GDP (2.32% relative to 3.75%). On the other hand, the perfect foresight solution scores very well in terms

[25] Looking at Table 6 we observe that for the period 1970 - 1979 the perfect foresight solution of our model predicts an average annual growth rate of real per capita GDP equal to 4.68%, well above its 2% trend rate. So, our model predicts that detrended real per capita GDP will grow during the same period at an average annual growth rate of 2.68%. Thus, detrended real per capita GDP in 1979 is predicted to be: $Y_{1979} = Y_{1970} * \left((1.0268)^9\right)$, or $\frac{Y_{1979}}{Y_{1970}} = 1.27$.

[26] All numbers in the parentheses hereafter, refer to growth rates in the model relative to the data respectively. See Table 7 for the comparison in levels. Obviously as the period under consideration becomes longer any differences in growth rates are magnified in terms of levels.

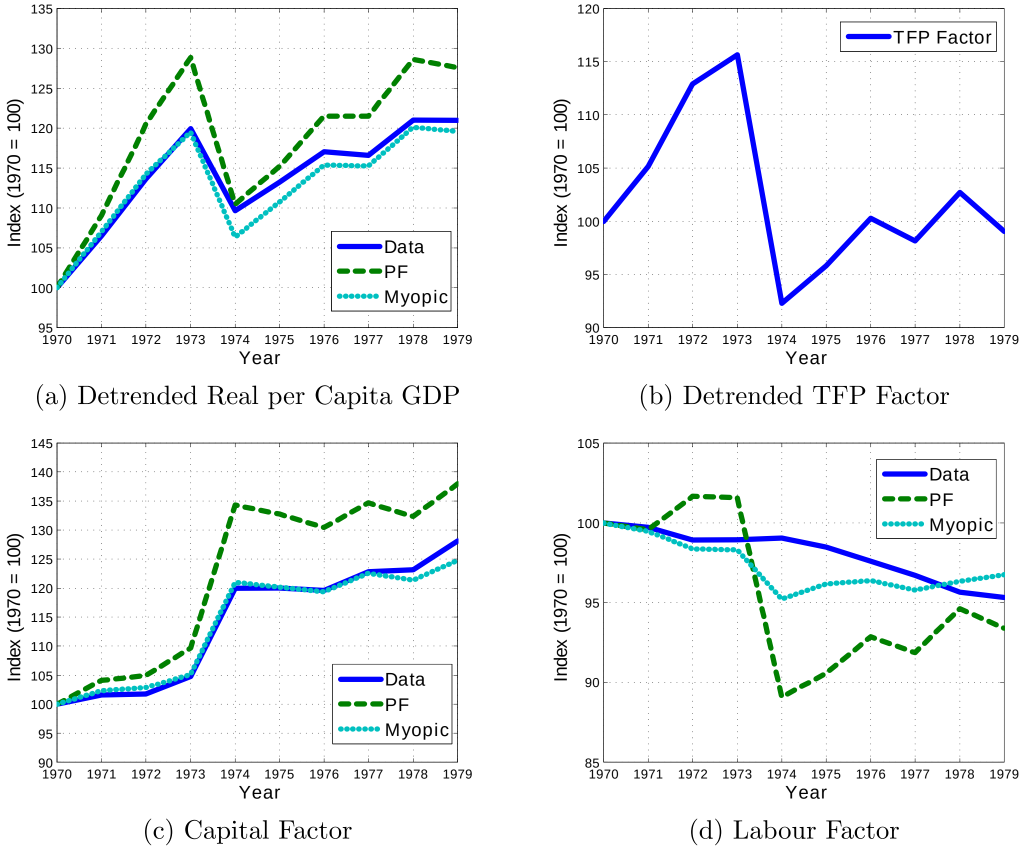
of the growth rate of real per capita GDP, while, it underestimates the decrease of the capital factor (-0.14% relative to -0.49%) as well as the increase in the labour factor (0.99% relative to 1.34%).

Table 5.
Average Annual Changes in Real per Capita GDP (%)

Components	Data	Solution Perfect Foresight	Solution Myopic Expectations
1970-1979			
Real per Capita GDP	4.09	4.68	3.96
TFP Factor	1.87	1.87	1.87
Capital Factor	2.75	3.57	2.46
Labour Factor	-0.53	-0.76	-0.37
1979-1995			
Real per Capita GDP	-0.07	-1.08	-0.15
TFP Factor	-1.31	-1.31	-1.31
Capital Factor	1.81	1.21	1.66
Labour Factor	-0.57	-0.98	-0.5
1995-2001			
Real per Capita GDP	3.13	3	2.53
TFP Factor	3.47	3.47	3.47
Capital Factor	-1.09	-1.61	-1.2
Labour Factor	0.75	1.14	0.26
2001-2007			
Real per Capita GDP	3.75	3.75	2.32
TFP Factor	2.9	2.9	2.9
Capital Factor	-0.49	-0.14	-0.59
Labour Factor	1.34	0.99	0.01

Table 6.
Levels (Indexes)

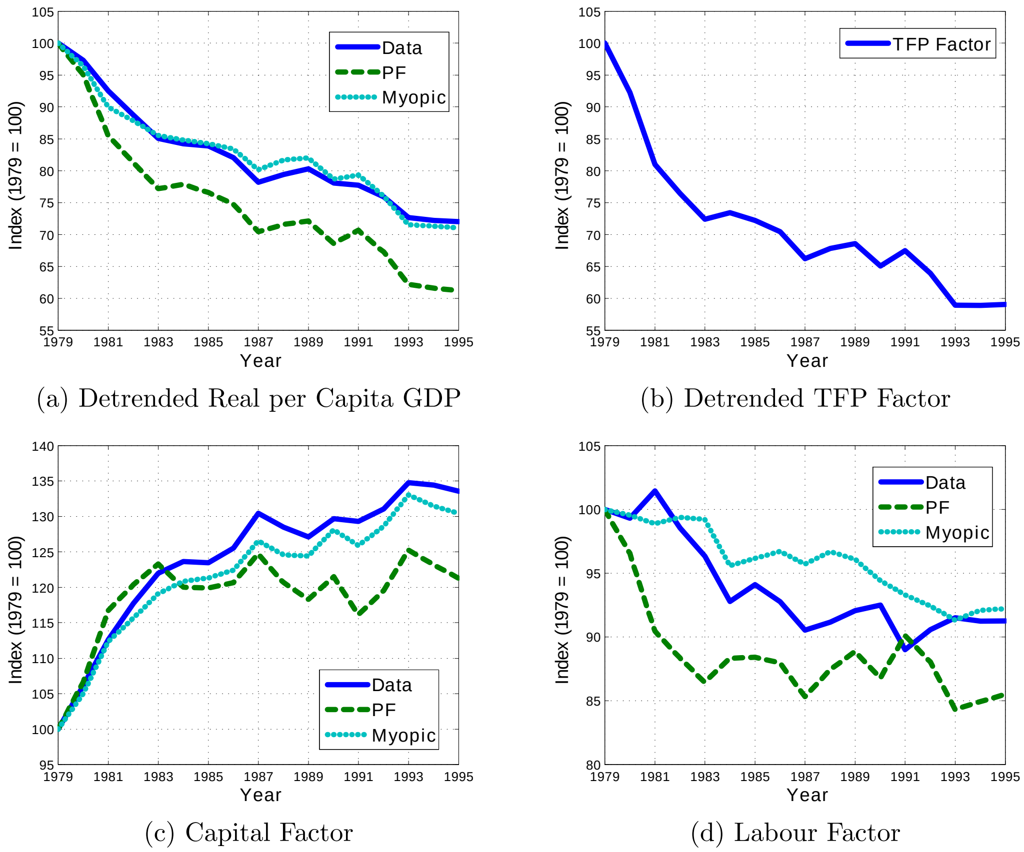
Components	Data	Solution Perfect Foresight	Solution Myopic Expectations
1979 (1970=100)			
Detrended Real per Capita GDP	120.97	127.6	119.59
Detrended TFP Factor	99.05	99.05	99.05
Capital Factor	128.12	137.95	124.8
Labour Factor	95.33	93.39	96.74
1995 (1979=100)			
Detrended Real per Capita GDP	72	61.27	71.08
Detrended TFP Factor	59.08	59.08	59.08
Capital Factor	133.56	121.30	130.44
Labour Factor	91.26	85.50	92.24
2001 (1995=100)			
Detrended Real per Capita GDP	107.15	106.31	103.37
Detrended TFP Factor	109.36	109.36	109.36
Capital Factor	93.67	90.78	93.06
Labour Factor	104.6	107.1	101.58
2007 (2001=100)			
Detrended Real per Capita GDP	111.22	111.16	102.05
Detrended TFP Factor	105.68	105.68	105.68
Capital Factor	97.09	99.14	96.52
Labour Factor	108.39	106.1	100.05



(a) Detrended Real per Capita GDP (b) Detrended TFP Factor

(c) Capital Factor (d) Labour Factor

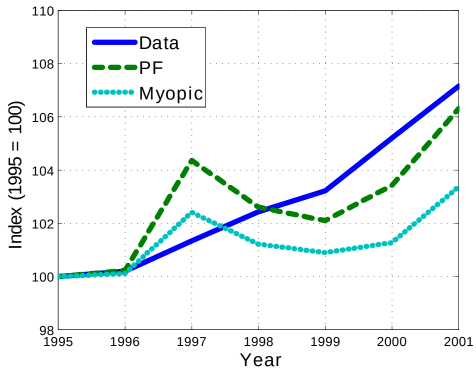
Figure 5: Before Depression (1970-1979)



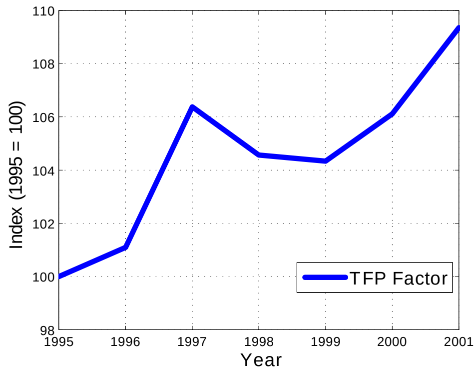
(a) Detrended Real per Capita GDP (b) Detrended TFP Factor

(c) Capital Factor (d) Labour Factor

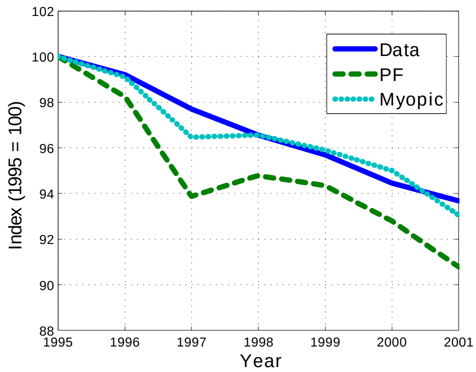
Figure 6: Crisis (1979-1995)



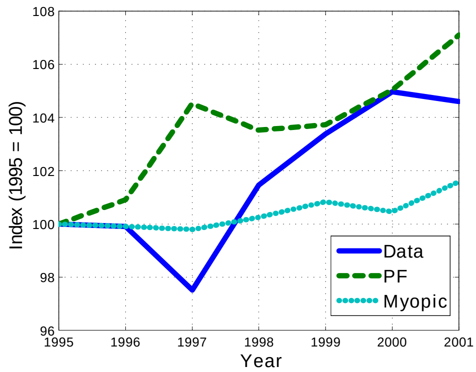
(a) Detrended Real per Capita GDP



(b) Detrended TFP Factor

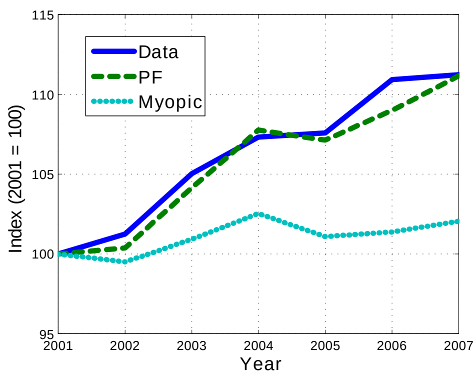


(c) Capital Factor

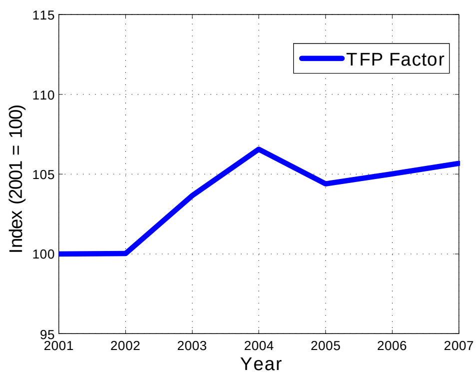


(d) Labour Factor

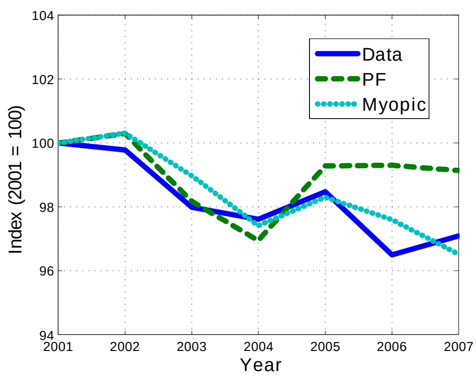
Figure 7: Recovery (1995-2001)



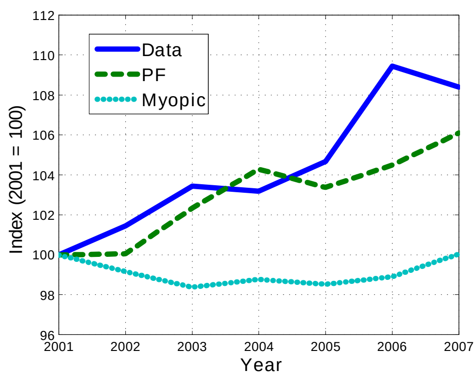
(a) Detrended Real per Capita GDP



(b) Detrended TFP Factor



(c) Capital Factor



(d) Labour Factor

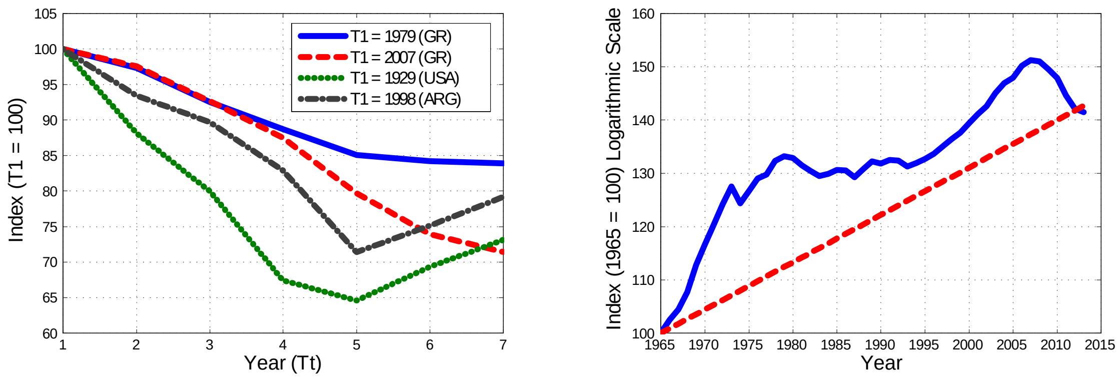
Figure 8: Post Depression (2001-2007)

7.2 A (Second) Great Depression?

Since 2007, Greece is experiencing a steep downfall in economic activity. As Figure 9 (a) depicts, there are many similarities with the beginnings of the 1979-2001 great depression episode. The Greek economy in 2011, already fulfills the first two of the Kehoe and Prescott (2002) criteria and given the current economic situation and the perceived future prospects most probably it will also fulfill the third. It remains to be seen whether 2007 signals the beginning of a second - in only three decades - great depression episode for Greece, as happened in Argentina (see footnote 21). This depends on how the economy will evolve in the near future, given the current debate on the resolution of the Greek debt crisis.

Figure 9 (a) provides striking evidence on the severity of the ongoing Greek crisis (periods 6 and 7 for Greece are the OECD projections for 2012 and 2013 respectively). Compared to the 1929 USA great depression, the 1998 Argentinian depression and the 1979 Greek depression, the current Greek crisis seems to be more prolonged and eventually as deep as the other episodes.

Moreover it is worth noting that, as we see in Figure 9 (b), the sharp deterioration in the economy after 2007 has already led the country "back to the mid 60's". It seems that in just a handful of years Greece fell back to the trajectory it would have followed if, ceteris paribus, everything remained as in 1965.



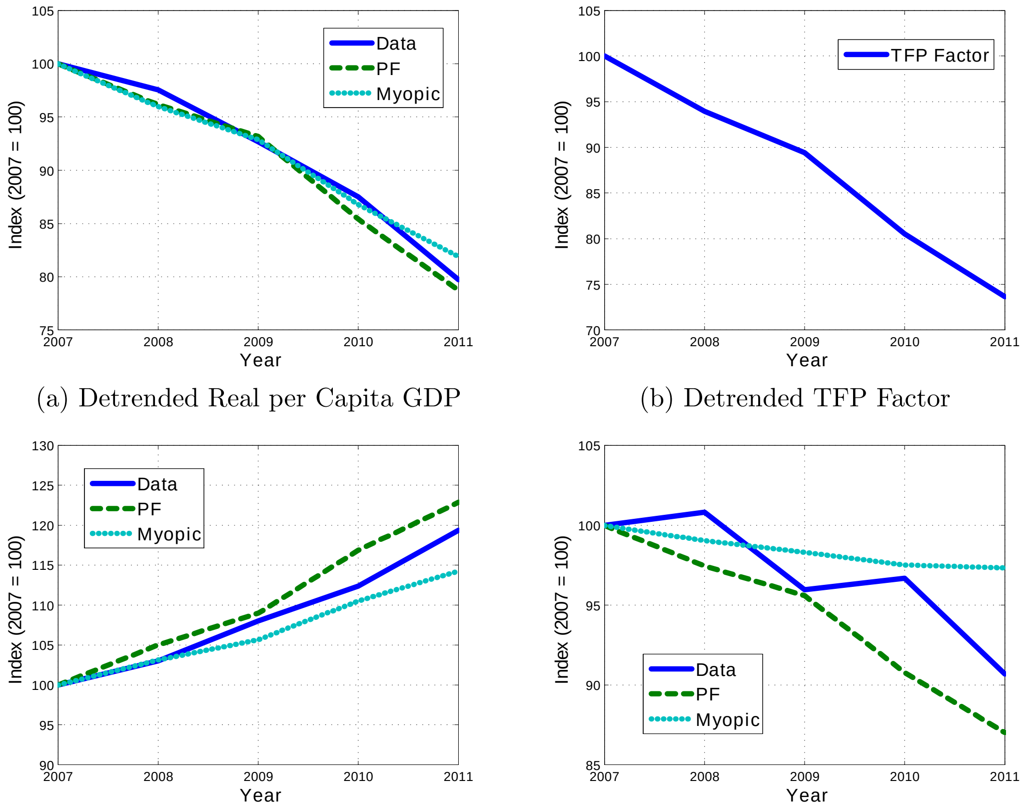
(a) Detrended Real Per Capita GDP (b) Real per Capita GDP and 2% Trend

Figure 9: Greece 2013 - Back to the mid 60's

Table 7 and Figure 10 summarize the results of the great depression methodology applied to the period 2007-2011. Both the perfect foresight and myopic solutions predict the substantial fall of detrended real per capita GDP. When it comes to the labour factor the myopic solution fails to account for the substantial fall of the labour factor, while the perfect foresight solution scores much better. Furthermore, both solution are more or less consistent with the substantial increase in the capital factor.

Table 7.
Average Annual Changes in Real per Capita GDP (%) and Levels (Indexes)

Components	Data	Solution Perfect Foresight	Solution Myopic Expectations
2007-2011			
Real per Capita GDP	-3.69	-4	-3.02
TFP Factor	-5.67	-5.67	-5.67
Capital Factor	4.42	5.15	3.33
Labour Factor	-2.44	-3.48	-0.68
2007-2011$_{(2007=100)}$			
Real per Capita GDP	79.72	78.74	81.92
TFP Factor	73.65	73.65	73.65
Capital Factor	119.36	122.86	114.27
Labour Factor	90.68	87.01	97.33



(a) Detrended Real per Capita GDP

(b) Detrended TFP Factor

(c) Capital Factor

(d) Labour Factor

Figure 10: New Crisis (2007-2011)

8 Concluding Remarks

In this paper we have identified and analyzed Greece's Great Depression episode during the 80's and 90's from a neoclassical perspective. Our results suggest that the basic RBC model can account rather well for this incident: Changes in TFP are crucial in accounting for the Greek great depression. Given the exogenous paths of TFP and population our model economy predicts a big decline in economic activity during the 80's and until the mid 90's, and a strong recovery for the period 1995-2001. This is exactly what happened in Greece during this twenty year period. In terms of timing, both with respect to peaks - troughs , as well as the paths as a whole, for most key macroeconomic variables our model economy moves synchronously with the data. However, puzzles between theory's predictions and the observed data are not missing. For instance, things are (not surprisingly for the RBC model) less successful when it comes to the labour factor. In addition, the perfect foresight solution predicts a deeper, than actually observed, recession.

The next step in our research agenda on the exploration of the recent history of the Greek economy, is to reduce the dependence of our results on the behavior of the exogenous TFP, i.e., "the measure of our ignorance", and thus enrich our model's propagation mechanism. Introducing, for example, government as well as quality of institutions (as in e.g. Angelopoulos et al. (2009) or Angelopoulos et al. (2011)) could be fruitful candidates.

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Appendix 1.

Our aim here is to write the DCE of our economy in aggregate quantities. To do this, we use the market clearing conditions. We first express the DCE in terms of household's h quantities:

$$M_t Y_t^f = N_t Y_t^h \Rightarrow Y_t^f = \left(\frac{N_t}{M_t}\right) Y_t^h \tag{55}$$

$$M_t L_t^f = N_t L_t^h \Rightarrow L_t^f = \left(\frac{N_t}{M_t}\right) L_t^h \tag{56}$$

$$M_t K_t^f = N_t K_t^h \Rightarrow K_t^f = \left(\frac{N_t}{M_t}\right) K_t^h \tag{57}$$

We then insert the above equations to the representative firm's optimality conditions (24) and (25), and the production function (22). That is:

$$w_t = (1-a)A_t \left(K_t^f\right)^\alpha \left(L_t^f\right)^{-\alpha} \Rightarrow w_t = (1-a)A_t \left(\left(\frac{N_t}{M_t}\right) K_t^h\right)^\alpha \left(\left(\frac{N_t}{M_t}\right) L_t^h\right)^{-\alpha}$$

$$\Rightarrow w_t = (1-a)A_t \left(K_t^h\right)^\alpha \left(L_t^h\right)^{-\alpha} \tag{58}$$

$$r_t = aA_t \left(K_t^f\right)^{\alpha-1} \left(L_t^f\right)^{1-\alpha} \Rightarrow r_t = aA_t \left(\left(\frac{N_t}{M_t}\right) K_t^h\right)^{\alpha-1} \left(\left(\frac{N_t}{M_t}\right) L_t^h\right)^{1-\alpha}$$

$$\Rightarrow r_t = aA_t \left(K^h\right)^{\alpha-1} \left(L_t^h\right)^{1-\alpha} \tag{59}$$

$$Y_t^f = A_t \left(K_t^f\right)^\alpha \left(L_t^f\right)^{1-\alpha} \Rightarrow \left(\frac{N_t}{M_t}\right) Y_t^h = A_t \left(\left(\frac{N_t}{M_t}\right) K_t^h\right)^\alpha \left(\left(\frac{N_t}{M_t}\right) L_t^h\right)^{1-\alpha}$$

$$\Rightarrow Y_t^h = A_t \left(K_t^h\right)^\alpha \left(L_t^h\right)^{1-\alpha} \tag{60}$$

Equations (6), (19), (20), (58), (59), and (60) describe the DCE of our artificial economy in terms of the representative household's quantities. This is a system of six equations in six unknowns, Y_t^h,C_t^h,K_{t+1}^h,L_t^h,r_t,w_t, in each period t. Making the assumption that all households are identical we obtain:

$$\sum_{h=1}^{N_t} \left(Y_t^h\right) = N_t Y_t^h = Y_t \Rightarrow Y_t^h = \frac{Y_t}{N_t} \tag{61}$$

$$\sum_{h=1}^{N_t} \left(C_t^h\right) = N_t C_t^h = C_t \Rightarrow C_t^h = \frac{C_t}{N_t} \tag{62}$$

$$\sum_{h=1}^{N_t} \left(L_t^h\right) = N_t L_t^h = L_t \Rightarrow L_t^h = \frac{L_t}{N_t} \tag{63}$$

$$\sum_{h=1}^{N_t} \left(H_t^h\right) = N_t H_t^h = H_t \Rightarrow H_t^h = \frac{H_t}{N_t} \tag{64}$$

$$\sum_{h=1}^{N_t} \left(K_t^h\right) = N_t K_t^h = K_t \Rightarrow K_t^h = \frac{K_t}{N_t} \tag{65}$$

Now we insert equations (61), (63), and (65) in equations (58) to (60). We thus obtain:

$$w_t = (1-a)A_t \left(K_t^h\right)^\alpha \left(L_t^h\right)^{-\alpha} \Rightarrow w_t = (1-a)A_t \left(\frac{K_t}{N_t}\right)^\alpha \left(\frac{L_t}{N_t}\right)^{-\alpha}$$

$$\Rightarrow w_t = (1-a)A_t \left(K_t\right)^\alpha \left(L_t\right)^{-\alpha} \tag{66}$$

$$r_t = aA_t \left(K^h\right)^{\alpha-1} \left(L_t^h\right)^{1-\alpha} \Rightarrow r_t = aA_t \left(\frac{K_t}{N_t}\right)^{\alpha-1} \left(\frac{L_t}{N_t}\right)^{1-\alpha}$$

$$\Rightarrow r_t = aA_t \left(K_t\right)^{\alpha-1} \left(L_t\right)^{1-\alpha} \tag{67}$$

$$Y_t^h = A_t \left(K_t^h\right)^\alpha \left(L_t^h\right)^{1-\alpha} \Rightarrow \frac{Y_t}{N_t} = A_t \left(\frac{K_t}{N_t}\right)^\alpha \left(\frac{L_t}{N_t}\right)^{1-\alpha}$$

$$\Rightarrow Y_t = A_t \left(K_t\right)^\alpha \left(L_t\right)^{1-\alpha} \tag{68}$$

We then substitute equations (62) and (64) into the instantaneous utility function of our model, that is equation (18):

$$U(\frac{C_t}{N_t}, \frac{H_t}{N_t}; \gamma) = \gamma \log(\frac{C_t}{N_t}) + (1-\gamma)\log(\frac{H_t}{N_t}) \tag{69}$$

The partial derivatives with respect to C_t^h and H_t^h are:

$$U_{C_t^h}\left(C_t^h, H_t^h\right) = \left(\frac{\gamma}{C_t}\right) N_t \tag{70}$$

$$U_{H_t^h}\left(C_t^h, H_t^h\right) = \left(\frac{1-\gamma}{H_t}\right) N_t \tag{71}$$

In order get the household's optimality conditions in aggregate terms we insert equations (62) and (64) to equations (15) and (16):

$$w_t U_{C_t^h}\left(C_t^h, H_t^h\right) = U_{H_t^h}(C_t^h, H_t^h) \Rightarrow w_t \left(\frac{\gamma}{C_t}\right) N_t = \left(\frac{1-\gamma}{H_t}\right) N_t \tag{72}$$

$$\Rightarrow w_t \left(\frac{\gamma}{C_t}\right) = \left(\frac{1-\gamma}{H_t}\right) \tag{73}$$

and

$$\begin{aligned} U_{C_t^h}\left(C_t^h, H_t^h\right) &= (\beta^*)\, U_{C_{t+1}^h}\left(C_{t+1}^h, H_{t+1}^h\right)(1 + r_{t+1} - \delta) \\ \Rightarrow \left(\frac{\gamma}{C_t}\right) N_t &= (\beta^*)\left(\frac{\gamma}{C_{t+1}}\right) N_{t+1}\,(1 + r_{t+1} - \delta) \\ \Rightarrow \left(\frac{C_{t+1}}{C_t}\right) &= (\beta^*) n\,(1 + r_{t+1} - \delta) \end{aligned} \tag{74}$$

Using the household's time constraint and equations (63) and (64) we obtain the aggregate time constraint of our model economy:

$$\overline{h} = H_t^h + L_t^h \Rightarrow \overline{h} N_t = H_t + L_t \tag{75}$$

Then, inserting equation (75) into (73) we obtain:

$$w_t \left(\frac{\gamma}{C_t}\right) = \left(\frac{1-\gamma}{\overline{h}N_t - L_t}\right) \Rightarrow w_t\left(\overline{h}N_t - L_t\right) = \left(\frac{1-\gamma}{\gamma}\right) C_t \tag{76}$$

Finally, we write the aggregate budget constraint of all households:

$$\begin{aligned} C_t^h + K_{t+1}^h - (1-\delta)\, K_t^h &= w_t L_t^h + r_t K_t^h \\ \Rightarrow N_t C_t^h + N_t K_{t+1}^h - (1-\delta)\, N_t K_t^h &= w_t N_t L_t^h + r_t N_t K_t^h \\ \Rightarrow C_t + K_{t+1} - (1-\delta)\, K_t &= w_t L_t + r_t K_t \end{aligned} \tag{77}$$

Equations (66), (67), (68), (74), (76), and (77) describe the DCE of our model economy in aggregate terms. It is a system of six equations in six unknowns, that is Y_t, C_t, K_{t+1}, L_t, r_t, w_t, in each period t. These are equations (30) to (35) in the main text.

Appendix 2.

In this appendix we analyze the long run characteristics of the basic RBC model.

We assume that TFP, A_t, and population, N_t, grow at the exogenously given constant gross growth rates $g^{1-\alpha}$ and n respectively. Hence our basic RBC model converges to a balanced growth path along which output per working age person, $\frac{Y_t}{N_t}$, grows at the net growth rate $g-1$, and the capital - output ratio, $\frac{K_t}{Y_t}$, and hours worked per working age person, $\frac{L_t}{N_t}$, remain constant. The production function, the resource constraint, the time constraint, and the way that the neoclassical economy accumulates real capital stock determine the feasibility of the balanced growth path.[27] Starting from the law motion of real capital stock we obtain:

$$\frac{K_{t+1}}{K_t}=\frac{I_t}{K_t}+(1-\delta) \tag{78}$$

Along a balanced growth path the LHS of equation (78) must be constant. Since δ is a constant parameter, it follows that $\frac{I_t}{K_t}$ must also be constant. For $\frac{I_t}{K_t}$ to be constant, I_t and K_t must grow at the same rate.

Now we return to the resource constraint of the economy and do some algebra:

$$Y_t=C_t+I_t\Rightarrow\frac{Y_{t+1}}{Y_t}=\frac{C_{t+1}}{Y_t}+\frac{I_{t+1}}{Y_t}$$

$$\Rightarrow\frac{Y_{t+1}}{Y_t}=\frac{C_{t+1}}{C_t}\frac{C_t}{Y_t}+\frac{I_{t+1}}{I_t}\frac{I_t}{Y_t} \tag{79}$$

If g_{Y_t}, g_{C_t} and g_{I_t} denote the gross growth rates of Y_t, C_t, and I_t respectively, and S_{C_t}, S_{I_t}, the sharer of C_t, I_t over Y_t, equation (79) can be written:

$$g_{Y_t}=g_{C_t}S_{C_t}+g_{I_t}S_{I_t} \tag{80}$$

Since $S_{C_t}+S_{I_t}=1$ we obtain:

$$g_{Y_t}=g_{C_t}S_{C_t}+g_{I_t}\left(1-S_{C_t}\right)\Rightarrow\left(g_{Y_t}-g_{I_t}\right)=\left(g_{C_t}-g_{I_t}\right)S_{C_t}$$

$$\Rightarrow\frac{\left(g_{Y_t}-g_{I_t}\right)}{\left(g_{C_t}-g_{I_t}\right)}=S_{C_t} \tag{81}$$

Along a balanced growth path g_{Y_t}, g_{C_t} and g_{I_t} are all constant (g_Y, g_C, g_I). Therefore since the LHS of equation (81) is constant the same must hold for the RHS. Consequently $\frac{C_t}{Y_t}$ is also constant. Therefore C_t and Y_t must grow at the same constant gross growth rate, $g_C=g_Y$. Hence equation (81) along the balanced growth path becomes:

$$\frac{\left(g_Y-g_I\right)}{\left(g_Y-g_I\right)}=S_{C_t}$$

$$\Rightarrow\left(g_Y-g_I\right)=S_{C_t}\left(g_Y-g_I\right) \tag{82}$$

Equation (82) can only hold in two cases. First, when $g_Y-g_I=0\Rightarrow g_Y=g_I$, and second when $S_{C_t}=1$, that is $S_{C_t}=1\Rightarrow\frac{C_t}{Y_t}=1\Rightarrow C_t=Y_t\Rightarrow I_t=0$. The latter case is not interesting since it does not imply an interior solution for investment. As a result equation (83) implies $g_C=g_Y=g_I$. From equation (78) it also follows $g_C=g_Y=g_I=g_K$.

Now we return to the time constraint of our economy and divide both sides with N_t:

$$\overline{h}N_t=H_t+L_t\Rightarrow\overline{h}=\frac{H_t}{N_t}+\frac{L_t}{N_t} \tag{83}$$

Since $H_t,L_t,N_t,\overline{h}>0$ then:

$$\overline{h}-\frac{H_t}{N_t}=\frac{L_t}{N_t}>0\Rightarrow\overline{h}>\frac{H_t}{N_t}>0$$

$$\overline{h}-\frac{L_t}{N_t}=\frac{H_t}{N_t}>0\Rightarrow\overline{h}>\frac{L_t}{N_t}>0$$

Hence along a balanced growth path the only feasible growth rate for $\frac{H_t}{N_t}$ and $\frac{L_t}{N_t}$ is:

$$\frac{\frac{H_{t+1}}{N_{t+1}}}{\frac{H_t}{Nt}}=\frac{\frac{L_{t+1}}{N_{t+1}}}{\frac{L_t}{Nt}}=1\Rightarrow\frac{H_{t+1}}{H_t}=\frac{L_{t+1}}{L_t}=\frac{N_{t+1}}{N_{t+1}} \tag{84}$$

Thus, $g_H=g_L=n$, where g_H and g_L are the gross growth rates of leisure and labour hours respectively.

[27] This technical exposition for the feasibility of the balanced growth path comes form King et al. (2002).

To summarize, along a balanced growth path $g_C = g_Y = g_I = g_K$ and $n = g_H = g_L$. Now, if we write the production function in two subsequent periods, that is t and $t+1$, and take the ratio we get the following result:

$$\frac{Y_{t+1}}{Y_t} = \frac{A_{t+1}}{A_t} \left(\frac{K_{t+1}}{K_t}\right)^{\alpha} \left(\frac{L_{t+1}}{L_t}\right)^{1-\alpha} \tag{85}$$

Note also that the gross growth rate of real per capita GDP g_y is $\frac{\frac{Y_{t+1}}{N_{t+1}}}{\frac{Y_t}{Nt}} = \frac{\frac{Y_{t+1}}{Y_t}}{\frac{N_{t+1}}{Nt}} = \frac{g_Y}{n}$. Then along a balanced growth path:

$$g_Y = (g^{1-\alpha})\,(g_K)^{\alpha}\,(n)^{1-\alpha} \Rightarrow g_Y = \left(g^{1-\alpha}\right)(g_Y)^{\alpha}\,(n)^{1-\alpha}$$

$$(g_Y)^{1-\alpha} = (g^{1-\alpha})\,(n)^{1-\alpha} \Rightarrow (\frac{g_Y}{n})^{1-\alpha} = (g^{1-\alpha})$$

$$\Rightarrow g_y = g \tag{86}$$

Appendix 3.

In this appendix we present for illustrative purposes our finite dimension system in the cases of two and three time periods $[T_0,\ T_0+1]$, $[T_0,\ T_0+1,\ T_0+2]$ respectively. This is helpful in sketching the solution algorithm.

For the two period case our system has the following form:

$$(1-a)A_{T_0}K_{T_0}^{a}L_{T_0}^{-a}\left(\overline{h}N_{T_0}-L_{T_0}\right)=\left(\frac{(1-\gamma)}{\gamma}\right)\left(A_{T_0}K_{T_0}^{a}L_{T_0}^{1-a}-K_{T_0+1}+(1-\delta)\,K_{T_0}\right) \tag{87}$$

$$(1-a)A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{-a}\left(\overline{h}N_{T_0+1}-L_{T_0+1}\right)=\left(\frac{(1-\gamma)}{\gamma}\right)\left(A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{1-a}-K_{T_0+2}+(1-\delta)\,K_{T_0+1}\right) \tag{88}$$

$$\frac{A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{1-a}-K_{T_0+2}+(1-\delta)\,K_{T_0+1}}{A_{T_0}K_{T_0}^{a}L_{T_0}^{1-a}-K_{T_0+1}+(1-\delta)\,K_{T_0}}=\beta\left(1-\delta+aA_{T_0+1}K_{T_0+1}^{a-1}L_{T_0+1}^{1-a}\right) \tag{89}$$

$$K_{T_0+2}=(g)(n)(K_{T_0+1}) \tag{90}$$

This a system of four equations in 4 unknowns, that is L_{T_0}, K_{T_0+1}, L_{T_0+1}, and K_{T_0+2}.

For the three period case our system has the following form:

$$(1-a)A_{T_0}K_{T_0}^{a}L_{T_0}^{-a}\left(\overline{h}N_{T_0}-L_{T_0}\right)=\left(\frac{(1-\gamma)}{\gamma}\right)\left(A_{T_0}K_{T_0}^{a}L_{T_0}^{1-a}-K_{T_0+1}+(1-\delta)\,K_{T_0}\right) \tag{91}$$

$$(1-a)A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{-a}\left(\overline{h}N_{T_0+1}-L_{T_0+1}\right)=\left(\frac{(1-\gamma)}{\gamma}\right)\left(A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{1-a}-K_{T_0+2}+(1-\delta)\,K_{T_0+1}\right) \tag{92}$$

$$\frac{A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{1-a}-K_{T_0+2}+(1-\delta)\,K_{T_0+1}}{A_{T_0}K_{T_0}^{a}L_{T_0}^{1-a}-K_{T_0+1}+(1-\delta)\,K_{T_0}}=\beta\left(1-\delta+aA_{T_0+1}K_{T_0+1}^{a-1}L_{T_0+1}^{1-a}\right) \tag{93}$$

$$(1-a)A_{T_0+2}K_{T_0+2}^{a}L_{T_0+2}^{-a}\left(\overline{h}N_{T_0+2}-L_{T_0+2}\right)=\left(\frac{(1-\gamma)}{\gamma}\right)\left(A_{T_0+2}K_{T_0+2}^{a}L_{T_0+2}^{1-a}-K_{T_0+3}+(1-\delta)\,K_{T_0+2}\right) \tag{94}$$

$$\frac{A_{T_0+2}K_{T_0+2}^{a}L_{T_0+2}^{1-a}-K_{T_0+3}+(1-\delta)\,K_{T_0+2}}{A_{T_0+1}K_{T_0+1}^{a}L_{T_0+1}^{1-a}-K_{T_0+2}+(1-\delta)\,K_{T_0+1}}=\beta\left(1-\delta+aA_{T_0+2}K_{T_0+2}^{a-1}L_{T_0+2}^{1-a}\right) \tag{95}$$

$$K_{T_0+3}=(g)(n)(K_{T_0+2}) \tag{96}$$

This a system of four equations in 4 unknowns, that is L_{T_0}, K_{T_0+1}, L_{T_0+1}, K_{T_0+2}, L_{T_0+2}, K_{T_0+3}.

By induction it is obvious that whenever we increase the periods of our dynamic system by one, then two additional equation are added in our system. Therefore when $t=T_0,T_0+1,...,T_1$ we end up with a system of $2\,(T_1-T_0+1)$ equations in $2\,(T_1-T_0+1)$ unknowns. In our case, $T_0=1970$, $T_1=2039$ and the number of periods over which we solve our model is 70 $(2039-1970+1)$. Hence we must solve a system of 140 equation in 140 uknowns, namely that is: $\{L_t\}_{t=T_0}^{t=T_1}$ and $\{K_t\}_{t=T_0+1}^{t=T_1+1}$.

Appendix 4.

Details on the sources of the data and the construction of Figures and Tables are provided below. All data have been extracted from two sources, OECD and Groningen Growth Development Center Databases:

a) OECD (2010), "Aggregate National Accounts: Gross domestic product", OECD National Accounts Statistics (database), b) OECD (2010), "Aggregate National Accounts: Disposable income and net lending/borrowing", OECD National Accounts Statistics (database), c) OECD (2010), "Revenue Statistics: Greece", OECD Tax Statistics (database), d) OECD (2010), "Labour Force Statistics: Population and labour force", OECD Employment and Labour Market Statistics (database), e) OECD (2010), "Aggregate National Accounts: Population and employment by main activity", OECD National Accounts Statistics (database), f) OECD (2012), "OECD Economic Outlook No. 91", OECD Economic Outlook: Statistics and Projections (database), g) OECD (2011), "OECD Economic Outlook No. 90", OECD Economic Outlook: Statistics and Projections (database), h) OECD (2010), "OECD Economic Outlook No. 88", OECD Economic Outlook: Statistics and Projections (database), i) The Conference Board Total Economy Database (January 2012), "Output, Labour, and Labour Productivity, Country Details 1950-2011", j) The Conference Board Total Economy Database (January 2012), "Growth Accounting and Total Factor Productivity, Country Details 1950-2011".

Table 8.

Data For Greece : Description — Last Update: 22/6/2012

Code	Variable	Unit	Time Period	Source
GR.1	Gross Domestic Product	Millions of euros	1960-2011	a)
GR.2	Gross Domestic Product	Millions of 2005 euros	1960-2013	a), f)[28]
GR.3	Final Consumption Expenditure	Millions of 2005 euros	1960-2011	a)
GR.4	Gross Capital Formation	Millions of euros	1960-2011	a)
GR.5	Gross Capital Formation	Millions of 2005 euros	1960-2011	a)
GR.6	Gross Fixed Capital Formation	Millions of euros	1960-2011	a)
GR.7	Gross Fixed Capital Formation	Millions of 2005 euros	1960-2011	a)
GR.8	Consumption of Fixed Capital	Millions of euros	1960-2011	b)
GR.9	Taxes Less Subsidies on Production and Imports	Millions of euros	1970-2011	a)
GR.10	Employer's Contributions to Social Security	Millions of euros	1965-2009	c)
GR.11	Compensation of Employees	Millions of euros	1970-2011	a)
GR.12	Total Employment	Thousands of Persons	1961-2011	f), h)[29]
GR.13	Total Dependent Employment	Thousands of Persons	1961-2011	f), h)[30]
GR.14	Hours Worked per Employee	Hours	1960-2010	f)
GR.15	Total Employment	Thousands of Persons	1995-2011	e)
GR. 16	Total Employment	Thousands of Hours	1995-2011	e)
GR. 17	Total Annual Hours Worked	Thousands of Hours	1960-2011	i)
GR. 18	Labor Compensation Share	Percentage %	1990-2011	j)
GR.19	Working Age Population	Thousands of Persons	1960-2013	g), h)[31]

Using the the variables from Table 8 we construct the following time series and parameters:

Table 9.

Data for Greece: Construction of Time Series and Parameters

GRC.1=I_t	$I_t = GR.6 * \left(\frac{GR.2}{GR.1}\right)$, where $Y_t = GR.2$ is real GDP and $Y_t^n = GR.1$ is nominal GDP.
GRC.2=C_t	$C_t = GR.2 - GRC.1$.
GRC.3=L_t	$L_t = (GR.14 * GR.12)$, since for the variable $GR.14$ we have data only for the period 1970-2010 for the year 2011 we extrapolate forward by one year using the growth rate of the variable $\frac{GR.16}{GR.15}$ and for the years 1960-1969, we extrapolate L_t backwards using the growth rate of the variable $GR.17$.
GRC.4=K_t	For the construction of real capital stock K_t we use $\frac{\delta K_t}{Y_t} = \frac{GR.6}{GR.1}$ as consumption of fixed capital over GDP, $GRC.1 = I_t$ as real investment and the formula $K_{t+1} = I_t + (1-\delta) * K_t$.
GRC.5=α	To compute the labour share parameter we use $TCE^{DE} = GR.11$, $TCE^{SE} = \left(\frac{(GR.11 - GR.10)}{GR.13}\right) * (GR.12 - GR.13)$, $Y_t = GR.1$, $NIT = GR.9$.
GRC.6=A_t	For the construction of TFP series we use series for $K_t = GRC.4$, $L_t = GRC.3$, $\alpha = GRC.5$, and $Y_t = GR.2$ and the formula $A_t = \left(\frac{Y_t}{K_t^{\alpha} L_t^{1-\alpha}}\right)$.

The description of the variables at the Tables has as follows:

Table 10. Data for Greece: Tables	
Table 1.	We take averages of natural logarithm differences. The variable g_y is the natural logarithm difference of $\frac{GR.2}{GR.19}$, the variable g_c is the natural logarithm difference of $\frac{\left(GR.3*\left(\frac{GR.2}{GR.1}\right)\right)}{GR.19}$. and the variable g_i is the natural logarithm difference of $\frac{\left(GR.6*\left(\frac{GR.2}{GR.1}\right)\right)}{GR.19}$.
Table 2.	We compute the detrending values of the variables in Table 1 using the formula $\widetilde{x}_t = \left(\frac{x_t}{(g^{t-T_0}x_{T_0})}\right) * 100$.
Table 3.	We take averages of natural logarithm differences. Where $\frac{Y_t}{N_t} = \frac{GR.2}{GR.19}$, $A_t = \left(\frac{GR.2}{GRC.4^{\alpha}*GRC.3^{1-\alpha}}\right)$, $\frac{K_t}{Y_t} = \frac{GRC.4}{GR.2}$, $\frac{L_t}{N_t} = \frac{GRC.3}{GR.19}$, and $\alpha = GRC.5$.
Table 4.	We take averages. Where $\gamma = \frac{GRC.2*GRC.3}{\left[GR.2*\left(\overline{h}*GR.19-GRC.3\right)*(1-GRC.5)+GRC.2*GRC.3\right]}$ and $\beta = \frac{GRC.2_{t+1}}{\left[GRC.2_t*\left(1-\delta+GRC.5*\left(\frac{GRC.4_{t+1}}{GR.2_{t+1}}\right)\right)\right]}$.

The description of the variables in the Figures has as follows:

Table 11. Data for Greece: Figures	
Figure 1.	a) The line is $\ln\left(\frac{Y_t}{N_t}\right) = \ln\left(\frac{GR.2}{GR.19}\right)$. b) The line is annual differences of $\ln\left(\frac{Y_t}{N_t}\right) = \ln\left(\frac{GR.2}{GR.19}\right)$.
Figure 2.	a) and b) The line is $\left(\frac{Y_t}{N_t}\right) = \left(\frac{GR.2}{GR.19}\right)$ detrended by 2%, the dashed line presents a 2% trend growth path.
Figure 3.	The line is self employment over total employment, $\left(\frac{GR.12-GR.13}{GR.12}\right)$.
Figure 4.	Real per capita GDP is $\left(\frac{Y_t}{N_t}\right) = \left(\frac{GR.2}{GR.19}\right)$, the TFP factor is $A_t^{1-\alpha} = \left(\frac{Y_t}{K_t^{\alpha}L_t^{1-\alpha}}\right)^{1-\alpha} = (GRC.6)^{1-\alpha}$, $L_t = GRC.3$, $K_t = GRC.4$, and $\alpha = GRC.5$.
Figures 5., 6., 7., and 8.	a) The solid line is $\left(\frac{Y_t}{N_t}\right) = \left(\frac{GR.2}{GR.19}\right)$ detrended by 2%, the dashed lines are analogues from model's solutions. b) The solid line is $\left(A_t^{1-\alpha}\right) = (GRC.6)^{1-\alpha}$ detrended by 2%. c) The solid line is $\left(\frac{K_t}{Y_t}\right) = \left(\frac{GRC.4}{GR.2}\right)$, the dashed lines are analogues from model's solutions. d) The solid line is $\left(\frac{L_t}{N_t}\right) = \left(\frac{GRC.3}{GR.19}\right)$, the dashed lines are analogues from model's solutions.
Figure 9.	a) The lines are $\left(\frac{Y_t}{N_t}\right) = \left(\frac{GR.2}{GR.19}\right)$ detrended by 2%, for Argentina and USA data were obtained from Kehoe (2003). b) The solid line is $\ln\left(\frac{Y_t}{N_t}\right) = \ln\left(\frac{GR.2}{GR.19}\right)$, the dashed line presents a 2% trend growth path.
Figure 10.	The same as in Figures 5 to 8.