

Greece in recession: Economic predictions, mispredictions, forecast suggestions and policy recommendations †

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Abstract

This article documents the sizable forecast errors that have been made in relation to the economic recession in Greece by major policy-shaping international organizations, as well as Greek research centres and the Greek government. All were very optimistic with disastrous policy implications as the success of the country's bailout loans was based on assumptions resting on some of these forecasts. The authors look into the predictions made at the beginning of 2013 for each GDP component and estimate what might happen under the worst, best and medium case scenario predictions regarding each component. They also analyse the available macroeconomic figures using both the autoregressive integrated moving average model and traditional macroeconomic models and find that any prediction regarding the Greek GDP contraction rate can lie in the 2.9-7.2% range, which illustrates the high degree of uncertainty surrounding the predictions. To address the recession and help the economy return to growth, a number of policy recommendations are made. To ameliorate the technical forecast problem, a range of methodological improvements is needed.

Keywords: recession, forecast errors, GDP, Greece.

1. Introduction

Caught in the tide of the recent international economic crisis while having surrendered monetary policy sovereignty for the operation of the euro-zone, and unable because of the high level of public debt to engage in prolonged fiscal expansion in order to sustain the gross domestic product

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(GDP), in May of 2010 Greece accepted bailout loans from other euro-zone countries and the International Monetary Fund (IMF). In exchange, the government pledged to adopt austerity measures to bring the state deficit under control and to carry out reforms closely monitored and evaluated by the European Commission (EC), the European Central Bank (ECB) and the IMF. As a result, the mild contractions in real GDP in 2009 and 2010 (3.1% and 4.9%, respectively) were succeeded by more severe contractions in 2011 and 2012 (7.1% and 6.4%, respectively).¹ This represents a cumulative fall of 19.9% in five years according to the figures published by the Hellenic Statistical Authority (ELSTAT).

It is generally assumed that the measures taken in 2011 and 2012 were to some or a considerable extent based on expert views and expectations regarding the economy's condition and performance. However, time and time again a good number of forecasts concerning how the economy would react or evolve turned out to be wide of the mark. In particular, the early estimates published since October 2010 by the EC, the IMF, the Organization for Economic Co-operation and Development (OECD) and research centres in Greece, namely, the Centre for Planning and Economic Research (KEPE) and the Institute for Economic and Industrial Research (IOBE), as well as the Greek government, have been found to be overly optimistic. Understandably, while recognizing the challenges of estimating the level of economic activity in advance (especially when the progress of each and every factor involved is surrounded by uncertainty), such incidents cast doubt on the usefulness of the aforementioned reported predictions.

Clearly, the issue is by no means new or limited to early predictions (as opposed to predictions carried out later), nor it is specific to Greece (see e.g. Heilemann & Stekler, 2007; Loungani, 2001; Merola & Pérez, 2012; Öller & Barot, 2000). However, the repercussions may be crucial insofar as GDP mispredictions affect the accuracy of budgetary projections and other macroeconomic variables (Buettner & Kauder, 2010). In this context, Strauch et al (2004) suggest that both GDP growth and budgetary forecasts in the EU range from being too optimistic to overly cautious depending, respectively, on whether policy-makers are exercising discretion or abiding by rules. Jonung and Larch (2006), in linking the accuracy of potential GDP

¹ The second figure (regarding 2012) is an official, yet temporary, estimate. It was expected to be finalized in October 2013. However, the relevant ESTAT release has been postponed. In a similar fashion, the figure for the 2011 recession, which was estimated at approximately 6.9% in March 2012, was finalized at 7.1% when the updated data were released in December 2012.

growth forecasts to EU Stability and Growth Pact fiscal policies, find that forecasts in several member states (Germany, France and Italy) were consistently overoptimistic.

Apparently, the GDP forecasts in the EU were also optimistic from the outset of the recent international economic crisis. According to Alogoskoufis (2012), in the spring of 2008, the EC expected the Eurozone's growth rate to reach 1.7% by the end of the year and 1.5% in 2009, when in fact the Eurozone's economy slowed to 0.4% in 2008 and fell by 4.4% in 2009. By regressing the forecast error for real GDP growth on forecasts of fiscal consolidation for 23 EU member states and other European countries, Blanchard and Leigh (2013) maintain that forecasters underestimated fiscal multipliers. As a result, disappointments in growth were larger in economies that planned greater fiscal cutbacks. The IMF (2013b) goes further by adding that due to a number of idiosyncrasies and events, the private sector in Greece did not react as expected either and admits that the economy encountered a recession that was much deeper than expected. Pisani-Ferry et al (2013) spell out a good number of policy mistakes and inconsistencies in both Greece and the EU more widely. In addition, they point out that although it is not unusual for IMF programmes to disappoint in comparison to initial forecasts, the orders of magnitude are usually much smaller. Indeed, an output shortfall as large as that which occurred in Greece can only be found in 1% of IMF programmes. However, as we will show in the next section, the IMF was not the only expert body that got the recession forecast wrong.

A large number of techniques have been used to obtain short-term GDP forecasts in a range of countries worldwide. These include time series models, such as the autoregressive integrated moving average (ARIMA) model (e.g. Cushman, 2012; Kiariakidis & Kargas, 2013; Runstler & Sedillot, 2003) and vector autoregression (VAR) models (e.g. Cushman, 2012; Runstler & Sedillot, 2003), as well as models that employ larger sets of explanatory variables, such as factor models (e.g. Antipa et al, 2012; Schumacher, 2011; Van Nieuwenhuyze, 2005) and bridge models (e.g. Antipa et al, 2012; Barhoume et al, 2012; Runstler & Sedillot, 2003), and mixed data sampling techniques (e.g. Andreou et al, 2013; Ferrara & Marsilli, 2013) using financial data observed at higher frequencies to forecast GDP. With respect to Greece, Kiariakidis and Kargas (2013) used time series decomposition, ARIMA methodology and standard GDP regression techniques to obtain the 2012 GDP forecasts.

Most analysts tend to use multiple methodologies to produce GDP forecasts in order to crosscheck and validate the associated figures. With this in mind, we employ (a) a straightforward technique that produces GDP forecasts based on alternative scenarios regarding its components in a

deterministic manner, (b) time series ARIMA models and (c) a macroeconomic formulation that allows GDP forecasting based on different investments and unemployment scenarios. Our primary purpose is not to obtain a point estimate of GDP, but to quantify and elaborate on the uncertainty involved in GDP predictions, even if one adopts the scenarios suggested by the aforementioned organizations and entities.

The rest of the paper is organized as follows: Section 2 looks into the early predictions made concerning the recession in Greece in 2011, 2012 and 2013 by several international organizations (EC, IMF and OECD), the Greek government and Greek research centres prior to or at the beginning of each year. Sections 3 and 4 proceed to re-estimate the predictions pertaining to 2013, using the same information available at the beginning of the year (up to March) and employing different statistical and macroeconomic models. As the new forecasts are not particularly encouraging and yield a range of likely results, Sections 5 and 6 supply a number of proposals regarding the course of the country's economic policy and the improvement of technical forecasts. The final section (Section 7) provides the conclusions.

2. The issue of early predictions and mispredictions

Table 1 lists the predictions made in late 2010 and early 2011 by the EC, IMF, OECD, KEPE, IOBE, and the government concerning the evolution of basic macroeconomic variables in the course of 2011, and (in the last column) the corresponding final figures published by ELSTAT. It turns out that while the predictions regarding the fall in real GDP were in the range of 2.6–3.5%, the recession was much deeper: 7.1% (more than double the drop predicted). Looking into the factors behind the misprediction, we note that although the expected fall in private investments was between 7.0% and 16.6%, the contraction evidenced in the data was approximately 19.6%. Exports, which were expected to grow by 3.9–10.7%, barely moved (+0.3%). The unemployment rate, which was expected to be between 14.5% and 15.5%, rose to 17.7%. The domestic consumer price index (CPI) and its harmonized counterpart, projected by the Ministry of Finance and the IMF to increase by 2.2%, rose by 3.3% and 3.1%, respectively, instead. Labour costs dropped more than anticipated by the OECD and EC.²

² It is conceivable that some of these mispredictions were associated with lower inflation predictions. If that is so, then an argument may be made that the forecasters perhaps assumed more flexibility in product and labour markets than was the case in Greece at the time. It has been suggested that rigidities and delays in the introduction of structural reforms envisaged by the economic adjustment programme that aimed to improve the

Likewise, even though the early predictions made concerning the fall in real GDP in 2012 were in the range of 2.0–4.7%, the estimates provided by ELSTAT (2013b) suggest the recession was more severe: approximately 6.4% (see Table 2). Again, we note that while the expectations regarding private investments lay between -4.0 and -13.1%, the estimates provided by ELSTAT suggest that in fact private investments shrank considerably more, by approximately 19.2%. Imports, which were expected to fall by 2.8–5.7%, and exports, which were expected to rise by 3.2–6.5%, appear to have fallen by 13.8% and 2.4%, respectively. The unemployment rate, which was expected to reach 17.1–20.3% in the course of the last quarter of 2012 seems to have reached 26.4% (as per ELSTAT's seasonally adjusted monthly data), thus affecting an annual average of 24.4%. The domestic CPI and harmonized CPI were forecast at 0.6% and -0.5% by the Ministry and the EC, respectively, but the corresponding temporary outcomes for 2012 were 1.5% and 1.0% instead. Labour costs may have dropped less (more) than the EC (OECD) anticipated.

The early predictions made for 2013 prepared the public for a recession of 4.1–4.6% and came with expectation that private investments would fall by 3.3–9.5% and the unemployment rate would reach 22.8–27.3% (see Table 3). In some quarters, the figures fostered optimism that the recession would be mild – approximately 3.0% (Alpha Bank, 2013). On the other hand, KEPE expressed concern that the unemployment rate could climb to 30.1%. In our view, a rate in the region of or in excess of 28% is quite conceivable bearing in mind the rate's continuous rise over the last couple of years. The Bank of Greece (2013a: 21, 80) appears to share this view.

This begs the question of what would happen if the unfavourable estimates for each GDP component materialize in the course of 2013. That is, if private consumption were to fall by 8.7% (as conjectured by IOBE), if public consumption were to fall by 7.2% (as estimated by the Greek Ministry of Finance), and if private investment were to fall by 9.5% (as estimated by the OECD), etc. In this case, the answer is both mathematical and straightforward: the GDP expression which sums the demands of the different sectors of the economy serves as the point of departure.

economy's competitiveness prevented the materialization of the predictions. On the other hand, the achievement of labour cost reductions larger than those anticipated by the OECD and the EC may undercut certain aspects of the argument.

TABLE 1

*Predictions of basic macroeconomic figures
made before or at the beginning of 2011 and final 2011 outcomes*

Source	Ministry of Finance	EC	IMF	OECD	KEPE	IOBE	Results
Publication date	Oct. 2010	Jan. 2011	Oct. 2010	Dec. 2010	Jan. 2011	Mar. 2011	ELSTAT
GDP (% change, constant prices)	-2.6	-3.5	-2.6	-2.7	-3.5	-3.2	-7.1
Private consumption (% change, constant prices)	-4.5	-6.4	:	-4.3	:	>-4.5	-7.7
Public consumption (% change, constant prices)	-8.0	-2.6	:	-6.9	:	:	-5.2
Investments (% change, constant prices)	-7.0	-	:	-10.6	:	:	-19.6
Exports of goods and services (% change, constant prices)	6.1	10.7	:	3.9	:	:	0.3
Imports of goods and services (% change, constant prices)	-6.6	-8.4	:	-10.0	:	:	-7.3
Domestic consumer price index (% change)	2.2	:	:	:	:	3.0	3.3
Harmonized consumer price index (% change)	:	2.4	2.2	2.5	:	:	3.1
GDP deflator (% change)	1.3	0.3	1.3	2.4	:	:	1.0
Employment (% change)	-3.0*	-2.6	-3.2	-2.4	:	:	-6.8
Unemployment rate (yearly average)	14.5*	15.2	14.6	14.5	:	15.5	17.7
Unit labor cost (across the economy)	:	-0.1	:	-0.2	:	:	-1.8
General government budget balance (% GDP)	-7.0	-9.5	-7.3	-7.6	:	:	-9.4
General government gross debt (% GDP)	142.2	157.7	139.3	133.5	:	:	170.6
Current account balance (% GDP)	:	-8.3	-7.7	-7.5	:	:	-9.9
GDP (million euro, current prices)	232,100	:	232,942	231,532	:	:	208,531

*Note:** The employment predictions are supplied in the government budget and are expressed in terms of national accounts figures.

Sources: EC (2011), ELSTAT (2013a), IMF (2010), IOBE (2011a), KEPE (2011), Ministry of Finance (2010), OECD (2010).

TABLE 2
*Predictions of basic macroeconomic figures
made before or at the beginning of 2012 and final 2012 outcomes*

Source	Ministry	EC	IMF	OECD	KEPE	IOBE	Results (some tem- porary, some final)
	of Finance	Jan.	Sep.	Dec.	Jan.	Dec.	
Publication date	Nov. 2011	2012	2011	2011	2012	2011	
GDP (% change, constant prices)	-2.8	-4.7	-2.0	-3.0	-3.4	-3.0	-6.4 ^a
Private consumption (% change, constant prices)	-4.1	-5.7	:	-5.2	:	-6.5	-9.1 ^a
Public consumption (% change, constant prices)	-7.5	-11.0	:	-6.6	:	:	-4.2 ^a
Investments (% change, constant prices)	-4.0	-6.6	-13.1	-5.5	:	:	-19.2 ^a
Exports of goods and services (% change, constant prices)	6.4	3.2	:	6.5	:	:	-2.4 ^a
Imports of goods and services (% change, constant prices)	-2.8	-5.1	:	-5.7	:	:	-13.8 ^a
Domestic consumer price index (% change)	0.6	:	:	:	:	1.2 to 1.4	1.5 ^b
Harmonized consumer price index (% change)	:	-0.5	1.0	1.1	2.1	:	1.0 ^b
GDP deflator (% change)	0.4	-0.7	0.3	1.6	:	:	-0.8 ^a
Employment (% change)	-2.0*	-4.8	-2.6	-2.6	:	:	-8.0 ^b
Unemployment rate (yearly average)	17.1*	19.7	18.5	18.5	20.3	18.5	24.4 ^b
Unit labor cost (across the economy)	:	-8.1	:	-2.3	:	:	-6.2 ^a
General government budget balance (% GDP)	-5.4	-7.3	-6.9	-7.0	:	:	-6.6 ^c
General government gross debt (% GDP)	145.5	160.6	189.1	177.1	:	:	175.8 ^d
Current account balance (% GDP)	:	-7.8	-6.7	-6.3	-8.2	:	-2.9 ^e
GDP (million euro, current prices)	212,544	:	217,083	215,048	:	:	193,749 ^a

Notes: *The employment predictions are supplied in the government budget and are expressed in terms of national accounts figures. ^a Temporary data ELSTAT (2013b). ^b Final data ELSTAT (2013a). ^c Budget deficit according to Ministry of Finance (2012), GDP according to ELSTAT (2013b). ^d Gross debt according to Ministry of Finance (2012), GDP according to ELSTAT (2013b). ^e Current account according to Bank of Greece (2013b), GDP according to ELSTAT (2013b).

Sources: Bank of Greece (2013b), EC (2012a), ELSTAT (2013a,b), IMF (2011), IOBE (2011b), KEPE (2012), Ministry of Finance (2011, 2012), OECD (2011).

TABLE 3

*Predictions of basic macroeconomic figures
made before or at the beginning of 2013*

Source	Ministry of Finance	EC	IMF	OECD	KEPE	IOBE
Publication date	Nov. 2012	Jan. 2013	Jan. 2013	Dec. 2012	Feb. 2013	Jan. 2013
GDP (% change, constant prices)	-4.5	-4.4	-4.2	-4.5	-4.1	-4.6
Private consumption (% change, constant prices)	-7.0	-7.7	-6.9	-5.4	:	-8.7
Public consumption (% change, constant prices)	-7.2	-3.5	-7.2	-7.1	:	>-6.5
Investments (% change, constant prices)	-3.7	-4.9	-3.3	-9.5	:	-7 to -9
Exports of goods and services (% change, constant prices)	2.6	2.7	2.7	3.0	:	≥0
Imports of goods and services (% change, constant prices)	-5.2	-5.9	-6.2	-4.3	:	-10
Domestic consumer price index (% change)	-0.8	:	:	:	:	1
Harmonized consumer price index (% change)	:	-0.8	-0.8	-0.2	1.6	:
GDP deflator (% change)	-1.2	-1.2	-1.2	-0.5	:	:
Employment (% change)	-2.1*	-3.5	-3.9	-5.9	:	:
Unemployment rate (yearly average)	22.8*	27.0	26.6	26.7	30.1	27.3
Unit labor cost (across the economy)	:	-6.1	:	-7.2	:	:
General government budget balance (% GDP)	-5.2	-4.6	-4.5	-5.6	:	:
General government gross debt (% GDP)	189.1	175.6	178.0	188.6	:	:
Current account balance (% GDP)	:	-4.3	-1.2	-4.6	-0.7	:
GDP (million euro, current prices)	183,049	:	185,000	184,569	:	:

Note: * The employment predictions are supplied in the government budget and are expressed in terms of national accounts figures.

Sources: EC (2013), ELSTAT (2013a), IMF (2013a), IOBE (2013), KEPE (2013), Ministry of Finance (2012), OECD (2012).

In scientific notation this is as follows:

$$Y_t = C_t + I_t + G_t + X_t - Z_t + S_t, \quad (1)$$

where Y_t stands for GDP, C_t for private consumption, I_t for private investment, G_t for public consumption, X_t for exports, Z_t imports, and S_t for the stocks that reconcile the other figures in year t . The percentage change in GDP from year $t-1$ to year t is given by:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \left(\frac{C_{t-1}}{Y_{t-1}}\right) \frac{C_t - C_{t-1}}{C_{t-1}} + \left(\frac{I_{t-1}}{Y_{t-1}}\right) \frac{I_t - I_{t-1}}{I_{t-1}} + \left(\frac{G_{t-1}}{Y_{t-1}}\right) \frac{G_t - G_{t-1}}{G_{t-1}} + \left(\frac{X_{t-1}}{Y_{t-1}}\right) \frac{X_t - X_{t-1}}{X_{t-1}} - \left(\frac{Z_{t-1}}{Y_{t-1}}\right) \frac{Z_t - Z_{t-1}}{Z_{t-1}} + \left(\frac{S_{t-1}}{Y_{t-1}}\right) \frac{S_t - S_{t-1}}{S_{t-1}}$$

$$\Rightarrow \dot{Y} = w_1 \dot{C} + w_2 \dot{I} + w_3 \dot{G} + w_4 \dot{X} - w_5 \dot{Z} + w_6 \dot{S}, \quad (2)$$

with the dotted terms standing for the percentage changes in GDP and its expenditure components, and the w_i -terms standing for the relative weights of these components during the previous year. It is clear that $w_1 + w_2 + w_3 + w_4 - w_5 + w_6 = 1$. The relative weights, including those pertaining to 2012, can easily be calculated from the annual data published by ELSTAT (Table 4).

TABLE 4

Relative weights of the expenditure components in real GDP (%)

Year	Private consumption (w_1)	Public consumption (w_2)	Private investments (w_3)	Exports of goods and services (w_4)	Imports of goods and services (w_5)	Change in stocks (w_6)
2005	69.79	18.10	20.73	23.21	-32.50	0.67
2006	69.02	17.68	22.58	22.95	-34.22	1.99
2007	69.06	18.29	26.78	23.74	-37.85	-0.02
2008	72.16	17.85	22.99	24.19	-38.27	1.09
2009	73.33	19.33	20.48	20.12	-31.52	-1.73
2010	72.32	18.57	18.31	22.26	-31.12	-0.35
2011	71.84	18.96	15.84	24.05	-31.04	0.34
2012	69.78	19.40	13.67	25.06	-28.59	0.68

Note: Calculations based on quarterly data of the GDP and its expenditure components as published by ELSTAT (2013b) until the last quarter of 2012.

Thus, by replacing the 2013 predictions for \dot{C} , \dot{I} , etc., made by each national or international expert or the government, and by using the 2012 weights in equation (2), we are in a position to estimate alternative scenarios.

Indeed, we find that if the worst case predictions for the GDP components were to come about (Table 5), we ought to expect real GDP to contract by 5.9%; if the best case predictions occur, the recession should be around 2.9%.³

³ Through this procedure, we may also confirm the internal consistency of each expert's model or the government's model. That is, if the individual GDP components evolve in the manner expected by each expert or the government, then the GDP ought to lie in the level reported.

The range of potential outcomes underscores considerable uncertainty; the prediction of a modest fall in private investment (a critical GDP determinant) of about 9.5% in 2013 is perhaps optimistic compared to the average decline of 19.4% observed in the previous couple of years.

TABLE 5

Predictions of real GDP for 2013 based on the 2012 relative weights of its components (Table 4) and the different scenarios regarding the evolution of GDP's components (as per the predictions provided in Table 3). Juxtaposition to outcomes of the previous years

Basic macroeconomic figures	Scenarios (% change)			Results (% change)	
	Worst	Best	Middle	2011	2012
Real GDP estimate (\dot{Y})	-5.91	-2.92	-4.57	-7.10**	-6.38**
1. Private consumption (\dot{C})	-8.7	-5.4	-7.1	-7.7	-9.1
2. Public consumption (\dot{G})	-7.2	-3.5	-6.3	-5.2	-4.2
3. Investments (\dot{I})	-9.5	-3.3	-5.4	-19.6	-19.2
4. Exports of goods and services (\dot{X})	0.0	3.0	2.2	0.3	-2.4
5. Imports of goods and services (\dot{Z})	-10.0 *	-4.3	-6.3	-7.3	-13.8

Notes: * Although it is the worst scenario, we use the largest drop in imports (which in fact bolsters real GDP), since it is in accordance with the predicted decrease in private consumption and investments. If the smallest predicted decrease of imports is used (-4.3), then the resulting real GDP change is -7.5%.

** The estimated change of real GDP in 2011 and 2012 (based on equation (2) and the relative weights) is in accordance with the latest data published by ELSTAT (2013b).

3. Two predictive models of real GDP based on time series

In view of the above, we now attempt two purely technical forecasts concerning the evolution of real GDP in the course of 2013. Both are based on the quarterly data provided by ELSTAT (2013a, b) from the first quarter of 2000 (i.e. 2000 Q1) to the fourth quarter of 2012 (i.e. 2012 Q4). More specifically, we make use of ARIMA time series models to estimate and predict the GDP based solely on its history, without resorting to assumptions about its components or other economic variables. That is, the forecast is based only on the dynamics of the series and does not take into account other factors, such as future policy measures, broader developments, etc. Understandably, some degree of uncertainty has to be tolerated insofar as the models must predict four quarters ahead under the

limitation that the published data regarding 2012 have not yet been finalized.⁴

The first model uses quarterly GDP data from 2000 onwards and the second model quarterly GDP data from 2005 onwards.⁵ Yet, both provide similar forecasts (Table 6). According to the first model, the 2013 recession is estimated to be approximately 6.08%, with a possible range of $\pm 2.16\%$ (due to the increased uncertainty in the multiple periods ahead of forecasting); according to the second model, the recession is estimated to be approximately 6.18%, with a possible range of $\pm 1.72\%$. In our view, it is encouraging that both models yield GDP forecasts of -6.7% and -6.4%, respectively, for 2012, i.e. similar to the outcome of -6.4% announced by ELSTAT. Last but not least, both models display a high degree of fitness: $R^2 = 98.2\%$ (see Figure 1).

4. Predictions based on a typical macroeconomic model

Having approached the issue of real GDP growth through its past values, we now endeavour to estimate its evolution by turning to the factors which – by and large – determine real GDP, namely the variables that (a) enter the production function (and hence the aggregate supply) and (b) affect equilibrium in the goods and services market, the money market, and the country's financial integration with the rest of the world (and hence aggregate demand).

To that end, we outline a conventional, reduced form framework for an economy that is not in full employment (e.g. Ackley, 1961; Mankiw, 2003; Parkin, 1984), the expressions of which are also illustrated using graphs in Figure 2.

⁴ As already mentioned in footnote 1, a good indication of the direction of GDP in 2013 will be available when the revised 2012 national account figures are finalized and perhaps when data regarding the first quarter of 2013 are known. This said, if an early prediction is required on the basis of available data due to the urgent and pressing fiscal pressures experienced in Greece and/or the need to (re)design economic development and social cohesion policies, then, with due caution, it might be better if the prediction were carried out using more than one model.

⁵ Often the use of the most recent data provides a better forecast as it takes into account the most recent history of the series. On the other hand, estimated parameters are less robust due to the limited number of observations. In addition, there is a risk of higher standard errors in certain periods.

TABLE 6

Real GDP predictions based on time series models

	Model 1		Model 2	
Dependent variable: Quarterly GDP in constant prices (2005)				
Real GDP forecast 2013 in % change (standard error of forecast)	-6.08% (1.08%)		-6.18% (0.86%)	
Real GDP forecast 2012 in % change* (standard error of forecast)	-6.69% (1.09%)		-6.37% (0.86%)	
Sample period	2000 Q1 -2012 Q4		2005 Q1 -2012 Q4	
Explanatory variables:	Coefficient **	p-value	Coefficient **	p-value
Constant	38512.12	0.0000	42067.54	0.0000
Time trend	453.96	0.0000	333.39	0.0000
Dummy for 1 st quarter	-2876.24	0.0000	-3489.32	0.0000
Dummy for 2 nd quarter	114.31	0.7821	191.76	0.8076
Dummy for 3 rd quarter	2203.69	0.0000	2362.64	0.0027
Dummy for crisis period (2009 Q1 - 2012 Q4=1)	39947.12	0.0000	37326.29	0.0000
Dummy for crisis period x Trend	-1168.49	0.0000	-1064.50	0.0000
Moving average 1 period	0.293	0.0315	0.471	0.0087
Moving average 3 periods	:	:	-0.317	0.0149
Moving average 5 periods	-0.463	0.0001	:	:
Seasonal moving average 6 periods	-0.440	0.0059	-0.708	0.0013
<i>RMSE</i> 2011 Q1 - 2012 Q4 (out of sample) ***	0.0193		0.0227	
<i>R</i> ²	0.982		0.982	
<i>adj R</i> ²	0.978		0.975	
<i>F-stat p-value</i>	0.000		0.000	
<i>Durbin-Watson stat</i>	1.900		1.786	

*Notes:** The 2012 forecasts of the two models were re-estimated based on the observations until 2011 Q4, and out of sample forecasts were obtained for the period 2012 Q1 - 2012 Q4.

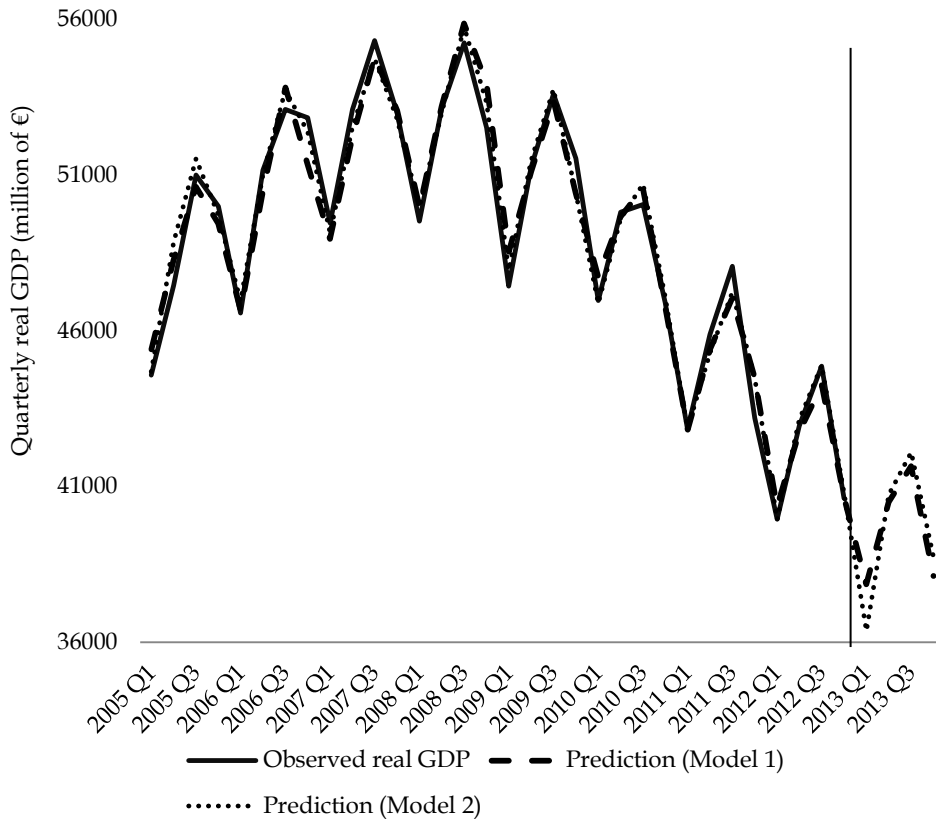
** White heteroskedasticity corrected coefficients.

*** The Root Mean Square Error is calculated based on the out of sample forecasts for the quarter-on-quarter growth of the period 2011 Q1 - 2012 Q4, after re-estimating the model using the observations until 2010 Q4 (to obtain out-of sample forecasts for 2011 Q1 - 2011 Q4) and 2011 Q4 (to obtain out-of sample forecasts for 2012 Q1 - 2012 Q4), respectively.

Sources: The analysis is based on the latest data released by ELSTAT (2013b). The explanatory variables considered include: trend, trend², trend³, dummies for each quarter, a dummy for the crisis period (taken also as a multiple of Trend, Trend², Trend³), moving average terms of one up to six periods, seasonal moving average terms of two up to six periods. Autoregressive terms were not used so as to be able to perform static forecasting several quarters ahead. Model selection was based on the predictive ability of the models (i.e. out of sample RMSE) and the correction for statistical significant autocorrelations and partial autocorrelations of several periods.

FIGURE 1

Observed quarterly GDP in constant prices (2005) and predictions on the basis of the two alternative time series models (2005 Q1 to 2013 Q4)



The equilibrium in the money market is given by:

$$r=f(M, Y, P, \text{constant terms}) \quad (3)$$

where r stands for the interest rate, M for the quantity of money, Y for the real GDP, P for the average price level.

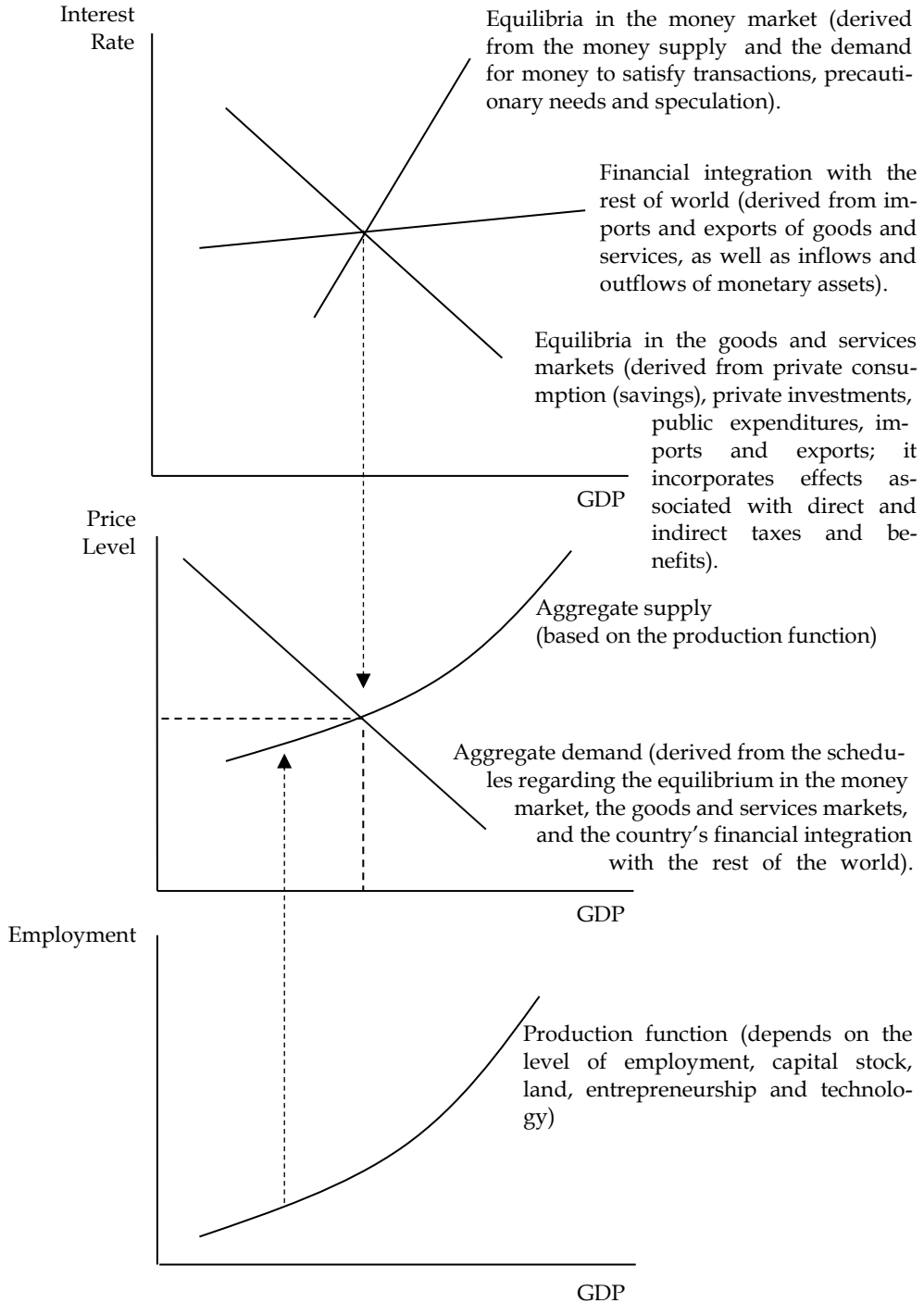
The equilibrium in the goods and services market is given by:

$$r=g(Y, G, B, I_1, Y^*, P, \text{constant terms}) \quad (4)$$

where G stands for public expenses, B for transfers, I_1 for private investments attributed to expectations over the future level of Y , Y^* for the income of foreign trading partners (in this context, the total GDP of OECD countries). Typically, indirect taxes are also included, but here these by and large replicate the time series of Y .

FIGURE 2

The economy in terms of graphs regarding the factors that determine the level of GDP



At the same time, financial integration with respect to the rest of the world is given by:

$$r=h(Y, Y^*, P, \text{constant terms}) \quad (5)$$

under flexible exchange rates. However, r is inflexible in the case of fixed exchange rates.

So, aggregate demand is derived on the basis of expressions (3)–(5):

$$P=j(Y, M, G, B, I_1, Y^*, \text{constant terms}) \quad (6)$$

In addition, aggregate supply is given by:

$$P=\omega(L, K, A, \text{constant terms}) \quad (7)$$

where L stands for the number of people employed in paid work activities, K for the capital stock, A for entrepreneurship and technology. The amount of land is taken as a constant.

Thus, based on equations (6) and (7), the real GDP level may be written as follows:

$$Y=y(M, G, B, I_1, Y^*, L, K, A, \text{constant terms}) \quad (8)$$

In order to estimate and predict the real GDP level empirically, we consider the time series of: (a) the annual 1960–2011 national accounts published by ELSTAT; (b) the monthly 1980–2012 monetary aggregates supplied by the Bank of Greece (2013b); (c) the annual 1988–2001 drachma to US dollar and 2002–2013 Euro to US dollar exchange rates; (d) the annual 1960–2012 five-year government bond yields supplied by Eurostat (2013). Then, after testing the interpretive ability of these regressors and taking into account the currency changeover, as well as weighing up the need to preserve degrees of freedom,⁶ we estimate the following variant of equation (8) for the period 1981–2011:

$$\text{Change in real GDP}_{1981-2011} = 0.027*\Delta L + 0.639*\Delta I_1, N=31, R^2=43.39\% \quad (9)$$

(3‰) (2‰)

with ΔL standing for the annual change in the number of actively employed people and ΔI_1 for the annual change in the value of private investments attributed to expectations concerning future income and

⁶ Understandably due to the paucity of observations (32–52 years), we do not use many explanatory variables. Among those considered is the technology–entrepreneurship (TFP) vector supplied in Figure 4.3. It is empirically estimated (as a residual) from the production function $Y = AL^{0.567}k^{0.942}$ recovered from the 1960–2011 data (k is the orthogonal variant (residual) of capital with respect to labor, L . $R^2=99.54\%$. The estimated output elasticities of labor and capital are statistically significant at the 1‰ level). A more detailed estimate of the technology–entrepreneurship variable across regions in Greece has been carried out by KEPE (2010).

demand (in euro billion at constant 2005 prices).⁷ The aforementioned regressors prevail over other available explanatory variables. The estimated coefficients, obtained via a robust variance estimator, are statistically significant. The probabilities of error (p-values) are supplied in parentheses below the estimates.

It is clear that it is important to verify the equation's predictive capacity for 2012. Indeed, for an employment (job market) contraction of approximately 371 thousand people and a private investment contraction of approximately €5.5 billion (as per the 2012 national account figures published by ELSTAT),⁸ according to expression (9), we should expect a fall in real GDP of approximately 6.6%. Indeed, according to the official statistics, in 2012 the contraction was approximately that (see Table 2).

Likewise, in order to engage in predictions for 2013, we incorporate the figures pertaining to 2012 and re-estimate the relationship. Thus:

$$\text{Change in real GDP}_{1981-2012} = 0.026*\Delta L + 0.666*\Delta I_1, N=32, R^2=50.91\% \quad (10)$$

(<1‰) (2‰)

Understandably, we would prefer a more extended model in order to take into account long-run effects rather than focusing on the short-run dynamics, which may over- or under-estimate the variables of interest. Yet, the findings are indicative and suggest the following:

- a) For an additional contraction in employment of approximately 250–300 thousand people (i.e. a contraction smaller than that observed in 2012),⁹ and a contraction in private investment of €4.7 billion (i.e. four fifths of that observed in 2012), *ceteris paribus*, real GDP is estimated to shrink by 5.6–6.4%,¹⁰ or more if the contraction in employment is larger (see Table 7). This would be consistent with (and by and large corroborates) the findings of the two technical predictions. On the other hand, if in the course of 2013, private investment falls as much as in the middle and

⁷ The size of I_1 is empirically estimated from the residuals of $I_{1960-2011} = 6.455 - 0.420*r + 0.198*Y$. $R^2=90.68\%$. The coefficients are statistically significant at the 1‰ level.

⁸ The €5.5 billion contraction in private investments corresponds to the 19.2% drop, which is supplied in the last column of Table 2.

⁹ If these people do not migrate or withdraw from the workforce, the unemployment rate will climb to 28–29%.

¹⁰ If we incorporate the figures associated with 2012, then the investment expression takes the form: $I = 6.329 - 0.377*r + 0.192*Y$. $R^2=87.15\%$. The estimated coefficients are statistically significant at the 1‰ level. Accordingly, I_1 is estimated from the residuals as follows: $I_1 = I - (6.329 - 0.377*r + 0.192*Y)$, hence $\Delta I_1 = \Delta I + 0.377*\Delta r - 0.192*\Delta Y$. As a result, the 2013 GDP prediction is calculated in conjunction with expression (10) and is as follows: $\Delta Y = 0.026*\Delta L + 0.666*\Delta I_1 = 0.026*\Delta L + 0.666*(\Delta I + 0.377*\Delta r - 0.192*\Delta Y) \rightarrow \Delta Y = (0.026*\Delta L + 0.666*\Delta I + 0.251*\Delta r)/(1.128)$. To estimate the change in real GDP, all one has to do is to substitute the values of ΔL , ΔI , Δr . (see Table 7.)

worst scenarios listed in Table 5, then the recession will be milder and real GDP may shrink by 4.4-5.5%.¹¹

- b) For an additional contraction in employment of 200 thousand people due to a sudden steep slowdown in the job-loss growth rate¹² and a contraction in private investment: (i) Of 4.7 billion euro (i.e., equal to average contraction observed in 2011 and 2012 or four fifths of the contraction observed in 2012) then real GDP may shrink by 4.9%. (ii) Similar to the one predicted in the middle or worse scenarios listed in Table 5, then real GDP may shrink by 3.6-4.0%.

TABLE 7

Forecasts of real GDP change during 2013 based on scenarios

A. If the private investments in Greece decrease by	B. If the number of employed persons (as measured in the national accounts) decreases by			
	200 thnd.	250 thnd.	300 thnd.	350 thnd.
1.2 billion euro in constant 2005-prices (or by 5.4% of the value of investments of 2012): middle scenario of Table 6	-3.6%	-4.4%	-5.1%	-5.9%
2.2 billion euro in constant 2005-prices (or by 9.5% of the value of investments of 2012): worst scenario of Table 6	-4.0%	-4.7%	-5.5%	-6.3%
4.7 billion euro in constant 2005-prices or by 19.4% of the value of investments of 2012 (i.e. the average contraction observed in the course of 2011 and 2012)	-4.9%	-5.6%	-6.4%	-7.2%

Note: No significant changes were observed for changes of the interest rate of magnitude $\pm 1.5\%$.

In this context, the simultaneous presence of a recession and relative price stability witnessed in the second half of 2012 (Ministry for Development and Competitiveness, 2013)¹³ ought to be attributed to leftward shifts of

¹¹ To provide a measure of comparison for the private investment figures involved, suffice it to say that the annual value of depreciation in the private sector is estimated to be €13-15 billion. This corresponds to a depreciation rate of 6% for a capital of €230-250 billion (in terms of 2005 prices).

¹² For instance, political unrest in Egypt might stimulate a greater than expected flow of visitors to Greece which, in turn, could result in an exceptionally good tourist season that might partially offset several job losses in other sectors of the economy.

¹³ This is on the basis of the consumer price index. We are aware of the deflator estimate supplied in Table 2.

the aggregate supply and aggregate demand schedules (see Figure 3).¹⁴ This suggests that initiatives to end the recession could be carried out on either front. We therefore turn our attention to the options available.

5. Policy options

First of all, we ought to take into account the fact that the current economic crisis is the longest and most severe the country has experienced in the last sixty years (see Figure 4.I). The closest historical parallel may be found in 1974, a year marked by political instability and regional tension as the Turkish invasion of Cyprus brought Greece to the brink of war with Turkey. However, the similarity is superficial. In economic terms, the current situation is clearly worse both in magnitude and length (five consecutive years, not counting 2013). Last but not least, whereas until recently it was possible to deal with negative growth rates by resorting to tried, tested and effective fiscal and monetary interventions, as mentioned in the Introduction, these basic policy instruments are no longer at the government's disposal. As a result, the options are limited, like:

- a) Encourage foreign demand for Greek products and services and attract investments in all sorts of projects (above or under the ground or water, relating to tangible or intangible assets). As already shown in Table 7, the smaller the contraction (or the greater the rise) in investments in 2013 compared to 2012, the smaller the recession. An improved economic climate in the Eurozone and/or worldwide may be helpful.¹⁵

¹⁴ For a decrease in the general price level of goods and services to occur in 2013 and 2014, the aggregate demand schedule would have to contract more than its aggregate supply counterpart.

¹⁵ Our econometric analyses of macroeconomic (national account) figures suggest that, *ceteris paribus*: an increase (decrease) in income of 1% in OECD countries will positively (negatively) affect Greek exports by 0.55%. A decrease (increase) of 1% in relative prices in Greece vis-à-vis OECD countries is expected to stimulate (reduce) the volume of tourism services from foreign countries by 0.87%. A decrease (increase) in the real effective exchange rate of 1% is expected to stimulate (reduce) Greek exports by 0.32%.

FIGURE 3

*The presentation in terms of graphs of
the empirical findings regarding the determination of the GDP*

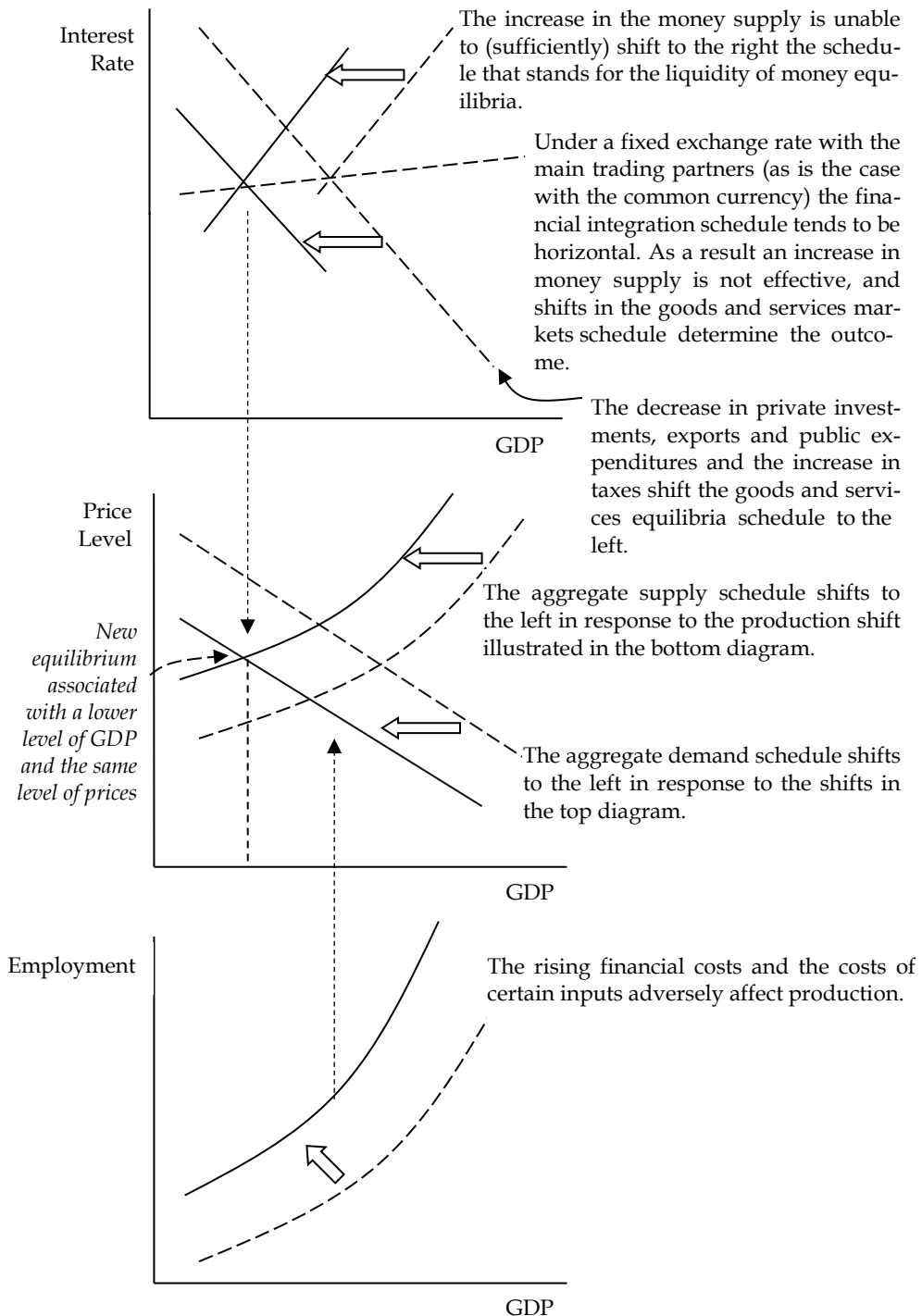
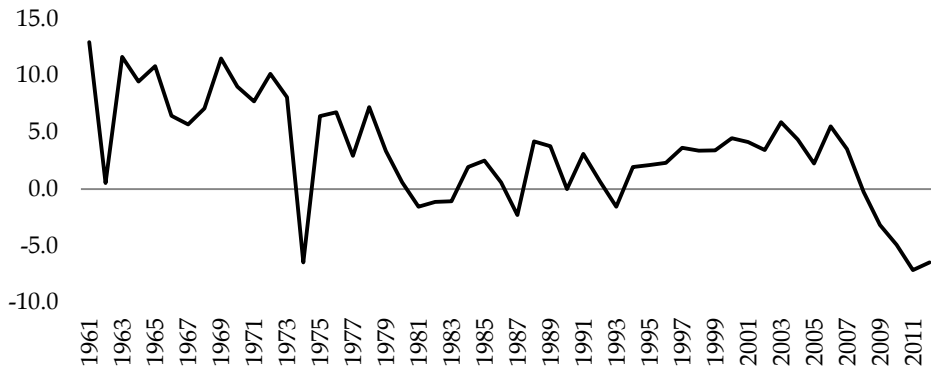


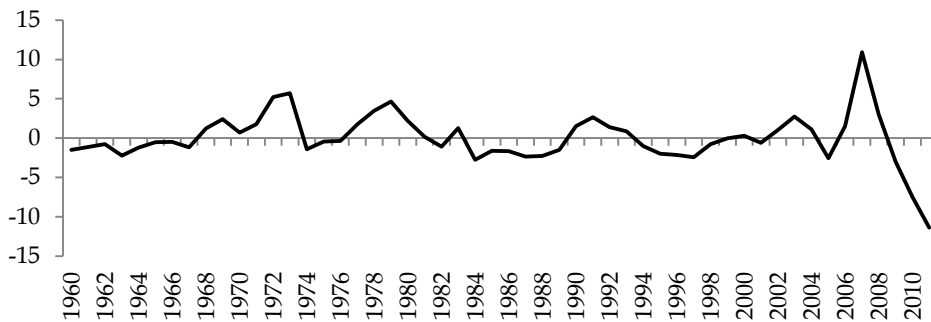
FIGURE 4

Evolution of real GDP and some rarely quantified figures (1960-2012)

I. Annual growth rate of the Greek economy (% change of GDP in terms of constant 2005-prices)

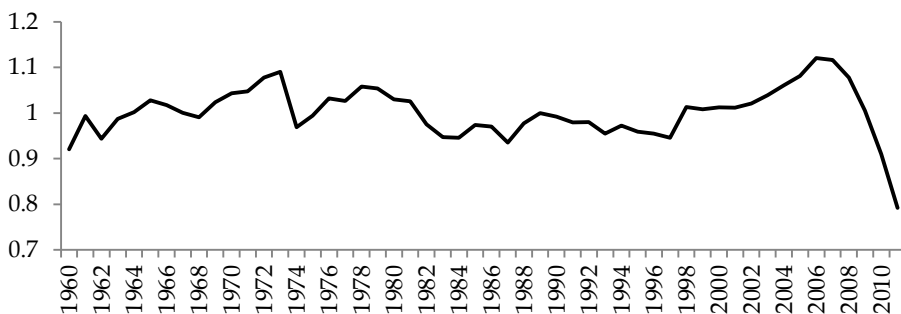


II. The size of investments associated with expectations over future income (on the demand side)



Note: Calculation details are given in footnote 7.

III. The size of entrepreneurship and technology (on the supply side)



Note: Calculation details are given in footnote 6.

Nonetheless, the effort should be made even if conditions abroad were to become unfavourable, or the creditability of other EU member states were to be downgraded, or confidence in the security of deposits in the Eurozone at large were to be undermined, etc.¹⁶ Unfortunately, the euphoria of 2007–2008 about the country's prospects has been succeeded by disappointment (see Figure 4.II). A succession of consistent signals from the authorities and the public building faith in doing business in Greece is needed for the psychology to change. It is hoped that the long-awaited resumption of work on the expansion and modernization of the transportation network, privatizations, and the achievement of a budget surplus are steps in that direction. Additionally, it should be noted that reforms which strengthen the function of institutions are conducive to an improvement in the business climate and attracting foreign investment.

- b) Increase the quantity and/or velocity of money to reduce the cost of borrowing and facilitate monetary transactions. Currently, despite the recapitalization of Greece's banking sector, the presence of very many nonperforming loans on the sector's balance sheets prevents banks from issuing new loans to small and medium-sized companies, while some of the country's largest companies are transferring a number of their operations overseas in order to raise new funds. At the same time, the state is procrastinating in making payments for (i) money owed to private sector suppliers and (ii) VAT returns to other businesses. Consequently, the economy is by and large asphyxiating due to the lack of capital. Somehow, stringent conditions set on banks and the state need to be loosened. As things stand, the only step aimed at increasing the velocity of money is the deregulation of Sunday shopping among small retailers.
- c) Deregulate markets and remove distortions in competition (in agriculture, trade, services, the labour market, etc.) so as to reduce prices, raise the level of output and enhance the competitiveness of the Greek economy.
- d) Promote the overall state of technology and entrepreneurship, both essential production inputs which currently seem to be at an all-time low (see Figure 4.II), and establish a friendlier business environment (see Vima, 2011).

¹⁶ For instance, the EC-ECB-IMF proposal in mid-March to seize a part of insured deposits in Cyprus (although eventually rejected by the Cypriot legislature), as well as a large proportion of deposits over €100,000, would be likely to prevent potential investors from engaging in businesses (for which such kinds of large bank accounts are needed) in other Eurozone countries in which the EC, the ECB and the IMF collectively have a say.

- e) Improve the effectiveness of the tax collection system as it may contribute to GDP growth (IMF, 2012).
- f) Absorb and utilize the funds earmarked for economic development by the EU via the Greek National Strategic Reference Framework (NSRF) in areas and sectors associated with significant multipliers. Unfortunately, several NSRF operational programmes lack a strategic focus; planning and implementation are often based on (i) broad regional averages with little or no consideration of intra-regional heterogeneity and spillovers, or (ii) subordinate criteria, which in turn weaken the overall effect on real GDP (Prodromidis, 2012; Prodromidis & Tsekeris, 2011). These flaws ought to be addressed.

All of the above have the potential to offset the contraction in employment so that the economy may expand once again.

6. Suggestions for improving forecasts

As the reader may have noticed, we have refrained from making a spot prediction, rather choosing to supply either a range of likely outcomes depending on different scenarios or the confidence interval.

It has been documented that it is quite difficult to predict key macroeconomic series such as GDP growth due to structural breaks owing to the great moderation and, subsequently, the recent international (financial) economic crisis (e.g. D'Agostino et al, 2007). Hence, the literature has tried to identify models and predictors that improve univariate benchmarks, such as the random walk and the autoregressive model. One important finding is that *autoregressive distributed lag (ADL)* models augmented by quarterly factors (FADL) can improve benchmark forecasts substantially (Giannone et al, 2005; Stock & Watson, 2003). These refer to common factors extracted from a panel of series, which include real variables (sectoral industrial production, employment and hours worked), nominal variables (consumer and producer price indices, wages, money aggregates), asset prices (stock prices and exchange rates), the yield curve and surveys. Perhaps Greek and other forecasts could be improved through such methods.

Another path is to consider forecast combinations. That is, to use evidence from all the models considered rather than relying on an individual one (e.g. Timmermann, 2006). Put differently, forecast combinations can help the forecaster to account for model uncertainty by pooling forecasts produced by different modelling approaches. Forecast combinations can address model instability and structural breaks under certain conditions

and simple strategies can produce more stable forecasts than is possible in an individual forecast. In this framework, Bayesian model determination techniques can be used to perform model averaging across different models and/or numerous predictors of GDP (i.e. leading indicators, macroeconomic news announcements, international growth determinants, stock data, etc.) that could be incorporated in the analysis (see Petralias & Dellaportas, 2013, for recent methods). Such methods may prove very useful in the case of Greek economic activity given the high degree of uncertainty associated with the individual forecasts.

Future attempts might also consider employing nowcasting methods that use the real-time flow of data releases. Nowcasting (a contraction of the words *now* and *forecasting*) addresses the real-time nature of macroeconomic releases directly; this nature is jagged or ragged-edged due to unevenly timed releases (see Giannone et al, 2008). In the same spirit, as argued by Andreou et al (2013), the use of timely financial information derived from regression models which allow for mixed frequencies (known as MIDAS regressions) may afford improvements in forecasts.

7. Conclusions and suggestions

The early estimates of a number of international organizations, the Greek government and the country's research institutes suggested that the economic recession in 2011 and 2012 would range between 2.6–3.5% and 2.0–4.7%, respectively, when in fact real GDP decreased by 7.1% in 2011 and 6.4% in 2012 (according to the provisional data of ELSTAT). Similar forecast errors are observed for individual GDP components. All forecasts were very optimistic with disastrous policy implications as the success of the country's bailout loans was based on assumptions resting on some of these forecasts. From this perspective, perhaps it is best if we treat the early 2013 projections with caution.

It is conceivable that the 2011 and 2012 mispredictions were associated with market rigidities and/or the delayed introduction of structural reforms suggested by the economic adjustment programme. If that is so and rigidities have now been removed and delays reduced, then the accuracy of predictions ought to improve. In addition, it is quite possible that the forecast techniques employed by the said organizations, research institutes and the government have been revised and refined.

Considering the results of the alternative models that we estimate based on different methodological approaches and temporal frequency, we are concerned that the early predictions of the actual GDP growth may contain

a high degree of uncertainty. Using the evidence available for the first quarter of 2013, we find that the economic recession may be in the range of 2.9–7.2%, possibly (a) 4.4–6.4% if employment contracts by 250–300 thousand people (i.e. comparable to the unemployment rate climbing to 28–29%), more if employment contracts further, and (b) 3.6–4.9% if employment contracts by approximately 200 thousand people.

Understandably, the predictions are based on the provisional data for 2012, which may also be revised in the near future. To this end, an analysis taking into account data from different periods, incorporating successive revisions made by ELSTAT, as well as those of the experts, would be of increased interest. However, given our findings, it is probably best to avoid any complacency and to keep on taking steps towards improving the variables which contribute to growth as if the likelihood of recession on the scale experienced last year has not gone dissipated. The situation is sensitive and stabilization has not yet occurred. As much as we hope for the best and that the measures taken by the policy-makers and the mobilization of society at large, or that unexpected developments (such as an exceptionally good tourist season), may halt the downward economic trend of recent years and even disprove the economic forecasts concerning contraction, it is important to have (prepare) alternative or additional plans to take the country in the direction of economic development and to ensure financial and social cohesion if the optimistic scenarios do not materialize.

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