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## Productivity developments of the Greek economy at the macro and sectoral levels

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### Abstract

*The improvement of productivity has a durable effect and determines the living standards in a country and the growth rate of its economy on a long-term horizon. This article focuses on the productivity developments and key determinants of the Greek economy, giving emphasis on the period following the outbreak of the crisis. First, it signifies the importance of productivity in relation to the growth strategy of the country. It then describes some stylized facts concerning the macroeconomic environment and changes in the productivity of the country, compared with other EU countries. The constituent factors of productivity are properly disentangled and major determinants are analyzed. In addition, productivity developments at the sectoral level are presented, giving emphasis on key sectors of the Greek economy and identifying those sectors with strong and weak productivity performance. The results highlight a significant decrease in productivity and a departure from the international production frontier during the crisis period as well as a considerable loss of competitiveness in almost all sectors. Finally, it provides insight into the sectors which possess the largest room for productivity enhancement and it suggests policies for improving productivity, such as growing the rate of diffusion of technology and innovation, and further harnessing human capital to promote industrial production.*

*JEL classification:* O47

*Keywords:* Productivity, efficiency, benchmarking, reforms, sectoral analysis.

### 1. Introduction

The improvement of productivity has a durable effect and determines the living standards in a country and the growth rate of its economy on a long-term horizon. During the five decades preceding the outbreak of the economic crisis, the continuous improvement of productivity, the expanding labor supply, significant investments in gross fixed capital formation and technological change and innovation led to a considerable increase of the total long-term supply in the Greek economy, allowing it to operate at a higher level of total demand, which, in turn, led to a significant increase of the actual income (Papaioannou et al., 2017). During the period 2008-2017, Greece had the worst economic performance among EU countries, with an average annual growth rate of -2.8%. In order to reverse this negative trend, expedite the recovery of the economy and create a sustainable development path, a new growth strategy and economic production model has been put forward.

As far as the organization of the article is concerned, Section 2 outlines the role of productivity in the framework of the strategic growth plan of the Greek government and provides a brief overview and some key indices for analyzing and measuring productivity. Section 3 provides some stylized facts about the macroeconomic environment and changes in the productivity of the country, compared with other EU countries, in order to understand productivity developments in the Greek economy. In addition, sectoral productivity developments are described in Section 4, giving emphasis on key sectors of the Greek economy and

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identifying those with strong and weak productivity performance. Section 5 summarizes and concludes, providing some policy suggestions.

## 2. The role of productivity in the current policy context

In the framework of the national growth strategy (Greek Government, 2018), the issue of productivity is of crucial importance. Particular emphasis is given to reform policies to tackle long-standing problems of low productivity levels and to increase productivity through

promoting knowledge, innovation and human capital, especially in dynamic sectors which can help improve the competitiveness of the Greek economy in globalized markets. The formulation of alternative scenarios for the labour productivity trends is also important in order to assess the impact of specific structural reforms in line with the strategic objectives of the national growth plan.

The efforts to surge productivity also include the implementation of a range of structural reforms at the sectoral level, especially upgrading the transport and logistics, energy and ICT infrastructure networks, and

**TABLE 1 Key indexes related to productivity and relevant data sources**

Index	Sources
Potential GDP	AMECO, OECD
Unit Labour Cost	Eurostat, OECD
Competitiveness	Bank of Greece, DHL, IMD, IMF, UNCTAD, WEF, World Bank
Export share of GDP and relevant share of high-tech, knowledge-intensive sectors	COMTRADE, Eurostat
Value chain forward-backward linkages	OECD
Economic complexity	MIT
Ratio of gross value added in international tradable goods and services	Eurostat
Ratio of gross value added in high-tech, knowledge-intensive sectors	Eurostat
FDI share of GDP	Bank of Greece
Gross fixed capital investment share of GDP	Hellenic Statistical Authority
Bank financing of enterprises	Bank of Greece
Digitization	Digital Scoreboard, European Digital Progress Report
R&D expenditure	Eurostat, National Documentation Centre, OECD
Innovation	European Innovation Scoreboard
Entrepreneurship	Global Entrepreneurship Development Institute
Human capital	Processing of data from European Digital Progress Report, Hellenic Statistical Authority
Brain drain	Processing of data from Hellenic Statistical Authority, National Documentation Centre
Unemployment of young and highly skilled persons	Processing of data from Hellenic Statistical Authority
Population aging	Processing of data from Hellenic Statistical Authority
Social and regional inequalities	Processing of data from Hellenic Statistical Authority

*Sources:* Literature review of various relevant studies and papers, such as Mas and Stehrer (2012), OECD (2001, 2017), Papaioannou et al. (2017), van Ark and Jäger (2017) and the Greek Government (2018).

enhancing entrepreneurship, export performance and investment influx. Emphasis is given to dynamic sectors which involve the production of larger value added and higher quality international tradable goods and services, so as their growth to pull the total economic activity (Tsekeris, 2017). Due to the significant heterogeneity pertaining to the Greek economy across sectors, the proposed policies aiming to enhance productivity should be selected, prioritized and coordinated according to the (income and employment) multiplier effects of various types of investment and fiscal measures (Athanasassiou et al., 2014; Mariolis and Soklis, 2015; Papaioannou, 2015).

Estimations about the productivity of the Greek economy, including the analyses of production factors and the sectors of economic activity, are carried out –on a regular basis– by the Hellenic Statistical Authority (ELSTAT), as well as other domestic and international organizations, as included in the database ONE of the OECD (OECD, 2001), the EU KLEMS (van Ark and Jäger, 2017), the IMF statistics, the EUROSTAT database and the Penn World Tables (Feenstra et al., 2015).

Table 1 above presents several key indicators associated with developments in the productivity of the national or regional economy. These key indexes are closely related to intrinsic characteristics of the production system of the country. They depict different aspects of the production capacity utilization, the quality of production factors, the demand structure, the potential of economic output, the outward-looking orientation, the technological level, the knowledge intensity, the financing conditions, the integration into global value chains, the entrepreneurship and the competitiveness of the whole economy.

Any productivity-enhancing policy proposal should recognize the peculiarities, prospects and comparative or competitive advantages of each sector and region of the Greek economy, giving particular emphasis to the innovation content, the knowledge intensity and the value added. In addition, the institutional framework and the financing conditions underlying the functioning of the product and labour markets should be taken into consideration, such as the degree of competition, the proportion of part-time employees and the level of wages, in order to help promote a sustainable and equitable growth and diminish social and regional inequalities. The quality of government institutions and policies at both the national and regional levels (e.g., see Charron et al., 2016) can have a significant impact on the efficacy of factors influencing the economic performance in the long run.

In the current context, the proposed indexes can offer measurable attributes regarding the effective imple-

mentation of the main objectives of the new growth model of Greece. Therefore, they could be used to establish a systematic methodology for measuring and interpreting productivity developments in Greece towards the strategic direction of a sustainable and inclusive growth.

### 3. Macroeconomic environment and productivity change

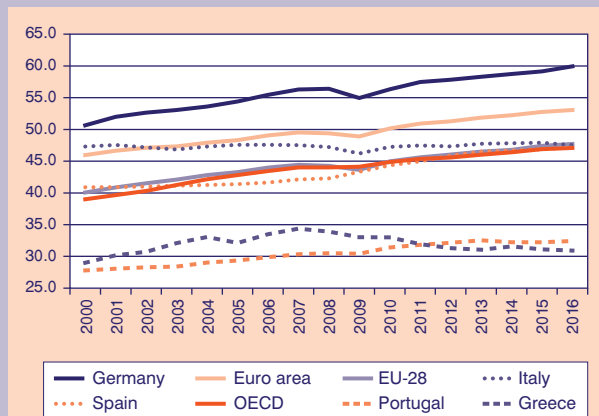
It is widely agreed that a fundamental problem of the Greek economy refers to its low productivity and the structural weaknesses of the domestic firms to directly compete with corresponding foreign firms. There are significant differences among the productivity level of Greece and the corresponding average level of the EU-28 countries, in particular, the Euro area countries (Figure 1). The resulting productivity gap –as a percent of the productivity level of Germany, which is the best performer among the set of countries considered here– has been expanded since the crisis outbreak (2008), even with respect to Italy and Spain, while the level of Greek productivity fell behind that of Portugal in 2010 (Figure 2).

In 2016, the level of productivity in Greece was approximately 65% of the average productivity level of the OECD and EU-28 countries and 58% of the Euro area countries, having reduced by almost 9% in the period 2008-2016 (Figure 3). However, it should be noted that this reduction is not significant on an annual basis, as the considerable fall of real GDP has also been followed by considerable decrease in employment.

Figure 4 illustrates the significant reduction of the GDP per capita as well as of labour utilization, which adversely affected labour productivity after the outbreak of the economic crisis. In the process of recovering and increasing the competitiveness of the country, several previous efforts orientated toward the devaluation of the domestic economy. This strategy was followed by a severe reduction of wages and pensions, unemployment and increasing social inequalities.

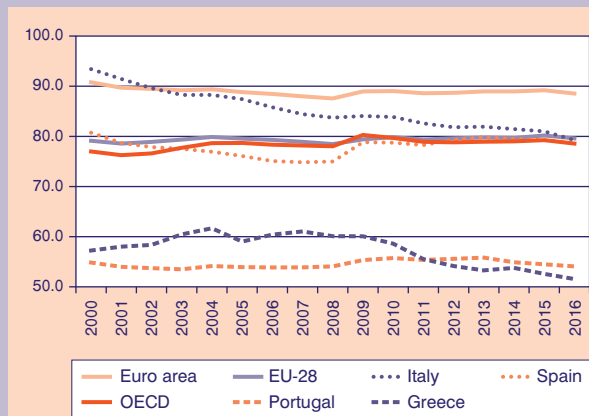
Figure 5 shows the decomposition of the growth of value added in Greece into the contribution of all the underlying factors: labour, capital and total factor productivity (TFP). It is noted that TFP is included as it measures how much output is produced given all of the (capital and labour) inputs to the production process; in other words, it indicates how efficiently the inputs are turned into outputs. In this decomposition, factor inputs of labor and capital are disaggregated into quantity (hours worked and capital stock) and quality (composition of workers in terms of education-

**FIGURE 1**  
GDP per hour worked, USD, constant prices, 2010 PPPs, for Greece, Germany, Portugal, Spain, Italy, the Euro area, the EU-28 and OECD countries, 2000-2016



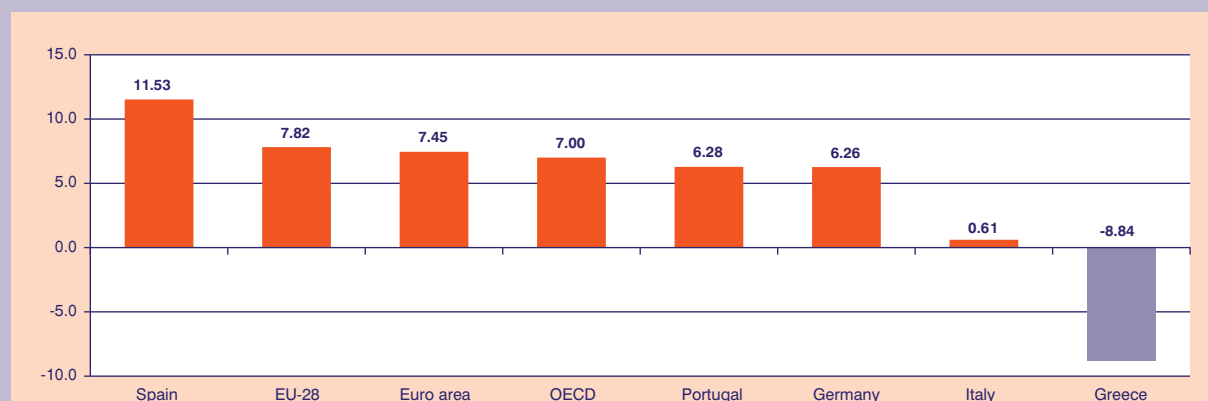
Source: OECD.

**FIGURE 2**  
Evolution of the productivity gap of Greece and other countries, as a percentage of the German productivity (GDP per hour worked, USD, constant prices, 2010 PPPs), 2000-2016



Source: OECD.

**FIGURE 3**  
Productivity change (%) for Greece, Germany, Portugal, Spain, Italy, the Euro area, the EU-28 and OECD countries between 2008-2016



Source: OECD.

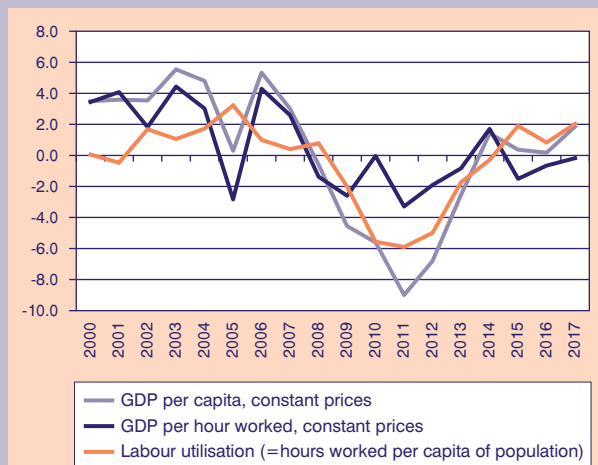
al attainment and composition of capital in terms of various asset types or asset groups such as ICT and non-ICT assets) (de Vries and Erumban, 2017).

During the whole period 2000-2016, productivity developments are dominated by the contributions of labour quantity (total hours worked) and TFP. On the contrary, the composition of labour and capital have minor contributions to output growth. The contribution of non-ICT capital is found to be negative after 2010, compared to its positive contribution in the previous period. The contribution of ICT capital is steadily positive but small, and it was significantly reduced after

2008, i.e., it dropped by almost 84% during the period 2008-2016. The contribution of labour quality to output growth is steadily positive (except for 2014) and it demonstrated an increase on average after 2010.

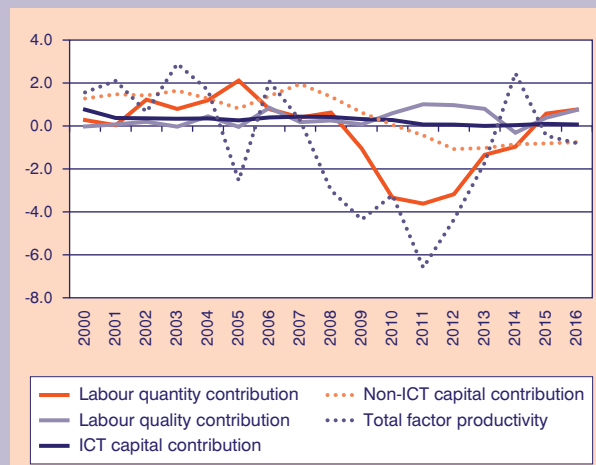
These results are mostly consistent with those of other EU countries, suggesting that the adoption of the knowledge economy in Europe has been lagging, compared to the US, which makes more and better use of ICT capital as well as high-skilled labour (Mas and Stehrer, 2012). However, the proportion of persons working in high- and medium-high technology manufacturing sectors as well as in knowledge-inten-

**FIGURE 4**  
Annual change in GDP per capita, GDP per hour worked and labour utilization in Greece, 2000-2017



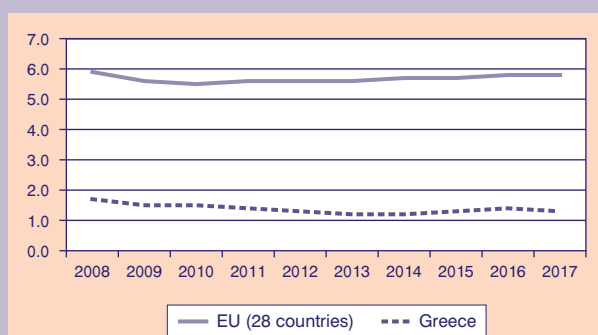
Source: OECD.

**FIGURE 5**  
Output growth decomposition (%) for Greece, 2000-2016



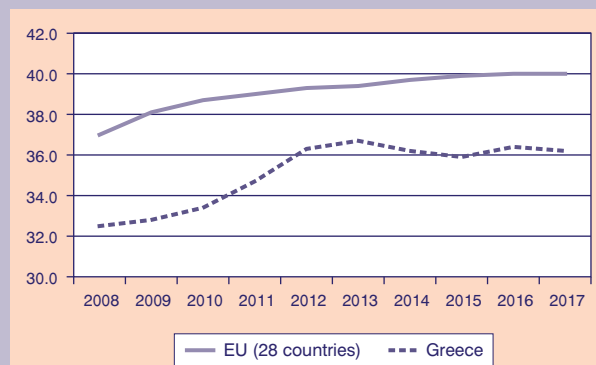
Source: The Conference Board.

**FIGURE 6**  
Employment (% of the total) in high- and medium-high technology manufacturing sectors in Greece, 2008-2017



Source: Eurostat.

**FIGURE 7**  
Employment (% of the total) in knowledge-intensive service sectors in Greece, 2008-2017



Source: Eurostat.

sive service sectors in Greece is significantly lagging, in comparison to the corresponding proportion in the EU-28 (Figure 6 and Figure 7, respectively).

#### 4. Sectoral productivity developments

In addition to productivity developments at the macroeconomic level, the examination of sectoral patterns can offer insight into more detailed aspects of productivity and how it evolves over time and differs from other (best-performing) countries. Table 2 and Table 3 report the level of productivity in 20 sectors of economic activity in Greece, in terms of their gross value added (GVA) per hour worked and GVA per employed person, re-

spectively, in years 2008 and 2016, the corresponding percentage change, and their participation in the country's GDP in the given years. It is noted that the labour productivity may significantly vary among sectors, not (only) because of their performance, but also because of the differences in capital/labour intensity.

In relation to both metrics, the most productive sector of the Greek economy is by far that of Real estate activities, with those of Electricity, gas, steam and air conditioning supply, Water supply, sewerage, waste management and remediation activities, and Financial and insurance activities to follow in order. It is stressed that the increased productivity in the Real estate activities is attributed to the particular characteristics of the given

**TABLE 2 Gross value added (GVA) per hour worked (euro in 2010 constant prices) by sector of economic activity and GDP participation (%) of sectors in 2008 and 2016**

Sector (NACE rev. 2)	2008		2016		GVA per hour change %
	GDP share %	GVA per hour	GDP share %	GVA per hour	
Agriculture, forestry and fishing	2.7	5.7	3.9	6.5	14.4
Mining and quarrying	0.4	35.1	0.3	19.5	-44.4
Manufacturing	9.0	18.6	9.4	22.8	22.7
Electricity, gas, steam and air conditioning supply	1.0	50.3	1.4	56.9	13.1
Water supply; sewerage, waste management and remediation activities	1.7	61.0	1.4	45.2	-26.0
Construction	4.4	11.3	3.1	13.6	20.5
Wholesale and retail trade; repair of motor vehicles and motorcycles	12.8	12.5	9.0	8.2	-34.3
Transportation and storage	8.3	33.8	5.5	21.4	-36.6
Accommodation and food service activities	5.8	17.4	6.7	13.8	-20.6
Information and communication	4.0	46.6	3.1	29.8	-36.1
Financial and insurance activities	4.64	44.2	4.5	43.2	-2.1
Real estate activities	13.7	1,433.1	21.3	1,746.2	21.8
Professional, scientific and technical activities	3.9	16.8	3.1	10.6	-37.0
Administrative and support service activities	2.7	25.9	1.6	10.5	-59.6
Public administration and defence; compulsory social security	8.9	22.3	11.8	25.9	16.2
Education	5.6	26.4	6.5	26.8	1.5
Human health and social work activities	6.3	29.3	4.1	16.1	-45.0
Arts, entertainment and recreation	1.5	29.8	1.3	24.8	-16.9
Other service activities	2.2	12.8	2.6	12.0	-6.2
Activities of households as employers; undifferentiated goods-producing activities of households for own use	0.6	9.6	0.3	6.9	-27.7

Source: Eurostat and own calculations.

sector, being of high capital intensity and pertaining to high transaction values, due to the land/property prices, and low number of employees. On the other hand, the least productive sectors are those of Agriculture, forestry and fishing, Activities of households as employers, and Wholesale and retail trade, repair of motor vehicles and motorcycles.

During the period 2008-2016, the sectors with the largest improvement in productivity are those of Real estate activities, Manufacturing, Construction (in terms of GVA

per hour worked) and Agriculture, forestry and fishing (in terms of GVA per employed person). In the same period, Real estate activities and Manufacturing experienced an increase of their participation in GDP and, in 2016, they had the largest participation in GDP, together with the Public administration and defense, and compulsory social security, whose productivity was also considerably increased. Most of the sectors showed a significant drop of their productivity during the crisis period. The sectors with the largest reduction in productivity during

**TABLE 3 Gross value added (GVA) per employed person (euro in 2010 constant prices) by sector of economic activity and GDP participation (%) of sectors in 2008 and 2016**

Sector (NACE rev. 2)	2008		2016		GVA per person change %
	GDP share %	GVA per person	GDP share %	GVA per person	
Agriculture, forestry and fishing	2.7	11,206	3.9	13,680	22.1
Mining and quarrying	0.4	75,579	0.3	41,600	-45.0
Manufacturing	9.0	39,908	9.4	47,516	19.1
Electricity, gas, steam and air conditioning supply	1.0	105,641	1.4	119,366	13.0
Water supply; sewerage, waste management and remediation activities	1.7	122,999	1.4	90,568	-26.4
Construction	4.4	25,086	3.1	25,552	1.9
Wholesale and retail trade; repair of motor vehicles and motorcycles	12.8	28,349	9.0	18,023	-36.4
Transportation and storage	8.3	81,698	5.5	46,460	-43.1
Accommodation and food service activities	5.8	39,619	6.7	31,520	-20.4
Information and communication	4.0	96,884	3.1	60,220	-37.8
Financial and insurance activities	4.64	90,777	4.5	89,676	-1.2
Real estate activities	13.7	3,110,352	21.3	3,783,344	21.6
Professional, scientific and technical activities	3.9	36,176	3.1	22,014	-39.1
Administrative and support service activities	2.7	53,667	1.6	21,081	-60.7
Public administration and defence; compulsory social security	8.9	45,630	11.8	52,079	14.1
Education	5.6	38,440	6.5	35,790	-6.9
Human health and social work activities	6.3	59,412	4.1	30,251	-49.1
Arts, entertainment and recreation	1.5	58,067	1.3	46,617	-19.7
Other service activities	2.2	26,042	2.6	22,738	-12.7
Activities of households as employers; undifferentiated goods-producing activities of households for own use	0.6	19,495	0.3	12,802	-34.3

Source: Eurostat and own calculations.

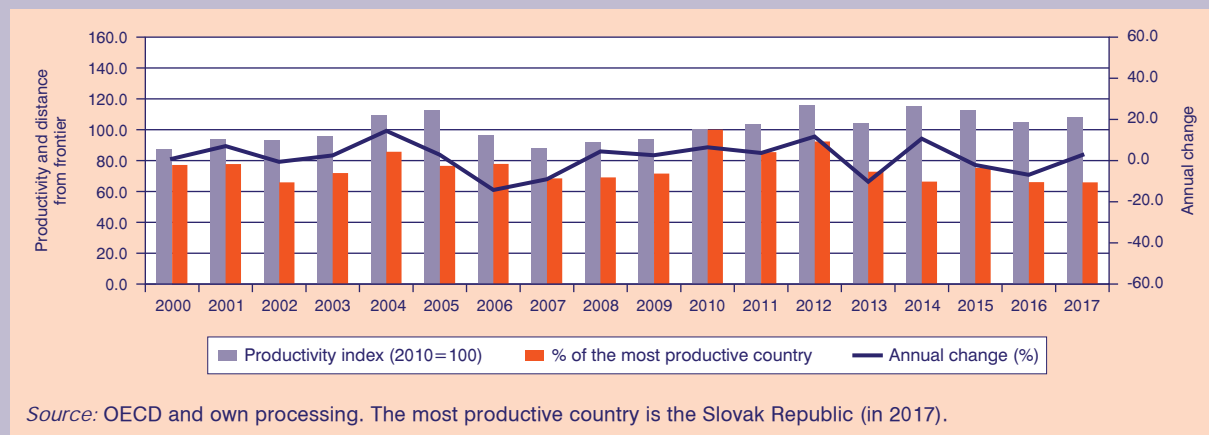
the same period are those of Administrative and support service activities, Human health & social work activities, Mining and quarrying, Transportation and storage, Professional, scientific and technical activities, Information and communication, and Wholesale and retail trade.

Figures 8-15 illustrate the evolution of the productivity index in Greece, measured in terms of the GVA per hour

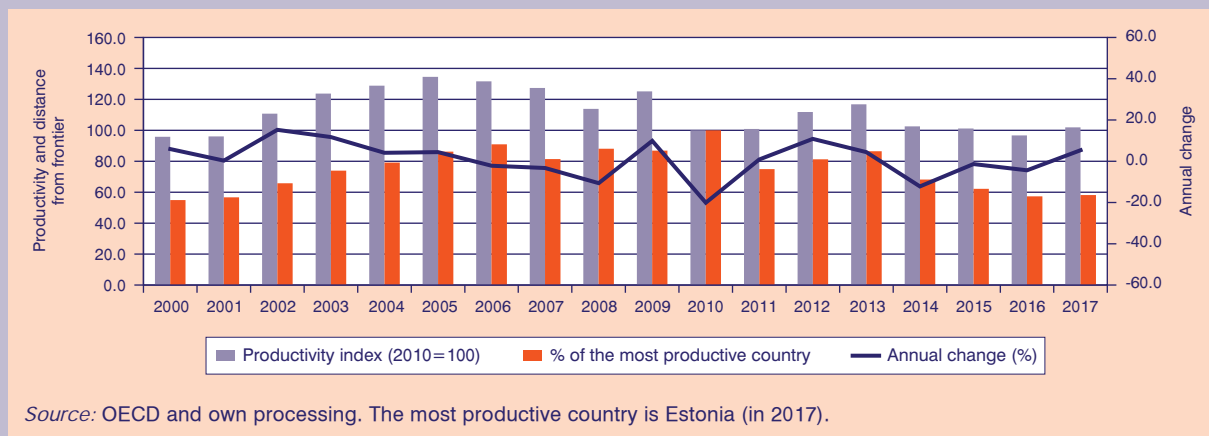
worked, its annual change and the gap from the most productive country among those of the OECD (with the exception of the US, Japan and Turkey, for which detailed statistics on hours worked are not available) for the following broad sectors of economic activity:

- Agriculture, forestry and fishing,
- Mining and utilities,

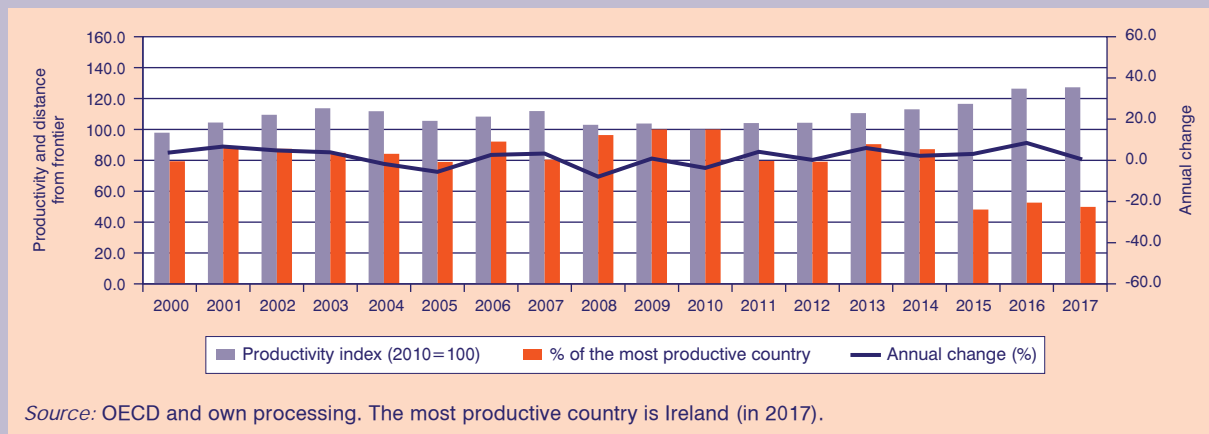
**FIGURE 8**  
**Volume index, gap from the most productive country and annual change of productivity in Agriculture, forestry and fishing in Greece, 2000-2017**



**FIGURE 9**  
**Volume index, gap from the most productive country and annual change of productivity in Mining and utilities in Greece, 2000-2017**



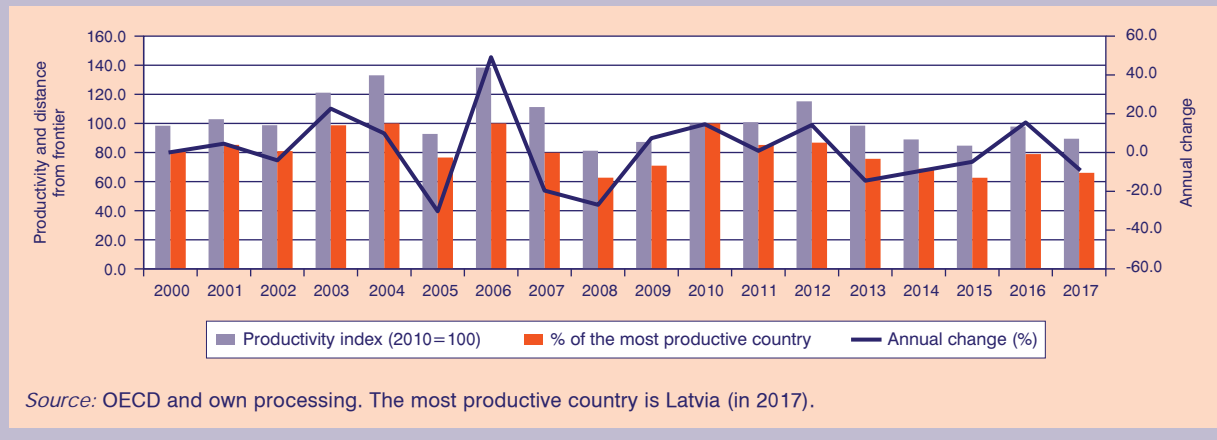
**FIGURE 10**  
**Volume index, gap from the most productive country and annual change of productivity in Manufacturing in Greece, 2000-2017**





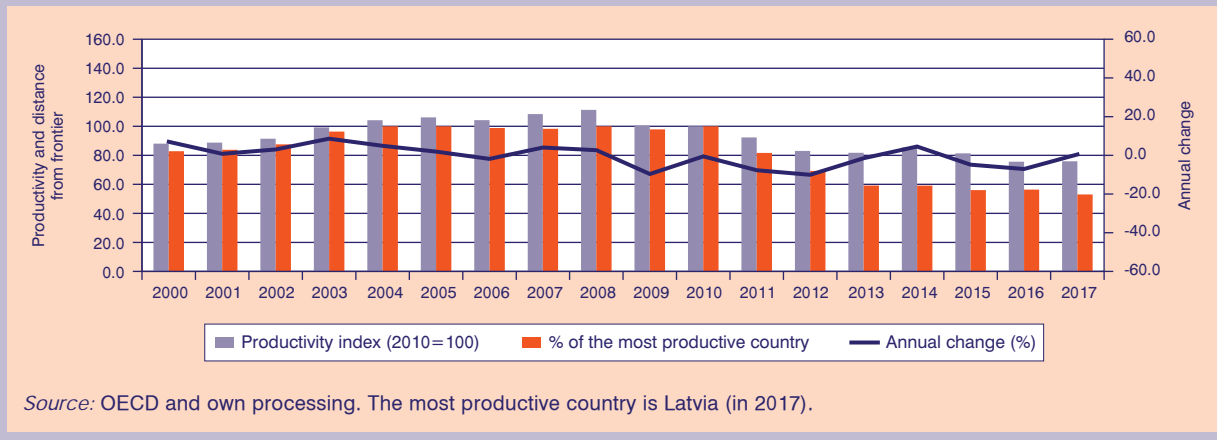
**FIGURE 11**

**Volume index, gap from the most productive country and annual change of productivity in Construction in Greece, 2000-2017**



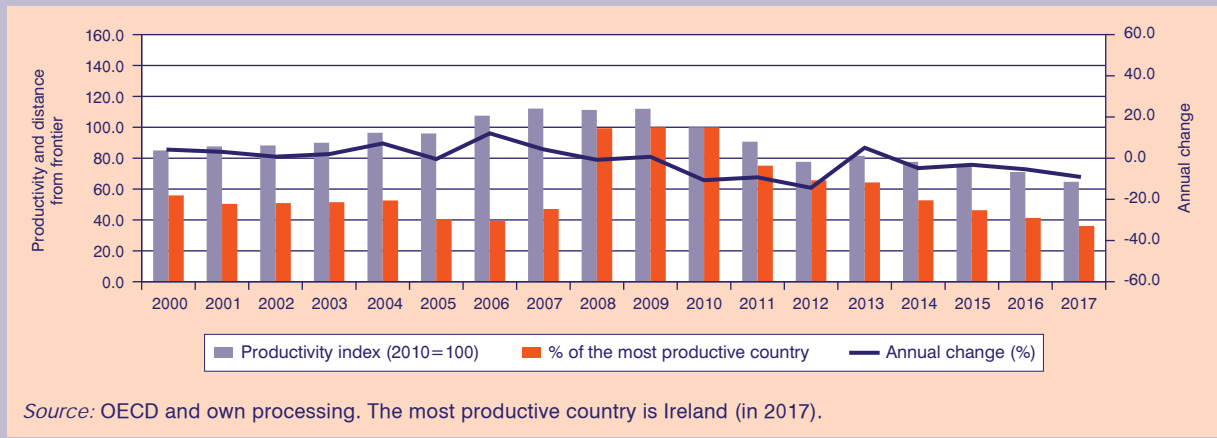
**FIGURE 12**

**Volume index, gap from the most productive country and annual change of productivity in Wholesale and retail trade, accommodation and food services, transportation and storage in Greece, 2000-2017**

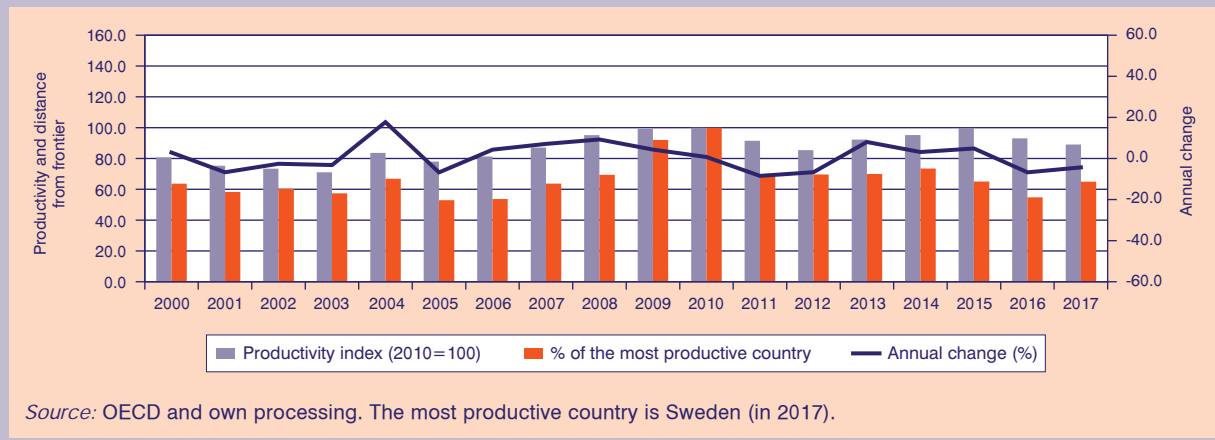


**FIGURE 13**

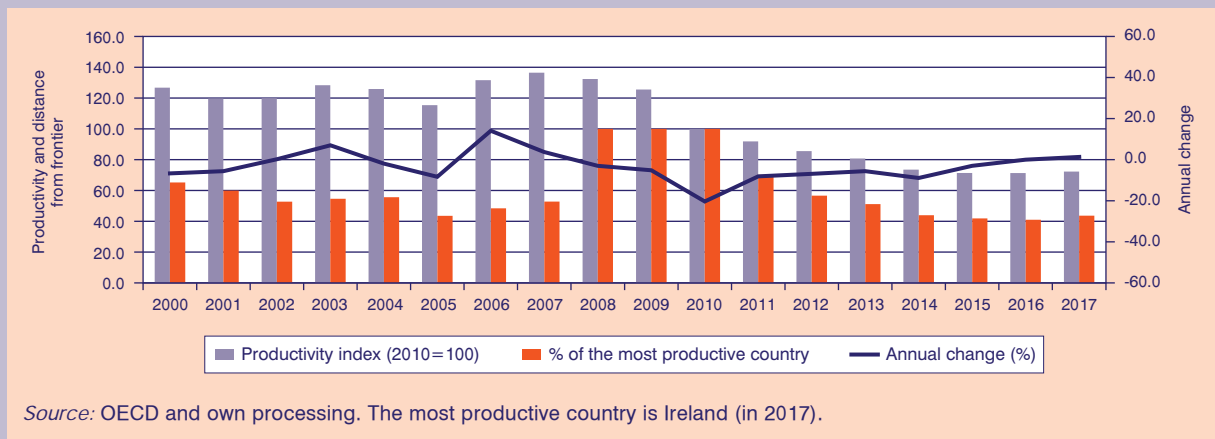
**Volume index, gap from the most productive country and annual change of productivity in Information and communication in Greece, 2000-2017**



**FIGURE 14**  
**Volume index, gap from the most productive country and annual change of productivity in Financial and insurance activities in Greece, 2000-2017**



**FIGURE 15**  
**Volume index, gap from the most productive country and annual change of productivity in Professional, scientific and technical activities, Administrative and support service activities in Greece, 2000-2017**



- Manufacturing,
- Construction,
- Wholesale and retail trade, accommodation and food services, transportation and storage,
- Information and communication,
- Financial and insurance activities,
- Professional, scientific and technical activities, Administrative and support service activities.

Given that there is no single country for each sector that is steadily the most productive over the whole sample period, the use of a dynamic benchmark is adopted. This benchmark is composed of the most productive OECD countries and its composition may vary with time. The specific approach ensures that the

comparison group is composed of the most productive economies. It is evident that, in almost all cases, together with the loss of productivity, the distance of the broad sectors of the Greek economy from the production frontier has increased, particularly during the last years. During the whole period 2000-2017, the services sectors of Information and communication, Financial and insurance activities, and Professional, scientific and technical activities, Administrative and support service activities showed, on average, the largest distance from the production frontier (between 60%-70%). In 2017, there were sectors wherein Greece was far behind the corresponding production frontier (<50%), such as those of Information and communication, Professional, scientific and technical activities, Administrative and support service activities, and Manufacturing.

In those sectors, it can be regarded that there is the largest room for productivity improvement. During the crisis period (2008-2016), all broad sectors of economic activity in Greece increased their distance from the production frontier, except for Construction, which reduced its distance by 5.4%.

The broad sectors of the Greek economy which showed the largest departure from the production frontier during the crisis period are those of Information and communication (by 64%), Professional, scientific and technical activities, Administrative and support service activities (by 56%), Manufacturing (by 48%) and Wholesale and retail trade, accommodation and food services, transportation and storage (by 47%). Namely, sectors wherein Greece is persistently far behind the production frontier, such as Information and communication and Professional, scientific and technical activities, Administrative and support service activities, also showed the largest departure from the production frontier during the economic crisis. This outcome suggests the limited capacity of those sectors to adapt to the rapidly changing environment of global economic competition and technological progress. The need for an increase of adaptive capacity also concerns Manufacturing, which, although its productivity improved during the crisis period, departed further from the corresponding production frontier.

## 5. Conclusions

This article presented the developments and some long-term, persistent problems pertaining to the productivity of the Greek economy. The analysis demonstrated the important reduction of productivity in Greece and its further departure from the international production frontier during the crisis period, signifying the loss of competitiveness in almost all sectors of economic activity. The largest room for productivity enhancement is found in the sectors of Information and communication, Professional, scientific and technical activities, Administrative and support service activities, and Manufacturing.

The contribution of ICT capital and labour quality to output growth were found to be positive but considerably low, suggesting the need for improving the rate of diffusion of technology and innovation, and further harnessing human capital to promote industrial production. It is stressed that Greece is ranked at the last positions among the OECD countries in relation to the direct government funding of business R&D, tax incentives for R&D and R&D expenditure by business enterprises, although it is highly ranked in terms of the participation of young people in tertiary education and the

percentage of tertiary education graduates in natural sciences and engineering (Tsekeris and Skintzi, 2017).

In addition to increasing the adaptive capacity to technological change, other factors behind low productivity (such as limited openness, (mis)regulation and lack of competition) should be addressed, hastening the required structural reforms in public administration and the product and labour markets. The role of institutional and political factors is also widely recognized, as the quality of government institutions and policies (including, amongst others, the enforcement of rules of law, government efficiency and transparency) at the national and regional level may have a significant impact on the efficacy of factors influencing the economic performance in the long run (Acemoglu, 2008; Rodríguez-Posé, 2013; Rodríguez-Posé and Di Cataldo, 2015).

Based on the national growth strategy of the country, resources from laggard firms or industries should be reallocated to more productive firms or industries, giving emphasis to internationally tradable sectors of economic activity, such as those of agriculture (as long as it relates to agricultural exports and tourism), manufacturing, transportation and storage, accommodation and food service activities, and information and communication. Finally, the upgrading and modernization of the regional governance and land-use planning system are anticipated to positively contribute to the output and productivity growth of the country (OECD, 2017).

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