CHAPTER 10

Insights of the Production Prototype Change During the Crisis (2008–2018)

10.1 INTRODUCTION

Following the outburst 2010 crisis in the Greek economy, an economic policy has been implemented which has pursued structural change in the economy to a significant extent. In particular, efforts were made for the production sector to improve its competitiveness (as outlined in the previous chapter).

This chapter attempts to investigate whether and to what extent the country’s production model has changed during the period of economic crisis (2008–2017). Attempts are also being made to address the issue with the productive structure of the Greek economy and the fact that there is no significant production differentiation. As a result that there is a need to change the production prototype. This fact, was highlighted by the emergence of the Covid-19 pandemic and its impact on the economic outcome.

Investigating whether and to what extent the productive model of the country has changed during the 2008 debt crisis, is attempted in two ways. The first one concerns the separation of the Greek economy into

The authors would like to thank Dr. Angelos Efstratoglou for his contribution to this chapter.
two segments and the control of a number of developments within them. That is, the domestic one, which produces goods and services for the domestic market and the international and competitive segment, which produces goods and services that are tradable for international markets.

The second concerns monitoring developments in the Greek economy sectors, on the one hand, by technological specialization and on the other hand by the intensity of their work skills. This is because the process of changing the production model of the Greek economy is going through the strengthening of the internationalized and competitive segment and through the strengthening of the high and medium-technological skills sectors and through the high-intensity skill sectors. To the extent that this is the case, it could be argued with some certainty that developments in the Greek economy during the crisis have led to a process of changing its production model at the same time.

The structure of the chapter is the following: Initially (Sect. 10.2), the structural change in the Greek production system is presented, while Sect. 10.3 describes the distinction between the domestic and competitive and internationalized part of the Greek economy, and the next Sect. (10.4) shows the developments in gross value added, employment and productivity, along with imports, exports and the trade balance for the domestic and international part of the Greek economy. The next Sect. (10.5) shows the technological specialization of the Greek economy sectors and Sect. 10.6 describes the skill intensity of the Greek economy sectors. Finally, in Sect. 10.7, the impact of Covid-19 on the sectors of activity of the Greek economy is analyzed.

10.2 Structural Change in the Production System

The Greek economy has been through significant structural changes in the years of the crisis of 2011, which is evident from the observation of the Phillips curve, the Okun curve (see Chapter 12) and the Beveridge curve (see Petrakis, 2020). However, these changes are not certain that they achieved in changing significantly the productive system of the economy.

Monitoring the diversification of the country’s production model, by monitoring developments in the domestic and international sectors, the technological specialization of the broader industrial sector, and the intensity of skills, does not represent the reality as it is. On the contrary,
a number of developments indicate a process of diversification of the production model, while another number indicate its conservation and reproduction.

In particular, a faster recovery in employment and investment (from 2012 onwards) in the internationalized part of the economy could be seen as evidence of a trend toward diversification of the production model. However, these are annulled, at least in part, by a faster recovery in production, productivity and exports to the domestic segment. In the field of technology, limited increases in investment and productivity and lower reductions in production and employment in the highly skilled sectors are not sufficient to show a trend toward diversification, mainly due to the limited size of these sectors. The absence of a trend toward diversification can also be seen in the light of the strong reductions in production, employment, and investment in the medium-to-high technology specialization sectors, with any positive developments in the medium-to-low technology specialization sectors indicating more the reproduction of the existing model rather than its diversification. In the field of skills intensity, increasing the high-skills intensity, particularly at the expense of those with low skills, is, first and foremost, a positive development and a condition for diversification of the production model. However, this is limited by the finding that this is mainly concentrated on the domestic part of the economy, with sectors using high skills only showing positive developments in the field of employment and negative in the fields of production and productivity.

10.3 The Distinction Between the Domestic and the Competitive and Internationalized Parts of the Greek Economy

The distinction of the Greek economy in a domestic and international part is usually made at the level of single-digit sectors. This is due to both the availability of statistical data and to methodological issues. Such an approach, however, incorporates a significant degree of generalization as it is not mandatory for all sectors of industry to be integrated into the internationalized part of the economy or necessarily for all service sectors (except hotels—restaurants and transport—storage) to be integrated into the domestic market. The distinction between the two segments based on the breakdown (two-digit classification code) of sectors of the economy is
actually closer to reality. In order to classify and integrate the breakdown into one of these sections, three criteria are used: (a) the value of their exports between 2008 and 2016 (average annual value); (b) the rate of change over the same period; and (c) the relationship between exports and gross value added.\(^4\) On the basis of these criteria, the classification of Table 10.1 of the Appendix was obtained.

A number of issues relating to classification should be clarified. First of all, exports, which are the basic criterion of the classification, do not

| Technological specialization | 2008 | 2017 | Change | % change |
|-----------------------------|------|------|--------|----------|
| **Gross Value Added**       |      |      |        |          |
| High                        | 871  | 930  | 59     | 6.8      |
| Medium-High                 | 2729 | 1984 | -745   | -27.3    |
| Medium-Low                  | 12,751 | 8380 | -4371  | -34.3    |
| Low                         | 15,790 | 7273 | -8517  | -53.9    |
| Agricultural products & raw materials | 7610 | 8879 | 1269   | 16.7     |
| Total                       | 39,751 | 27,446 | -12,305 | -31.0    |
| **Employment**              |      |      |        |          |
| High                        | 22,132 | 20,389 | -1746  | -7.9     |
| Medium-High                 | 57,947 | 31,551 | -26,399 | -45.6    |
| Medium-Low                  | 178,561 | 123,053 | -55,507 | -31.1    |
| Low                         | 352,762 | 242,557 | -110,215 | -31.2    |
| Agricultural products & raw materials | 533,519 | 483,606 | -49,913  | -9.3     |
| Total                       | 1,144,920 | 901,156 | -243,764 | -21.3    |
| **Productivity**            |      |      |        |          |
| High                        | 39,345 | 47,414 | 8069   | 20.5     |
| Medium-High                 | 47,097 | 65,577 | 18,480 | 39.2     |
| Medium-Low                  | 71,410 | 70,905 | -505   | -0.7     |
| Low                         | 44,760 | 28,968 | -15,792 | -35.3    |
| Agricultural products & raw materials | 14,264 | 18,907 | 4643   | 32.5     |
| Total                       | 65,016 | 65,484 | 468    | 0.7      |
| **Investments**             |      |      |        |          |
| High                        | 242  | 204  | -38    | -15.9    |
| Medium-High                 | 371  | 319  | -52    | -14.0    |
| Medium-Low                  | 2221 | 2087 | -135   | -6.1     |
| Low                         | 1443 | 843  | -600   | -41.6    |
| Agricultural products & raw materials | 2780 | 1515 | -1265  | -45.5    |
| Total                       | 7058 | 4968 | 2090   | -29.6    |

Source Hellenic Statistical Authority (2019a, 2019b) and authors’ creation
constitute an exclusive activity of the sectors of the internationalized segment. Sectors of the domestic segment also export. However, these are limited in value, but also in relation to production in the sector and are usually reduced during the crisis, which gives an important indication of their inability to respond to a highly internationalized and competitive environment.

All sectors with average annual exports of more than €500 million are included in the internationalized segment. Most of them showed an increase in their exports in the crisis while their exports are high in relation to their production. Of the sectors with an export value of between €100–500 million in the internationalized segment, the paper and paper product manufacturing industries are included as they showed a high rate of growth in their exports (51.5%), and their exports were particularly high on the basis of their production, the manufacture of motor vehicles, trailers and semi-trailers sector, which showed a decrease in its exports (34.6%), but which was particularly high in relation to its production, and the computer programming, consultancy and related activities and information services activities due to the very high rate of growth in its exports (104.6%—the second highest in all sectors of the economy) but also due to its increased exports in relation to its production. Finally, the only sector with a very limited export value (below €100 million) in the internationalized segment is the repair of computers and personal and household goods, as it showed a very high rate of growth in its exports (104.6%—the second highest in all sectors), which was also relatively high in relation to its production. This classification shows that the most sectors which are integrated into the internationalized part of the economy, in addition to the primary sector, belong to the manufacturing sectors, with a limited number of service sectors, which are certainly relevant to transports, storage, hotels and restaurants and two other of smaller range, in respect of their exports.

At the same time, only two manufacturing sectors (printing and reproduction of recorded media and repair and installation of machinery and equipment) are integrated into the domestic part of the Greek economy.
10.4 DEVELOPMENTS IN THE KEY FIGURES IN THE DOMESTIC AND INTERNATIONAL PART OF THE GREEK ECONOMY

The following are developments concerning gross value added, investments, employment, productivity, imports, exports, and the trade balance for the domestic and international part of the Greek economy.

10.4.1 Gross Value Added and Investments

At the time of the crisis, production and investment were higher domestically than in the internationalized segment, with production showing similar reduction rates in both segments but highly diversified investments (Fig. 10.1).

The Gross Value Added GVA in 2008–2017 was decreased by 24.4% domestically and by 22.3% in the internationalized segment, with the latter showing a low (2.3%) increase from 2013 onwards and the domestic segment stabilizing its production. It therefore appears that this limited recovery in the economy is due to the internationalized segment and, in particular, to its performance since 2013. This is expected to be linked to

![Fig. 10.1 Gross value added (GVA) and investments in the domestic and internationalised part of the Greek economy (Source: Hellenic statistical authority [2019a] and authors’ calculations and creation)]
the fact that some of the leading industries (wood industry, rubber manufacture, other non-metallic mineral production, base metal production and metal manufacturing) are included in the internationalized segment, as well as the four (food and drink industry, wood industry, manufacture of rubber products and manufacture of electrical equipment) out of the five sectors with the highest direct vertical interconnections, and only the wood industry is among the five with the highest horizontal linkages. At the same time, some of the leading sectors of production (film production, video production, etc., advertising and market research and other professional, scientific and technical activities) and four sectors (postal, financial, legal and accounting activities and architectural and engineering activities) are included in the domestic section of the five sectors with the highest horizontal linkages, with only the architectural and engineering sector being among the five with the highest direct vertical linkages.

In the field of investment, their rapid decline in the period of crisis (57.6% between 2008 and 2017) does not allow them to act as a growth driver for the economy. Moreover, this reduction has been distributed differently between the two segments, with the internationalized segment showing a lower rate of reduction (42.0%) than domestic (63.1%), while showing a recovery of 37.2% since 2013, against a limited reduction (1.4%) in the domestic segment over the same period. This trend tends to equalize the investments of the two segments, despite the significant difference in the scale of their production, which also creates different requirements for the formation of fixed capital. Although this recovery cannot completely differentiate the picture, it is indicative of a trend toward diversification of the country’s production model.

10.4.2 Employment and Productivity

Employment and productivity are significantly higher domestically than in the internationalized segment of the economy. However, developments in these two figures have been significantly differentiated.

Figure 10.2 shows employment and productivity rates in the domestic and internationalized part of the Greek economy for the period 2008 to 2017.

The decline in employment during the crisis (2008–2018) was lower in the internationalized segment (10.6%) than in the domestic segment (19.9%). In addition, the recovery in employment started earlier (2013) in the internationalized segment compared to the domestic segment (2014).
and has expanded since then at a faster rate (13.5%), creating 168,798 new jobs, compared to the domestic segment, which showed a rate of employment growth (6.8%), creating 156,490 new jobs. However, as the majority of jobs created in the internationalized segment, mainly due to the hotel/restaurant sector, are low-skilled jobs, it appears, at least in part, to cancel one of the conditions for diversification of the production model that refers to the creation of highly skilled jobs and high added value (Efstratoglou, 2018).

In addition, the domestic section includes four (forestry, retail, architectural and engineering activities, and households as employers) of the five sectors with higher vertical and horizontal linkages to employment. Only sector 01, crop and animal production, was integrated into the internationalized part of the economy, contrary to the majority of the employment leaders in the 10 sectors of the economy (Markaki, 2018), which appears to be hampering faster employment growth in the internationalized segment.

In the field of productivity, developments have been reversed compared to employment (Fig. 10.2), with productivity in the internationalized segment showing, through more pronounced fluctuations, reductions of 13.2% (or 2.2 euros per hour of employment) and productivity in the domestic segment, through less pronounced fluctuations, reduced by 0.5% (or 0.5 euros per hour of employment). This kind
of lower productivity of the internationalized segment and its further decline create potential obstacles to improving the competitiveness of the segment and its intended expansion, which is also a factor in the diversification of the production model.

### 10.4.3 Imports, Exports, and Trade Balance

Considering exports as the main criterion for classifying sectors in the domestic and internationalized segment of the economy, in all of their three dimensions, it is reasonable to expect that the performance of the internationalized segment related to them to be higher. However, exports should be presented separately and in relation to imports, in order to more clearly highlight the relevant procedures and opportunities or obstacles to the diversification of the country’s production model.

Figure 10.3 shows the course of imports and exports and the trade balance in the domestic and international part of the economy for the period 2008 to 2017.

![Figure 10.3](image_url)  
Fig. 10.3 Imports—exports and trade balance in the domestic and international part of the economy 2008–2017 (in thousands) (Source Hellenic statistical authority [2019a] and authors’ calculations and creation)
Imports and exports of the internationalized segment are significantly higher than those of the domestic segment, throughout the period under analysis. At the beginning of the economic crisis (2008), imports in both segments were higher than exports, highlighting aspects of the country’s trade deficit. During the crisis (2008–2017), in the internationalized segment imports decreased by €22.9 billion or 28.5% while exports increased by €524 million or 1.0%, improving their trade balance by 81.5%, which still remained negative until 2017. Imports reached their lowest point in 2013 (€49 billion) when their rise started again (€57.5 billion in 2017), while exports fell by €10.1 billion in 2009 when they started their slow recovery, with their intensity increasing from 2013 onwards (€52.2 billion in 2017). It is clear that the export nature of the internationalized segment is closely linked to imports, which in part cancels the process of diversification of the production model. In the domestic segment imports were decreased by €1.8 billion or 27.2%, slightly below the rate of the international segment, while exports were increased by €700 million or 14.5% leading to a positive trade balance (€761 million in 2017). The internal devaluation policy imposed through the MoU in the country, with wage reductions as its main tool, did not make a significant contribution to exports, but rather to the contraction of imports, through lower domestic demand (Vagianos, Vettas, Megir, & Pissaridis, 2017).

### 10.5 The Technological Specialization of the Greek Economy Sectors

A second check on the diversification of the country’s production model is carried out through the technological specialization of the manufacturing and wider industrial sectors. The classifications of the industry sectors based on their technological specialization are usually made in two ways. The first concerns the products produced by the sector. That is, whether the production of the products in the sector incorporates low, medium, or high technology (Yiannitsis, 2008). The second concerns direct industry classifications, mainly based on R&D expenditure, which is usually a percentage of their total production (Hatzichronoglou, 1997; OECD, 2011). Under these classifications, the sectors fall into four categories of
high, medium to high, medium to low and low technological specialization, while a separate category of low technological specialization is formed for agricultural products and raw materials. Both of these modes of classification are of a relative nature. The first highlights issues such as the coexistence, within a sector, of different businesses and products that internalize different levels of technology. The second, despite its broad acceptance, is partially disputed, leading to different classifications, using different uses of the R&D criterion. On the basis of this classification, the primary and secondary sectors of the economy are presented in Table 10.2 of the Appendix.

10.5.1 Production, Employment, Productivity, Investment, and Technological Specialization of the Sectors

In the period of crisis, the process of restructuring manufacturing and the wider industrial sector has continued, by maintaining the leading profile of the food and drink industry, reducing the participation of traditional sectors such as textiles, clothing, leather and furniture, and strengthening capital industries, for intermediate and final goods such as machinery and equipment, base metals, repair and installation of machinery, pharmaceutical and chemical products (Koutroulis, Athanasiou, Kanellopoulos, Cotsi, & Cholezas, 2018). In the midst of this process, the country’s wider industrial sector has seen a significant decline in production (19.1%), employment (22.4%) and investment (21.7%), improving only its productivity by 23.7% (Table 10.1).

These developments have been divided differently between the categories of industries in terms of their technological specialization. High-technology specialization sectors, particularly limited in size, have slightly increased their production, reduced their employment, significantly increased their productivity, while reducing their investments. The medium-high technology specialization sectors have significantly reduced their production, lost around half of their employment, which has led to productivity gains, while reducing their investments. The medium-low technology specialization sectors have seen a sharp decline in output and employment, reducing their productivity marginally and to a limited extent their investments. The low-technology specialization sectors, the most vulnerable to the effects of the crisis, have reduced their production, and have significantly reduced their employment, productivity and investments. Finally, the agricultural and raw material sectors
have increased their production, decreased (12.0%) their employment, significantly improving their productivity, in an environment of reduced investments (41.9%).

The extremely limited presence of high and medium-tech specialization sectors and the negative developments in most of their figures give significant indications of the absence of a strong trend toward diversification of the country’s production model. Increases in production in the high-tech specialization and agricultural product sectors and improvements in their productivity (together with those of medium-high technology specialization) are not sufficient to show a strong trend toward model diversification. In addition, the long-standing strong reductions in investment up to 2013 in all sectors further reinforce the above findings.

10.5.2 Imports, Exports, and Technological Specialization of the Sectors

Industry in the period 2008-2017, despite a significant drop in production, increased its exports in an attempt to find a way out of the economic crisis. Overall, exports increased by 32.4% to €29.6 billion in 2017. Export increases were shown by three of the four categories of sectors, with medium-high technology specialization being the only category with a decline in exports, which in 2017 were reduced to €3.3 billion, accounting for 11.2% of all industrial exports. The main volume of exports was from the medium-low technology specialization sectors, mainly due to the oil industry, with a total increase of 70.7% to €15.8 billion in 2017, accounting for 53.3% of all industrial exports. High growth (54.4%) was also seen by the highly skilled industries, but with limited contribution as they reached €2.3 billion, accounting for 7.8% of total industrial exports. Lower growth rates (18.6%) was shown by low-tech specialization sectors, with exports at €7.8 billion, accounting for 26.4% of all industrial exports.

In the same period, imports into industry decreased by 27.8% (from €60.3 billion to €45.5 billion in 2017), with reductions in all four categories of the sectors. The highest (45.3%) were medium-high-tech specialization sectors (from €23.5 billion to €11.0 billion), accounting for 27.8% of total industry imports, followed by low (24.8%), high (16.7%) technology sectors, with medium-low-technology specialization sectors showing the lowest rate of decrease in their imports (5.7%). This is
mainly due to the oil industry, which has seen an increase in its imports. These different developments have led to a significant diversification of their trade balance (Fig. 10.4).

A trend toward an improvement in the trade balance has emerged in all sectors, mainly due to a decrease in imports. The medium-low technology specialization sectors have succeeded in turning their negative trade balance into a positive one, with a relatively limited reduction (5.7%) in their imports and a significant increase (70.7%) in their exports. The improvement in the balance in the medium-high technology specialization sectors, which remains negative, is due to a higher decrease in imports than exports, as they are the only group of sectors with a decrease in exports. A negative but improved balance also showed low-tech specialization sectors through a combination of a reduction (24.8%) in their imports and an increase (18.6%) in their exports. Finally, a better balance has also been achieved by the high-tech specialization sectors, through a combination of limitation and reduction (16.7%) in their imports and significant increase (54.4%) in exports.

![Fig. 10.4](image_url)  

Fig. 10.4  Course of trade balance (exports minus imports) in the sectors on the basis of their technological specialization 2008–2017 (Source: Hellenic statistical authority [2019a] and authors’ calculation and creation)
If the trend toward an improvement in the trade balance of the sectors in all categories does not prove to be a one-off event, which is unlikely in view of the significant dependence of many industrial sectors on imports, its further improvement through a reduction in imports and an expansion of exports, will be an important step in the process of diversifying the country’s production model and overcoming the economic crisis.

10.6 Skills Intensity in the Sectors of Greek Economy

The intensity of skills is a particularly important factor not only in the process of diversifying the production model but also in facilitating and adopting the technological changes associated with the 4th Industrial Revolution. Rapid technological change is expected to diversify the skills needed to carry out economic activities rapidly, so that the capacity to adapt human skills to the specific requirements of the productive system is a particularly critical factor.

Throughout the economy, skills intensity is steadily improving during the crisis period (Fig. 10.5), with high skills increasing by 16.9%, improving their participation in total employment from 24.1% in 2008 to

![Fig. 10.5](image-url)
33.8% in 2018, mainly at the expense of low skills, which were decreased by 48.0%, reducing their participation from 30.4% to 18.9% in the years concerned, and medium skills, which were decreased by 13.8%, but at a rate lower than that of total employment (16.8%), slightly improving their participation from 45.6% in 2008 to 47.3% in 2018. However, it should be pointed out that this way of looking at developments in terms of skill intensity does not answer the question of whether these developments are due to (and highlight) the real needs of the productive system in terms of skills. They do not respond to whether existing jobs require these skill levels or their structure is due to oversupply leading to the use of high skills in jobs requiring medium or low skills. In other words, whether the vertical mismatch of skills occurs and prevails.\textsuperscript{20} In addition, the positive aspects of the increase in high skills are limited if they are seen in the light of the distinction of the economy between the domestic and internationalized segments, as most of them are concentrated in the first (Efstratoglou, 2018).

At sectoral level, sectors using high skills\textsuperscript{21} (only service sectors with just two industrial sectors among them—the oil and gas industry, and the pharmaceutical industry) experienced at the time of the crisis a relatively limited 7.0% reduction in employment with 62,362 job losses compared to the medium skills sectors, which experienced a 13.1% reduction and 263,530 job losses and the low-skilled sectors, with a 29.9% reduction and 519,697 job losses. In terms of output, between 2008 and 2016, high skill-intensive sectors lost 33.3% (€14.0 billion), medium skill-intensive sectors significantly less (in terms of percentage), by 14.3% (€17.1 billion), with low skill-intensive industries showed the highest losses both in terms of percentage (35.2%) and in absolute terms (€18.2 billion). The significant reductions in output in the high skill-intensive sectors are partly due to the high presence of self-employed in them, whose activities have been significantly reduced. In terms of productivity, the highest losses by 28.3% were experienced by the highly skilled sectors (from €47,214 per person employed per year in 2008 to €33,865 in 2017), as a result of the combination of the limited reduction in their employment with a high reduction in their output, while medium skill-intensive industries almost maintained their productivity (down by 1.3%, from €59,780 to €59,012 per year over the relevant period) and low skill-intensive sectors, which also have the lowest productivity, registered losses of 7.7% (from €29,766 to €27,486 for the years concerned).
10.7  The Structural Effects of Covid-19 on the Greek Economy

In addition to the impact on the core macroeconomic figures (see Sect. 9.12), the effects of Covid-19 are also significant in specific sectors of activity of the economy.

Indeed, in an economy like the Greek one, where the production model does not offer risk diversification as the most important part of economic activity is generated by specific sectors (tourism, shipping) the risk for the Greek economy is high.

The sector with perhaps the greatest problems due to the presence of the pandemic in Greece is tourism. Greece has one of the highest dependence on tourism worldwide, as according to the OECD annual report released on 4 March 2020 (OECD, 2020), Greece is the 6th most dependent economy in terms of contribution to GDP and the 4th most dependent economy in terms of contribution to employment between the 35 Member States monitored for this sector by the Organization.

On the basis of 2018 figures, tourism contributed directly to the generation of 11.7% of Greece’s GDP, while overall (directly and indirectly) tourism contributed between 25.7% (EUR 47.4 billion) and 30.9% (EUR 57.1 billion) to the GDP (INSETE, 2019).

In fact, the economy of three island regions is highly dependent on tourism, since the sector’s contribution to the regional GDP is 47.2% in Crete, 71.2% in the Ionian Islands and 97.1% in the South Aegean. These regions have one of the highest GDP per capita in the Greek economy.

This very high dependence of the Greek economy on the tourism sector makes the Greek economy particularly vulnerable to any adverse situation which may affect tourism activity.

Such a situation is undoubtedly connected to the emergence of the coronavirus pandemic. One of the most important economic effects of the emergence of Covid-19 in the Greek economy is the fact that international travel receipts for the Greek economy are expected to be decreased as a result of travellers’ fear, but also of the strict policies implemented by the various countries to prevent the virus from spreading.

The following shows what the effect of a EUR 1 billion reduction in tourist revenue on the GDP of the Greek economy would be. Using the Global Economic Model offered by Oxford Economics (2020), it appears that every 1 billion euros of loss of international travel revenue causes:
- A reduction in the GDP of the economy by around EUR 0.784 billion—a 0.39% reduction.
- A reduction in employment in the economy by about 5851 employees—a 0.15% reduction.
- A reduction in the balance of goods and services by around EUR 0.550 billion.

Indeed, it is not only the tourism sector that it is expected to have significant effects from the emergence of the Covid-19 pandemic in the Greek economy. A number of other sectors are expected to face a significant reduction in their added value to the economy as a result of lockdown of the Greek economy and the international and domestic uncertainty associated with the existence of the pandemic.

Figure 10.6 shows the estimate of the annual change in the real gross value added per industry of the Greek economy in 2020 compared to 2019, before and after the onset of the pandemic in Greece.

Note: (1) The case “Before Covid-19” presents estimates for the change in gross value added by sector from 2019 to 2020 based on the estimates of the Oxford Economics Global Economic Model in January 2020. The “After Covid-19” case presents estimates of the change in gross value added by sector from 2019 to 2020 based on estimates of April 2020 of Oxford Economics Global Economic Model. A detailed presentation of these estimates is set out in Chapters 11 and 12, where the April 2020 estimates are presented as the Normal scenario.

(2) Some of the sectors presented are sub-sets of others.

The biggest reduction in value added is expected for the Hotels and catering sector as before the crisis it was expected that in 2020 the added value of the sector would increase by 4.5%; after the crisis, it is ultimately expected to decrease by 16.6%. A significant reduction in value added is expected for the arts, entertainment, and recreation sector as, before the crisis, for 2020, the value added of the sector was expected to increase by 2.7%. After the pandemic, it is expected to eventually decrease by 16.1%. Significant negative (and also with a change from positive to negative) new changes in added values are expected for sectors such as trade, other services, transport and communication, manufacturing, and construction.

On the other hand, there are sectors which are presented as the winners of the crisis. This is the health sector, the extraction, the public administration, and the public services.
From the above, the need for a change in the production prototype arises. Production should be broken down into more economic sectors so that possible external shocks—such as the 2008 debt crisis or the Covid-19 pandemic—will be sources that will create lower imbalance for the economic activity. In order to change the production prototype, a structural reform program has to be implemented (see Chapters 11 and 12) which will focus simultaneously on the areas of sustainable development, sustainable governance, inclusivity, social behaviors that promote growth and growth and dynamic development and growth (see Petrakis & Kostis 2020).
### APPENDIX: CLASSIFICATION OF SECTORS

See Tables 10.2 and 10.3.

### Table 10.2 Classification of sectors in the domestic and internationalized segment of the Greek economy

| Domestic segment | Internationalised segment |
|------------------|---------------------------|
| 01 Crop and animal production, hunting | 01 Crop and animal production, hunting |
| 02 Forestry, logging | 03 Fishing, aquacultures |
| 18 Printing & reproduction of recorded media | 05–09 Mining and quarrying |
| 33 Repair and installation of machinery and equipment | 10–12 Food, beverage, and tobacco industry |
| 35 Electricity, gas, steam, and air conditioning supply | 13–15 Manufacture of textiles, clothing, leather, and leather clothes |
| 36 Water collection, treatment and supply | 16 Wood industry, wood, and cork products |
| 37–39 Sewerage, Waste collection, Remediation activities and other waste management services | 17 Manufacture of paper and paper products |
| 41–43 Construction | 19 Manufacture of coke and refined petroleum products |
| 45 Wholesale and retail trade and repair of motor vehicles and motorcycles | 20 Manufacture of chemicals and chemical products |
| 46 Wholesale trade, except of motor vehicles and motorcycles | 21 Manufacture of basic pharmaceutical products & pharmaceutical preparations |
| 47 Retail trade, except of motor vehicles and motorcycles | 22 Manufacture of rubber and plastics |
| 53 Postal and courier activities | 23 Manufacture of other non-metallic mineral products |
| 58 Publishing activities | 24 Manufacture of basic metals |
| 59–60 Motion picture, video and television programme production, sound recording and music publishing activities, Programming and broadcasting activities | 25 Manufacture of metal products, except machinery, and equipment |
| 61 Telecommunications | 26 Manufacture of computers, electronics & optical products |
| 64 Financial service activities, except insurance, and pension funding | 27 Manufacture of electrical equipment |
| 65 Insurance, reinsurance and pension funds, except compulsory social security | 28 Manufacture of machinery and equipment |
| 66 Other financial activities | 29 Manufacture of motor vehicles, trailers, and semi-trailers |
| 68 Real estate activities | 30 Manufacture of other transport equipment |
| 69–70 Legal & accounting activities—activities of head offices, etc. | 31–32 Manufacture of furniture & construction industries |
| 71 Architectural and engineering activities; technical testing, and analysis | 49 Land transports and transports via pipelines |
| 72 Scientific research & development | 50 Water transports |
| 73 Advertising & market research | 51 Air Transport |
| 74–75 Other professional, scientific, and technical activities |  |
### Table 10.2 (continued)

| Domestic segment | Internationalised segment |
|------------------|---------------------------|
| 77 Rental & leasing activities | 52 Warehousing and support activities for transportation |
| 78 Employment activities | 55–56 Accommodation & Food and beverage service activities |
| 79 Travel agency and tour operator activities | 62–63 Information technology and Information service activities |
| 80–82 Other administrative & support activities | 95 Repair of computers and personal and household goods |
| 84 Public administration, defence, compulsory social security | |
| 85 Education | |
| 86 Medical and dental practice activities | |
| 87–88 Residential care activities & social care without accommodation | |
| 90–92 Creative & cultural activities, such as arts, entertainment, libraries, archives, museums, gambling & betting | |
| 93 Sports activities and amusement and recreation activities orts activities, recreation, entertainment | |
| 94 Activities of membership organisations | |
| 96 Other personal service activities | |
| 98 Activities of households as employers | |

**Source** Authors’ creation

### Table 10.3 Classification of primary and secondary sectors for their technological specialization

| Technological expertise         | Sectors of economic activity |
|--------------------------------|------------------------------|
| Agricultural products & raw materials | 01 Agriculture—livestock farming |
|                                  | 02 Forestry—logging |
|                                  | 03 Fishing and aquaculture |
| High                            | 05–09 Mining—quarrying |
| Medium-high                     | 20 Manufacture of chemicals and chemical products |
|                                | 21 Manufacture of pharmaceutical products |
|                                | 26 Manufacture of computers electronic and optical products |
|                                | 27 Manufacture of electrical equipment |
|                                | 28 Manufacture of machinery and equipment |
|                                | 29 Manufacture of motor vehicles |
|                                | 30 Manufacture of other transport equipment |

(continued)
Table 10.3 (continued)

| Technological expertise | Sectors of economic activity |
|-------------------------|-----------------------------|
| Medium-low              |                             |
|                         | 19 Manufacture of refined petroleum products |
|                         | 22 Manufacture of rubber and plastic products |
|                         | 23 Manufacture of other non-metallic products |
|                         | 24 Manufacture of basic metals |
|                         | 25 Manufacture of fabricated metal products, except machinery and equipment |
|                         | 33 Repair and installation of machinery & equipment |
|                         | 35 Electricity, gas, steam and air conditioning supply |
| Low                     |                             |
|                         | 10–12 Food & beverage industry |
|                         | 13–15 Textiles, leather clothes |
|                         | 16 Wood Industry |
|                         | 17 Manufacture of paper and paper products |
|                         | 18 Printing |
|                         | 32 Manufacture of furniture |
|                         | 36 Water collection, treatment and supply |
|                         | 37–39 Sewerage, Waste collection, Remediation activities, and other waste management services |

Source: Hatzichronoglou (1997) and OECD (2011) and authors’ creation

Notes

1. Employment data relate to the period 2008–2018.
2. It is clear that the presence of high skills in these sectors alone cannot create conditions for limiting the reduction of production.
3. This approach includes the primary sector, mining, quarrying, manufacturing, hotels, restaurants, and transport—storage in the internationalized and competitive segment, and all other sectors fall in the domestic and non-competitive segment.
4. This criterion does not estimate the share of production exported, as in many cases the value of exports includes the value of imports, which is not recorded in the gross value added. It provides an estimate of the value of the two figures.
5. Out of a total of 64 sectors (two-digit classification) 13 sectors do not export and are therefore included in the domestic section (in italics in the table).
6. Out of the 21 sectors with average annual exports of over €500 million, 14 increased their exports, while 7 reduced them.
7. The rate of decrease in production between 2008 and 2013 was the same (24.4%) in both segments.
8. The direct vertical linkages of a sector reflect the demand for products and services that are developing in the economy by changing demand in the sector by one unit. These are sectors which generate high demand for products and services as a result of their expansion. Overall horizontal linkages reflect the overall effect on the economy caused by an increase in the primary inputs of an industry by one unit. The sectors with high horizontal linkages are sectors with a high supply of their products and services to other sectors of the economy. Finally, key sectors or leading sectors of the economy are the most connected and therefore most important as they contribute to a greater extent to strengthening the internal dynamics of the production system (Markaki, 2018).
9. The direct vertical linkages of a sector reflect the demand for products and services that are developing in the economy by changing demand in the sector by one unit. These are sectors which generate high demand for products and services as a result of their expansion. Overall horizontal linkages reflect the overall effect on the economy caused by an increase in the primary inputs of an industry by one unit. The sectors with high horizontal linkages are sectors with a high supply of their products and services to other sectors of the economy. Finally, the key sectors or leading sectors of the economy are the most connected and therefore most important as they contribute more to strengthening the internal dynamics of the production system (Markaki, 2018; Petrakis, 2020; Petrakis & Kostis, 2020).
10. The vertical employment multiplier of an industry estimates the total number of employees created in the economy through a unit increase in the final demand of the sector. In other words, it estimates the contribution made by sectoral links to employment growth and thus the internal dynamics of the productive system for job creation. The horizontal employment multiplier estimates the total number of employees created in the economy through a unit increase in the sector’s primary inputs. Finally, key sectors or employment leaders are considered to be those with high vertical and horizontal employment multipliers (Markaki, 2018).
11. For an overview of the role of exports to the Greek economy through a sectoral approach, see, inter alia, Agnantopoulos and Efstratoglou (2015).
12. For the service sectors, the criterion of research and technology is not appropriate. Indicators such as skill intensity, which are detected through the educational level of employees and the professional structure of the
sectors (i.e., the type of professional activity required by the production of the sector) are usually used in this case.

13. The absence of appropriate statistical data for our country, which would be relevant to the level of research and technology expenditure for each sector, makes the adoption of the OECD and Eurostat classifications mandatory.

14. In terms of their production, the sectors showed a hierarchical provision, whereby the higher the technological specialization the lower the output reduction and the lower the technological specialization the higher the production losses.

15. However, the recovery of investment in the wider industrial sector by 25.4% since 2013 is stronger in the medium-high (82.2%) and high (46.4%) sectors than in the low (32.7%) and medium-low (25.4%) technology specialization sectors.

16. Oil exports amounted to €10.7 billion in 2017, accounting for 36.2% of all industrial exports.

17. The country’s total imports fell from €87 billion in 2008 to €62.4 billion in 2017, with the industry, without the mines, accounting for 69.5% of them.

18. For example, see the World Economic Forum (2016) and the literature presented there.

19. The intensity of skills is assessed through the educational level of employees, recommending an indirect assessment, which fails to identify their content and actual dimensions. In recent work (Grundke, Jamet, Kalamova, Keslair, & Squicciarini, 2017), it was attempted, using data on adult research (PIACC), to build six indicators based on the tasks of works. These indicators relate to ICT skills, learning potential and creative problem-solving, management and communication, self-organization, calculations and marketing, and scientific, technological, engineering and mathematical skills. Skills are perceived as a continuous one, with some of them mainly cognitive, others are more personality-related, while others combine both. It is estimated that knowledge skills such as literacy, numeracy and problem-solving are more general in nature, outside and beyond activities and tasks, closely linked to productivity and the possibility of integration into international production chains. However, other, more closely linked to economic activities and occupations, such as ICT, management and communication skills and learning capacity, contribute to productivity growth and integration into international production chains.

20. The high skills mismatch in our country is examined in Cedefop’s works (2014) and (2018), which state that most of this mismatch is due to the fact that people with high educational qualifications occupy jobs requiring lower education qualifications.
21. The percentage of tertiary graduates employed in each sector was used as a criterion for classifying sectors of high, medium and low skill intensity levels. The year of 2008 served as the base year and high intensity sectors were considered to be those with more than 40.0% graduates (upper quartiles of the relevant classification), while of medium intensity sectors were those within 40.0—10.0% (intermediate quartiles) and of low intensity were those with less than 10.0% (lower quartile).

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