GREEK NATIONAL PRODUCTIVITY BOARD

Annual Report 2022

Struggling for a New Regime

GREEK NATIONAL PRODUCTIVITY BOARD (NPB)

CENTRE OF PLANNING AND ECONOMIC RESEARCH (KEPE)

Greek National Productivity Board Annual Report 2022

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Contributions

This report was prepared by the Centre of Planning and Economic Research which acts as the National Productivity Board (NPB) of Greece, under the coordination and scientific editing of its Steering Committee.

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1.1. Global crises and national policies (**Theodore Tsekeris**), 1.2. Regional challenges: The insularity dimension (**Theodore Tsekeris**), 1.3. Horizontal and sectoral reforms (**Ersi Athanassiou**, **Ioannis Cholezas**, **Agapi Kotsi**), 1.4. Productivity from the stakeholders' viewpoint (**Theodore Tsekeris**), 1.5. The scope of the annual report for 2022 (**Theodore Tsekeris**), 2.1. Macroeconomic environment (**Costas Passas**), 2.2. Own projections for 2022–2023 (**KEPE**), 2.3. Aggregate productivity growth (**Costas Passas**), 2.4. Sectoral productivity growth (**Costas Passas**), 2.5. Contribution of costs to energy prices (**Nikolaos Rodousakis**, **George Soklis**, **Theodore Tsekeris**), 2.6. Productivity indices for the European countries (**Nikolaos Rodousakis**, **George Soklis**), 3.1. Recent developments in public finance and current account (**Georgia Skintzi**), 3.2. Cost/price competitiveness indices (**Georgia Skintzi**), 3.3. Competitiveness and value chain participation (**Georgia Skintzi**), 3.4. Competitiveness indicators for resilient and sustainable growth (**Athanasios Chymis**), 3.5. Research and innovation (**Georgia Skintzi**, **Alexandra Kontolaimou**), 5. Conclusions and policy suggestions (**all authors**).

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Foreword

Panagiotis Liargovas

The Centre of Planning and Economic Research (KEPE) assumed the function of the Greek National Productivity Board in April 2019.[1] Even though this is a new role for KEPE, the Centre has a long history of research in matters concerning the Greek economy and its productivity. Indeed, since its establishment in 1959, headed by Andreas G. Papandreou, who would later become the Prime Minister of Greece, KEPE has kept a close eye on the Greek economy, producing studies and reports that have helped economic policy makers in their decisions and contributed to the scientific study of the Greek economy. Today, with 30 researchers on staff, KEPE remains the largest research institute on economic matters in Greece. KEPE is mostly financed by the Greek Government, but retains its independence. Researchers are hired with open calls for specific positions, and their recruitment and promotion is decided by independent committees. We have researchers specialising in different fields of research and sectors of the Greek economy. This expertise has been put to use in producing the fourth productivity and competitiveness report at hand.

Apart from producing the annual report on productivity, KEPE has already produced a number of studies and reports that deal directly with issues pertaining to productivity. As a National Productivity Board, KEPE is in the process of producing a number of more specialised studies that will help us understand the productivity and competitiveness challenges of the Greek economy.

During the current year (2022), despite the occurrence of various crises (economic, pandemic, energy), significant improvements in economic aggregates, productivity indices and competitiveness indicators are observed in Greece. The GDP growth rate is expected to increase by 5.7% in 2022 and 1.2% in 2023 (baseline scenario), labour productivity in the Greek economy is expected to fully recover and grow by 2.19% in 2022 and 1.87% in 2023, whereas Total Factor Productivity (TFP) is expected to grow by 2.73% during 2022 and 2.23% in 2023, that is faster than the corresponding EU27 and EA19 forecasted average growth rates. Based on these improvements, the Greek economy is anticipated to continue converging with the EU27 and EA19 in terms of the GDP per worker and TFP, mainly as a result of the government policies, investment and tourism growth.

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1. Law 4605/2019, Art. 37, Gov. Gaz. A΄ 52/1.4.2019.

Despite the above positive trends, there are legitimate concerns stemming from the evolution of inflation and of interest rates. At the national level, structural inflation reached 4.98% in September, indicating that price increases have spread to all goods and services in the consumer's "basket". The same is true for the corresponding index of the Harmonised Index of Consumer Prices. The Harmonised Index of Consumer Prices excluding fuel and taxes stood at 5.2% for Greece in September, compared to 4% for the euro area average. These figures are worrying both for their social impact and for their effect on the competitiveness of the Greek economy and, consequently, on exports. In addition, the rise in euro interest rates, which is directly related to the path of inflation, creates additional concerns about the future path of the Greek economy.

To avoid the negative consequences of high inflation and interest rates, the Greek government can employ several policies, strategies and plans that boost growth while ensuring economic, social and environmental sustainability. These include, among others, the National Reform programme and the Stability programme, the policies included in the National Energy and Climate Plans until 2030 and as to be revised along the lines of the REPowerEU plan, preparation of a National Implementation Plan for the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs), the Just Development Transition Programme for decarbonisation, the Greek Recovery and Resilience Plan, Greece 2.0, over the period 2021–2026 and the National Strategic Reference Framework (NSRF) in the context of the EU Multiannual Financial Framework for the programming period 2021–2027. A consistent monitoring and comprehensive evaluation of all these national policies, strategies and plans is necessary.

We hope that this report, which takes a long view of examining the performance of the Greek economy, will provide a useful overview of the current situation and will indicate the necessary reforms to accompany the growth path of the economy.

Professor Panagiotis Liargovas
Scientific Director, National Productivity Board
Chairman of the Board and Scientific Director,
Centre of Planning and Economic Research (KEPE)

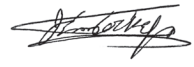
Preface

Theodore Tsekeris

During the last three years, major sources of risk have emerged, as the COVID-19 pandemic, coupled with the war in Ukraine, has unveiled the inefficiencies and vulnerabilities of global supply chains, while food and fuel prices are rising dramatically. These conditions as well as requirements about security, strategic autonomy (in energy, food and critical raw materials) and climate change have forced the EU to take unprecedented measures that are affecting asymmetrically national and regional economies. At the same time, the unstable international environment calls for caution and vigilance, since fiscal risks remain substantial. Investment and reform measures should focus on productivity enhancement and be suitably adjusted according to the particular needs and prospects of each member country, so as to diminish imbalances and expedite, without compromising EU competitiveness.

The enduring implications of the pandemic continued to affect the Greek economy in 2021. The country kept the budget balance, the primary balance, and the current account balance below zero. It also fell behind most of the competitiveness index scores, as it still suffers the results of the long economic crisis of the previous decade. However, it improved a wide range of cost (real effective exchange rate and the nominal unit labour cost) and non-cost competitiveness indicators, compared to the previous year. It overperformed the progress made at the EU average level, together with the recovery of the GDP during 2021, while this trend seems to continue during 2022. In addition, the participation of Greece in global value chains continues to increase and remains well above the EU average, albeit signifying an increasing reliance on imports.

Greece also performs above the EU average in the green transition. However, the considerable progress that has taken place in the last few years should be reinforced to catch up to the EU average in other dimensions of sustainability (economic, social and governance). Public policies that support digital and green transitions, investments in knowledge, research, innovation, the regionalisation of supply chains and production reshoring, and new technologies related to Industry 4.0 can play an important role in mitigating risks and improving Greece's competitiveness. Such policies could help the country to shape a more robust growth strategy in this interconnected but highly volatile environment, focusing on higher value-added and knowledge-intensive activities.



Theodore Tsekeris
Head of the Steering Committee
National Productivity Board of Greece

Executive Summary

As economies are trying to recover from the pandemic-induced recession, the war in Ukraine, the energy crisis and inflationary pressures pose additional challenges. The findings of this report show the fast recovery of the Greek economy from the pandemic shock as well as substantial improvements in growth and several productivity indices, such as 7.6% in labour productivity per person employed, 4% in total factor productivity (TFP) and 8.4% in per capita output. Tourism and transport are among those industries which experienced the highest increases in labour input, capital input and TFP, while the capital productivity performance of the Greek economy is top rated among the European economies.

However, the current conditions tend to increase uncertainty and threaten to upend growth dynamics. The rate of downward adjustment in the medium run will rely on several factors, such as the government expenditure to contain the adverse impact of inflation, the implementation of the scheduled investments and the course of tourism receipts. Specifically, income and import substitution policies can contain energy prices and favourably contribute to the price formation of industrial sectors.

From the stakeholders' viewpoint, the major problems inhibiting the productivity of the Greek economy are its weak production base, the small average size of firms, the inefficient labour market conditions and institutional dysfunctionalities. The most promising policies for raising productivity refer to active labour market and educational reforms, productive investment, the promotion of research and innovation (R&I), the exploitation of synergies and incentives to grow the average firm size, and institutional reforms in the public sector and markets.

The amelioration of the competitiveness of the Greek economy in 2021 is manifested in the improvement of a series of measures, including the primary deficit and the government deficit, the debt-to-GDP ratio, the current accounts deficit and the cost-competitiveness indicators of the CPI-based REER and the ULCT-based REER. The country has also made substantial improvement in attracting FDI, but more efforts should be made to attract greenfield investments and improve its business climate, particularly in terms of reforming contract enforcement and property registration.

Furthermore, the country continues to improve in digitisation, but it needs to increase the number of firms that provide ICT training, fixed VHCN coverage, fibre to the premises coverage, the number of SMEs with at least a basic level of digital intensity, the number of firms using the cloud and the digital public services for businesses and for citizens as well as the number of pre-filled forms. It also presents high scores in the green transition, but it should improve green society indicators, particularly in recycling and green transport, and make progress in clean innovation indicators, such as green patents and foodtech private investment, as well as in climate policy indicators, including the sustainability of agriculture and other climate actions in alignment with the Paris Agreement. Moreover, Greece should enhance its position in attracting (foreign and domestic) investments in renewables, and accelerate in all other aspects of transition (in addition to the green and the digital ones) to converge with and exceed the EU average.

Additionally, the country should increase public spending on R&I to reinforce the positive spillover effects on industry and the entire economy, together with the regular monitoring and evaluation of suitable R&D effectiveness measures. To this end, it should facilitate —via a wide range of incentives— the training of employees in the public and private sectors in new technologies and promote knowledge transfer, exploiting collaborations between the business sector and the government, universities, and research centres, through joint research projects and training programmes, and university-based science parks and business incubators.

1. Introduction

1.1. Global crises and national policies

The EU and the global economy currently face a unique amalgam of multi-level and multi-scale risks arising from various types of contemporary crises (public health, geopolitical, energy, climate), interdependencies between them and the resulting supply chain disruptions. At the same time, the limited (if any) GDP growth prospects at the EU level and the increased inflationary pressures pose challenges for fiscal and monetary policies.

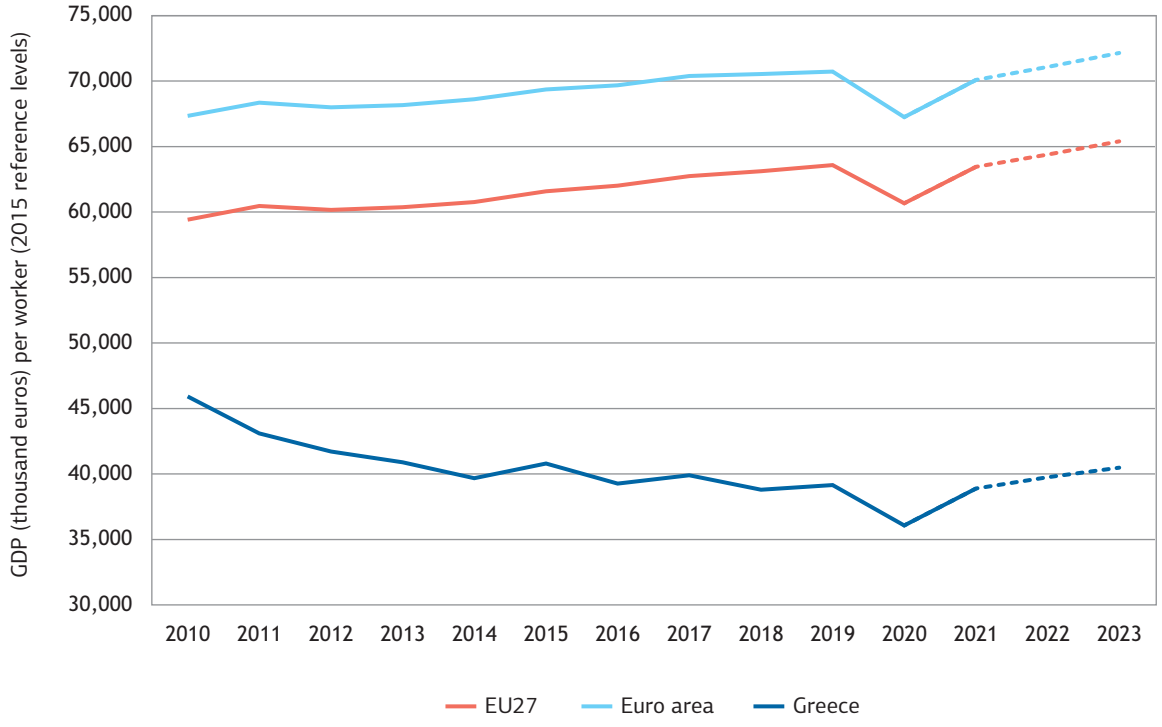
In this turbulent environment, the EU and each member country individually should employ alternative scenarios about economic growth and stability, the future of technology and the green transformation. They should also coordinate efforts to establish collaborative strategies and coherent policies to address several key thematic priorities. Such priorities may concern research and innovation (R&I), education and skills, and relevant financing tools that would help to reduce spatial and socio-economic disparities (EC, 2021a). Optimal tradeoffs should also be sought between the cost of the supply of energy, food and key raw materials, and the security risks, geopolitical tensions, green transition and external costs, especially those associated with the environment and climate change.

The EU has responded to the COVID-19 pandemic and the geopolitical and energy crises through a set of —more or less— coordinated policies. These policies include a package of massive investment (Next Generation EU) mostly focused on digital technologies and the green transition, and the REPowerEU actions to reinforce the use of clean energy sources, reduce energy costs, promote independence from fossil fuels and ensure energy security.

During the current year (2022), significant improvements in economic aggregates, productivity indices and competitiveness indicators have been observed in Greece (for more details, see Sections 2 and 3). Rising productivity trends are also recorded for the EU27 and the EA19. More specifically, the labour productivity of the Greek economy, in terms of GDP per worker, experienced smaller losses (-0.65%) during the pandemic (2019–2021), compared to the EA19 average (-0.91%), because of its faster recovery during 2021 (7.85% versus 4.20% in 2020). Moreover, labour productivity in the Greek economy is expected to fully recover and grow by 2.19% in 2022 and 1.87% in 2023, which is faster than the corresponding EU27 and EA19 forecasted average growth rates (1.48% and 1.42%, and 1.58% and 1.51%, respectively) (Figure 1.1).

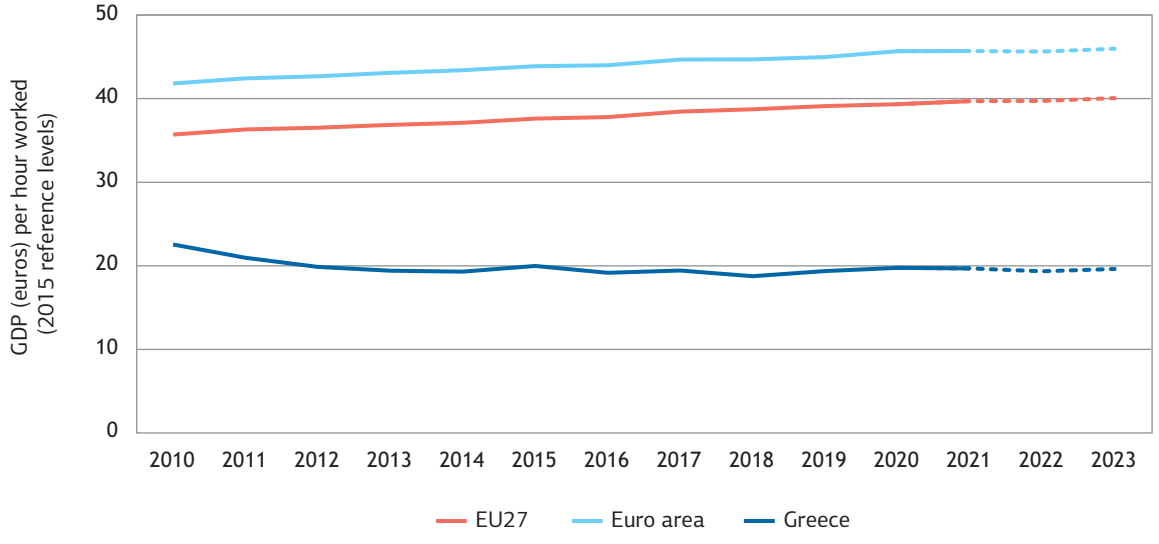
On the other hand, labour productivity, in terms of GDP per hour worked, experienced higher losses in Greece during 2021, compared to the EU27 and EA19 averages, and its average rate of growth during the period 2020–2023 is expected at 1.30%, a rate lower than the corresponding EU27 and EA19 averages (2.46% and 2.25%, respectively) (Figure 1.2). The latter outcome can be largely explained by the government policies implemented to protect job positions and businesses during the pandemic (see subsection 2.3.1).

Figure 1.1 Labour productivity in GDP (thousand euros) per worker in Greece, the EA19 and the EU27 during 2010–2021, and 2022–2023 forecasts (at 2015 reference level)



Source: AMECO.

Figure 1.2 Labour productivity in GDP (euros) per working hour in Greece, the EA19 and the EU27 during 2010–2021, and 2022–2023 forecasts (at 2015 reference level)



Source: AMECO.

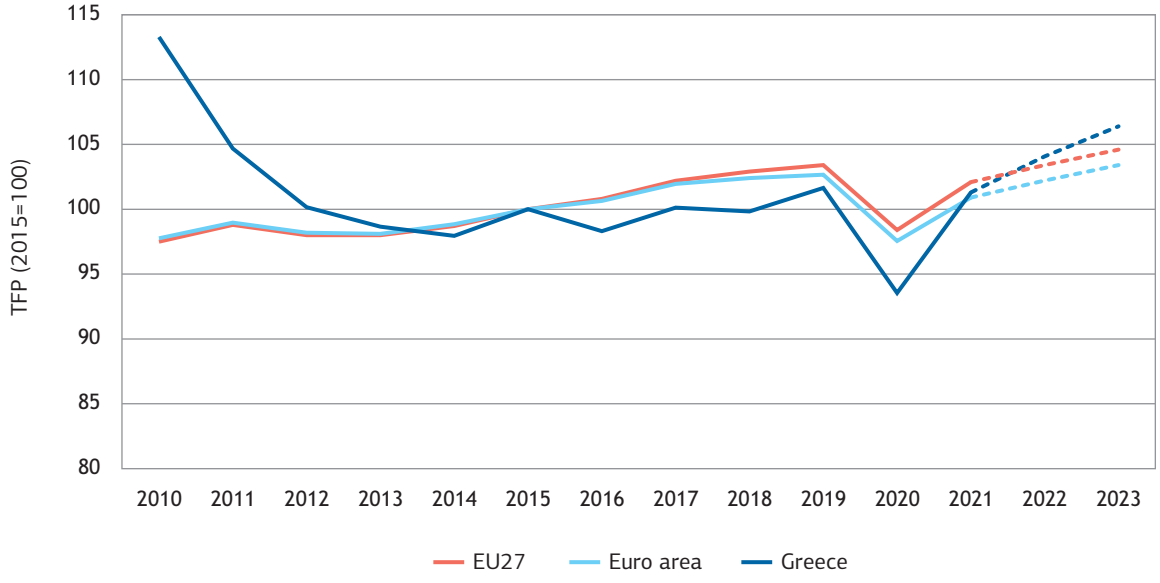
Similarly to the labour productivity in GDP per worker, the TFP of the Greek economy experienced smaller losses (-0.34%) during the pandemic (2020–2021), compared to the EU27 and EA19 averages (-1.26% and -1.72%, respectively), due to the stronger rebound in Greece in 2021 (by 8.28% compared to 3.76% and 3.43%, respectively). The TFP of the Greek economy is expected to fully recover and grow by 2.73% during 2022 and 2.23% in 2023, which is faster than the corresponding EU27 and EA19 average rates (1.27% and 1.16%, and 1.31% and 1.16%, respectively) (Figure 1.3).

On the basis of the above, the Greek economy is anticipated to continue converging with the EU27 and EA19 in terms of the GDP per worker and TFP, mainly as a result of government policies, investment and tourism growth (see Sections 2.1-2.3).

Despite the productivity developments, in this turbulent period, considerable uncertainties remain regarding the extent and direction of the various impacts of EU and national policies on the key macroeconomic aggregates and the distribution of relevant effects among different types of firms, sectors and regions. Therefore, these policies should be incorporated in the deployment of holistic plans to foster a coherent transition to not only an environmentally, but also an economically and socially sustainable and inclusive development. Such plans necessitate a wide range (mixture) of investment to enhance human capital, R&I and sustainable job creation, together with structural reforms in the public sector and market operation.

Particularly with regard to Greece, the government employs several policies, strategies and plans in order to boost robust growth while ensuring economic, social and environmental sustainability. These include, among others, the National Reform programme and the Stability programme;

Figure 1.3 TFP evolution in Greece, the EA19 and the EU27 during 2010–2021, and 2022–2023 forecasts (2015=100)



Source: AMECO.

the National Energy and Climate Plans until 2030 as to be revised along the lines of the REPowerEU plan; the preparation of a National Implementation Plan for the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs); the Just Development Transition Programme for decarbonisation; the Greek Recovery and Resilience Plan, Greece 2.0, over the period 2021–2026 and the National Strategic Reference Framework (NSRF) in the context of the EU Multiannual Financial Framework for the programming period 2021–2027. Given the increased uncertainty arising from the pandemic, geopolitical and energy crises and inflationary pressures, there is a need for consistent monitoring and comprehensive evaluation of all these national policies, strategies and plans, as well as analytical strategic scenario building.

Moreover, the country should exploit its human capital, physical infrastructure and strategic position at the crossroads of international trade between Europe, the Mediterranean region, North Africa, the Middle East and the Far East to attract commodity flows and function as an international and regional (Eastern Mediterranean and Southeastern European) trade and combined transport hub, among others, for energy and agricultural–food products. This will reinforce Greece's participation in regional and global value chains and promote the security and diversification of the supply of key raw material resources in the wider regions.

1.2. Regional challenges: The insularity dimension

Greece is characterised by a complex geomorphological landscape, with significant heterogeneity and diversity of island complexes, which cover about 18.7% of the total surface area and 15.1% of the total domestic population of the country. It is estimated that at least 25% of the country's GDP comes from sea-related activities, mostly concerning shipping and tourism (Kotios, 2022). Despite their importance for economic development and territorial cohesion, island regions fall behind mainland regions in innovation (except for Kriti) and public investment, while they remain more reliant on the services sector (especially tourism) and are vulnerable to climate change.

The implementation of targeted policy measures to enhance accessibility and territorial cohesion and the development of the island regions is important for population and job retention, and for increasing the productivity and competitiveness of local businesses. A crucial component of island policies in the country refers to the reduction of transport costs from/to mainland Greece. This is because transport costs do not only adversely affect the insularity and accessibility of islands, but they also induce negative externalities that vary greatly across space. These externalities are associated with conditions of limited competition (monopoly and monopsony on smaller islands), unavailability/inefficient use of natural resources, lack of productivity gains due to the inability to develop agglomeration economies, and poor access to socio-economic opportunities, highly skilled labour pools and specialised intermediaries.

A characteristic example of this spatial market distortion is depicted in the significantly increased retail prices (typically, above 0.15 euro per litre) of fuels (gasoline and diesel for motorised transport, and diesel for heating) —as the difference from the corresponding average prices at

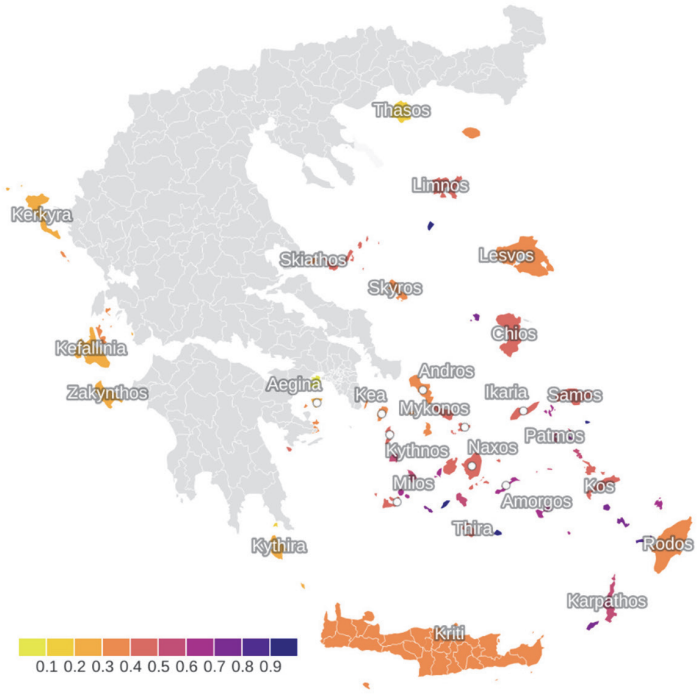
the metropolitan region of Attiki— on the medium-size islands (between about 5,000 and 20,000 inhabitants), in contrast with the large islands. It is noted that these price differences on small-size islands have been successfully addressed through the implementation of the measure of the Transport Equivalent for fuels (Tsekeris, Lychnaras and Passas, 2022). In turn, this problem adversely affects the affordability of fuels for local households and firms. Therefore, even though growth does occur in the macro-economy, this change may substantially deviate or even vanish in the local economic conditions.

Insularity, also referred to as 'islandness" (Spilanis, Kizos and Petsioti, 2012), can be simply expressed as a function of two variables: transport cost and population size. It can be argued as being similar to the measure of 'remoteness' typically found in the international trade literature (Wei, 1996; Deardorff, 1998). Namely, it denotes that more remote countries/regions are expected to trade less than those (of similar size) geographically well-positioned nearby large markets, while, if nearby countries/regions are large, then the magnitude of distance becomes less relevant. Specifically, the insularity index (normalised in the 0-1 range) is calculated as the ratio of the generalised transport cost (in euros), which is a function of the ferry connection time (in hours) and connection distance (in kilometres), weighted by the time value coefficient (in euros/hour) and the kilometre cost coefficient (in euros/km) corresponding to each pair of regions, respectively, to the estimated population of each island (Tsekeris, 2022). Map 1.1 shows the significant difference in the degree of insularity in Greece, which receives a wide range of values: from very low values for 'coastal' islands (Salamina, Thasos, Ammouliani, Elafonisos) to very high values for remote small islands (Agathonisi, Anafi, Sikinos, Megisti, Agios Efstratios).

Another indicator that reflects the regional problem in the country is that of accessibility. It is calculated for all regional units (NUTS-3) of Greece, and it relies on the well-known measure of market access (or market potential) (Harris, 1954). Specifically, it is expressed as the sum of all freight flows (amount in tonnes) moving by truck vehicles (including movements by ships) within and between pairs of regional units of the country, weighted by the generalised transport cost, as it was defined before (Tsekeris, 2022). Map 1.2 illustrates the significant heterogeneity in the size of the accessibility index, which receives the lowest values for the islands of Voreio Aigaio, Dodekanisa, and Kriti, and the highest values for the metropolitan areas of Attiki and Thessaloniki. The relatively low values of the accessibility index for the island regions can be attributed to both their relatively smaller market size and the higher transport cost between them and the core markets of the mainland, compared to the metropolitan regional units of mainland Greece, particularly those of Attiki, where the capital city of Athens is located, and neighbouring areas.

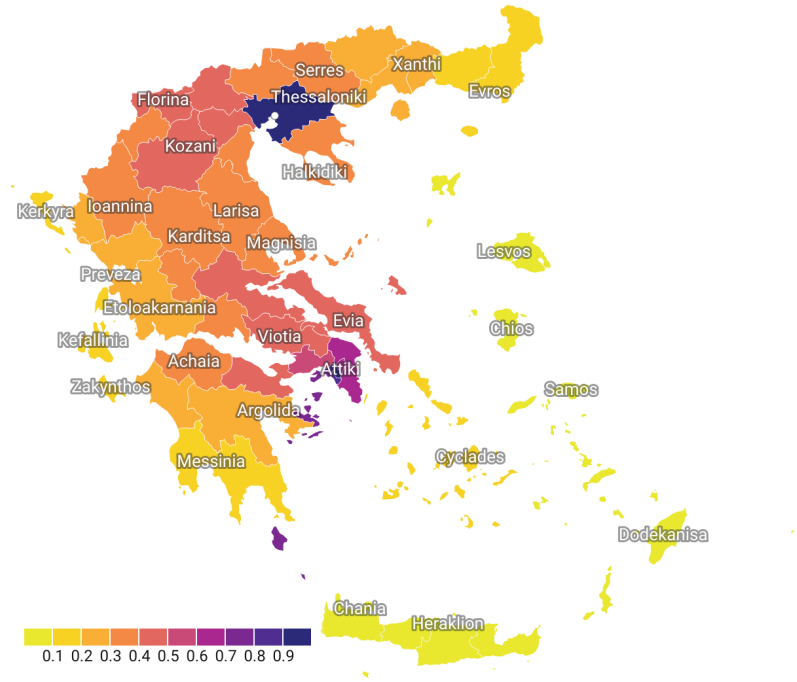
Therefore, suitable policies to effectively address the problems of increased insularity and reduced accessibility and transport affordability should be place-sensitive, knowledge-based and designed according to the particular needs of the local communities. Among others, they may include improvements in local transport and logistics infrastructure, increased and higher-quality intra- and interregional connectivity within island complexes and between them and the mainland country, the management of transport demand, the upgrading of public transport services, and

Map 1.1 The insularity index for the Greek islands



Source: Tsekeris (2022).

Map 1.2 The accessibility index for the Greek regional units



Source: Tsekeris (2022).

the promotion of energy-efficient transport to reduce household and firm expenditure for fossil fuels and enhance the competitiveness of island regions.

The level of accessibility could also be enhanced through the integrated planning of land use and local transport interventions, as specified in the Sustainable Urban Mobility Plans (SUMPs) and the formulation and implementation of other local/special urban, general and thematic (e.g., maritime, energy, tourism) regional plans. A more integrated policy, referred to as the Island Equivalent, could also be developed to combine all three components of the Transport Equivalent measure, i.e., for passengers, businesses, and fuels, as well as other possible negative externalities influencing the conditions of competition, the level of prices and the living standards in island areas. This policy may be supplemented with the design and provision of suitable incentives for entrepreneurship and start-up innovation, mostly connected with the local comparative advantages of islands (e.g., climate, food, natural resources, culture).

1.3. Horizontal and sectoral reforms

Reforms to improve productivity, support competitiveness and enhance growth prospects have remained at the heart of Greece's economic policies from the beginning of the long economic crisis, when a wide-ranging reform programme was developed to address the country's severe imbalances. In the more recent period of recovery from the impact of the COVID-19 crisis, the reform priorities across the EU have been reformulated to promote sustainability and resilience and to address the new challenges and opportunities of the green and digital transition. Accordingly, in Greece, the reform agenda in progress has been adjusted to contribute to these strategic targets, while also serving the country's long-standing reform objectives, e.g., with respect to fiscal sustainability, institutional improvement, efficient market operation and public administration effectiveness.

At present, reform policies in Greece are pursued on the basis of the Greek Recovery and Resilience Plan (RRP), Greece 2.0, and the National Reform Programme (NRP) 2022. The Greek RRP is a strategic investment and reform plan covering the period 2021–2026 and supported by a budget of €17.8 billion in grants and €12.7 billion in loans under the EU's Recovery and Resilience Facility (RRF). The NRP encompasses the major reform initiatives already incorporated in the list of 68 reforms of the RRP, and extends beyond these, outlining additional reform commitments corresponding to challenges that the RRP addresses partially. The reforms of the NRP revolve around the four main reform categories of the RRP, namely; the green transition; the digital transformation; employment, skills & social cohesion; and private investment & the transformation of the economy, with an additional emphasis on fiscal structural reforms and a greater spectrum of reform initiatives across all individual reform areas.

The implementation of reforms under the NRP is supported by the Structural Funds of the Cohesion Policy and by other EU funding instruments, including the RRF, which supports the execution of RRP-related reforms. Progress with reforms under the RRF is monitored closely, with the disbursement of the programme's funds being subject to the satisfactory fulfillment of relevant investment and reform milestones and targets.

The European Commission Recovery and Resilience Scoreboard provides an overview of the progress of EU countries in structural reforms, focusing on the reform milestones set in each member-country's RRP. Based on the information provided in this Scoreboard, at the time of the disbursement of the first payment of the RRF to Greece in April 2022, the country had successfully completed a total of 8 reform milestones relating to reforms in the energy sector, waste management, the railway sector, the labour market, healthcare, fighting poverty, tax legislation and business extroversion promotion.

More particularly, these milestones were addressed via new legislation for the installation and operation of charging infrastructure for electric vehicles, a new legal framework for waste management and recycling, a roadmap for railway reform, revised legislation for risk-sharing and binding targets for minimum clawback reduction in the healthcare sector, a national action plan to combat energy poverty, a schedule for the codification and simplification of tax legislation, a new national strategy for business extroversion, and a new Labour Law introducing several important reforms listed in Table 1.1.

In the course of 2022, further reforms are progressing across all reform pillars, with Greece having submitted in September 2022 a list of 28 more reform and investment milestones completed towards the disbursement of the second payment of the RRF. From the list of key reforms planned in the RRP, Greece has progressed with respect to reforms in the Renewable Energy Sources (RES) account, online cash registers & POS and public administration. More specifically, the country implemented legislative amendments to the RES account, proceeded with reforms for the simplification of RES licensing, started the implementation of a legal framework for online cash registers and POS, and launched a performance-pay system in public administration, starting from a pilot rewarding system covering civil servants involved in the implementation of the RRP.

Further to progress with these key reforms, Greece has also completed several other reform milestones, including the activation of the legal framework regarding life-long learning, the launch of the provision of personal support services to persons with disabilities, the implementation of amendments to the legal framework providing incentives for electronic transactions, the implementation of legislation for the reform of the legal framework concerning tourist ports, entry

Table 1.1 Main reforms of Labour Law 4808/2021

I.	Adoption of a strict framework to prevent and combat violence and harassment in the workplace.
II.	Provisions for flexible working time, brake during work, allowed overtime and working on Sunday.
III.	Provisions with reference to the termination of employment contracts and redundancies.
IV.	Provisions for teleworking.
V.	Introduction of a new digital system for monitoring working hours remotely (digital work card).
VI.	Establishment of paid paternity leave, changes in parental leave, leave for the protection of family and flexible work provisions for parents.
VII.	Transformation of the Labour Inspectorate into an independent authority.

into force of legislation for the organisational reform of the railway sector, and the implementation of the revised legal framework regarding basic and applied research, strategic investments and the internal processes and organisation of the Hellenic Capital Markets Commission.

It should be noted that, since many of the reform milestones listed above represent stages towards the completion of wider reform initiatives, productivity gains from these reforms are subject to the completion of the remaining related reform steps and their successful implementation.

1.4. Productivity from the stakeholders' viewpoint

The analysis presented in this section originates from the preliminary analysis of the outcome of the public consultation process undertaken during 2022 by the Greek NPB. It is mentioned here that the European Commission attaches great importance to and encourages the consultation of National Productivity Boards with social partners and other stakeholders on productivity and competitiveness issues in each country. Among others, the public consultation process can encourage the access to/collection of (firm-level) data, and facilitate the exchange of knowledge, ideas and best practices as well as understanding and collaboration among experts, policy-makers and stakeholders for reaching a consensus and selecting commonly accepted solutions to productivity-related problems. This process is anticipated to raise the impact of productivity-enhancing recommendations and policies on individual markets and the whole economy. Additionally, other key issues, mega-trends and macro-forces, which influence the acceleration and importance of trends, can be jointly identified regarding the twin transition, demographics, skills, institutions and governance.

The current process involves the construction of an open-ended questionnaire with nine questions on key issues related to the productivity and competitiveness of the Greek economy. The questionnaire was addressed to 14 social partners and stakeholders (chambers/business associations, trade unions, banks, research centres, state authorities).[1] Its principal aim was to gather information and record views about the main factors inhibiting and policies potentially fostering the productivity and competitiveness of the Greek economy, as well as about sectors and thematic areas (education and skills, digitisation, the green transition) assumed to have a horizontal influence on productivity. It is stressed that the full presentation of the results of the public consultation process is to be published by the Greek NPB in the next months. The current analysis allows us to identify for the first time in qualitative terms the most critical factors

1. The social partners and stakeholders who participated in the public consultation include the Economic and Social Council of Greece (OKE), the Institute of Labour, General Confederation of Greek Workers (INE-GSEE), the Institute of the Greek Tourism Confederation (INSETE), the Hellenic Federation of Enterprises (SEV), the Economic Chamber of Greece (OEE), the Athens Chamber of Commerce and Industry (EVEA), the Hellenic Parliamentary Budget Office (HPBO), the Special Secretariat of Foresight Strategy, the Foundation for Economic and Industrial Research (IOBE), the Bank of Greece (Economic Analysis and Research Department), the National Bank of Greece (Economic Analysis and Research Department), Piraeus Bank (Greek Economic and Sectoral Research Department), Alpha Bank (Economic - Markets Research Department) and Eurobank (Economic Research Department).

Figure 1.4 Key productivity problems facing the Greek economy (as % of total responses)

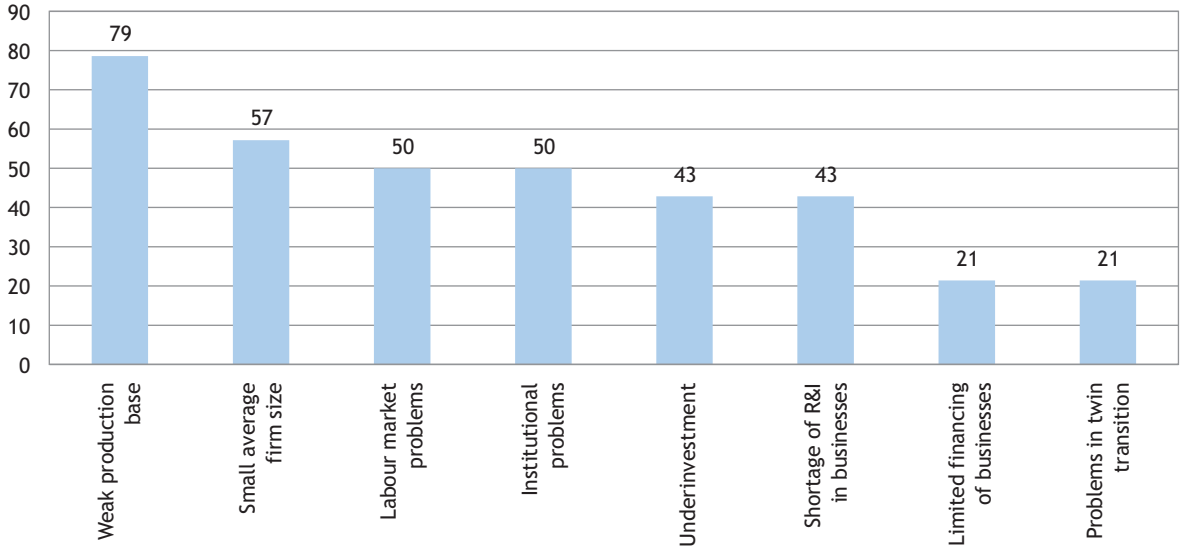
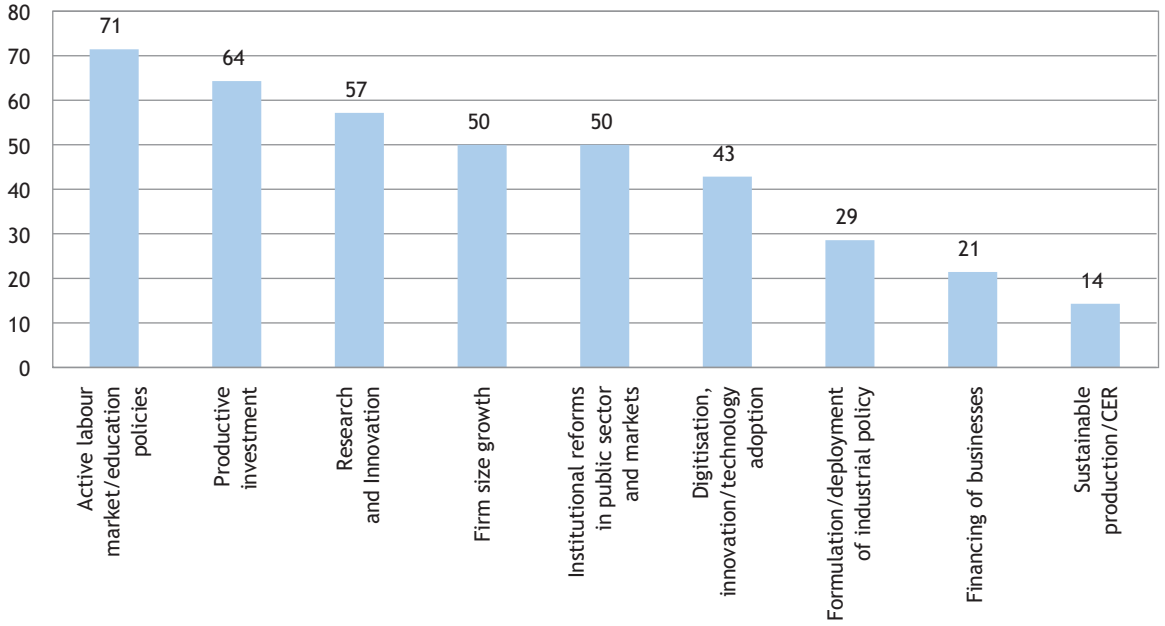


Figure 1.5 Main horizontal policies to boost productivity in the coming years (as % of total responses)



inhibiting productivity growth and to prioritise policies, measures and instruments that are expected to have the highest impact on boosting the productivity of the Greek economy, on the basis of the most frequent responses of social partners and stakeholders to the questions at hand.

The first question concerned the coverage and completeness of the material included in the three previous annual reports of the Greek NPB (2019–2021). It was found that these reports are widely regarded as highly sufficient and balanced in their thematic coverage, well prepared and well documented on the issues of the productivity and competitiveness of the Greek economy as well as on various other issues of current interest. Therefore, they should be seriously considered in the formulation and evaluation of economic policy making and development planning in the country. It was also recognised that these reports are submitted in a constantly changing economic environment, with a number of uncertainties, so that forecasts and estimates should be reassessed on a regular basis. Nonetheless, they constitute a valuable tool, above all, for policy makers as well as for all other kinds of stakeholders.

It is noted that most of the issues raised by the respondents as topics worthy of further investigation are addressed in the current year's report at hand. These issues included the measurement of capital productivity, the investigation of R&I activity and related performance indicators, and the role of energy costs and the green transition in light of current developments, including the war in Ukraine, inflationary pressures, disruptions/shortages in supply chains, etc.

Other issues that were pointed out by the respondents and remain for further investigation refer to public sector efficiency, the quality of institutions, and entrepreneurship, including factors influencing, among others, the economic sentiment and investment attractiveness. Additionally, the potential for the use of micro-data (at the firm level) for productivity analysis was raised. Although such data are not easily accessible and readily available, the use of disaggregate data would produce useful and more detailed productivity indices for (quality-adjusted) labour inputs, and capital and raw/intermediate material inputs, as well as firm performance measures (related to turnover, added value production and sales), to facilitate the examination of inequalities and productivity gaps at the firm and sectoral levels. Some stakeholders also stressed the need to include regular monitoring and evaluation of the Development Laws and of the performance of investment programmes, using different criteria and by source of funding (including the Greek Recovery and Resilience Plan, Greece 2.0) at the sectoral and regional levels.

As far as the question about the key productivity problems facing the Greek economy is concerned, the respondents reported a wide range of issues (Figure 1.4). These issues have been separated into several broad categories of productivity-related problems. The problems identified by more than 50% of respondents are:

- The weak production base/model of the Greek economy, involving the misallocation of production factors, the low value-added investment and production, the very high share of the services sector, the low economic complexity and the low share of internationally tradable goods and high-tech exports, the low allocative efficiency, and the limited intra- and intersectoral linkages in the Greek economy.
- The small average size of firms, which is connected to reduced scale economies, the limited adoption of new technologies, the production of low value-added services, the high share of self-employed and the limited access to funding.
- Poor/inefficient labour market conditions, with reference to labour underutilisation, underpaid jobs, increased non-wage costs, informal/undeclared employment, the lack and

waste of skills, the horizontal and vertical mismatch of skills, the brain drain, the limited labour mobility and the low participation of women.

- Dysfunctionalities in institutions in public administration, the judicial system and the business sectors, which, among others, are associated with remaining complexities in the legal/regulatory framework for the licensing and operation of enterprises, public sector inefficiencies and the lack of spatial planning.

Other key productivity problems facing the Greek economy include:

- The shortage of R&I in businesses and, particularly, the lack of incentives and of new business models, as well as the limited linkages between universities/research centres and businesses.
- The underinvestment or shortage of (productive) investment in infrastructure, networks, and research and development.
- The limited financing of businesses, involving problems of access to loans, low financing and low advisory support by banks, the increased cost of financing and the non-performing loans (NPLs).
- Problems with the twin transition, which mainly refer to the increased cost of the digital and green transitions, and the insufficiency of related incentives and subsidies.

In relation to the question about the main horizontal policies that should be implemented to boost productivity in the coming years, there was also a wide range of responses (Figure 1.5). The responses have been separated into several broad categories of productivity-enhancing policies. The policies that are included in each category can be considered —to a large extent— as complementary with each other. Specifically, the policies that are identified by more than 50% of the respondents are:

- Active labour market/education policies, including life-long education and training programmes, particularly in sectors with increased export specialisation, strengthening linkages between education and the labour market, lower taxation and non-wage costs, higher salaries/wages and support of highly skilled employment, young and female workers/scientists.
- Productive investment, including foreign direct investment (FDI) and public investment in high-productivity, capital-intensive sectors and in (transport, logistics, energy, information and communication–ICT) infrastructure networks with increased positive externalities and multiplier effects, and investment to improve the efficiency of capital infrastructure usage.
- Promotion of R&I, which encompasses the increase of R&D expenditure, particularly in high-tech and export-oriented industries, the systematic measurement and monitoring of R&I performance, the promotion of R&I funding mechanisms, the provision of related incentives, the establishment of technology transfer centers, and the development of synergies among the government, universities/research centres and the business sector.
- Growth of average firm size, which mainly corresponds to the provision of incentives for the promotion of synergies, acquisitions, merging, scaling-up, the participation of small-

and medium-size enterprises (SMEs) in global value chains (GVCs) and intergenerational transmission.

- Institutional reforms in the public sector and markets, which may involve improving the reliability of economic decision making, reinforcing the protection of property rights, reducing bureaucracy, increasing transparency and accountability, upgrading the quality of public services, completing the cadastral system, completing the general and specific spatial plans (e.g., for renewables, industry, tourism, aquaculture, fossil raw materials) and the local and special urban plans, improved planning for the development of business parks, increasing the efficiency of the judicial system and the codification of laws and legal rules, promoting out-of-court dispute resolution mechanisms, strengthening legal training, enhancing market supervisory mechanisms, revising the business taxation system, creating a new corporate governance framework, easing licensing for the operation of economic activities and the installation of renewables, improving the operation of energy and freight transport markets, and the (further) liberalisation of some professional legal/engineering services.

The remaining main horizontal policies which are suggested to be implemented to boost productivity in the coming years include:

- Digitisation and innovation/technology adoption, which refers, among others, to the provision of incentives, subsidies and training to adopt and use digital technologies, and the promotion of the interoperability of digital services offered to citizens and businesses.
- Formulation/deployment of industrial policy, which encompasses integrated plans for the provision of incentives and the facilitation of processes for goods' exports, the authorisation and planning regulations for industrial plants, the coordination of projects for Industry 4.0 and industrial infrastructure, and the containment of energy costs for industry.
- The improvement of the financing of businesses by banks and other sources, for instance, through the exploitation of capital markets, crowdfunding, micro-credits and loans through the Hellenic Development Bank.
- The promotion of sustainable production and corporate environmental responsibility, through the provision of suitable incentives.

1.5. The scope of the annual report for 2022

Given the increased uncertainty arising from the pandemic, the geopolitical and energy crises, and inflationary pressures, there is a need for consistent monitoring and comprehensive evaluation of public policies at all tiers of government and over multiple time horizons. This process would help governments to ensure the most synergistic effects and sectoral/spatial complementarities (spillovers) and avoid unplanned substitution effects and potential conflicts. Particularly in the light of the twin transition and the related massive investments and reforms, such as those related to the RRF, net outcomes on GDP, productivity and well-being would largely rely on the extent and the type of factor substitution and the technological progress. The impacts of instruments used

to facilitate the digitisation or automation and the green transition may interact and widely vary among each other as well as across sectors, firms and regions (EC, 2021a).

For instance, the impacts of the green transition and of related innovations on labour and capital productivity indices, the (un)employment and sustainable job creation and the reduction of productivity and competitiveness gaps within the EU27 and between Europe and other countries worldwide are still questionable. For this purpose, a suitable mix of taxation, subsidies, regulation, physical infrastructure investment, education and skills development, and decarbonisation policies needs to be designed to ensure the maximum possible cost-effectiveness and inclusiveness of all the beneficiaries. In this new environment, the role of R&I is crucial to address possible threats, socioeconomic disparities and environmental concerns, and develop capacities to foster more integrated policy responses in both scientific-technological, social, economic, organisational and institutional dimensions (EC, 2021a).

Greece should shape its competitiveness and growth strategy in this interconnected but highly volatile environment, through upgrading its production to higher value-added and knowledge-intensive activities. Despite the considerable progress that the country has made in the green transition during the last years, compared to the EU average, the policy efforts should be reinforced to catch up to the EU average in other dimensions of sustainability, including its economic, social and governance dimensions.

In this context, Section 2 reports the macroeconomic developments and policies of the country, encompassing an analysis of components and drivers of productivity growth at the national and sectoral levels. Further attention is given to the comparative analysis of (labour and capital) productivity indices of the Greek economy with other European economies, as well as on the cost components and impact of increased energy prices on the Greek economy.

Section 3 discusses the cost and non-cost competitiveness developments of the Greek economy. In this year's report, emphasis is given to the competitive performance of the country in FDI attractiveness, digitisation, the green (and other dimensions of) transition to a more sustainable future, and the R&I system. It is argued that public policies that support digital and green transitions and investments in knowledge, research, innovation, and technology can play an important role in improving the country's competitiveness. Section 4 concludes and provides several policy implications and comprehensive recommendations regarding the enhancement of various components of productivity, the pillars of competitiveness and the dimensions of the transition to sustainability.

2. Macroeconomic Environment and Productivity Developments

2.1. Macroeconomic environment

After the severe contraction of the economy during 2020 because of the COVID-19 pandemic, a vigorous V-shaped recovery in 2021 almost fully recouped the previous year's losses. The latest estimates for the contraction of volume output during 2020 indicate that the economy shrank by 9%, while on the contrary, during 2021, the economy expanded at a rate of 8.4%. Current estimates for the first two quarters of 2022 indicate an expansion of 9% and 7.8%, respectively. However, the conditions of the expansion have brought about an inflationary process which, combined with several significant external factors such as the war in Ukraine, increases uncertainty and threatens to upend current growth dynamics. Particularly, in a process, that mirrors the global trend, after experiencing deflation by 1.3% in 2020, inflationary pressures started being felt during late 2021, with the harmonised CPI increasing by 0.6%. Because of the war in Ukraine, this initial mild increase in inflation, fuelled by pent-up demand and backed by cumulated unspent savings during the pandemic, has metastasised into a more malignant form, as energy and food import prices have pushed inflation up to an unprecedented 11.3% during May 2022. Despite the appearance of new headwinds, the economic expectations remain strongly positive, with future investment flows of the Greek National Recovery and Resilience Plan, Greece 2.0, guaranteed by the EU Recovery and Resilience Facility.

During 2021, the effects of the pandemic were arrested through the widespread vaccination of the general population, with the vaccination rate currently standing close to 75%. However, starting in November 2021, an additional wave of the pandemic, fuelled by the Delta and Omicron variants, had a significant impact on hard COVID-19 indicators. Despite this fact, the effects of the pandemic on economic activity appeared to be reduced compared to previous episodes. This was partially the result of less stringent social distancing measures, allowing for greater mobility of the population and thus enhanced economic activity, and partially the result of the economy being better prepared for the effects of the pandemic. In particular, the increased use of digital tools, especially for teleworking and retail purposes, has greatly offset the impact of reduced mobility and is gradually transforming long-term habits in those particular fields. In addition, tourism receipts strongly rebounded in 2021 to 10.5 billion euros after the collapse of 2020 to 4.3 billion euros, compared to the historical high of 2019 that reached 18.2 billion euros. Expectations regarding tourism receipts in 2022 remain strong, fuelled by further normalisation of travel conditions, with minimal impact from the war in Ukraine, as tourists from Russia and Ukraine form only a very small percentage of the total. Therefore, although the impact of COVID-19 on the economy remained significant during 2021, its effects were greatly offset by several counteracting factors, with the recovery process gaining momentum.

Increased energy prices, a trend that started in the autumn of 2021 and has intensified at an alarming rate after the Russian invasion of Ukraine, are beginning to cause a downward

adjustment on growth dynamics. Especially, the rise of inflation is driven mainly by energy prices, with natural gas prices for the consumer increasing y-o-y by 172.7%, electricity prices by 80.2%, and heating oil by 65.1%. The causes of increased energy prices can be found in both transitory and more structural phenomena. Transitory phenomena include: (a) base effects resulting from the deflationary episode of the pandemic, (b) pent-up demand backed by increased household savings during the pandemic and the effect of loose fiscal and monetary policies aiming to mitigate the sharp reduction in economic activity, (c) disruptions in the supply chains leading to a supply shortage in several goods. Structural phenomena include: (d) changes in the energy mix away from fossil fuels towards renewable energy, causing short- and mid-term disruptions and increased energy costs, (e) the end of energy dependence on Russia.

The concurrent causes of the current inflationary episode underly the significant differences between Europe and the United States. Particularly, even though inflation both in the Eurozone and in the USA is increasing at a similar rate, the USA has significantly less exposure to Russian fossil fuels, and therefore, the inflationary process there can be almost exclusively attributed to domestic causes. On the contrary, European reliance on Russian fossil fuels indicates that a large part of the increase in prices can be attributed to imported inflation. Therefore, monetary policy is less able to address inflationary pressures in Europe compared to the USA.

Structural phenomena are being addressed by the EU initiative REPowerEU that leverages funds additional to the Recovery and Resilience Facility (RRF) in order to promote the green transition and address gas supply interruptions stemming from the war in Ukraine. Currently, the dependence of the Greek economy on imports of Russian fossil fuels is significant, as imports of natural gas were, until recently, substituting domestically produced lignite coals. In particular, lignite coal accounted for 54% of the energy mix in 2010, falling to 14% in 2020, and natural gas accounted for 40% in 2020, up from 17% in 2010, with half of the natural gas imports coming from Russia. Currently, a number of Liquified Natural Gas (LNG) projects are being considered in order to reduce energy dependency on Russia.

However, the persistence of high inflation will affect expectations and thus has the potential to become entrenched if a wage-price spiral is initiated due to labour market developments. Conditions in the labour market continue to improve, with the latest figures for the unemployment rate (12.2%) indicating that it has, for the first time, fallen below the levels last seen before the beginning of the Greek debt crisis in 2010. Critically, the fall in the unemployment rate has been coupled with an increase in employment; transitions of employed persons to outside the labour force, a phenomenon that gained momentum during the first stage of the pandemic, have now been reversed. However, taking a long view, the labour force still remains lower by 300,000 persons relative to the levels of 2010, indicating the significant exodus of skilled workers during the last decade.

The general improvement of conditions in the labour market can be clearly observed when the relation between the vacancy and the unemployment rates, i.e., the Beveredge curve, is considered. It is critical to note that after 2015, the curve has shifted inward, indicating a falling rate of unemployment with a more or less constant rate of vacancies. We note that the improvement of labour market conditions has not yet resulted in a labour market where unemployment

decreases concurrently with higher vacancy rates. On the contrary, the current result, i.e., a lower unemployment rate and a constant vacancy rate, probably indicates an improvement in labour market efficiency.

Higher inflation has already had some impact on wage setting, although this remains subdued. In the recent setting of the minimum wage by the government, inflation expectations and the need to support lower incomes resulted in a significant increase in the minimum wage in 2022. In particular, after having remained stagnant at 586 euros[2] (511 euros for employees under 25) from February 2012 to February 2019, reduced by 22% (and by 32% for employees from 18 to 25 years old), minimum wages increased by 10.91% for employees over 25 and by 27.22% for employees under 25 to 650 euros. This significant increase was followed, in January 2022, by a modest rise of 2%, resulting in a minimum wage of 663 euros, and following that by an increase of 7.5% to 713 euros. Therefore, minimum wage increases, after being severely reduced and kept stagnant for seven years, currently have not yet exceeded changes in inflation. Similarly, average wages have not been affected by inflation increasing in 2021 at an average rate of 2.15%.

Fiscal policy overall has been accommodating during the pandemic crisis, resulting in the reappearance of primary deficits and a substantial increase in public debt (see Section 3.1). It is important to note that, under the current conditions, the rate of the recovery process is the main determining factor for the quick return to fiscal prudence as all magnitudes of receipts, payments, and the GDP depend on it.

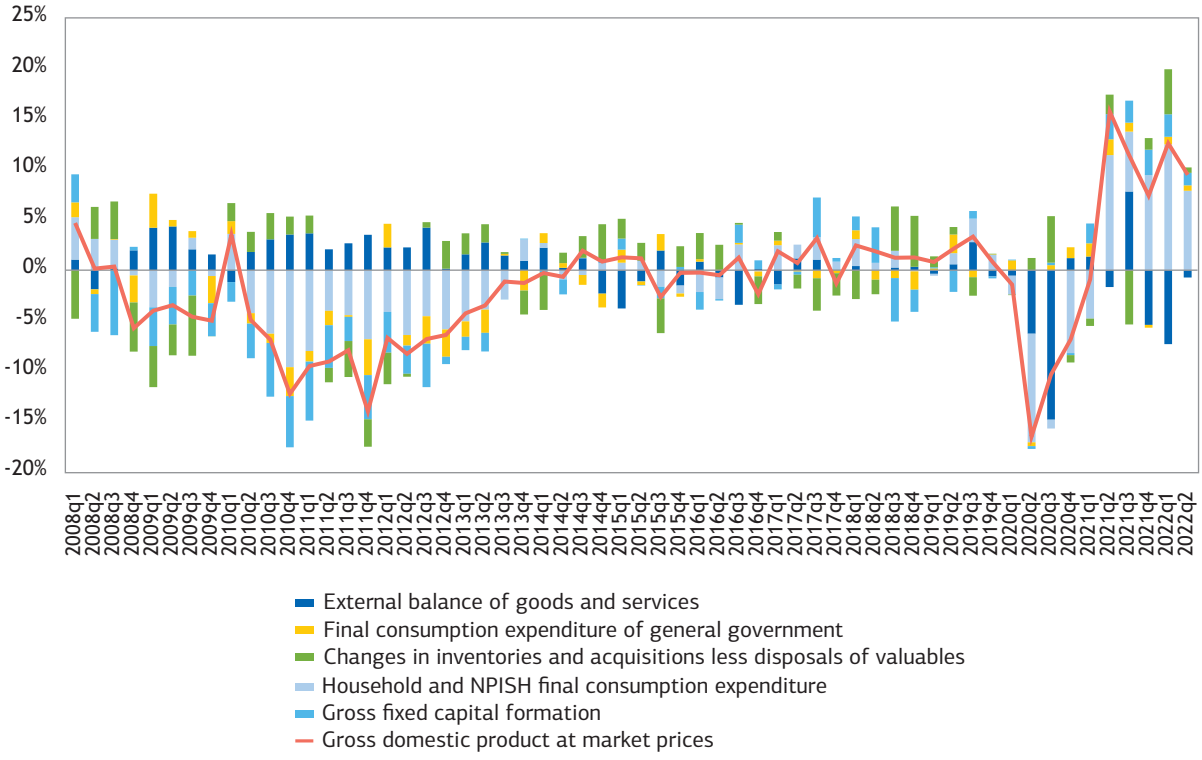
Turning to a more detailed examination of the factors contributing to the strong rebound in GDP growth, starting from the second quarter of 2021 and continuing to 2022 (Figures 2.1.1 to 2.1.3), we find that the rebound is led by the unusually strong household consumption expenditures, mainly a result of pent-up demand during the pandemic proper. In particular, during the second quarter of 2021, GDP expanded by 15.7%, a result that can be attributed to an increase in consumer spending by 11.4%, an increase in investment by 2.5%, increases in inventories by 1.9%, an increase in government spending by 1.6% and a negative external trade balance of -1.7% (see Section 3.1).

During the summer months of 2021, aggregate demand increased by 11.4%, with the external balance turning strongly positive, at 7.8%, because of the normalised conditions in the tourism industry, followed by strong consumer demand, contributing 5.9% to GDP growth, with investment also remaining strong at 2.2%, general government spending contributing 0.9%, and, finally, a negative impact by the draw down of inventories, contributing a negative 5.4%.

During the fourth quarter of 2021, despite the resurgence of hard COVID-19 indicators due to the appearance of the Delta and Omicron variations, economic activity remained strong. In particular, GDP increased by 7.4%, with consumer spending contributing 9.4%, investment 2.5%, inventories 1.1%, and with government spending and the external sector having a negative impact on GDP growth by 0.3% and 5.4%, respectively.

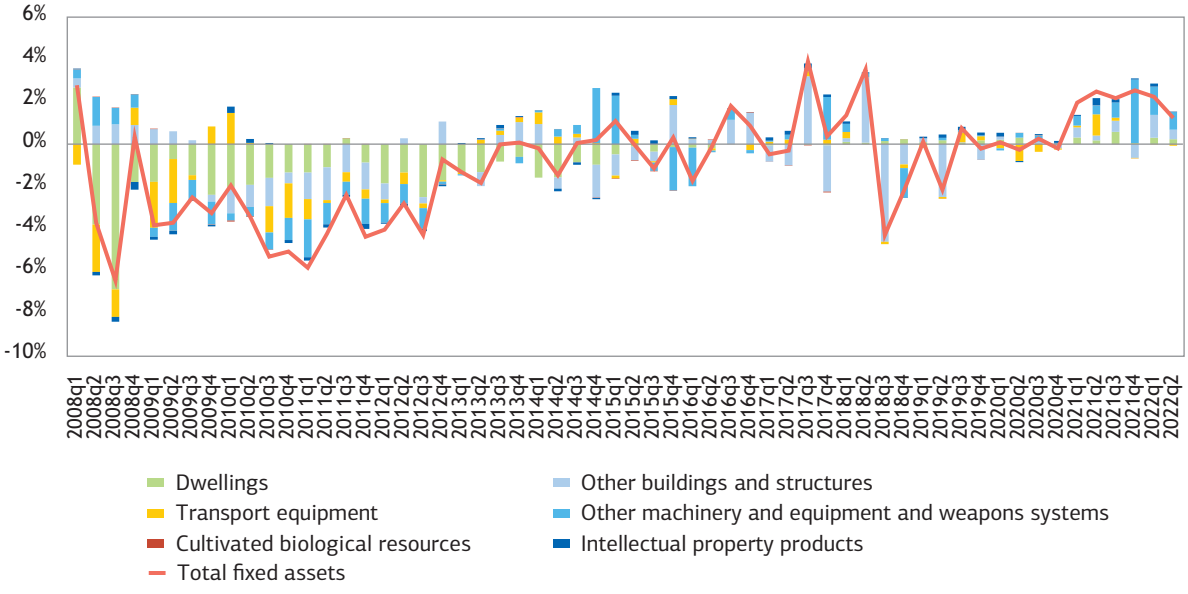
2. Gross wage on the basis of a 14-month (per year) payment system.

Figure 2.1.1 Contributions to GDP growth



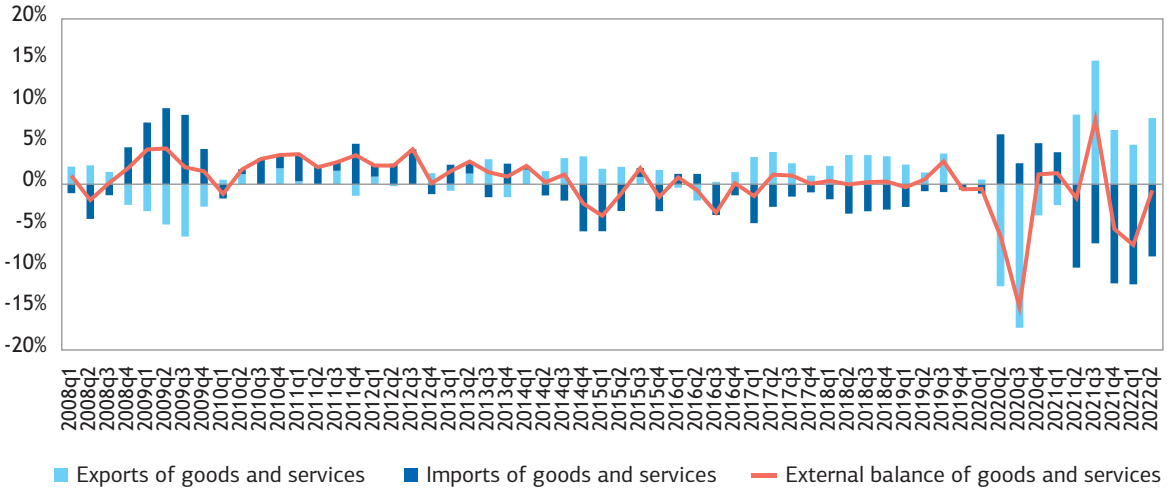
Source: Eurostat, author's own calculations.

Figure 2.1.2 Contributions to GDP gross fixed capital formation growth



Source: Eurostat, author's own calculations.

Figure 2.1.3 Imports and exports of goods and services



Source: Eurostat, author's own calculations.

During the first quarter of 2022, and despite the significant impact of the combined effect of COVID-19, increased energy prices and the initiation of hostilities in Ukraine, the economy grew by 11.4%, a result that again came as a consequence of strong consumer spending and investment activity, the former contributing 12.7% and the latter 2.2%. In addition, government spending increased GDP by 1.3%, with inventories contributing an additional 2.3% and the external sector having a negative impact of 7.1%.

Finally, during the second quarter of 2022, GDP increased by 9.4% with household consumption contributing 7.9%, investment 1.2%, changes in inventories a further 0.5%, while net exports had a negative impact of 0.7%.

Therefore, in conclusion, the recovery process is fuelled by strong consumer spending and also a favourable investment behaviour, with the latter growing consistently at a rate surpassing 2% of GDP. In particular after, the second quarter of 2021, GDP growth averages at 11.3%, consumer spending at 9.4%, and investment activity at 2.1%, indicating that a strong recovery is underway.

Increased investment activity during the recovery period encompasses all classes of fixed assets. In particular, dwellings and other constructions each contributed 0.3% to GDP growth, or a quarter of the total investment activity. Transport equipment contributed an additional 0.3%, with other machinery contributing 1.4%. Therefore, machinery in general account for an exceptional 70% of investment activity, indicating the dire need of new capital structures in the Greek economy after a decade of zero or negative investment. However, it is critical to note that in ICT equipment and in intellectual property products, which are asset classes closely related with high technology and innovation, investments remain extremely low.

Finally, we also note that despite the initial increase in general government net borrowing, as a direct result of slightly lower tax revenues and significantly higher expenditures during the pandemic, the situation appears to be normalising. In particular, after the second quarter of 2021, net borrowing

has come significantly down, indicating that a macroprudential fiscal stance continues to be a high priority. Future investment flows also positively affect the prospects of the Greek economy in the near and medium term. In particular, more than 80 billion euros, or 45% of GDP, are expected to be available in the near future, resulting in an investment shock for the Greek economy: (i) RRF funds amounting to 31.16 billion euros, resulting in total mobilised investment resources of 59.81 billion euros, (ii) 19.3 billion euros from the Common Agricultural Policy for the new programming period, additional funds, (iii) 26.2 billion euros from the Cohesion Policy funds.

2.2. Own projections for 2022–2023

In order to project the macroeconomic aggregates of the model[3] over the 2022–2023 period, we assume that tourism will almost recover in 2022, i.e., the international travel receipts will increase by about 7 billion euros. The increase in the number of travel receipts is not optimistic, and such an assumption leads to the gnawing of expectations for the exports in 2023. We also assume that the government will continue to support the economy in 2022 through additional expenditure to reduce the implications of inflationary pressures, particularly the increased energy costs. This means that the government expenditure will basically remain at the 2022 level, even though it is expected to reduce slowly so that it reaches the pre-pandemic levels in 2023. We further include our evaluation about the impact of the Greek Recovery and Resilience Plan, Greece 2.0, in our baseline projections. We assume that the Greek government will receive in time all the money that corresponds to 2022 and 2023, which will be entirely spent on investments. This assumption implies that the investments will increase by about 13% both in 2022 and in 2023.

Table 2.2.1 GDP, employment and imports estimates

	2022	2023
Baseline scenario		
GDP	5.7%	1.2%
Employment	7.4%	2.0%
Imports	5.6%	0.8%
Optimistic scenario		
GDP	6.2%	2.1%
Employment	7.8%	2.8%
Imports	5.9%	2.2%
Pessimistic scenario		
GDP	5.7%	0.6%
Employment	7.4%	0.1%
Imports	5.6%	0.2%

Source: KEPE's own estimates.

3. This model is based on a dynamic extension of Kurz's (1985) matrix multiplier framework in the cases of open economy (Metcalfe and Steedman, 1981) and pure joint production (Mariolis, 2008).

Based on all the above assumptions, the model in the baseline scenario projects a y-o-y increase of real GDP by 5.7% in 2022 and 1.2% in 2023. This outcome denotes that the Greek economy will exceed its pre-pandemic GDP level. By assuming that, in 2022, the travel receipts return to the 2019 level and, at the same time, in 2023, the government expenditure will remain at the 2022 level, then, real GDP will increase by 6.2% in 2022 and 2.1% in 2023 (optimistic scenario). However, except for the risk of inflation and increased energy costs, which are expected to be substantially contained by the government, there is the risk originating from the low capacity of the Greek authorities to timely implement the Greece 2.0 plan. This scenario corresponds to an increase of investments by about 7.3% in 2023 and, in turn, an increase in real GDP by 0.6% in 2023 (pessimistic scenario).

In a nutshell, the GDP is expected to range between 5.7-6.2% on average during 2022, while the exact amount of growth will depend on the course of travel receipts. In 2023, the GDP is expected to range between 0.6-2.1%, on average, depending upon both the continuation of the government to support the economy and the implementation of the Greece 2.0 plan. Therefore, on this basis, the successful effort of the government to support the economy and the acceleration of the absorption of the EU funds must be continued.

2.3. Aggregate productivity growth

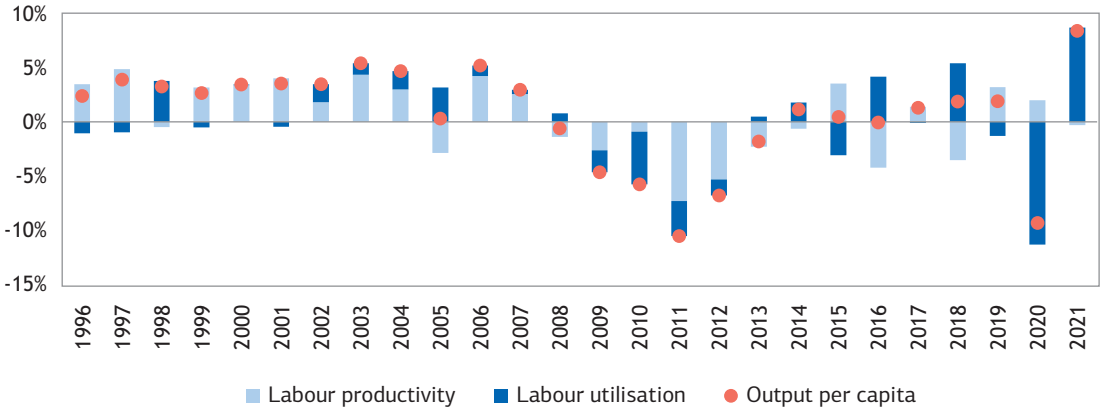
2.3.1. Aggregate productivity growth decomposition

During 2021, real output increased by 8.3%, hours worked by 8.7%, and employment by 0.5%. As a result, labour productivity per hour worked marginally declined by 0.31% (Figure 2.3.1), whereas labour productivity per person employed increased by 7.55%. Such an outcome can be understood as transposing the effects of the previous year when labour productivity per hour worked mildly increased and labour productivity per person strongly decreased (see also Section 1.1). Therefore, it appears that labour productivity measured on a per person basis became more volatile during the pandemic crisis, compared with the same measure using hours worked as labour input. This is because large swings in output were not coupled with equally large variations in employment status, due to the unprecedented fiscal measures aiming at keeping people at work during the pandemic crisis.

The same issue also affects estimates of total factor productivity (see Figure 2.3.2). In particular, the use of employed persons, instead of hours worked, as the measure of labour input, produces measures of TFP growth that suffer from very high volatility; especially when coupled with a variable —year specific— wage share. On the contrary, using hours worked and a fixed —period average— adjusted wage share results in TFP growth of 3.95% for 2021. Therefore, we conclude that labour productivity during 2021 declined by 0.31%, whereas total factor productivity increased by 3.95%, when both measures use hours worked as labour input.

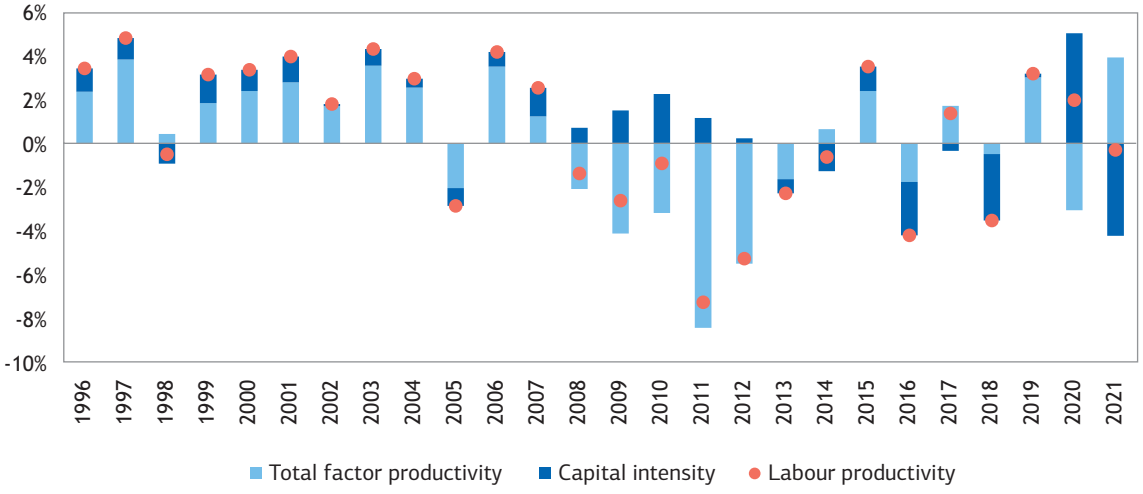
In order to obtain additional information on the determinants of labour and TFP, we proceed by decomposing aggregate per capita output growth into changes in labour productivity and labour utilisation (Figure 2.3.1). In particular, the rebound in per capita output by 8.39% in 2021 can

Figure 2.3.1 Output per capita decomposition, 1996–2021



Source: Eurostat, author's own calculations.

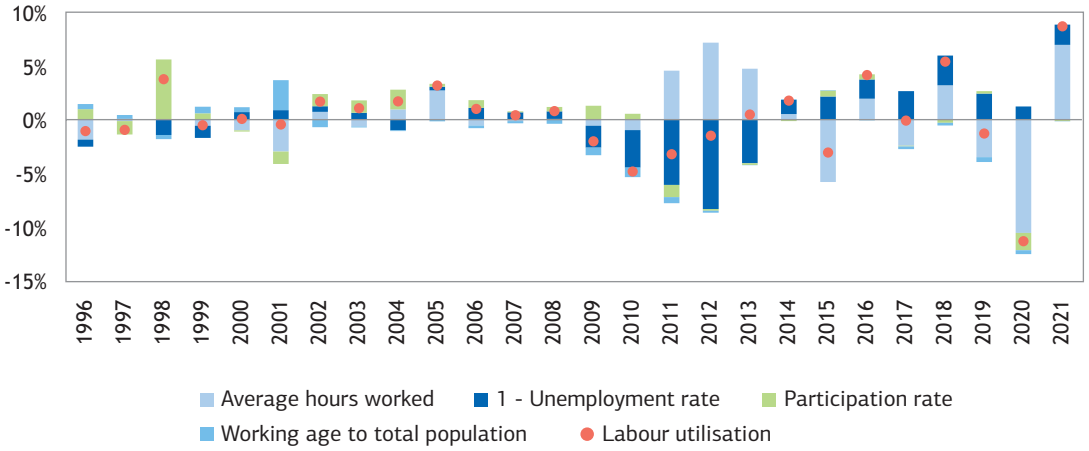
Figure 2.3.2 Labour productivity decomposition, 1996–2021



Source: Eurostat, author's own calculations.

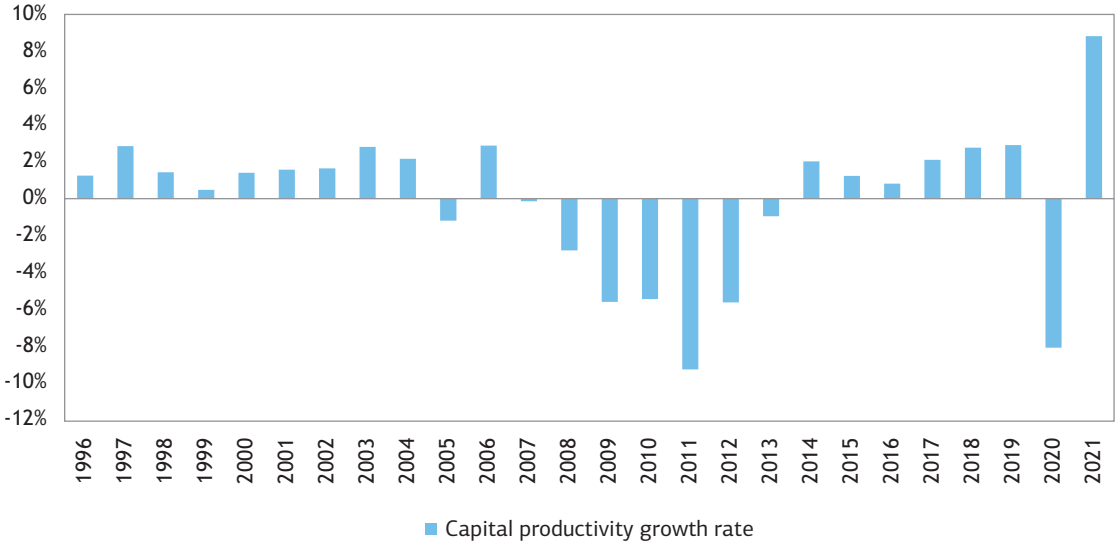
exclusively be attributed to the rebound in labour utilisation, which increased by 8.70%, whereas labour productivity growth, as already mentioned, contributed negatively by 0.31%. In greater detail, the fall in labour productivity growth cannot be attributed to the trajectory of TFP, since the latter, as mentioned, increased by 3.95%, but instead was heavily influenced by a fall in capital intensity, with the latter decreasing by 4.26%. In turn, the fall in capital intensity was the result of increasing hours worked and steadily decreasing capital stock. We note that this marks the twelfth consecutive year that capital stock declines in Greece. Turning our focus on the decomposition of labour utilisation, we find that the significant increase in that variable can be attributed to the increase by 6.97% of average hours worked, while other factors had a somewhat limited effect (Figure 2.3.3). In particular, the participation rate and effect of population aging

Figure 2.3.3 Labour utilisation decomposition, 1996–2021



Source: Eurostat, author's own calculations.

Figure 2.3.4 Capital productivity, 1996–2021



Source: Eurostat, author's own calculations.

reduced labour utilisation only marginally, by 0.15% and 0.01%, respectively, while the continued decrease in unemployment helped to increase labour utilisation by an additional 1.88%.

Capital productivity, measured as output per physical capital, is the counterpart of labour productivity and conceptually has an equally important role in determining the standard of living of the population (see Section 2.6). Physical capital comprises of structures, machinery, including ICT, and intellectual and cultivated assets. Therefore, increasing capital productivity can be equated with more efficient use of capital assets in the production process, whereas decreasing capital productivity can be equated with progressively less efficient use of capital. Our results indicate

the significant impact of the COVID–19 pandemic on this measure of productivity, as capital productivity first declined sharply in 2020 and then strongly rebounded in 2021 (Figure 2.3.4).

Therefore, we conclude by stating that a normalisation of conditions during the ongoing COVID-19 pandemic was indeed translated into a significant rebound in output. This result can almost exclusively be attributed to fiscal measures allowing people to stay at work during the pandemic and therefore be immediately available to restart production processes at the first opportunity. This policy did not only prove to be beneficial for workers and their families in the short run, as employment positions were subsidised by the state, but also to the economy as a whole in the medium run, since the rebound in output would have been significantly lower without the implementation of such a policy.

However, long-term issues remain as a result of a number of factors. First, the significant fiscal burden of the pandemic has to be addressed in order to avoid aggravating inflationary pressures and macroeconomic imbalances during the recovery, a process made significantly more difficult during the current war-induced difficulties. Greece is uniquely set up to address this problem, since, during the past decade, fiscal consolidation and a prudent debt strategy have been institutionally hardwired into the functions of the state. Second, supply chain disruptions arising both from the pandemic crisis and the war in Ukraine pose a significant threat to the trajectory

Box 2.3.1 Output decomposition

Given that labour productivity can be decomposed into total factor productivity and capital intensity (see, e.g., Gomez-Salvador et al., 2006):

$$\frac{Y}{L} = TFP \times \left(\frac{K}{L}\right)^{1-a}$$

and that labour utilisation can be decomposed into effects for average hours worked, the unemployment rate, the employment rate, and aging, as follows:

$$\frac{L}{N} = \left(\frac{L}{EMP}\right) \times \left(1 - \frac{U}{LF}\right) \times \left(\frac{LF}{POP}\right) \times \left(\frac{POP}{N}\right)$$

then, output per capita can be decomposed into the effects of labour productivity and labour utilisation:

$$\frac{Y}{N} = \frac{Y}{L} \times \frac{L}{N}$$

where Y is the output, L the hours worked, K the capital, a the labour share of income, TFP the total factor productivity, N the total population, EMP the employment, U the unemployment, LF the labour force, and POP the population of working age.

of the recovery process, especially if current inflation dynamics become entrenched in inflation expectations. Current actions by the ECB and other central banks in the world move to address this situation. Third, chronic underinvestment leading to a historically decreasing capital stock is another headwind to future productivity. However, current investment plans organised into the framework of the Greek RRF, Greece 2.0, are a source of optimism as they guarantee a significant increase in investment activity in the near and medium terms. Finally, demographics pose an additional long-term issue, which is expected to have possibly the greatest impact on the future of the Greek economy (Hellenic Parliament, 2018; Kotzamanis, 2022). Finally, it is important to note that a significant threat mentioned in previous reports of the Greek National Productivity Board, namely non-performing loans (NPLs), has been largely addressed, with the overall NPL ratio falling from an all-time high of 49.1% in March 2017 to 30.3% in March 2021, and to 12.1% in March 2022. This result strengthens confidence in the ability of the Greek banking system to finance future investment and, therefore, guarantee the recovery process.

2.3.2. Malmquist index

Data Envelopment Analysis (DEA) is an alternative, non-parametric method of measuring efficiency, which circumvents the problem of specifying a particular functional form for the production function and, hence, relies on fewer assumptions regarding the underlying technology. In particular, we make use of a Malmquist Productivity Index (MPI) in order to calculate the efficiency of the Greek economy relative to other countries in the European Union. The MPI is based on the calculation of a distance function of an observation of inputs and outputs calculated between two periods with respect to a constant returns to scale frontier benchmark. In particular, following Balk (2001) and Balk and Zofío (2018), it is possible to decompose MPI into a component for efficiency change, a component for technological change, a component of the scale and input mix effect, and a component for the output mix effect.

The first component, the efficiency change, can be understood as representing the technological catching-up effect of the country under consideration between the base and subsequent period. The second component, technological change, can be understood as representing the shifting of the technological frontier happening between the two periods. The third component, scale and input mix effect, can be considered as corresponding to efficiency improvements resulting from changes in the scale of production and from the input mix. The fourth component, output mix, presents the effects resulting from changes in the output mix; such a component exists only in the case of a multi-output model and need not be considered here. Our calculations about Greece, in comparison with the European Union using capital and labour as inputs and producing a single output over the years 2018–2019, indicate that the output-oriented MPI increased, implying an increase in efficiency.

Moreover, using the decomposition of the MPI, we can identify the first component, catching up, as the sole contributor, since technological change and scale and input mix components had a negative, although minimal, impact on MPI. Those results indicate that although the Greek economy was seeing productivity gains during the period under consideration, those came mainly as a result of catching-up effects and not due to incorporating new technology. Moreover,

Table 2.3.1 Malmquist index decomposition, EU countries, 2018–2019

DMU	M	EC	TC	SCE
AT	0.9987	1.0024	1.0009	0.9954
BE	1.0036	1.0076	0.998	0.998
BG	1.036	1.0213	1.0141	1.0002
CY	1.0279	1.0312	0.988	1.0089
CZ	1.0038	1.0113	0.9923	1.0002
DE	1.0017	1	1.0106	0.9913
DK	1.0055	1.0088	0.9925	1.0043
EE	1.0109	1.01	0.9969	1.0041
EL	**1.0389**	**1.04**	**0.9992**	**0.9997**
ES	1.0048	1.0017	1.0018	1.0012
FI	0.9973	1.0074	0.991	0.999
FR	1.011	1	1.0064	1.0046
HR	1.0159	1.0197	0.9953	1.001
HU	1.039	1.0389	1	1.0001
IE	1.0056	0.9801	0.994	1.0322
IT	1.0045	1.0017	1.0034	0.9995
LT	1.0138	1.0066	1.0048	1.0024
LU	1.007	1	1.0095	0.9975
LV	1.0219	1.0255	0.9964	1.0001
MT	1.0202	1	1.0032	1.017
NL	0.9997	0.9968	1.0018	1.0012
NO	0.9948	1	1.0014	0.9933
PL	1.0301	1	1.0301	0.9999
PT	1.0293	1.0346	0.9948	1
RO	1.022	1.0128	1.0088	1.0002
SE	1.0274	1.0279	0.9975	1.002
SI	1.0265	1.0318	0.9916	1.0033
SK	1.0082	1.0101	0.9936	1.0045
UK	0.9945	1	1.0106	0.9841
Mean	1.0138	1.0113	1.001	1.0016
Std	0.0136	0.0146	0.0087	0.0081
Max	1.039	1.04	1.0301	1.0322
Min	0.9945	0.9801	0.988	0.9841

Source: Eurostat, author's own calculations.
M = Malmquist; EC = Efficiency Change; TC = Technological Change; SCE = Scale Effect.

aggregate statistics over the entire sample of countries under consideration indicate much can be done to improve the effects of incorporating new technologies since frontier shift effects remain subdued.

2.4. Sectoral productivity growth

2.4.1. Labour productivity growth

Turning to the sectoral dimension of productivity growth in the Greek economy, we find that due to the effects of the pandemic, the effects of recovery were not uniformly distributed across economic sectors, as was the case with the initial decline in output and employment. In particular, we find that out of the 11 major sectors of the economy, 5 experienced slight productivity increases, as output increased faster than employment; 2 sectors experienced slight productivity decreases; and 3 sectors behaved as outliers.

The first group of sectors includes both production and services sectors. In particular, "Construction" experienced a significant rebound both in output (10.3%) and hours worked (6.4%), leading to a labour productivity increase of 3.6%. The same is true for "Information and communication" that also experienced increased output (7.3%) and hours worked (4.9%), leading to a labour productivity increase of 2.3%. Another sector with significant increases in both output (11.7%) and hours worked (9.5%) was that of "Professional, scientific and technical activities; administrative and support service activities", leading to a labour productivity increase of 2%. Slightly lower productivity increases, namely 1.8%, were experienced by "Industry" as hours worked increased by 8.3% and output increased by 10.3%. Finally, negligible increases in labour productivity, 0.1%, were experienced by "Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organisations and bodies" as hours worked increased (12.4%) almost in tandem with output (12.5%).

The second group of sectors, those that experienced slight productivity decreases during 2021, includes "Public administration, defense, education, human health and social work activities" and "Financial and insurance activities". The former sector experienced a significant increase in output (2.9%), but increases in hours worked were greater (4.8%), resulting in a productivity decrease of 1.8%. The latter sector experienced a significant decrease in output (-7.9%), coupled with significant decrease in hours worked (-6.8%), resulting in a productivity decrease of 1.2%.

Perhaps more interesting is the behaviour of the three outlier sectors during 2021. The first such sector is that of "Real estate activities", where output increased only marginally (0.3%) and hours worked increased substantially (36.9%), resulting in a significant decrease in productivity by 26%. The second outlier sector is that of "Agriculture, forestry and fishing", where output decreased by 8.4% and hours worked increased by 11.1%, also leading to significant reduction in productivity by 17.6%. Lastly, "Wholesale and retail trade, transport, accommodation and food service activities", a sector greatly affected by the pandemic crisis, experienced exceptional increases in both output (19.4%) and hours worked (10.4%), leading to a very significant increase in labour productivity by 8.2%.

Table 2.4.1 Contributions to labour productivity growth per sector, 2021

Code	Sector	Labour productivity	GVA	Hours worked
A	Agriculture, forestry and fishing	-17.6%	-8.4%	11.1%
B-E	Industry (except construction)	1.8%	10.3%	8.3%
F	Construction	3.6%	10.3%	6.4%
G-I	Wholesale and retail trade, transport, accommodation and food service activities	8.2%	19.4%	10.4%
J	Information and communication	2.3%	7.3%	4.9%
K	Financial and insurance activities	-1.2%	-7.9%	-6.8%
L	Real estate activities	-26.7%	0.3%	36.9%
M-N	Professional, scientific and technical activities; administrative and support service activities	2.0%	11.7%	9.5%
O-Q	Public administration, defence, education, human health and social work activities	-1.8%	2.9%	4.8%
R-U	Arts, entertainment and recreation; other service activities; activities of households and extra-territorial organisations and bodies	0.1%	12.5%	12.4%
TOTAL	**Total - all NACE activities**	**-1.1%**	**7.5%**	**8.7%**

Source: Eurostat, author's own calculations.

2.4.2. Sectoral determinants of productivity growth

Focusing on the proximate sources of output growth using a growth accounting framework, we can identify the impact of heterogeneous capital inputs. In a standard growth accounting framework, we distinguish between four capital asset classes, including structures, machinery, biological and intellectual capital. In particular, we estimate the average contribution of labour, capital and TFP to output over a period extending from 1995 to 2019. No adjustment is made for differences in labour quality due to data unavailability.

Our results indicate that significant differences exist between industries. In particular, using a two-digit sectoral classification (see Table A.1 in the Appendix), we find that the five sectors that had the greatest increases in output and TFP were "employment activities", "repair and installation of machinery and equipment", "travel agency, tour operator, etc.", "water transport", "insurance, etc.". The industries experiencing the greatest increases in labour input were "Activities auxiliary to financial services and insurance activities", "Computer programming, consultancy, and information service activities", "Manufacture of basic metals", "Water transport", "Forestry and logging". The top five industries in capital input growth were "Water transport", "Other personal service activities", "Travel agency, tour operator and other reservation service and related activities", "Postal and courier activities", "Warehousing and support activities for transportation".

Table 2.4.2 Growth accounting, by sector of the Greek economy, 1995–2019

Industry	Output	Labour	Capital	Structures	Machinery	Biological	Intellectual	TFP
A01	-0.3%	-0.1%	0.0%	0.0%	-0.1%	0.0%	0.0%	-0.2%
A02	0.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%
A03	1.2%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	1.1%
B	-1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.6%
C10_C12	-0.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.9%
C13_C15	-4.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-5.0%
C16	-6.6%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-6.7%
C17	-4.3%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-4.5%
C18	-5.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-5.6%
C19	-2.9%	0.2%	0.0%	-0.1%	0.1%	0.0%	0.0%	-3.0%
C20	1.7%	0.2%	-0.1%	0.0%	-0.1%	0.0%	0.0%	1.5%
C21	2.5%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.4%
C22	-0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.4%
C23	-3.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-3.7%
C24	-1.8%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.1%
C25	-0.4%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	-0.4%
C26	2.3%	0.0%	-0.1%	0.0%	0.0%	0.0%	0.0%	2.4%
C27	-2.8%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.8%
C28	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.1%
C29	-3.6%	-0.2%	-0.1%	-0.1%	0.0%	0.0%	0.0%	-3.3%
C30	3.8%	-0.1%	-0.2%	0.0%	-0.2%	0.0%	0.0%	4.1%
C31_C32	-3.4%	0.3%	0.1%	0.0%	0.1%	0.0%	0.0%	-3.7%
C33	6.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	5.9%
D	1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%
E36	-1.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.3%
E37_E39	-1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.1%
F	-1.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.0%
G45	1.8%	0.0%	0.0%	0.0%	-0.1%	0.0%	0.0%	1.8%
G46	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.7%
G47	-2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-2.3%
H49	0.2%	0.1%	-0.1%	-0.1%	0.0%	0.0%	0.0%	0.2%
H50	5.7%	0.3%	0.3%	0.0%	0.3%	0.0%	0.0%	5.1%
H51	1.3%	-0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%

Table 2.4.2 (continued)

Industry	Output	Labour	Capital	Structures	Machinery	Biological	Intellectual	TFP
H52	2.1%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	1.9%
H53	2.1%	-0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	2.0%
I	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%
J58	-2.5%	0.0%	-0.1%	0.0%	-0.1%	0.0%	0.0%	-2.4%
J59_J60	-1.3%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	-1.3%
J61	2.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%
J62_J63	3.2%	0.4%	-0.3%	0.0%	-0.2%	0.0%	-0.1%	3.1%
K64	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
K65	4.7%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	4.5%
K66	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.5%
L	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%
M69_M70	2.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%
M71	-2.0%	0.1%	-0.2%	-0.1%	-0.1%	0.0%	0.0%	-1.9%
M72	0.7%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
M73	-5.4%	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%	-5.4%
M74_ M75	-9.9%	0.0%	-0.1%	-0.1%	0.0%	0.0%	0.0%	-9.8%
N77	-2.5%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	-2.5%
N78	8.9%	0.1%	-0.3%	-0.1%	-0.2%	0.0%	0.0%	9.1%
N79	5.8%	0.1%	0.1%	0.2%	0.0%	0.0%	0.0%	5.6%
N80_N82	-2.5%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	-2.6%
O	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%
P	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%
Q86	-0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-0.3%
Q87_Q88	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
R90_R92	2.9%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	2.7%
R93	0.8%	0.2%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.6%
S94	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	-0.1%
S95	-0.9%	-0.4%	0.0%	0.0%	0.0%	0.0%	-0.1%	-0.5%
S96	2.0%	-0.1%	0.2%	0.0%	0.2%	0.0%	0.0%	1.9%
TOTAL	**0.8%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.8%**

Source: Eurostat, author's own calculations.

Those results indicate the importance of the tourism and transport industries, particularly the water transport industry, for the Greek economy.

2.5. Contribution of costs to energy prices

Taking into account the crucial role of energy costs in the Greek economy, in this section, we focus on the estimation of the contribution of primary inputs costs to the formation of energy prices. For this purpose, we use the more recent (compared to the Symmetric Input-Output Tables) data from the Supply and Use Tables of the Greek economy for 2018 (the year with the latest available data).[4] The empirical results revealed that the energy prices in the Greek economy are mostly formed by Profits and Imports (Table 2.5.1). For reasons of comparison, the average contribution of costs to price formation in the Greek economy is also reported.

Table 2.5.1 The contribution of costs to energy prices

Type of cost	Energy	Economy's average
Wages	16.4%	26.9%
Profits	36.9%	20.5%
Net taxes	3.5%	10.3%
Consumption of fixed capital	10.8%	9.6%
EU imports	9.7%	18.4%
Extra EU imports	22.8%	14.3%

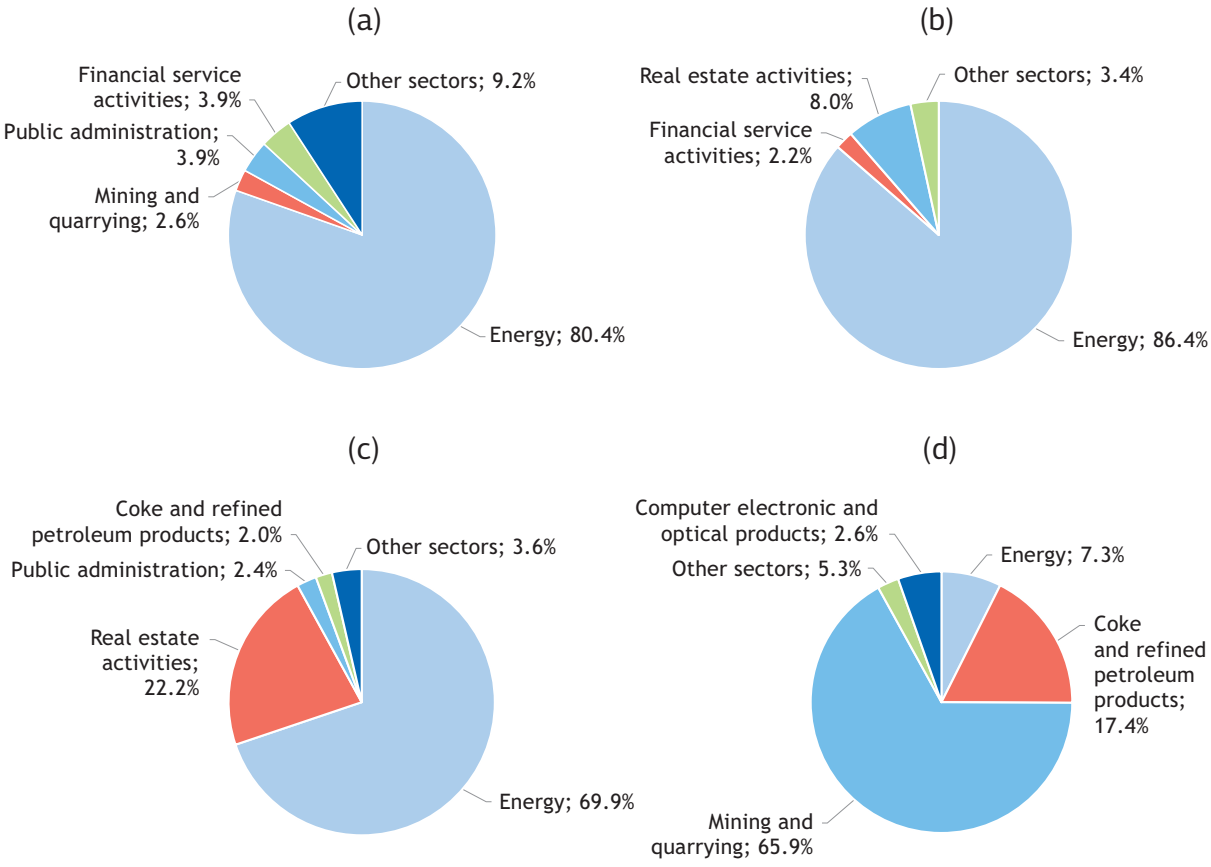
Note: The percentages may not add up to 100% due to rounding.

From the results reported in Table 2.5.1, it follows that Profits have the highest contribution in the formation of energy prices, while Profits and total Imports form almost 70% of energy prices. We stress here the relatively higher importance of Profits and Extra EU imports and the relatively lower contribution of Wages, Net taxes and EU imports in the formation of energy prices, in comparison with the price formation in the rest of the Greek economy.

Next, we examine the contribution of costs to energy price formation per primary input cost and industry of origin by estimating the matrices of the contribution of costs to price formation per primary input cost and industry of origin in the Greek economy (Figure 2.5.1). The Profits that form energy prices are mainly distributed to the energy sector itself (about 86.4%). The Imports

4. The contribution of primary inputs costs to the net outputs of the various industries of a national economy through a supply and use model (Rodousakis, Soklis and Tsekeris, 2022) is estimated. This model captures the direct and indirect contribution of each primary input to the price formation in all industries of the economy.

Figure 2.5.1 The contribution of costs to energy prices per primary input cost and industry of origin: (a) Wages; (b) Profits; (c) Consumption of fixed capital; (d) Extra EU imports



Source: Rodousakis, Soklis and Tsekeris (2022).

largely concern Extra EU imports of "Mining and quarrying products" and "Coke and refined petroleum products". Another industry of the Greek economy that has a noticeable contribution to the formation of energy prices is "Real estate activities", which contributes to about 8.0% of the profits and about 22.2% of the consumption of fixed capital that form energy prices.

As far as the contribution of the energy sector to the price formation of the other industries of the Greek economy is concerned, the energy sector mainly contributes to the price formation of industrial sectors (Table 2.5.2). The highest contribution is identified in the industries "Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services" (9.4%), "Water collection, treatment and supply" (8.1%) and "Manufacture of basic metals" (8.0%).

These results are in line with the findings of Lychnaras, Rodousakis and Soklis (2021) and Rodousakis and Soklis (2022) regarding the intersectoral linkages of the Greek energy sector. Specifically, Lychnaras, Rodousakis and Soklis (2021) found that the Greek energy sector mostly relies on buying inputs from the industries "Mining and quarrying products" and "Coke and refined

Table 2.5.2 The contribution of the energy sector to the price formation of the other sectors of the Greek economy

Industries	Energy sector contribution
Sewerage; waste collection, treatment and disposal activities	9.4%
Water collection, treatment and supply	8.1%
Manufacture of basic metals	8.0%
Sports activities and amusement and recreation activities	4.1%
Manufacture of other non-metallic mineral products	3.0%
Warehousing and support activities for transportation	2.9%
Social work activities	2.8%
Manufacture of electrical equipment	2.7%
Activities of membership organisations	2.4%
Average	**2.1%**

Note: The industries to which the Energy sector contributes more than its national average contribution are shown.

petroleum products". Additionally, Rodousakis and Soklis (2022) found that the industry that mostly depends on the energy sector for the purchase of inputs is "Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services".

Since energy prices have risen dramatically during the previous months and policy authorities struggle to take sufficient measures to contain energy prices, the proposed methodology and empirical results in this study could be relevant and important. More specifically, our results for the formation of energy prices in the Greek economy indicate that a policy to contain them could be mainly based on the implementation of income and import substitution policies.

In the short run, the relatively high share of profits distributed to the energy sector that form energy prices indicates that an income policy that would limit excessive profits could have significant positive effects on the containment of energy prices. This policy would be particularly beneficial for the competitiveness of the industries in which the energy sector has a relatively high contribution in the price formation of their products, i.e., "Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services", "Water collection, treatment and supply" and "Manufacture of basic metals". It is worth noting that the implementation of such a policy has recently been proposed by the UN secretary-general, who declared that "*The combined profits of the largest energy companies in the first quarter of this year are close to $100 billion. I urge governments to tax these excessive profits, and use the funds to support the most vulnerable people through these difficult times*" (UN, 2022). In the long run, an import substitution policy towards the exploitation of domestic mining and quarrying products as well as the coke and refined petroleum products could have a significantly positive impact, not only on containing energy prices, but also on increasing the energy security of the country.

2.6. Productivity indices for the European countries

There are many different approaches to productivity measurement, and their calculation and interpretation requires careful consideration, in particular when undertaking international comparisons. Most of these approaches are based on econometric methods, while others apply an input-output (IO) methodology. The IO tables can be considered the core of the National Accounting System (NAS), as they capture the interrelationships between the sectors, the commodities they produce, and the sectors that use these commodities. Hence, the measure of productivity that has been estimated on the basis of the structure of IO systems has the advantage of considering the technology of all sectors of the productive system and the technical relations established amongst them, summarising this complex network of technical relations into single indicators. For this reason, the IO approach is considered more adequate in terms of international comparisons. Hence, the latest available IO tables provided by the OECD (as of the 2021 edition), i.e., for the year 2018, are used here.[5]

Map 2.6.1 presents the estimates of labour productivity for the European countries in the OECD. The cluster of counties with the highest labour productivity performance are Luxembourg, Denmark, Sweden, Switzerland, Ireland and Belgium, while the cluster of countries with the lowest labour productivity performance include Lithuania, the Slovak Republic, the Czech Republic, Latvia, Poland and Hungary. The OECD average of labour productivity is about 70.4 thousand US dollars per worker, while the corresponding average in the European countries of the OECD is about 74 thousand US dollars per worker.

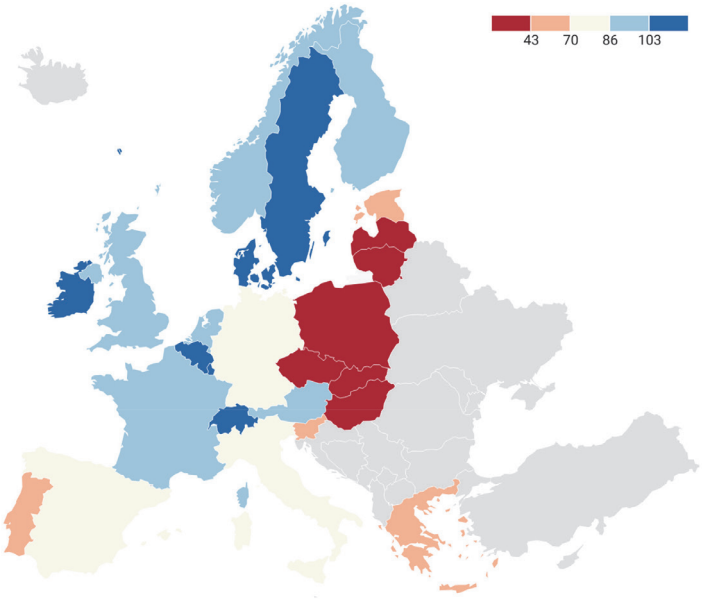
Map 2.6.2 depicts the capital productivity for each OECD member country in Europe. The cluster of countries with the top capital productivity performance are Greece, Denmark, Lithuania and Sweden, while the countries with the lowest capital productivity performance are Luxemburg, Austria, Estonia, the Slovak Republic, the Czech Republic and Poland. The OECD average of capital productivity is about 0.90, while the average for the European countries of the OECD is about 0.84.

It is interesting to note that, with the exception of 3 outlier OECD countries (i.e., Luxemburg, Israel and Colombia), the dispersion of the measure of capital productivity is much lower than the dispersion of the measure of labour productivity among the OECD countries. More specifically, excluding the outlier mentioned above, the distance between the best and the worst performing country, in terms of capital productivity, is 74%, while the corresponding distance in terms of labour productivity is 395%.

Map 2.6.3 presents a dichotomy of the European countries in the OECD, between those having both labour and capital productivity higher than the OECD average and those who have not. Simply put, it presents the countries that should be considered as the strongest in terms of economic structure. It appears that the specificities of each economy, its geographical location, its institutions, and its historical social and political background play a major role in determining the

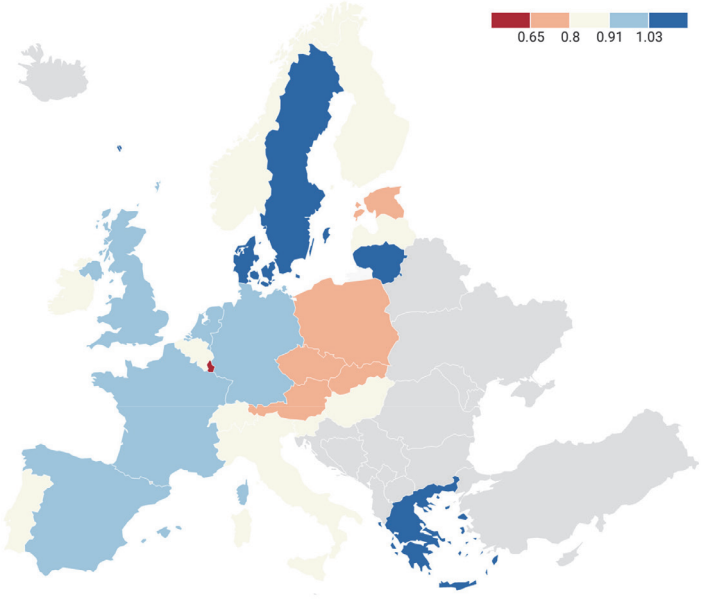
5. For Cyprus, Malta, Bulgaria, Romania and Croatia there are no available IO tables provided by the OECD. For the estimation of all the OCED countries, see Bragoudakis et al., 2022.

Map 2.6.1 Labour productivity (in thousand US dollars per working person) for the European countries of the OECD



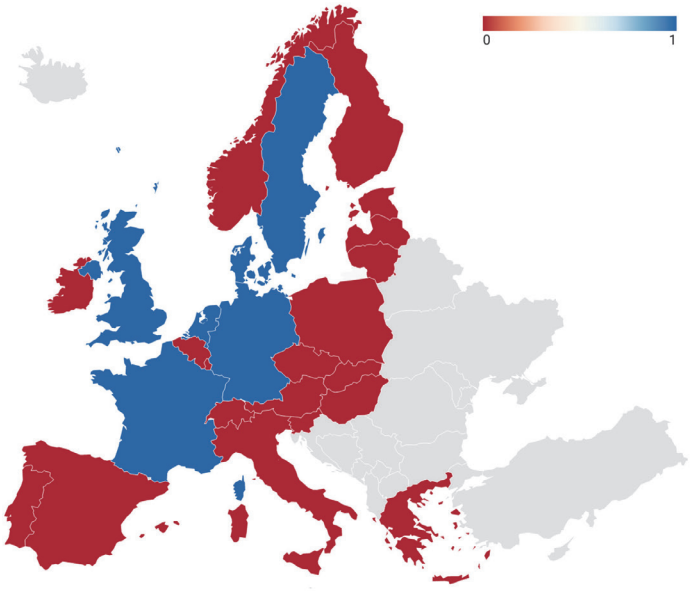
Note: The bin ranges are expressed here as 'natural breaks' according to the Jenks optimisation method (Jenks, 1967), which is a data clustering method designed to determine the best arrangement of values into different classes. This method minimises the average deviation of each class from the class mean, while it maximises the deviation of each class from the means of the other groups; hence, it reduces the variance within classes and maximises the variance between classes.

Map 2.6.2 Capital productivity for the European countries of the OECD



Note: The same as in Map 2.6.1.

Map 2.6.3 Countries with labour and capital productivity above the OECD average



Note: Blue colour shows countries with labour and capital productivity above the OECD average.

robustness of the economic structure. It is likely of no coincidence that the majority of the strongest countries (mostly located in central–western Europe) have undergone a long industrialisation process. Alternatively stated, it can be argued that the overperformance in both productivity measures is not the outcome of specific policy prescriptions that have been implemented during the past one or two decades, but the result of a long-run development process.

Finally, Greece stands out as an interesting example. The country registers the third highest capital productivity among the OECD countries and the highest capital productivity (equal to 1.12) among all the European countries in the OECD (see Map 2.6.2). This could supposedly be translated into a strong and sustainable Greek economy. Yet, in the past decade, Greece has become known for the deep recession it experienced, which has been the most intense among the OECD countries since 1945. In advance, there is a large gap between labour and capital productivity. As depicted in Map 2.6.1, Greece has a labor productivity below the OECD average. Based on an intersectoral IO analysis, this fact could be attributed to the large dependence of the Greek economy on imports and the increased importance of the services sector, in conjunction with meager activity in the secondary sector (see Greek NPB, 2020, Chapters 1-2). At the same time, the shallow industrial structure of the Greek economy was further weakened in the run-up to the euro (see Greek NPB, 2019, Chapt. 2). Thereby, other factors are likely critical in examining economic efficiency vis-à-vis the higher standards of living.

The example of Greece succinctly points to the need of employing both quantitative and qualitative tools in the analysis, since relying solely on productivity is insufficient and ineffective. Factors that consider the productive structure as an outcome of a long-run developmental path and take into account the institutions that govern the behaviour of economic agents are expected to

provide a deeper understanding of the relation between the variables under examination. On top of that, developing the time dimension of the sample, thus generating a panel sample (possibly including also the subnational dimension), would allow for a better comparison of the evolution of the productivity measures across time and space, and their relation to the living standards. In conjunction, the above extensions would allow a deeper understanding of the economies at hand and the appropriate re-contextualisation of policy making, thus, avoiding ineffective one-size-fits-all policy proposals.

Box 2.6.1 An input-output modelling approach to measure productivity

Consider a linear economic system with only circulating capital that produces n commodities by n single production activities, in which the net product is distributed to wage-earners and profit-earners (for more analytical details of the present framework, see Bragoudakis et al., 2022). The price system of this economy is described by the following equation:

$$\mathbf{p}^{\mathrm{T}} = (1 + r)\mathbf{p}^{\mathrm{T}}\mathbf{A} + w\mathbf{a}^{\mathrm{T}}$$

Where $\mathbf{p}$ is the vector of commodity prices, r the uniform rate of profits, $\mathbf{A}$ the matrix of input-output coefficients, w the uniform wage rate, $\mathbf{a}$ the vector of labour coefficients, i.e., the amount of labour per unit of output (in persons employed) and T is the transpose operator.

Since the maximum rate of profits (say, R) of the economic system is given for $w = 0$, it is obtained that:

$$R = \frac{\mathbf{p}^{\mathrm{T}}[\mathbf{I} - \mathbf{A}]\mathbf{x}}{\mathbf{p}^{\mathrm{T}}\mathbf{A}\mathbf{x}}$$

The right-hand side of the above equation gives the value of the net product of the economic system per unit of invested capital. Therefore, R is a measure of the productivity of capital in the economic system. If now the wage rate is chosen as *numeraire*, i.e. $w = 1$, then it is obtained

$$\mathbf{p}^{\mathrm{T}} = \mathbf{v}^{\mathrm{T}}$$

Where $\mathbf{v}^{\mathrm{T}} \equiv \mathbf{a}^{\mathrm{T}}[\mathbf{I} - \mathbf{A}]^{-1}$ is the vector of the "vertical integrated labour coefficients" (Pasinetti, 1973) or labour values. Each element of the vector of labour values, $\mathbf{v} \equiv [v_j]$, represents the total (direct and indirect) labour necessary to produce one unit of commodity j as net output. Thus, the reciprocals of the labour values, v_j^{-1}, can be considered as indices of labour productivity in the economic system.

3. Competitiveness Trends and Outlook

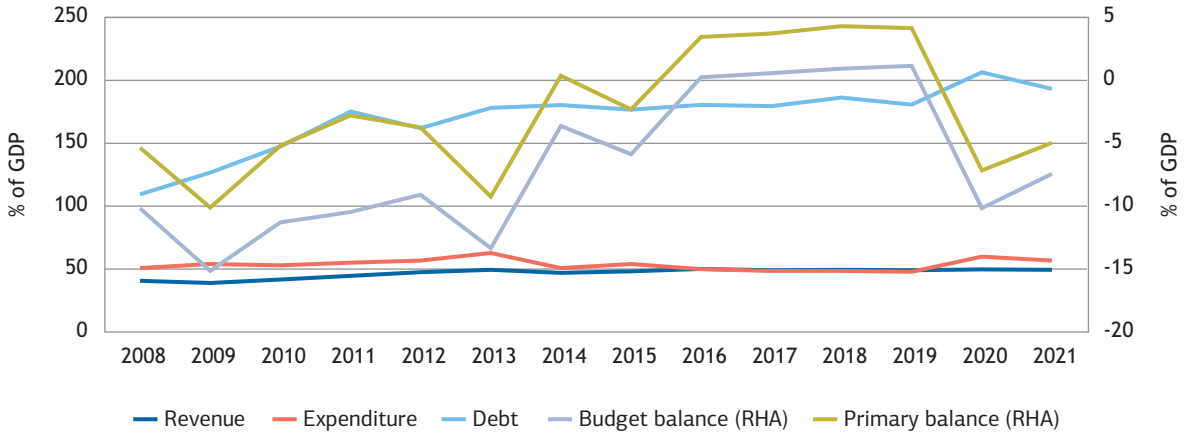
3.1. Recent developments in public finance and the current account

The COVID-19 pandemic and the implemented fiscal measures to support businesses, households and the health system led to an increase of the government expenditure in million euros, but a decrease as a percentage of GDP, since GDP increased in 2021 (Figure 3.1.1). Greece recorded the second highest expenditure (as a percentage of GDP) among the EU27 member-states, following France. Revenues also increased in million euros, but slightly decreased as a percentage of GDP. Consequently, the Budget balance and the Primary balance remained below zero for a second consecutive year after four years of surpluses (2016–2019). Nevertheless, the Primary deficit was improved, from 7.16% in 2020 to 4.97% in 2021. The government deficit was also improved (from 10.15% to 7.43%, respectively), but it remained above the EA19 average (4.7%) and the EU27 average (5.1%).

The government debt-to-GDP ratio improved in 2021, since it dropped to 193.3%, from 206.3% in 2020. The main components of the government debt are long-term loans (144.2% of GDP), followed by long-term securities (38.4% of GDP). Long-term loans decreased as a percentage of GDP, by 16.1 percentage points (pp), while long-term securities increased by 4.4 pp. It is worth noting that the debt-to-GDP ratio in 2021 was 10pp lower than expected, mainly due to an increased nominal GDP and a reduced primary deficit (EC, 2022a).

The enduring implications of the pandemic continued to affect global trade and the current account (CA) balance in 2021, but signs of recovery are becoming apparent. Fourteen EU27

Figure 3.1.1 Debt, General Government and primary balance, revenue, and expenditure (Greece)



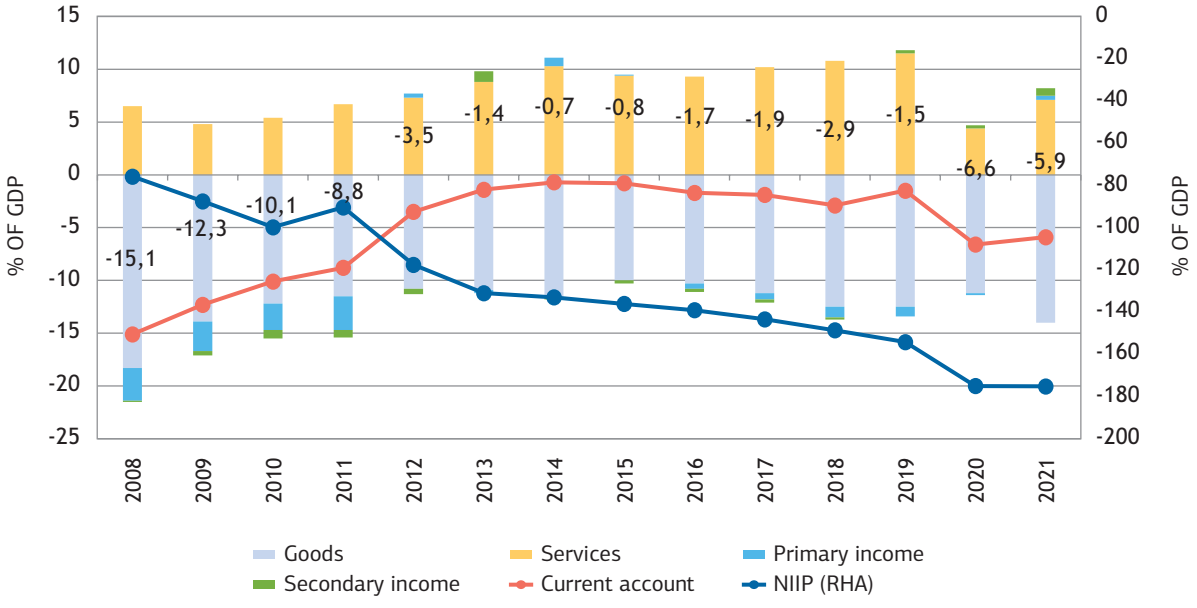
Source: Eurostat.

member-states demonstrated CA deficits, and for six member-states, a CA surplus in 2020 turned into a deficit in 2021. Only three member-states (France, Croatia, and Ireland) recorded reversals from deficit to surplus in 2021. Greece experienced the third largest CA deficit in 2021 among the EU27 member-states, 5.9% of GDP, slightly contracted compared to 2020 (6.6%), as depicted in Figure 3.1.2. Although the balance of services improved significantly in 2021 (7.1% from 4.4% in 2020), as well as the balance of primary and secondary income (0.4% and 0.7% from -0.2% and 0.3% in 2020), the balance of goods deteriorated, dropping from -11.2% in 2020 to -14% in 2021. Greece recorded the fourth largest increase in the balance of services, along with Cyprus, by 2.7 pp, and the sixth largest decrease in the balance of goods, by 2.8 pp. It is worth noting that only two member-states improved their balance of goods (Ireland and Cyprus), while nineteen member-states improved their balance of services.

Greek exports of goods increased by 3.2 pp, the largest increase throughout the period under investigation (2008–2021), accounting for 21.4% of GDP (Figure 3.1.3). Imports of goods also reached a record high 36.3% of GDP for the same period, increased by 6.3 pp. EA19 exports and imports of goods followed a similar pattern, reaching record high levels in 2021. Greek exports of goods were significantly lower than EA19 exports, but the gap seems to have narrowed since 2017. Greek imports (as a percentage of GDP) were also lower than EA19 imports from 2008–2020, while 2021 was the first year that Greek imports surpassed EA19 imports.

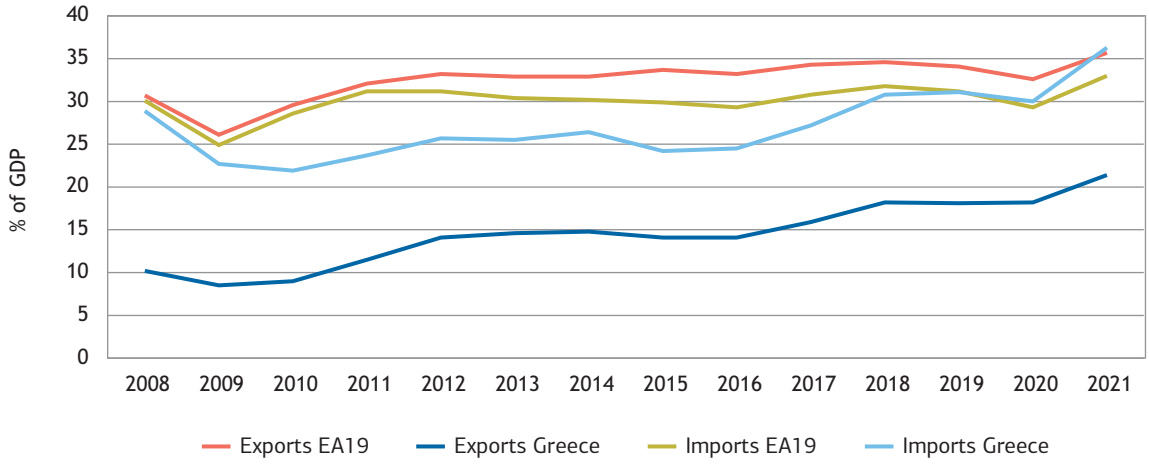
On the other hand, the Greek exports of services (as a percentage of GDP) surpass those of the EA19 during the examined period, while the opposite holds for imports (Figure 3.1.4). After the staggering decrease of Greek exports of services in 2020, by 8.1 pp, exports recovered in 2021,

Figure 3.1.2 Current account balance, components, and NIIP (Greece)



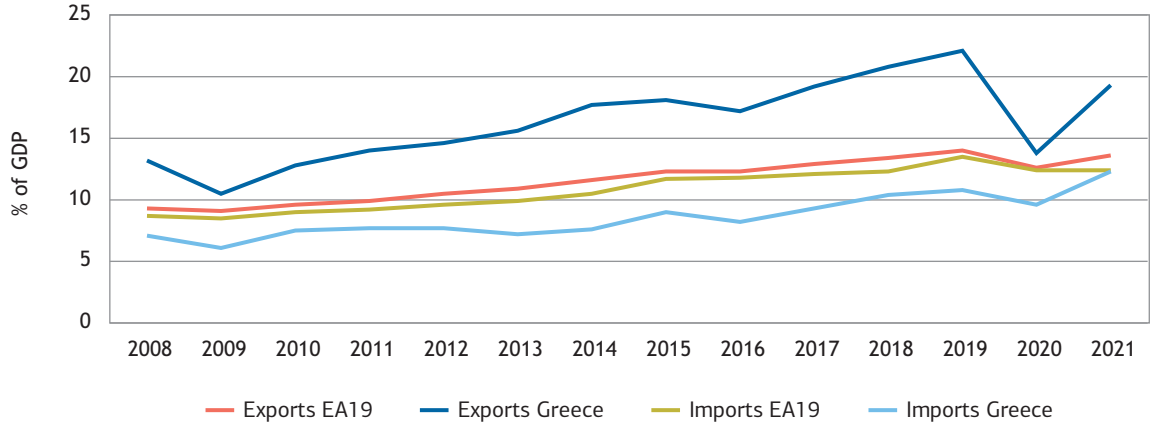
Source: Eurostat.

Figure 3.1.3 Exports and imports of goods, in Greece and the EA19 (% of GDP)



Source: Eurostat.

Figure 3.1.4 Exports and imports of services, in Greece and the EA19 (% of GDP)



Source: Eurostat.

by 5.5 pp, reaching 19.3% of GDP, recording the largest increase for the period under examination and the third largest increase among the EU27 member-states. The Greek imports of services also recorded the highest increase, by 2.7 pp.

In conclusion, the efficient, prudent, and transparent management of public finance is vital, especially when public deficit and debt levels are high, in order to enhance competitiveness and support sustainable development. Greece exceeded expectations as far as the primary balance and the debt are concerned (EC, 2022a). The signs of recovery are evident, Greece's real GDP increased by 8.3% in 2021, driven by tourism and private investment. Nevertheless, the implications of the war in Ukraine on energy prices and inflation, coupled with increased geopolitical uncertainty,

are expected to affect Greece's growth, which is projected to continue at a slower pace (see also Section 2.2). Headline inflation is projected to reach 8.9% in 2022, from 0.6% in 2021, putting a strain on disposable income. In order to mitigate the negative impact of surging energy prices and high inflation on households and businesses, the government has adopted emergency fiscal measures that correspond to 2.3% of GDP. The measures may be temporary, but they will put pressure on the government budget. In addition, as high inflation is becoming a global phenomenon, eroding the spending power of incoming tourists, Greece's tourism sector may also be affected. Moreover, the impact of the war in Ukraine on international trade and global supply chains, which have just started to recover from the pandemic, may decelerate Greek exports (EC, 2022b). To conclude, the unstable international environment calls for caution and vigilance since fiscal risks remain substantial.

3.2. Cost/price competitiveness indices

Among the most commonly used cost/price competitiveness indicators are the Real Effective Exchange Rates (REERs). The main purpose of REERs is to depict a country's price/cost competitiveness relative to its principal competitors. REERs are usually calculated using as a deflator either the consumer price index (CPI) or the unit labour cost in the total economy (ULCT). As far as Greece is concerned (Figure 3.2.1[6]), the CPI-based REER slightly decreased in 2021 for the third consecutive year, whereas the ULCT-based REER, which significantly increased in 2020, reached its lowest point in 2021 for the period under consideration (2010–2021). As far as the EA19 and the EU27 are concerned, both indices continued to increase, indicating that the competitiveness of the Eurozone and the EU27 deteriorated. It should be noted that results are not uniform. Three EU member-states, Greece, Cyprus and Slovenia, experienced a decrease in CPI-based REER and two, Ireland and Romania, recorded a decrease in ULCT-based REER during both pandemic years, 2020 and 2021.

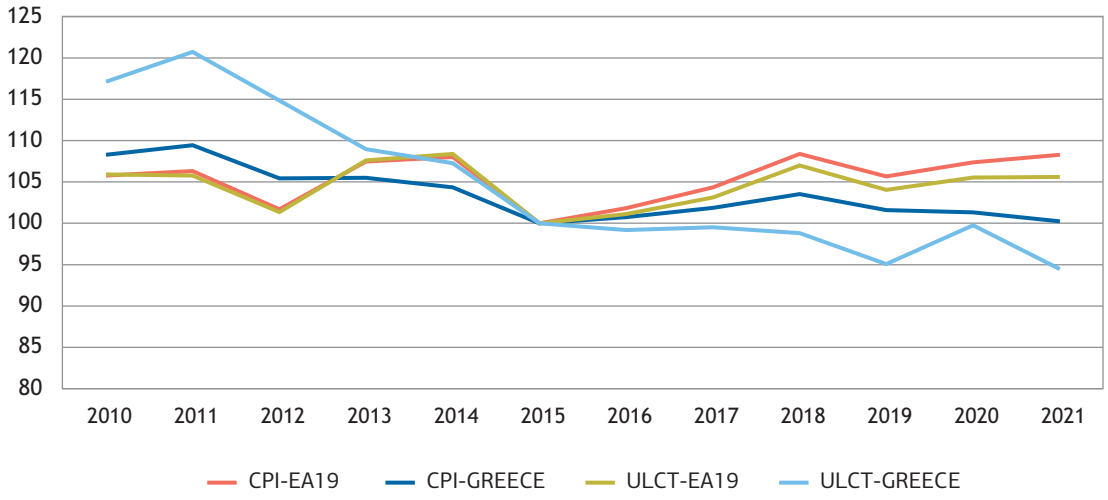
Moreover, the nominal unit labour cost[7] (ULC) that increased dramatically in Greece in 2020 (compared to 2019) decreased significantly in 2021 (Figure 3.2.2). On the other hand, the ULC continued to increase in the EA19 and EU27 in 2021, but the increases were more modest than the ones recorded in 2020. Furthermore, the relative unit labour cost, which measures the trading position of Greece relative to its EA partners, decreased by 8.2 pp in 2021 compared to 2020, the largest decrease recorded among EU member-states, indicating an amelioration in Greece's competitive position (relative to its euro area partners). Greece is among the 10 EU member-states that exhibited a decrease in relative unit labour cost.

As economies try to recover from the pandemic-induced recession, the war in Ukraine poses additional challenges. World trade is once more affected significantly as the disturbances in global supply chains are intensified and food and fuel prices are increasing dramatically. During the last

6. Thirty-seven trading partners are selected, i.e., the EU27 and 10 other countries (Australia, Canada, Japan, Mexico, New Zealand, Norway, Switzerland, Turkey, the United Kingdom, the USA).

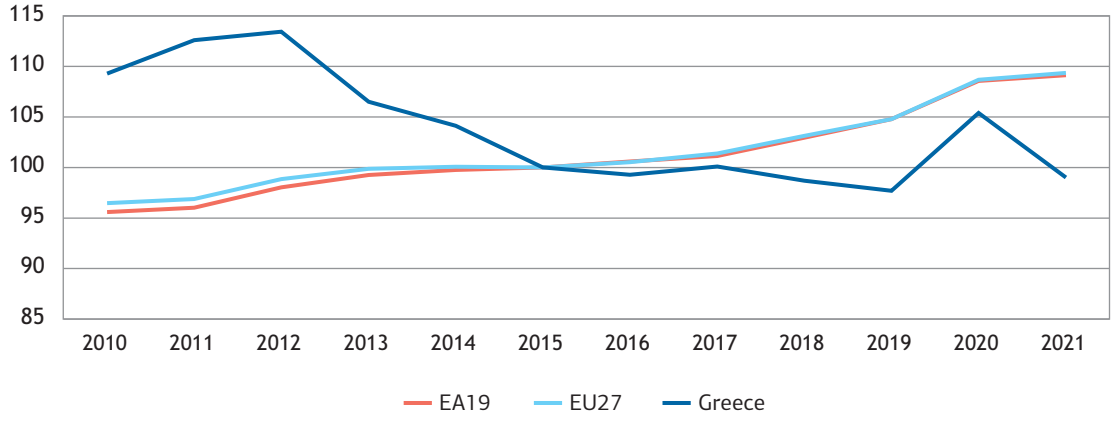
7. Nominal unit labour cost on hours worked.

Figure 3.2.1 Real effective exchange rates (37 trading partners, 2015=100)



Source: Eurostat.

Figure 3.2.2 Nominal unit labour cost based on hours worked (2015=100)



Source: Eurostat.

three years, major sources of risk have been unveiled, forcing countries to take unprecedented measures that are affecting the world economy and competitiveness.

3.3. Competitiveness and value chain participation

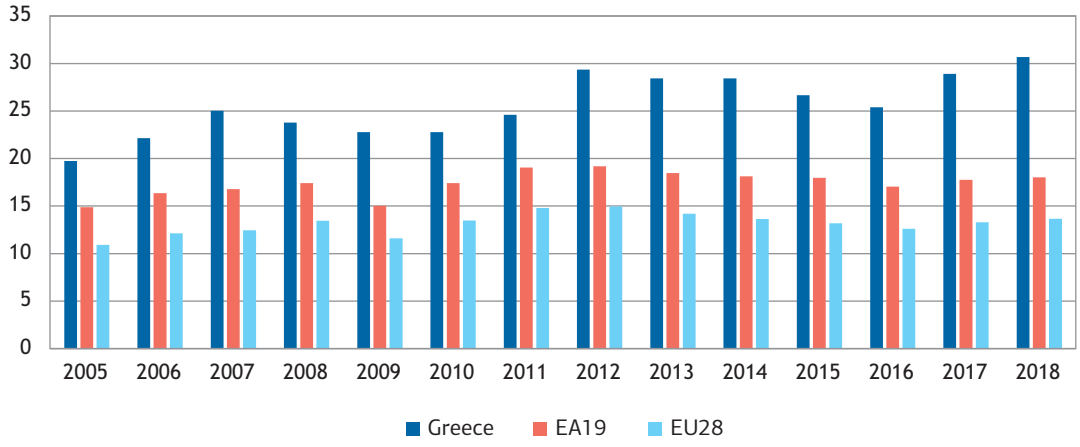
Offshoring has emerged as a dominant business practice during the last four decades, enhancing the role of interconnectivity and global value chain (GVC) participation in international trade (Tsekeris and Skintzi, 2017; Cigna, Gunnela and Quaglietti 2022). Traditional trade measures on

a gross basis may not be sufficient to capture the role of GVCs in competitiveness; for example, gross exports incorporated both domestic and foreign-sourced inputs. Therefore, in this section, we investigate the participation of Greece in GVCs. It should be noted that available data are up to 2018; therefore, the effects of the pandemic and the war in Ukraine on GVCs are not captured.

The foreign value-added contribution to Greece's gross exports, (i.e., the backward participation in GVCs) reached its peak in 2018. Throughout the examination period (2005–2018), the corresponding EA19 and EU28 average were significantly lower than that of Greece (Figure 3.3.1). This means that Greece depends more on imported inputs in order to produce goods or services that will be exported, compared to the other EA19 and EU28 member-counties. The top three import partners of Greece in terms of value-added are Germany (10.4%), Italy (7.2%) and the Russian Federation (6.9%).[8] It should be noted that Greece, the EA19 and the EU28 follow a similar pattern: backward participation in GVCs decreased from 2013 to 2016 and increased in 2017 and 2018.

Regarding the forward participation in GVCs (i.e., the domestic value added incorporated in intermediate goods or services exported to a partner economy that re-exports them), Greece is close to the EA19 and EU28 averages. Greece exceeded the EA19 average only in 2008, 2010 and 2011, but is above the EU28 from 2008 onwards (Figure 3.3.2). In 2018, after three years of contraction, Greece's forward participation in GVCs increased. The top three importers of Greece's value added in 2018 were the USA (11.5%), Germany (9.2%) and Italy (6.8%).[9] In total, Greece's participation in GVCs (backward and forward linkages) exceeds the EA19 and EU28 averages (Figure 3.3.3), indicating that Greece is highly involved with and dependent on GVCs.

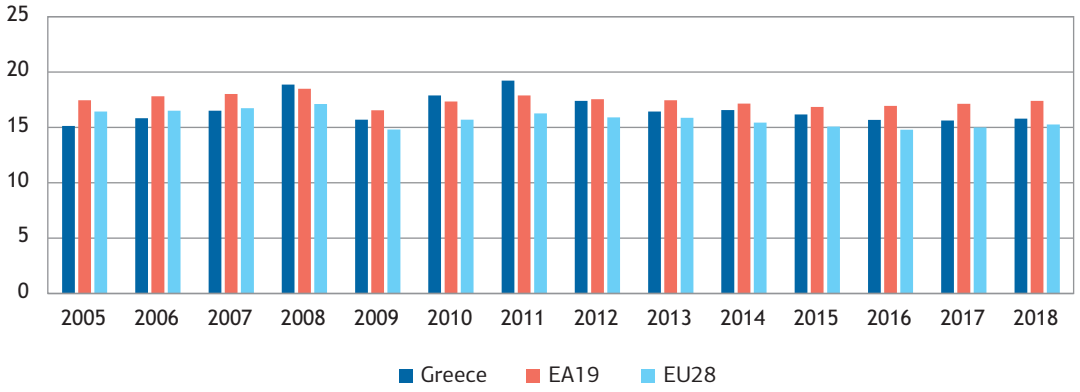
Figure 3.3.1 Backward participation in GVCs (% of total gross exports)



Source: OECD database, Trade in Value Added.

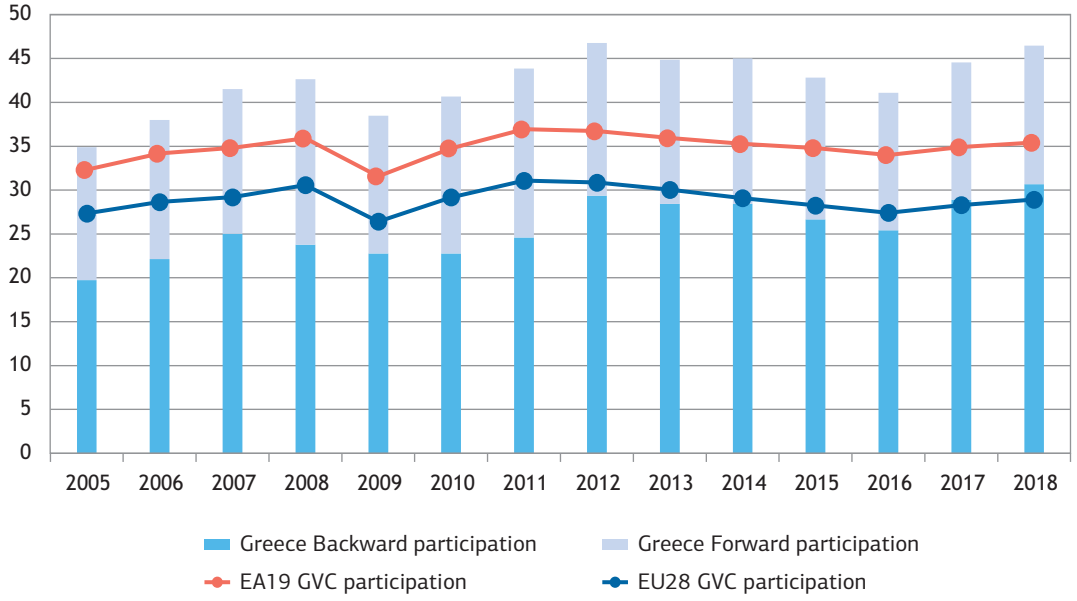
8. <https://www.oecd.org/sti/ind/CN2021_GRC.pdf>
9. <https://www.oecd.org/sti/ind/CN2021_GRC.pdf>

Figure 3.3.2 Forward participation in GVCs (% of total gross exports)



Source: OECD database, Trade in Value Added.

Figure 3.3.3 Participation in GVCs (% of total gross exports)



Source: OECD database, Trade in Value Added.

As far as the sectoral backward linkages are concerned, the foreign value-added contribution to Greece's gross exports lies above the corresponding EA19 and EU28 averages, for most sectors. Notably, the manufacturing export industry is heavily dependent on imported inputs. The foreign content of the industry's gross exports is 46.8%, increased by 10pp since 2008 (Table 3.3.1).

The COVID-19 pandemic and the war in Ukraine have unveiled the inefficiencies and vulnerabilities of global supply chains and the associated risks. The transmission of shocks through supply

Table 3.3.1 Foreign sectoral value-added contributions to gross exports (% of industry's total gross exports), 2018

Export industry	Greece	EA19	EU28
Agriculture forestry and fishing	16.1	15.1	10.4
Mining and quarrying	9.7	18.5	11.2
Manufacturing	46.8	21.5	16.9
Electricity, gas, water supply, sewerage, waste and remediation services	16.4	17.6	12.3
Total services (including construction)	19.8	12.9	9.5

Source: OECD database, Trade in Value Added.

chains, as well as environmental considerations, the servicification of manufacturing and the emergence of new technologies related to Industry 4.0 have reignited the debate about reshoring production, shortening the international parts of the supply chains and regionalisation. Increased transparency, digitalisation and risk mitigation strategies (e.g., diversification of suppliers) could improve the resilience of global supply chains. Nevertheless, the current challenges may lead to the reshaping of GVCs. Greece should shape its competitiveness and growth strategy in this interconnected but highly volatile environment. Upgrading to high value-added and knowledge-intensive activities could prove vital for Greece. Public policies that support the digital and green transitions and investments in knowledge, research, innovation, and technology can play an important role in improving the country's competitiveness.

3.4. Competitiveness indicators for resilient and sustainable growth

This section presents a set of indictors that are closely connected with current policy priorities and challenges at the national and the EU level. They refer to the ability to attract foreign direct investment, the digitisation process, and the green transition of the economy. All the related indicators (and their constituent subindexes) can allow us to monitor and evaluate different aspects of the sustainable and competitive growth of Greece and the rest of the EU. The issue of R&D and innovation is investigated separately in Section 3.5.

3.4.1. Foreign Direct Investment

At a global level, FDI flows increased drastically by 88% in 2021, after a decline in 2020 due to the pandemic, and rose above the pre-pandemic levels. In Greece, FDI also increased by 73% in 2021, at a record level of $5.73 billion. This is good news, but Greece needs a further and substantial increase of FDI. Table 3.4.1 shows the FDI inward flows as well as the FDI inward stock in 22 EU countries for which the OECD provides data. Countries are ranked based on the 2021 amount of

Table 3.4.1 FDI flows and stocks in the EU countries since 2019

Economy	FDI inward flows in billion $			Economy	FDI inward stock (% of GDP)*		
	2019	2020	2021		2019	2020	2021
Germany	52.66	64.44	31.26	Luxembourg	273.9	1,505.9	1,169.3
Sweden	9.11	18.81	26.97	Ireland	312.4	324.7	276.5
Poland	13.33	13.65	24.82	Netherlands	183.0	312.4	253.5
Belgium	-9.21	13.88	22.96	Belgium	109.1	100.8	
Ireland	158.49	82.12	15.93	Estonia	88.4	110.1	91.2
France	28.36	4.86	14.16	Czech Republic	67.9	79.6	71.0
Spain	17.42	12.61	9.78	Portugal	65.8	75.0	68.5
Finland	13.46	-1.42	8.93	*EU27*	*58.5*	*78.5*	*61.8*
Italy	18.15	-23.57	8.49	Latvia	52.4	61.1	61.0
Portugal	12.25	7.57	7.98	Sweden	60.4	71.4	57.5
Austria	2.91	-14.96	5.86	Hungary	57.5	65.9	56.0
Czech Republic	10.11	9.41	5.81	Spain	51.7	63.6	54.7
Greece	**5.02**	**3.21**	**5.73**	Slovakia	57.6	61.1	51.7
Denmark	7.07	3.21	5.54	Lithuania	42.5	52.6	44.9
Hungary	4.33	6.80	5.46	Austria	45.0	48.0	43.0
Latvia	0.90	1.01	5.33	Poland	40.5	42.3	39.9
Lithuania	3.02	3.48	2.05	Slovenia	33.5	37.9	32.6
Slovenia	1.46	0.21	1.52	Denmark	37.1	41.7	33.7
Estonia	3.18	3.39	0.99	France	31.3	36.6	
Slovakia	2.51	-1.93	0.06	Finland	31.0	32.5	
Luxembourg	12.08	102.04	-9.05	Germany	25.5	30.6	26.8
Netherlands	-19.12	-126.53	-81.05	Italy	22.1	25.0	21.6
EU27	*405.72*	*194.58*	*138.29*	**Greece**	**22.0**	**22.0**	

Source: OECD, 2022.

* The definition of FDI stock by the OECD is the following: "The inward FDI stock is the value of foreign investors' equity in and net loans to enterprises resident in the reporting economy. FDI stocks are measured in USD and as a share of GDP."

FDI inflow as well as the FDI stock as a percentage of GDP. EU27 FDI inflow is the sum of all its member-states, and thus, it is not ranked. Regarding FDI stock, the EU27 is the average of the member-states, so it is ranked.

Despite the increase in FDI during 2021, Greece ranks last with respect to its FDI stock expressed in GDP percentage. This is a direct result of the considerably low FDI flows Greece has received

in the past many years. It will take a considerable increase in yearly FDI flows for Greece to approach the EU average of FDI stock. It is important to note that FDI can play a key role in the development of small economies such as Greece (OECD, 2022).

Data from the Bank of Greece (2022) show that in recent years there has been an increase of FDI in real estate. Particularly, in 2021, FDI in real estate is close to 30% of total FDI in the Greek economy. Although any kind of FDI is welcome, different kinds of FDI affect the economy differently. As Gholipour, Al-Mulali and Mohammed (2014) show, FDI in real estate does not contribute to economic growth in OECD countries.

Canton and Solera (2016) demonstrate that the kind of FDI that has the most positive effect is greenfield investment. Greenfield investment is defined as "the creation of a firm from scratch by one or more nonresident investors —and the extension of capacity— an increase in the capital of already established foreign enterprises" (Canton & Solera, 2016:3). According to these authors, greenfield investments, compared to mergers and acquisitions, create more jobs and boost productivity growth in the recipient country via new economic activity generation and international technology spillovers.

However, for an economy to be attractive to such productive investments, structural reforms that reduce regulatory bottlenecks, improve contract enforcement, and facilitate tax-paying are necessary to improve the business climate (Canton & Solera, 2016). Although Greece has considerably improved the 'starting a business' indicator of the Ease of Doing Business[10] index (11th in 190 economies), it ranks far behind all European countries, let alone the EU27 average, in indicators such as 'registering property' (156th) and 'enforcing contracts' (146th), having the third worst performance among 190 countries in 'the time required to enforce a contract through the courts' (1,711 days).

Digitisation and the green transition are the two pillars on which current socio-economic transformation takes place in the EU27. Both are closely related to FDI. Digitisation can be an enabler and business climate enhancer, while, at the same time, it is positively affected by technology spillovers that FDI brings to the Greek economy. The green transition cannot take place without large investments in research and innovation as well as in actual renewable energy production. The following section discusses the digitisation of the Greek economy and section 3.4.3 deals more extensively with the green transition, which the war in Ukraine brought to the top of the EU policy priorities.

3.4.2. Digitisation

The Digital Economy and Society Index–DESI has been published every year since 2014 by the European Commission. In 2021, there were some changes to the index to be better aligned

10. The World Bank has stopped publishing the *Doing Business* report due to some data irregularities in the 2018 and 2020 reports. The last *Doing Business* report was published in 2020, the data of which are used here. More information can be found at: <https://www.worldbank.org/en/news/statement/2021/09/16/world-bank-group-to-discontinue-doing-business-report>.

with the Digital Compass as well as the Recovery and Resilience Facility policies. Specifically, the five DESI indicators, namely, Connectivity, Human capital, Use of internet services, Integration of digital technology and Digital public services, have been reduced to four, in the following order: Human capital, Connectivity, Integration of digital technology and Digital public services.

Greece has made significant improvement between the 2020 and 2021 editions, when it gained two ranks. Although Greece has made equally important improvements in the 2022 edition (note that each edition's data refer to the previous year at best), it has not gained ranks. This can be attributed to the fact that other countries just above Greece's ranking, such as Poland, improved at a similar pace. According to DESI 2022, Greece ranks 9th among the 16 countries that have overperformed in making progress between the years 2017–2022. This progress has offered Greece 2 ranks and some considerable convergence to the EU27 average (Table 3.4.2a). The greater progress has been made in Connectivity where Greece has gained 5 ranks since the 2021 edition. This is due to significant improvements in the Very High-Capacity Networks (VHCN) as well as 5G coverage, although VHCN is still far below the EU average (Table 3.4.2b). Overall fixed broadband take-up, fast broadband coverage as well as 5G assigned spectrum indicators are above the EU average.

Considerable progress has also taken place in Digital public services, particularly e-government services users (above the EU average). However, Greece still lags well behind the EU average in Digital public services to businesses, Digital public services to citizens and Pre-filled forms.

Regarding Integration of digital technology, Greece is above the EU average in SMEs selling online, but significant effort should be placed on increasing the percentage of SMEs that have at least a basic level of digital intensity. Moreover, the use of advanced digital technologies such as the cloud and Artificial Intelligence needs to improve faster, as these are far behind the EU average.

In Human capital, Greece receded to the 22nd rank from the 21st in the 2021 edition. This is not so much due to worsening performance, but to the faster progress of other countries. Greece

Table 3.4.2a Greece's score and rank according to DESI 2022

Indicator	Greece '20 rank	Greece '21 rank	Greece '22		EU 2022 Average score	Best performer	
			Rank	Score		Country	Score
DESI	**27**	**25**	**25**	**38.9**	**52.3**	**Finland**	**69.6**
Human capital	25	21	22	40.1	45.7	Finland	71.4
Connectivity	28	27	22	49.6	59.9	Denmark	77.1
Integration of digital technology	24	22	22	26.6	36.1	Finland	59.1
Digital public services	27	26	26	39.4	67.3	Estonia	91.2

Source: Digital Economy and Society Index (DESI) 2022 Greece (EC, 2022c).

Table 3.4.2b Comparison between Greece and the EU27 average on specific DESI 2022 indicators

Indicator	Greece 2021	Greece 2022	EU27 average
Human capital			
At least basic digital skills (% individuals)	*n/a*	*52%*	*54%*
Above basic digital skills (% individuals)	*n/a*	*22%*	*26%*
ICT specialists (% individuals in employment aged 15-74)	*2.1%*	*2.8%*	*4.5%*
Female ICT specialists (% ICT specialists)	*29%*	*21%*	*19%*
Enterprises providing ICT training (% enterprises)	*12%*	*12%*	*20%*
ICT graduates (% graduates)	*3.4%*	*3.5%*	*3.9%*
Connectivity			
Overall fixed broadband take-up (% households)	*77%*	*82%*	*78%*
At least 100Mbps fixed broadband take-up (% households)	*3%*	*9%*	*41%*
At least 1Gbps take-up (% households)	*<0.01%*	*<0.01*	*7.58%*
Fast broadband (NGA) coverage (% households)	*87%*	*92%*	*90%*
Fixed very high-capacity network (VHCN) coverage (% households)	*10%*	*20%*	*70%*
Fibre to the premises (FTTP) coverage (% households)	*10%*	*20%*	*50%*
5G spectrum (assigned as a % of total harmonised 5G spectrum)	*99%*	*99%*	*56%*
5G coverage (% populated areas)	*0%*	*66%*	*66%*
Mobile broadband take-up (% individuals)	*67%*	*76%*	*87%*
Broadband price index (0-100)	*53*	*58*	*73*
Integration of digital technology			
SMEs with at least a basic level of digital intensity (% SMEs)	*n/a*	*39%*	*55%*
Cloud (% enterprises)	*n/a*	*17%*	*34%*
AI (% enterprises)	*n/a*	*4%*	*8%*
e-Invoices (% enterprises)	*n/a*	*n/a*	*32%*
SMEs selling online (% SMEs)	*n/a*	*20%*	*18%*
e-Commerce turnover (% SME turnover)	*n/a*	*11%*	*12%*
Selling online cross-border (% SMEs)	*4%*	*7%*	*9%*
Digital public services			
e-Government users (% internet users)	*67%*	*69%*	*65%*
Pre-filled forms (0-100)	*n/a*	*45*	*64*
Digital public services for citizens (0-100)	*n/a*	*52*	*75*
Digital public services for businesses (0-100)	*n/a*	*48*	*82*

Source: Digital Economy and Society Index (DESI) 2022 Greece (EC, 2022c). Green color indicates performance above the EU average.

has more women ICT specialists than the EU average and has increased the percentage of ICT specialists as well as ICT graduates, but scores below the EU average. The number of enterprises that provide ICT training must also increase significantly to approach the EU average.

3.4.3. The Green transition

About the transition

The European Union long ago identified the need for fair and sustainable growth aligned with the United Nations Sustainable Development Goals (EC, 2022d). To capture the evolution of its member-states in the transition to an inclusive and prosperous sustainability, the European Commission published in 2022 the new Transitions Performance Index–TPI, which is an index that measures transition in four dimensions: Economic (education, wealth, labour productivity, research and development intensity, and industry base), Social (health life, work and inclusion, free or non-remunerated time, and equality), Environmental (greenhouse gas emissions reduction, biodiversity, material use, and energy productivity), and Governance (fundamental rights, security, transparency, and sound public finances) (Table 3.4.3).

TPI ranks the EU27 countries as well as 45 other countries. It captures their performance between 2011 and 2020. Greece has made significant improvements since 2011, and it has the 2nd highest progress (11.0%) behind Croatia (13.5%). In Table 3.4.3, Greece is ranked among the EU27. It is noted that the TPI does not include all countries.

It is good news that Greece performs above the EU average in the Environmental dimension (the green transition) (See also NPB, 2021). However, a lot needs to be done for the other three dimensions (economic, social and governance), where Greece ranks 25th, 25th and 26th, respectively, well below the EU average. It is true that despite the considerable progress that has taken place in the last few years, the Economic and Governance (e.g., sound public finances) pillars still suffer the results of the recent long economic crisis.

Table 3.4.3 TPI 2020 transition scores and progress (EU27)

	Greece		EU average	Best performer	
	Score	Rank	Score	Country	Score
TPI	62.08	24	68.96	Denmark	78.36
Economic	45.2	25	61.1	Ireland	76.1
Social	70.9	25	77.5	Slovenia	85.9
Environmental	65.5	10	65.0	Malta	74.4
Governance	63.8	26	74.0	Luxembourg	85.0
Progress 2011-2020	*11.0%*	*2*	*4.9%*	*Croatia*	*13.5%*

Source: (EC, 2022e). Red (green) color indicates below (above) the EU average.

Although the focus of this section is on the green transition, it is useful to get an overview of all kinds of transitions the EU measures. The TPI indicates that transitions are related to each other. Moreover, the RRF is an inclusive plan to boost the transition of the European Union toward an economically, socially, and environmentally sustainable future.

Under the RRF, Greece will receive €30.5 billion (€17.77 billion in grants and €12.73 billion in loans) by 2026. From this amount, the biggest chunk (37.5%) will support climate objectives (i.e., the green transition) and 23.3% will support the digital transition, while the rest will support social, economic, health and institutional reforms that will help Greece get better prepared for the necessary transitions to become more sustainable and resilient in all aspects of socio-economic life.

The Green transition

Resiliency and Sustainability have been at the epicenter of European policy for many years (EC, 2022d). Crises such as the climate crisis and COVID-19 pushed European economies further toward the transition to a more resilient and sustainable future. The fund allocation of the RRF demonstrates that the green transition was already the priority of the EU even before the war in Ukraine. The war has caused a major disruption in the energy market globally and clearly illustrates that the green transition (also called environmental or energy transition) is the only way to a sustainable future free of fossil fuels.

A large part of the green transition refers to the renewable sources of energy, or renewables. Eurostat recently published data for the EU27 on the use of renewables in 2020. Table 3.4.4 illustrates the performance of Greece compared to the EU average as well as to the best performers in the use of renewables, as a percentage of a) gross final energy consumption, b) electricity consumption, c) energy for heating and cooling, and d) energy in transport activities.

Greece is very close to the EU average in the use of renewables in gross final energy consumption, exceeding the 2020 target of 18%. Note that almost all countries either reached their national

Table 3.4.4 Share of energy from renewable sources in Greece and the EU27 countries, 2020

	Greece/rank	EU average	Best performer
Renewable energy in gross final energy consumption	21.7%[1]/13th	22.1%[1]	Sweden 60.1%
Renewable sources in electricity consumption	35.9%/13th	37.5%	Austria 78.2%
Renewable sources in energy for heating and cooling	31.9%/13th	23.1%	Sweden 66.4%
Renewable energy in transport activities	5.3%[2]/27th	10.2%[2]	Sweden 31.9%

Source: Eurostat, 2022. Orange color indicates below EU average, but very close. Red (green) color indicates below (above) the EU average.

Notes: 1. EU's target: 20%, Greece's target: 18%.
2. EU's and all countries' target: 10%.

targets or exceeded them. Similarly, Greece is very close to the EU average in the use of renewables in electricity consumption. It is above average in the use of renewables for heating and cooling, but far below the EU average (it ranks last) in the use of renewables in transport.

From the table, it becomes clear that there are significant differences among the EU27 countries. Particularly in the first three categories of the renewables use, the distance between the best performer and the worst is 50, 70 and 60 percentage points, respectively. This indicates that the EU needs to act in a more coordinated way to achieve convergence.

The war in Ukraine is expected to accelerate the process of decarbonisation and the EC has set the priority of ending dependence on Russian fossil fuels (petroleum and gas) (EC, 2022e). Already under the Fit for 55 (the EU's plan for a green transition), 2030 climate targets have been raised. Moreover, the Council has agreed to increase the binding EU target of energy from renewables in the total energy mix to 40% by 2030. Consequently, the national energy and climate plans (NECPs) are expected to be revised along the lines of the REPowerEU plan. While these plans are worked out, Europe (including Greece) is allowed to use lignite and coal to cover the energy gap by drastically reduced Russian oil and gas. All this turmoil has brought up the discussion of nuclear plants and if nuclear power should be labeled green energy.

In January 2022, MIT published the second edition of the Green Future Index (GFI). The GFI 2022 ranks 76 economies based "on their progress and commitment toward building a low-carbon future", as the subtitle of the index suggests (MIT, 2022). The index has 5 pillars: a) Carbon emissions ('measures how effectively countries are curbing carbon dioxide emissions overall and in key sectors'), b) Energy transition ('assesses the contribution and growth rate of renewable energy sources including nuclear power'), c) Green society (captures 'the efforts made by government, industry, and society to promote green practices'), d) Clean innovation ('measures

Table 3.4.5a The Green Future Index 2022*

Country	Score	Rank '22	Rank '21	Country	Score	Rank '22	Rank '21
Denmark	6.55	2	2	Italy	5.53	17	22
Netherlands	6.42	3	10	Portugal	5.51	18	30
Finland	6.21	6	6	**Greece**	**5.33**	**22**	**37**
France	6.12	7	4	Austria	5.31	23	15
Germany	6.12	8	11	Hungary	5.31	24	39
Sweden	6.07	9	12	Bulgaria	5.28	25	44
Belgium	5.95	11	9	Czech Republic	5.21	27	28
Ireland	5.85	12	5	Luxembourg	5.19	28	13
Spain	5.83	13	18	Slovakia	4.52	46	50
Poland	5.59	16	34	Romania	4.52	47	48

Source: MIT Technology Review Insights, 2022.

* Only 20 EU27 countries are included.

Table 3.4.5b The Green Future Index 2022 detailed

	Greece[1]	Best performer	Best performer EU
The Green Future Index	5.33 (22) (13)	Iceland 6.92	Denmark 6.55 (2)
Carbon emissions	*6.61 (8) (3)*	*Iceland 8.06*	*Finland 7.32 (2)*
CO_2 emissions	6.7 (30) (10)	Iceland 10.0	Luxembourg 8.7 (8)
CO_2 emissions growth	8.8 (6) (2)	Ukraine 10.0	Denmark 9.0 (3)
CO_2 emissions growth in transport sector	8.0 (34) (10)	Norway 10.0	Sweden 9.9 (2)
CO_2 emissions growth in industrial sector	4.6 (11) (1)	Iceland 10.0	**Greece** 4.6 (11)
GHG emissions growth in agriculture	5 (19) (5)	UAE 10.0	Finland 9.0 (2)
Energy transition	*2.85 (56) (12)*	*Ethiopia 7.18*	*Sweden 4.43 (18)*
Renewable energy production growth	3.3 (36) (7)	Kuwait 10.0	Luxembourg 5.9 (14)
Renewable energy contribution	2.8 (36) (8)	Uganda 10.0	Sweden 6.2 (13)
Nuclear energy production growth	1.0 (-)*	Japan 10.0	Belgium 5.6 (6)
Nuclear energy contribution	1.0 (-)*	France 10.0	France 10.0 (1)
Green society	*5.06 (40) (19)*	*S. Korea 7.04*	*Ireland 6.79 (3)*
Green buildings	6.1 (30) (12)	USA 10.0	Finland 8.5 (2)
Recycling efforts	4.8 (33) (15)	Germany 10.0	Germany 10.0 (1)
Net change in forestation	5.0 (40) (10)	Ireland 8.6	Ireland 8.6 (1)
Meat and dairy consumption	3.8 (51) (7)	Nigeria 10.0	Slovakia 5.7 (33)
Green transport	5.7 (34) (18)	Norway 10.0	Sweden 8.7 (3)
Clean innovation	*5.83 (32) (12)*	*Finland 7.67*	*Finland 7.67 (1)*
Green patents	2.7 (32) (17)	S. Korea 10.0	Finland 9.3 (3)
Cross-border clean energy investment	7.2 (28) (1)	Angola 10.0	**Greece** 7.2 (28)
Foodtech private investment	5.7 (39) (19)	Israel 10.0	Sweden 8.9 (3)
Climate policy	*5.70 (25) (16)*	*Denmark 8.12*	*Denmark 8.12 (1)*
Climate action	4.0 (37) (17)	Morocco 9.0	Many countries 7.0 (7)
Carbon capture and storage readiness	5.5 (20) (10)	USA 10.0	Denmark 7.7 (7)
Carbon pricing initiatives	7.0 (17) (11)	Many countries	Many countries 8.0 (1)
Sustainable agriculture policy/strategy	1.0 (57) (17)	Many countries	Many countries 9.0 (1)
Pandemic pivot	9.0 (2) (1)	India 10.0	Denmark, **Greece** 9 (2)

Source: MIT Technology Review Insights, 2022.

Note: 1. The first parenthesis shows the ranking among the 76 countries of the index, while the second parenthesis shows the ranking among the 20 EU countries the index includes.

* Due to the large number of countries with the same score, ranking does not provide any more information than the score does.

the innovation environment for building a low-carbon future, such as the relative penetration of green patents, investment in cross-border clean energy, and investment in food technology') and e) Climate policy ('measures the ambition and effectiveness of climate policy, including carbon financing incentives, sustainable agriculture policy, and the use of pandemic recovery spending to achieve a green economic recovery').

According to the GFI, the top 20 countries are called 'green leaders', the next 20 are the 'greening middle', while the next 20 are the 'climate laggards' and the last 16 the 'climate abstainers'. Table 3.4.5a shows the 20 EU countries included in the Index, their 2022 score as well as their 2021 and 2022 rankings. Greece, like many other European countries, has made significant improvements in policy and energy infrastructure. It has made an impressive gain of 15 ranks since the last edition of the index (2021) and belongs to the group of the greening middle, but is fast approaching the green leaders. Moreover, according to the Index, Greece "has earmarked more than 30% of its €18 billion EU recovery fund package for clean energy and transition efforts" (MIT, 2022:17).

Table 3.4.5b presents all main indicators the GFI measures. The data came from a wide range of publicly available sources, including the International Energy Agency (IEA), the International Renewable Energy Agency, the World Bank, the United Nations Food and Agriculture Association (FAO), the World Intellectual Property Organization, and the Climate Action Tracker (CAT), among others. An important note is that most data refer as far back as 2019 and/or cover periods between 2014–2019. For example, the CO_2 emissions growth in the industrial sector, where Greece ranks 1st among the 20 EU countries included, covers the period between 2014 and 2019. The cross-border clean energy investment, another indicator where Greece ranks 1st among the 20 EU countries included, is measured as the total renewables public investment received and provided in 2016–2020 as % of GDP in 2020.[11]

Based on Table 3.4.5b, Greece needs to improve green society indicators, particularly recycling and green transport (here it measures electric passenger vehicles). It also needs to make progress in clean innovation indicators, such as green patents and foodtech private investment, as well as in climate policy indicators, such as increasing the sustainability of agriculture and undertaking more climate action in alignment with the Paris Agreement.

Before closing this section, the Renewable Energy Country Attractiveness Index (RECAI) is presented (Table 3.4.6). The RECAI captures completed, on-going and scheduled or announced investments, considers public policy that hinders or enables the exploitation of renewables as well as grid infrastructure quality and storing capacity, macroeconomic stability, and country investment climate. The RECAI is published by Ernst & Young (EY). It includes 40 countries, 14 of which are EU member-states. Table 3.4.6 presents all 14 EU countries as well as the top performer, the USA. The RECAI contains 8 technology-specific indicators, all of which are renewables.

11. For more information on the measure, the reader is referred to the GIF 2022 data set available online at: <https://docs.google.com/spreadsheets/d/1rEf_F4x0bdDVDzTcE-sMxyeahmrGeUrIraheaxDl0A0/edit#gid=674941145>.

Table 3.4.6 Renewable Energy Country Attractiveness index 2021

Rank	Country	Score	Onshore wind	Offshore wind	Solar PV	Solar CSP	Biomass	Geothermal	Hydro	Marine
1	USA	74.2	58.8	60.2	58.8	47.0	30.1	47.0	40.7	21.2
4	Germany	69.6	54.3	52.0	53.4	17.5	50.9	38.6	35.1	20.7
5	France	69.5	55.6	53.6	54.2	23.5	47.6	39.9	41.8	38.9
9	Spain	64.4	49.2	34.4	51.5	29.0	39.8	15.6	25.2	23.5
10	Netherlands	64.3	52.2	49.8	46.8	15.7	49.6	22.1	25.0	24.3
11	Denmark	62.4	53.2	50.2	44.6	16.0	45.4	15.0	20.8	20.7
12	Ireland	62.3	51.0	40.0	45.6	19.5	26.8	17.7	23.3	24.9
15	Italy	61.9	45.7	40.6	48.6	31.8	42.4	32.5	44.5	18.7
17	Sweden	59.4	49.5	40.9	42.1	15.2	43.9	17.7	32.8	26.1
19	Poland	59.3	44.6	40.1	48.0	13.4	44.7	17.4	32.5	14.2
21	**Greece**	**58.9**	**49.2**	**23.5**	**46.4**	**35.2**	**45.5**	**28.0**	**41.0**	**14.2**
23	Portugal	58.3	42.5	24.6	47.1	26.1	38.1	23.2	36.3	24.4
24	Finland	58.2	59.8	31.9	34.0	15.4	50.5	15.4	22.8	15.4
29	Belgium	56.7	48.4	27.7	41.5	18.0	42.3	20.0	21.4	14.8
37	Austria	52.9	43.6	15.7	40.7	13.5	38.6	17.0	36.0	13.5

Source: EY, 2022.

Notes: The greener the color, the higher the ranking; orange indicates low ranking and red close to the bottom. The Index includes 40 countries.

According to the index, Greece is performing well in concentrated solar power (CSP) (it ranks 2nd among the countries presented in the table, behind the USA) as well as in hydro power, geothermal and biomass. However, for the sunniest country in Europe one would expect Greece to perform better in solar photovoltaic. Offshore wind is rapidly being taken up worldwide and Greece should follow at a fast pace, given that it is a country surrounded by sea. Marine renewable energy (also known as hydrokinetic energy, coming from the natural movement of water such as waves, tides, rivers, and ocean currents) has great potential in Greece too. According to the index "Greece aims to double its installed renewables capacity to around 19GW by 2030 and recently energised a 204MW bifacial solar park, the largest of its kind in Europe." (EY, 2022:4).

Overall, Greece overperforms in the green transition relatively to other competitiveness indicators such as economic, social, governance as well as digital transition. However, given the urgent conditions of the imminent climate change, the supply chain bottlenecks created by COVID-19 and exacerbated by the war in Ukraine as well as the subsequent energy and food crises, Greece must accelerate in all aspects of transition (green, digital, economic and societal) in order to converge to the EU average, let alone to place itself higher than the EU average rankings.

3.5. Research and innovation

The linkages between research and development (R&D), innovation, and productivity have been widely explored and highlighted in the international literature (Huergo and Moreno, 2011; Baumann and Kritikos, 2016). R&D investments are likely to advance the stock of knowledge in a firm, leading to innovation and subsequently increased firm productivity and growth. In addition, R&D expenditure and innovation are found to positively affect firms' export performance (Roper and Love, 2002; Harris and Li, 2009; Ganotakis and Love, 2011) with product innovation being recognised as a critical driver of firms' export success and international competitiveness (Dosi, Grazzi and Moschella, 2015). Given their importance for productivity, competitiveness and growth, supporting R&D and innovation activities has been highly prioritised in almost every policy agenda during the last decades at both national and international/European levels.

In this context, the present section examines and evaluates the performance of the Greek R&D and innovation system in comparison with those of other European countries.

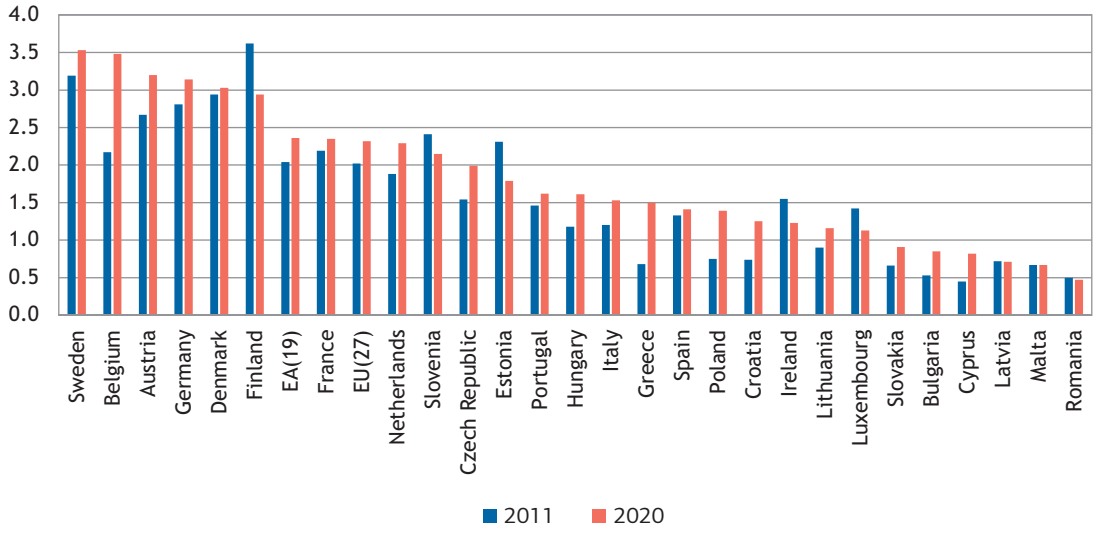
3.5.1. Research and Development

Investing in R&D can play an important role in improving national productivity and competitiveness and supporting long-term growth (Coccia, 2012). Gross expenditure in R&D (GERD) has increased significantly in Greece during the last decade. From 2011 to 2020, GERD in Greece increased by 78% (from 1.39 to 2.47 billion euros), while in the EU27 and EA19, it increased by 36% and 34%, respectively. R&D intensity (GERD as a percentage of GDP) increased from 2011 to 2020, by 0.87 pp in Greece, while in the EU27 and EA19, it increased by 0.30 pp and 0.32 pp, respectively (Figure 3.5.1). Nevertheless, Greece ranks below the EU27 and the EA19, both in terms of R&D intensity (ranking 17th) and GERD per inhabitant (ranking 19th) (Figures 3.5.1 and 3.5.2).

In the EU27 and the EA19, the main source of funding for R&D is the business sector (59%), while in Greece, both the business sector and the government sector contributed almost equally (41.4% and 41.1%, respectively) to the total funding in 2019 (Figure 3.5.3). Nevertheless, in Greece, R&D funding (as a percentage of GDP) from both the government sector (0.52%) and the business sector (0.53%) are below the corresponding EU27 and EA19 figures (0.65% and 0.66% from the government sector and 1.31% and 1.34% from the business sector, respectively). As far as the sectors of performance are concerned, R&D intensity in Greece was below the EU27 and EA19 corresponding figures in the business and higher education sectors and above those in the government sector in 2020 (Figure 3.5.4).

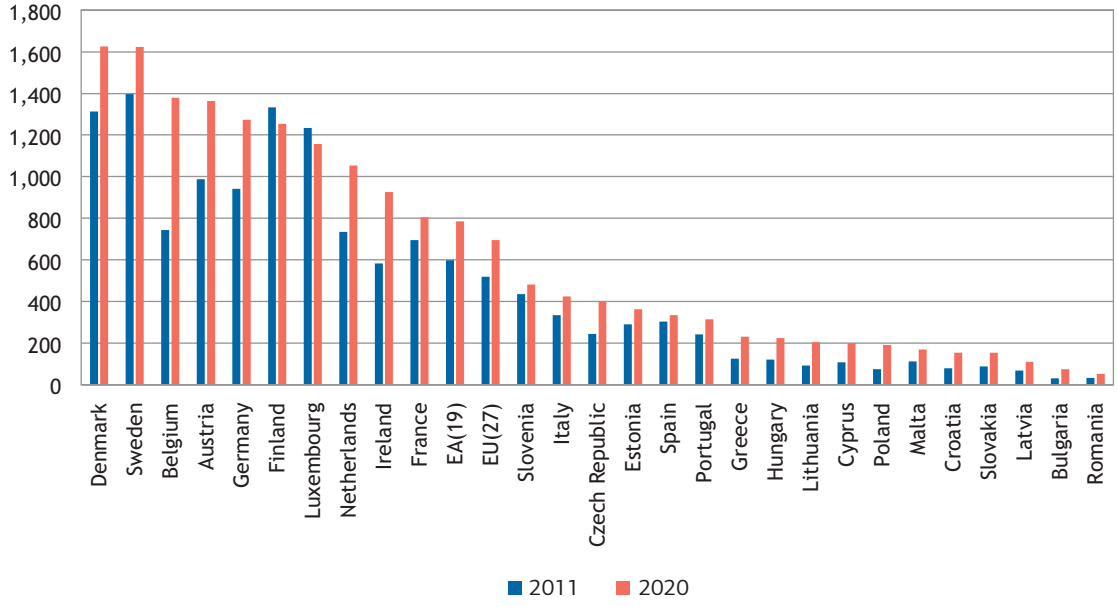
One of the most crucial inputs in the creation of knowledge and the R&D processes is human capital. As shown in Figure 3.5.5, Greece ranks 8th as far as the share of researchers (as a percentage of total employment, in full-time equivalent–FTE) is concerned. It is worth noting, that, in Greece, more than half of the researchers are employed in the higher education sector (52% of researchers are employed in the higher education sector, 28% in the business sector and 20% in the government sector), and the same phenomenon is reported in five other countries

Figure 3.5.1 GERD (% of GDP)



Source: Eurostat.

Figure 3.5.2 GERD per inhabitant, in Euros

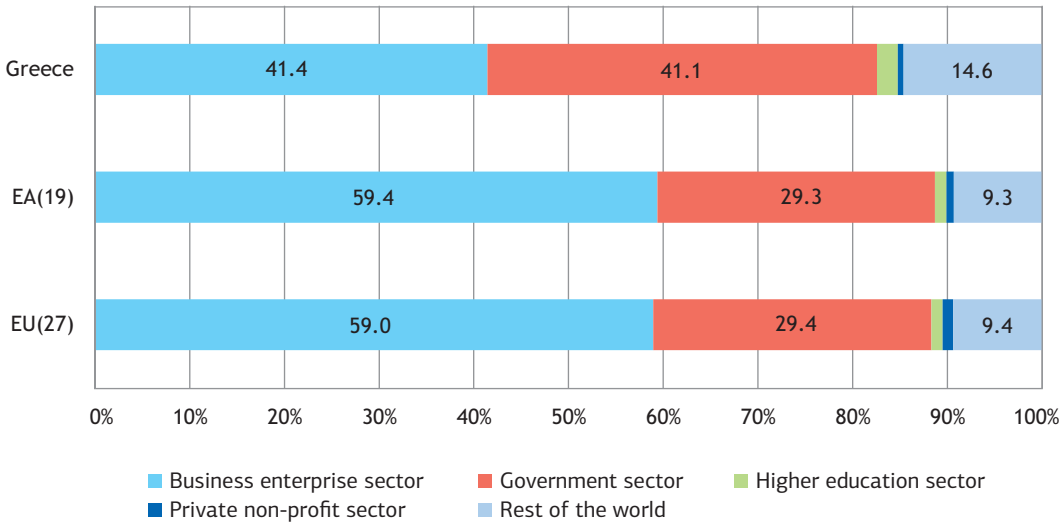


Source: Eurostat.

(Croatia, Latvia, Lithuania, Portugal and Slovakia). On the other hand, in fourteen member-states more than 50% of researchers are employed in the business sector. Greece has the 5th lowest percentage of researchers employed in the business sector.

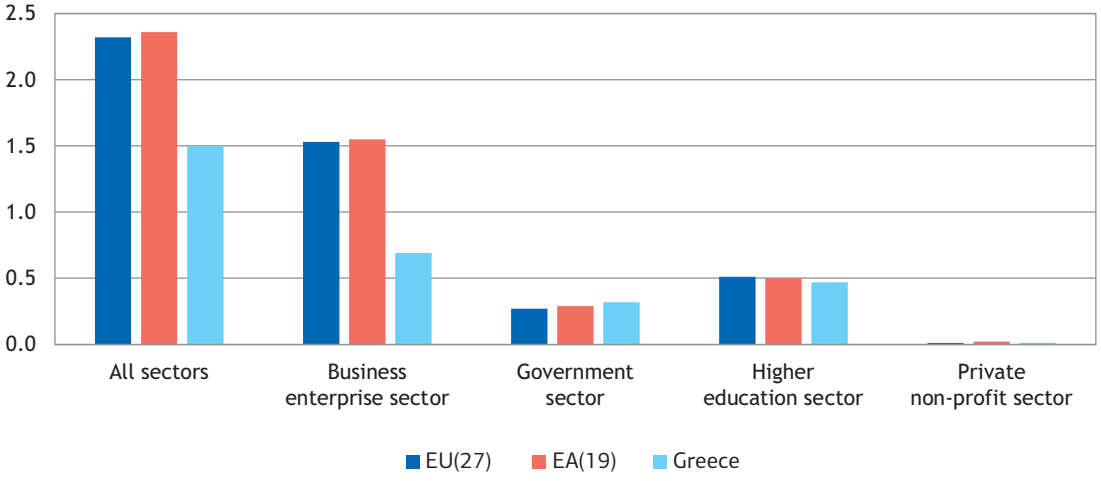
Although R&D expenditure is considered as an important constituent of economic growth and competitiveness, it is important to measure the effectiveness of such investment. Research

Figure 3.5.3 GERD by source of funding (% of total funding), 2019



Source: Eurostat.

Figure 3.5.4 GERD (% of GDP), by sectors of performance, 2020

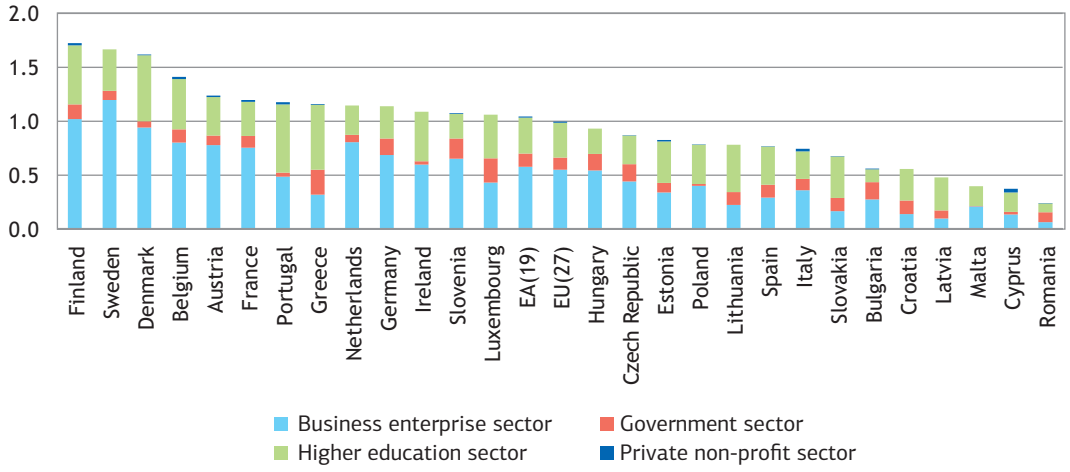


Source: Eurostat.

indicates that the efficiency of investment in R&D and innovation may vary significantly across countries due to a wide range of contributing factors (Hillier et al., 2011; Johansson, Lööf and Savin, 2015; Kontolaimou, Giotopoulos and Tsakanikas, 2016).

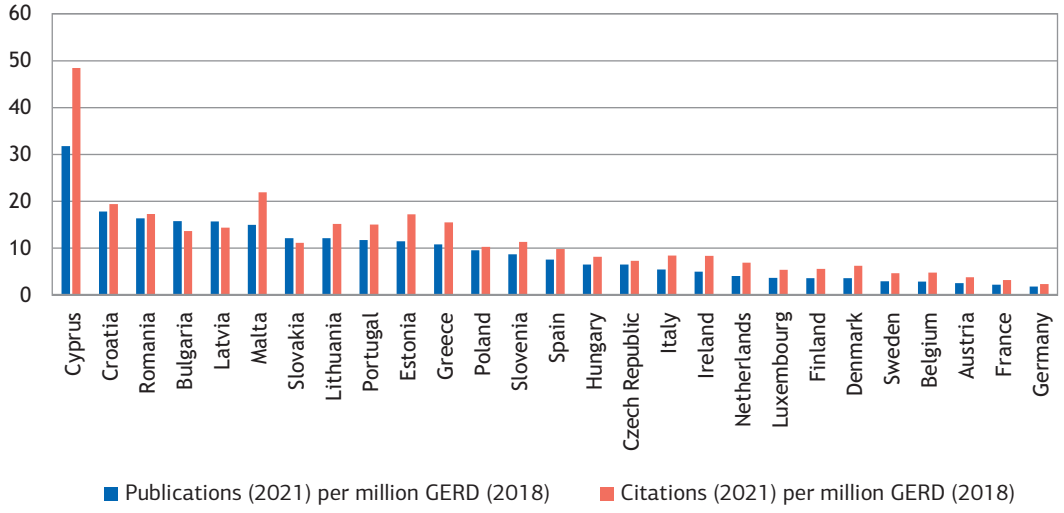
For the purposes of the current analysis, R&D effectiveness is measured as the ratio of an R&D output to the basic R&D input, that is, GERD. To this end, based on the relevant literature (Wang, 2007; Thomas, Sharma and Jain, 2011; Carrillo, 2019), four indicators regarding R&D outputs are considered: (a) scientific publications, (b) citations, (c) patent applications and (d) high-tech

Figure 3.5.5 Share of researchers in total employment (%), numerator in FTE, 2020



Source: Eurostat.

Figure 3.5.6 Publications and citations (2021) per million GERD (2018)

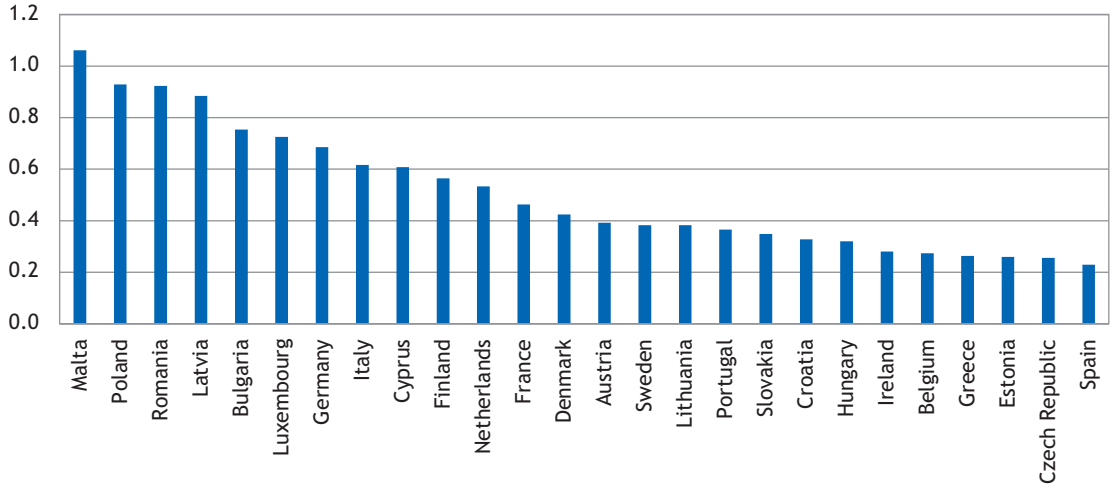


Source: Scimago Journal & Country Rank, Eurostat, own calculations.

exports.[12] As depicted in Figure 3.5.6, Greece performs relatively well as far as the publications and citations per million GERD are concerned, ranking 11th and 6th, respectively. On the contrary, Greece performs poorly as far as patent applications per million GERD (ranking 23rd out of 26

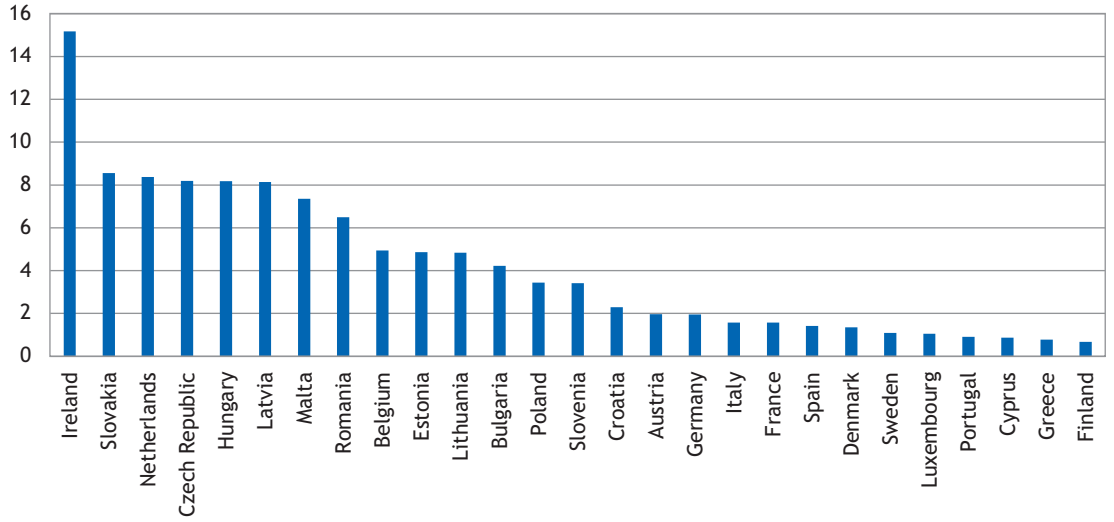
12. Since a certain length of time (usually two or three years) is required between the provision of inputs and the outcomes (Thomas, Sharma and Jain, 2011; Kontolaimou, Giotopoulos and Tsakanikas, 2016; Carrillo, 2019), the data on publications, citations and patents have been taken for the year 2021 and data on high-tech exports for year 2020 (the most recent year with available data), while the data on GERD have been taken for the years 2018 and 2017, respectively.

Figure 3.5.7 Patent applications (2020) per million GERD (2017)



Source: WIPO, Eurostat, own calculations.
Notes: Total patent applications (direct and Patent Cooperation Treaty national phase entries). Data for Slovenia are not available.

Figure 3.5.8 High-tech products exports (2021)/GERD (2018)



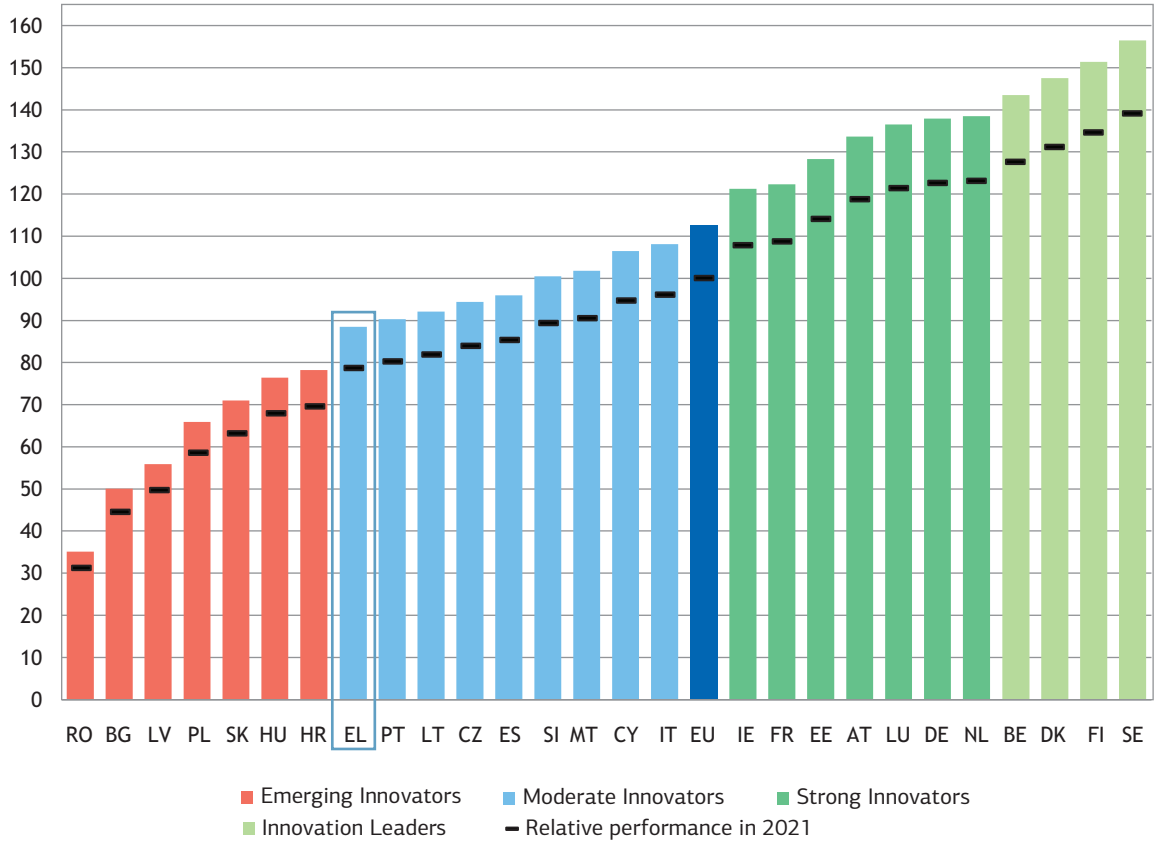
Source: Eurostat, own calculations.

member-states) and high-tech exports per million GERD (ranking 26th) are concerned (see Figures 3.5.7 and 3.5.8, respectively). As Figure 3.5.8 illustrates, a euro spent in R&D corresponds to 0.78 euros in high-tech exports in the case of Greece, while it corresponds to 15.17 euros in the case of Ireland. This ratio (value of high-tech exports/GERD) is less than 1 only for four member-states (Portugal, Cyprus, Greece, and Finland), indicating rather low R&D effectiveness in terms of exporting high-tech products.

3.5.2. Innovation

The European innovation scoreboard measures and compares the innovation performance of the EU27 countries on an annual basis using the Summary Innovation Index (SII).[13] Figure 3.5.9 presents the performance of each member-state in 2021 relative to the performance of the EU27 in 2014,[14] that is, the reference year, according to the last European innovation scoreboard report (EC, 2021b).

Figure 3.5.9 Classification of EU27 member-states based on their innovation performance



Source: Innovation Union Scoreboard 2021.

Notes: Coloured columns show member-states' performance in 2021 relative to that of the EU27 in 2014. Member-states' relative performance in 2021 is defined as their performance in 2021 relative to that of the EU27 in 2021.

13. The SII is a composite indicator constructed as an unweighted average of individual indicators. The SII in the 2022 edition of the European innovation scoreboard is based on 32 indicators classified in 12 dimensions. For more information see <https://ec.europa.eu/info/research-and-innovation/statistics/performance-indicators/european-innovation-scoreboard_en>.

14. It is computed as the ratio of the SII for each member-state in 2021 to the average SII for the EU27 in 2014, expressed as a percentage (%).

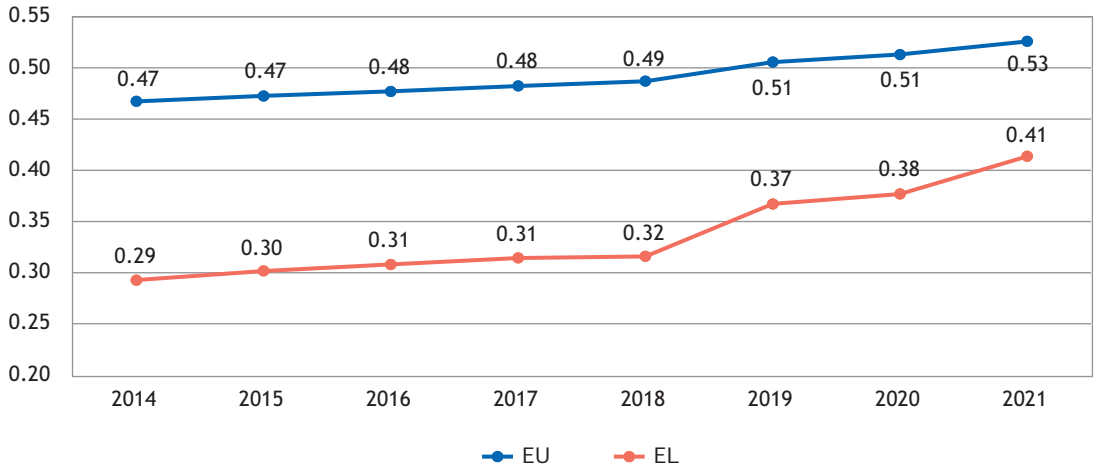
Greece attains a score of 88.49, i.e. below the EU27 average, being classified as a 'Moderate Innovator' along with Portugal, Latvia, Czech Republic, Slovenia, Spain, Malta, Cyprus and Italy. This group includes countries with a relative performance in 2021 between 70% and 100% of the EU27 average in 2021. Greece outperforms 7 countries (Romania, Bulgaria, Latvia, Poland, Slovakia, Hungary and Croatia), which compose the group of 'Emerging Innovators', with a relative performance in 2021 below 70% of the EU27 average. On the contrary, four countries, i.e., Belgium, Denmark, Finland and Sweden, are characterised as 'Innovation Leaders' since they perform well above, i.e., more than 125% of the EU27 average in 2021. Finally, the group of 'Strong Innovators' consists of seven countries (Ireland, France, Estonia, Austria, Luxembourg, Germany, and Netherlands) with a relative performance in 2021 between 100% and 125% of the respective EU27 average.

Regarding the change in the Greek innovation performance over time, the SII of Greece appears to increase rather slightly during 2014–2018, but from 2018 onwards, it presents a marked improvement, closing the innovation gap with the EU27 average (Figure 3.5.10 and Figure 3.5.11). Overall, based on the SII, the innovation performance of Greece has increased by 41.3% since 2014 and by 31.0% since 2018, with the respective values for the EU27 being significantly lower, i.e., 12.5% and 8.0%.

Despite the considerable improvement in its innovation performance, especially since 2018, Greece continues to lag behind the EU27 average in most of the twelve innovation dimensions captured by the SII (Figure 3.5.12). The country appears to outperform the EU27 average only in three dimensions, i.e., 'Innovators', 'Linkages' and 'Employment impacts'. The high percentages of SMEs reporting product and business process innovations appear to drive the good performance of Greece in the 'Innovators' dimension. With respect to 'Linkages', Greece performs above the EU27 average in two related indicators: the share of SMEs with innovation co-operation activities and the number of public-private coauthored research publications. Finally, the superior performance of Greece in 'Employment impacts' is due to the higher share of employed persons in innovative enterprises in Greece than in the EU27.

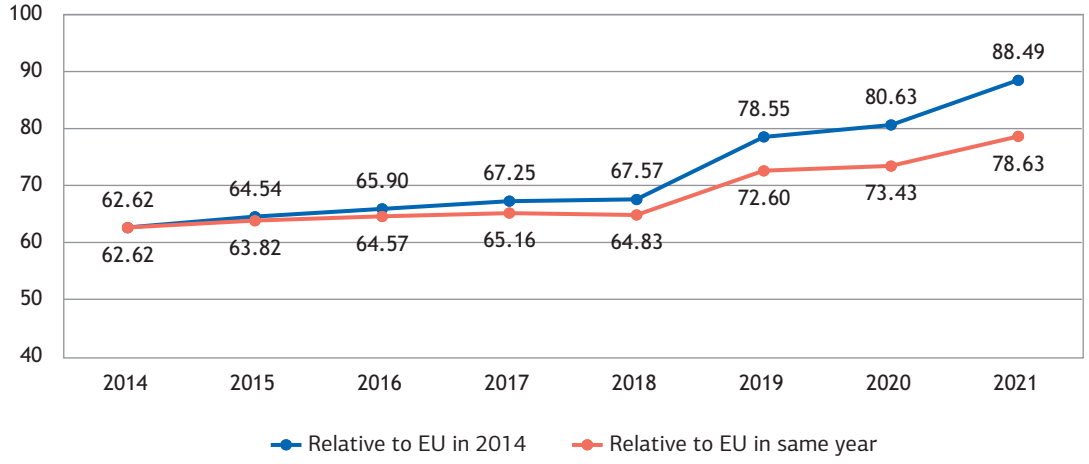
On the contrary, the most significant weaknesses of the Greek innovation system are identified in 'Intellectual assets', 'Information Technologies' and 'Finance and Support', dimensions where the relative performance of Greece was below or slightly above 50% of the EU27 average in 2021. The poor performance in 'Intellectual assets' relates to the particularly small numbers that Greece reports in patent applications filed under the Patent Cooperation Treaty (19% of the EU27 average) and design applications at the European Union Intellectual Property Office (22.8% of the EU27 average). Regarding the 'Information Technologies' dimension, Greece significantly underperforms the EU27 average in both related indicators concerning the provision by enterprises of any type of training to develop ICT related skills of their personnel (46.7% of the EU27 average) and the number of employed ICT specialists (35.7% of the EU27 average). Finally, Greece scores very low in two out of three 'Finance and Support' indicators and, specifically, in venture capital expenditures (29.1% of the EU27 average) and the direct government funding and government tax support for business R&D (25.6% of the EU27 average).

Figure 3.5.10 Innovation performance of Greece and the EU27, 2014–2021



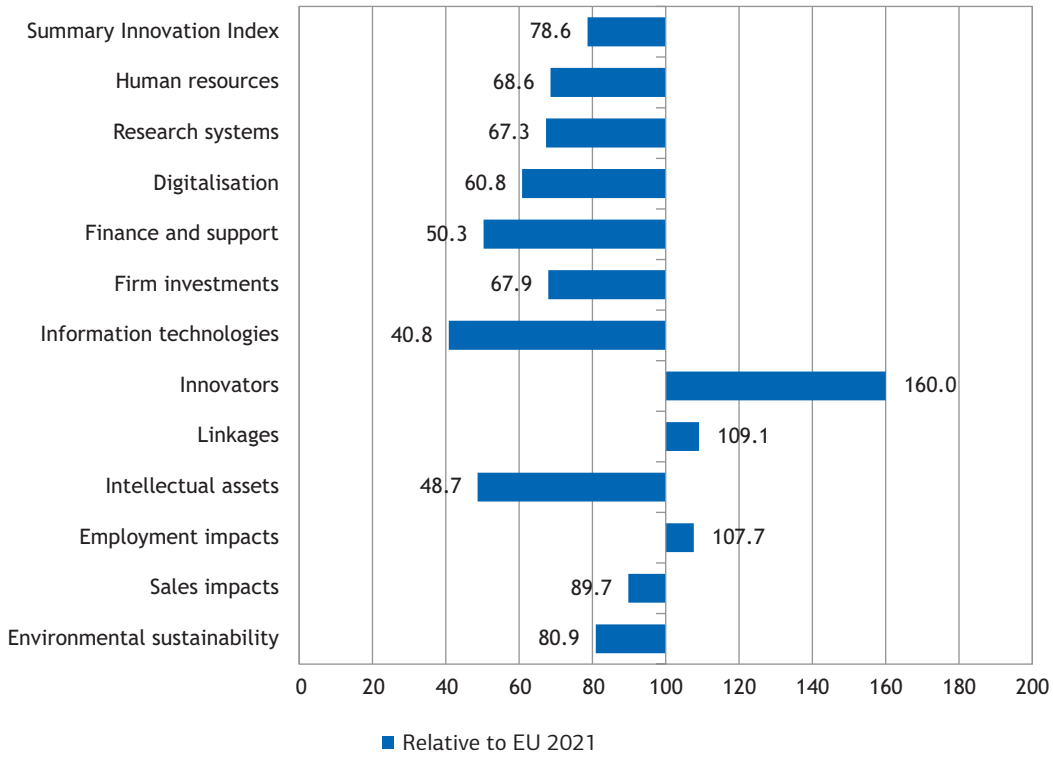
Source: Innovation Union Scoreboard 2021.

Figure 3.5.11 Relative innovation performance of Greece, 2014–2021



Source: Innovation Union Scoreboard 2021.

Figure 3.5.12 Relative innovation performance of Greece in 2021



Source: Innovation Union Scoreboard 2021.

4. Conclusions and Policy Suggestions

As economies are trying to recover from the pandemic-induced recession, the war in Ukraine poses additional challenges. The findings of this report showed the fast recovery of the Greek economy from the pandemic shock and substantial improvements in several components of productivity and pillars of competitiveness. Many reform policies are currently pursued on the basis of the Greece 2.0 plan and the National Reform Programme, although they constitute stages towards the completion of wider reform initiatives and, hence, the consequent productivity gains are subject to the completion of the remaining related reform steps and their successful implementation. Thus, there is the need for consistent monitoring and comprehensive evaluation of all the national, regional and sectoral policies, strategies and plans, and analytical strategic scenario building to facilitate the assessment and treatment of various kinds of risks in the medium and long run. These plans and assessments should involve stakeholders to achieve more realistic and commonly accepted solutions, and they should not only concentrate on the economy, but also on all other (social, environmental and governance) aspects influencing sustainability. Public policies that support the digital and green transitions and investments in knowledge, research, innovation, and technology can play an important role in improving Greece's competitiveness.

Macroeconomic developments and policies

After the severe contraction of the economy during 2020 because of the COVID-19 pandemic, a vigorous V-shape recovery in 2021 almost fully zegained the previous year's losses. However, the conditions of expansion have brought about an inflationary process, which, combined with several significant external factors, such as the war in Ukraine, tend to increase uncertainty and threaten to upend current growth dynamics, which are estimated to follow a downward adjustment. Despite the appearance of new headwinds, the economic expectations remain strongly positive, with future investment flows of the Greek National Recovery and Resilience Plan, Greece 2.0, guaranteed by the EU Recovery and Resilience Facility. Among others, the medium-term growth path depends on government expenditure to contain the adverse impact of increased inflation, the implementation of the scheduled investments and the course of tourism receipts. In this line, the government should continue to effectively support the economy and facilitate the absorption of the EU funds.

Productivity components and growth drivers

During 2021, labour productivity per hour worked declined by 0.31%, whereas labour productivity per person employed increased by 7.55% and total factor productivity increased by 3.95%. By decomposing aggregate per capita output growth into changes in labour productivity and labour utilisation, the rebound in per capita output by 8.39% in 2021 can exclusively be attributed to

the rebound in labour utilisation, which increased by 8.70%. The fall in labour productivity growth was heavily influenced by a fall in capital intensity, which decreased by 4.26%. In turn, the fall in capital intensity was the result of increasing hours worked and steadily decreasing capital stock. The significant increase in labour utilisation can be largely attributed to the increase of average hours worked by 6.97%.

Although the Greek economy has experienced productivity gains, those can mainly be considered as a result of catch-up effects and not of new technology incorporation. Hence, much should be done to improve the effects of incorporating new technologies since frontier shift effects remain subdued. Moreover, Greece is found to have, at the same time, a poor labour productivity performance and a top capital productivity performance, compared to other European countries. This outcome may reflect structural problems underlying the Greek economy, including its high dependence on imports and the services sector, institutional dysfunctionalities and the footprint of the long economic crisis during the previous decade.

Similar to the initial decline in output and employment following the outbreak of the pandemic, the effects of recovery were not uniformly distributed across economic sectors. In particular, out of the 11 major sectors of the economy, 5 experienced slight productivity increases, since output increased faster than employment, 2 sectors experienced slight productivity decreases, and 3 sectors behaved as outliers. There are also significant differences regarding the determinants of productivity growth among industries. There is a notable influence of tourism and transport industries, in particular, of the water transport industry on the Greek economy, as both industries experienced two of the highest increases in both labour input and capital input, as well as in TFP.

The cost components and impact of increased energy prices

The increased energy prices in the Greek economy were found to be largely attributed to Profits (37%) —mainly distributed to the energy sector itself— and, to a lesser extent, the Extra EU imports (23%), mainly of Mining and quarrying products and Coke and refined petroleum products, while the contribution of total Imports is 30%. The latter component manifests the significant impact of such exogenous factors as the Ukraine war. Furthermore, it was found that the energy sector primarily contributes to the price formation of industrial sectors. In turn, policies are recommended to contain prices based on the implementation of income and import substitution policies, towards the exploitation of domestic mining and quarrying products, and coke and refined petroleum products. Such policies are expected to have a significantly positive impact, not only on the retainment of energy prices, but also on the increase of the energy security of the country.

Risks and opportunities to strengthen competitiveness

The enduring implications of the pandemic continued to affect the Greek economy in 2021, but the signs of recovery became evident. Government expenditure and revenues, albeit increased

in million euros, decreased as a percentage of GDP, mainly due to the significant increase of the level of GDP. Moreover, the Budget balance and the Primary balance remained below zero for a second consecutive year after four years, of surpluses (2016-2019). Nevertheless, the Primary deficit and the government deficit decreased in 2021 compared to the previous year. In addition, the debt-to-GDP ratio also improved in 2021.

Global trade, which was severely disrupted in 2020, started to recover in 2021. Greek exports and imports (as a percentage of GDP) of both goods and services increased in 2021, compared to the previous year. The Current Account deficit slightly improved in 2021, mainly due to the improvement of the balance of services (Greece recorded the fourth largest increase among the EU member-states), since the balance of goods deteriorated. Greece is highly involved with and dependent on GVCs. Greece's participation in GVCs (backward and forward linkages) exceeded the EA19 and EU27 averages throughout the period 2005–2018. Both the backward and the forward participation of Greece in GVCs increased in 2018 compared to 2017. As far as the sectoral backward linkages are concerned, the foreign value-added contribution to Greece's gross exports lies above the corresponding EA19 and EU28 averages, for most sectors. Notably, the manufacturing export industry is heavily dependent on imported inputs.

Greece's competitiveness improved in 2021, as also indicated by the decrease of the CPI-based REER and the ULCT-based REER, while both indices increased for the EA19 and the EU27. Moreover, the ULC that increased dramatically in Greece in 2020 (compared to 2019) decreased significantly in 2021. Furthermore, Greece's relative unit labour cost recorded the largest decrease among the EU member-states, indicating an amelioration in Greece's competitive position relative to its euro area partners.

Promoting FDI attractiveness

Greece has made significant improvements in attracting FDI. As a result, during the last few years FDI has been rising continuously and has hit new records. However, two points require special attention. First, a significant part of FDI in Greece refers to real estate through the golden visa programme. This part of FDI does not result in the most beneficial effects for the economy as other parts of FDI, such as greenfield investments, which is what the Greek economy needs the most. Second, Greece still needs to improve its business climate, particularly in reforming its very slow and ineffective contract enforcement and property registration, if its economy is to approach the EU average in FDI inward stock.

Fostering digitisation

Regarding digitisation, Greece continues to improve. According to the DESI, most improvements have been made in connectivity, where it moved up in rank to 22nd from 27th. However, all indicators lag behind the EU average, and there is a lot to be done to catch up. Particularly, Greece needs to increase a) the number of firms that provide ICT training, b) fixed VHCN coverage, c) fibre

to the premises coverage, d) the number of SMEs with at least a basic level of digital intensity, e) the number of firms using the cloud, f) digital public services for businesses and for citizens as well as the number of pre-filled forms.

Improving (green) transition performance

Among FDI, digitisation and the green transition, the best performance of Greece seems to be in the latter. According to the Transition Performance Index (TPI), Greece ranks 10th, with a score of 65.5, slightly above the European average of 65.0 in Environmental transition. In Economic, Social and Governance transitions, Greece ranks 25th, 25th and 26th, respectively. The latter rankings show the long road that Greece must cover to reach the European average in these transitions. The use of renewables is on a good track, although the use of renewable energy in transport activities (last among the EU27) needs to increase substantially. According to the last edition of the Green Future Index, Greece has made significant improvements and climbed 15 ranks. What needs to be improved includes a) recycling, b) green transport, c) green patents, d) climate action, e) sustainable agricultural policy/strategy. It should be noted that improving the business climate —which directly affects FDI— will also enhance Greece's position in the Renewable Energy Country Attractiveness Index, which is very important regarding investments (foreign and domestic) in renewables.

Boosting the role of Research and Innovation

Research and Innovation can play a vital role in promoting sustainability, competitiveness and resilience. Even though Greece has significantly increased R&D expenditure and has reduced the innovation gap during the last years, it still lies well below the EU27 and the EA19 in R&D intensity, particularly in the business sector, and is classified as a 'Moderate Innovator', with low R&D effectiveness in patent applications and high-tech exports. The most significant weaknesses of the Greek innovation system are identified in patent and design applications, the employment of ICT specialists, the provision of ICT training to businesses' personnel, venture capital expenditures and government support for business R&D. Possible directions for policy design and action to promote R&I include:

- Increasing public spending on R&D to reinforce the positive spillover effects on the industry and the entire economy and improve the national talent pool. Public spending on R&D should also be coupled with the regular monitoring and evaluation of the corresponding effectiveness measures.
- Encouraging firms to invest in R&D, employ researchers and provide training in new technologies to their personnel via a wide range of incentives (e.g. tax incentives, direct funding, tech hubs).

- Reinforcing linkages between research and innovation carried out in universities/research centres and the business sector by developing effective channels for industry-university knowledge transfer based on:
  - joint research projects, joint patenting and exchange of information on R&D results between universities and industry,
  - a mobility system of scientists, academia, research personnel and managers between universities and industry,
  - joint training programmes to upgrade firms' human resources provided by universities and industry, and
  - university-based science parks and business incubators.

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Appendix

TABLE A1 Description of the 2-digit codes of economic activities according to NACE rev. 2

Code	Description
A01	Crop and animal production, hunting and related service activities
A02	Forestry and logging
A03	Fishing and aquaculture
B	Mining and quarrying
C10_C12	Manufacture of food products; beverages and tobacco products
C13_C15	Manufacture of textiles, wearing apparel, leather and related products
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Manufacture of paper and paper products
C18	Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
C22	Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24	Manufacture of basic metals
C25	Manufacture of fabricated metal products, except machinery and equipment
C26	Manufacture of computer, electronic and optical products
C27	Manufacture of electrical equipment
C28	Manufacture of machinery and equipment n.e.c.
C29	Manufacture of motor vehicles, trailers and semi-trailers
C30	Manufacture of other transport equipment
C31_C32	Manufacture of furniture; other manufacturing
C33	Repair and installation of machinery and equipment
D	Electricity, gas, steam and air conditioning supply
E36	Water collection, treatment and supply
E37_E39	Sewerage, waste management, remediation activities
F	Construction
G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
G46	Wholesale trade, except of motor vehicles and motorcycles

TABLE A1 (continued)

Code	Description
G47	Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52	Warehousing and support activities for transportation
H53	Postal and courier activities
I	Accommodation and food service activities
J58	Publishing activities
J59_J60	Motion picture, video, television programme production; programming and broadcasting activities
J61	Telecommunications
J62_J63	Computer programming, consultancy, and information service activities
K64	Financial service activities, except insurance and pension funding
K65	Insurance, reinsurance and pension funding, except compulsory social security
K66	Activities auxiliary to financial services and insurance activities
L	Real estate activities
M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities
M71	Architectural and engineering activities; technical testing and analysis
M72	Scientific research and development
M73	Advertising and market research
M74_M75	Other professional, scientific and technical activities; veterinary activities
N77	Rental and leasing activities
N78	Employment activities
N79	Travel agency, tour operator and other reservation service and related activities
N80_N82	Security and investigation, service and landscape, office administrative and support activities
O	Public administration and defence; compulsory social security
P	Education
Q86	Human health activities
Q87_Q88	Residential care activities and social work activities without accommodation
R90_R92	Creative, arts and entertainment activities; libraries, archives, museums and other cultural activities; gambling and betting activities
R93	Sports activities and amusement and recreation activities
S94	Activities of membership organisations
S95	Repair of computers and personal and household goods
S96	Other personal service activities

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GREEK NATIONAL PRODUCTIVITY BOARD ANNUAL REPORT 2022

The 2022 edition of the Greek National Productivity Board Annual Report is constructed as follows. Section 1 starts with a description of the global crises and the corresponding national policies, emphasising Greece's regional challenges related to insularity and the main reforms that were implemented in 2022 and encompassing the Greek stakeholders' viewpoint on productivity problems and policies. Section 2 reports macroeconomic developments and scenario analysis and investigates the components and drivers of productivity growth at the national and sectoral levels. Further attention is given to the comparative analysis of productivity indices of the Greek economy with other European economies, as well as to the cost components and impact of increased energy prices on the Greek economy. Section 3 discusses the cost and non-cost competitiveness developments of the Greek economy. Emphasis is given to the competitive performance of the country in FDI attractiveness, digitisation, the green (and other dimensions of) transition to a more sustainable future, and the R&I system. Section 4 concludes and provides several policy implications and comprehensive recommendations regarding the enhancement of various components of productivity, pillars of competitiveness and dimensions of transition to sustainability.

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