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Approved By
European Department

Prepared by Efthymios Argyropoulos, Shiqing Hua, Yi Liu, María Méndez, Francisco Parodi, and Xin Cindy Xu. Ritzy Dumo and Daniel Murphy Pineda provided assistance.

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CORPORATE VULNERABILITIES IN THE WAKE OF COVID-19[1]

Greek firms have improved their balance sheets over the last decade notwithstanding the challenging macro-economic environment. Simulations of the impact of the pandemic on firm's ability to continue servicing their debt show resilience in Greek non-financial corporates. Specifically, we find that the government's robust response to the pandemic prevented a deterioration in corporate balance sheets that otherwise would have rivalled the experience during the early phase of the sovereign debt crisis. Going forward, given narrowing fiscal space, a data-driven approach is recommended to deploy further policy support that targets viable sectors. The implementation of the new solvency framework will be key to reducing the incidence of zombie firms.

A. Introduction

1. Greek Non-Financial Corporations (NFCs) were severely affected by the sovereign debt crisis in 2010. During 2010–18, Greece agreed to three economic assistance packages with international official creditors (including two arrangements with the IMF), undertook a large sovereign debt restructuring program, imposed capital controls in 2015, and committed to undertaking wide-ranging fiscal and structural reforms. Despite the macroeconomic instability during this period, the Greek NFC sector successfully deleveraged and repaired balance sheets to pre-crisis levels prior to the COVID-19 pandemic.

2. Most of the existing studies on Greece during this period take a macro perspective and assess the consequences of various reform measures, typically based on micro-founded macroeconomic models calibrated to aggregate data (see Arellano and Bai, 2017; Chodorow-Reich et al., 2019; Dellas et al., 2017; Economides et al., 2017 & 2020; Gloom et al., 2018; Gourinchas et al., 2016; and Papageorgiou and Vourvachaki, 2017, among others). This paper complements these studies by focusing on the financial performance of Greek NFCs since 2010 and simulating the impact of the COVID-19 shock on firms' financial vulnerabilities.

3. Using firm-level data, we find evidence of broad-based deleveraging among Greek NFCs across different firm sizes and exporting status since 2010. The reduction in leverage was accompanied by improvements in the investment rate, profitability, and the Interest Coverage Ratio (ICR), which measures a firm's ability to pay interest expenses using earnings. On a sectoral basis, liquidity vulnerabilities prior to COVID-19 were concentrated in the construction, electricity, transportation, manufacturing, information and communication technology, and accommodation sectors. The share of debt held by firms with ICR ratios less than one (denoting liquidity vulnerabilities) had fallen from 31 percent of total debt in 2013 to 13 percent in 2018.

[1] Prepared by Efthymios Argyropoulos, Yi Liu, and Francisco Parodi. Ritzy Dumo, Shiqing Hua, and Daniel Murphy Pineda provided assistance. The paper benefitted from comments from Dimitris Malliaropulos, Marianthi Anastasatou, and Filippos Petroulakis (all BoG) and the Greek Council of Economic Advisers.

4. Simulations using a counter-factual analysis show that the Greek government fiscal support measures during the COVID-19 shock prevented a surge in financial distress. Specifically, absent the sizable (and targeted) policy support measures by the Greek authorities, the adverse impact of the pandemic on the financial health of firms would have rivaled that of the sovereign debt crisis. Moreover, we find that the fiscal support was particularly effective in mitigating financial distress in the accommodation, manufacturing, wholesale and retail, and transportation sectors.

5. Given that zombie firms could have a long-lasting, negative effect on economic growth, we also investigate how the pandemic would have affected the distribution of firms with liquidity vulnerabilities across sectors and firm size categories. [2] On a debt-weighted basis, our simulations suggest that the electricity and gas and construction sectors, as well as large firms (≥250 employees) would contribute disproportionately to the incidence of firms with liquidity vulnerabilities relative to their activity shares. Going forward, using the firm-level analysis presented in this paper could also provide a framework for further improving sectoral and firm-level targeting once the pandemic recedes.

6. The remainder of the paper proceeds as follows: Section B discusses the relevant literature. Section C describes the dataset and presents stylized facts about the financial situation of Greek NFCs prior to the onset of the COVID-19 pandemic. Section D estimates the relationship between ICR and macroeconomic variables. Section E simulates the impact of COVID-19 on firm ICRs. Section F concludes.

B. Literature Review

7. Our paper is connected to a rapidly expanding literature on the effects of COVID-19 on firm level outcomes. Within this body of work, our analysis relates most closely to papers that examine firm liquidity shortfalls following the pandemic. Crouzet and Gourio (2020), for example, forecast the future cash balances of U.S. nonfinancial publicly traded firms based on a cash flow accounting identity; they use projected earnings paths in combination with assumptions about firm decisions on working capital, investment, and dividend payouts and find that the shock to earnings caused by the pandemic could have made one-fourth of US public firms run out of cash by Q3 2020. Greenwood, Iverson, and Thesmar (2020) adopt a similar methodology and extend the forecasts to U.S. private firms. Other studies that employ an accounting rule approach include Carletti et al. (2020), Demmou et al. (2020), and Schivardi and Romano (2020).) Ebeke et al. (2021) use an analytical framework that projects country-sector shocks to firms' turnover and assesses the end-2020 liquidity and solvency situation of European companies with and without policy measures, and find that the COVID-19 shock could have resulted in sizable liquidity and equity shortfalls in Europe's corporate sector by end-2020 and that policies announced by country authorities, if fully implemented as designed, could significantly lower liquidity risks but their impact of reducing policy

[2] The prevalence of zombie firms has been shown in general to impede productivity-enhancing reallocation of resources among firms and slow down aggregate growth (Adalet McGowan et al., 2018; Andrews and Petro ulakis, 2019; Banerjee and Hofmann, 2018; Caballero et al., 2008).

risks was more limited. Relative to these studies, our empirical approach does not require explicit assumptions about various firm decisions; it requires, instead, that firms react similarly to the pandemic as they did to past macroeconomic shocks so we can infer future firm ICRs based on the historical relationship between our shock measures and realized ICRs.[3]

8. Separately, Gourinchas et al. (2020) calibrate a structural model to forecast the number of bankruptcies among small and medium sized enterprises (SMEs) in Europe by the end of 2021. They define bankruptcy as a negative cash balance at the end of the period and find that for Greece, the SME bankruptcy rate would increase by 57 percent under COVID-19 and in the absence of policy intervention. Similarly, in a no-policy scenario, our results suggest that the zombie share among SMEs would rise by two-thirds in 2021.[4,5]

C. Greek NFCs Prior to COVID-19

9. Our firm-level dataset is based on Orbis Amadeus data, covering the period 2009–18 and contains about 131,000 firm by year observations. We clean the raw data following Díez et al. (2019), Gal (2013), Gopinath et al. (2017), and Kalemli-Özcan et al. (2015).[6] When aggregated, the dataset covers about 46 percent of the total operating revenues in Greece as reported by the OECD Structural and Demographic Business Statistics (SDBS).[7] While the dataset is broadly representative of the sectoral and size distributions of Greek NFCs when compared to SDBS tabulations (Figure 1), it underrepresents micro firms (≤ 9 employees) and overrepresents medium-sized firms (50–249 employees) and large firms (≥ 250 employees); the share of small firms (10–49 employees) is consistent with SDBS.

Firm Coverage in Sample, 2008–19

Number of Firms			Operating Revenue (billions of euro)		
Total	SMEs	Large	Total	SMEs	Large
100541	98156	2385	1136	636	500

Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.

[3] We remain agnostic about how exactly firms adjust to macroeconomic shocks and model the relationship between firm ICR and macroeconomic shocks in reduced-form fashion.

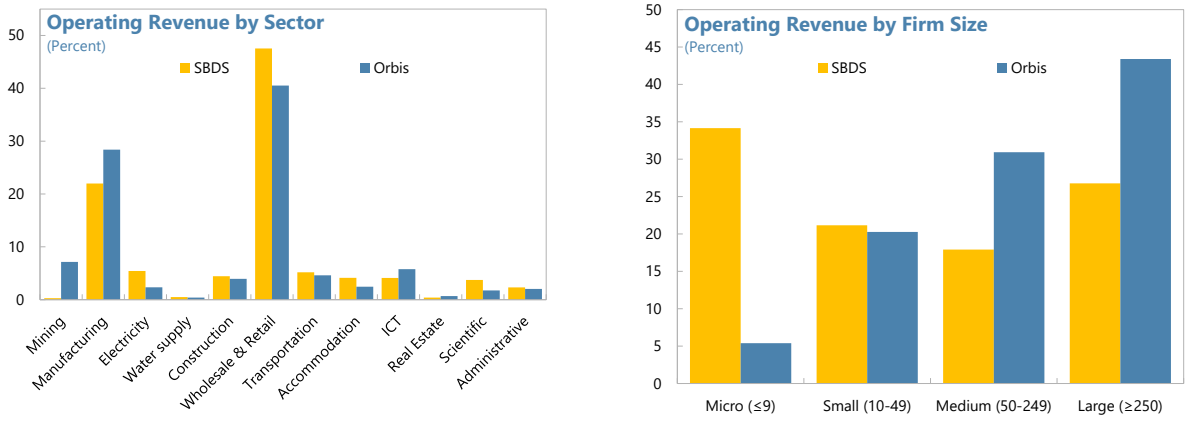
[4] Gourinchas et al. (2020) compute the national bankruptcy rate using the weighted average of the one-digit NACE bankruptcy rates, where the weights are given by 2017 sector gross value added. We follow the same weighting scheme to obtain the 66 percent increase in SME zombie share in 2021.

[5] For studies on the effect of policy intervention in the U.S. or in general, see Blanchard et al. (2020), Brunnermeier and Krishnamurthy (2020), Core and De Marco (2021), Crouzet and Gourio (2020), Drechsel and Kalemli-Özcan (2020), Elenev et al. (2020), Granja et al. (2020), Greenwood et al. (2020), Hanson et al. (2020), and Landais et al. (2020), among others. For the effect of policy intervention on the Greek labor market, see Betcherman et al. (2020).

[6] Detailed cleaning steps are described in Appendix A.

[7] The level of coverage in our cleaned sample is comparable to other studies using Orbis Amadeus data for Greece. Gourinchas et al. (2020), for example, report that their sample covers about 48 percent of the aggregate revenues for Greece and that Greece is considered a well-covered country among the list of European countries that they study

Figure 1. Sectoral and Size Representation of the Analysis Sample



Sources: Bureau van Dijk Orbis; and IMF staff calculations.
Notes: *Panel (a) plots the sectoral distribution of total operating revenues in our analysis sample against that reported by the OECD Structural and Demographic Business Statistics (SDBS), averaged over the period 2009–2018. Sectors are defined at the one-digit NACE level and limited to non-farm, non-financial, and private business sectors. Panel (b) plots the size distribution of total operating revenues in our sample against that reported by SDBS, averaged over the period 2009–2017 for which firm size statistics are available in SDBS.*

10. Greece's NFCs financial performance was negatively impacted by the sovereign debt crisis that started in 2010 but improved gradually during 2013–18 (Figures 2 and 3). This improvement is broadly shared across the firm size distribution and exporting status.

- ***Leverage.*** Greek NFCs underwent a substantial deleveraging process since 2010. Following Crouzet and Gourio (2020), we measure leverage using the ratio of gross debt to EBITDA. The share of turnover in Greek NFCs with gross debt/EBITDA ratio above four fell from 41 percent in 2010 to 28 percent in 2016.[8] Large corporates' leverage experienced greater volatility than SMEs during 2010–16, possibly due to larger sensitivity to macroeconomic and market developments.[9] Leverage increased slightly irrespective of firm size beginning in 2016 in line with the recovery in the economy.
- ***Investment.*** Business investment (measured as the change in log fixed tangible assets) contracted during 2010–12 but has recovered since 2013 across all size categories, peaking at roughly 8 percent in 2014. Investment growth in SMEs has been higher relative to large firms for most of the sample period.
- ***Profitability.*** There was a broad recovery in profitability in parallel to the decrease in leverage. The share of turnover in firms with ROA higher than 5 percent increased from 22 percent in 2011 to close to one-third in 2017–18. Large firms experienced higher volatility in earnings than SMEs, possibly due to larger sensitivity to macroeconomic developments.

[8] We use turnover-weighted measures to reflect the activity-weighted financial positions of firms. Our results also hold using debt-weighted financial ratios.

[9] Greece entered successive financial arrangements with the IMF in 2010 and 2012. Greece managed to return to the international bond market in 2014. Capital control measures put in place in 2015 were lifted in September 2019.

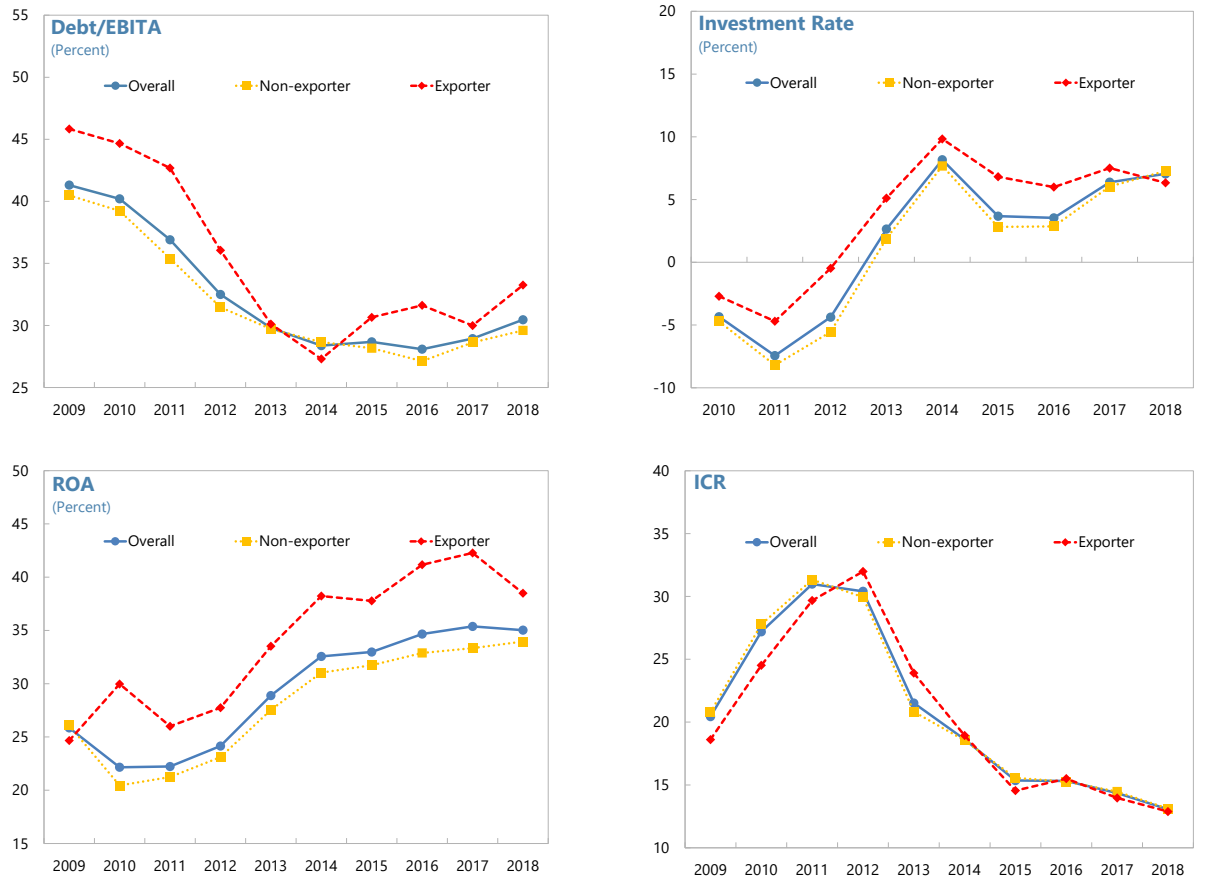
- ***Financial distress.*** The share of turnover in firms with an ICR below one has declined from 31 percent in 2011 to 13 percent in 2018. Financial vulnerability is higher in large firms than in SMEs, possibly reflecting their higher leverage levels.
- ***Exporters vs. Non-Exporters.*** Greek exporting firms had higher leverage, investment, and profitability, and slightly lower liquidity buffers than non-exporting firms (Figure 3).[10] In this respect, high-leverage exporting firms share in total turnover was about 33 percent in 2018, compared to 30 percent for non-exporters. In parallel, exporting firms had higher investment rates than non-exporting firms for most of the sample period.
- ***Sectoral vulnerabilities.*** Liquidity vulnerabilities prior to COVID-19 were concentrated mostly in the construction, electricity, transportation, manufacturing, information and communication technology, and accommodation sectors (Figure 4). In parallel, the wholesale and retail sectors had a lower share of vulnerable firms (8.5 percent of turnover in firms with ICR less than one), but it accounted for about 40.6 percent of total turnover in the sample.

Figure 2. Historical Performance of Greek NFCs: SME vs. Large

Sources: Bureau van Dijk Orbis; and IMF staff calculations.
Notes: Debt is measured as long-term debt and short-term loans. EBITDA stands for earnings before interest, taxes, depreciation, and amortization. Investment (growth) rate is measured as the change in log fixed tangible assets. ROA stands for return on assets. ICR stands for interest coverage ratio and is measured as earnings before interest and taxes (EBIT) over interest paid. SME stands for small and medium sized enterprises and is defined as firms with fewer than 250 employees; large firms are those with greater than or equal to 250 employees. The different lines represent sales-weighted statistics. All variables including the sales weight are winsorized at the top and bottom 0.5% of the distributions. The figu re is restricted to firms with non-missing employment information.

[10] We define a firm as an exporting firm when exports account for more than 20 percent of revenue in a given year. About 12.4 percent of firms in our sample fall into the category of exporters. Exporters altogether account for about 22.3 percent of the sample turnover.

Figure 3. Historical Performance of Greek NFCs: Exporters vs. Non-Exporters

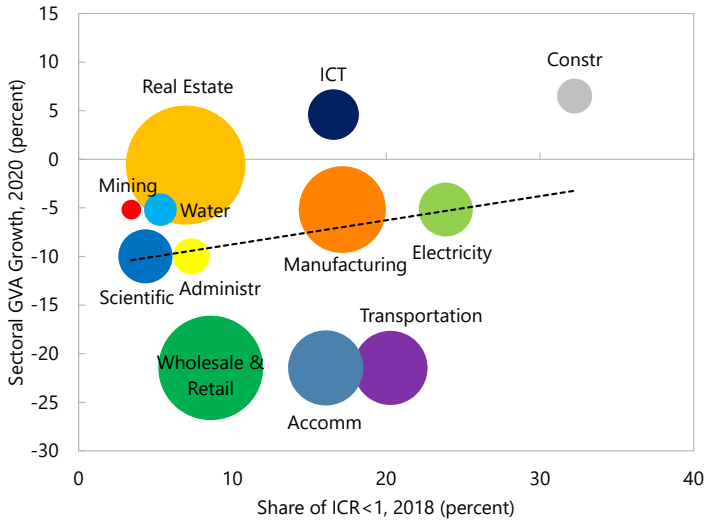


Sources: Bureau van Dijk Orbis; and IMF staff calculations.
Notes: Debt is measured as long-term debt and short-term loans. EBITDA stands for earnings before interest, taxes, depreciation, and amortization. Investment (growth) rate is measured as the change in log fixed tangible assets. ROA stands for return on assets. ICR stands for interest coverage ratio and is measured as earnings before interest and taxes (EBIT) over interest paid. A firm is defined as an exporter for all years if it has positive export revenue in any year between 2009 and 2018. The different lines represent sales-weighted statistics. All variables including the sales weight are winsorized at the top and bottom 0.5% of the distributions. To be compatible with Figure 2, this figure is restricted to firms with non-missing employment information.

D. Estimation Procedure

11. Our analysis of financial distress is based on the ICR. More specifically, ICR is defined as the ratio of earnings before interest and taxes (EBIT) to interest paid and indicates the ability of a firm to pay interest expenses on outstanding debt using contemporaneous earnings. The higher the ICR, the stronger the firm's ability to sustain its leverage level. An ICR less than one is typically used as an indicator of financial distress because earnings are insufficient to cover interest payments and additional financing may be needed to sustain operations.

Figure 4. Correlation Between Sectoral Pre-Existing Fragility and Shock Severity (Baseline)



Source: Bureau van Dijk Orbis; and IMF staff estimates.
Notes: The x-axis is the sale-weighted share of firms with an interest coverage ratio (ICR) below one, where ICR is measured as earnings before interest and taxes (EBIT) over interest paid. Sectors are defined at the one-digit NACE level. The size of the circles reflects the total sales of a sector as of 2018. The solid red line fits a linear prediction. Firm level ICRs and sales are winsorized at the top and bottom 0.5% of the respective distributions.

12. Following Adalet McGowan et al. (2018), we use an ICR-based classification for non-viable "zombie" firms. Specifically, zombie firms are defined as those with an ICR below one for three consecutive years and have been in operation for at least 10 years. The three-year window is meant to capture persistent financial weakness that is not driven purely by business cycle fluctuations. The age restriction is used to help distinguish real zombie firms from young, innovative businesses that may experience a prolonged period of low earnings relative to interest expenses.

13. We use a two-step procedure to project the impact of COVID-19 on Greek NFCs. First, we employ a dynamic panel framework to establish a robust link for how firm ICRs have historically tended to respond to aggregate and sector-specific shocks, conditional on a set of firm-level covariates. We use the output gap and real interest rate to capture the aggregate demand component of a macroeconomic shock that is common across sectors, and the growth rate of sectoral real Gross Value Added (GVA) at the one-digit NACE level to proxy for sector-specific shocks. In the second step, we project firm ICRs for the period 2019–2021 using the estimated coefficients from the first step along with the projected macroeconomic variables in 2021 and their realized values in 2019 and 2020.

14. We adopt a dynamic panel framework to model firm financial sustainability as a path-dependent adjustment process.[11] To that end, we estimate the following dynamic panel model over the period 2009–2018:

$$ICR_{ijt} = \alpha ICR_{ijt-1} + FirmChar'_{ijt-1}\Gamma + \beta \Delta GVA_{jt} + Macro'_t\Omega + u_i + \epsilon_{ijt}, \qquad (1)$$

where i, j, and t stands for firm, one-digit NACE sector, and year respectively; $FirmChar_{ijt-1}$ is a set of lagged firm-level variables such as leverage and profitability that may affect current ICR; ΔGVA_{jt} is the growth rate of sectoral real gross value added at the one-digit NACE level; $Macro_t$ captures common aggregate demand shocks and includes the output gap and the real interest rate; u_i stands for the unobserved firm fixed effects; and ϵ_{ijt} denotes the disturbances that are assumed to be serially uncorrelated. This methodology allows contemporaneous ICR to depend on its own past realizations. We treat ICR_{ijt-1} and $FirmChar_{ijt-1}$ as predetermined and ΔGVA_{jt} and $Macro_t$ as strictly exogenous. The assumption that sectoral and aggregate shocks are orthogonal to the unobserved component of the firm-specific error term in (1) is formally tested.

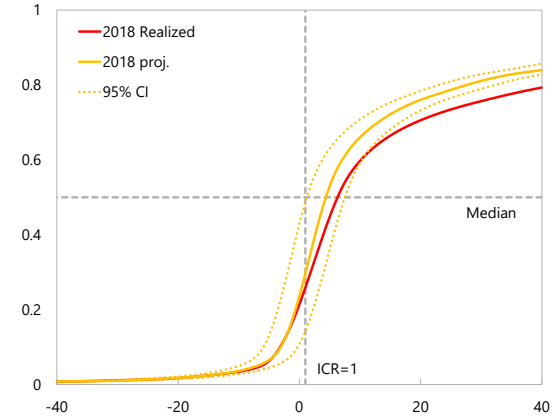
15. A parsimonious specification that includes past realizations and macroeconomic and sectoral explanatory variables yields statistically significant results and is robust to a host of diagnostic tests (Table 2). Our benchmark difference GMM estimation includes lagged ICR, contemporaneous sectoral GVA growth rate, output gap, and real interest rate as the independent variables (column 3). Twice lagged ICR is added in order to satisfy the Arellano-Bond test for second-order autoregression or AR(2) in the first differences of the disturbances. All instruments are jointly valid, and the IV-style instruments for sectoral GVA growth rate, output gap, and real interest rate satisfy the exogeneity test given by the difference-in-Hansen statistic. The estimated coefficients on lagged ICR indeed lie between the OLS and fixed effects counterparts (columns 1 and 2), suggesting that the model is correctly specified. Specifically, a one-point increase in lagged (twice lagged) ICR is associated with a 0.368 (0.049)-point increase in contemporaneous ICR. Sectoral GVA growth, output gap, and real interest rate are all statistically significant. All three variables affect ICR positively and are statistically significant.[12]

[11] We follow the literature on dynamic panel data models and, more generally, Generalized Method of Moments (GMM) estimators (see Anderson and Hsiao, 1982; Arellano and Bond, 1991; Arellano and Bover, 1995; Baum et al., 2003; Bond, 2002; Blundell and Bond, 1998; Blundell, Bond, and Windmeijer, 2000; Hansen, 1982; Holtz-Eakin, Newey, and Rosen, 1988; Roodman, 2009a & 2009b; Windmeijer, 2005; among others).

[12] Our analysis interprets the real interest rate more as a measure of aggregate demand than of the actual cost of borrowing for firms.

16. Augmented specifications including firm-level covariates or alternative specifications do not outperform the benchmark model. Specifications including additional firm-level covariates such as profitability (return on assets) and leverage (debt-to-assets ratio) fail both the Hansen and difference-in-Hansen tests (column 4).[13] Similarly, GMM estimation in which lagged differences in ICR are used as additional instruments to the level equation also fail (column 4). The benchmark model is robust to alternative specifications in lag length, weighting matrix, and transformation methods (Table 3). In addition, assessment of the in-sample fit for realized 2018 ICRs (Figure 5) suggests that the model has adequate predictive power with respect to firms with ICRs below 10, but underpredicts for values of ICRs higher than that, which is less relevant for the simulation given that we are primarily focus on firms with low ICRs. Extension of the estimation approach to address possible sample selection bias (extending the data set to begin in 2001 to capture all stages of the business cycle), data shortcomings (Orbis data underestimates the exit of firms and the number of micro firms), and omitted variable bias (possible exclusion of employment and consumption variables) merit further research.

Figure 5. In-Sample Fit of the Forecasting Model



Sources: Bureau van Dijk Orbis; and IMF staff estimates.
Notes: *We estimate model (1) using our preferred specification for the period 2009–2017 and make in-sample ICR forecasts for 2018. The solid black line plots the cumulative density function of realized ICRs in 2018, the solid red line plots the forecasted counterpart, and the dashed red lines indicate the 95% confidence interval. The underlying firm-level ICRs are winsorized at the top and bottom 0.5% of the distribution.*

E. COVID-19 Simulation

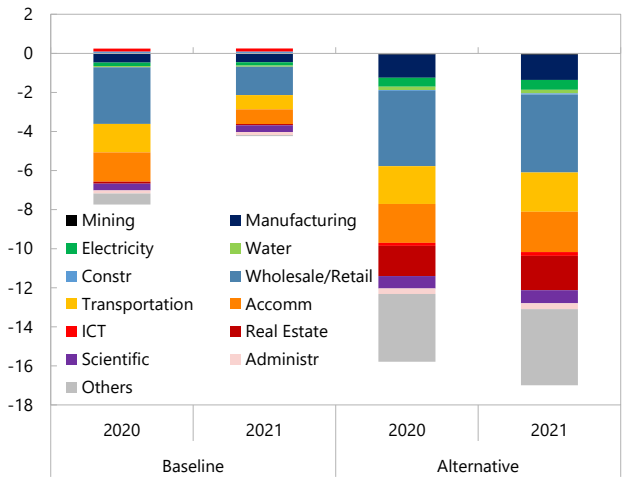
17. We project firm ICRs for 2020–21 using estimated coefficients under the baseline and alternative scenarios. The baseline scenario macro assumptions are consistent with the 2021 Article IV projections. The alternative scenario is defined as the scenario including the values of the regressors projected without the implementation of fiscal support measures. To this end, alternative GDP, output gap and sectoral GVA measures are derived by using only fiscal multipliers and estimates of the pandemic-fiscal support measures implemented in 2020–21.[14] Other financial sector and EU-wide measures introduced in response to COVID-19 are indirectly captured in the baseline scenario and are not changed in the alternative scenario..

[13] We prefer debt-to-assets than debt-to-EBITDA used in Section III given the high correlation between EBITDA and EBIT (the numerator in ICR), which is 0.92 in our sample.

[14] Support measures involved a mix of liquidity loans conditionally becoming grants ("refundable advances"), loan guarantees, rent reductions, intermediate purchase support, and other assorted programs. While these facilities arguably created different incentives and hence may ultimately have different effects, modelling the impact of specific measures is outside the scope of this paper.

18. Figure 6 shows the projected drops in sectoral activity in 2020–21. In this respect, the wholesale and retail, transportation, and accommodation and food services sectors faced large drops in sectoral activity in 2020. Under the baseline scenario, which includes fiscal support measures totaling 11 percent of GDP in 2020 and 7.4 percent of GDP in 2021, contact-intensive sectors are expected to recover half of the output lost during 2020.

Figure 6. Contribution to Culmulative Growth in Gross Value Added Since 2019
(Percent)

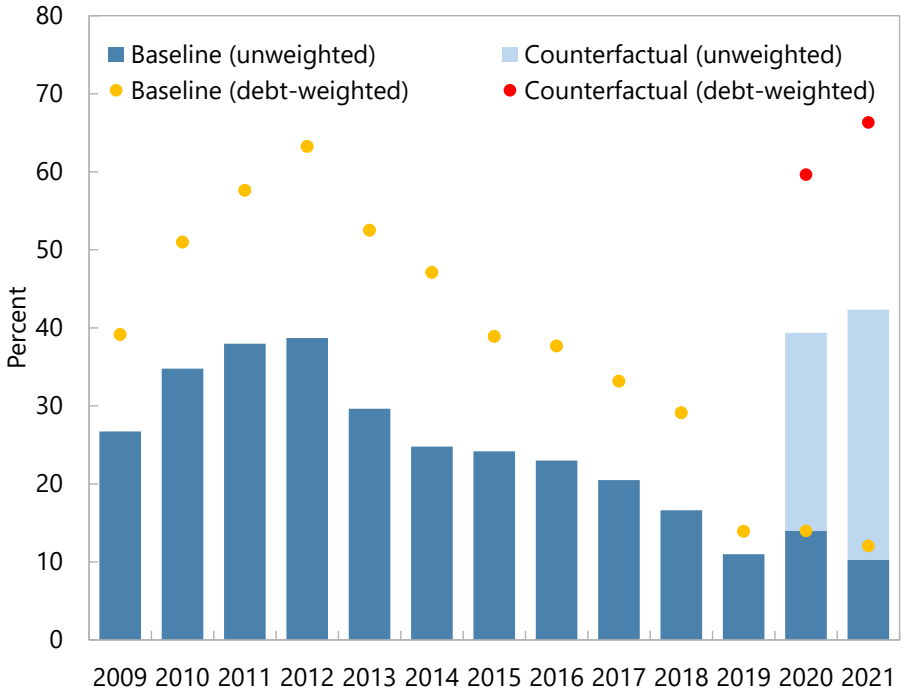


Source: Country Authorities; and IMF staff estimates.
Notes: The category "Other" includes Mining & Quarrying; Water Supply, Sewerage, Waste Management and Remediation Activities; Information and Communication; Professional, Scientific and Technical Activities; and Administrative and Support Service Activities.

19. Simulation results suggest that government fiscal support measures helped to significantly contain the impact of the COVID-19 pandemic on the Greek corporate sector (Figure 7).[15] Specifically, the share of firms with an ICR less than one is projected at 10 percent in 2021 compared to 11 percent pre-pandemic. Meanwhile, debt trapped in financially distressed firms is projected to decline from 2019 to 2021 by two percentage points to 12 percent of total debt. In the alternative scenario without fiscal policy support, the share of firms under distress would have been roughly four times larger relative to the baseline and exceed the 2010–13 average. Debt held by firms under distress would have been about six times higher than the baseline and above the 2010–13 average.

[15] We focus on point forecasts from here on given the difficulty in computing confidence intervals for aggregated statistics such as the share of firms with an ICR below one or the share of zombie firms.

Figure 7. Share of Firms with ICR<1



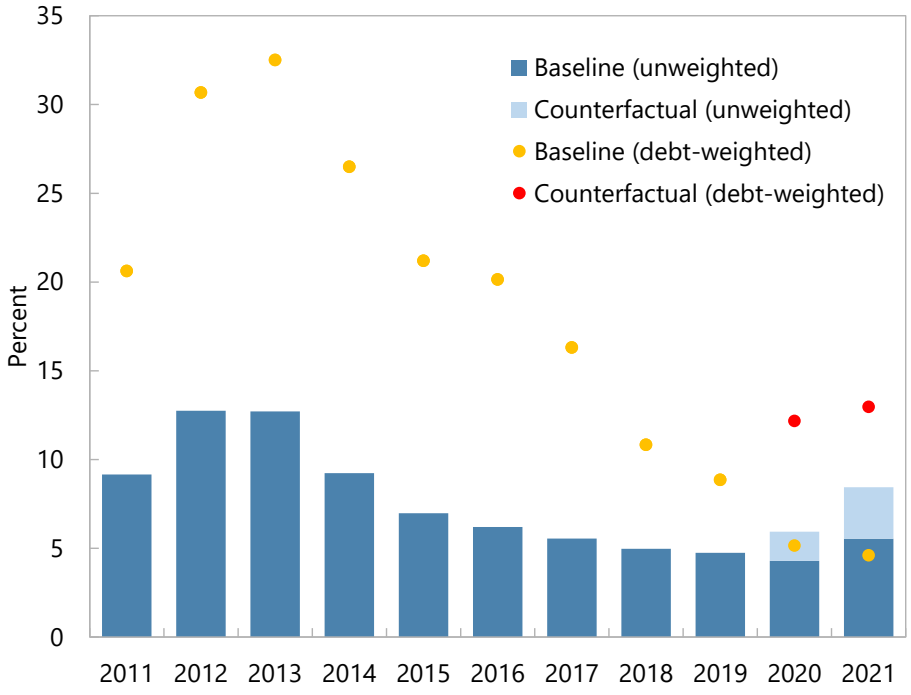
Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.
Notes: The baseline scenario features policy intervention whereas the counterfactual scenario assumes no policy intervention. Dark (light) blue bars represent the shares of firms with an ICR below one under the baseline (counterfactual) scenario. Yellow (red) dots represent the shares of debt sunk in these firms under the baseline (counterfactual) scenario. Debt is measured as the sum of long-term debt and short-term loans. Each firm's debt level in 2019, 2020, and 2021 are assumed to remain the same as 2018. The underlying firm-level ICRs and debt levels are winsorized at the top and bottom 0.5% of the distributions.

20. On a sectoral basis, simulations suggest that government measures had a large impact on a few key sectors (Table 4). We estimated the impact of COVID-19 measures on a sectoral basis by computing the number of firms with ICR less than one, and the share of debt held by firms with ICR less than one on a sectoral basis under both the baseline and alternative scenarios. Table 4 show the difference between the two scenarios for selected sectors, which can be also interpreted as the estimated reduction in vulnerabilities stemming from the macroeconomic impact of the policies by end-2021. For example, our simulations suggest that in the wholesale and trade sector, the macro impact of the government support policies helped reduce the number of financially vulnerable firms by 33 percentage points, and helped reduce the share of debt held by distressed firms by 65 percent of total debt.

21. The share of zombie firms is expected to increase only slightly in the baseline scenario, but the corresponding share of 'trapped' debt would be lower than pre-pandemic levels and substantially below the 2011–13 average (Figure 8). A smaller share of firms entered the pandemic in zombie status compared to firms with ICR less than one. The projected share of zombie firms are estimated to change slightly between 2019 and 2021, suggesting that policies are effective in mitigating the impact of the pandemic on zombie firms. In addition, the share of trapped debt in

zombie firms would decline by about half relative to pre-pandemic levels, suggesting that trapped debt in zombie firms would not become as large of a problem as during 2010–15.

Figure 8. Share of Zombie Firms



Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.
Notes: The baseline scenario features policy intervention whereas the counterfactual scenario assumes no policy intervention. A firm is classified as a zombie firm if it is aged 10 years or older and has an ICR less than one for three consecutive years. Dark (light) blue bars represent the shares of zombie firms under the baseline (counterfactual) scenario. Yellow (red) dots represent the shares of debt sunk in zombie firms under the baseline (counterfactual) scenario. Debt is measured as the sum of long-term debt and short-term loans. Each firm's debt level in 2019, 2020, and 2021 are assumed to remain the same as 2018. The underlying firm-level ICRs and debt levels are winsorized at the top and bottom 0.5% of the distributions. The figure is restricted to firms with non-missing firm age information.

22. The share of zombie firms and 'trapped' debt under the baseline scenario are substantially lower relative to the alternative scenario. In this respect, the share of zombie firms is projected to reach 5.5 percent under the baseline scenario compared to 8.5 percent under the alternative scenario (about one-third lower in the baseline relative to the alternative scenario). Similarly, the share of trapped debt under the baseline is projected to reach 4.6 percent compared to 13 percent in the alternative scenario.

23. In order to identify pockets of vulnerability, we disaggregate the projected increase in zombie firms under the baseline scenario by firm sector and size categories (Tables 5 and 6). The sectoral distribution reflects both a within-sector effects (how prevalent zombie firms are within a sector, tabulated in columns 1–3) and a composition effect (how big a sector is, tabulated in column 4). On a sectoral basis, the share of projected trapped debt for 2021 is highest in the accommodation, manufacturing, and construction sectors. While the share of trapped debt in 2021

in manufacturing is explained by the composition effect, within sector effects explain the increases in the accommodation and construction sectors. The wholesale and retail sector, while largely unaffected by the pandemic, is expected to hold a relatively small share of trapped debt (5.5 percent) compared to the total debt held by firms in the sector (25 percent). Lastly, large firms, however, are projected to account for more than 50 percent of trapped debt in 2021, even though only about 24 percent of total debt is held by these firms.

F. Concluding Remarks and Policy Recommendations

24. Using a new firm-level dataset, we provided evidence of the macroeconomic and sectoral impact on financial vulnerability of Greek NFCs. Simulations of the macroeconomic impact of Greek government fiscal support measures indicate that these measures would help contain the impact of the COVID-19 pandemic on the NFC sector, compared to a counterfactual scenario of no policy support in which the impact on NFC financial distress would be similar than during the Greek sovereign crisis. In this respect, improvements in NFC financial performance over the past decade resulted in a large reduction of 'trapped debt' held by zombie firms. This suggests that the impact of the crisis on NFCs is adequately addressed by temporary support measures.

25. Going forward, a data-driven approach could help improve the targeting of measures to support viable NFCs. The approach followed in this paper can help identify firms that face temporary liquidity problems compared to those with persisting financial distress ('zombie' firms). Further, allowing the resolution framework to function would help address the persistence of 'zombie' firms. In this respect, the new Insolvency Code and the lifting temporary measures put in place to "freeze" debt resolution activity, which were the result of disruptions in the operation of the courts caused by the pandemic and containment measures are a step in the right direction. Implementation of a data-driven approach can complement stepped-up enforcement procedures to ensure that only viable firms are provided with state-supported rescheduling options.

Table 1. Summary Statistics

	Mean	Median	Std	Count
Firm-level variables				
Employees	30.9	12.0	63.7	116,541
Age	18.5	16.0	14.0	128,739
Log operating revenue	14.2	14.1	1.6	128,509
Debt/EBITDA	2.7	0.6	11.7	108,075
Debt/Assets	0.2	0.1	0.2	130,915
Debt/Equity	0.9	0.2	1.9	130,914
Investment growth	11.7	-4.4	111.9	98,364
ROA	2.7	1.5	9.0	130,196
ROE	6.1	3.7	29.6	130,258
ICR	30.4	2.8	89.7	111,780
Macro variables				
Sectoral GVA growth	-2.3	-2.4	11.2	200
GDP growth	-2.6	-1.84	3.9	10
Output gap	-9.9	-11.18	4.9	10
Real interest rate	-0.5	-0.37	1.6	10
Unemployment rate	20.8	22.5	5.9	10

Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.
Notes: EBITDA stands for earnings before interest, taxes, depreciation, and amortization. ROA stands for return on assets. ROE stands for return on equity. ICR stands for interest coverage ratio and is measured as earnings before interest and taxes (EBIT) over interest paid. Sectoral GVA growth rates are measured at the one-digit NACE level. Real interest rate is measured as the difference between the euro area short-term deposit rate and the inflation rate in Greece. All nominal firm-level variables are converted to 2010 values using the consumer price index and winsorized at the top and bottom 0.5% of the respective distributions.

Table 2. Dynamic Panel Regression Results

VARIABLES	(1) OLS	(2) FE	(3) Diff	(4) Diff 2	(5) System
L.ICR	0.542***	0.202***	0.368***	0.410***	0.432***
	(0.015)	(0.017)	(0.034)	(0.033)	(0.028)
L2.ICR	0.139***	-0.019	0.049***	0.054***	0.074***
	(0.011)	(0.014)	(0.016)	(0.016)	(0.015)
GVA	0.113***	0.098***	0.152***	0.184***	0.154***
	(0.033)	(0.032)	(0.037)	(0.034)	(0.038)
Output gap	0.326***	0.860***	0.326**	0.268**	0.232
	(0.123)	(0.123)	(0.158)	(0.123)	(0.159)
Real rate	1.944***	2.870***	2.067***	0.924***	1.907***
	(0.260)	(0.249)	(0.303)	(0.247)	(0.305)
L.ROA				-0.025	
				(0.126)	
L.leverage				21.766***	
				(5.967)	
Observations	65,407	65,407	50,567	50,566	50,567
R-squared	0.43	0.045	n/a	n/a	n/a
Instruments	n/a	n/a	11	27	20
Arellano-Bond test for AR(2) in differences (p-val)	n/a	n/a	0.726	0.892	0.499
Hansen test of joint validity	n/a	n/a	0.389	0.000	0.089
Difference-in-Hansen test on IV instruments (p-val)	n/a	n/a	0.192	0.000	0.260
Difference-in-Hansen test on additional moments (p-val)	n/a	n/a	n/a	0	0.048

Sources IMF staff estimates.
Notes: L. is used to indicate once lagged variables and L2. twice lagged variables. Column (1) fits an ordinary least squares (OLS) regression with robust standard errors clustered at the firm level. Column (2) fits a fixed effects (FE) regression with robust standard errors clustered at the firm level. The coefficient on lagged ICR from a correctly specified dynamic panel model should be bounded by the OLS and FE coefficients in column (1) and (2). Column (3) features our benchmark two-step difference GMM estimation with Windmeijer (2005)-corrected standard errors clustered at the firm level; it treats lagged ICRs as predetermined and sectoral GVA growth, output gap, and the real interest rate as exogeneous/IV-style. Twice lagged ICR is included to meet the Arellano-Bond test for AR(2) in the first differences of the disturbances. Column (4) adds onto column (3) lagged ROA and leverage, proxied by the ratio of total debt to total assets, and treats these additional firm-level variables as predetermined. Column (5) features two-step system GMM estimation; it adds onto column (3) lagged differences in ICR as additional instruments for the level equation. All GMM-style instruments are collapsed. *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Robustness of Benchmark Specification

VARIABLES	(1) Benchmark	(2) Just Identified	(3) One-Step	(4) Forward
L.ICR	0.368***	0.356***	0.358***	0.410***
	(0.034)	(0.034)	(0.034)	(0.030)
L2.ICR	0.049***	0.048***	0.052***	0.056***
	(0.016)	(0.016)	(0.016)	(0.015)
GVA	0.152***	0.150***	0.142***	0.121***
	(0.037)	(0.037)	(0.037)	(0.034)
Output	0.326**	0.314**	0.251	0.548***
	(0.158)	(0.160)	(0.165)	(0.142)
Real Interest Rate	2.066***	2.125***	2.096***	2.374***
	(0.303)	(0.307)	(0.305)	(0.263)
Observations	50,567	50,567	50,567	51,159
Instruments	11	5	11	11
Arellano-Bond test for AR(2) in differences (p-val)	0.726	0.698	0.455	0.758
Hansen test of joint validity	0.389	n/a	0.331	0.296
Difference-in-Hansen test of IV instruments (p-val)	0.192	n/a	0.162	0.255

Sources: IMF staff estimates

Notes: L. is used to indicate once lagged variables and L2. twice lagged variables. Column (1) is the benchmark specification reported in column (3) of Table 2 and is included here for reference. Column (2) further reduces the number of instruments by curtailing (in addition to collapsing); it uses only the twice and trice lagged ICR as instruments in the first differenced equation. By construction, the model is just identified and hence the Hansen and difference-in-Hansen tests are not applicable. Column (3) features one-step difference GMM estimation. Lastly, column (4) reports two-step difference GMM estimation with forward orthogonal deviations transformation. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Impact of Government Measures on Greek NFCs – Selected Sectors

	(1)	(2)
	Increase in firms with ICR<1 (% of total firms)	
	2020	2021
Nace		
Manufacturing	36.3	55.0
Electricity & gas	26.2	23.7
Construction	21.2	33.9
Wholesale & retail	33.3	65.0
Transportation	30.9	63.4
Accommodation	39.6	57.7
Real estate	31.4	35.2
Other	20.3	42.3
Firm Size		
SME (<250)	32.3	59.7
Large (≥250)	29.6	45.1

Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.

Table 5. Share of Zombie Firms by Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	% zombies within sector			% sectoral firm in total	% contribution to total zombies		
	2016–18 avg.	2020 proj.	2021 proj.	2016–18 avg.	2016–18 avg.	2020 proj.	2021 proj.
Unweighted							
Manufacturing	7.6	5.1	7.1	23.5	31.9	29.6	31.5
Electricity & gas	2.5	8.2	9.8	1.5	0.6	2.3	2.2
Construction	6.4	6.7	9.4	5.3	6.1	7.9	8.6
Wholesale & retail	4.7	3.3	3.9	41.4	34.5	35.6	32.3
Transportation	5.9	4.0	7.6	4.7	4.9	4.2	6.1
Accommodation	9.6	8.3	8.7	7.0	12.0	10.2	8.2
Real estate	12.7	8.6	8.6	1.9	4.3	2.8	2.2
Other	2.1	2.7	4.2	14.7	5.6	7.4	9.0
Weighted by Debt							
Manufacturing	14.5	3.9	4.2	35.2	32.8	26.5	31.9
Electricity & gas	2.6	4.8	4.9	3.6	0.4	5.1	5.9
Construction	21.4	20.6	22.0	4.7	6.3	13.8	16.5
Wholesale & retail	14.8	1.0	1.0	24.7	23.3	4.9	5.5
Transportation	12.1	4.1	4.3	3.8	1.9	4.4	5.0
Accommodation	19.2	15.4	10.4	16.1	19.9	43.9	33.4
Real estate	26.1	1.1	1.1	5.2	9.0	1.1	1.2
Other	15.5	0.3	0.4	6.8	6.3	0.3	0.5

Sources: Bureau van Dijk Orbis; IMF, WEO database; and IMF staff estimates.

Notes: A firm is classified as a zombie firm if it is aged 10 years or older and has an ICR less than one for three consecutive years. The category "Other" includes Mining & Quarrying; Water Supply, Sewerage, Waste Management and Remediation Activities; Information and Communication; Professional, Scientific and Technical Activities; and Administrative and Support Service Activities. The underlying firm-level ICRs are winsorized at the top and bottom 0.5% of the distribution. Each firm's debt level in 2020 and 2021 are assumed to remain the same as 2018. The table is restricted to firms with non-missing firm age and industry information.

Table 6. Share of Zombie Firms by Firm Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	% zombies within size category			% sectoral firm in total	% contribution to total zombies		
	2016–18 avg.	2020 proj.	2021 proj.	2016–18 avg.	2016–18 avg.	2020 proj.	2021 proj.
Unweighted							
SME (<250)	5.6	4.3	5.7	96.9	97.0	95.3	97.1
Large (≥250)	5.5	4.1	3.3	3.1	3.0	4.7	2.9
Weighted by Debt							
SME (<250)	17.6	3.3	3.4	76.1	85.7	41.0	48.2
Large (≥250)	10.5	9.2	7.2	23.9	14.3	59.0	51.8

Sources: Bureau van Dijk Orbis; and IMF staff estimates.

Notes: A firm is classified as a zombie firm if it is aged 10 years or older and has an ICR less than one for three consecutive years. The category "Other" includes Mining & Quarrying; Water Supply, Sewerage, Waste Management and Remediation Activities; Information and Communication; Professional, Scientific and Technical Activities; and Administrative and Support Service Activities. The underlying firm-level ICRs are winsorized at the top and bottom 0.5% of the distribution. Each firm's debt level in 2020 and 2021 are assumed to remain the same as 2018. The table is restricted to firms with non-missing firm age and employment information.

References

Adalet McGowan, Müge, Dan Andrews, and Valentine Millot, "The Walking Dead? Zombie Firms and Productivity Performance in OECD Countries," *Economic Policy*, 2018, *33* (96), 685 – 736.

Anderson, T.W. and Cheng Hsiao, "Formulation and estimation of dynamic models using panel data," *Journal of Econometrics*, 1982, 18 (1), 47–82.

Andrews, Dan and Filippos Petroulakis, "Breaking the shackles: zombie firms, weak banks and depressed restructuring in Europe," 2019. ECB Working Paper No. 2240.

Arellano, Cristina and Yan Bai, "Fiscal austerity during debt crises," *Economic Theory*, 2017, *64*, 657–673.

Arellano, Manuel and Stephen Bond, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 1991, 58 (2), 277–297.

Arellano, Manuel and Olympia Bover, "Another look at the instrumental variable estimation of error-components models," *Journal of Econometrics*, 1995, 68 (1), 29–51.

Banerjee, Ryan and Boris Hofmann, "The Rise of Zombie Firms: Causes and Consequences," *BIS Quarterly Review*, 2018, 67–78.

Baum, Christopher F., Mark E. Schaffer, and Steven Stillman, "Instrumental variables and GMM: Estimation and testing," *Stata Journal*, 2003, 3 (1), 1–31.

Betcherman, Gordon, Nicholas Giannakopoulos, Ioannis Laliotis, Ioanna Pantelaiou, Mauro Testaverde, and Giannis Tzimas, "Reacting Quickly and Protecting Jobs: The Short-Term Impacts of the COVID-19 Lockdown on the Greek Labor Market," 2020. IZA Discussion Paper No. 13516.

Blanchard, Olivier, Thomas Philippon, and Jean Pisani-Ferry, "A New Policy Toolkit is Needed as Countries Exit COVID-19 Lockdowns," 2020. Peterson Institute for International Economics Policy Brief.

Blundell, Richard, Stephen Bond, and Frank Windmeijer, "Estimation in dynamic panel data models: improving on the performance of the standard GMM estimator," 2000. IFS Working Paper WP 00/12.

Blundell, Richard and Stephen Bond, "Initial conditions and moment restrictions in dynamic panel data models," *Journal of Econometrics*, 1998, 87 (1), 115–143.

Bond, Stephen R., "Dynamic panel data models: a guide to micro data methods and practice," *Portuguese Economic Journal*, 2002, 1, 141–162.

Brunnermeier, Markus and Arvind Krishnamurthy, "Corporate Debt Overhang and Credit Policy," 2020. Brookings Papers of Economic Activity.

Caballero, Ricardo J., Takeo Hoshi, and Anil K. Kashyap, "Zombie Lending and Depressed Restructuring in Japan," *American Economic Review*, 2008, 98 (5), 1943–77.

Carletti, Elena, Tommaso Olivero, Marco Pagano, Loriana Pelizzon, and Marti G. Subrahmanyam, "The COVID-19 Shock and Equity Shortfall: Firm-Level Evidence from Italy," *Review of Corporate Finance Studies*, 2020, 9 (3), 534–568.

Chodorow-Reich, Gabriel, Loukas Karbarbounis, and Rohan Kekre, "The Macroeconomics of the Greek Depression," 2019. Federal Reserve Bank of Minneapolis Working Paper No. 758.

Core, Fabrizio and Filippo De Marco, "Public Guarantees for Small Businesses in Italy during Covid-19," 2021. CEPR Discussion Papers.

Crouzet, Nicolas and François Gourio, "Financial Positions of U.S. Public Corporations," Federal Reserve Bank of Chicago, Chicago Fed Insights Blog Posts, May–June 2020.

Dellas, Harris, Dimitris Malliaropulos, Dimitris Papageorgiou, and Evangelia Vourvachaki, "Fiscal policy with an informal sector," 2017. Bank of Greece Working Paper No. 235.

Demmou, Lilas, Guido Franco, Sara Calligaris, and Dennis Dlugosch, "Corporate sector vulnerabilities during the Covid-19 outbreak: Assessment and policy responses," OECD Tackling Coronavirus Series, 2020.

Díez, Federico, Jiayue Fan, and Carolina Villegas-Sánchez, "Global Declining Competition," 2019. IMF Working Paper No. WP/19/82.

Dinlersoz, Emin, Şebnem Kalemli-Özcan, Henry Hyatt, and Veronika Penciakova, "Leverage Over the Firm Life Cycle, Firm Growth, and Aggregate Fluctuations," Federal Reserve Bank of Atlanta Working Paper No. 2019–18.

Drechsel, Thomas and Şebnem Kalemli-Özcan, "Are standard macro and credit policies enough to deal with the economic fallout from a global pandemic? A proposal for a negative SME tax," 2020. University of Maryland mimeo.

Economides, George, Dimitris Papageorgiou, and Apostolis Philippopoulos, "The Greek Great Depression: A General Equilibrium Study of its Drivers," in Ioannis Bournakis, Christopher Tsoukis,

Dimitris K. Christopoulos, and Theodore Palivos, eds., *Political Economy Perspectives on the Greek Crisis*, Palgrave Macmillan, 2017, pp. 205–221.

Ebeke, Christian , Nemanja Jovanovic, Laura Valderrama, and Jing Zhou, "Corporate Liquidity and Solvency in Europe during COVID-19:The Role of Policies," 2021, International Monetary Fund Working Paper 21/56.

Economides, George, Dimitris Papageorgiou, and Apostolis Philippopoulos, "Macroeconomic Policy Lessons for Greece from the Debt Crisis," 2020. CESifo Working Paper No. 8188.

Elenev, Vadim, Tim Landvoigt, and Stijn Van Nieuwerburg, "Can the Covid Bailouts Save the Economy," 2020. NBER Working Paper No. 27207.

Gal, Peter N., "Measuring Total Factor Productivity at the Firm Level using OECD-ORBIS," 2013. OECD Economics Department Working Paper No. 1049.

Glomm, Gerhard, Juergen Jung, and Chung Tran, "Fiscal Austerity Measures: Spending Cuts vs. Tax Increases," *Macroeconomic Dynamics*, 2018, 22 (2), 501–540.

Gopinath, Gita, Şebnem Kalemli-Özcan, Loukas Karabarbounis, and Carolina Villegas-Sánchez, "Capital Allocation and Productivity in South Europe," *Quarterly Journal of Economics*, 2017, *132* (4), 1915–1967.

Gourinchas, Pierre-Olivier, Thomas Philippon, and Dimitri Valynos, "The Analytics of the Greek Crisis," in Martin Eichenbaum and Jonathan A. Parker, eds., *NBER Macroeconomics Annual*, University of Chicago Press, 2016, vol. 31, chapter 1, pp. 1–81.

Gourinchas, Pierre Olivier, Şebnem Kalemli-Özcan, Veronika Penciakova, and Nick Sander, "COVID-19 and SME Failures," 2020. NBER Working Paper, No. 27877.

Granja, João, Christos Makridis, Constantine Yannelis, and Eric Zwick, "Did the Paycheck Protection Program Hit the Target," 2020. NBER Working Paper No. 27095.

Greenwood, Robin, Benjamin Iverson, and David Thesmar, "Sizing Up Corporate Restructuring in the COVID Crisis," 2020. NBER Working Paper No. 28104.

Greenwood, Daniel L., John Krainer, and Pascal Paul, "The Credit Line Channel," 2020. Federal Reserve Bank of San Francisco Working Paper 2020–26.

Hansen, Lars Peter, "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 1982, 50 (4), 1029–1054.

Hanson, Samuel G., Jeremy Stein, Adi Sunderam, and Eric Zwick, "Business Credit Programs in the Pandemic Era," Brookings Papers on Economic Activity, 2020.

Holtz-Eakin, Douglas, Whitney Newey, and Harvey S. Rosen, "Estimating Vector Autoregressions with Panel Data," *Econometrica*, 1988, 56 (6), 1371–1395.

Kalemli-Özcan, Şebnem, Bent Sorensen, Carolina Villegas-Sánchez, Vadym Volosovych, and Sevcan Yesiltas, "How to Construct Nationally Representative Firm Level Data from the Orbis Global Database: New Facts and Aggregate Implications," 2015. NBER Working Paper No. 21558.

Landais, Camille, Emmanuel Saez, and Gabriel Zucman, "A progressive European wealth tax to fund the European COVID response," *Europe in the Time of Covid-19*, 2020, *1*, 113–118.

Papageorgiou, Dimitris and Evangelia Vourvachaki, "Macroeconomic effects of structural reforms and fiscal consolidations: Trade-offs and complementarities," *European Journal of Political Economy*, 2017, *48*, 54–73.

Roodman, David, "A Note on the Theme of Too Many Instruments," *Oxford Bulletin of Economics and Statistics*, 2009a, 71 (1), 135–158.

Roodman, David, "How to do xtabond2: An introduction to difference and system GMM in Stata," *Stata Journal*, 2009b, 9 (1), 86–136.

Schivardi, Fabiano and Guido Romano, "A simple method to estimate firms liquidity needs during the COVID-19 crisis with an application to Italy," *Covid Economics*, 2020, 35, 51–69.

Windmeijer, Frank, "A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators," *Journal of Econometrics*, 2005, 126 (1), 25–51.

Appendix

I. Cleaning of Orbis-Amadeus Data

We download the raw data from the IMF SQL server that houses Orbis data. The raw data is cleaned following Díez et al. (2019), Gal (2013), Gopinath et al. (2017), and Kalemli-Özcan et al. (2015). Detailed cleaned steps are described below.

- We limit ourselves to unconsolidated firm accounts in the non-farm, non-financial, and private business sectors. Specifically, we drop the accounts that are associated with NACE letter A (Agriculture, Forestry and Fishing), K (Financial and Insurance Activities), O (Public Administration and Defense), P (Education), Q (Human Health and Social Work), R (Arts, Entertainment and Recreation), S (Other Service Activities), as well as a set of manually identified state-owned enterprises.

- For a given firm and year, we populate missing string variables such as NACE code and firm founding year by using non-missing information for this firm from other years.

- We adjust the year variable based on the following convention. If the reported "Closing Date" is after or on June 1st, the current year is assigned. Otherwise, the previous year is assigned.

- There are duplicate records for the same firm-year resulting from different entries of filing type, accounting standards, or closing date (all financial variables are of the same value). To remove these duplicate records, we keep the records with (i) "local registry filing", (ii) "local GAAP", or (iii) the closing date closest to December 31st.

- To clean basic reporting mistakes, we (i) drop the entire company (all years) if total assets or tangible fixed assets are negative in any year; (ii) drop the entire company if the number of employees is negative or greater than 2 million (that of Walmart) in any year; (iii) drop the entire company if sales are negative in any year (no filter is applied to revenue, which can be negative); and (iv) drop the entire company if total assets are missing or if total assets, operating revenue, sales, and the number of employees are missing simultaneously.

- We compute the ratio of the number of employees per million assets, the ratio of the number of employees per million sales, and the ratio of sales over assets, and we drop the entire company if any of the ratios is above the 99.9th percentile of the distribution.

- We drop firm-year observations with negative firm age.

- To deal with spurious jumps in the data arising from a switch of units from, say, thousands to millions from one year to the next, we drop the entire company if the growth rate of total assets in any year is above the 98th or below the 2nd percentiles of the distribution.

- To ensure that our results are not driven by outliers, we further trim the sample on four dimensions: liquidity, solvency, profitability, and leverage. Specifically, we drop the top and bottom one percent of the observations in (i) the liquidity ratio (defined as in Orbis), (ii) the asset-based solvency ratio (defined as in Orbis), (iii) return on equity (defined as in Orbis), and (iv) the leverage ratio (defined as the sum of long-term debt and current liabilities divided by total equity).
- For further quality checks, we verify that the following variables are non-negative: current liabilities, current assets, loans, long-term debt, interest paid, and trade creditors. We also verify that the following ratios are below unity: fixed tangible assets over fixed assets, fixed intangible assets or fixed assets, inventories over current assets, trade receivables over current assets, long-term debt over non-current liabilities, loans over current liabilities, and trade creditors over current liabilities.

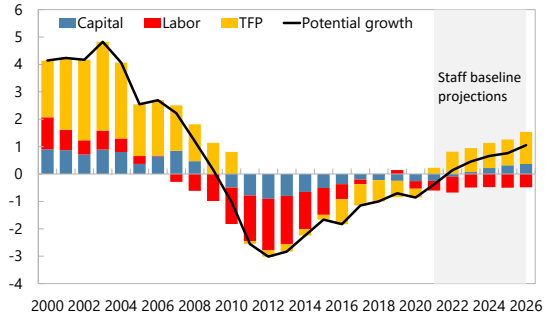
GREECE'S INVESTMENT GAP[1]

Greece's investment rate is one of the lowest in the world. This note explores investment during the past decade and it compares against benchmarks estimated from three different approaches. Two approaches suggest Greece over-invested prior to the sovereign debt crisis and all three suggest Greece has been under-investing since. The estimated investment gap ranges from 1.6–8 percent of GDP in 2019. Structural factors seem to be driving the low level of corporate investment, while household investment seems to be driven by business cycle and balance sheet developments. Structural reforms are recommended to remove bottlenecks to corporate investment, improve the efficiency of public investment, and promote growth which, if equitable, should boost household savings and investment.

A. Background

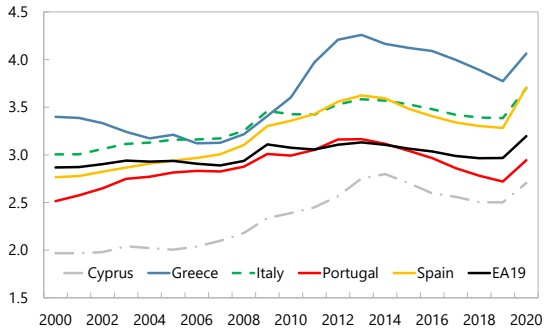
1. To raise potential growth and living standards, Greece needs stronger capital accumulation and productivity. Stronger growth is needed to lift per capita income and to reduce debt ratios. Higher investment and productivity are particularly relevant for an aging society, where a shrinking population is expected to weigh heavily on potential output (text figure). Staff's baseline projects that real investment rates stabilize between 15–17 percent of GDP, in line with the historical capital-output ratio (see text charts). The Greek Government's macro-fiscal baseline (in line with its new Stability and Growth Pact, SGP) projects the investment-to-GDP ratio will increase to around 17 percent by 2025, though with higher payoffs in the longer term due to the ambitious Recovery and Resilience National Plan (RRP), which expects that the combination of funding and reforms will boost the level of private investment by 20 percent by 2026. Both estimates are lower than Greece's pre-sovereign debt crisis total investment rate peak of 24 percent of GDP, which was accompanied by an unsustainable current account deficit.

Contribution to Potential Growth
(Percentage points)



Sources: AMECO; Haver Analytics; OECD; Hall and Jones (1999); and IMF staff calculations.

Capital-Output Ratio
(Real net capital stock in percent of real output)



Sources: European Commission; Haver Analytics; and IMF staff calculations.

2. The decade following the GFC featured disappointing investment rates. Following Eurozone accession, Greece's investment increased across all sectors, with a notable increase in

[1] Prepared by Shiqing Hua, María Méndez, and Xin Cindy Xu. Ritzy Dumo and Daniel Murphy Pineda provided assistance. The paper benefitted from comments from Dimitris Malliaropulos, Marianthi Anastasatou, and Filippos Petroulakis (all BoG).

household investment. However, since the GFC, total investment growth rates have disappointed with recent growth close to 0 percent (2015–19) resulting in an investment-to-GDP ratio of 10 percent at end-2019. This is close to 10 percentage points lower than the regional average. Greece also ranks low compared to income peers in terms of the capital stock per capita, contributing to low levels of productivity (Figure 1). Beyond historical averages and peer group comparisons, there are few estimates in the literature of Greece's investment gap or "steady state" investment, though ample analytical work has sought to identify the reasons behind weak investment rates. Gourinchas, Phillipon and Vayanos (2017), for example, find that investment in Greece between 2009 and 2013 was impacted by the increase in funding costs due to the sudden stop, but thereafter private-sector credit risk, fiscal austerity, and price-markup shocks have been more relevant drivers. Alogoskoufis (2021) finds lower real interest rates and post-accession euphoria led to a large increase in household investment and a decline in national savings. Meanwhile, business investment was constrained by structural characteristics and incomplete reforms in a context of fiscal and internal adjustment. Albani, Papageorgiu, and Sideris (2018) identify uncertainty and financial conditions as the main determinants of subdued business investment in the post-crisis years.

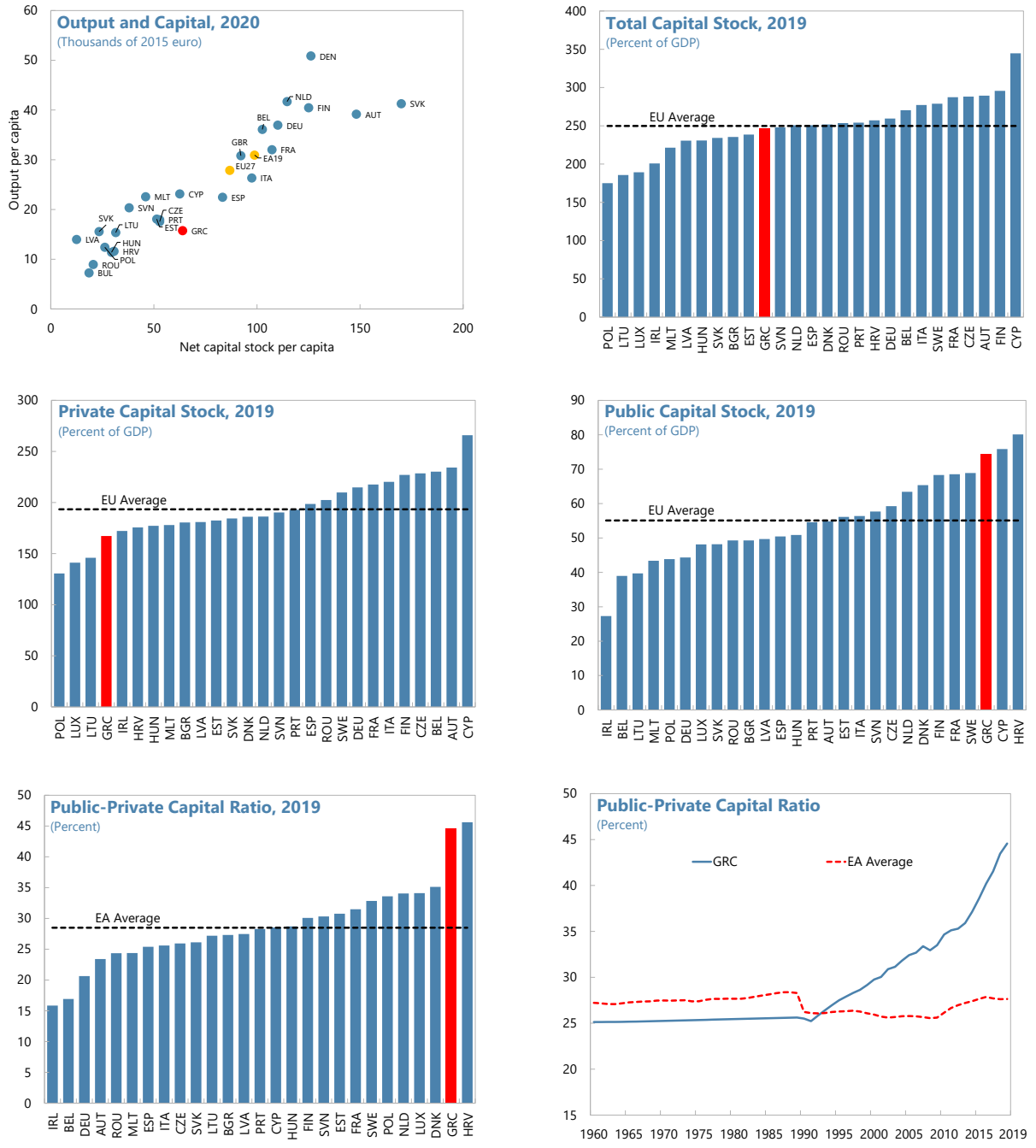
3. This paper aims to provide an estimate of Greece's investment gap. The next section provides stylized facts on investment and the capital stock. The third section presents three approaches to estimate Greece's investment gap. The fourth section identifies constraints to investment by sector. We conclude with policy implications.

B. Capital Stock and Investment: Where Does Greece Stand?

4. Greece's total capital stock is broadly in line with the regional average, but private capital lags behind (Figure 1). The total capital stock to GDP ratio is close to the euro area's average, while net capital stock per capita in Greece is about two thirds of the Euro Area's average. Greece's net capital stock contracted by an average of 1.2 percent annually in the last decade. However, this was relatively less than the decline in output (26 percent). As elsewhere in the region, most of the capital stock is held by the private sector (70 percent of total) and this is where gaps exist compared to peers. However, at end-2019 the total net capital stock stood broadly in line with the regional average thanks to the higher-than-average public capital stock, the third largest in the region in percent of GDP. The relative importance of public capital and the low level of the private stock is reflected in the rising public-to-private capital ratio, estimated close to 45 percent in 2019 and higher than the growth-maximizing ratio found in the literature for advanced economies (42 percent).[2] This could potentially have growth implications, as discussed in Section D.

[2] EIB (2005). In addition, Kangur et al (2019) find evidence of complementarity (not substitutability) of public and private capital stocks, particularly for advanced economies. Kangur et al also find public-private ratios tend to average 30 percent for Advanced Economies (15 percent lower than Greece's) which could indicate sub-optimality of Greek asset ownership.

Figure 1. Greece: Capital Stock and Output

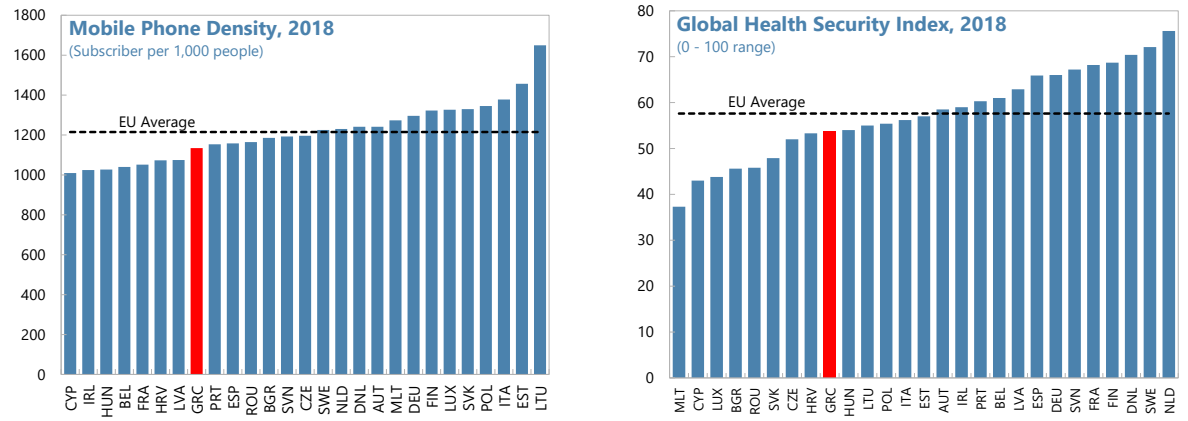


Source: European Commission; IMF, Investment and Capital Stock database; and IMF staff calculations.

5. The picture in infrastructure is mixed, with sizeable gaps in transportation and to a lesser extent in energy, digital, and healthcare infrastructure (Figures 2, 10). Greece's transportation infrastructure is lower than the EU average, with nearly 30 percent lower road density and 60 percent lower railroad density compared to peers, though this is partly due to Greece's

geography (islands and rugged mountain terrain) and the gap has likely narrowed in recent years given completion of several motorways. Greece is closer to the EU average in utility infrastructure, notably in electricity generation capacity and renewable energy production. While water supply reliability ranks high, water transport has gaps.[3] Information and communication technology (ICT) infrastructure and health infrastructure coverage in Greece are slightly higher than regional peers, except for mobile phone penetration (7 percent below EU average). Greece has higher-than-average medical devices and equipment, but as of 2019 the number of hospital beds was 16 percent below the EU (this may have improved in the context of COVID-19). As of 2018, the health security index in Greece was also lower than the regional average, though this likely improved given health infrastructure investments during the pandemic.

Figure 2. Greece: Selected Infrastructure

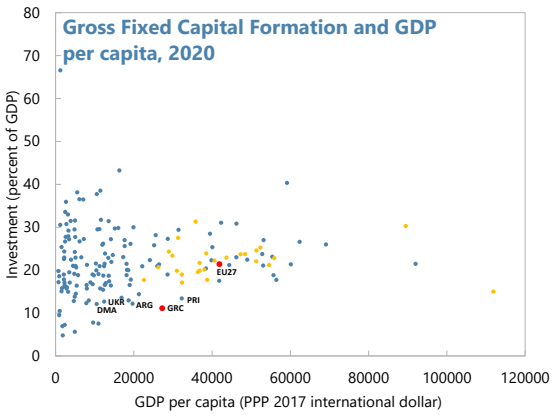


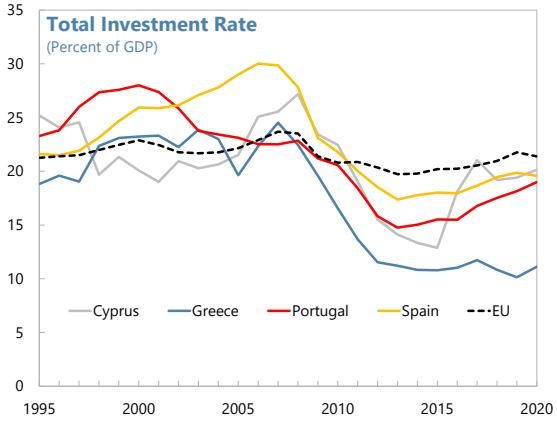
Source: IMF, WEO database; and IMF staff calculations.

6. Greece's investment rate, however, is one of the lowest in the world (Figure 3). Prior to 2008, Greece's investment rate was broadly in line with peers (Cyprus, Portugal, and Spain) and close to or above the EU average. Investment was particularly strong in the construction sector, notably in residential dwellings. After dropping sharply at the onset of the GFC (2008–10), the investment-to-GDP ratio has remained flat on an annual basis, with large volatile swings between quarters subject to purchases of ships or arms/equipment (text chart). By end-2019 Greece's investment-to-GDP ratio ranked the lowest in the EU and among the lowest in the world, at 10 percent of GDP.

[3] Global Competitiveness Report (2019) ranks Greece 61 out of 100 countries in Water Transport and 91 out of a 100countries in Water Supply Availability.

Figure 3. Investment Rate

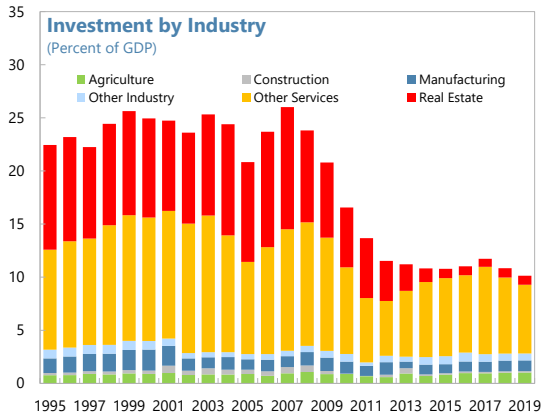


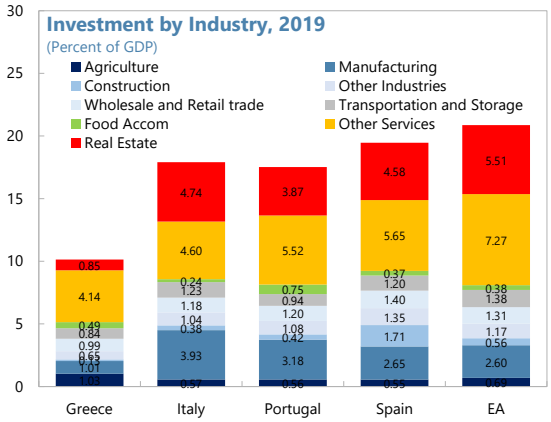


Source: IMF, WEO database; and IMF staff calculations.

7. Low investment is prevalent across industries, particularly in real estate, followed by manufacturing and other industries. From an industry perspective, the drop in investment has been largely driven by the housing market slump. Historically, Greek investment had been centered around the real estate industry and service sectors, while primary and secondary industries were relatively under-invested in (see Figure 4). At its peak, the real estate industry represented 40 percent of total investment and nearly 10 percent of GDP. As the housing market collapsed in 2007, the country suffered one of the steepest reductions in housing prices across the EU. The introduction of higher property taxes and the contraction in household disposable incomes sharply lowered investment in real estate. From 2007 to 2019, investment in dwellings and other building structures dropped by more than 80 percent, and total investment in the real estate industry currently represents less than 1 percent of GDP, significantly below the level of its regional peers and the EU average of 4.5 percent of GDP.

Figure 4. Greece: Investment by Industry



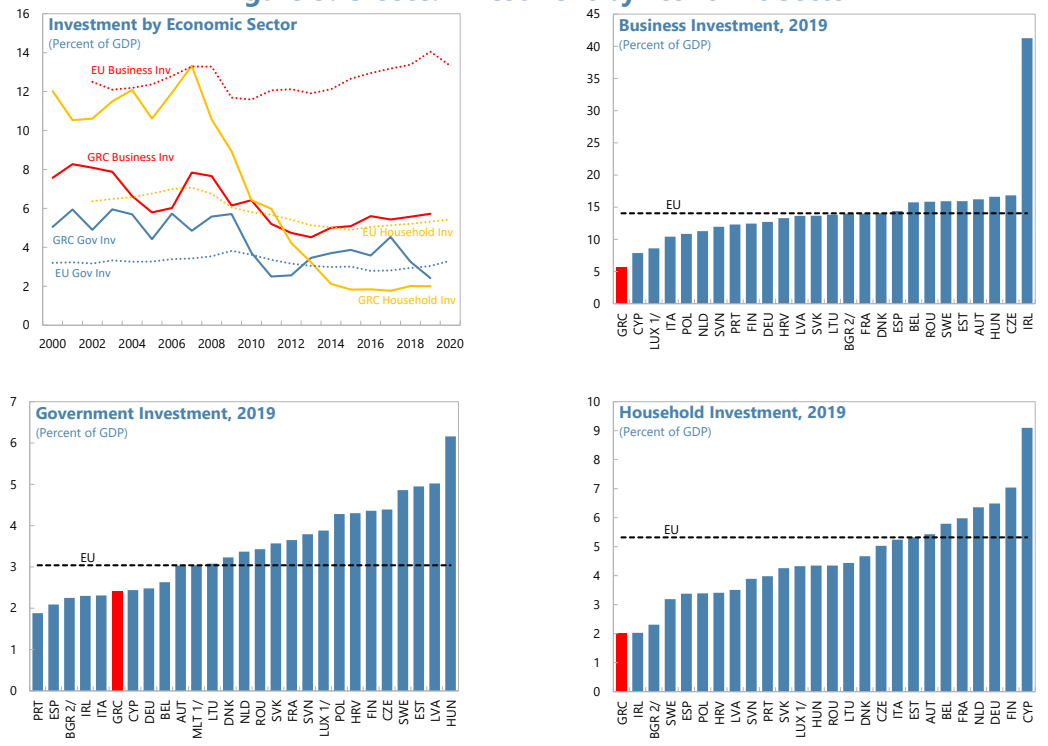


Source: Eurostat; Haver Analytics; and IMF staff calculations.

8. Household investment has retrenched the most since the sovereign debt crisis, but it is in business investment where the highest regional gap is found (Figure 4). Low investment is broad-based across the private sector. Greece is currently ranked at the bottom among EU countries in both business and household investment.

- *Business investment* has the widest gap (about 10 percentage points lower) compared to the EU. Greece has been consistently below the EU average and the gap has increased recently.
- *Household investment* was once half of total investment in Greece, almost twice the size of the regional average prior to the sovereign debt crisis, but it has since experienced the sharpest drop (over 10 percentage points). The household sector now features the lowest investment rate across the three sectors.
- *Government investment* in Greece has been relatively stable and higher than the EU average in relative terms in the past two decades. Boosted by EU funds, public capital expenditure remained around 2 percentage points higher than EU level until 2011 when it briefly dropped below due to spending cuts. However, it quickly rebounded in 2013 before dipping again in 2019.

Figure 5. Greece: Investment by Economic Sector



Source: Eurostat; Haver Analytics.
1/ 2018 data.
2/ 2017 data.

9. Sectoral investment dynamics must be considered with certain caveats. Given Greece's prevalence of micro family-owned firms, investment by unincorporated enterprises ("self-employed) can often be accounted as household investment, while public capital expenditure can include capital transfers destined for SOE operations. Arms or ship purchases are reflected in highly volatile swings in quarterly investment growth figures, but these may have no bearing on private sector growth. Given the difficulty in weeding out true measures of private sector investment, the analysis in Section C focuses on total investment. We provide more granular analysis by sector in Section D.

C. Is Greece underinvesting? What is the Size of the Investment Gap?

10. Following recent IMF work (2016, 2017), this section applies three approaches to estimate Greece's total investment benchmark rates.[4] These include: (i) the "Golden Rule" approach, a neo-classical growth model-based steady-state equilibrium level of investment; (ii) the "Historical Benchmark", the stylized transition investment dynamics derived from the historical experience of selected advanced European countries (Germany, France, Spain, Italy) who have successfully achieved convergence; and (iii) the "Predicted Norm", the estimated investment rate determined by a set of economic fundamentals and structural characteristics, through a panel regression from a sample of 27 EU countries over the past three decades. Each method has merits and drawbacks (Table 1), but taken together, they provide a good measure of Greece's benchmark investment rates (Annex I).

Table 1. Estimating Benchmark Investment Rates: Three Analytical Approaches

Methods	Pros	Cons
Golden Rule	A steady-state equilibrium rate, invariant to initial conditions.	Require knowledge of unobservable variables (e.g. social rate of time preference, SRTP).
Historical Benchmark	Proven achievable and sustainable investment rate based on historical experience of advanced EU peers.	Assumes a similar economic structure as advanced EU peers, independent of external balance consideration.
Predicted Norm	Value determined by set of Greece's own economic fundamentals, structural characteristics, and external factors.	Sample and model specification dependent.

11. Greece's current investment rate falls short of the benchmarks across all three methods (Figure 6). The size of the estimated investment gap (as of 2019) ranges from 1.6 to 8 percent of GDP depending on the approach and the specification.

a. **The "golden rule" approach standard estimate points to an investment gap of about 4 percent of GDP.** In its standard form, the golden rule may be interpreted as a steady state to which the investment-to-GDP ratio converges. The assumptions for the future may be based on

[4] See more details in Annex I, the IMF REI (May 2016), and IMF Poland Selected Issues (July 2017)

estimates of reform payoffs that encourage savings (such as pension reform) and/or those that increase the capital share of income (through a decline in the number of self-employed and economies of scale). This approach is suitable for Greece because of the prevalence of self-employed workers and because of Greece's low level of domestic savings.[5] The standard calculation for the period 2015–19 adjustment—which does not adjust the capital income share and uses the average social rate of time preference—suggests an investment gap of about 4 percent. Adjusting the labor share of income, the savings preferences, or the methodology for calculating total factor productivity (TFP)[6], changes the size of the gap as expected (e.g. higher savings preferences imply a higher steady state to converge to and a higher investment gap compared to the present.

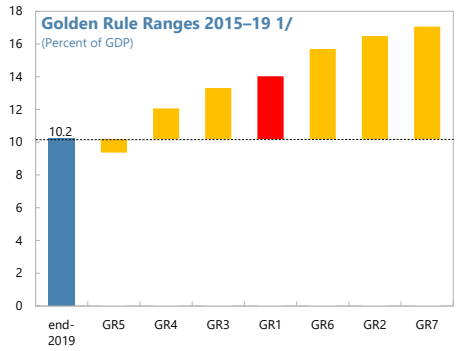
b. **The largest estimated gap at end-2019 (8 percent) arises in the "historical benchmark" approach, but this represents an upper bound.** Under this perspective Greece has been under-investing even prior to the sovereign debt crisis, although the benchmark itself has declined relative to its pre-crisis level. This approach may not be suited for Greece as it assumes full convergence to mature economy characteristics, including "balanced growth" that does not compromise external balances. In the past, Greece has approached this historical benchmark, but not sustainably so.

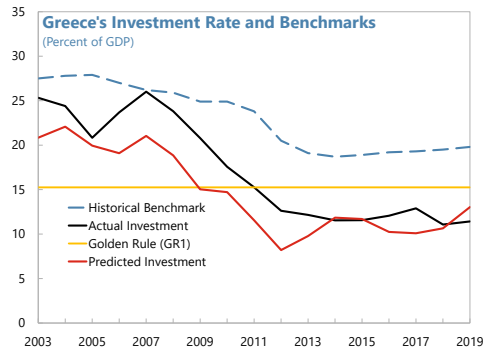
c. **The smallest gap is found in the "predicted norm" approach indicating that Greece's low investment rate is largely explained by its income level, economic fundamentals, and structural characteristics.** This is the richest of the three approaches as it is grounded in the economy's structural features. It suggests that actual investment is only slightly below the predicted value based on the historical experiences of EU 27 countries and Greece's country-specific characteristics.

[5] The unadjusted labor share is calculated in the Penn World Tables as total compensation over GDP. Following IMF (2016), the adjusted the labor by increasing the unadjusted labor share by adding either 100 or 67 percent of the income of the self-employed based on balance sheet data. For savings, we adjust the social rate of time preference upward/downward from the standard average for the Euro Area found in the literature (5 percent).

[6] Based on absorption instead of domestic demand, so-called "welfare-maximizing" TFP.

Figure 6. Benchmark Investment Rates and Investment Gap



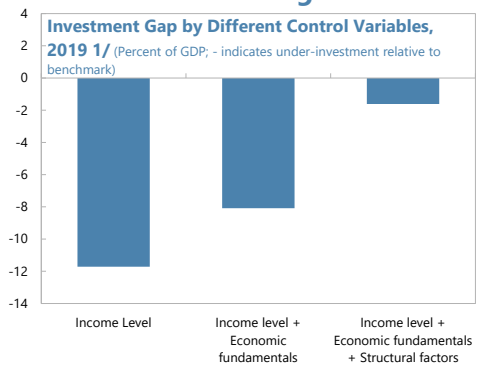


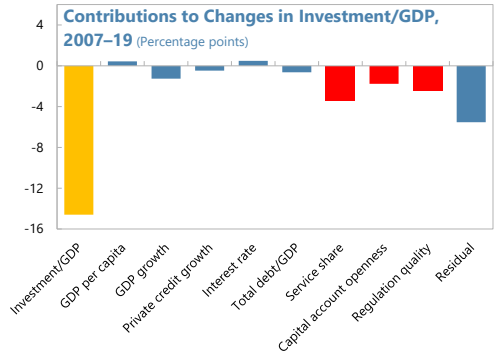
Source: ELSTAT; Penn World Tables 9.0; and IMF staff estimates.
1/ GR1–GR7 refer to different iterations of the Golden Rule. See Annex for details.

12. Greece's low investment rate is an outlier compared against its peer group, but it seems to be in line with its economic structure. The historical benchmark approach suggests that Greece's investment gap has been negative (under-investing) through the period under consideration, echoing Greece's status as an outlier in its investment rates compared to advanced EA peers. The other two, more granular approaches that allow for country-specific characteristics suggest Greece sustained a positive gap (over-investment) prior to the sovereign debt crisis averaging between 4 and 8 percentage points. Since then, Greece has under-invested, but the gap is narrower than its advanced economy status would suggest. At end-2019 the calculated gap ranges between 1.6 (predicted norm) and about 4 percent of GDP (golden rule), broadly in line with the lower bound of staff's baseline investment rate.

13. The analysis suggests that structural constraints explain the bulk of the investment gap (Figure 7). The golden rule approach shows that the size of the investment gap is sensitive to assumptions about the share of self-employed workers (and how much of their income accrues to labor instead of to capital) and savings preferences. The predicted norm panel regression results show that the size of the investment gap is sensitive to model specifications (Table 2). As more controls are added, the gap becomes smaller. Absent structural factors, the investment benchmark predicted by Greece's income level and economic fundamentals is close to 20 percent of GDP (mirroring the historical benchmark), with a large gap relative to actual investment at 8 percent of GDP. After adding various structural constraints, the predicted investment rate gets closer to actual levels, with a much smaller gap of 1.6 percent of GDP once all structural factors are controlled for. Looking at the main contributors to the sharp fall in the investment rate from the pre-crisis peak in 2007 to the record-low in 2019, the top three drivers are all structural factors, including the services share, capital account openness (capturing the introduction of capital flow management measures in 2015), and regulatory quality. These three structural factors together account for over 50 percent of the decline. Other control variables, including the income level and economic fundamentals are also statistically significant, but their explanatory power is smaller than structural factors.

Figure 7. Determinants of the Investment Gap





Source: IMF staff estimates.
1/ Estimated gap in 2019 using different control variables. Economic fundamentals include GDP growth, private credit growth and interest rate; structural factors include total public and private debt to GDP ratio, the service share of GVA , openness and regulatory quality.

Table 2. Investment Gap Estimates under different Model Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	m1	m2	m3	m4	m5	m6	m7
GDP per capita	-5.026***	-2.400*	4.166**	3.847**	2.938	0.0176	-4.101*
	(0.914)	(1.343)	(1.937)	(1.901)	(1.847)	(2.114)	(2.097)
GDP growth	0.405***	0.595***	0.679***	0.627***	0.496***	0.438***	0.340***
	(0.0406)	(0.0470)	(0.0577)	(0.0581)	(0.0620)	(0.0669)	(0.0646)
Private credit/GDP growth		0.0772***	0.0735***	0.0605***	0.0440***	0.0408***	0.0337**
		(0.0139)	(0.0138)	(0.0137)	(0.0137)	(0.0143)	(0.0142)
Short-term deposit rate			0.0373	0.0770	0.0389	0.00682	-0.232**
			(0.0829)	(0.0828)	(0.0805)	(0.0808)	(0.0945)
Debt/GDP (public + private)				-0.0259***	-0.0208***	-0.0133**	-0.00596
				(0.00520)	(0.00513)	(0.00552)	(0.00534)
Service/Gross value added					-0.343***	-0.458***	-0.512***
					(0.0688)	(0.0787)	(0.0745)
Capital account openness						0.0349**	0.0282*
						(0.0150)	(0.0146)
Regulatory quality							5.427***
							(0.864)
Constant	71.16***	47.05***	-18.74	-17.67	14.17	47.89**	91.29***
	(8.671)	(13.49)	(19.97)	(19.86)	(20.24)	(23.38)	(22.80)
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,116	515	422	392	392	374	356
R-squared	0.363	0.546	0.519	0.540	0.572	0.598	0.659
Number of ifscode	27	27	22	22	22	21	21
Inv. Gap in 2019	**-11.7**	**-10.2**	**-8.1**	**-6.4**	**-4.7**	**-3.9**	**-1.6**

Standard errors in parentheses. The dependent variable is gross fixed capital formation in percent of GDP, and all control variables
*** p<0.01, ** p<0.05, * p<0.1

D. Sectoral Drivers of Investment

14. Business investment is mainly constrained by structural factors. Corporate investment averaged 7 percent of GDP in the decade preceding the GFC and around 5½ percent of GDP since. The 2020 EIB Survey notes that 71 percent of firms indicate they invested the "right" amount in the past three years, slightly below the 80 percent EU average, while two thirds of firms were operating at or about capacity in 2019. The highest-cited barrier to investment according to the same survey is business regulation, though this recently improved (from 95 percent of firms in 2019 to 86 percent of firms in 2020). Energy costs (70 percent, from 79 percent in 2019) and labor market regulations (71 percent, down from 78 percent in 2019) are other structural factors that firms cite as limiting investment.

15. Low returns, high debt levels, and financing constraints may also be at play (Figure 5). The results of the 2020 EIB Survey, however, suggest other drivers could also be at play. In particular, 92 percent of firms note uncertainty about the future remains a barrier to investment, while 62 percent of firms note that low domestic demand prevents them from investing more. We consider others factors here in addition:

- Low returns on capital provides less incentives to invest. The gross return on capital of Non-Financial Corporations (NFCs) in Greece experienced a sharp drop from the pre-crisis peak of 34 percent in 2008 and 38 percent in 2011 to a historic low of 13.7 percent in 2019, 10 percentage points below the EA average.

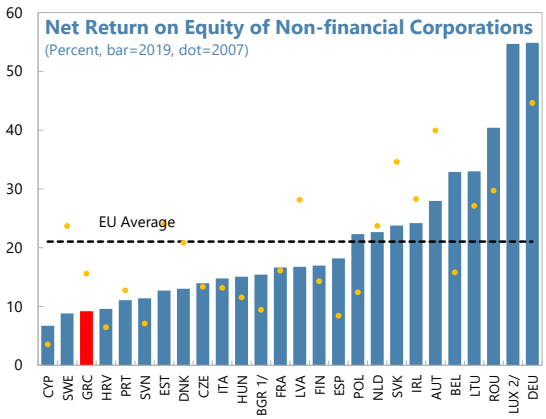
- High debt burden restrains the companies from investing. The average net debt-to-income ratio of Greek NFCs increased since 2013. By 2016, it had more than doubled compared to its 2008 level.[7] Despite the gradual reduction in the last three years, Greece companies still feature the second highest gross debt burden for the EA-15 region (Figure 8).

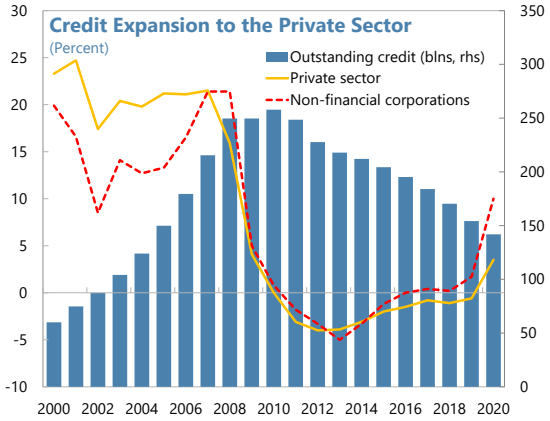
- Insufficient domestic savings—together with poor channeling of these as credit—limit the financial resources for corporate investment. In addition, the saving rate of Greek NFCs was lower than the EU average pre-crisis and the gap has widened in recent years. In 2018, the NFC saving-to-GDP ratio dipped into single-digit percentage points for the first time.

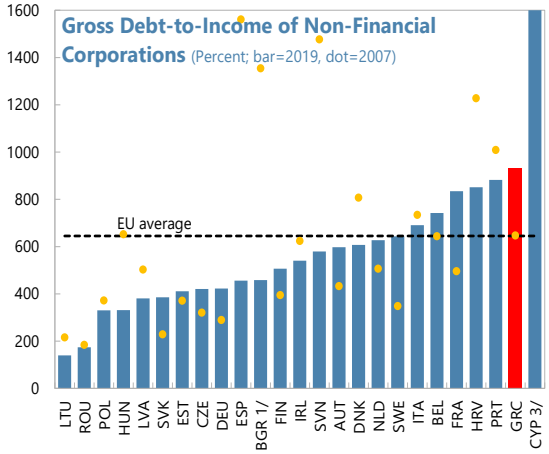
- Meanwhile, access to bank credit was significantly reduced. The pre-crisis credit boom vanished since the GFC, with negative credit growth until 2020. Banks to date remain in the process of deleveraging their balance sheets, with high non-performing exposures (NPEs) constraining credit supply. According to the EIB Survey, firms in Greece remained considerably more likely to lack access to finance (13 percent) than the EU average (6 percent). Firms also remark on the high cost of finance (12 percent compared to an average of 5 percent in the EU) and on collateral rules (10 percent) as a barrier to investment.

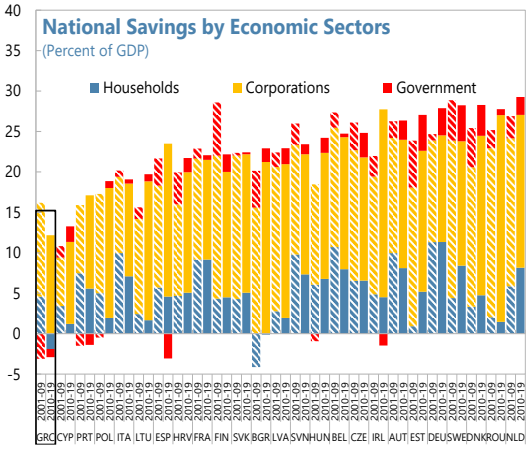
[7] The data sample is different from the Parodi et al (2021 SIP), which is using gross debt/EBITDA firm-level data accounting for 45 percent of total operating revenues of Greek NFCs, mostly excluding small firms. The Eurostat definition uses total debt (sum of currency & deposits, debt securities, and loans)/(net entrepreneurial income – tax).

Figure 8. Greece: Other Drivers of Low Business Investment





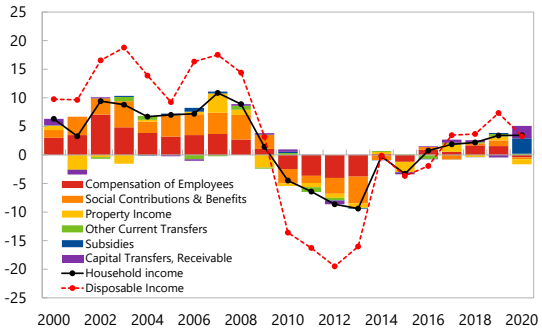




Source: Bank of Greece; Eurostat; Haver Analytics; and IMF staff calculations.
1/ 2017 data.
2/ 2018 data.
3/ 5807.1 (2007) and 3175.2 (2019).

16. Household investment seems to be closely linked to income and savings dynamics (Figure 9). The household investment decline is in tandem with lower household savings driven by the sharp decline in disposable income (text chart). Greece currently has the lowest saving rate among EU countries by a wide margin: average national saving from 2010 to 2019 was 9.2 percent of GDP, 13 percentage points below the regional average. While the public sector was historically the main driver of the low savings rate in Greece, household savings entered and have stayed in negative territory since 2012 despite the recovery in disposable income and employment (though this was in large part led by low-paying, part-time, or seasonal jobs). Wealth effects might also have been at play. While debt to income ratios seem to be broadly on par with the regional average, Greece's high degree of home ownership and investment through real estate, linked to plummeting housing prices after the sovereign debt crisis, have also driven the drop in investment, as Greek households are dis-saving to cope with the reduction in their disposable income and with the reduction in credit that used to finance housing expenditures. Although the real estate sector started to recover prior to the pandemic (partly driven by tourism and Airbnb), transaction volume is difficult to ascertain as the statistics agency halted the production of series on housing starts or transactions after the GFC. Housing prices, however, continued increasing even through 2020.

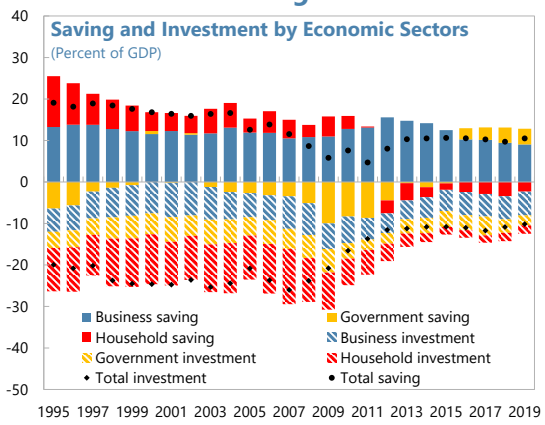
Household Income
(Percent of total household income)

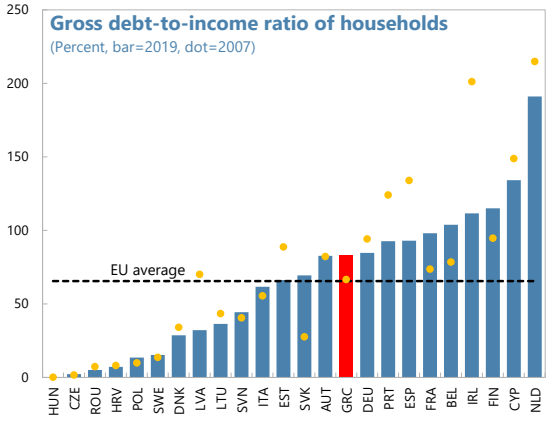


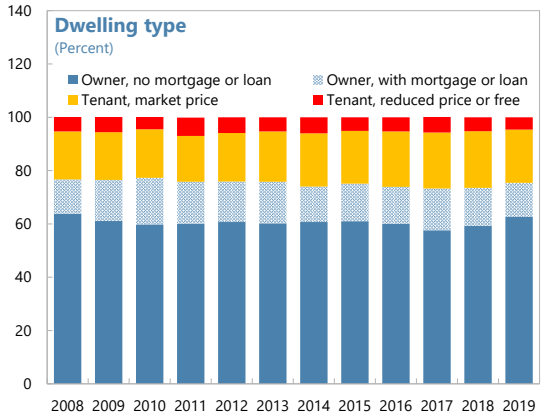
Sources: ELSTAT, Haver Analytics and IMF staff calculations.

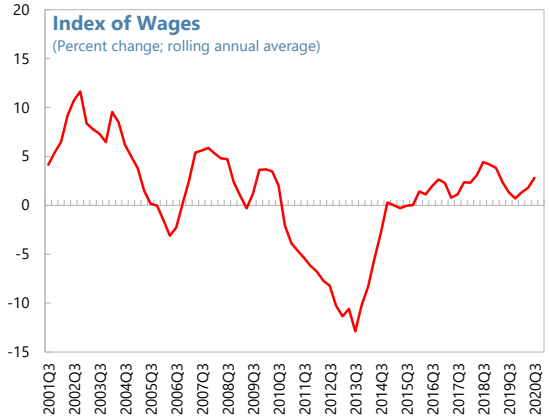
17. Public investment seems to have been broadly stable despite limited fiscal space. The public investment-to-GDP ratio has been stable and slightly higher than the regional average. This could be due to measurement issues (transfers classified as investment), the rising importance of EU structural funds in a shrinking economy, and/or necessary investments needed to maintain the relatively large public capital stock held by State-Owned Enterprises. As mentioned above, Greece's public-to-private capital ratio stands above the regional average at 45 percent at end-2019.

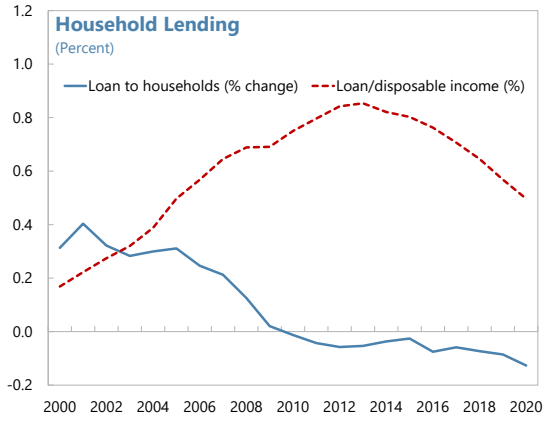
Figure 9. Greece: Drivers of Household Investment

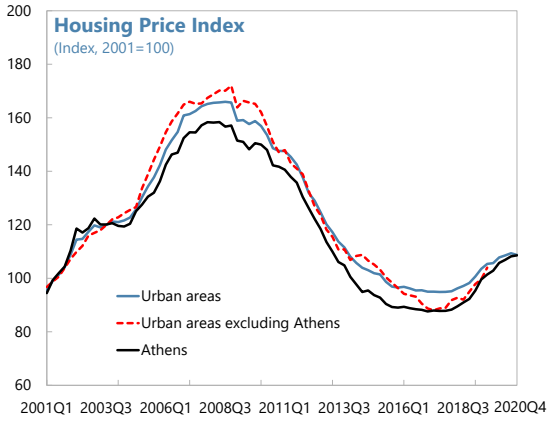












Source: Bank of Greece; ELSTAT; Eurostat; Haver Analytics; and IMF staff calculations.

E. Conclusion and Policy Recommendations

18. There is scope for expanding the frontier of private investment possibilities in Greece through structural reforms and sound macro-financial policies. The predicted norm approach provides a useful investment benchmark based on cross-country evidence and Greece's own specific characteristics, while the equilibrium investment rate is estimated through the "golden-rule" approach. The two approaches complement each other, and together with the historical benchmark, provide a good gauge of the magnitude of the investment gap. Consistent with the literature, two of the three approaches suggest Greece's low level of total investment is linked to structural features in the economy. The empirical analysis, in particular, finds that countries tend to invest more if they have a lower debt burden, a smaller service share (as these tend to be less capital-intensive), higher capital account openness, and better regulatory quality. The high degree of self-employment also seems to be holding back investment, though this by itself is not necessarily a concern. Rather, this could be linked to the prevalence of Greek micro firms that are constrained in their investment due to the size of the markets they serve or because of financing/technology constrains. Addressing these challenges, via product market reforms that encourage economies of scale and/or trade facilitation that integrates them into global markets could boost Greece's corporate investment and growth prospects. In turn, higher, more productive, private sector investment would improve earnings for employees and encourage savings. Thus household investment could be expected to increase as disposable income grows, in line with higher wages and a more dynamic real estate market. Young people, in particular, tend to drive demand for housing but need access to credit, good-paying jobs, and availability of infrastructure and services (transport, childcare, elder care, and unemployment benefits) to feel secure enough to invest in a home.

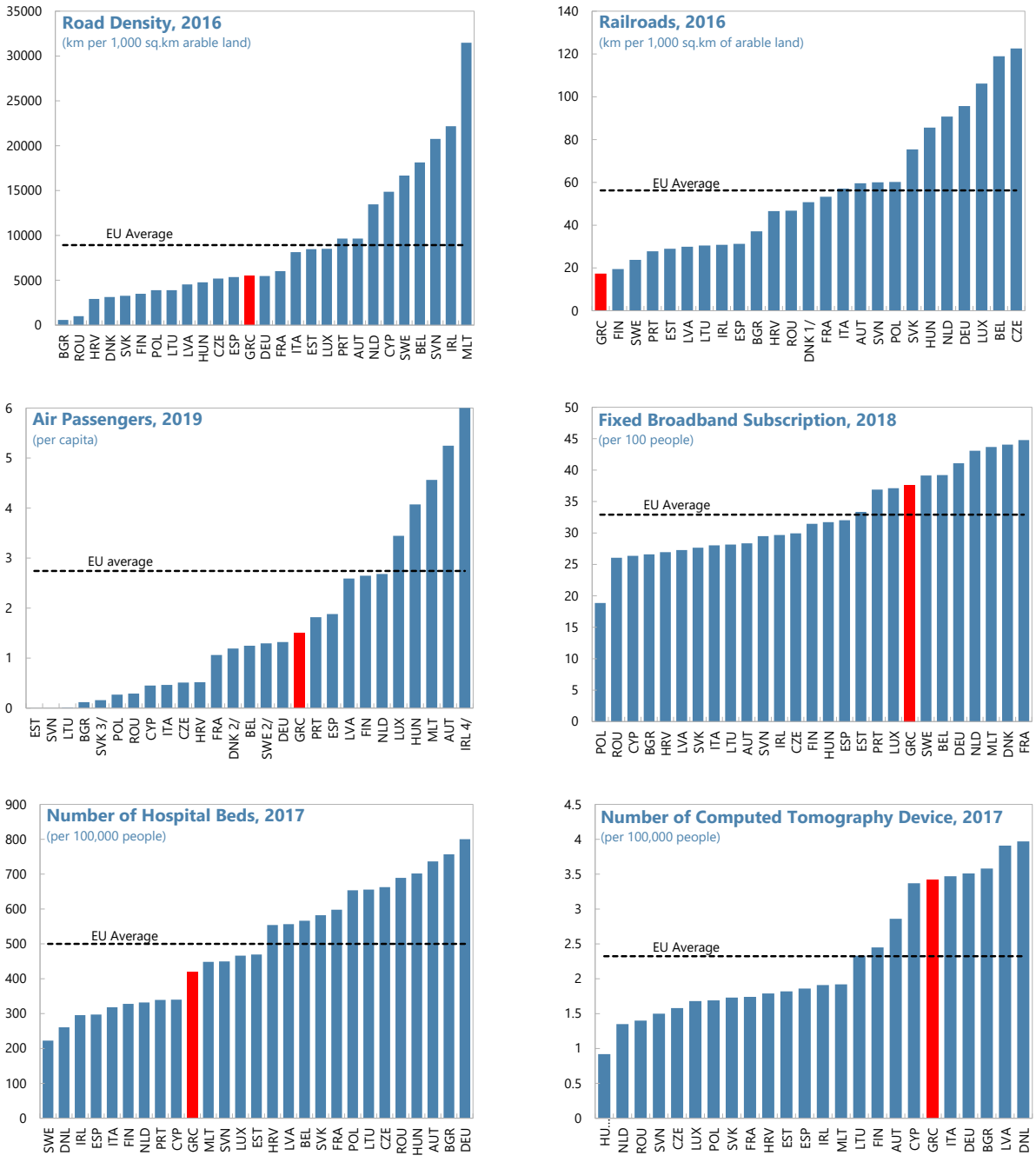
19. The authorities are taking steps to tackle structural barriers. The authorities' Recovery and Resilience Plan (underpinned by the 2020 National Growth Strategy) features reforms focused on improving the investment climate (see also 2021 AIV Staff Report Box 2), geared towards digitalization, green investments, up- and re-skilling the labor force, and encouraging economies of scale. Other adopted policies that will support investment in the near term include a lower tax wedge and cuts to red-tape in business processes. Other efforts by the authorities to improve public investment efficiency (interoperability of the public investment budget, establishment of a Strategic Projects Pipeline and a Project Preparation Facility) and NGEU-grant financed investment, if fully executed, should also boost the growth impact of public investment. The authorities also requested, but then delayed, Public Investment Management Assessment technical assistance from the IMF, which would help maximize the public investment payoffs of NGEU funds.

20. More ambitious reforms could potentially unlock higher private investment without endangering external sustainability. Some examples include overhauling the burdensome judicial system, finally completing the delayed cadaster reform, adjusting pensions to encourage private savings and labor force participation in older cohorts, and tackling on-the-ground barriers to more competitive product markets and closed professions, as recommended by the Hellenic Competition Commission. Completing long-promised privatization could also unlock higher, more sustainable

investment rates, as long as it attracts greenfield projects that strengthen corporate governance and competition.

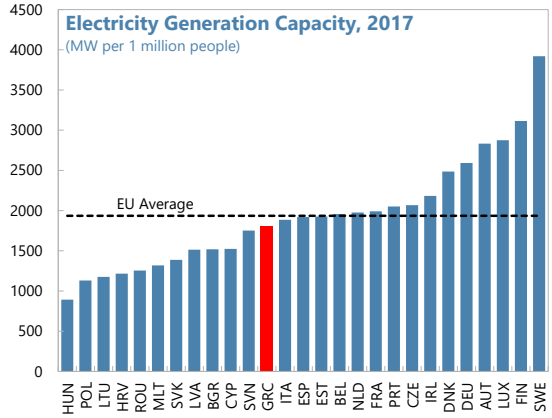
21. Adequate sequencing of reforms and prioritization of public investment would maximize the investment potential of NGEU resources in the near term. Prioritizing reforms that encourage structural transformation and keep growth momentum would help address private investment barriers. On the analytical front, exploring the interaction of public and private capital in Greece could help determine if supplementary or substitution effects dominate. This could help policymakers allocate public investment to areas that encourage and maximize productive private sector investment.

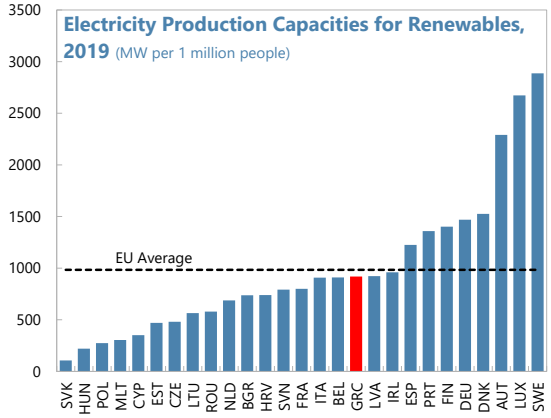
Figure 10. Greece: Transport, ICT, & Health Infrastructure Gap

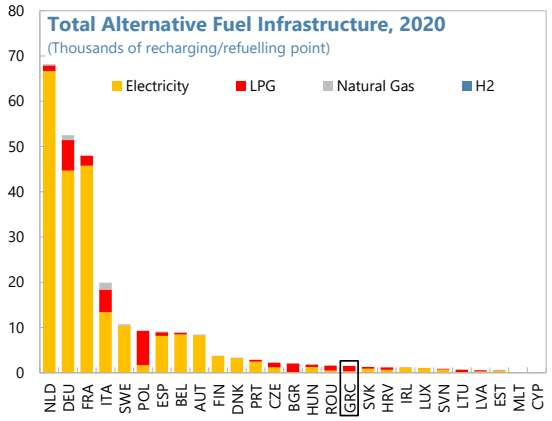


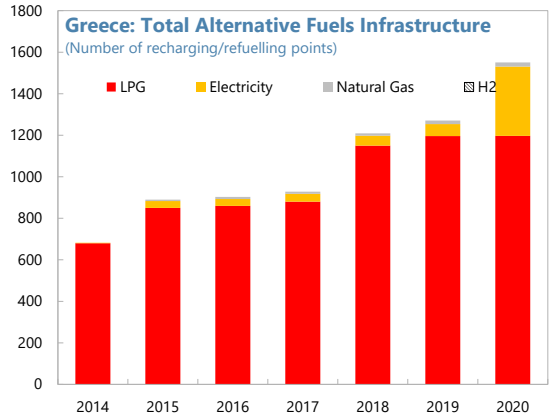
Source: Eurostat; IMF, WEO database; OECD; WDI; and IMF staff calculations.
1/ 201s2 data.
2/ 2004 data.
3/ 2017 data.
4/ 34.7.

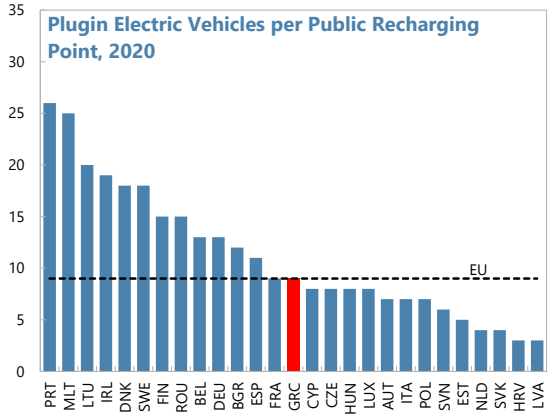
Figure 10. Greece: Energy & Green Infrastructure Gap (Concluded)

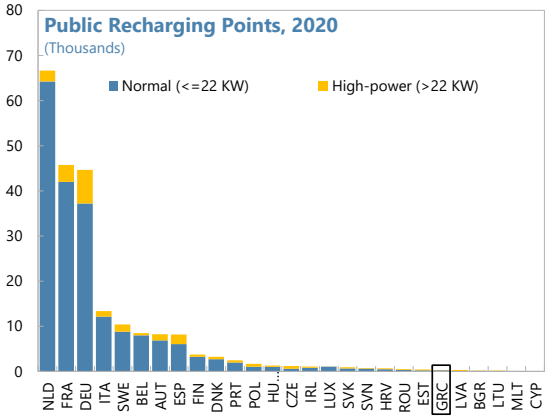












Source: European Alternative Fuels Observatory; Eurostat; IMF, WEO database; OECD; WDI; and IMF staff calculations.

Appendix I. Investment Gap Estimations

1. The **Golden Rule** approach can be interpreted as a lower bound to which a country's investment rate eventually converges as it approaches it's the steady state level, underpinned by its structural characteristics and exogenous parameters. A neo-classical growth model, modified to allow for exogenous growth of labor-augmenting productivity (Cass-Koopmans model) predicts that—for given parameters of the aggregate production function, social rate of time preference (SRTP), depreciation, exogenous growth rates of the labor force and labor-augmenting productivity, and initial conditions with positive values—an economy converges to a steady-state equilibrium, in which income, consumption, and capital all grow at a fixed rate equal to the sum of the growth rates of labor force and labor-augmenting productivity. In the *augmented* neoclassical (Ramsey-Cass-Koopmans) growth model, an economy converges to its steady state equilibrium where consumption is maximized, the saving/investment rate is constant at its "golden-rule" value, and income, consumption, and capital all grow at a fixed rate equal to the sum of the exogenous growth rates of the labor force and labor-augmenting productivity.

2. The "golden-rule" of capital accumulation is thus given by:

$$\frac{S}{Y}=\frac{I}{Y}=\frac{\alpha(\delta+n+g)}{(p+\delta+n+g)}$$

3. where α is the capital share of output; p is the social rate of time preference; δ is the depreciation rate; n is the growth of the labor force; and g is the rate of technical progress.

4. The estimate replicated for Greece follows the methodology IMF (2016) used for European Union (EU) countries, using Penn World Tables (PWT) data, now updated to version 10.0. Similar to IMF (2016), we adjust the capital share of output based on Eurostat balance sheet data, reducing it by either 100 or 63 percent of self-employed income given Greece's prevalence of micro firms and large segment of self-employed. In IMF (2016), the SRTP is constant and set equal to 5 percent for all countries, corresponding to the SRTP derived from the golden rule under the assumption that the euro area has been close to its steady-state path of development on average over 2002–14. We test other SRTPs given the observed dis-saving in Greece over the past decade (and potential for future developments that might encourage saving in the future). In addition, the new PWT 9.0 data set now includes total factor productivity based on absorption (instead of domestic demand, the so-called "Welfare-relevant TFP") which aims to capture TFP based on prices and quantities as perceived by consumers, not firms (the results do not vary much). The scenarios are included in Table 3.

Table 1. Golden Rule Variations

Scenario	Gap (% of GDP)	Adjustment
GR5	-0.8	Self-employed income accrues 100 percent to labor.
GR4	1.9	SRTP=6 (higher consumption).
GR3	3.1	Self-employed income accrues 67 percent to labor.
GR1	**3.8**	**No adjustment to PWT values, SRTP=5.**
GR6	5.5	Adjusted for welfare-relevant TFP (based on absorption).
GR2	6.3	SRTP=4.0 (lower consumption).
GR7	6.9	SRTP=3.5 (lowest consumption).

5. The **Historical Benchmark** provides a yardstick investment rate (for a given K/L ratio and technology) that is consistent with capital accumulation path of selected advanced European economies during 1951–2011 that proved to be sustainable. The main advantage of this approach is that it does not require any assumptions about the social rate of time preference and the position of the country on the saddle-path. The main disadvantage is that it assumes similarity in economic structures of selected countries and their advanced peers. The benchmark values can be calculated for each country and each point in time, given the TFP and population growth rates, as well as the country's capital-labor ratio. The purpose of the benchmark is to provide a proxy for a sustainable path of the investment rate during the transition to a steady state. Although neoclassical growth theory does not offer a closed-form solution for such transition dynamics, the "catch-up" is essentially driven by differences in real interest rates that affect intertemporal choices of consumption and savings (the Euler equation; see Barro and Sala-i-Martin 2003). When relative capital scarcity makes capital more productive, bearing a higher real interest rate, it stimulates saving and investment rates and leads to faster pace of capital accumulation. With a rising K/L ratio, the real return to capital declines and saving and investment rates gradually fall to their steady-state constant level. The further the economy is from its steady-state K/Y ratio, the faster it will accumulate capital. Therefore, the transition path for the investment rate I/Y may be approximated by a function of the real return to capital (given by the marginal product of capital, using Cobb-Douglas production function, where A is labor-augmenting productivity, K is capital, L is labor, and α is the capital share):

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

$$ln\left(\frac{I_t}{Y_t}\right) = c + \beta \ln(A_t) - (1-\alpha) ln\left(\frac{K_t}{L_t}\right) + \varepsilon_t,$$

6. and where in the steady-state c equals ln( ) and β equals (1-a). This suggests that the approximation of the transition path is a plausible transition dynamic since it converges into the balanced growth path. In order to evaluate the parameters c, α, and β, we use the method used in IMF (2016), which established the historical experiences of countries in Western Europe with their capital accumulation path over 1951–2011. Fitting the above specified transition path for the investment rate on a panel for Germany, France, Italy, and Spain over 1951–2011 (R2=0.87, asterisks denote statistical significance with *** at 1 percent and ** at 5 percent), yielded:

$$ln\left(\frac{I_t}{Y_t}\right) = -0.18^{**} + 0.7^{***}\ln(A_t) - 0.6^{***}ln\left(\frac{K_t}{L_t}\right)$$

7. Using these parameters and Greece's country-specific K/L ratio and labor-augmenting productivity, we computed the sustainable "historical benchmark" investment rate which mimics earlier transition dynamics of advanced economies. This approach may not be suitable for Greece under its current economic structure, as the period of time where the investment rate more closely approached the historical benchmark was characterized by unsustainable external and fiscal positions.

8. The **"Predicted Norm"** is estimated using a panel fixed-effects regression model for 27 EU countries (the actual sample size varies depending on data availability of different controlling variables) over the past three decades. The estimates shown in Table 2 are based on the specification that includes both country and year fixed effects, as well as countries' economic fundamentals, structural characteristics and external conditions identified in the literature as significant determinants of investment. The regression results are robust and broadly in line with expectations. In the simple fixed-effects specification, the country fixed effects capture all the unobservable (time-invariant) factors, including structural characteristics. However, based on the literature, surveys and stylized facts, there are some structural factors that seem to play an important role in explaining private investment activity in most countries. Hence, the regression specifications explicitly control for some of these factors (e.g. regulatory efficiency, trade, and financial account openness). The random effects model specification is estimated as well as a robustness tests. On this latter, staff tested different control variables for Greece's structural characteristics, including the OECD's Product Market Regulation indicators, World Economic Forum Global Competitiveness Index, World Uncertainty Index, Doing Business Index and others. Alternative controls of economic fundamental were also considered, such as the NPL ratio in lieu of private sector/GDP and export share GDP. The final, most complete model specification is a function of data availability and provides the best fit. Staff ran additional robustness checks by using random effect models and dynamic panel models. Possible multicollinearity among regressors are detected, but it doesn't affect the overall fit and predictive power of our model.

References

Bank of Greece, 2019, "Housing Wealth, Household Debt and Financial Assets: Are there Implications for Consumption?" BOG Working Paper No. 263 (Athens).

European Central Bank, 2016, "Savings and Investment Behavior in the Euro Area," *ECB Occasional Paper Series No. 167*.

European Commission, 2019, "2019 SBA Fact Sheet – Greece," (Brussels: European Commission).

European Investment Bank, 2019, "EIB Group Survey on Investment and Investment Finance 2019. Country Overview: Greece," *European Investment Bank*.

European Investment Bank, 2020, "EIB Group Survey on Investment and Investment Finance 2020. Country Overview: Greece," *European Investment Bank*.

Foundation for Economic and Industrial Research, 2019, "Boosting Savings and Growth through the Capital Markets," IOBE (Athens).

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer, 2015, "The Next Generation of the Penn World Table" American Economic Review, 105(10), 3150-3182, available for download at https://www.ggdc.net/pwt

International Monetary Fund, 2016, *Euro Area Policies,* IMF Country Report No. 16/220 (Washington D.C.).

International Monetary Fund, 2016, "Central, Eastern, and Southeastern Europe: How to Get Back on the Fast Track" Regional Economic Issues (Washington).

International Monetary Fund, 2017, "Republic of Poland," IMF Country Report SM/17/178 (Washington)

International Monetary Fund, 2018, "Financial Conditions and Growth at Risk in Portugal," IMF Country Report No. 18/274 (Washington)

International Monetary Fund, 2019, "On Substitution of Private and Public Capital in Production," IMF WP/19/232 (Washington).

International Monetary Fund, 2020, "Infrastructure in Central, Eastern, and Southeastern Europe: Benchmarking, Macroeconomic Impact, and Policy Issues," (Washington).

McKinsey Global Institute, 2012, "Investing in Growth: Europe's Next Challenge," (New York).
National Bank of Greece, 2020, "Financial Frictions and Covid-19," *NGB Economic Analysis Division,* pp. 2—11.

Organization for Economic Co-operation and Development, 2001, "Measuring Capital" *OECD Manual: Measurement of Capital Stocks, Consumption of Fixed Capital and Capital Services*, OECD Publishing, Paris, 9-119.

PricewaterhouseCoopers, 2017, "From Recession to Anemic Recovery," PwC (Athens).

PricewaterhouseCoopers, 2020, "Infrastructure in Greece: Funding the Future," PwC (Athens).

ResearchGate, 1998, The White Paper on Growth, Competitiveness and Employment and Greek Small and Medium Sized Enterprises," *Kluwer Academic Publishers*.

World Economic Forum, 2019, "The Global Competitiveness Report 2019," WEF (Geneva).