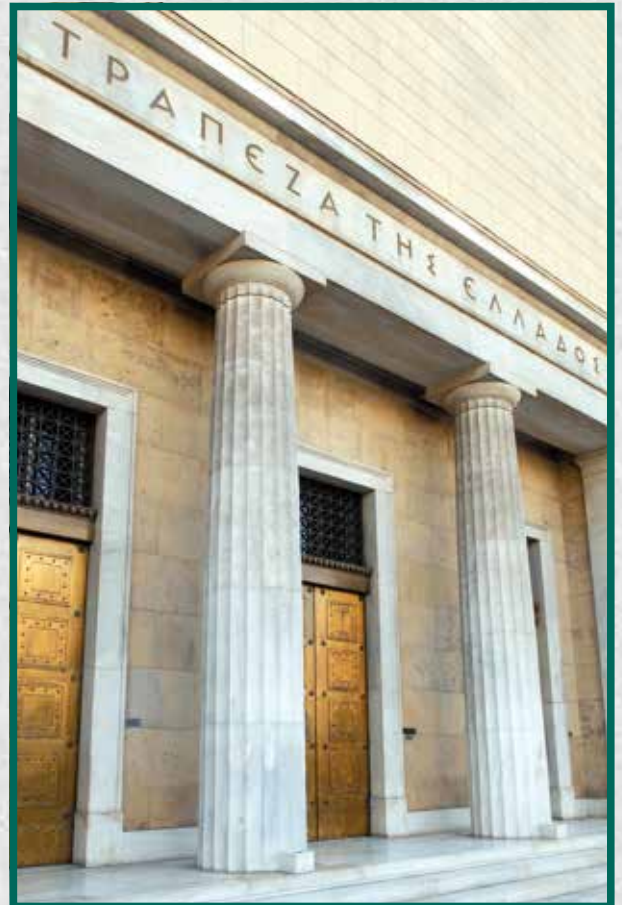


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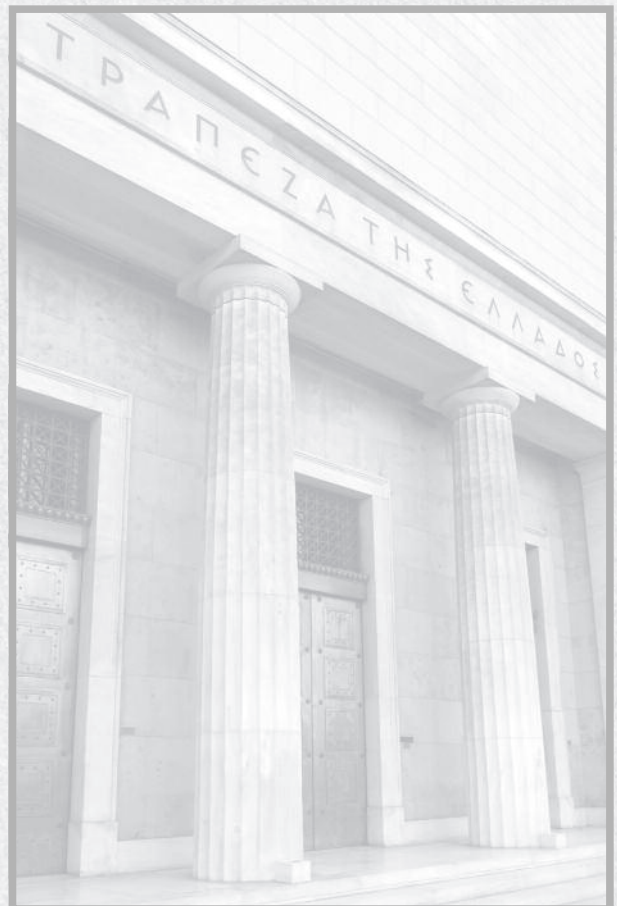
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BANK OF GREECE

21, E. Venizelos Avenue
GR-102 50 Athens

www.bankofgreece.gr

Economic Analysis and Research Department
E-mail: dep.economicresearch@bankofgreece.gr

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THE INVESTMENT GRADE AND FUNDS' PORTFOLIO ALLOCATION IN GREEK ASSETS

Haris Giannakidis

Bank of Greece, Economic Analysis and Research Department

Louis Karathanos

Humboldt University of Berlin

Athanasios Kontinopoulos

Bank of Greece, Economic Analysis and Research Department

Athanasios Lampousis

Bank of Greece, Economic Analysis and Research Department

Petros Migiakis

Bank of Greece, Economic Analysis and Research Department

ABSTRACT

The importance of investment funds for the global economy has increased in the aftermath of the global financial crisis. In the present paper, we focus on the case of Greece and the developments in investment funds' portfolios, with a special emphasis on the period before the sovereign credit rating upgrade of Greece to investment grade. By means of a differences-in-differences estimator, we find that, in the aftermath of the change in Greece's sovereign credit rating outlook to positive by the rating agency Standard and Poor's (S&P), investment funds increased their holdings of Greek sovereign bonds in relation to other comparable euro area sovereign bonds. Next, in a dynamic panel data model setup we find that this increase in investment funds' positions in Greek government bonds (GGBs) explains about 80% of the reduction in Greek sovereign bond spreads. Our results highlight the strong association between investment funds' portfolio allocation and the underlying assets' credit ratings, and provide incentives for continuing reforms that may lead to rating upgrades, as a means of increasing demand for Greek sovereign bonds and controlling the cost of debt. This is especially important when the monetary policy environment becomes tighter and interest rates, as well as the cost of funding, increase.

Keywords: Demand-based asset pricing; investment funds; sovereign bonds; credit ratings

JEL: F21; G12; G15; G24; H63

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Η ΕΠΕΝΔΥΤΙΚΗ ΚΑΤΗΓΟΡΙΑ ΚΑΙ ΟΙ ΤΟΠΟΘΕΤΗΣΕΙΣ ΤΩΝ ΕΠΕΝΔΥΤΙΚΩΝ ΚΕΦΑΛΑΙΩΝ ΣΕ ΕΛΛΗΝΙΚΟΥΣ ΤΙΤΛΟΥΣ

Χαρίλαος Γιαννακίδης

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Louis Karathanos

Humboldt University of Berlin

Αθανάσιος Κοντινόπουλος

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Αθανάσιος Λαμπούσης

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Πέτρος Μηγιάκης

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

ΠΕΡΙΛΗΨΗ

Η σημασία των επενδυτικών κεφαλαίων για τη χρηματοδότηση της παγκόσμιας οικονομίας έχει αυξηθεί πολύ τα χρόνια μετά την παγκόσμια χρηματοπιστωτική κρίση. Τα επενδυτικά κεφάλαια επενδύουν τα διαθέσιμά τους σε χαρτοφυλάκια αξιογράφων, σε στενή συνάφεια με τις πιστοληπτικές αξιολογήσεις των τελευταίων. Έτσι, οι αναβαθμίσεις των πιστοληπτικών αξιολογήσεων της ελληνικής οικονομίας και κυρίως η προοπτική για την αναβάθμιση στην επενδυτική κατηγορία οδήγησαν σε σημαντική αύξηση των τοποθετήσεων των επενδυτικών κεφαλαίων σε ελληνικά κρατικά ομόλογα. Συγκεκριμένα από το δ' τρίμηνο του 2022 έως το γ' τρίμηνο του 2023, η αξία των ελληνικών αξιογράφων στα χαρτοφυλάκια των διεθνών επενδυτικών κεφαλαίων αυξήθηκε κατά 7 δισεκ. ευρώ, ενώ, αν απομονωθεί η επίδραση της αύξησης των τιμών των μετοχών και των ομολόγων εκείνη την περίοδο, η αύξηση αυτή υπολογίζεται σε 5 δισεκ. ευρώ, εκ των οποίων 2,9 δισεκ. ευρώ αφορούν θέσεις σε μετοχές και 2,1 δισεκ. ευρώ θέσεις σε ομόλογα.

Στην παρούσα μελέτη εξετάζεται κατά πόσον οι αυξήσεις στις τοποθετήσεις των επενδυτικών κεφαλαίων σε ελληνικά ομόλογα ξεπέρασαν τη γενικότερη τάση στην αγορά και εκτιμάται η επίδραση της αυξημένης ζήτησης στις αποδόσεις των ελληνικών κρατικών ομολόγων. Τα ευρήματα υποδεικνύουν ότι η μεταβολή των προοπτικών της κρατικής πιστοληπτικής αξιολόγησης της ελληνικής οικονομίας σε θετικές από τον οίκο Standard and Poor's (S&P) τον Απρίλιο του 2023 οδήγησε σε σημαντική αύξηση των θέσεων των επενδυτικών κεφαλαίων σε ελληνικά κρατικά ομόλογα, η οποία ξεπέρασε τις εξελίξεις που παρατηρήθηκαν σε άλλα κρατικά ομόλογα της ζώνης του ευρώ. Η εξέλιξη αυτή εκτιμάται ότι οδήγησε σε μείωση στις αποδόσεις των ελληνικών κρατικών ομολόγων που αντιστοιχεί σε περίπου 80% της πτώσης των διαφορών αποδόσεών τους έναντι των γερμανικών ομολόγων αναφοράς.

Τα αποτελέσματα αυτά είναι σημαντικά για δύο λόγους. Αφενός, η αύξηση της ζήτησης ελληνικών αξιογράφων παρατηρήθηκε σε μια περίοδο κατά την οποία τα επενδυτικά κεφάλαια μείωναν τις θέσεις τους σε ομόλογα με χαμηλές πιστοληπτικές αξιολογήσεις. Αφετέρου, η μείωση στις αποδόσεις των ελληνικών κρατικών ομολόγων, που εξηγείται σε μεγάλο βαθμό από την αύξηση των θέσεων των διεθνών επενδυτικών κεφαλαίων, υπερχέρασε τις αυξητικές πιέσεις που παρατηρήθηκαν στα ομόλογα διεθνώς λόγω των αυξήσεων των επιτοκίων. Κατά συνέπεια, τα αποτελέσματα αυτά υπογραμμίζουν τη σημασία της αναβάθμισης στην επενδυτική κατηγορία της κρατικής πιστοληπτικής αξιολόγησης της ελληνικής οικονομίας, καθώς, εκτός των άλλων, επιφέρει αύξηση της ζήτησης για ελληνικά κρατικά ομόλογα και, ως εκ τούτου, σημαντική βελτίωση στο κόστος δανεισμού του Ελληνικού Δημοσίου.

THE INVESTMENT GRADE AND FUNDS' PORTFOLIO ALLOCATION IN GREEK ASSETS*

Haris Giannakidis

Bank of Greece, Economic Analysis and Research Department

Louis Karathanos

Humboldt University of Berlin

Athanasios Kontinopoulos

Bank of Greece, Economic Analysis and Research Department

Athanasios Lampousis

Bank of Greece, Economic Analysis and Research Department

Petros Migiakis

Bank of Greece, Economic Analysis and Research Department

I INTRODUCTION

Ever since the global financial crisis (GFC) of 2007-2009, the role of market-based financing of economic activity has become more important globally. The shift towards market-based financing can be attributed to several factors, including the weakness of the banking sector in the aftermath of the crisis, combined with central banks' increased attention to market developments.¹ Thus, market actors, such as investment funds, and analytical tools, such as credit ratings, have also gained in importance.

In the present study, we examine the effects of a credit rating upgrade on the cost of market funding through investment funds' holdings. In particular, we pursue the idea that key investors, such as investment funds, allocate their holdings across different bond issuers based on credit ratings and credit rating outlooks. As a result, ratings affect bond yields and the cost of funding of bond issuers by affecting investors' risk taking. We examine whether bond investment portfolios are affected by credit ratings and, then, to what extent changes in investment funds' portfolios affect sovereign bond yields. We use recent developments in Greece's sovereign credit rating to study the impact of ratings on investment funds' holdings and, subsequently, their effects on the cost of funding of public debt.

Sovereign credit ratings are an important determinant of the cost of funding of public debt in sovereign bond markets.² Their relationship with sovereign bond yields becomes even more important, as it may actually determine the sustainability of public debt: in particular, as shown by Ghosh et al. (2013) and Blanchard (2019), the main conditionality for public debt sustainability is a low level of interest rates, compared to the growth rate of the economy. Then, if, as shown in previous studies, some of which are cited herein, credit ratings determine the market risk premium demanded by investors as a compensation for sovereign credit risk, a linkage between credit ratings and debt sustainability is established: credit ratings affect sovereign risk premia, which then determine the path to debt sustainability.

Developments in Greece's sovereign credit rating, before its upgrade to investment grade in 2023 Q3/Q4, motivate our analysis. The case of Greece may provide evidence of the mechanics of portfolio rebalancing due to changes in credit ratings, with broader implications for public debt and financial stability. To this end, we make use of a granular dataset of interna-

* The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

¹ See, among others, Altavilla et al. (2019) and Lo Duca et al. (2016).

² See, among others, Cantor and Packer (1996), Livingston et al. (2010), Aizenman et al. (2013), Malliaropoulos and Migiakis (2018).

tional investment funds' portfolio positions, at fund level, to assess trends and dynamics in their portfolio allocation. Then, we focus on the prospect of an upgrade of the sovereign credit rating of Greece to investment grade and make use of a detailed, security-level dataset of investment funds' portfolios. With this dataset we examine whether changes in investment funds' portfolio allocation towards Greek assets, due to the prospect of an upgrade of the sovereign rating to investment grade, affected sovereign bond yields.

In a nutshell, we find that after the rating agency S&P changed the outlook on its sovereign credit rating for Greece to positive, international investment funds increased their positions in Greek sovereign bonds and equities and this resulted in a substantial decrease in Greek sovereign bond yields. This development came at a time when investment funds globally rebalanced their portfolios towards safer investment positions. Next, we employ a demand-based asset pricing framework to examine the effects that changes in investment funds' holdings of Greek sovereign bonds have had on the yields of these bonds. To this end, we estimate the relationship between investment funds' portfolio holdings and Greek sovereign bond yields. Finally, by distinguishing the effects that the change in outlook to positive by S&P has had on investment funds' holdings of Greek sovereign bonds, we conclude that they account for about 80% of the total reduction in spreads. The implications of this finding are important: a permanent increase in funds' holdings may lower the cost of funding of Greek public debt, thus enhancing its sustainability.

The present study is structured as follows: Section 2 motivates the examination by outlining some stylized facts, as well as findings of previous studies on investment funds' portfolio allocation. Section 3 describes the dataset and provides some preliminary findings. Section 4 presents the findings of the empirical analysis. Finally, Section 5 concludes and discusses the implications of the present study.

2 INVESTMENT FUNDS: STYLISED FACTS

Investment funds are entities that pool individual investors' savings and allocate them collectively in portfolios of financial assets. Usually, these assets are securities issued and traded in financial markets. Investment funds intermediate between individual investors and the entities that require funding from markets. In order to distinguish their impact on financial intermediation from standard bank institutions, these entities are identified as "Non-Bank Financial Intermediaries" (NBFIs).

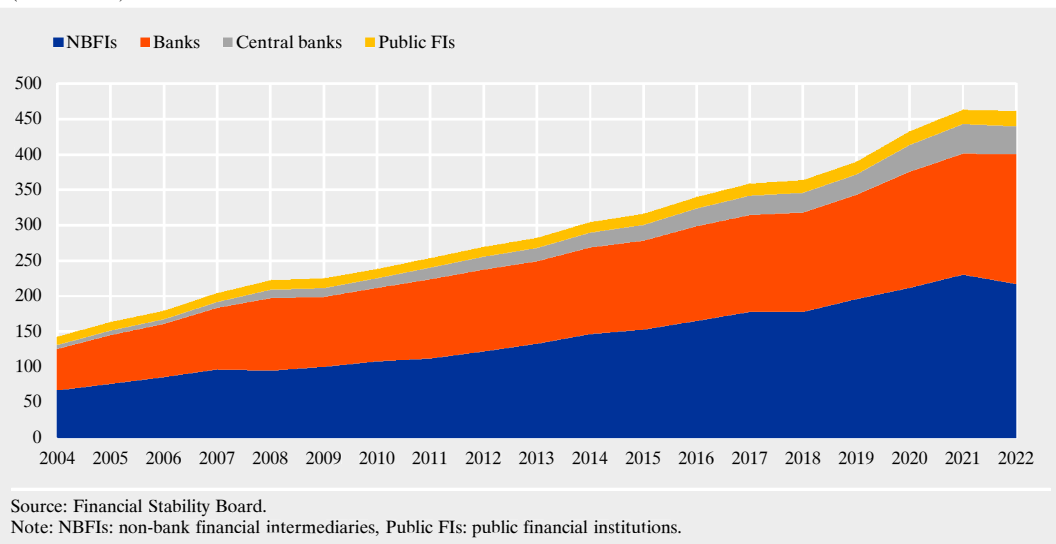
In recent years, the importance of investment funds has grown, in comparison to banks, as has market-based funding of the global economy. In particular, according to the Financial Stability Board, the size of the NBFI sector has grown two times since 2009, while 2022 marked the first year since the GFC, when the asset side of the NBFIs balance sheet declined somewhat (see Chart 1 below). Especially in the years up to 2017, the financial assets of NBFIs had grown at an average rate that was twice that of banks. As a result, the proportion of NBFIs' assets to total financial assets globally had grown to 49.8% by late 2021, up from 42.9% in 2008.

The non-bank financial intermediation sector is a very broad category, which comprises five sub-categories, according to the economic functions performed by NBFI entities. Grouping NBFIs according to their economic functions provides an overview of their activities. Table 1 outlines the separate sub-groups of the NBFI sector.

As shown in Table 1, investment funds belong to the sub-category "Economic function 1", as they consist of vehicles delegated with collectively managing the portfolios of individual investors (so-called "end investors"), while the ease of liquidating end-investor positions by redeeming the shares of the fund makes them susceptible to runs (IMF 2015). According to the Financial Stability Board, this category has grown much more rapidly than the remaining

Chart 1 Holdings of global financial assets

(USD trillions)



NBFIs: by the end of 2022, the group of entities classified under “Economic function 1” constituted about 75% of the NBFIs sector, up from just 44% at end-2008. At the same time, this development fostered the shift of the economy towards market-based funding. For example, Altavilla et al. (2019) find that as euro area banks tightened their credit standards following the GFC, economic entities, such as firms, established a stronger access to market funding.

Although this development was very important, as it provided an alternative to the constrained

bank financing at the time, it also made the world economy more vulnerable to changes in market conditions. For example, previous studies show that entities that are relying more on market-based funding are more prone to financial sector turmoil (see, e.g., Rajan 2005). Also, as highlighted in a study by the US Office of Financial Research (2013), investment funds focusing on short-term funding activities may be more vulnerable to shifts in liquidity preferences by investors. The period of the Covid-19 shock has provided a prominent example of such vulnerability. Vissing-Jorgensen (2021)

Table 1 Economic functions of NBFIs

Sub-category	Definition	Entity types (indicative)
Economic function 1	Collective investment vehicles susceptible to runs	Money market funds, fixed income funds, mixed funds
Economic function 2	Loan provision based on short-term funding	Finance companies, leasing/factoring companies, consumer credit companies
Economic function 3	Intermediation of market activities	Broker-dealer, securities finance companies
Economic function 4	Facilitation of credit creation	Credit insurance companies, financial guarantors, monoline insurers
Economic function 5	Securitisation-based credit intermediation	Securitisation vehicles, structured finance vehicles, asset-backed securities

Source: Financial Stability Board (2023).

shows that large outflows from bond mutual funds resulted in sales of US Treasuries that ended up in yield spikes. The fact that this channel of transmission of funds' liquidity needs to asset prices affected bonds considered to be the benchmark of safe assets, i.e. US Treasuries, demonstrates the degree of vulnerability of investment funds' holdings to changing economic conditions.

In brief, following the GFC, the financial sector has shifted towards market-based funding, which is more direct relative to bank-based intermediation, with investment funds playing a key role in this development. Nevertheless, this development makes the global economy more prone to market shifts and can result in abrupt changes in asset pricing, possibly with negative repercussions for the funded entities.

There are several ways to classify investment funds. A very popular one is according to the purposes of the fund. Under this criterion, a pension fund is actually an investment fund that faces strict restrictions on how to manage its contributors' (i.e. future pensioners) funds, so that it prioritises safety; as a result, such investment allocation would include AAA bonds, shares in money market funds and real estate investment trusts. At the other extreme, a hedge fund in all likelihood is mandated to hedge other investments and, by doing so, it usually invests in "tail scenarios", i.e. scenarios with low probability. Thus, in contrast to a pension fund, a hedge fund would mainly introduce derivatives and alternative investments in its hypothetical portfolio or short positions in assets that are expected to lose their "safe asset" status (e.g. investment grade (IG) bonds that are about to be downgraded to non-IG).

Another way to classify funds is according to their holdings. Under this criterion, a fund holding mostly bonds would be classified as a "bond fund", whereas a fund that holds equities would belong to the "equity funds" class. In order to mark such a clear distinction, the proportions of the characteristic asset must be very large: for example, except for cash, a bond or

an equity fund must invest roughly around nine-tenths of its portfolio in the specific asset category in order to be characterised by it. On the other hand, when it comes to portfolios that include both debt and equity, the investment fund can be characterised as "mixed". To be clear, whereas a mixed fund may hold a 60-40 (or 50-50 or 70-30) mix of equities and bonds, equities may also be included in the portfolios of bond funds and bonds may be included in the portfolio of equity funds, but in these cases the proportion of the funds that are not allocated to the characterising asset (i.e. bonds and equities, respectively) is very low.

One of the most important factors that determines the portfolio allocation of an investment fund is its mandate. Mandates are legally binding documents that usually describe a risk-return relationship that must be respected by the funds' investment managers, when allocating their clients' savings in financial markets. The risk parameter in this relationship is crucial: if a manager accumulates risk, e.g. in order to exceed the market return, but the investment fails, the fund may face lawsuits from its contributors. For example, when it comes to bond funds, credit ratings are one of the main determinants of portfolio allocation. Actually, according to findings by Baghai et al. (2023), bond mutual funds' mandates define their investment policies by using credit ratings at a rate of 94% for US funds and 65% for European ones, while around 89% of funds make use of the IG threshold as a key strategic allocation parameter. Thus, these findings imply that credit ratings may determine a large part of the long-term strategies of funds.

Additionally, funds proceed to changes in their portfolios for several reasons, e.g. due to changes in the risk profile of the underlying assets or due to search for yield. For example, rating changes may induce changes in the portfolios, so that the long-term strategic allocation is kept unchanged: a bond that is downgraded below the IG threshold may actually be sold, so that the overall ratio between IG and high-yield (non-IG) bonds in the portfolio remains

unchanged. Alternatively, a change in the overall market conditions may alter the risk-taking attitude of funds, thus inducing changes in their portfolios. Indicatively, Giuzio et al. (2021) find that accommodative monetary policy shocks result in increased risk taking by funds, due to their search for yield. Also, Kaufmann (2023) associates the “hunt for yield” by investment funds with the loosening of monetary policy by the Fed, which spurred fund flows to financial markets worldwide.

3 DATA AND PRELIMINARY FINDINGS

3.1 DATA

In order to assess the portfolio allocation of bond funds, we collected fund-level data on the funds’ portfolio holdings per asset type and on the basis of other characteristics for the period from 2018 Q4 to 2023 Q3. The source of data is Lipper for Investment Management and the frequency of our dataset is quarterly.³ The database covers around 120 thousand investment funds globally, with a total aggregate fund value of €54 trillion in 2023 Q3; as a result, in terms of aggregate fund market value,

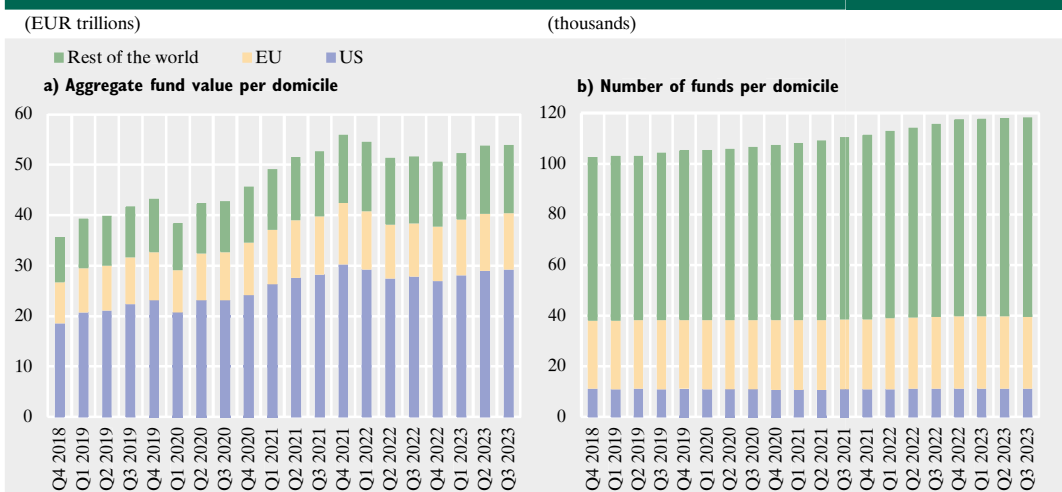
our dataset covers about 90% of the total market of regulated open-end investment funds, after excluding funds of funds (see International Investment Funds Association 2023).

This dataset provides information on the type and other characteristics of both the funds and the investments held in their portfolios, including the following: country of origin of the fund or asset; type of securities and other assets (e.g. cash, derivatives, REITs) held by the fund; credit quality (i.e. credit ratings) of the bonds and of their issuers; market value of the fund’s holdings for each asset, etc.

Chart 2 shows some details about the investment funds in our dataset: the total value of their assets under management, their number and their geographical distribution. As can be seen in Chart 2, European- and US-domiciled funds together represent roughly around 75% to 80% of the total market, in terms of aggregate fund value. Nevertheless, they are outnumbered by their counterparts from other regions; as a result, we can conclude that EU

³ Other studies using Lipper as their source of data on portfolio holdings by investment funds include Bubeck et al. (2018).

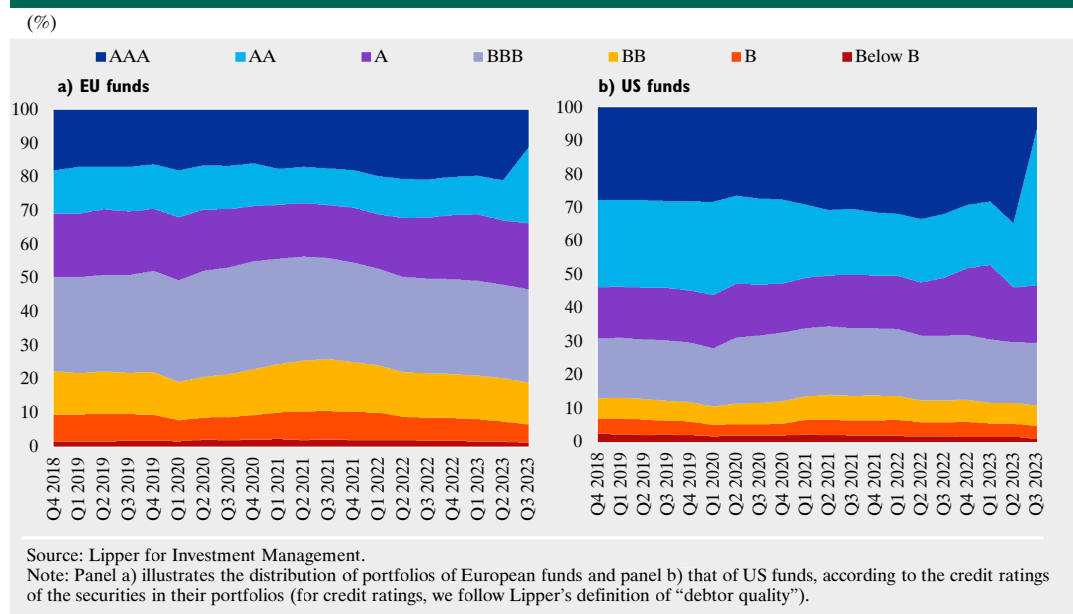
Chart 2 Geographical origin of investment funds



Source: Lipper for Investment Management.

Notes: Panel a) illustrates the total value of the portfolios of the investment funds in our dataset, classified by domicile and grouped in three large geographical regions: US (light purple bars), euro area (light orange bars) and the rest of the world (light green bars). Panel b) illustrates the number of funds domiciled in each region (same colours for the three broad regions).

Chart 3 Distribution of investment funds according to the credit rating of the assets



and, especially, US funds are much larger in average value terms than funds from other regions.

Furthermore, we can assess their strategic portfolio allocation, but also their portfolio rebalancing. Indicatively, we explore the portfolio allocation of investment funds domiciled in the EU and the United States by (a) the geographical origin and (b) the credit ratings of their assets.

As per the geographical distribution of the assets that investment funds have included in their portfolios in 2018 Q4-2023 Q3, we can see that about 80% (+/-2%) of the assets held in US funds' portfolios consist of securities issued in the US, while European funds hold about 45% (+/-3%) in securities issued in Europe and about 34% in US securities. The high tendency of US funds to hold US securities may be associated with the role of the dollar as the main global reserve currency or exchange rate risk concerns.⁴ At the same time, the high sovereign credit rating of the United States plays an important role in considering US Treasury bonds as a safe asset, which, in turn, has been

documented to be associated with increased demand by investors.⁵

Indeed, the role of credit ratings seems to be very important for the portfolio allocation of investment funds. As shown in Chart 3, both European and US funds hold a very large part of their portfolios in investment grade (IG) securities. In particular, 80% of the value of European investment funds' portfolios and about 88% of the value of US investment funds' portfolios correspond to IG investment holdings. This observation is in line with the frequency of the allocation described in their mandates.⁶ Moreover, it is also interesting that these relative holdings, i.e. holdings in the IG category vis-à-vis those in the high yield (HY) category, remained virtually unchanged during the period under examination, despite the large shocks that occurred in this period (i.e. Covid-19 shock, inflation surge and increase in

⁴ See Longaric, P.A. and M.M. Habib, "The US dollar bias of US-fixed income funds" (Box 2), in ECB, *The international role of the euro*, June 2021.

⁵ So much so that US Treasuries have been found to carry a "convenience yield" which is linked to their safe assets status; see, e.g., Engel (2020) and Acharya and Laarits (2023).

⁶ See Baghai et al. (2023).

interest rates). Thus, it seems that there is a strong connection between investment funds' strategies and the credit ratings of their assets.

So, it is even more interesting to observe that since 2021 Q4⁷ both European and US investment funds have increased their positions in highly-rated securities at the expense of securities with lower credit rating. Specifically, European funds have increased their investment holdings of IG securities by 6 percentage points (pps), while reducing by equal amounts their holdings in non-IG/HY positions. Likewise, US funds have increased their investment positions in IG securities by 5 pps, while at the same time they have reduced their non-IG/HY holdings.

Thus, it seems that the period since the Fed signalled its gradual departure from an ultra-accommodative monetary policy stance is characterised by a portfolio rebalancing of both US and European investment funds away from riskier assets and towards highly-rated ones. The timing of the risk-off shift is also interesting: it implies that investment funds rebalanced their portfolios away from lower-rated, i.e. riskier, assets at the same time as central banks were about to shift their mon-

etary policy stance towards less accommodative levels. As a result, in all likelihood, the reduction in lower-rated assets must be reflecting investment decisions by funds' managers to increase their holdings of higher-rated assets in view of the stricter monetary conditions.

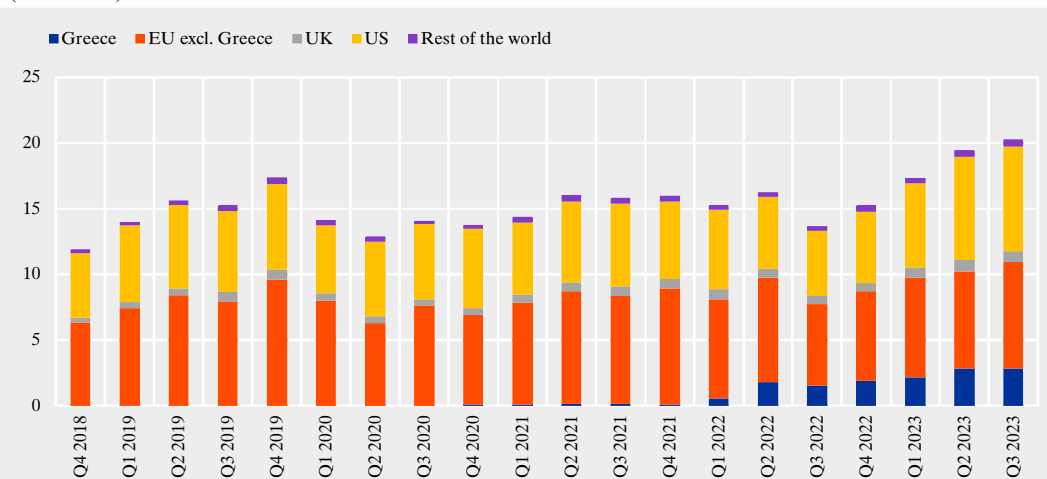
3.2 GREEK HOLDINGS OF INVESTMENT FUNDS

The issue of portfolio allocation of investment funds on the basis of the credit ratings of the underlying assets is even more interesting when it comes to Greece. In particular, on 21 April 2023, the credit rating agency Standard and Poor's (S&P) changed its outlook on the sovereign credit rating of Greece to positive. Given that the rating stood at BB+, this action signalled that, in the short term, S&P could upgrade Greece to investment grade, which it did on 20 October 2023. As a result, should there be a shift in investment funds' positions away from riskier assets and towards less risky ones, this could also be reflected in their holdings of Greek bonds and equities.

⁷ The fourth quarter of 2021 marks a point in time (December 2021) when the US Federal Reserve began tapering its asset purchases, following the Federal Open Market Committee's (FOMC) decision of 3 November 2021.

Chart 4 Value of Greek assets in investment funds' portfolios

(EUR billions)

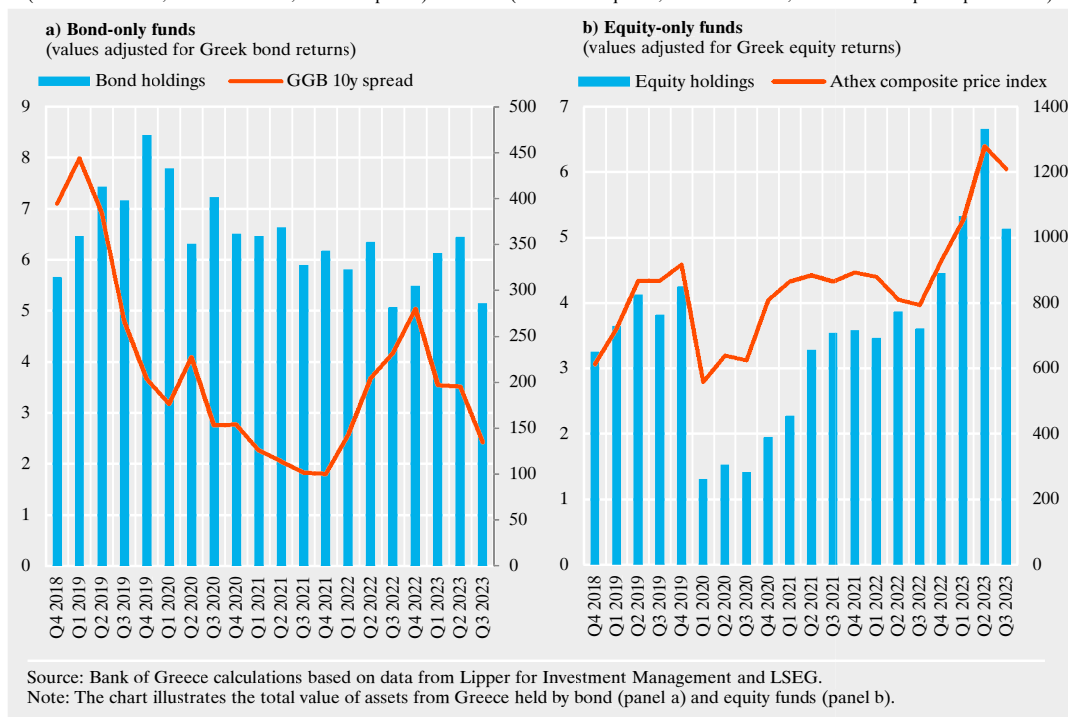


Source: Bank of Greece calculations based on data from Lipper for Investment Management.

Chart 5 Adjusted values of Greek bonds and equities in investment funds' portfolios

(lhs: Greek bonds, in EUR billions; rhs: basis points)

(lhs: Greek equities, in EUR billions; rhs: Athex composite price index)



In particular, initially, when Greece's sovereign credit rating was below the IG category, any risk-off rebalancing of funds' portfolios would imply a reduction in funds' holdings of Greek assets. Indeed, as shown in Chart 4, this was the case during the period from 2021 Q4 to 2022 Q3: the total value of Greek assets under management in investment funds' portfolios decreased by about €3 billion. However, since 2022 Q4, this development started to reverse: just before the IG upgrade, in the beginning of 2023 Q4, the value of Greek assets in funds' portfolios increased by about €7 billion compared with 2022 Q3.

What drives this development? In particular, is this development due to market valuations of existing assets or to additions of Greek assets in investment funds' portfolios? Starting from the second question, we have isolated the pricing effects in bonds and equity shares and recalculated the value of investment funds' holdings.⁸ Thus, the two panels in Chart 5 below show developments in the value of Greek bonds

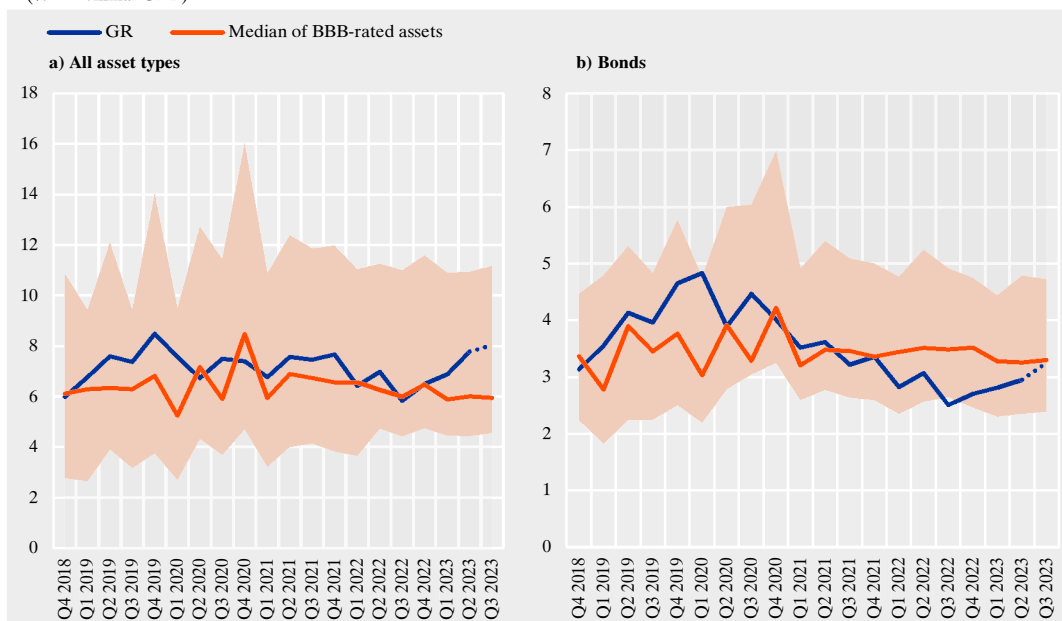
(panel a) and equities (panel b), after deducting market pricing effects, since 2018 Q4.

As shown in Chart 5, even if we deduct the market valuation effects stemming from the price increases in the Greek stock and bond markets, there is an increase of about €5 billion in the Greek assets held by investment funds. This can be broken down into an increase of about €2.1 billion in the holdings of Greek bonds and €2.9 billion in the holdings of Greek equities in investment funds' portfolios. The fact that this development occurred at a time when investment funds reduced their exposure to non-IG holdings is important. So, even if we have not, yet, provided an answer to the question of why we observe an increase in investment funds' holdings of Greek assets, we know that the increase

⁸ The market valuation effects have been isolated by eliminating the cumulative return, since 2018 Q4, of Greek equity shares and bonds from the respective holdings of investment funds' portfolios. To do so, we used the composite price index of the Athens Stock Exchange and the price of the Greek 10-year sovereign bonds.

Chart 6 Investment funds' portfolio weights of Greek and BBB-rated securities as a percentage of nominal GDP

(% of nominal GDP)



Source: Bank of Greece calculations based on data from Lipper and LSEG.

Notes: The chart illustrates the weights of all securities (panel a) or bonds only (panel b). The red line depicts the median weight of assets with a BBB rating, with the shaded area depicting the interquartile range in this category; the blue line depicts the weight of Greek assets. All weights have been standardised, according to the GDP of the underlying economies.

in the prices of Greek bonds and equities cannot explain in full this development.

In addition, it is interesting to note that investment funds' holdings of Greek assets increased relative to the holdings of other assets in the same rating category. In particular, as shown in Chart 6 above, the weights of Greek assets in investment funds' portfolios (i.e. funds' holdings of Greek assets relative to their total holdings), adjusted for the Greek economy's size, have increased since 2022 Q4. By contrast, holdings of assets in the BB rating category, to which Greek sovereign bonds belonged before the upgrade, have decreased, while BBB-rated assets, as shown in Chart 6, have remained broadly stable.

The above stylised facts raise the question of whether the prospects of an upgrade of Greece's sovereign credit rating to investment grade help explain the increase of Greek asset holdings in investment funds' securities portfolios. To examine whether the change in the

outlook of Greece's sovereign rating by S&P resulted in an increase in investment funds' holdings of Greek assets, we rely on estimations of a differences-in-differences (DiD) setup.

Next, we employ a demand-based asset pricing framework to examine the effects that changes in investment funds' holdings of Greek sovereign bonds have had on their yields. To this end, we estimate the relationship between investment funds' portfolio holdings and Greek sovereign bond yields and capture the effects the positive outlook by S&P has had on investment funds' holdings of Greek sovereign bonds.

4 EMPIRICAL ANALYSIS

4.1 DIFFERENCES-IN-DIFFERENCES

First, we examine whether the increase in the relative holdings of Greek sovereign bonds by investment funds is related to the change in

Greece's sovereign credit rating by S&P. To do so, we use the weights of each asset in investment funds' portfolios, relative to the total portfolio fund value, at each point in time. To formalise this, let us think of a portfolio consisting of two assets, A and B. Then, the market value (MV) of the fund (FMV) is given as the sum of the market value of assets A and B, as follows:

$$FMV_t = MV(A)_t + MV(B)_t \quad (1)$$

From equation (1), it is easy to produce weights, in market value terms, for each asset in the funds' portfolio, i.e. the weight of asset A (w_t^A) and the weight of asset B (w_t^B) at each point in time (t) will be given by the following relationship:

$$mw_t^i = MV(i)_t / FMV_t \quad (2)$$

where $i = \{A, B\}$. Now we may generalise, if we lift the assumption that the fund holds only two assets: for $i = \{1, 2, 3, \dots, K\}$, the hypothetical fund may hold K assets. Weights that are calculated based on equation (2) inherently change due to both investment funds' allocation decisions and pricing effects. On the other hand, we have to isolate the latter effects, since our intention is to use weights in order to estimate the effects of funds' net demand on Greek sovereign bond yields. As a consequence, we calculate net weights, based on the funds' initial book values (BV), of positions i , at each point in time, with FBV_t giving the total value of the fund's portfolio value in book value terms:

$$w_t^i = BV(i)_t / FBV_t \quad (3)$$

Then, based on the above definition of weights of Greek sovereign bonds and all other assets in funds' portfolios, we can estimate the changes in the former in comparison to those of other assets.

To do so, we employ differences-in-differences (DiD) estimation techniques, in which the weights of GGBs, following the assignment of

a positive outlook by the rating agency S&P, is the treated group. We also need to choose a "never treated" or "control" group, which by definition must be identical to the treated one, except for the property that will define the treatment. This restricts our choice to euro area sovereign bond holdings with a rating low enough to be comparable to GGBs, which have neither experienced a change in their rating, nor have been subject to other country-specific developments in the period under examination.

Based on these criteria, we end up with Portuguese government bonds (PGBs): apart from being subject to the same monetary conditions as GGBs, they have had a low IG rating, during the period under examination, which makes them comparable to GGBs. Additionally, during the period under examination, Portugal did not experience political developments similar to those that marked other low-rated IG euro area economies. So, the DiD estimator is given by the following relationship:

$$\hat{\delta} = (\bar{w}_{GGB}^{post} - \bar{w}_{GGB}^{pre}) - (\bar{w}_{PGB}^{post} - \bar{w}_{PGB}^{pre}) \quad (4)$$

where *pre* and *post* denote the weights of Greek and Portuguese sovereign bonds (i.e. GGBs and PGBs, respectively) before and after the change in the outlook of the Greek sovereign credit rating to positive by S&P in April 2023. By using two-way fixed effects and controls, we estimate the DiD relationship as follows:

$$w_{i,j,t} = a_i + \beta T + \delta D_{i,t} + \gamma X_{i,j,t} + \varepsilon_{i,j,t} \quad (5)$$

In equation (5), the term $\delta D_{i,t}$ captures the deviation of weights on GGBs, after the assignment of the positive outlook, to what is expected by the remaining variables in the above structural relationship and by their own developments prior to the said assignment. We also introduce two-way fixed effects: a_i stands for the standard cross-section fixed-effects term and T captures time-fixed effects. Finally, $X_{i,j,t}$ is a vector of controls that includes bond-specific variables (with $j = \{1, 2, 3, \dots, N\}$ denoting the individual securities), such as the term-

to-maturity of each bond, in the funds' portfolios as well as global variables, such as the ECB's shadow rate, which reflects ECB's policies on interest rates, communication and asset purchases (Wu and Xia 2016). The bond-specific controls serve to isolate heterogeneity that may otherwise be reflected in the results. Additionally, the shadow rate captures developments such as the purchases of government bonds by the ECB, that may have affected Greek bonds differently from Portuguese ones. The results are summarised in Chart 7 below.

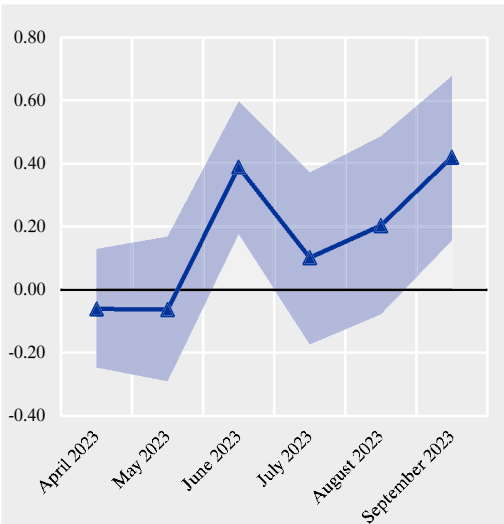
The estimation results show that, after the assignment of the positive outlook on Greece's sovereign credit rating by S&P in April 2023, GGBs' weights in investment funds' portfolios rose by about 0.8%, i.e. more than those of the control group. It should be noted that the control group includes weights on GGBs, before the change in outlook (not yet treated), and PGBs (never treated). Moreover, this result is net of any effects that may be linked to the ECB's monetary policy stance in the period under examination, which may have affected GGBs and PGBs differently.

The timing illustrated in Chart 7 implies that funds did not increase their holdings of Greek sovereign bonds at once: the first significant change in funds' holdings came in June 2023, i.e. 2 months after the change in outlook, and corresponded to an addition of GGBs in funds' portfolios exceeding by about 0.4% the addition of PGBs, under the same broader monetary and financial environment. The next significant additions of GGBs in funds' portfolios, equal to a little more than 0.4% of these portfolios' total value, took place in September 2023. This coincided with the 2-notch rating upgrade of the Greek sovereign credit rating by Moody's.

This means that, indeed, the positive change in the outlook of Greece's sovereign credit rating is likely to have sparked an increase in investment funds' positions in Greek sovereign bonds, relative to broader developments. The findings reported herein provide evidence of

Chart 7 Evolution of holdings of Greek vs Portuguese government bonds in view of the IG upgrade

(Change in the share of portfolios invested in Greek bonds in %)



Source: Bank of Greece econometric model.

Notes: The above chart shows the two-way fixed effects coefficients of the differences-in-differences specification of the weights of investment funds' portfolios of Greek government bonds (GGBs), after the assignment of the positive outlook for the Greek sovereign credit rating by S&P (in April 2023). The control group (never treated) includes the weights of Portuguese government bonds and those of GGBs before the assignment of the positive outlook (not yet treated). The specification also includes bond-specific and market-wide controls, such as bond term-to-maturity and interest rate variables.

an association between the effects stemming from the change in the outlook of Greece's sovereign rating to positive and investment funds' holdings of GGBs. Of course, since there may be factors for which we do not have adequate controls (e.g. national elections in June 2023), we do not argue that these results offer adequate ground for claiming causal inference. However, they seem to suggest that there is a strong enough link between the outlook change and the increase in the funds' GGB portfolio, in comparison with the broader developments in the euro area.

4.2 EFFECTS OF INVESTMENT FUNDS' HOLDINGS ON GREEK SOVEREIGN BOND YIELDS

Next, we investigate whether such a positive change in investment funds' portfolios is eco-

nomically important. To do so, we rely on demand-based asset pricing à la Kojien and Yogo (2019) and, more specifically, on the bond-specific setup provided in Kojien et al. (2021). In particular, we specify yields as subject to rebalancing in investors' portfolios. We depart from the aforementioned study in that, instead of using the quantitative easing transactions as the trigger of the rebalancing, we use a time dummy marking the change in the outlook of Greece's sovereign credit rating. Specifically, we estimate the following relationship:

$$y_{i,j,t} = a_i + \theta w_{i,j,t} + \beta x_{i,j,t} + \gamma I_{i,t} + \varepsilon_{i,j,t} \quad (6)$$

where y denotes the yield at time t of bond j issued by sovereign i ; w denotes the weights of bonds in investment funds' securities portfolios. Control variables, such as the €STR, the ECB's shadow rate, the term spread between 10-year and 2-year OIS rates and the term-to-maturity of each bond are denoted by x . $I_{i,t}$ is an indicator (dummy) variable taking the value 1 for GGBs after the change in the outlook by S&P to positive for the Greek sovereign credit rating, and 0 otherwise. We also include a vari-

able that reflects net demand effects in the Greek sovereign bond market, as noted in Kojien and Yogo (2019). In particular, the "demand" variable incorporates the aggregate holdings of GGBs by Greek banks and the Eurosystem, as a ratio to the total amount outstanding of GGBs in the market. Finally, a_i denotes the fixed-effects term.

The relationship represented by equation (6) allows to infer the effects of a given change in weights on the yields of the bonds included in our sample. At the same time, we also allow for residual effects, due to the positive outlook to be captured by the indicator variable $I_{i,t}$ and we also control for global and bond-specific developments. This specification is estimated based on a dynamic panel data model, with instruments appropriate for a large cross-section and few time observations (Arellano-Bover estimators), with robust standard errors. The results are presented in Table 2 below:

The results reported in Table 2 above confirm the intuition that an increase in funds' weights for a particular sovereign bond reduces its

Table 2 Funds' demand effects on bond yields

Dependent variable: sovereign bond yields				
	(1)	(2)	(3)	(4)
y_{t-1}	0.123** (0.036)	0.258*** (0.045)	0.111** (0.037)	0.131*** (0.037)
w	-0.444*** (0.050)	-0.509*** (0.045)	-0.418*** (0.049)	-0.442*** (0.052)
I	-0.299*** (0.039)	0.008 (0.029)	-0.308*** (0.038)	-0.301*** (0.038)
<i>Demand</i>	-0.424*** (0.112)	-0.630*** (0.325)	-0.368*** (0.111)	-0.426*** (0.112)
€STR	0.248*** (0.024)		0.308*** (0.038)	0.241*** (0.025)
<i>Maturity (in years)</i>	0.019*** (0.006)	0.014 (0.015)		0.019*** (0.006)
<i>OIS 10y-2y</i>		-0.258** (0.099)	-0.057 (0.069)	-0.065 (0.070)
Fixed Effects	Yes	Yes	Yes	Yes
Obs.	552	552	552	552

Notes: The table reports dynamic panel data estimations (Arellano-Bover estimator), with robust standard errors. Asterisks denote significance (10%: *, 5%: **, 1%: ***).

yields. In particular, a 1 pp increase in funds' weights reduces bond yields by 42-50 basis points (bps). As a result, the total average increase in GGB weights in investment funds' portfolios in the aftermath of the positive outlook assigned by S&P to Greece explains a reduction in GGB yields by 35-40 bps.

Is this corroborated by actual data? In order to fit the results into the developments of the period, we have to isolate the effect that rising interest rates had on government bond yields. To do so, we can use the yield differentials (i.e. spreads) of Greek sovereign bonds vis-à-vis euro area benchmark ones, assuming that both have been affected roughly to the same extent by monetary policy. That said, we observe that the spread against the German 10-year sovereign bond, just before the positive outlook assigned by S&P on 20 April 2023, stood at around 190-200 bps. In mid-October, i.e. just before the actual rating upgrade on 20 October 2023, it had fallen to 145 bps. Thus, our findings are very closely associated to the developments of the period, as they suggest that the 45-55 bps reduction in spreads is explained to a large extent by the increase in investment funds' holdings of Greek sovereign bonds.

From the remaining variables, we may draw intuitive results: a rise in base rates, reflected in the €STR, has a positive and highly significant effect on yields, even though the pass-through is not on a one-on-one basis. This may stem from the fact that we have excluded from the sample securities with remaining maturities of below 1 year, so that our results are not distorted by short-term horizon pricing, with a particular relevance for bond yields. The €STR seems to be very closely correlated with the term spread (10y-2y) of OIS rates, as when both variables are included in the same specification the latter is not significant.

At the same time, the indicator variable $I_{i,t}$, reflects a further yield reduction of about 30 bps vis-à-vis what is captured by the remaining parameters. This, however, changes when,

instead of the €STR, we include the term spread 10y-2y of OIS rates, an indication that both the IG and the term spread variable contain common information. This is probably specific to the period under examination, during which the initial optimistic expectations for a pause in interest rate rises by major central banks were revised, while the slope of the yield curve dived into more negative levels, as the prospects for euro area economic activity deteriorated. Additionally, the maturity variable, which is however a rough bond-specific determinant, is found to have a significant positive relationship with yields.

Finally, our results suggest that an increase in the demand from other investors, such as Greek banks or the Eurosystem, also has sizeable reduction effects on the yields of GGBs. These are estimated to deduct about 40-60 bps for every 1 pp increase in the GGB holdings of other investors. These effects are broadly in line with the ones reported in the extant literature about the effects of central bank asset purchase programmes on sovereign bond yields (e.g. Kojen et al. 2021; Malliaropoulos and Migiakis 2023).

All in all, our panel data estimation results suggest that about eight-tenths (80%) of the reduction in GGBs' sovereign risk premium came as a result of the increase in investment funds' positions, relative to broader monetary and other euro area and country-specific developments. These findings are combined with the ones presented in Section 4.1, which imply that the increase in investment funds' positions in GGBs is associated, in a statistically significant way, with the positive change in Greece's sovereign credit rating outlook by S&P in April 2023. We, thus, conclude that the combination of the two findings suggests that (a) investment funds increased their positions in GGBs in view of a possible sovereign credit rating upgrade of Greece to investment grade, and (b) this had significant economic effects on the yields of Greek sovereign bonds, as it explains a very large part of the overall reduction in spreads.

5 CONCLUDING REMARKS

We have examined the effects of (a) sovereign credit ratings on portfolio allocation by investment funds, and (b) investment funds' portfolio rebalancing on sovereign bond yields. To do so, we focused on the case of Greece at the onset of the positive change in its sovereign credit rating in April 2023, which led to its upgrade to investment grade six months later. By focusing on the case of the sovereign credit rating of Greece, we find that ratings have significant effects on funds' portfolio allocation: the prospect of Greece regaining the investment grade status resulted in an increase in investment funds' portfolio holdings of Greek sovereign bonds, in relation to other monetary and financial developments during the same period. In its turn, this increase has had significant, both in statistical and economic terms, downward effects on Greek sovereign bond yields.

In particular, we find that the change in the outlook of the sovereign credit rating of Greece to positive by S&P, which denoted a high likelihood of an IG upgrade, created increased demand for Greek sovereign bonds by investment funds. Specifically, investment funds' weights on Greek sovereign bonds increased in total by about 0.8%.

Then, by employing dynamic panel data model estimation techniques, we find a negative and highly significant relationship between funds' portfolio weights and the yields of the underlying bonds; that is, when funds increase their holdings of a given bond, its yields decrease. Based on this result, we can estimate the reduction effects on Greek sovereign bond yields due to the increase in funds' holdings. We find that the above-mentioned rise in the weights of Greek sovereign bonds in funds' portfolios explains a reduction of about 35-40 bps in their yields or about 80% of the total reduction of spreads in the period under examination.

The implications of these findings are important: a permanent increase in funds' holdings may result in lowering the cost of funding for Greek public debt, thus enhancing its sustainability. Therefore, the prospect of an IG upgrade helped Greece to rein in its cost of funding. By achieving rating upgrades, Greece managed to gradually regain the IG status and, thus, increase the demand for its sovereign bonds. This insulated Greece's cost of funding from rising interest rates in a period of tightening monetary policies and financial conditions.

REFERENCES

- Acharya, V.V. and T. Laarits (2023), “When do treasuries earn the convenience yield? – A hedging perspective”, NBER, Working Paper No. 31863, November.
- Aizenman, J., M. Binici and M. Hutchison (2013), “Credit ratings and the pricing of sovereign debt during the euro crisis”, *Oxford Review of Economic Policy*, 29(3), 582-609.
- Altavilla, C., M. Darracq Pariès and G. Nicoletti (2019), “Loan supply, credit markets and the euro area financial crisis”, *Journal of Banking & Finance*, 109, 105658.
- Baghai, R.P., B. Becker and S. Pitschner (2023), “The use of credit ratings in the delegated management of fixed income assets”, *Management Science*, 70(5), 3059-3079.
- Blanchard, O. (2019), “Public debt and low interest rates”, *American Economic Review*, 109(4), 1197-1229.
- Bubeck J., M.M. Habib and S. Manganelli (2018), “The portfolio of euro area fund investors and ECB monetary policy announcements”, *Journal of International Money and Finance*, 89, 103-126.
- Cantor, R. and F. Packer (1996), “Determinants and impact of sovereign credit ratings”, Federal Reserve Bank of New York, *Economic Policy Review*, 2(2), 37-54.
- Engel, C. (2020), “Safe U.S. assets and U.S. capital flows”, *Journal of International Money and Finance*, 102, 102102.
- Financial Stability Board (2023), *Global monitoring report on non-bank financial intermediation 2023*, 18.12.2023.
- Ghosh, A.R., J.I. Kim, E.G. Mendoza, J.D. Ostry and M.S. Qureshi (2013), “Fiscal fatigue, fiscal space and debt sustainability in advanced economies”, *The Economic Journal*, 123(566), F4-F30.
- Giuzio, M., C. Kaufmann, E. Ryan and L. Cappiello (2021), “Investment funds, risk-taking, and monetary policy in the euro area”, ECB, Working Paper No. 2605.
- International Investment Funds Association (2023), “Worldwide regulated open-end fund assets and flows”, 2023 statistics - 4th quarter (retrieved from https://iifa.ca/page/industry_statistics on 11.6.2024).
- International Monetary Fund (2015), “The asset management industry and financial stability”, *Global Financial Stability Report*, Chapter 3, 93-135, April 2015.
- Kaufmann, C. (2023), “Investment funds, monetary policy, and the global financial cycle”, *Journal of the European Economic Association*, 21(2), 593-636.
- Koijen, R.S.J. and M. Yogo (2019), “A demand system approach to asset pricing”, *Journal of Political Economy*, 127(4), 1475-1515.
- Koijen, R.S.J., F. Koulischer, B. Nguyen and M. Yogo (2021), “Inspecting the mechanism of quantitative easing in the euro area”, *Journal of Financial Economics*, 140(1), 1-20.
- Livingston, M., J. Wei and L. Zhou (2010), “Moody’s and S&P ratings: Are they equivalent? Conservative ratings and split rated bond yields”, *Journal of Money, Credit and Banking*, 42(7), 1267-1293.
- Lo Duca, M., G. Nicoletti and A. Vidal Martínez (2016), “Global corporate bond issuance: What role for US quantitative easing?”, *Journal of International Money and Finance*, 60, 114-150.
- Longaric, P.A., K. Cera, G. Georgiadis and C. Kaufmann (2023), “Do global investment funds have a stabilizing effect on euro area government bond markets?”, European Central Bank, *Financial Stability Review*, Chapter 2, 51-53, May 2023.
- Malliaropulos, D. and P. Migiakis (2018), “The re-pricing of sovereign risks following the Global Financial Crisis”, *Journal of Empirical Finance*, 49, 39-56.
- Malliaropulos, D. and P. Migiakis (2023), “A global monetary policy factor in sovereign bond yields”, *Journal of Empirical Finance*, 70, 445-465.
- Office of Financial Research (2013), *Asset management and financial stability*, September 2013.
- Rajan, R.G. (2005), “Has finance made the world riskier?”, *European Financial Management*, 12(4), 499-533.
- Vissing-Jorgensen, A. (2021), “The treasury market in spring 2020 and the response of the Federal Reserve”, *Journal of Monetary Economics*, 124, 19-47.

Wu, J.C. and F.D. Xia (2016), “Measuring the macroeconomic impact of monetary policy at the zero lower bound”, *Journal of Money, Credit and Banking*, 48(2-3), 253-291.

BENEFITS FOR THE GREEK ECONOMY FROM RESOLVING BAD LOANS AND ZOMBIE FIRMS

Georgios Gatopoulos

Foundation for Economic and Industrial Research (IOBE)
and American College of Greece

Alexandros Louka

Foundation for Economic and Industrial Research (IOBE)

Konstantinos Peppas

Foundation for Economic and Industrial Research (IOBE)

Nikolaos Vettas

Foundation for Economic and Industrial Research (IOBE),
Athens University of Economics and Business
and Centre for Economic Policy Research, UK

ABSTRACT

We examine the type and magnitude of negative externalities stemming from “zombie” firms in the Greek economy, focusing on investment, employment and productivity. For this purpose, we use a panel dataset of Greek firms broken down by size and sector of economic activity for the period 2002-2021. A descriptive analysis reveals a high positive correlation in the trends between non-performing business loans and the number of zombie companies in the Greek economy over the last twenty years. Through quantitative analysis, significant direct and indirect effects emerge from the degree of density of zombie firms at the total economy and sectoral levels. First, healthy firms outperform zombie firms in terms of investment growth, employment growth and productivity levels. Second, a high concentration of capital in zombie firms negatively affects the rate of investment growth of healthy firms in specific sectors of economic activity. Third, a high concentration of capital in zombie firms forces healthy firms to increase their overall productivity in order to survive. Fourth, a high concentration of capital in zombie firms prevents the reallocation of capital to more productive investments across firms and sectors of activity. Finally, younger and larger companies generally perform better in terms of investment and employment growth, and productivity levels. Overall, a faster resolution of zombie firms and non-performing corporate loans, both on and off bank balance sheets, allows a more efficient allocation of resources and can boost investment, employment and growth rates in the Greek economy in the medium to long term.

Keywords: non-performing loans; zombie firms; growth; investment; productivity

JEL classification: E22; G20

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ΟΦΕΛΗ ΓΙΑ ΤΗΝ ΕΛΛΗΝΙΚΗ ΟΙΚΟΝΟΜΙΑ ΑΠΟ ΤΗ ΜΕΙΩΣΗ ΤΩΝ ΜΗ ΕΞΥΠΗΡΕΤΟΥΜΕΝΩΝ ΔΑΝΕΙΩΝ ΚΑΙ ΤΩΝ ΕΤΑΙΡΙΩΝ ΖΟΜΠΙ

Νίκος Βέττας

Ίδρυμα Οικονομικών και Βιομηχανικών Ερευνών (IOBE),
Οικονομικό Πανεπιστήμιο Αθηνών
και Centre for Economic Policy Research, Ην. Βασίλειο

Γιώργος Γατόπουλος

Ίδρυμα Οικονομικών και Βιομηχανικών Ερευνών (IOBE)
και Αμερικανικό Κολλέγιο Ελλάδος

Αλέξανδρος Λουκά

Ίδρυμα Οικονομικών και Βιομηχανικών Ερευνών (IOBE)

Κωνσταντίνος Πέππας

Ίδρυμα Οικονομικών και Βιομηχανικών Ερευνών (IOBE)

ΠΕΡΙΛΗΨΗ

Η διατήρηση των επιχειρήσεων “ζόμπι” στην ελληνική οικονομία προκαλεί σημαντικές αρνητικές εξωτερικότητες σε όρους επενδύσεων, απασχόλησης και παραγωγικότητας. Η ανάλυση βασίζεται σε στοιχεία διαστρωματικών και χρονολογικών σειρών που αφορούν ελληνικές επιχειρήσεις την περίοδο 2002-2021, με διάκριση ανά μέγεθος και κλάδο οικονομικής δραστηριότητας. Μέσα από περιγραφική ανάλυση διαφαίνεται υψηλή θετική συσχέτιση στις τάσεις μεταξύ των επιχειρηματικών μη εξυπηρετούμενων δανείων και του αριθμού των εταιριών “ζόμπι” στην ελληνική οικονομία κατά τη διάρκεια της πρόσφατης εικοσαετίας. Μέσα από ποσοτική ανάλυση, αναδεικνύονται σημαντικές άμεσες και έμμεσες επιδράσεις του βαθμού πυκνότητας των εταιριών “ζόμπι” στο σύνολο της οικονομίας και σε επιμέρους τομείς δραστηριότητας. Πρώτον, οι υγιείς επιχειρήσεις εμφανίζουν καλύτερες επιδόσεις από τις εταιρίες “ζόμπι” σε όρους ρυθμού αύξησης επενδύσεων, απασχόλησης και επιπέδου παραγωγικότητας. Δεύτερον, η υψηλή συγκέντρωση κεφαλαίου σε εταιρίες “ζόμπι” επηρεάζει αρνητικά το ρυθμό αύξησης των επενδύσεων στις υγιείς επιχειρήσεις σε επιμέρους τομείς της οικονομικής δραστηριότητας. Τρίτον, η υψηλή συγκέντρωση κεφαλαίου σε εταιρίες “ζόμπι” αναγκάζει τις υγιείς επιχειρήσεις να αυξήσουν τη συνολική παραγωγικότητά τους προκειμένου να επιβιώσουν. Τέταρτον, η υψηλή συγκέντρωση κεφαλαίου σε επιχειρήσεις “ζόμπι” εμποδίζει την ανακατανομή κεφαλαίου προς πιο παραγωγικές επενδύσεις μεταξύ επιχειρήσεων και τομέων δραστηριότητας. Τέλος, οι νεότερες σε ηλικία και μεγαλύτερες σε μέγεθος επιχειρήσεις εμφανίζουν εν γένει καλύτερες επιδόσεις σε όρους ρυθμού αύξησης επενδύσεων και απασχόλησης, αλλά και επιπέδου παραγωγικότητας. Συμπερασματικά, η ταχύτερη διευθέτηση των μη εξυπηρετούμενων δανείων επιτρέπει την αποτελεσματικότερη κατανομή των πόρων και δύναται να ενισχύσει τις επενδύσεις, την απασχόληση και την παραγωγικότητα της ελληνικής οικονομίας.

BENEFITS FOR THE GREEK ECONOMY FROM RESOLVING BAD LOANS AND ZOMBIE FIRMS*

Georgios Gatopoulos

Foundation for Economic and Industrial Research (IOBE)
and American College of Greece

Alexandros Louka

Foundation for Economic and Industrial Research (IOBE)

Konstantinos Peppas

Foundation for Economic and Industrial Research (IOBE)

Nikolaos Vettas

Foundation for Economic and Industrial Research (IOBE),
Athens University of Economics and Business
and Centre for Economic Policy Research, UK

I INTRODUCTION

A large number of “zombie” firms¹ and a high level of non-performing business exposures (NPEs),² either on or off bank balance sheets, can have significant side effects on the economy. Their delayed resolution has been shown to have a negative impact on investment, employment and competition in goods and services markets, as well as on average productivity across sectors and in the wider economy. This is of critical importance for the Greek economy for two reasons. First, because the economy reached an unprecedented level of non-performing loans during the sovereign debt crisis and, second, because the economy faces significant investment and productivity gaps, which need to be tackled so as to achieve a sustainable growth path.

Firms that have weak prospects for recovery, based on a number of alternative criteria, are labelled as “zombies”. The criteria proposed for classifying firms as zombies vary, with many of them relating to ratios derived from financial statements, combined with firm age criteria. The prevalence of zombie firms appears to be related to the share of business Non-Performing Exposures (NPEs) in total loans for the Greek economy as a whole, as well as for individual sectors. It has occasionally been documented that banks may tend to support, in various ways, firms that do not service their

loans. Such ways include offering favourable refinancing terms, reducing the interest rate on existing loans, extending new loans, etc. This practice is pursued when banks aim to avoid or postpone the recording of provisions or losses on their balance sheets, which, in turn, would affect their capital adequacy.

Keeping zombie firms in operation has been shown internationally to have a negative impact not only on macroeconomic aggregates, but also on the functioning of healthy firms, especially in sectors where the former are more prevalent. Channelling financial resources to zombie firms to prevent them from going out of business deprives other, healthy firms of resources, both financial and physical, with corresponding negative effects on employment, investment and productivity growth for the total economy. This is critical in the case of Greece for at least two reasons. On the one hand, the investment gap over recent decades, the underutilised human resources due to high unemployment and low labour market participation, and adverse demographic trends, all

* The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

1 Following criteria suggested by existing literature, we define a zombie firm as one which, in a given year, (a) is at least 10 years old; and (b) has an interest coverage ratio of less than 1 for the last three consecutive years.

2 NPEs are defined by supervisory authorities as exposures (loans) which are more than 90 days past due, as well as exposures unlikely to pay, regardless of the number of days past due.

imply a need to ensure the recovery of investment and employment rates. On the other hand, sustained long-term output growth requires productivity growth beyond investment in physical and human capital, which would be hard to achieve if resources are allocated to unproductive activities.

This study assesses the nature and magnitude of the externalities caused to the Greek economy by keeping zombie firms in operation. The case of Greece is of particular interest, as the problem of NPEs intensified exponentially during the period of the sovereign debt crisis. At the same time, the number of firms classified as zombies is estimated to have increased during the same period (PwC 2015; IMF 2021). While NPEs on bank balance sheets declined significantly between 2016 and 2022 (by 85% cumulatively), the reduction of NPEs in the economy as a whole is much smaller (28% cumulatively), as the bulk of “legacy NPEs”, which are managed by servicers, remain non-performing in the economy. Thus, resolving all NPEs, part of which are owed by zombie firms, is a key policy priority.

The analysis focuses on three research questions. The first one attempts to estimate the number and share of zombie firms in the Greek economy, by sector of economic activity, and their correlation with the trend in NPEs. The second question examines the direct effects of zombie firms on the Greek economy, with a focus on investment, employment and productivity, and assesses whether these effects vary by sector of activity. The third question investigates the indirect economic impact of zombie firms, for example through their side effects on existing healthy firms.

The study is structured in six sections. Section 2 provides a literature review, presenting various empirical models that have been used in the literature for the classification of zombie firms and econometric findings about their economic effects. Section 3 provides a description of the data available to carry out the descriptive and quantitative analyses. The

descriptive analysis in Section 4 assesses the evolution of zombie firms in the Greek economy over time and highlights recent trends in NPEs at the sectoral level. Section 5 deals with the quantitative assessment of the direct and indirect effects of maintaining zombie firms in the Greek economy. Section 6 summarises the main findings of the descriptive and quantitative analyses, while linking them to policy priorities.

2 LITERATURE REVIEW

The literature on the impact of zombie firms on productivity, investment and employment is relatively recent. It started to develop in the early 1990s, in the wake of the prolonged stagnation and low productivity of the Japanese economy that followed the credit and real estate bubbles. According to Peek and Rosengren (2005), during this period – the so-called “lost decade” – in order to achieve the exit of the Japanese economy from stagnation, the authorities exercised loose supervision over the banking system, discouraged banks from being strict with overindebted firms and encouraged them to provide more credit to such firms so that they would be able to repay their loans (evergreening loans). Under this approach, firm bankruptcies were postponed and banks avoided recording losses on their balance sheets, which, in turn, would reduce their capital adequacy. These firms have been characterised in the relevant literature as zombie firms, a term coined by Kane (1987). According to the literature (e.g. Caballero et al. 2008; da Silva and Gonçalves 2022), zombie firms have poor financial performance, are highly dependent on bank lending and/or government grants, and are unable to meet their financial obligations without concessions.

The study of Ahearne and Shinada (2005) was one of the first to investigate the validity of the so-called “zombie hypothesis” in the case of the Japanese economy, according to which the poor performance of the 1990s was due to the fact that Japanese banks continued to provide

loans to inefficient, low-productivity and highly leveraged firms. The authors estimated that non-tradeable sectors showed a much stronger decline in Total Factor Productivity compared to the tradeable ones; they argued that this result is consistent with the “zombie hypothesis”, as it arose from the fact that inefficient firms (i.e. mostly zombie firms) in non-tradeable sectors gained market share at the expense of the most productive firms because of the support received from banks. This result was corroborated by the finding that the correlation between changes in market share and changes in the share of outstanding bank loans to tradeable sectors, which was positive in the period 1980-1990, turned negative in the period 1991-2001, while in the case of non-tradeable sectors, it remained positive in both periods.

Caballero et al. (2008), in their seminal paper, investigated the effect of zombies on the rate of change in employment, investment and productivity in the Japanese economy for the period 1981-2002. They consider as zombies those firms that are struggling to service their bank loans and banks keep them alive by charging a lower interest rate compared to most creditworthy borrowers. Their estimates show that an increase in the share of zombies in an industry significantly reduces investment and employment growth rates for healthy, non-zombie firms. At the same time, the productivity gap between zombie and non-zombie firms widens in favour of the former. This is because, as the share of zombie firms in an industry increases, healthy firms wishing to enter a market have to achieve higher productivity levels to overcome the entry barriers posed by zombies. Finally, when they included the current rate of change in sales as an explanatory variable in their estimations, the finding persisted that an increase in the share of zombie firms in an industry significantly reduces investment and employment growth rates of non-zombies.

Balgova et al. (2017) indirectly investigated the effect of zombie firms on the economy, as they

examined in a broader context the effect of non-performing loans (NPLs) on a range of economic variables, using data for 194 countries for the period 1990-2016. Analysing the available data, they found that episodes of high NPLs last for about six years on average and that once the average NPL ratio reaches 21%, it starts to fall, which then positively affects the growth rates of the economy. Also, they argue that the best way to reduce NPLs is a combination of the existence of asset management companies and the implementation of bailout programmes, since, in this case NPL reduction was estimated to be two to three times faster compared to the case of relying on asset management companies alone. They concluded that a sharp reduction in the NPL ratio is associated with extra GDP growth of more than 1.5 percentage points (pps) per annum over several years, an increase that begins approximately two years after the start of NPL reduction and is maximised in the fourth year. Stronger positive effects from a reduction in NPLs were found in the case of investment, while positive effects, although weaker compared to those on investment, also appear in consumption growth. Finally, the positive effect on exports was estimated to be weaker compared to that on investment and consumption, possibly because exporting firms are less exposed to the conditions prevailing in the domestic credit market.

Contrary to the above studies, Fukuda and Nakamura (2011) did not investigate the effects of zombie firms on an economy, but examined the reasons why zombies recovered in Japan during the first half of the 2000s. However, their contribution to the relevant literature lies in the fact that they recognised the shortcomings of the definition of zombies used by Caballero et al. (2008) and modified it by adding two criteria. The first is the “profitability criterion”, whereby a firm is classified as a zombie if its EBIT is lower than its hypothetical risk-free interest payments. The second is the “evergreening criterion”, whereby a firm is classified as a zombie if it is highly leveraged and has increased its debt levels.

Schivardi et al. (2017), in their study of the Italian economy for the period 2004-2013, examined the impact of zombie financing from banks with low capital adequacy. However, unlike Caballero et al. (2008) and Fukuda and Nakamura (2011), they define a firm as zombie if (i) it has negative profitability, i.e. its three-year moving average of the ROA is less than the cost of capital faced by healthier firms; and (ii) its leverage exceeds a certain threshold. In addition, they also used an alternative criterion, the interest coverage ratio, which they define as the ratio of EBITDA to interest expenses. According to their estimates, low capital banks financed zombie firms more compared to non-zombie firms during the financial crisis and this did not change when different econometric specifications were used. Also, they assessed whether zombie financing affects the growth of healthy firms in an industry. Using employment as a dependent variable in their model, they found a negative relationship between the share of zombie firms and the performance of non-zombies. A negative relationship was also estimated when they used employment and sales as dependent variables. Thus, low capital banks, by granting loans to zombie firms, constrain the growth of healthy firms. Finally, they estimated that, as the share of zombie firms in a sector increases, the dispersion of total factor productivity (TFP) also increases, i.e. there is an unequal distribution of resources to the benefit of zombies and at the expense of healthy firms. However, this only applies to industries with a high share of zombie firms.

Adalet McGowan et al. (2018) estimated the impact of zombie firms on firm productivity using a sample of 12 countries covering the period 2003-2013. As opposed to previous studies, they used a different definition of zombie firms. A firm is classified as zombie if its interest coverage ratio is less than one for three consecutive years and its age is more than ten years. They found that mainly large-sized (over 250 employees) and older (over 40 years) firms have the highest probability of being classified as zombies. Furthermore, an increase in the

share of zombie firms in an industry negatively affects the rate of investment and employment growth of non-zombie firms. In the same vein as Caballero et al. (2008), they estimated that the difference in productivity between zombie and non-zombie firms widens as the percentage of zombies in an industry increases. This suggests that the presence of zombies creates market distortions by reducing productivity and keeping inefficient firms in the market at the expense of more productive new entrants. At the same time, given that zombie firms cause congestion in an industry, they create barriers to entry and new entrants need to achieve higher levels of productivity in order to enter the industry, which, in turn, aggravates the productivity gap between zombies and non-zombies. Moreover, they estimated that the congestion caused by zombie firms in an industry leads to a less efficient allocation of capital, at the expense of healthy firms. The results were the same when they limited their estimates to the period before the financial crisis (2003-2007), which showed that loan resources committed to zombie firms were not due to the financial crisis but rather a phenomenon that pre-existed in the economies and a symptom of policy weaknesses.

Hallak et al. (2018) investigated the effects of zombie firms in 19 European countries in the period 2010-2013. As opposed to previous studies, they used three alternative definitions to classify a firm as zombie. In particular, a firm is defined as a zombie if it has (i) an interest coverage ratio less than or equal to one for three consecutive years, regardless of its age; or (ii) an interest coverage ratio less than or equal to one for three consecutive years and an age greater than or equal to ten years; or (iii) an interest coverage ratio less than or equal to one for five consecutive years and an age greater than or equal to ten years. Using the above criteria, they confirmed the finding of Adalet McGowan et al. (2018) that the share of zombies increases with age and size. Estimates of their model in which the dependent variable was the rate of change in investment or employment revealed that non-zombies

invest and grow faster than zombies, regardless of the zombie definition used. At the same time, the growth of non-zombie firms is negatively affected by the existence of zombie firms in the industry. When they used labour productivity as a dependent variable, the results did not change, while the presence of non-zombies was shown to negatively affect the labour productivity of zombies. Also, they examined the effect that the presence of zombies has on the growth and productivity of new firms, i.e. firms less than seven years old. Using the growth rates of investment and employment as dependent variables, it emerged that new non-zombie firms grow faster than the “average firm” and twice as fast compared to old non-zombie firms. Moreover, new non-zombie firms are negatively affected by the presence of zombies in their industry, but this was statistically significant only when employment growth was used as the dependent variable.

In contrast to previous studies, Banerjee and Hofmann (2018) used data covering a longer period of time (1980-2016) and 32,000 listed companies in 14 developed economies. They also used two alternative definitions to characterise a firm as zombie. According to the first, broader definition, a firm is considered as zombie if its interest coverage ratio is less than one for three consecutive years and its age is equal to or greater than ten years. According to the second, narrower definition, a company is characterised as zombie if, on top of the criteria of the first definition, it also has a lower expected future growth potential (using Tobin’s Q index). They found that lower interest rates are associated with an increase in the share of zombie firms in an industry, while no statistically significant relationship was established between the share of zombies and bank health. This implies that low interest rates reduce the incentive for zombie firms to restructure or leave the market. In this respect, they estimated that a reduction in nominal interest rates by 10% leads to a 17% increase in the share of zombies, but this effect is statistically significant only in industries where firms rely heavily on external borrowing. How-

ever, no statistically significant results were obtained regarding the effect of bank health on the share of zombie firms. They also estimated that a 1% increase in the share of zombies reduces investment of non-zombies by 1% and employment growth by 0.26 pps, although these negative effects were statistically significant only in the case of the narrower definition. Finally, they found that a 1% increase in the share of zombie firms reduces total factor productivity growth by 0.3 pps, but this effect was statistically significant only in the case of the narrower definition.

Andrews and Petroulakis (2019) investigated the relationship between zombie firms and bank health, and the consequences for productivity growth in the economy. To this end, they used data for 11 European countries covering the period 2001-2014. Their estimates clearly showed that the existence of zombies is facilitated by the existence of non-healthy (weak) banks. The above picture does not vary before and after the financial crisis period, indicating that banks’ choice to lend to zombie firms is not a cyclical phenomenon. Additional estimates showed that a restrictive regulatory framework facilitates the survival of zombies and, once again, this result is robust across different econometric specifications and definitions of zombie firms. Moreover, more productive firms grow at a statistically significant higher rate, suggesting that the capital reallocation process enhances overall productivity. Also, bank health acts as a reinforcement in the capital reallocation process, since productive firms operating in sectors where they are exposed to healthy banks grow faster than firms operating in industries exposed to weak banks. They also estimated that a higher share of zombie firms in an industry reduces the efficiency of capital reallocation. Finally, they estimated that in industries where the share of zombie firms is high, healthy firms have limited access to bank loans and this result did not change when either the amount of total borrowing or the amount of new credit was used as the dependent variable in their model.

Da Silva and Gonçalves (2022) examine the effect of zombie firms on the economy of a single country, namely Portugal, for the period 2011-2018. They characterise a firm as zombie if it has an interest coverage ratio of less than one for three consecutive years, an age of more than ten years and negative net income for three consecutive years. They estimated that the existence of zombie firms in an industry negatively affects the investment rate and labour productivity growth. In more detail, a 1% increase in the assets trapped in zombies in a sector reduces the average investment rate by 23.1 pps and labour productivity of healthy firms by €43.0 thousand. However, no statistically significant results were found when the dependent variable of the model was employment growth. At the same time, across all three dependent variables, it was estimated that non-zombie firms invest more (4.79 pps higher) and record higher employment growth (by 2.54 pps) and productivity (by €12.2 thousand) compared to zombies. Also, they found that a 1 pp increase in resources held by zombie firms leads to a decrease in employment (by 9.67 pps) and in labour productivity (by €15.4 thousand). Repeating the estimations for the Wholesale and retail trade, Accommodation and food service activities sectors, they found that the presence of zombies negatively affects the investment rate in the food service activities sector and labour productivity in the Accommodation sector. Thus, it was mainly these specific industries that were most negatively affected by the existence of zombie firms, which is in line with their descriptive analysis indicating that such sectors also had the highest percentage of zombie firms. Finally, on the other hand, non-zombie firms show a higher investment rate in the Wholesale trade and Food service activities sectors and higher productivity in the Wholesale trade, Accommodation and food service activities sectors.

To sum up, most studies used data concerning groups of countries (e.g. Balgova et al. 2017; Adalet McGowan et al. 2018; Hallak et al. 2018; Banerjee and Hofmann 2018; Andrews and Petroulakis 2019), but there are also stud-

ies that used data for only one country (e.g. Ahearne and Shinada 2005 and Caballero et al. 2008 for Japan; Schivardi et al. 2017 for Italy; da Silva and Gonçalves 2022 for Portugal). Most studies use firm-level data either on listed companies (e.g. Ahearne and Shinada 2005; Caballero et al. 2008; Banerjee and Hofmann 2018) or on unlisted firms (e.g. Balgova et al. 2017; Hallak et al. 2018; Andrews and Petroulakis 2019; da Silva and Gonçalves 2022). Moreover, the time span of the data extends from the beginning of the 1970s (e.g. Ahearne and Shinada 2005) up to 2018 (e.g. da Silva and Gonçalves 2022), while in most studies data is available for the manufacturing and services sectors, but not for the primary sector or the financial sector.

Besides, most studies investigate the effect that zombie firms have on the economy either indirectly (e.g. Ahearne and Shinada 2005; Balgova et al. 2017) or directly (e.g. Caballero et al. 2008; Adalet McGowan et al. 2018; Hallak et al. 2018; da Silva and Gonçalves 2022). They examine the effect of their presence on employment, investment and productivity (e.g. Caballero et al. 2008; Adalet McGowan et al. 2018; Banerjee and Hofmann 2018; da Silva and Gonçalves 2022), GDP, exports and consumption (e.g. Balgova et al. 2017), with the estimations in most cases showing a negative effect.

Regarding productivity, the literature review has shown that zombies cause congestion in an industry, create entry barriers for new entrants and, as a result, the latter have to be more productive in order to enter the market, a fact that, in turn, widens the productivity gap between zombies and non-zombies (e.g. Caballero et al. 2008; Adalet McGowan et al. 2018).

Furthermore, the literature has investigated the relationship between zombie firms, the capital adequacy of banks and the provision of loans by the latter (e.g. Schivardi et al. 2017; Andrews and Petroulakis 2019). The results show that undercapitalised banks lend more to zombie

firms —compared to well-capitalised ones— while limiting the growth of healthy firms (Schivardi et al. 2017). This finding does not seem to differ between the periods before and after the outbreak of the financial crisis, which implies that banks' choice to lend to zombie firms is not a cyclical phenomenon (Andrews and Petroulakis 2019). Finally, bank lending is not used for investment purposes, but to service debt, build cash reserves and/or improve firms' financial stability (Acharya et al. 2019).

3 DATA

We use firm-level data for Greek businesses available from the ICAP Data.Prisma database, which provides annual balance sheet information, for the period 2000-2021. ICAP's database is the largest electronic repository of business activity information in Greece, encompassing financial and commercial data for businesses since 2000, as well as sectoral financial analyses. The dataset includes a wide range of financial metrics (e.g. fixed assets, deposits, trade receivables, equity capital, reserves, short- and long-term liabilities to banks, turnover, operating profits, financial income and expenses, net profits) and demographic variables (e.g. year of establishment, prefecture of headquarters, legal form, employment, export activity) for a significant portion of domestic businesses. For the descriptive analysis, we also use sector-specific data from the Bank of Greece regarding non-performing exposures of domestic banks and non-bank servicers.

The definitions of variables and some descriptive analysis are presented in the following sections. IOBE (Vettas et al. 2022) evaluated the representativeness of ICAP's sample of firms for the period 2005-2019 in terms of firm size (turnover) and structural characteristics in comparison with the dataset of the Hellenic Statistical Authority's (ELSTAT) Business Register. In terms of the turnover of the Greek economy, based on comparable data from ELSTAT's Business Register, the average coverage rate for

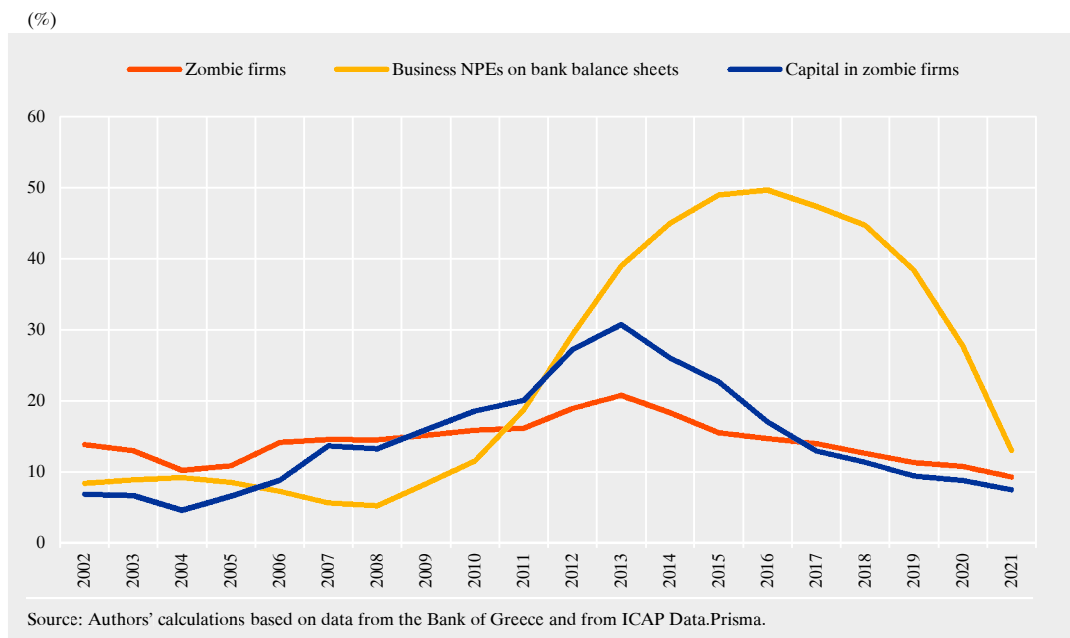
the period 2005-2019 was close to 60%. In terms of the number of businesses by turnover class, representativeness was the highest for very large (annual turnover above €50 million) and large enterprises (annual turnover between €5.0 and €50 million), at 89.3% and 81.1%, respectively. Additionally, more than half of the businesses with an annual turnover between €1.5 and €5.0 million and at least 25% of those with an annual turnover between €0.5 and €1.5 million are also included in our sample. Conversely, micro businesses (annual turnover between €0 and €500 thousand) are under-represented (only 2.1%) in ICAP's database, mainly due to the lack of data on sole proprietors, as most of them are not required to prepare and publish financial statements.

4 DESCRIPTIVE ANALYSIS

The estimated share of zombie firms is positively correlated with the share of business NPEs in bank balance sheets over the period 2002-2021 (Chart 1). However, the rise in the share of zombie firms preceded the rise in the share of NPEs in bank balance sheets, while the decline in the share of zombie firms preceded the decline in the share of NPEs. This suggests leading indicator properties of the zombie rate for the NPE ratio. In the recent period, the faster decline in the number of zombies relative to that in NPEs may be partly due to the accumulation and delayed resolution of non-performing loans owed by firms that have ceased operations and are in liquidation, therefore not included in the ICAP database. Moreover, the share of zombie firms is larger than the share of capital concentration in zombie firms up to 2008 and after 2017, implying that the average zombie firm was smaller in size before and after the Greek crisis.

Banks' NPEs to non-financial corporations (NFCs) reached a peak of €58 billion in 2015, accounting for 47.0% of total NFC exposures (Chart 2). However, by 2022 they had declined significantly to €8.9 billion or 8.1% of total exposures to NFCs, falling cumulatively by

Chart 1 Evolution of estimated shares of zombie firms, business NPEs and capital in zombie firms in Greece (2002-2021)



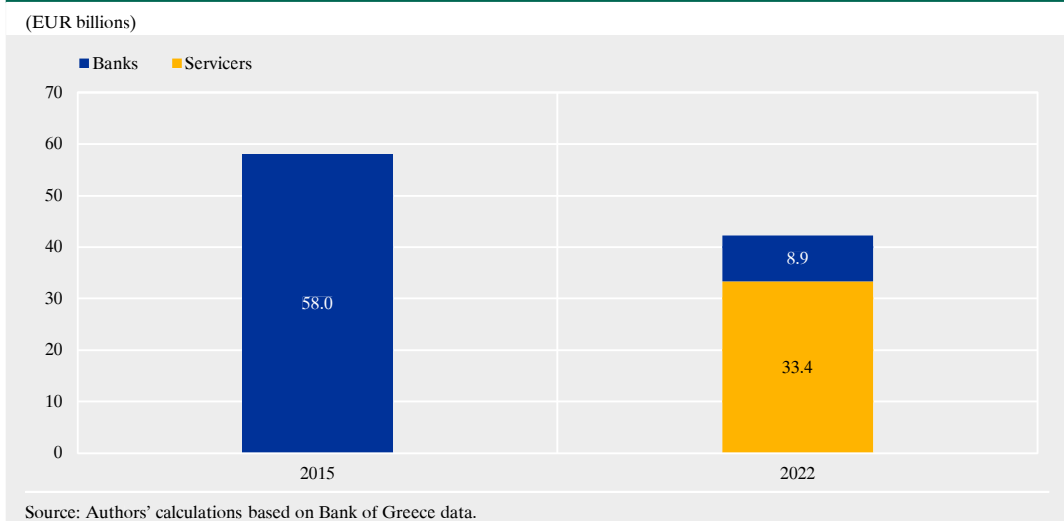
€49.1 billion (or 84.7%), mainly as a result of loan write-offs and sales during 2016-2019, and loan sales and securitisations carried out under the Hellenic Asset Protection Scheme (“Her-

cules”) in 2020-2022. At the same time, performing loans increased significantly, by €35 billion or 53.6%, to €100.3 billion by 2022, from €65.3 billion in 2015, due to both some

Chart 2 Evolution of non-performing and performing exposures of the domestic banking system towards non-financial corporations (NFCs) (2014-2022)



Chart 3 Non-performing exposures of banks and servicers to NFCs for the years 2015 and 2022



reperformance of NPEs and the disbursement of new loans.

Moreover, as shown in Chart 3, the significant reduction in NPEs on bank balance sheets does not automatically mean a removal of debt from Greek companies, as the largest part of NFCs' overdue liabilities, amounting to €33.4 billion, has been transferred to non-bank credit acquiring companies and is currently managed by servicers. The net reduction in NPEs towards NFCs in the economy as a whole is therefore estimated at around €15.7 billion during 2015-2022.

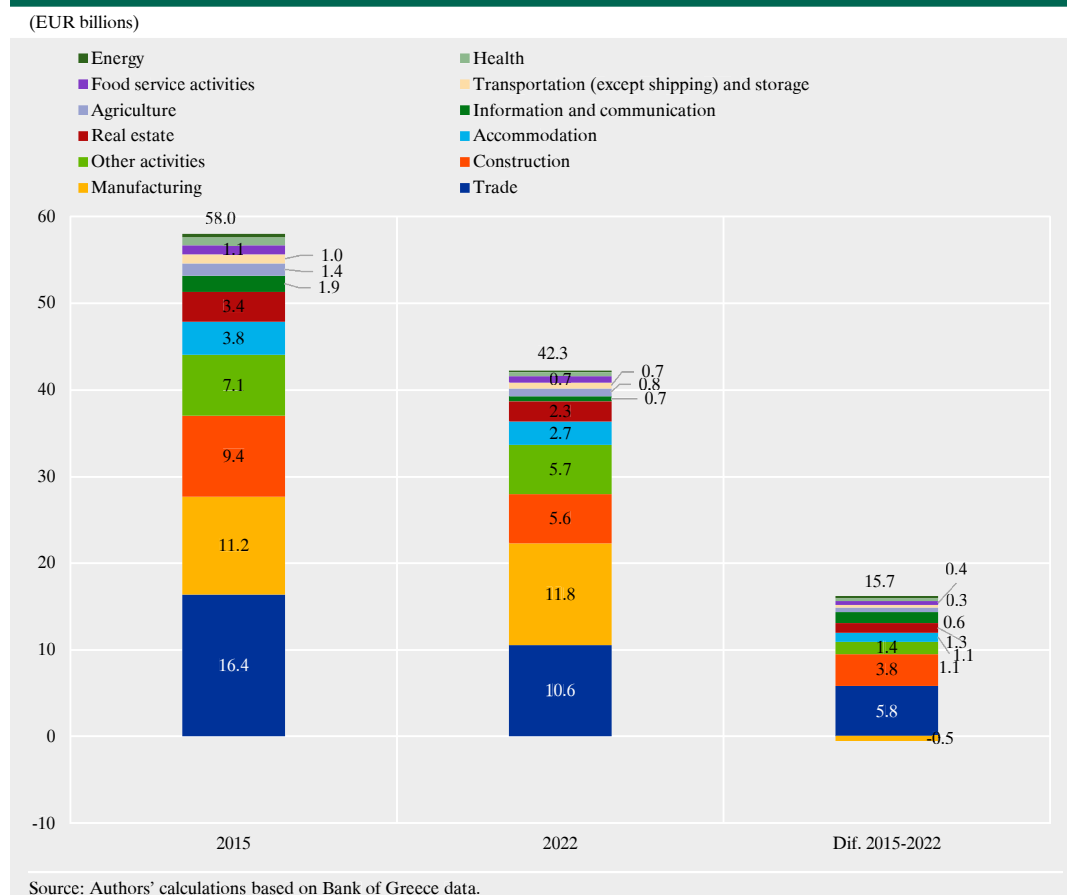
Looking at a sectoral breakdown of banks' NPEs to NFCs over the period 2015-2022 (Chart 4), it is clear that NPEs in banks' portfolios have shrunk across all sectors. In 2015 – the year when NPEs peaked – the largest share of NPEs was accounted for by the Wholesale and retail trade sector (€16.4 billion), followed by Manufacturing (€11.2 billion) and Construction (€9.4 billion). Other sectors with a significant share of NPEs include Accommodation (€3.8 billion) and Real estate activities (€3.4 billion).

It is generally accepted in the literature that the existence of non-performing loans in banks

has a negative effect on credit expansion rates, while a reduction in non-performing loans frees up resources that stimulate credit expansion. Using estimates from existing literature (Tölö and Virén 2021), a back-of-the-envelope calculation shows that the cumulative reduction in NPEs on banks' books by more than 40 bps over the period 2016-2023 led to an increase in net business loan flows of about €8 billion, out of a total increase of €22.5 billion recorded in this period (36% of credit expansion). However, this approach does not differentiate the effects of “organic” workouts (forbearance, reperformance of loans) vs. “non-organic” (sales, securitisations). Thus, the analysis below focuses on NPEs from a firm perspective.

In this regard, Chart 5 shows the evolution of the percentage of zombie firms in the ICAP sample of firms by size class based on turnover. Specifically, businesses with an annual turnover of less than €2.0 million are classified as “micro”, those with an annual turnover between €2 million and €50 million are classified as “small and medium-sized” (SMEs), and those with an annual turnover of more than €50.0 million are classified as “large”. A downward trend in the proportion of zombie firms is evident across all size classes after

Chart 4 Total amount of NPEs of banks and servicers to NFCs, by economic activity (2015, 2022)

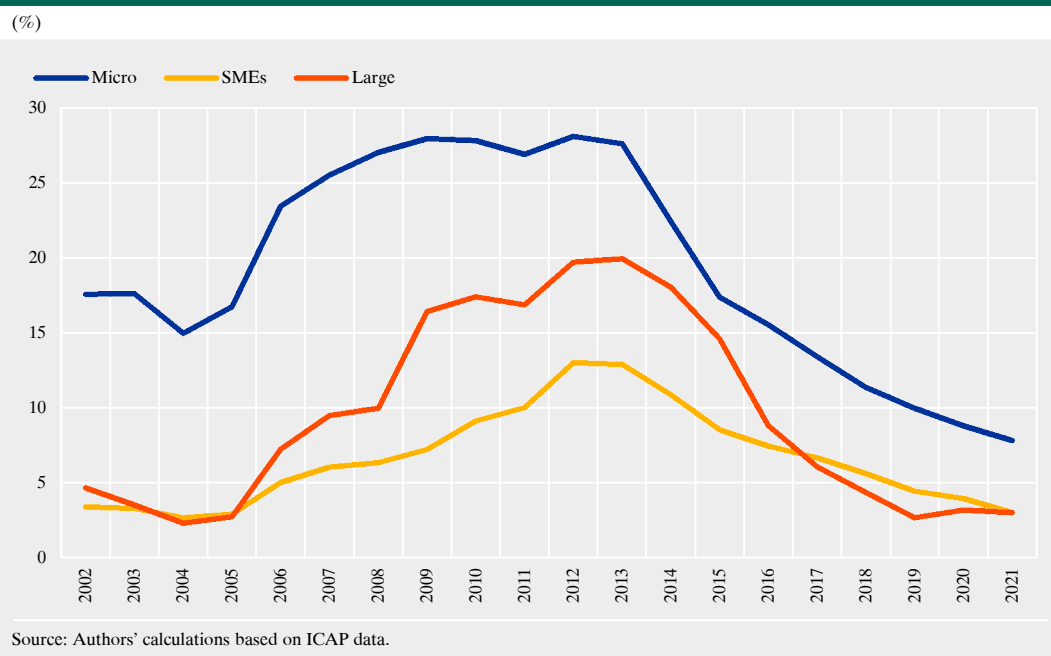


2013, with micro businesses featuring the highest zombie rate, 7.8%, compared with 3.0% for each of the other two size classes in 2021. The trend observed in the period 2005-2016, in which the share of zombie firms was higher among large firms than among small and medium-sized firms, is consistent with the findings in the literature (Adalet McGowan et al. 2018; Hallak et al. 2018). In the case of Greece, however, the above relationship is non-monotonic, as it reverses after 2016, while micro firms have the highest share over time (19.4% on average over the period 2002-2021).

As is evident from Chart 6, the highest share of zombie enterprises over time within each sector of economic activity is found in NACE sector (I) Accommodation and food service activities (22.5% on average over the period

2002-2021), followed by (L) Real estate activities (21.6% on average), (A) Agriculture (18.7% on average), (B) Mining and quarrying (17.8% on average) and (F) Construction (17.0% on average). The turning point of the trend from rising to declining varies across sectors. Indicatively, in sector (F) Construction, the share of zombie firms followed an upward trend since 2005, peaking at 26.6% in 2016 and easing only partially to 12.7% in 2021. In sector (L) Real estate activities, after contracting between 2002-2009 from 29.5% to 18.3%, the percentage of zombie enterprises increased from 2010 onwards, peaking at 26.3% in 2017 and gradually decreasing thereafter, still remaining at a high level of 14.9% in 2021. On the other hand, single-digit percentages of zombie enterprises are found in sectors (E) Water supply; sewerage, waste management

Chart 5 Share of zombie firms by turnover size class in the ICAP data sample (2002-2021)



and remediation activities (5.9%), (D) Electricity, gas, steam and air conditioning supply (6.2%) and (M) Professional, scientific and technical activities (9.0%).

Chart 7 shows the investment rate and employment growth for all Greek firms in the business economy that are recorded in the ICAP database, as well as for the subsets of non-zombies,

Chart 6 Share of zombie firms by NACE economic activity in the ICAP database (2002-2021)

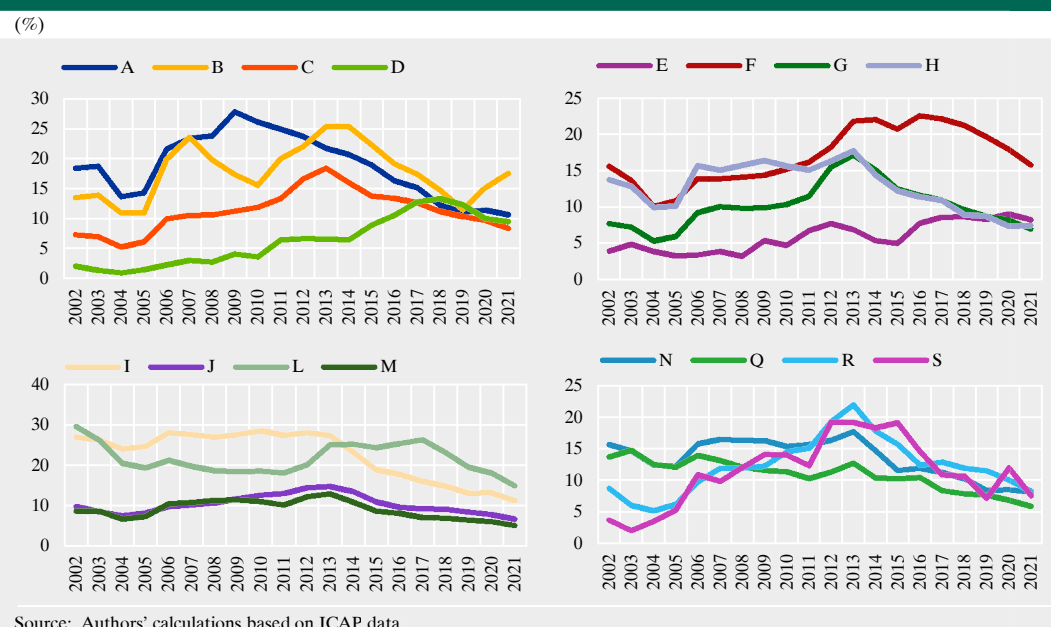


Chart 7 Investment rate and employment growth for total, non-zombie, zombie and young firms (2003-2021)

(%)

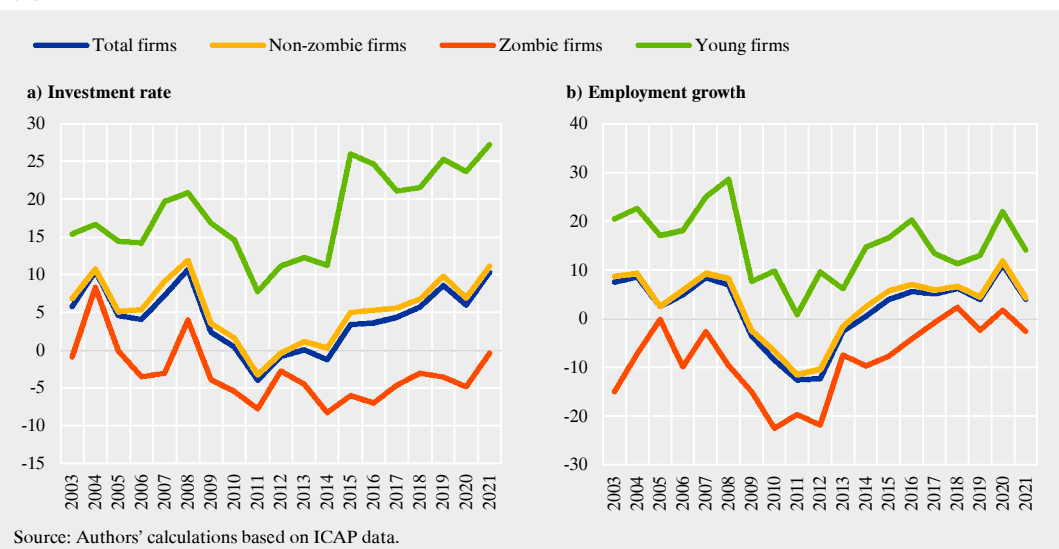


Chart 8 Evolution of capital share in zombie firms by economic activity (NACE sectors C, D, E, F, G and H) (2002-2021)

(%)

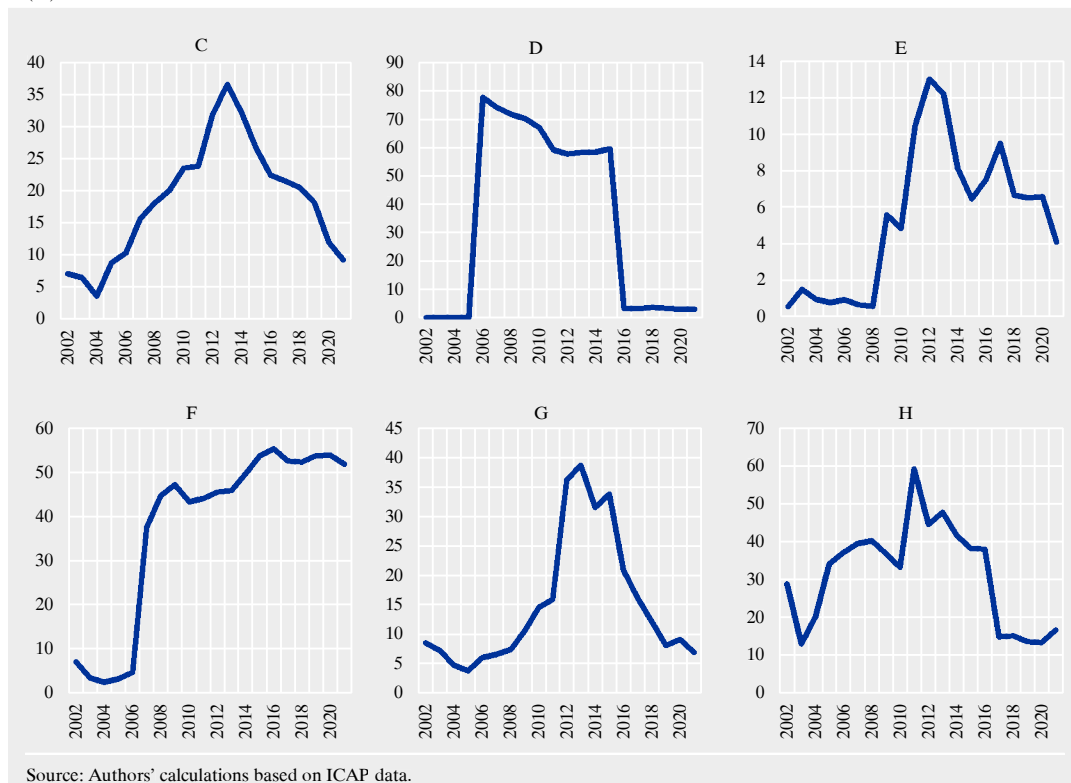
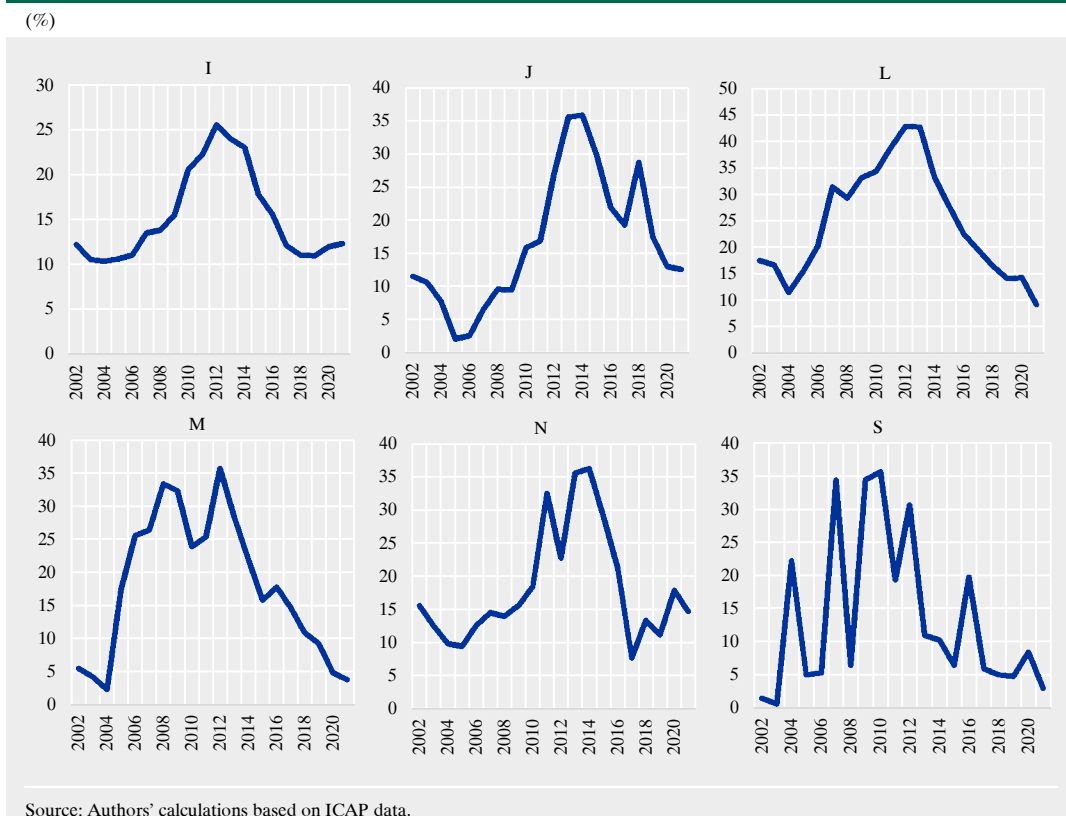


Chart 9 Evolution of capital share in zombie firms by economic activity (NACE sectors I, J, L, M, N and S) (2002-2021)



zombies and young firms. It is noteworthy that non-zombie firms perform systematically better than zombie firms over time, while young firms perform significantly better. Also, although the performance for the all-firms total appears to be close to that of non-zombie firms, which is due to the fact that the share of zombie firms is not particularly high, the question persists as to how the performance of non-zombie firms is affected by the existence of zombie firms.

Charts 8 and 9 show the evolution of the capital share in zombie enterprises by sector of economic activity at the NACE 1-digit level, enabling comparisons across sectors. In the majority of sectors, the peak of fixed capital concentration in zombie firms is observed when the Greek sovereign debt crisis intensified, i.e. during 2010-2014. In sectors such as (D) Electricity, gas, steam and air condition-

ing supply and (H) Transportation and storage, this percentage peaks at very high levels (74% and 59%, respectively). In the real estate sector, it reaches up to 43%, while in the remaining sectors the maximum percentage of fixed capital in zombie enterprises ranges between 24% (sector (I) Accommodation and food service activities) and 39% (sector (G) Wholesale and retail trade), with the exception of sector (E) Water supply; sewerage, waste management and remediation activities, where it reaches up to 13%.

5 QUANTITATIVE ANALYSIS

5.1 ECONOMETRIC MODEL

As stated in the introduction, the purpose of this study is to investigate the type and size of externalities generated by zombie firms in

terms of investment, employment and productivity. In addition, possible distortions caused by zombie firms in the allocation of resources between them and non-zombie firms are also explored. An important contribution of this study is that it examines the effects of zombie firms on a single economy across various sectors, while most of the studies examine such effects using data for groups of countries. At the same time, it is one of the few studies that investigate the above effects in the case of Greece, which is a natural case study of particular interest, as the problem of non-performing exposures (NPEs) intensified during the period of the sovereign debt crisis (PwC 2015; IMF 2021). Besides, the time horizon of the study spans twenty years (2002-2021), during which the Greek economy presented strong growth rates at the beginning and at the end of this period (4.0% on average in 2002-2007, 7.5% on average in 2020-2021), a deep recession in 2008-2013 due to the crisis (-5.0% on average) and mild GDP growth (0.7% on average) in 2014-2019. All the above, along with the fact that the data used are at firm level, allow an in-depth analysis of the effects of zombie firms on the Greek economy. In this regard, it is noted that besides carrying out the analysis for the entire Greek economy, estimations are extended to selected 1-digit sectors (NACE Rev. 2), in order to highlight any differences in the direction and magnitude of the effects.

This section presents the econometric model used in the estimations, which takes the following form:

$$Y_{ist} = \beta_1 \text{Non-zombie dummy}_{ist} + \beta_2 \text{Non-zombie dummy}_{ist} \\ + \beta_3 \text{Industry zombie capital sunk}_{st} + \beta_4 \text{firm controls}_{ist} + \delta_{st} + \varepsilon_{ist} \quad (1)$$

The variable Y_{ist} is the dependent variable of the model and has three alternative definitions. The first refers to employment growth ($d\log Emp_{ist}$), i.e. the annual percentage change in employment approximated by the log differences of employment between two consecutive years ($\log Emp_{ist} - \log Emp_{ist-1}$). It is noted

that in this variable, as well as in those that follow, the subscript i denotes the i th firm, the subscript s denotes the 1-digit sector, and t denotes the time (year). Under the second alternative definition, the dependent variable of the model is the investment ratio $\log(\frac{I}{K})$, i.e. the log difference of the real capital stock. Under the third alternative definition, the dependent variable of the model is the level of total factor productivity (multi-factor productivity or MFP). The estimation of the specific index was based on the Solow residual theory and is defined as:

$$\log Y - (1-s_L) \log K - s_L \log L,$$

where $\log Y$ is the logarithm of the firm's value added, $\log K$ is the logarithm of fixed capital and $\log L$ is the logarithm of employment. s_L is the labour share of output and is defined as the ratio of compensation of employees to output. For estimating the labour share we used data on the cost of labour and on output at the 2-digit level, retrieved from the National Accounts database of the Hellenic Statistical Authority (ELSTAT).

Before presenting the independent variables of the model, it should be noted that due to lack of data regarding value added per firm, turnover was used instead, and both turnover and fixed capital were deflated in order to express these figures in constant values. To deflate the turnover series, we used the GDP deflator at the 2-digit level of economic activity and to deflate the fixed capital series we used the deflators of gross fixed capital formation at the 2-digit level of economic activity.

The independent variable *Non-zombie dummy*_{ist} is a dummy variable that takes the value of 1 if the firm is non-zombie and 0 otherwise. A firm is characterised as zombie if, for three consecutive years:

- the value of the interest coverage ratio is less than 1, where the interest coverage ratio is the ratio of operating profits to financial expenses

$$\left(\frac{\text{Operating Profit}_{ist}}{\text{Financial Expenses}_{ist}} < 1\right),$$

- the age of the firm is equal to or greater than 10 years. In line with the relevant literature, ten years is introduced as a threshold, because firms less than ten years old are at an early stage of their operation and are expected to show unsatisfactory financial performance (e.g. negative net profitability, operating losses, negative equity), as they try to increase their market share and secure their presence in an industry. Age is defined as the difference between the year for which data is available for a firm and the year when it was founded, plus one year. We added a year to the above difference so that firms founded at the beginning of the period under review (i.e. 2002) do not have a zero value of age in that particular year.

The independent variable *Industry zombie capital sunk_{st}* represents the share of zombie firms in an industry. The share is approximated as follows:

- as a percentage of the fixed capital (Fixed Assets) of the sector in which they operate, in each year of the period under review, i.e. the ratio is calculated as:

$$\frac{\text{Total Fixed Assets of zombie Firms}_{st}}{\text{Total Fixed Assets of the Sector}_{st}}$$

The independent variable *firm controls_{ist}* includes a number of dummy variables at the firm level, related to the age and size of each firm.

The dummy variable concerning the age of the firm – following the relevant literature – is defined as follows:

- dummy variable for age (Young) takes the value of 1 if the firm is less than 6 years old, and 0 otherwise, i.e.

$$\text{young} = \begin{cases} 1, & \text{if age} < 6 \text{ years} \\ 0 & \text{otherwise} \end{cases}$$

Regarding the size dummy variables, firms were classified into micro, small/medium-sized and large, using the European Commission's definition. The definition of the corresponding dummies is as follows:

- micro dummy (Micro dummy), takes the value of 1 if the firm has an annual turnover of less than €2.0 million, and 0 otherwise, thus:

$$\text{Micro dummy} = \begin{cases} 1, & \text{if turnover} < \text{€}2 \text{ million} \\ 0 & \text{otherwise} \end{cases}$$

- small and medium-sized dummy (Small/Medium dummy) takes the value of 1 if the firm has an annual turnover greater than or equal to €2.0 million and less than €50.0 million, and 0 otherwise, thus:

$$\text{Small/Medium dummy} = \begin{cases} 1, & \text{if } \text{€}2 \text{ million} \leq \text{turnover} < \text{€}50 \text{ million} \\ 0 & \text{otherwise} \end{cases}$$

- large dummy (Large dummy) takes the value of 1 if the firm has an annual turnover greater than or equal to €50.0 million, and 0 otherwise, thus:

$$\text{Large dummy} = \begin{cases} 1, & \text{if turnover} \geq \text{€}50 \text{ million} \\ 0 & \text{otherwise} \end{cases}$$

The independent variable δ_{st} captures year- and industry-fixed effects. A fixed-effects approach is used to analyse the effect of time-varying variables on the rate of change in labour and investment and the level of total factor productivity. Each firm has its own special characteristics (e.g. business practices, business culture) that do not change with time (time invariant characteristics) and may affect the estimates of the independent variables. By using the fixed-effects approach, the effect of the above characteristics is controlled so that they do not lead to biased estimates of the independent variables. Consequently, it is assumed that the error term ε_{ist} and regressors x_{ist} are not correlated.

Regarding the expected results of the estimations, coefficient β_1 according to Adalet McGowan et al. (2018) may exhibit different

results. A positive sign indicates that non-zombie firms are expected to have higher rates of change in employment, investment and in the level of total factor productivity than zombie firms, if the latter are unable to spend as much as non-zombie firms, due to their lack of access to bank credit. On the other hand, a negative sign indicates that non-zombie firms are expected to have lower rates of change in employment, investment, and in the level of total factor productivity, compared to zombie firms, if the latter still have access to bank lending.

As far as the coefficient β_2 is concerned, a positive sign is expected when the dependent variable of the model is total factor productivity. A positive sign indicates that the gap between zombie and non-zombie firms in terms of total factor productivity widens in favour of the latter due to the higher productivity level they have to achieve in order to overcome entry barriers created by zombie firms. If the dependent variable of the model is the rate of change in employment and investment, a negative sign is expected for the coefficient β_2 , which shows that the presence of zombies in an industry creates “congestion” and reduces the ability and/or incentives of non-zombie firms to grow in terms of employment and investment.

Moreover, in order to investigate possible distortions caused by zombie firms in the allocation of resources between them and non-zombie firms, we examine the effect of a firm’s productivity level on attracting capital for investment. In this context, we employ the approach proposed by Adalet McGowan et al. (2018). Consequently, the following econometric model will be estimated:

$$Kgrowth_{ist} = \alpha + \beta_1 MFP_{ist-1} + \beta_2 MFP_{ist-1} * Industry\ zombie\ capital\ sunk_{st} + \beta_3 firm\ controls_{ist} + \delta_{st} + \varepsilon_{ist} \quad (2)$$

The dependent variable of the model, $Kgrowth_{ist}$, denotes the rate of change in capital of firm i , in sector s , in year t . The independent variable MFP_{ist-1} is the total factor productivity — as estimated above — of firm i ,

in sector s , in year $t-1$. We use total factor productivity with one year lag because a firm first acquires knowledge about its productivity levels (and hence its profitability) and then makes a decision on whether to invest or not. The independent variable, *Industry zombie capital sunk_{st}*, defined above, indicates the share of an industry’s fixed capital sunk in zombie firms. The independent variable *firm controls_{ist}* includes a number of control variables for the age and size of each firm, as defined above.

Regarding the expected results from the estimations of model (2) for coefficient β_1 , Adalet McGowan et al. (2018) argue that it will have a positive sign, since firms with higher productivity are expected to attract resources in order to invest and grow. The coefficient β_2 is expected to have a negative sign if the presence of zombies causes distortions in the efficient allocation of resources, with negative consequences on investment and growth for firms exhibiting high productivity.

5.2 ECONOMETRIC RESULTS

This section discusses the results of the quantitative estimations, which can be found in the Appendix, of the two econometric models presented in the previous section. The estimations use annual firm-level panel data covering the period 2002-2021, broken down by firm size and sector of economic activity, focusing on the business economy. We also note that the analysis is carried out at the level of 2-digit economic sectors when data are available, otherwise at the level of 1-digit economic sectors.

Table A1 in the Appendix reports the results when the investment rate is the dependent variable. In the economy as a whole (column “Total”), the estimate of the coefficient of the dummy variable for non-zombie firms (**Non-zombie dummy**) is positive and statistically significant, and suggests that non-zombie firms have, on average, an investment rate 1.6 pps higher compared to firms classified as zombies, probably because the latter are not able to spend as much as healthy firms due to their dif-

difficulty in raising funds from the banking system. The interaction of this dummy variable with the percentage of capital sunk in zombie firms by sector (**Non-zombie dummy x Industry zombie capital sunk**) was estimated to be positive, but statistically insignificant. That is, in the economy as a whole it appears that the concentration of capital in zombie firms does not reduce the ability and/or incentives of non-zombie firms to grow in terms of investment.

Compared to the other sectors, where the impact of zombie firms on investment rates is positive, it is indicative that in sector (C) Manufacturing, non-zombie firms exhibit an investment rate which is 3.87 pps higher compared to zombie firms, while in sector (G) Wholesale and retail trade, they show a 5.59 pps higher investment rate compared to zombie firms. However, in sector (D) Electricity, gas, steam and air conditioning supply, the coefficient of the variable is statistically significant and strongly negative (-0.2623).

Taking the above into account, the impact on the rate of investment for the average firm in the manufacturing sector on the ICAP database would amount to 0.56 pps or €23,810 additional net tangible assets, which would constitute 4.2% of average gross investment (which amounted to approximately €569 thousand for the average firm). Translating the above to the manufacturing sector as a whole, based on national accounts data on the level of gross investment in this sector, gross investment in the manufacturing sector in real terms would increase annually by 4.2% or about €108 million (in 2015 prices) for every 1 percentage point reduction in the capital share of zombie firms. Note, however, that the above calculation does not take into account the direct improvement that would result for the average firm from a reduction in the percentage of zombie firms, with the average zombie firm on the ICAP database showing a negative investment rate of -2.5% in 2021.

Table A2 in the Appendix presents the estimates of the regressions, with the rate of change

in employment as the dependent variable. It should be noted that the number of observations compared to Table A1 is considerably lower, due to numerous missing observations in the employment data through ICAP. The results in this case are broadly similar in terms of the sign of the coefficient, but the level of statistical significance of the results is lower, most likely due to the limited number of observations. In summary, the results of the estimations that are statistically significant show that the non-zombie dummy firms (**Non-zombie dummy**) show a higher rate of change in employment compared to zombie firms in sectors (C) Manufacturing, (G) Wholesale and retail trade, (J) Information and Communications, (N) Administrative and support service activities and the whole sample. In the case of the variable **Non-zombie dummy x Industry zombie capital sunk** a statistically significant positive result is obtained only in the Other Services sector.

Table A3 in the Appendix shows the results of the regression when total factor productivity is the dependent variable. It is first clear that the magnitude of the effects is strong and, in most cases, statistically significant. In the case of the **Non-zombie dummy** variable, statistically significant results are found in sectors (C) Manufacturing, (G) Wholesale and retail trade, (I) Accommodation and food service activities, (J) Information and communication, (M) Professional, scientific and technical activities, (N) Administrative and support service activities, and (S) Other service activities, showing a positive coefficient, which indicates that non-zombie enterprises are expected to achieve higher levels of total factor productivity compared to enterprises classified as zombie. It should be noted that in the business economy as a whole (column "Total"), non-zombie firms also exhibit higher total factor productivity, as indicated by the positive and statistically significant coefficient of the non-zombie dummy variable.

Regarding the variable **Non-zombie dummy x Industry zombie capital sunk**, in those cases where a statistically significant result is obtained, i.e. in the total sample and in sectors

(C) Manufacturing, (F) Construction, (G) Wholesale and retail trade, (H) Transportation and storage, (L) Real estate activities and (S) Other service activities, this result is positive and in line with the result of the estimations of Adalet McGowan et. al (2018). According to this finding, as the congestion of capital in zombie firms increases, the gap between zombies and non-zombies in terms of total factor productivity widens in favour of the latter due to the higher productivity threshold non-zombies have to achieve in order to overcome the entry and activity barriers created by zombie firms. On the contrary, a negative and statistically significant result is found for this variable only in sector (I) Accommodation and food service activities.

Table A4 in the Appendix presents the results of the estimations of model (2), which explores the existence of possible distortions caused by zombie firms in the allocation of resources between them and healthy firms within a sector of economic activity. Besides, it highlights the effect of the level of productivity of firms (with a lag of one year) on the attraction of capital for investment, both in the whole business economy (column “Total”) and by sector of economic activity.

The results of the estimations are in line with the literature for the whole business economy (column “Total”) and for all sectors except (D) Electricity, gas, steam and air conditioning supply and (S) Other service activities. The positive and statistically significant coefficient result for the variable MFP_{t-1} indicates that firms with higher than average productivity also perform better in attracting capital in order to invest and grow. The strongest effects are found in sectors (J) Information and communication, (I) Accommodation and food services, (M) Professional, scientific and technical activities, (G) Wholesale and retail trade and (C) Manufacturing. On the other hand, weaker effects were estimated in sectors (F) Construction, (L) Real estate activities and (N) Administrative and support service activities.

Similarly, the estimated coefficients for the interaction of productivity with industry capital sunk in zombies are consistent with the results in the literature. They show a negative sign and are statistically significant both in the total economy case (column “Total”) and in sectors (C) Manufacturing, (G) Wholesale retail trade, (I) Accommodation and food service activities, (L) Real estate activities and (M) Professional, scientific and technical activities, suggesting that the presence of zombie enterprises causes distortions in the efficient allocation of resources, with negative consequences on investment and growth of high-productivity enterprises. In other words, the greater the congestion of capital in zombie firms, the more limited the reallocation of capital to more productive investment across industries.

A recurring trend evident across all the aforementioned findings is the consistently positive and statistically significant impact of the “Young” variable, indicating that newly-established firms tend to demonstrate higher levels of performance. This outcome likely suggests that newborn enterprises, in order to survive and then stabilise and improve their market position, must exhibit higher productivity and adopt a more aggressive approach towards investment and employment expansion. Furthermore, the results of the estimations for the dummy variables related to small/medium-sized enterprises (Small/Medium dummy) and micro enterprises reveal the existence of a negative and statistically significant relationship between performance and firm size. It is plausible that some of the firms experiencing weak growth or stagnation have limited capacity to secure resources for investment or employment.

Finally, we conducted two additional robustness checks. First, we defined a firm as non-zombie only if it maintained this status throughout the entire sample period, thus eliminating the potential impact of status changes on estimated coefficients. Second, to control for heterogeneity not only across sectors, but also across individual firms, we introduced firm-fixed effects, thus allowing coeffi-

cients to be identified solely through the time dimension. While the tables with the detailed results are not presented here for economy of space, both checks yielded consistent findings in terms of coefficient signs and statistical significance.

6. CONCLUSIONS

The high share of non-performing business loans, either on or off bank balance sheets, and the density of zombie companies are major challenges for the Greek economy. Corporate NPEs and the number of zombie firms in Greece have recorded a significant decline since their peak in 2015 and 2013, respectively, but remain high, especially in individual sectors of activity. The analysis in the case of the Greek economy confirms literature findings that the prolonged presence of non-performing business loans and zombie firms constitutes an obstacle to investment and employment prospects, while negatively affecting productivity and the efficient allocation of resources. The effects are both direct at the firm level and broader at the total economy level, as they spill over to healthy firms in each sector of economic activity, thus damaging healthy competition in goods and services markets. Overall, a faster resolution of non-performing loans and zombie firms can release significant financial and physical resources, whose reallocation towards more productive uses may contribute to sustainable economic growth.

The estimated share of zombie firms is positively correlated with the share of business NPEs in bank balance sheets over the period 2002-2021. However, the increase in the share of zombie firms preceded the increase in the share of NPEs in bank balance sheets, while the decrease in the share of zombie firms preceded the decrease of NPE ratios. This suggests leading indicator properties of the zombie rate for the NPE ratio. In the recent period, the faster decline in the number of zombies relative to that in NPEs may be partly due to the accumulation and delayed resolution of non-

performing loans owed by firms that have ceased operations and are, therefore, no longer included in the ICAP database.

On one front, the NPEs to non-financial corporations (NFCs) recorded on bank balance sheets have declined significantly. They dropped cumulatively by 85% over the period 2016-2022, from €58 billion (or 47.0% of total NFC exposures) in 2015, to €8.9 billion in 2022 (or 8.1%) in 2022. Using literature estimates on the impact of NPEs on credit expansion, as a back-of-the-envelope calculation one can estimate that the recorded reduction in Greek NPEs during 2016-2023 led to an increase in net business loan flows of about €8 billion, out of a total increase of €22.5 billion recorded in this period (36% of credit expansion). However, the notable decline in NPEs was largely due to loan write-offs, disposals, loan sales and securitisations carried out in 2016-2022 and, to a lesser extent, to “organic” improvements. As a result, the largest stock of NPEs that was transferred off bank balance sheets is now managed by servicers and amounted to €33.4 billion at end-2022. Thus, business NPEs in the economy as a whole only declined by 28% over the period 2016-2022, to stand at around €42 billion in 2022.

On a parallel front, the evolution over time of the estimated percentage of zombie firms in the Greek economy shows a similar trend but leads in time the respective trend of NPEs. The percentage of zombie firms, based on a range of widely applied criteria, increased from 10% to 18.6% in the period 2005-2013 and declined thereafter, to reach 8.9% in 2022. In relation to the size class of enterprises by turnover, a higher share of zombie enterprises is observed among micro enterprises, with a downward trend after 2013 in all size classes. It is noteworthy that, during 2005-2016, the share of zombie firms was higher among large firms than among small and medium-sized firms, which is nevertheless consistent with findings in the literature.

A qualitative analysis of the evolution of zombie firms by sector of economic activity shows a

relatively higher density of zombie firms in sectors (F) Construction, (I) Accommodation and food service activities and (L) Real estate activities. Looking at the level of NFCs' liabilities to banks, the Construction sector consistently shows the highest liabilities from zombie firms, especially since the global financial crisis in 2008. Zombie firms in the Manufacturing sector (C) have consistently shown substantial levels of liabilities to banks, peaking in 2012 at €3.4 billion or 21.3% of total liabilities by zombie firms, while in 2021 they declined to €1.1 billion or 15.7% of the total, at a time when the share of manufacturing in total economy Gross Value Added (GVA) was around 10%. Also, the Wholesale and retail trade sector shows high levels of liabilities from zombie firms in comparison with its share in total economy GVA.

Within the quantitative analysis, five key findings emerge. First, non-zombie firms outperform zombie firms in terms of investment growth, employment growth and productivity levels. Second, a high concentration of capital in zombie firms negatively affects the rate of investment and productivity growth of healthy firms in certain sectors of economic activity. Third, a high concentration of capital in zombie firms forces healthy firms in many sectors of activity to increase their overall productivity and investment in order to survive. Fourth, a high concentration of capital in zombie firms prevents the reallocation of capital to more productive investments across firms and sectors of activity. Fifth, younger and larger firms generally perform better in terms of investment growth, employment growth and productivity levels.

More specifically, econometric models were used to investigate the effect of the congestion of zombie firms on non-zombie firms in Greece, both in the aggregate and in individual sectors of the business economy. Both the direct and indirect effects on healthy firms from capital

bottlenecks in zombie firms vary across economic sectors. Indicatively, the effects of zombie concentration on investment rates among healthy firms and on the speed of capital reallocation towards productive investments are relatively high in sectors with a significant share in the gross value added of the Greek economy, such as (I) Accommodation and food service activities and (C) Manufacturing. Thus, a conservative back-of-the-envelope interpretation of the estimated impact shows that real gross investment in the manufacturing sector alone would increase annually by 4.2% or about €108 million (in 2015 prices) for every 1 percentage point reduction in the capital share in zombie firms in the same sector.

The findings highlight the potential benefits for the Greek economy from resolving NPEs and reducing the number of zombie companies. This would have direct positive effects, such as through higher rates of investment, employment and productivity growth for the overall economy. Besides, this would yield significant, indirect positive effects, such as enhancing the operating and growth prospects for existing healthy firms. This is expected through the process of freeing up of financial and physical resources and their efficient and more productive re-allocation within the economy and across sectors of economic activity.

Policy priorities and measures aiming at a rapid and effective reduction in the amount of NPEs and the number of zombie companies are expected to accelerate the narrowing of the investment gap in the Greek economy, as well as to reduce the unemployment rate. Moreover, they may enhance the prospect of strengthening the overall productivity of the economy, as well as the reallocation of capital to productive investments, which are necessary conditions for achieving strong and sustainable growth rates of the Greek economy in the medium to long term.

REFERENCES

- Acharya, V.V., T. Eisert, C. Eufinger and C. Hirsch (2019), “Whatever it takes: The real effects of unconventional monetary policy”, *The Review of Financial Studies*, 32 (9), 3366-3411.
- Adalet McGowan, M., D. Andrews and V. Millot (2018), “The walking dead?: Zombie firms and productivity performance in OECD countries”, *Economic Policy*, 33 (96), 685-736.
- Ahearne, A.G. and N. Shinada (2005), “Zombie firms and economic stagnation in Japan”, *International Economics and Economic Policy*, 2 (4), 363-381.
- Andrews, D. and F. Petroulakis (2019), “Breaking the shackles: Zombie firms, weak banks and depressed restructuring in Europe”, European Central Bank, Working Paper No. 2240.
- Balgora, M., A. Plekhanov and M. Skrzypinska (2017), “Reducing non-performing loans: Stylized facts and economic impact”, mimeo.
- Banerjee, R. and B. Hofmann (2018), “The rise of zombie firms: Causes and consequences”, *Bank for International Settlements Quarterly Review*, September 2018, 67-78.
- Bogdanova, B., I. Fender and E. Takáts (2018), “The ABCs of bank PBRs”, *Bank for International Settlements Quarterly Review*, March 2018, 81-95.
- Borio, C., L. Gambacorta and B. Hofmann (2017): “The influence of monetary policy on bank profitability”, *International Finance*, 20 (1), 48-63.
- Caballero, R.J., T. Hoshi and A.K. Kashyap (2008), “Zombie lending and depressed restructuring in Japan”, *American Economic Review*, 98 (5), 1943-1977.
- da Silva, A. and A. Gonçalves (2022), “How zombie firms affect healthy firms: The case of Portuguese trade sector”, *Revista Galega de Economía*, 31 (3), 1-18.
- Fukuda, S. and J. Nakamura (2011), “Why did ‘zombie’ firms recover in Japan?”, *The World Economy*, 34 (7), 1124-1137.
- Gopinath, G., Ş. Kalemli-Özcan, L. Karabarbounis and C. Villegas-Sanchez (2017), “Capital allocation and productivity in South Europe”, *The Quarterly Journal of Economics*, 132 (4), 1915-1967.
- Hallak, I., P. Harasztosi and S. Schich (2018), “Fear the walking dead?: Incidence and effects of zombie firms in Europe”, European Commission, *Joint Research Centre Technical Report*.
- IMF (2021), “Corporate vulnerabilities in the wake of Covid-19”, *Greece: Selected Issues*, IMF Country Report No. 21/155, July.
- Kane, E.J. (1987), “Dangers of capital forbearance: The case of the FSLIC and ‘zombie’ S&Ls”, *Contemporary Economic Policy*, 5 (1), 77-83.
- Mingarelli, L., B. Ravanetti, T. Shakir and J. Wendelborn (2022), “Dawn of the (half) dead: The twisted world of zombie identification”, European Central Bank, Working Paper No. 2743.
- Peek, J. and E.S. Rosengren (2005), “Unnatural selection: Perverse incentives and the misallocation of credit in Japan”, *American Economic Review*, 95 (4), 1144-1166.
- Pissarides, C.A., C. Meghir, D. Vayanos and N. Vettas (The Pissarides Committee) (2020), “A growth plan for Greece”.
- PwC (2015), *Stars and Zombies: Greek corporates coming out of the crisis*.
- Schivardi, F., E. Sette and G. Tabellini (2017), “Credit misallocation during the European financial crisis”, *Bank for International Settlements*, BIS Working Paper No. 669.
- Tölö, E. and M. Virén (2021), “How much do non-performing loans hinder loan growth in Europe?”, *European Economic Review*, 136 (2021): 103773.
- Vaz, R. (2021), “Firm growth: A review of the empirical literature”, *Revista Galega de Economía*, 30 (2), 1-20.
- Vettas, N., A. Louka, K. Peppas, Y. Pountouraki and M. Vasileiadis (2022), “Trends in total factor productivity in Greece and its determinants during the period 2005-2019”, Bank of Greece, *Economic Bulletin*, No. 56, 7-43.
- Wang, Y. and Y. Zhu (2021), “The financing and investment crowding-out effect of zombie firms on non-zombie firms: Evidence from China”, *Emerging Markets Finance and Trade*, 57 (7), 1959-1985.

APPENDIX

Table A1 Results of model (1) estimations for the whole economy and by sector of economic activity with the investment rate [$\log(I/K)$] as the dependent variable for 2002-2021

Variables	Total	C	D	E	F	G	H	I	J	L	M	N	S
Non-zombie dummy	0.0160*** (0.0042)	0.0387*** (0.0086)	-0.2623*** (0.0463)	0.1713** (0.0717)	-0.0323 (0.0264)	0.0559*** (0.0085)	0.0188 (0.0340)	0.0421*** (0.0101)	0.0679*** (0.0240)	0.0599*** (0.0189)	0.0799*** (0.0227)	-0.0291 (0.0293)	0.3010 (0.2374)
Non-zombie dummy × Industry zombie capital sunk	0.0206	-0.0518*	0.3913***	-1.8631*	0.1471**	-0.0527	0.0385	-0.3156***	-0.0833	-0.2195***	0.0023	0.1400	-0.2550
Young	(0.0148)	(0.0306)	(0.0973)	(0.9921)	(0.0577)	(0.0386)	(0.0572)	(0.0604)	(0.0836)	(0.0657)	(0.0448)	(0.1017)	(0.5068)
	0.1809***	0.2155***	0.3517***	0.2197***	0.1834***	0.1555***	0.1991***	0.2011***	0.1836***	0.1232***	0.1562***	0.1617***	0.1186
Small/Medium dummy	(0.0034)	(0.0089)	(0.0210)	(0.0450)	(0.0112)	(0.0061)	(0.0155)	(0.0095)	(0.0163)	(0.0117)	(0.0129)	(0.0154)	(0.1270)
	-0.0243***	-0.0187*	0.0077	0.0944	-0.0143	-0.0303***	-0.0248	-0.0441	-0.0167	-0.1920*	-0.0411	-0.0003	
Micro dummy	(0.0070)	(0.0109)	(0.0478)	(0.1324)	(0.0385)	(0.0107)	(0.0295)	(0.0445)	(0.0355)	(0.1029)	(0.0741)	(0.0313)	
	-0.1087***	-0.0776***	-0.0037	0.0549	-0.1170***	-0.1250***	-0.1256***	-0.0948**	-0.1250***	-0.2388**	-0.1472**	-0.1227***	-0.1166
Sector-year FE	(0.0071)	(0.0111)	(0.0421)	(0.1355)	(0.0382)	(0.0108)	(0.0294)	(0.0443)	(0.0352)	(0.1016)	(0.0743)	(0.0304)	(0.0954)
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	492,994	90,312	15,009	2,325	39,437	148,367	18,572	70,658	21,471	33,392	31,979	21,001	318
Sectors	47	19	1	2	1	3	5	1	4	1	5	4	1
Adjusted R ²	0.0230	0.0314	0.0707	0.0280	0.0166	0.0177	0.0227	0.0292	0.0143	0.0114	0.0111	0.0154	-0.0058

Source: Authors' estimations based on ICAP data.
Notes: The dependent variable $\log(I/K)$ refers to the investment rate, that is the difference in logarithms of deflated net fixed capital. The variable "Industry zombie capital sunk" refers to the share of capital sunk in zombie firms (with age larger or equal to 10 years and an interest coverage ratio < 1 for more than 3 consecutive years) in an industry in the relevant sector of economic activity. The classification NACE Rev. 2 is used for business economy sectors (sectors 10-82, except for sectors 64-66) and sectors 94-96. Standard errors are included in parentheses. ***, ** and * denote statistical significance at levels 1%, 5%, and 10%, respectively.

Table A2 Results of model (1) estimations for the whole economy and by sector of economic activity with employment growth (dLogEmp) as the dependent variable for 2002-2021

Variables	Total	C	D	E	F	G	H	I	J	L	M	N	S
Non-zombie dummy	0.0558*** (0.0071)	0.0543*** (0.0121)	0.0649 (0.0885)	0.1569 (0.1181)	0.0126 (0.1727)	0.0623*** (0.0106)	0.0540 (0.0508)	0.0621 (0.0841)	0.0751** (0.0315)	0.0643 (0.0690)	0.0040 (0.0343)	0.1524*** (0.0448)	-0.0895 (0.0935)
Non-zombie dummy × Industry zombie capital sunk	0.0364	0.0463	0.1807	-13.023	0.0676	0.0764	0.0319	-0.3055	0.0502	-0.2871	0.0208	-0.1223	1.7073***
Young	0.1399*** (0.0260)	0.1567*** (0.0466)	0.0922 (0.2380)	0.1420** (-11.706)	0.1759*** (0.3361)	0.1333*** (0.0535)	0.1474*** (0.0893)	0.1221*** (0.5386)	0.1332*** (0.1041)	0.1727** (0.3109)	0.1202*** (0.0801)	0.1303*** (0.1622)	-0.3443 (0.0961)
Small/Medium dummy	-0.0000 (0.0061)	0.0105 (0.0134)	-0.1139** (0.0856)	0.0514 (0.0645)	-0.0126 (0.0310)	-0.0019 (0.0079)	-0.0134 (0.0240)	-0.1022 (0.0411)	0.0227 (0.0259)	-0.0430 (0.0725)	-0.0538 (0.0228)	-0.0298 (0.0316)	
Micro dummy	-0.0816*** (0.0052)	-0.0574*** (0.0071)	-0.1301*** (0.0502)	-0.0124 (0.0577)	-0.1489*** (0.0497)	-0.0806*** (0.0072)	-0.0656*** (0.0238)	-0.2150* (0.1248)	-0.0496** (0.0195)	-0.1856*** (0.0633)	-0.1470** (0.0644)	-0.1132*** (0.0415)	0.0031
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,444	29,315	1,086	693	6,460	45,305	4,832	6,814	5,508	1,874	5,946	4,438	4,438
Sectors	47	19	1	2	1	3	5	1	4	1	5	4	1
Adjusted R ²	0.0508	0.0695	0.0528	0.0631	0.0443	0.0571	0.0579	0.0237	0.0473	0.0406	0.0384	0.0525	0.0525

Source: Authors' estimations based on ICAP data.

Notes: The dependent variable dLogEmp refers to the employment growth rate. The variable "Industry zombie capital sunk" refers to the share of capital sunk in zombie firms (with age larger or equal to 10 years and an interest coverage ratio < 1 for more than 3 consecutive years) in an industry in the relevant sector of economic activity. The classification NACE Rev. 2 is used for business economy sectors (sectors 10-82, except for sectors 64-66) and sectors 94-96. Standard errors are included in parentheses. ***, **, * and * denote statistical significance at levels 1%, 5%, and 10%, respectively.

Table A3 Results of model (I) estimations for the whole economy and by sector of economic activity with multifactor productivity (MFP) as the dependent variable for 2002-2021

Variables	Total	C	D	E	F	G	H	I	J	L	M	N	S
Non-zombie dummy	0.5359*** (0.0207)	0.5287*** (0.0354)	0.5639 (0.3741)	0.4654 (0.4185)	0.3612 (0.2383)	0.5223*** (0.0329)	-0.0759 (0.1798)	0.6618*** (0.1077)	0.5791*** (0.0836)	-0.0067 (0.4375)	0.5584*** (0.0874)	0.8563*** (0.1414)	1.1456** (0.5708)
Non-zombie dummy × Industry zombie capital sunk	0.6497***	0.6190***	-0.8159	-11.601	1.9331***	0.9982***	1.0508***	-1.7150***	0.2543	2.7156*	-0.0949	-0.3199	6.4421***
Young	(0.0770)	(0.1262)	(0.6578)	-39.621	(0.4965)	(0.1431)	(0.2966)	(0.6450)	(0.2518)	-15.095	(0.2922)	(0.4435)	(0.7964)
	0.3878***	0.2742***	0.4848***	0.0566	0.6547***	0.4892***	0.2921***	0.3587***	0.1648***	0.6121***	0.1553***	0.1549***	-0.1794
	(0.0088)	(0.0184)	(0.1126)	(0.0887)	(0.0360)	(0.0124)	(0.0407)	(0.0354)	(0.0354)	(0.1334)	(0.0362)	(0.0418)	(0.1937)
Small/Medium dummy	-0.3516***	-0.1624***	-1.2942***	-0.1190	0.3817***	-0.6759***	0.3846***	0.3383**	0.4331***	0.4054	-0.5611***	-0.2255	
	(0.0173)	(0.0196)	(0.1572)	(0.2295)	(0.0868)	(0.0270)	(0.0723)	(0.1501)	(0.0660)	(0.3567)	(0.1588)	(0.1498)	
Micro dummy	-0.9567***	-0.6353***	-1.9399***	-0.8982***	-0.4184***	-1.2950***	-0.3325***	-0.0578	-0.1388**	-1.4674***	-1.2484***	-0.8829***	-0.0066
	(0.0178)	(0.0210)	(0.1465)	(0.2422)	(0.0876)	(0.0276)	(0.0744)	(0.1501)	(0.0662)	(0.3537)	(0.1595)	(0.1499)	(0.1841)
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	175,864	44,310	1,673	982	10,811	69,706	7,106	13,086	8,458	2,375	9,477	6,848	165
Sectors	47	19	1	2	1	3	5	1	4	1	5	4	1
Adjusted R ²	0.7092	0.5998	0.4908	0.5484	0.5569	0.3008	0.6908	0.3804	0.5929	0.2098	0.6647	0.7842	0.7882

Source: Authors' estimations based on ICAP data.

Notes: The dependent variable MFP refers to the estimate of the level of total factor productivity, based on the Solow residual theory. The variable "Industry zombie capital sunk" refers to the share of capital sunk in zombie firms (with age larger or equal to 10 years and an interest coverage ratio < 1 for more than 3 consecutive years) in an industry in the relevant sector of economic activity. The classification NACE Rev. 2 is used for business economy sectors (sectors 10-82, except for sectors 64-66) and sectors 94-96. Standard errors are included in parentheses. ***, ** and * denote statistical significance at levels 1%, 5%, and 10%, respectively.

Table A4 Zombie firms and capital reallocation: sensitivity of net fixed assets to lagged multifactor productivity for the whole economy and by sector of economic activity. Dependent variable: $\log(I/K)$

Variables	Total	C	D	E	F	G	H	I	J	L	M	N	S
MFP _{t-1}	0.0544*** (0.0016)	0.0609*** (0.0030)	0.0059 (0.0118)	0.0555*** (0.0178)	0.0362*** (0.0102)	0.0667*** (0.0031)	0.0461*** (0.0150)	0.0801*** (0.0104)	0.0849*** (0.0102)	0.0355*** (0.0101)	0.0790*** (0.0072)	0.0327*** (0.0098)	0.1012 (0.0654)
MFP _{t-1} × Industry zombie capital sunk	-0.0173***	-0.0546***	0.1070***	-0.2662	0.0330	-0.0890***	0.0080	-0.3538***	-0.0328	-0.0667*	-0.0337*	0.0600	-0.1604
Young	(0.0058)	(0.0128)	(0.0288)	(0.2366)	(0.0225)	(0.0203)	(0.0249)	(0.0699)	(0.0429)	(0.0403)	(0.0194)	(0.0390)	(0.1843)
	0.0880***	0.1055***	0.1606***	0.1162***	0.0945***	0.0794***	0.0588***	0.0376***	0.1382***	0.0309	0.0930***	0.1213***	0.2052
	(0.0041)	(0.0073)	(0.0378)	(0.0329)	(0.0165)	(0.0067)	(0.0215)	(0.0108)	(0.0211)	(0.0288)	(0.0209)	(0.0229)	(0.2037)
Small/Medium dummy	0.0074	-0.0014	0.0159	0.0570	0.0297	0.0212*	-0.0202	-0.0833	-0.0306	-0.1169	0.0051	0.0161	
	(0.0076)	(0.0102)	(0.0451)	(0.0921)	(0.0460)	(0.0118)	(0.0370)	(0.0730)	(0.0411)	(0.0871)	(0.0757)	(0.0645)	
Micro dummy	-0.0440***	-0.0417***	-0.0643	-0.0033	-0.0315	-0.0264**	-0.0797**	-0.1343*	-0.0875**	-0.1568*	-0.0502	-0.0876	-0.2846**
	(0.0077)	(0.0105)	(0.0428)	(0.0944)	(0.0458)	(0.0121)	(0.0373)	(0.0729)	(0.0408)	(0.0858)	(0.0755)	(0.0645)	(0.1214)
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	151,670	38,827	1,402	838	9,390	59,633	6,038	11,303	7,299	2,857	8,098	5,812	130
Sectors	47	19	1	2	1	3	5	1	4	1	5	4	1
Adjusted R ²	0.0317	0.0425	0.0661	0.0522	0.0301	0.0311	0.0241	0.0290	0.0322	0.0151	0.0295	0.0389	0.0315

Source: Authors' estimations based on ICAP data.

Notes: The dependent variable MFP refers to the estimate of the level of total factor productivity, based on the Solow residual theory.^a The variable "Industry zombie capital sunk" refers to the share of capital sunk in zombie firms (with age larger or equal to 10 years and an interest coverage ratio < 1 for more than 3 consecutive years) in an industry in the relevant sector of economic activity. The classification NACE Rev. 2 is used for business economy sectors (sectors 10-82, except for sectors 64-66) and sectors 94-96. Standard errors are included in parentheses. ***, ** and * denote statistical significance at levels 1%, 5%, and 10%, respectively.

PRICE LEVEL DIFFERENCES IN THE EURO AREA: THE CASE OF GREECE

Alexandros Karakitsios

Bank of Greece, Economic Analysis and Research Department

Theodora Kosma

Bank of Greece, Financial Stability Department

Dimitris Malliaropoulos

Bank of Greece, Economic Analysis and Research Department,
and University of Piraeus, Department of Banking and Financial Management

Georgios Papadopoulos

Bank of Greece, Economic Analysis and Research Department

Pavlos Petroulas

Bank of Greece, Economic Analysis and Research Department

ABSTRACT

Recent inflationary pressures have significantly affected household disposable incomes across Europe, with Greece being particularly impacted due to its low purchasing power. This study investigates the persistence and evolution of price level differences for fast-moving consumer goods in Greece compared to other euro area countries. It utilises the results of Dixon et al. (2023), who analysed price level differences across 41 product categories in ten euro area countries and found that the main factors contributing to price level differences include producer market competition, retail market structure, local costs and consumer habits. Building on these findings, we construct counterfactual prices and show that aligning Greece's market structures and consumer behaviour patterns with the euro area average could significantly reduce prices (by 17 percentage points on average for the products with the highest share in total sales). The study also finds that although Greece has become cheaper in relative terms in recent years, it is still, on average, about 10% more expensive compared to euro area countries' average. These results imply that there is scope for policy action, in particular, in areas that increase competition among producers, improve the structure of the retail market and enhance consumer economic literacy.

Keywords: market structure; consumer behaviour; international relative prices

JEL classification: D4; E31; F41

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ΔΙΑΦΟΡΕΣ ΣΤΑ ΕΠΙΠΕΔΑ ΤΙΜΩΝ ΣΤΗΝ ΕΥΡΩΖΩΝΗ: ΤΟ ΠΑΡΑΔΕΙΓΜΑ ΤΗΣ ΕΛΛΑΔΟΣ

Αλέξανδρος Καρακίτσιος

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Θεοδώρα Κοσμά

Τράπεζα της Ελλάδος, Διεύθυνση Χρηματοπιστωτικής Σταθερότητας

Δημήτρης Μαλλιαρόπουλος

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών,
και Πανεπιστήμιο Πειραιώς, Τμήμα Χρηματοοικονομικής και Τραπεζικής Διοικητικής

Γεώργιος Παπαδόπουλος

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Παύλος Πέτρουλας

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

ΠΕΡΙΛΗΨΗ

Οι πληθωριστικές πιέσεις των τελευταίων ετών έχουν επηρεάσει σημαντικά το διαθέσιμο εισόδημα των νοικοκυριών, καθώς μείωσαν σε μεγάλο βαθμό την αγοραστική τους δύναμη. Πέραν του πληθωρισμού, ωστόσο, το ενδιαφέρον επικεντρώνεται και στις διαφορές των τιμών μεταξύ των χωρών της ευρωζώνης, οι οποίες εξακολουθούν να είναι σημαντικές, παρά την απουσία εμπορικών περιορισμών και την εξάλειψη των διακυμάνσεων των συναλλαγματικών ισοτιμιών, ενώ διάφορες έρευνες καταδεικνύουν ότι η Ελλάδα είναι μεταξύ των ακριβότερων χωρών σε αγαθά όπως το βρεφικό γάλα και τα απορρυπαντικά πλυντηρίου ρούχων.

Η παρούσα μελέτη ερευνά την εξέλιξη και την επιμονή των διαφορών των τιμών, εστιάζοντας σε 41 κατηγορίες επώνυμων τυποποιημένων προϊόντων που περιλαμβάνονται στα 10 χώρες της ευρωζώνης, με έμφαση στις διαφορές των τιμών για την Ελλάδα. Η μελέτη μας βασίζεται στα αποτελέσματα των Dixon et al. (2023), σύμφωνα με τα οποία οι κύριοι παράγοντες που συμβάλλουν στη διαφοροποίηση του επιπέδου των τιμών μεταξύ των χωρών είναι ο ανταγωνισμός σε επίπεδο παραγωγού, η δομή της αγοράς λιανικής και οι συνήθειες των καταναλωτών.

Με βάση τα παραπάνω αποτελέσματα, στην παρούσα μελέτη κατασκευάζονται υποθετικές τιμές (counterfactual prices) για τα προϊόντα που μελετώνται. Το βασικό εύρημα είναι ότι η εξομείωση της δομής της ελληνικής αγοράς και της συμπεριφοράς των καταναλωτών στην Ελλάδα με τα αντίστοιχα επίπεδα της ευρωζώνης θα οδηγούσε σε σημαντικές μειώσεις στις διαφορές των τιμών, οι οποίες για τα προϊόντα με τις υψηλότερες πωλήσεις θα μπορούσαν να φθάσουν έως και τις 17 ποσοστιαίες μονάδες κατά μέσο όρο. Από τη μελέτη προκύπτει επίσης ότι τα τελευταία χρόνια στην Ελλάδα έχει επιτευχθεί αξιοσημείωτη πρόοδος, καθώς οι διαφορές των τιμών έχουν μειωθεί σημαντικά, αλλά παραμένουν σε υψηλότερα επίπεδα σε σύγκριση με την ευρωζώνη (κατά μέσο όρο περίπου 10%). Συνεπώς, υπάρχει δυνατότητα περαιτέρω βελτίωσης με παρεμβάσεις οι οποίες αυξάνουν τον ανταγωνισμό μεταξύ των παραγωγών, επιφέρουν αλλαγές στη δομή της αγοράς λιανικής και —σε μακροπρόθεσμο ορίζοντα— στοχεύουν στην ενίσχυση του καταναλωτικού αλφαριθμητισμού.

PRICE LEVEL DIFFERENCES IN THE EURO AREA: THE CASE OF GREECE*

Alexandros Karakitsios

Bank of Greece, Economic Analysis and Research Department

Theodora Kosma

Bank of Greece, Financial Stability Department

Dimitris Malliaropoulos

Bank of Greece, Economic Analysis and Research Department,
and University of Piraeus, Department of Banking and Financial Management

Georgios Papadopoulos

Bank of Greece, Economic Analysis and Research Department

Pavlos Petroulas

Bank of Greece, Economic Analysis and Research Department

I INTRODUCTION

Recent inflation developments have put pressure on household disposable income in Europe. The erosion of purchasing power has become particularly acute for countries with low disposable income such as Greece, which, in purchasing power parity (PPP) terms, is one of the poorest countries in the European Union (EU).¹ Public discussion in Greece has recently focused on price level differences in similar goods across European countries following recent findings by the Hellenic Competition Authority, indicating that Greece is among the most expensive countries for [baby food](#) and laundry detergents. Recent developments have also prompted [EU-level demands](#) to crack down on multinational companies that force retailers to pay highly different prices for the same branded product, as well as demands to [further deepen the European Single Market in order to protect consumers and their income](#).

In economic theory, the law of one price (LOP) suggests that “a good must sell for the same price in all locations”. However, deviations from the LOP have been found to be significant and persistent over time.² Even within the euro area, which does not have any internal barriers to trade and where exchange rate fluctuations have been eliminated, empirical

evidence suggests that while price dispersion across countries has decreased over time, it still remains significant.³

There are several underpinnings as to why the price levels of the same product may differ, such as transport costs (Dumas 1992), imperfect competition and pricing-to-market effects (Krugman 1987), and productivity differences between traded and non-traded goods (Balassa 1964; Samuelson 1964). Non-traded input costs have also been found to be important determinants of international price differences (Crucini et al. 2005). More recent studies consider consumer behaviour as an additional factor that may determine international price differences. For instance, Alessandria and Kaboski (2011) emphasise search frictions as a source of market power and pricing-to-market.

In this article, we utilise the results of Dixon et al. (2023), who analyse price level differences in 41 product categories of fast-moving

* The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

1 See Eurostat, “[Purchasing power parities and GDP per capita – flash estimate – Statistics Explained](#)”.

2 See for example Isard (1977), Haskel and Wolf (2001), Lach (2002), Anderson and van Wincoop (2004).

3 See Goldberg and Verboven (2004), Engel and Rogers (2004), Berlingieri et al. (2018), Reiff and Rumler (2014), Dixon et al. (2023).

consumer goods across ten euro area countries. In their study, they find that producer market competition, retail market concentration, local costs (such as wages and rents) and consumer habits explain a significant part (about 40%) of branded product price differences across countries.

Based on their empirical results, we construct counterfactual prices for those 41 product categories. Specifically, we investigate what prices for branded goods could be in Greece if the above-mentioned explanatory variables were set at the euro area average. We find that for Greece the prices of most goods included in the analysis could be significantly reduced, by up to 48 percentage points. Moreover, we update the price level data at the product level up to 2023 using inflation developments at the COICOP 5 level as an approximation.⁴

The results reveal that while Greece has become cheaper over the past decade compared to the euro area, it remains one of the most expensive countries for branded fast-moving consumer goods. We show that prices in Greece could be significantly lower if producer and retail market characteristics, as well as consumer preferences were aligned with the euro area average. This result holds across most products. In fact, for many products, adjusting the explanatory variables to the euro area average would make Greece significantly cheaper than the euro area average. Significant reductions in branded fast-moving consumer goods can be obtained by increasing competition in the producer market, as well as by improving the structure of the retail market. Specifically, the retail market would need to be more competitive across retailers at the local level towards the consumer, but also more concentrated when buying goods from the producers in order to counteract their monopolistic power. Finally, in the long run, educating consumers, i.e. improving economic literacy, would also contribute significantly to reducing price differentials with the euro area.

2 WHAT DO PRICE LEVEL DIFFERENCES DEPEND ON

2.1 THE DIXON ET AL. (2023) STUDY

Dixon et al. (2023) analyse price level differences in 41 product categories of fast-moving consumer goods across 58 regions in ten euro area countries. They use a large and highly disaggregated dataset of retail prices and quantities from A.C. Nielsen market research (Nielsen), covering the period from January 2009 to October 2011.⁵ Within each product category, they employ unit prices and quantities for four brands and private labels, which on average cover 80% of total sales in each category.⁶

The authors show that price dispersion across countries is about ten times higher than price dispersion within countries, indicating that price differences in similar products are significantly larger across countries than within countries. On balance, they find that Greece and Ireland were among the most expensive countries, while Spain and Germany among the cheapest.

Moreover, in order to account for quality differences that may be a determinant of price differences, they also compare unit prices of market leaders across locations and countries, the rationale being that market leaders, by definition, tend to have a broad consumption base and be characterised by good quality. They

⁴ The *Classification of Individual Consumption by Purpose*, abbreviated as COICOP, is a classification developed by the United Nations Statistics Division to classify individual consumption expenditures and was adapted to the compilation of the harmonised index of consumer prices (HICP) of the European Union (EU) and the euro area.

⁵ The product categories in Dixon et al. (2023) are: 100% juice, diapers, ground coffee, instant coffee, all purpose cleaners, automatic dishwasher detergent, baby food, beer, butter, cat food, cereals, condoms, carbonated soft drinks, deodorant, dog food, dry pasta, fabric softener, frozen fish, ice cream, strawberry jam, laundry detergent, margarine, refrigerated milk, UHT milk, olive oil, pantyliners, paper towels, frozen peas, rice, shampoo, shaving preps, sugar, tinned peas, tinned tuna, toilet tissue, toothpaste, vodka, sparkling water, still water, wet soups, whiskey. The countries included in the analysis are: Austria (AT), Belgium (BE), Germany (DE), Spain (ES), France (FR), Greece (GR), Ireland (IE), Italy (IT), the Netherlands (NL) and Portugal (PT).

⁶ This would imply that the markets in these product categories are better characterised as oligopolistic markets.

offer, in consumers' eyes, reasonable "value for money" within each country. Indeed, for many product categories, market leaders tend to be the same producers offering the same base products – for example, Barilla in the product category of dry pasta. In this respect, quality differences are minimised.⁷ In order to view the full range of price dispersion, they compare the time-averaged minimum and maximum unit value prices of market leaders (within each product category) across euro area countries. They show that there are very large differences in prices, indicating strong "pricing-to-market" effects as, on average, for the 41 product categories, the mean and the median price difference is a full 220% and 181%, respectively. Finally, they also show that there are significant differences across countries for the same product (for example Coca Cola or Lenor fabric softener).

2.2 THE MAIN DRIVERS OF PRICE DIFFERENCES

In their study, Dixon et al. (2023) set up an empirical estimation model, where the price of a branded product (j) in location (i) depends on: 1) competition characteristics on the producer side; 2) competition characteristics in the retail sector; 3) consumer habits; and 4) other variables such as VAT rates, rents, wages, local unemployment rate, local GDP per capita, etc.

In order to capture the competition characteristics in each location on the producer side, the following variables are included:

- The quantity share of the market leader. A higher share of the market leader in a given product category would imply higher monopoly power and higher mark-ups, that is higher prices.
- The quantity share of other brands, which would capture the strength of competition towards the market leader. A higher share of other brands would imply lower prices.
- The quantity share of private labels, which would capture competition from non-

branded goods. This would also have a downward effect on the prices of branded goods that consumers face.

The variables included in the characteristics of the retail market take the form of a Herfindahl-Hirschman index (HHI) that measures concentration. When assessing the market power of retailers, it is important to account not only for downstream market competition (i.e. with respect to consumers), but also for upstream market competition (i.e. with respect to producers, "buying power" of retailers), as the latter will determine significantly the price at which the retailer buys the product from the producer.^{8,9} Specifically, for the consumer at the local level (usually within a 5 kilometre radius), it is important that retailers face competition. This means that the consumer has several local options to buy goods from. As to retail concentration towards the producer, it is important that retailers form buying groups. By doing so, they can place larger orders, acting as a "monopsonist" towards the producer, and can, therefore, obtain better prices.¹⁰ This is of particular importance when producers are large multinationals with significant market shares in many countries and in many product categories within each country. For this purpose, local (5 km radius) and regional HHI indices are used to measure:¹¹

- Retail concentration towards the consumer – downstream competition. Increased concentration towards the consumer would

⁷ On average, market leaders are about 4% more expensive than the non-leading brands.

⁸ For an analysis of alternative measures of retail market competition, see ECB (2011), "Structural features of distributive trades and their impact on prices in the euro area", Report of the Task Force of the Monetary Policy Committee of the ESCB, Occasional Paper No. 128.

⁹ Several companies may form a buying group when making purchases in order to obtain more favourable prices from manufacturers, due to bulk. For the effects on prices, see Ciapanna and Colonna (2011), ECB (2011) and Corstjens (2022).

¹⁰ Retail alliances are horizontal alliances of retailers, retail groups or retail chains, aiming at creating a degree of buying power vis-à-vis producers, thus allowing retailers to negotiate lower prices with them. Recent studies find that retail alliances may lead to significant declines in prices, e.g. Corstjens (2022).

¹¹ These indices have been calculated from a unique dataset encompassing the exact location of over 100,000 individual grocery stores across the euro area for 2010. The indices were compiled for the purposes of the analysis in ECB (2011), op. cit. in footnote 8.

imply lower local competition and hence higher prices.

- Retail concentration towards the producer – upstream competition. Increased concentration towards the producer would imply higher monopsony power for retailers and hence lower prices.

For the variables capturing consumer habits, two variables are derived:

- One variable measures what we call consumption intensity, calculated as the number of units sold per person per month in a location. A priori, higher consumption intensity is associated with lower prices, as consumers will spend more time researching the market if they consider the product to be important and spend on it a relatively higher share of their disposable income. One could view this variable as measuring search costs at the product level.
- The second measure is based on the average pack size and captures the preferences of consumers for certain pack sizes. While in general the larger the pack size the lower unit prices tend to be, it is still the choice of the consumer what pack size to buy (provided that larger pack sizes do exist). One could view this variable as a consumer trait indicating some type of inattention, which will enable firms to set higher prices. Thus, larger pack sizes are associated with lower prices.

Finally, there are several additional variables capturing wage and rent costs, unemployment, VAT levels and promotions/sales.

All prices and explanatory variables are expressed in relative terms and in particular relative to the median price location. Specifically, the authors find the location with the median price for each product and obtain the relevant characteristics of all aforementioned variables in this median price location. They then express prices and all their explanatory variables (in all other locations) in relative terms.

Table 1 Empirical estimates: euro area

Variable	Effect of a 10% increase on relative price
Share of market leader	+0.5%
Share of other brands	-0.7%
Share of private labels	-0.2%
Average pack size	-4.5%
Consumption intensity	-0.6%
Retail concentration (towards consumer)	+3.3%
Retail concentration (towards producer)	-4.5%

Source: Dixon et al. (2023).

Note: The effects are based on results in Table 4 of Dixon et al. (2023).

Their main results for the euro area are summarised in Table 1. All variables have the expected sign. An increase in the monopoly power of the producer, captured by the share of the market leader, raises prices, while higher competition from other producers, captured by the share of other brands and private labels, reduces prices. As regards consumer habits, an increase in the average pack size and consumption intensity reduces prices. Finally, as regards the retail market structure, an increase in concentration towards consumers, i.e. lower local competition, raises prices, while an increase in concentration towards producers, i.e. higher monopsony power, reduces prices.

What do these results imply for Greece and the prices Greek consumers face? Greece tends, on average, to be characterised by a higher share of the market leader and low private label penetration. This implies higher monopoly power of the producer and less producer market competition. For many products, consumption intensity is lower and consumers purchase smaller pack sizes compared with the euro area average. Finally, with regard to retail concentration, Greece exhibits higher local concentration towards the consumer and lower concentration towards the producer, with both factors implying higher prices.

3 COUNTERFACTUALS: ADJUSTING GREECE TO BEING AVERAGE

The above results are averages across all products and apply to the euro area as a whole. However, we can use them to produce some counterfactuals. For example, if we take the products in which Greece is the most expensive across all euro area countries, such as ground coffee, butter, margarine, UHT milk, paper towels, toilet tissue, toothpaste and sparkling water, we can investigate to what extent these high prices depend on differences in our explanatory variables.

Specifically, we can observe the magnitude of each explanatory variable for each product, as well as the product-specific average of each explanatory variable across euro area countries (see Tables A-F in Dixon et al. 2023). For instance, we observe the share of the market leader in the product category of ground coffee for Greece and calculate the respective euro area average. We then calculate the percentage difference between the Greek value of the respective variable and the euro area average and multiply it by the coefficient for each variable obtained by the regressions. This would give us a counterfactual price for these

products in Greece, i.e. what prices would be if Greece stood at the euro area average for each explanatory variable. Each explanatory variable has a product-specific dimension except for the retail market structure, which is common for all products.

Table 2 shows for example that the price of ground coffee in Greece is 50% above the euro area average. If we adjust the market structure of producers to match the euro area average, this would reduce price differences by 7%. Moreover, if Greek consumers consumed as much ground coffee as in the euro area and bought similar (larger) pack sizes, price differences would be reduced by another 15%. Finally, if the retail market structure in Greece, both downstream towards the consumer (higher local competition) and upstream towards the producer (higher bargaining power of retailers), were similar to that of the euro area, average price differences would be further reduced by 13%. The remaining price difference of 15%, i.e. the price difference that could not be explained on the basis of this exercise if Greece had converged to the euro area average, is significantly smaller than the original 50%. Indeed, for all products the potential reduction of price differences in Greece is

Table 2 Counterfactual price differences: the effect of adjusting Greece to the euro area average on the prices of the most expensive products

	Observed price difference from the euro area average	Market leader effect	OB effect	PL effect	Pack size effect	Consumption intensity effect	Retail concentration effect	Model implied change	Final net price difference
Ground coffee	50%	-7%	1%	-1%	-10%	-5%	-13%	-35%	15%
Butter	54%	-7%	2%	-2%	0%	-5%	-13%	-25%	29%
Margarine	60%	-2%	-2%	-2%	-2%	-2%	-13%	-23%	36%
UHT milk	56%	-4%	6%	-1%	-7%	-6%	-13%	-25%	32%
Paper towels	100%	4%	2%	0%	-21%	-3%	-13%	-31%	68%
Toilet tissue	25%	-7%	1%	0%	-7%	-2%	-13%	-28%	-4%
Toothpaste	16%	-2%	1%	-2%	-5%	-3%	-13%	-24%	-8%
Sparkling water	129%	-5%	0%	-2%	-22%	-6%	-13%	-48%	81%
Average	61%	-4%	1%	-1%	-9%	-4%	-13%	-30%	31%

Source: Authors' calculations based on results in Table 4 and information from Table 2 and Tables A-F of Dixon et al. (2023).

Note: OB = other brands, PL = private labels.

Table 3 Counterfactual price differences: the effect of adjusting Greece to the euro area average on the prices of the products with the highest sales

	Observed price difference from the euro area average	Market leader effect	OB effect	PL effect	Pack size effect	Consumption intensity effect	Retail concentration effect	Model implied change	Final net price difference
Refrigerated milk	-8%	2%	0%	-1%	2%	1%	-13%	-9%	-16%
Carbonated soft drinks	15%	-2%	3%	-1%	-11%	-4%	-13%	-28%	-12%
Olive oil	-24%	0%	0%	-1%	48%	3%	-13%	37%	14%
Beer	0%	-4%	1%	2%	-18%	-5%	-13%	-37%	-36%
Toilet tissue	25%	-7%	1%	0%	-7%	-2%	-13%	-28%	-4%
Instant coffee	17%	-9%	-4%	-2%	-8%	3%	-13%	-33%	-15%
Whiskey	7%	-4%	24%	-1%	1%	-2%	-13%	5%	12%
Diapers	-4%	-1%	-5%	-1%	-5%	-1%	-13%	-26%	-29%
Cereals	15%	-14%	1%	-1%	-4%	-2%	-13%	-33%	-18%
100% juice	0%	-4%	-11%	-1%	-8%	-2%	-13%	-39%	-39%
Shampoo	-13%	-7%	-1%	0%	19%	1%	-13%	-1%	-14%
Average	3%	-4%	1%	-1%	1%	-1%	-13%	-17%	-14%
Average excl. olive oil	5%	-5%	1%	-1%	-4%	-1%	-13%	-23%	-17%

Source: Authors' calculations based on results in Table 4 and information from Table 2 and Tables A-F of Dixon et al. (2023).
Note: OB = other brands, PL = private labels.

significant, with sparkling water accounting for the largest reduction, namely 48 percentage points. On average, for the products presented in Table 2, the price difference would be reduced by half, from 61% to 31%.¹² It appears that improving producer market competition would lead to lower price differences vis-à-vis the euro area. However, a significant reduction in price differences would also come from improvements in the structure of the retail market, by increasing both local competition towards the consumer and retailers' bargaining power towards producers, e.g. through retail buying alliances. Finally, lower price differences could also originate from potential changes in consumer behaviour.

While the potential reduction of price differences in Table 2 is large, the reason for this could be that the products in which Greece is the most expensive across euro area countries are not the most representative ones from the consumer's point of view. To this end, we con-

duct a similar counterfactual exercise, focusing on a set of products with the highest shares in total sales in Greece, which is more representative of the actual Greek consumption basket. The results for the eleven product categories with the highest shares in total sales are presented in Table 3.¹³ The table reports the observed price differences between Greece and the euro area average (second column), as well as how prices would be affected if Greece stood at the euro area average for each explanatory variable (third to eighth column).¹⁴ We can draw four main conclusions from Table 3.

First, we can see that observed price differences between Greece and the euro area are now significantly smaller on average (only 3%,

¹² Referring to the averages of the explanatory variables for the eight products presented in the table.

¹³ These eleven product categories account for about 70% of total sales in Greece in the product categories included in the sample of Dixon et al. (2023).

¹⁴ Averages refer to the products included in Table 3.

or 5% excluding olive oil) as, depending on the product, price differences could be both significantly smaller and larger compared with the euro area average.

Second, as regards products that are more expensive, e.g. carbonated soft drinks, instant coffee, toilet tissue and cereals, prices could be 28%-33% lower if producer and retail market characteristics, as well as consumer preferences were aligned with the euro area averages (see Table 3, column “Model implied change”). Adjusting the explanatory variables to the euro area average would not only fully eliminate any price differences, but would also make these products even cheaper than in the euro area. Overall, adjusting the explanatory variables to the euro area average would make Greece 14% cheaper relative to the euro area.

Third, consumer habits play an important role in determining the price of some products. Adjusting consumer habits, such as the preferred pack size, to those of the average euro area consumer could, in some cases, lead to price increases instead of price declines. Olive oil is such an example. Our results in Table 3 suggest that the relative price of olive oil in Greece would increase by 37% if producer and retail market characteristics, as well as consumer preferences were aligned with the euro area averages. This is mainly because olive oil in Greece is typically bought in much larger pack sizes compared to the euro area and, hence, adjusting the pack size to the euro area average would lead to significant increases in prices.

Fourth, our results in Table 3 suggest that, on average, the largest part of the decline in prices after adjusting Greece to the euro area average comes from the market leader effect and the retail concentration effect. Overall, improving the market structure in Greece towards the euro area average would lower prices by 17% on average for the eleven product categories with the highest shares in the consumer basket (see Table 3, second row from the bottom). Most of this decline (13%)

would come from improving the structure of the retail market, both towards the consumer and towards producers. The decline in prices would, on average, be larger (23%) if we excluded olive oil (see Table 3, last row).

4 PRICE LEVELS NOW AND THEN

In order to get an idea of where Greece would stand today in terms of price differences, we perform a simple extrapolation of the unit prices of the products included in Dixon et al. (2023) using COICOP 5 price developments. In particular, we match the products in the Dixon et al. (2023) study to the relevant COICOP 5 index.¹⁵ We then approximate the current average price of the product using the cumulative annual rate of change in the relevant COICOP 5 index.¹⁶ We approximate therefore an implied price level in order to assess recent developments.

If we focus on the products in which Greece was the most expensive across euro area countries, i.e. ground coffee, butter, margarine, UHT milk, paper towels, toilet tissue, toothpaste and sparkling water, we see that Greece still ranks high (see Chart 1). However, it does not seem to be any more the most expensive country for all of these product categories, while for selected products the price difference with other countries has narrowed. Rather, there is now a clustering of implied prices at more similar values in products such as toothpaste, margarine, UHT milk and toilet tissue. A similar conclusion can be reached when focusing on the products with the highest sales (see Chart 2).

The picture emerging from the selected products presented in Charts 1 and 2 is further corroborated in Table 4. Table 4 shows the relative change over time in the examined countries' positions vis-à-vis the euro area average. For example, Austrian (AT) prices relative to

¹⁵ See Table A1 in the Appendix.

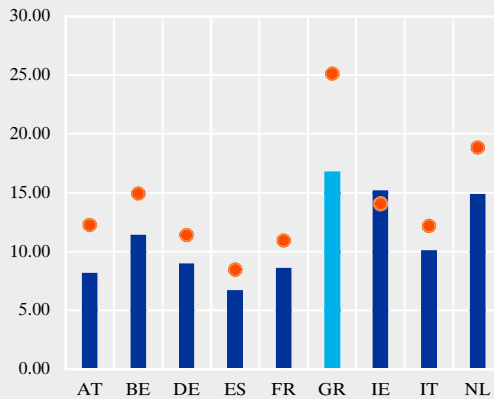
¹⁶ If the COICOP 5 index is not available for some time period, we approximate developments by the relevant COICOP 4 index.

Chart I Prices of the most expensive products in selected euro area countries (2011, 2023)

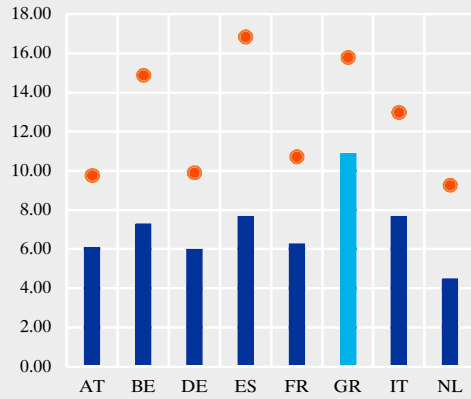
(EUR per unit)

■ 2011 ● 2023

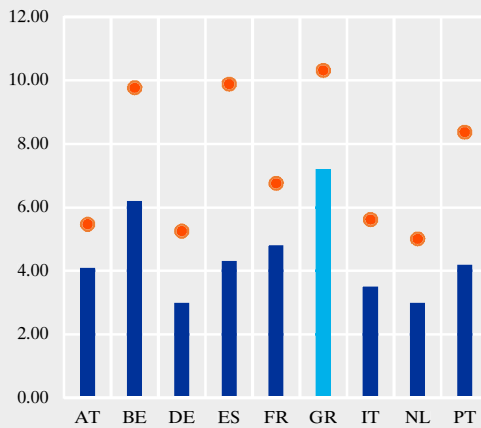
a) Ground coffee



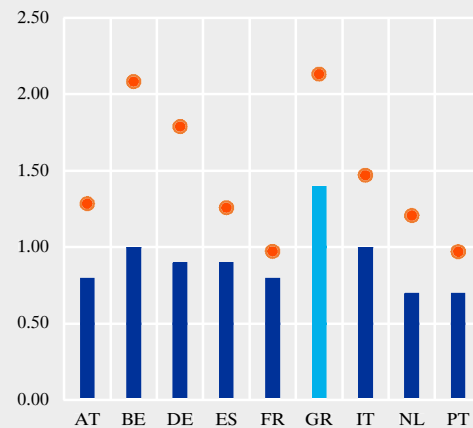
b) Butter



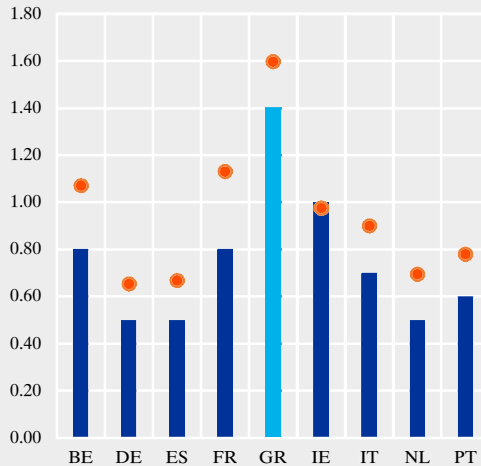
c) Margarine



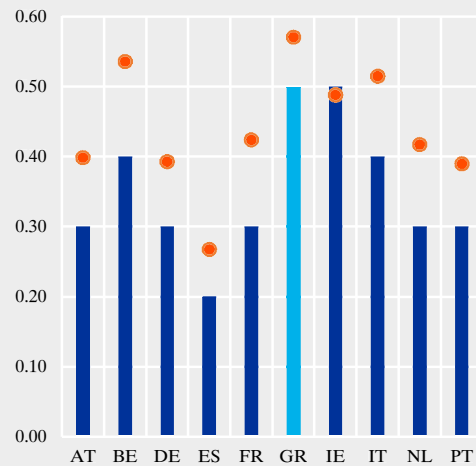
d) UHT milk



e) Paper towels



f) Toilet tissue



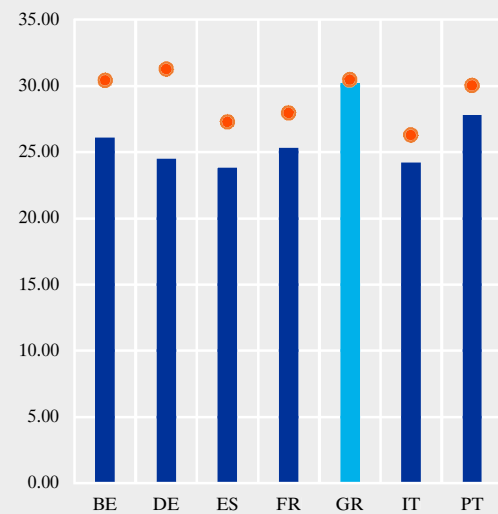
Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).
Note: For unit equivalence, see Table A1 in the Appendix.

Chart I Prices of the most expensive products in selected euro area countries (2011, 2023)
(continued)

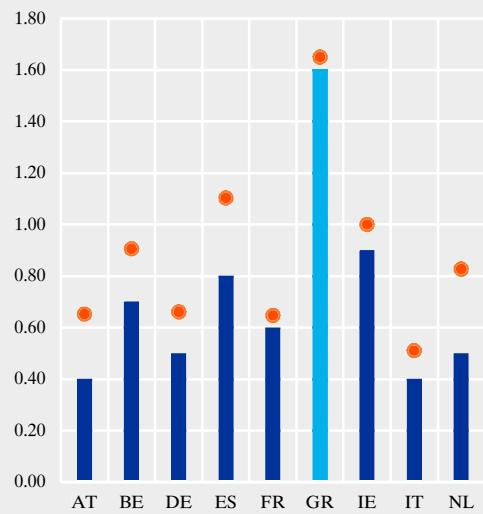
(EUR per unit)

■ 2011 ● 2023

g) Toothpaste



h) Sparkling water



Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).
Note: For unit equivalence, see Table A1 in the Appendix.

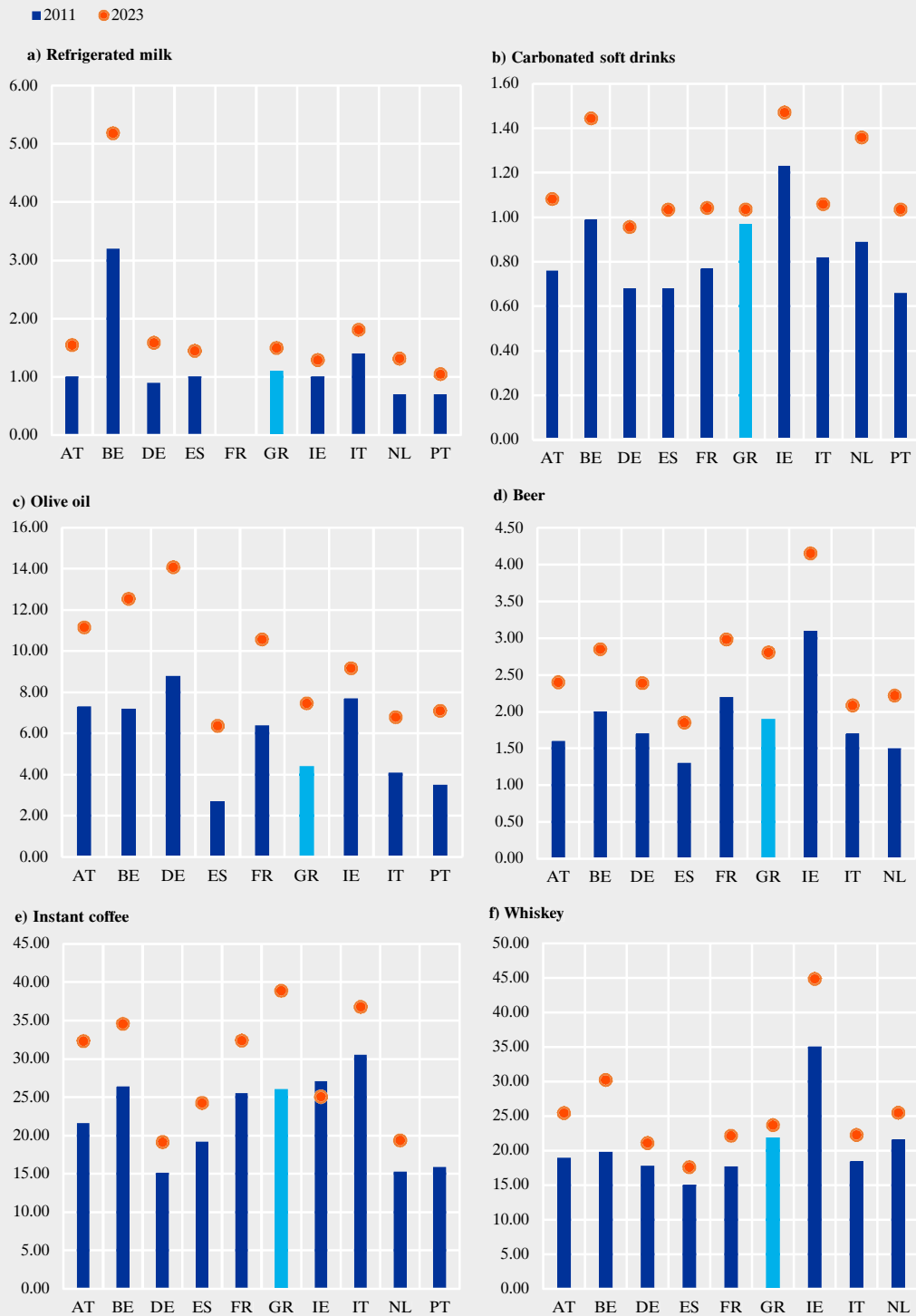
Table 4 Change in relative prices vis-à-vis the euro area average between 2011 and 2023

Country	All products	Food	Beverages	Other
Austria	6%	4%	12%	3%
Belgium	7%	5%	8%	8%
Germany	9%	12%	1%	10%
Spain	5%	8%	2%	4%
France	-3%	-7%	-3%	3%
Greece	-8%	-10%	-7%	-8%
Ireland	-24%	-26%	-18%	-26%
Italy	-2%	0%	-4%	-4%
Netherlands	5%	4%	8%	3%
Portugal	2%	4%	7%	-3%

Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).

Chart 2 Prices of products with the highest sales in selected euro area countries (2011, 2023)

(EUR per unit)

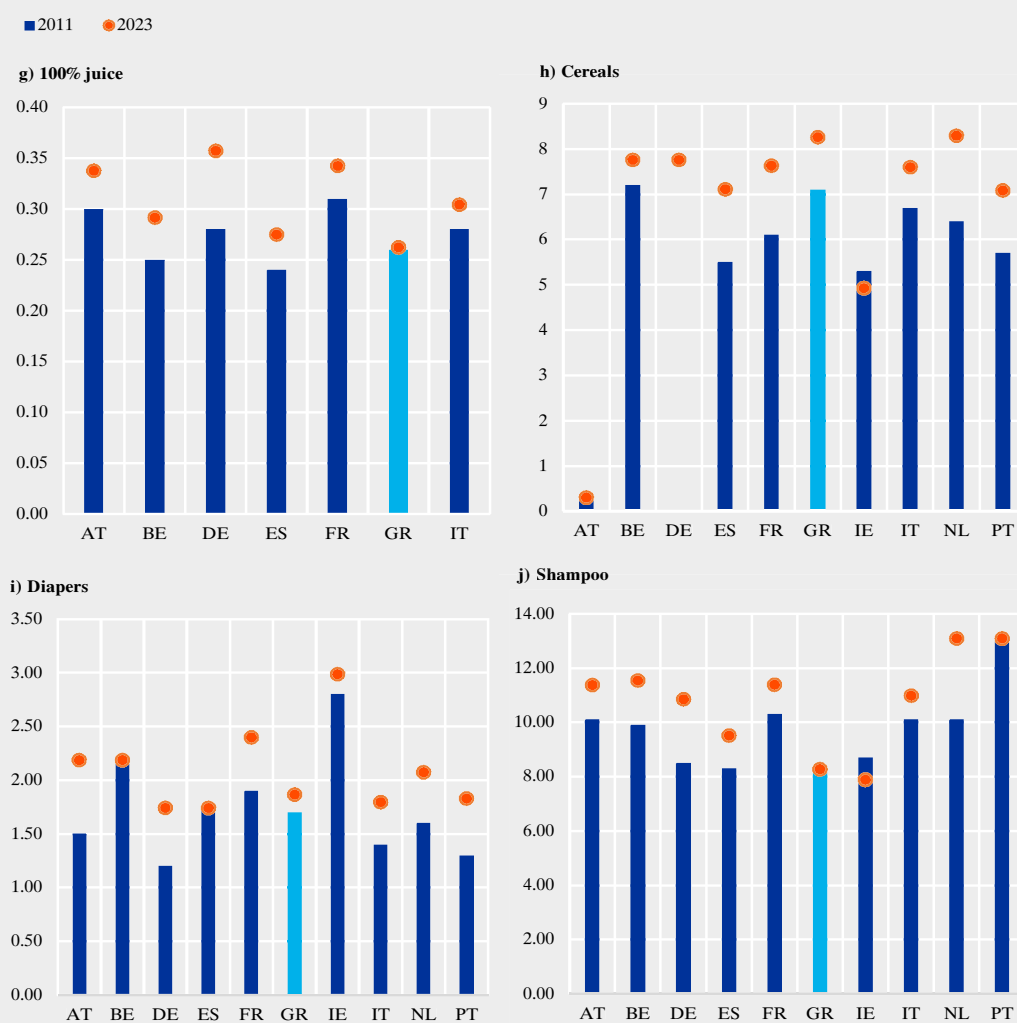


Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).

Note: For unit equivalence, see Table A1 in the Appendix.

Chart 2 Prices of products with the highest sales in selected euro area countries (2011, 2023)
(continued)

(EUR per unit)



Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).
Note: For unit equivalence, see Table A1 in the Appendix.

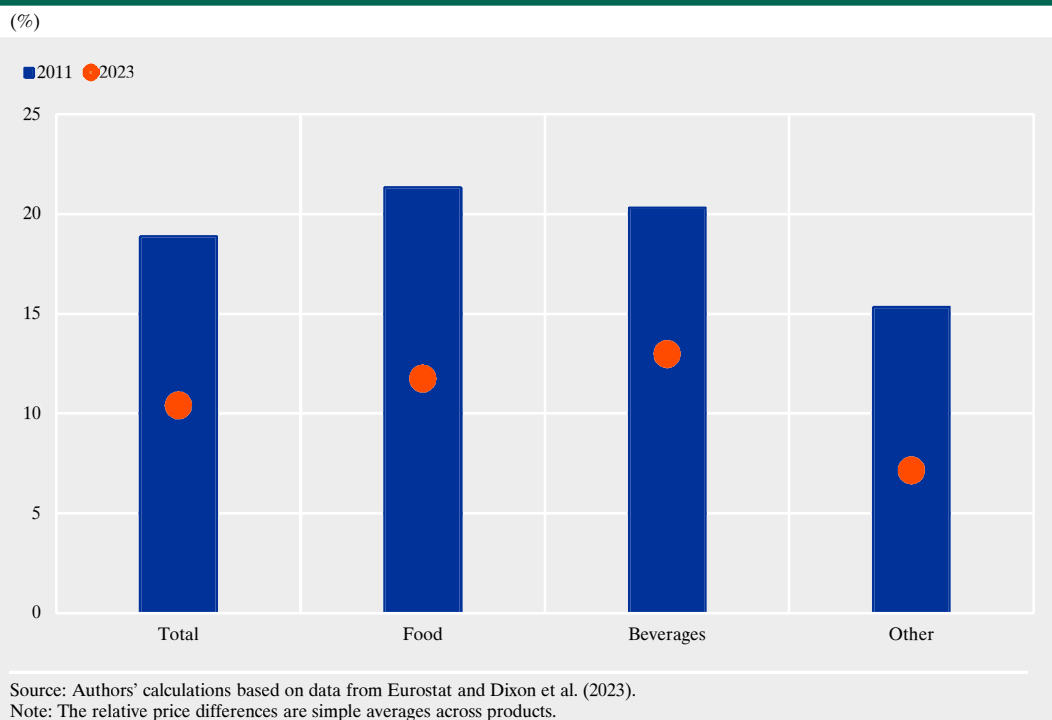
the euro area average have increased by 6% in 2023 compared to 2011. In other words, Austrian prices have increased more than the euro area average for these goods. In the same vein, Greece has, on average, become relatively cheaper and particularly in the food products category (see Table 4 and Chart 3). While Greece seems to have outperformed other countries, it has not experienced the remarkable adjustment of Ireland, which, together with Greece, appeared in Dixon et al. (2023) to be among the most expensive countries.

Finally, Germany and Spain, which appeared to be among the cheapest countries, have now reduced their relative distance from the euro area average and have become relatively more expensive compared to 2011.¹⁷

Combining the messages emerging from Table 4 and Charts 1, 2 and 3 suggests that even though, on average, Greece has become cheaper

¹⁷ See Table A2 in the Appendix for the average relative differences of all countries in the sample between 2011 and 2023.

Chart 3 Relative price difference for Greece vis-à-vis the euro area average (2011, 2023)



in relative terms vis-à-vis the euro area in recent years, it has not yet covered the entire distance, as it remains a rather expensive country in many product categories. Furthermore, our implied extrapolated prices could be interpreted as indicating that significant price differences persist in the euro area despite the observed convergence illustrated in Table 4. Therefore, the forces underlying these price differences are still at play and policy action may be required in order to exploit the full potential of the single market.

5 OTHER PRICES

Apart from fast-moving consumer goods, there is of course a range of products that are important to consumers, such as unprocessed food, services and rents. In order to obtain a picture about the relative prices facing the Greek consumer, we turn to a database called [Numbeo](#). The Numbeo database contains information about the prices of 55 standard items, which reflect the cost of living in over 11,500 cities worldwide. The data collection process

involves a combination of user-provided input and information gathered by Numbeo's team from reliable sources, including government institutions and supermarket websites.

The final, publicly available, dataset provides information on the minimum, maximum and average prices over the past twelve months for each item in the database. Numbeo classifies the 55 available items into ten broad categories: restaurants; markets; transportation; utilities (monthly); sports and leisure; child-care; clothing and shoes; rent per month; buy apartment price; and salaries and financing.¹⁸

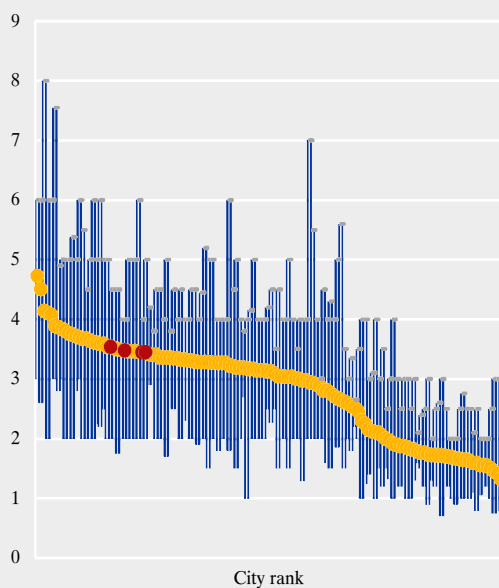
The current analysis uses data as of January 2024 for 134 cities from all 20 euro area countries. The sample includes four cities from Greece: Athens; Thessaloniki; Heraklion; and Larissa.

¹⁸ To ensure data quality, Numbeo uses various methods. It applies automatic and semi-automatic algorithms to reduce noise in the collected data, it assigns three times more weight to the information collected from reliable sources and it blocks IP addresses that are identified as spammers. Finally, Numbeo regularly removes incorrect data using existing data as a benchmark.

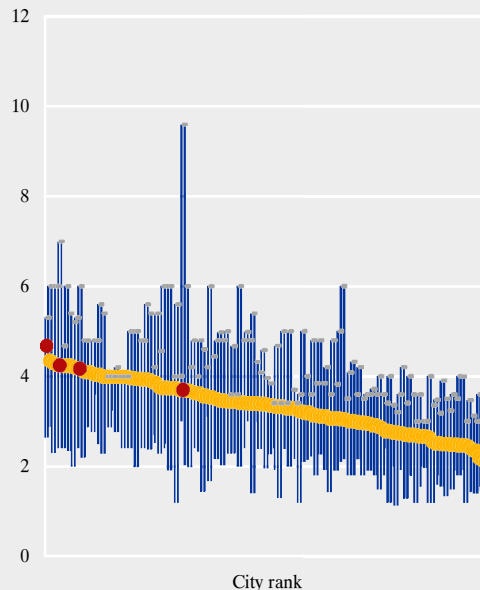
Chart 4 High-priced products

(EUR)

a) Regular cappuccino



b) Eggs (12 pieces)



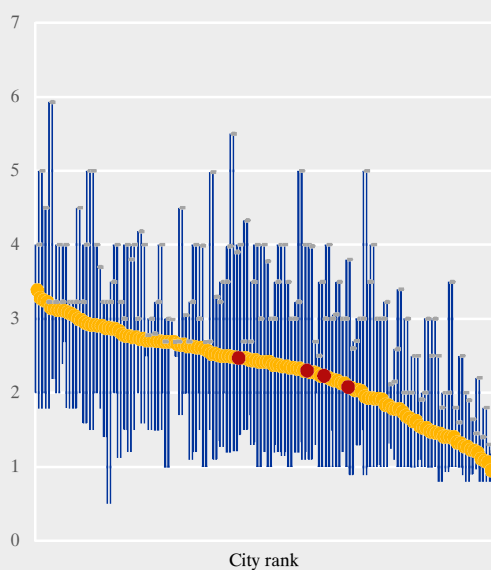
Source: Numbeo, January 2024.

Note: Red markers depict the four Greek cities included in the database (Athens, Thessaloniki, Heraklion, Larissa).

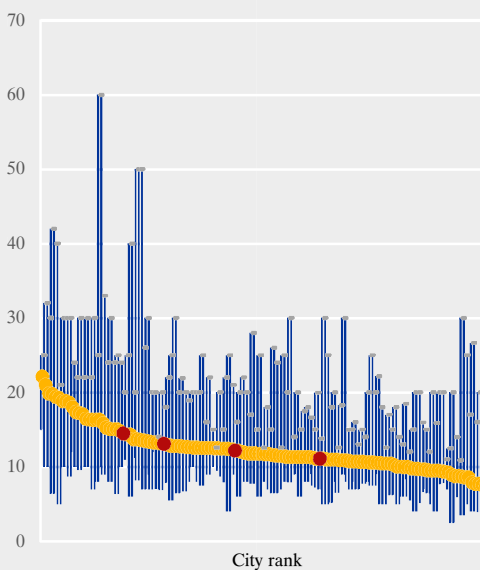
Chart 5 Mid-range-priced products

(EUR)

a) Rice (white, 1 kg)



b) Local cheese (1 kg)



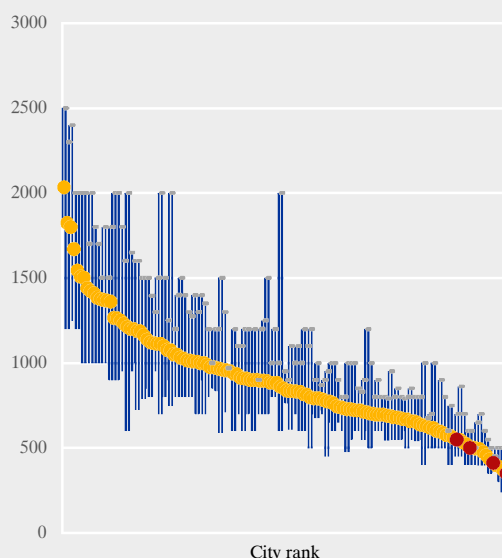
Source: Numbeo, January 2024.

Note: Red markers depict the four Greek cities included in the database (Athens, Thessaloniki, Heraklion, Larissa).

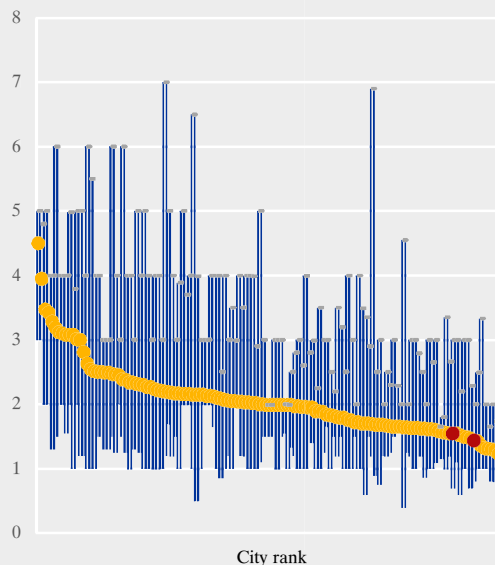
Chart 6 Low-priced products

(EUR)

a) Apartment (1 bedroom) in city centre



b) Oranges (1 kg)



Source: Numbeo, January 2024.

Note: Red markers depict the four Greek cities included in the database (Athens, Thessaloniki, Heraklion, Larissa).

Based on Numbeo's data, the analysis shows that Greek cities belong to the group of cities with the lowest prices for about half of the database's items. Such items are mostly unprocessed food (fresh fruits and vegetables, as well as unprocessed meat) such as tomatoes, potatoes, oranges, apples and beef, among other things. By contrast, for about 13% of the items, Greek cities are among those with the highest prices. Examples include supermarket items such as bottle of wine, domestic beer and eggs, as well as served coffee. Finally, for about 30% of the items, Greek cities cluster in the middle of the price range scale. This holds for items in the clothing category, as well as some processed food items such as chicken fillets and local cheese.

Charts 4, 5 and 6 show some representative examples of cities' ranking for various items. The vertical lines depict the range of prices and the yellow dots their average values. Red markers denote the four Greek cities.

On balance, while Greece is among countries with the lowest prices for a large share of other products, these refer mostly to locally produced goods or services. In this respect, small local producers may not follow the same pricing strategies as in the case of most fast-moving consumer goods that are produced by large multinational corporations.

6 CONCLUSIONS

In this article, we analyse price level differences between Greece and the euro area in 41 product categories of fast-moving consumer goods based on the estimates of Dixon et al. (2023), who find that producer market competition, retail market concentration and consumer habits explain a significant part of price differences across countries. In particular, we investigate what prices for branded goods could be in Greece if the above-mentioned explanatory variables were set at the respective euro area average.

We show that prices in Greece could be significantly lower if producer and retail market characteristics, as well as consumer preferences were aligned with the euro area average. This result holds across most products. For the goods in which Greece was the most expensive country, price reductions could reach 30% on average. Significant reductions could also be achieved for the set of goods with the highest shares in total sales, which are more representative for the Greek consumer basket. Specifically, for this set of goods, reductions of 17% on average (23%, if olive oil is excluded) could be obtained.

Our results further show that while Greece has become cheaper over the past decade compared to the euro area, it remains one of the most expensive countries for branded fast-moving consumer goods, implying that there is scope for policy interventions in order to further reduce prices in Greece in the fast-moving consumer goods segment.

For many years, policy discussions have focused on the importance of interventions to improve competition on the producer side, and recently on interventions that would reduce the pricing power of multinationals. Our results confirm this viewpoint, with price reductions reaching up to 14% through enhanced competition in the producer market towards the euro area average. However, there are additional areas on which policy should also focus.

In particular, improving the structure of the retail market, on the one hand, by increasing local competition and, on the other hand, by providing incentives for retailers to form buying groups —with a view to tackling the oligopolistic power of multinational producers— could significantly reduce observed price differentials. Finally, in the long term, educating consumers, i.e. improving economic literacy, would also contribute to reduced price differentials with the euro area and provide significant benefits for them.

REFERENCES

- Alessandria, G. and J.P. Kaboski (2011), “Pricing-to-market and the failure of absolute PPP”, *American Economic Journal: Macroeconomics*, 3(1), 91-127.
- Anderson, J.E. and E. van Wincoop (2004), “Trade costs”, *Journal of Economic Literature*, 42(3), 691-751.
- Balassa, B. (1964), “The purchasing-power parity doctrine: A reappraisal”, *Journal of Political Economy*, 72(6), 584-596.
- Berlingieri, G., H. Breinlich and S. Dhingra (2018), “The impact of trade agreements on consumer welfare – Evidence from the EU Common External Trade Policy”, *Journal of the European Economic Association*, 16(6), 1881-1928.
- Ciapanna, E. and F. Colonna (2011), “The effect of retail sector concentration on prices and SME performance in Italy”, mimeo.
- Ciapanna, E. and C. Rondinelli (2014), “Retail market structure and consumer prices in the euro area”, ECB, Working Paper No. 1744.
- Corstjens, M. (2022), “International retail buying groups: A force for the good? The case of AgeCore/EDEKA”, INSEAD, Working Paper No. 2022/30/MKT.
- Crucini, M.J., C.I. Telmer and M. Zachariadis (2005), “Understanding European real exchange rates”, *American Economic Review*, 95(3), 724-738.
- Dixon, H., T. Kosma and P. Petroulas (2023), “Explaining the endurance of price level differences in the euro area”, Bank of Greece, Working Paper No. 319.
- Dumas, B. (1992), “Dynamic equilibrium and the real exchange rate in a spatially separated world”, *The Review of Financial Studies*, 5(2), 153-180.
- ECB (2011), “Structural features of distributive trades and their impact on prices in the euro area”, Report of the Task Force of the Monetary Policy Committee of the ESCB, Occasional Paper No. 128.
- Engel, C. and J.H. Rogers (2004), “European product market integration after the euro”, *Economic Policy*, 19(39), 347-384.
- Goldberg, P. and F. Verboven (2004), “Cross-country price dispersion in the euro era: A case study of the European car market”, *Economic Policy*, 19(40), 483-521.
- Haskel, J. and H. Wolf (2001), “The Law of One Price: A case study”, *The Scandinavian Journal of Economics*, 103(4), 545-558.
- Isard, P. (1977), “How far can we push the ‘Law of One Price’?”, *The American Economic Review*, 67(5), 942-948.
- Krugman, P.R. (1987), “Pricing to market when the exchange rate changes,” in Arndt, S.W. and J.D. Richardson (eds), *Real-financial linkages among open economies*, Cambridge, MA: MIT Press, 49-70.
- Lach, S. (2002), “Existence and persistence of price dispersion: An empirical analysis”, *The Review of Economics and Statistics*, 84(3), 433-444.
- Reiff, Á. and F. Rumler (2014), “Within- and cross-country price dispersion in the euro area”, ECB, Working Paper No. 1742.
- Samuelson, P.A. (1964), “Theoretical notes on trade problems”, *The Review of Economics and Statistics*, 46(2), 145-154.

APPENDIX

Table A1 Correspondence table, products and COICOP

Product	Unit equivalent	COICOP 5 code	COICOP 5 code description	COICOP 4 code	COICOP 4 code description
100% juice	L	01223	Fruit and vegetable juices	0122	Mineral waters, soft drinks, fruit and vegetable juices
Diapers	PIECE	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care
Ground coffee	KG	01211	Coffee	0121	Coffee, tea and cocoa
Instant coffee	KG	01211	Coffee	0121	Coffee, tea and cocoa
All purpose cleaners	L	05611	Cleaning and maintenance products	0561	Non-durable household goods
Automatic dishwasher detergent	KG	05611	Cleaning and maintenance products	0561	Non-durable household goods
Baby food	KG	01193	Baby food	0119	Food products n.e.c.
Beer	L	02131	Lager beer	0213	Beer
Butter	KG	01151	Butter	0115	Oils and fats
Cat food	KG	09342	Products for pets	0934	Pets and related products
Cereals	KG	01117	Breakfast cereals	0111	Bread and cereal
Condoms	PIECE	06121	Pregnancy tests and mechanical contraceptive devices	0612	Other medical products
Carbonated soft drinks	L	01222	Soft drinks	0122	Mineral waters, soft drinks, fruit and vegetable juices
Deodorant	L	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care
Dog food	KG	09342	Products for pets	0934	Pets and related products
Dry pasta	KG	01116	Pasta products and couscous	0111	Bread and cereal
Fabric softener	L	05611	Cleaning and maintenance products	0561	Non-durable household goods
Frozen fish	KG	01132	Frozen fish	0113	Fish and seafood
Ice cream	L	01185	Edible ices and ice cream	0118	Sugar, jam, honey, chocolate and confectionery
Strawberry jam	KG	01182	Jams, marmalades and honey	0118	Sugar, jam, honey, chocolate and confectionery
Laundry detergent	KG/L	05611	Cleaning and maintenance products	0561	Non-durable household goods
Margarine	KG	01152	Margarine and other vegetable fats	0115	Oils and fats
Refrigerated milk	L	01141	Fresh whole milk	0114	Milk, cheese and eggs
UHT milk	L	01143	Preserved milk	0114	Milk, cheese and eggs
Olive oil	L	01153	Olive oil	0115	Oils and fats
Pantyliners	PIECE	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care
Paper towels	ROLL	05612	Other non-durable small household articles	0561	Non-durable household goods
Frozen peas	KG	01172	Frozen vegetables other than potatoes and other tubers	0117	Vegetables
Rice	KG	01111	Rice	0111	Bread and cereal
Shampoo	L	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care
Shaving preps	L/PACK	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care

Table A1 Correspondence table, products and COICOP

(continued)

Product	Unit equivalent	COICOP 5 code	COICOP 5 code description	COICOP 4 code	COICOP 4 code description
Sugar	KG	01181	Sugar	0118	Sugar, jam, honey, chocolate and confectionery
Tinned peas	KG	01194	Ready-made meals	0119	Food products n.e.c.
Tinned tuna	KG	01136	Other preserved or processed fish and seafood and fish and seafood preparations	0113	Fish and seafood
Toilet tissue	ROLL	05612	Other non-durable small household articles	0561	Non-durable household goods
Toothpaste	L	12132	Articles for personal hygiene and wellness, esoteric products and beauty products	1213	Other appliances, articles and products for personal care
Vodka	L	02111	Spirits and liqueurs	0211	Spirits
Sparkling water	L	01221	Mineral or spring waters	0122	Mineral waters, soft drinks, fruit and vegetable juices
Still water	L	01221	Mineral or spring waters	0122	Mineral waters, soft drinks, fruit and vegetable juices
Wet soups	KG/L	01194	Ready-made meals	0119	Food products n.e.c.
Whiskey	L	02111	Spirits and liqueurs	0211	Spirits

Table A2 Relative price differences from the euro area average in 2011 and 2023

Country	2011	2023	2011	2023	2011	2023	2011	2023
	Total		Food		Beverages		Other	
Austria	-2%	3%	3%	7%	-11%	1%	-3%	0%
Belgium	11%	18%	24%	29%	5%	12%	1%	9%
Germany	-10%	-2%	-12%	0%	-17%	-16%	-4%	5%
Spain	-12%	-7%	-1%	7%	-22%	-20%	-18%	-14%
France	-4%	-7%	-4%	-11%	-6%	-9%	-4%	0%
Greece	19%	10%	21%	12%	20%	13%	15%	7%
Ireland	26%	2%	16%	-10%	58%	40%	12%	-14%
Italy	-1%	-3%	3%	3%	-14%	-18%	4%	1%
Netherlands	-14%	-9%	-25%	-21%	-5%	3%	1%	5%
Portugal	-13%	-11%	-25%	-21%	-20%	-13%	4%	2%

Source: Authors' calculations based on data from Eurostat and Dixon et al. (2023).

Note: The relative price differences are simple averages across products.

LABOUR MARKET TIGHTNESS IN THE POST-COVID-19 ERA

Anastasia Theofilakou

Bank of Greece, Economic Analysis and Research Department

Melina Vasardani

Bank of Greece, Economic Analysis and Research Department

ABSTRACT

Since 2020, the labour market in advanced economies has shown resilience against successive supply-side shocks. High job vacancy rates and historically low unemployment, despite a recent weakening of economic growth, imply a lower sensitivity of the labour market to changes in the business cycle, underscoring the need to re-evaluate labour market tightness, as it could increase the risks of wage-price spirals and a more restrictive monetary policy. In the present paper, we analyse the degree of labour market tightness and its implications for wages, inflation and monetary policy in two large open economies, the US and the euro area, and in a small open economy, Greece, that has undergone substantial labour market reforms, to explore whether post-pandemic labour market developments have common or idiosyncratic features. We find that policy support measures to address the pandemic and the energy crisis have decoupled unemployment from cyclical fluctuations, with the gap narrowing in 2023. Labour market tightness in the post-pandemic era has mainly been driven by a robust increase in labour demand, while labour supply has reverted to or exceeded pre-pandemic levels in the US, the euro area and Greece. Real compensation per employee lags labour productivity levels in all three economies, whereas it remains below its pre-pandemic level in the euro area and Greece. This suggests that the economies in question could tolerate some further catch-up in real wages in the short term without experiencing inflation.

Keywords: labour market tightness; wage dynamics; inflation; Okun's Law; Beveridge curve

JEL classification: E24; J21; E32; E52

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Η ΣΤΕΝΟΤΗΤΑ ΤΗΣ ΑΓΟΡΑΣ ΕΡΓΑΣΙΑΣ ΣΤΗ ΜΕΤΑΠΑΝΔΗΜΙΚΗ ΕΠΟΧΗ

Αναστασία Θεοφιλάκου

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Μελίνα Βασαρδάνη

Τράπεζα της Ελλάδος, Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

ΠΕΡΙΛΗΨΗ

Από το 2020 η αγορά εργασίας στις προηγμένες οικονομίες έχει δείξει ανθεκτικότητα σε διαδοχικούς κλυδωνισμούς από την πλευρά της προσφοράς. Τα υψηλά ποσοστά κενών θέσεων εργασίας και η ιστορικά χαμηλή ανεργία, παρά την πρόσφατη εξασθένηση της οικονομικής ανάπτυξης, υποδηλώνουν χαμηλότερη ευαισθησία της αγοράς εργασίας στις μεταβολές του οικονομικού κύκλου, γεγονός που υπογραμμίζει την ανάγκη επανεκτίμησης της στενότητας της αγοράς εργασίας, καθώς θα μπορούσε να επιτείνει τους κινδύνους διαδοχικών αυξήσεων σε μισθούς και τιμές και πιο περιοριστικής νομισματικής πολιτικής. Στο παρόν άρθρο αναλύουμε το βαθμό στενότητας της αγοράς εργασίας και τις επιπτώσεις του στους μισθούς, τον πληθωρισμό και τη νομισματική πολιτική σε δύο μεγάλες ανοικτές οικονομίες, των ΗΠΑ και της ευρωζώνης, και σε μια μικρή ανοικτή οικονομία, της Ελλάδος, όπου έχουν γίνει σημαντικές μεταρρυθμίσεις της αγοράς εργασίας, για να διερευνήσουμε αν οι εξελίξεις στην αγορά εργασίας μετά την πανδημία έχουν κοινά ή ιδιοσυγκρασιακά χαρακτηριστικά. Διαπιστώνουμε ότι τα μέτρα στήριξης για την αντιμετώπιση της πανδημίας και της ενεργειακής κρίσης έχουν αποσυνδέσει την ανεργία από τις κυκλικές διακυμάνσεις, με τη μεταξύ τους απόκλιση να μειώνεται το 2023. Η στενότητα της αγοράς εργασίας στη μεταπανδημική εποχή οφείλεται κυρίως στη σταθερή αύξηση της ζήτησης εργασίας, ενώ η προσφορά εργασίας έχει επανέλθει στα προπανδημικά επίπεδα ή τα έχει υπερβεί στις ΗΠΑ, την ευρωζώνη και την Ελλάδα. Οι πραγματικές αμοιβές εργασίας ανά εργαζόμενο υστερούν του επιπέδου παραγωγικότητας της εργασίας και στις τρεις οικονομίες, ενώ παραμένουν κάτω από τα προπανδημικά τους επίπεδα στην ευρωζώνη και την Ελλάδα. Αυτό υποδηλώνει ότι στις οικονομίες αυτές θα μπορούσε να γίνει ανεκτή κάποια περαιτέρω αναπροσαρμογή των πραγματικών μισθών βραχυπρόθεσμα χωρίς να αντιμετωπίσουν πληθωρισμό.

LABOUR MARKET TIGHTNESS IN THE POST-COVID-19 ERA*

Anastasia Theofilakou

Bank of Greece, Economic Analysis and Research Department

Melina Vasardani

Bank of Greece, Economic Analysis and Research Department

I INTRODUCTION

The labour market in advanced economies has shown resilience against the successive disruptions caused by the pandemic and the energy crisis, partly due to fiscal policy measures supporting incomes and growth. In the post-pandemic period, unemployment reached historically low levels, and employment remained robust, despite the economic slowdown that started in 2021 amid heightened uncertainty, high inflation and a globally synchronised cycle of monetary policy tightening.

Labour shortages in many sectors following the pandemic may initially be attributed to the reopening of the economy and, particularly, the pent-up demand for contact-intensive services. However, high job vacancy rates and historically low unemployment in the current period of subdued economic growth could indicate a potentially lower sensitivity (or an increased resilience) of the labour market to changes in the business cycle. This underscores the need to re-evaluate the factors influencing labour market tightness in many advanced economies, as it could exert inflationary pressures through higher nominal wage growth. Large increases in nominal wages that are not in line with the average rise in labour productivity raise the risk of successive wage and price hikes (wage-price spiral), necessitating a more restrictive monetary policy stance.

The aim of this paper is to analyse the degree of labour market tightness and its implications for wages, inflation and monetary policy in two large open economies, namely the US and the euro area, as well as in a small open economy, Greece. We seek to shed light on the similarities and differences between the US and the euro area, but also to compare them with a

small euro area economy that has undergone substantial labour market reforms since 2010, in order to understand whether post-pandemic labour market developments have common or idiosyncratic features.

Against this backdrop, first, we assess labour market developments, proxied by the unemployment rate, in relation to shifts in the business cycle during the post-pandemic era. This can indicate whether the behaviour of the labour market is consistent with historical elasticities and in line with other global crises, such as the 2007-2009 global financial crisis. Second, we investigate the main factors driving labour demand and labour supply, which may elucidate the resilience of labour markets at the current economic juncture and offer valuable insights into the labour market outlook and wage dynamics. This task is challenging as labour market conditions in recent years have been influenced by various factors, including policy support measures and structural changes in consumer, worker and firm preferences, as well as in production patterns. Finally, we discuss the implications of labour market tightness for inflation and the ensuing challenges for the implementation of monetary policy.

This paper mainly relates to the literature on search and matching models of the labour market (see, among others, Diamond 1982; Pissarides 2009), which asserts that unemployment should be considered in conjunction with other metrics, like job vacancies, to assess labour market tightness. It is also associated with the body of literature examining the consequences of

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labour market tightness for wages (Hagedorn and Manovskii 2013; Jäger et al. 2020), the impact of the COVID-19 pandemic on the labour market (Anderton et al. 2020) and the ongoing policy debate on the relationship between labour market tightness and inflation, and its implications for monetary policy (Ball et al. 2022; Kiss et al. 2022; Doornik et al. 2023).

Several findings stand out from our analysis. *First*, policy support measures to address the economic shocks triggered by the COVID-19 pandemic and the energy crisis have decoupled unemployment from cyclical fluctuations, rendering it a less appropriate measure of labour market tightness. Only recently, in 2023, have the shifts in unemployment in relation to the business cycle become more aligned with pre-pandemic historical regularities in the US, the euro area and Greece.

Second, by certain metrics, such as the job vacancy rate, the labour market has recently shown signs of easing in the US and the euro area, whilst it has been tightening in Greece. This stems from idiosyncratic features of the economies, including more favourable growth prospects for the Greek economy compared to the euro area average. Moreover, the recent upward shift of the Greek Beveridge curve may indicate some signs of weaker job-matching efficiency compared to pre-pandemic.

Third, post-pandemic labour market tightness in all three economies under examination has primarily been driven by a surge in labour demand, more so in Greece where this increase compared to pre-pandemic levels has been double that of the US and the euro area. Several factors, such as labour hoarding, medium-term staff reskilling needs in light of the green and digital transitions, and the decreased cost of posting job vacancies can explain the robust increase in labour demand. By contrast, labour supply, as captured by the labour force participation rates, after dropping sharply during the pandemic, has rebounded to pre-pandemic levels in the US and at record highs in the euro area and Greece.

Fourth, despite significant rises, nominal compensation per employee growth has not kept pace with inflation post-pandemic, resulting in real wage declines and loss of purchasing power. However, since mid-2023, real compensation per employee growth has turned positive in all three economies, mainly reflecting a moderation in inflation. Interestingly, at the end of 2023, real compensation per employee lagged labour productivity levels in all three economies, whereas it remained below its pre-pandemic level in the euro area and Greece. This suggests that the economies in question could tolerate some further catch-up in real wages in the short term without experiencing inflation. Meanwhile, the lower costs of intermediate inputs and the sizeable profit margins accumulated post-pandemic create the space for firms to absorb part of the wage hikes, mitigating the second-round effects of wages on inflation. Overall, in the absence of new external shocks, a wage-price spiral seems less likely in the US, the euro area and Greece, as economic activity softens, inflation dissipates and the labour market rebalances.

The rest of the paper is structured as follows: Section 2 assesses the degree of labour market tightness using various metrics. Section 3 puts into perspective the labour demand and supply determinants that have shaped labour market conditions in the post-pandemic era. Section 4 outlines the implications of labour market tightness for wage growth, inflation and monetary policy, and Section 5 concludes.

2 INDICATORS OF LABOUR MARKET TIGHTNESS

A preliminary step in understanding labour market developments is to define labour market tightness. For the purpose of this analysis, we adopt a broad definition, whereby the labour market is considered tight when there is excess demand for labour. This section delves into the level of tightness in two large open economies, namely the US and the euro area, as well as in a small open economy, Greece. This examination is based on a series

of indicators that track the evolution of both labour supply and demand.

2.1 LABOUR MARKET AND THE BUSINESS CYCLE

A frequently used indicator of labour market tightness is the *unemployment rate* as a percentage of the labour force.¹ However, in recent years, in many advanced economies, the response of the unemployment rate to changes in the economic cycle has diverged from the historical negative relationship between unemployment and economic growth (referred to as Okun's Law) observed prior to the COVID-19 pandemic.²

The Okun coefficient that relates changes in the unemployment rate to changes in real GDP can be estimated using a simple regression model:

$$\Delta unemp_t = \beta_0 + \beta_1 \Delta GDP_t + e_t \quad (1)$$

where $\Delta unemp$ is the change in the unemployment rate, ΔGDP is output growth, β_1 measures the sensitivity of the unemployment rate to changes in real GDP (i.e. the Okun coefficient), and e_t is the error term capturing other factors influencing changes in unemployment, which are not accounted for in the model.³ By estimating the coefficient β_1 through a linear regression analysis, we provide insights not only into the extent to which the labour market has responded to recent fluctuations in economic activity, but also into the strength of the relationship.⁴

Estimates of the Okun coefficient may vary depending on the time period considered and the estimation approach. According to the Bank for International Settlements (Doornik et al. 2023), a 1 percentage point (pp) increase in the rate of economic growth in advanced economies is estimated to correspond to a 0.3 percentage points (pps) decrease in the unemployment rate, compared to a 0.15 pps decrease observed in previous economic crises.

We estimate equation (1) for the US, the euro area and Greece over the pre-pandemic period

2006 Q1 to 2019 Q4. The table below summarises the Okun's Law estimates for the three economies. The Okun coefficient is statistically significant for all economies, while the size of the coefficient, notably for the euro area and Greece, is broadly in line with recent estimates of Doornik et al. (2023) for advanced economies.

Chart 1 depicts the estimated change in the unemployment rate based on equation (1) and the actual change in unemployment for the US and the euro area (panel a) and for Greece (panel b). In 2020, the sensitivity of unemployment to the economic cycle was influenced by differences across countries in the policy

Okun's Law estimates for the US, the euro area and Greece

	(1) US	(2) Euro area	(3) Greece
Output growth	-0.64*** (0.06)	-0.39*** (0.04)	-0.49*** (0.09)
Constant term	1.09*** (0.20)	0.34** (0.12)	-0.20 (0.38)
Adjusted R ²	0.72	0.73	0.66
No. of observations	56	56	56

Notes: The dependent variable is the change in the unemployment rate. Heteroscedasticity and autocorrelation robust standard errors are reported in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

- 1 Shifts in unemployment need to be assessed in conjunction with more complex indicators as they lag economic activity developments.
- 2 The theoretical foundations of Okun's Law stem from the concept of the production function, in which labour plays a critical role. When real GDP increases, more goods and services are being produced, requiring a higher level of labour input. Firms tend to hire more workers to meet the increased demand, leading to a decline in the unemployment rate. Conversely, during economic downturns, real GDP contracts, signalling a decrease in the demand for goods and services. As a result, firms may reduce their production levels and cut back on labour to adjust to lower demand, leading to higher unemployment.
- 3 An alternative specification would be to regress the deviation of the unemployment rate from the natural rate of unemployment (NAIRU) on the output gap. Equation (1) implicitly assumes a constant equilibrium unemployment rate and constant potential growth.
- 4 The elasticity of unemployment to shifts in output is commonly based on linear analyses. However, recent studies corroborate the idea that a non-linear empirical framework may more properly capture asymmetries in the unemployment-output relation. See, among others, Valadkhani and Smyth (2015) for the US, Christopoulos et al. (2023) for the euro area and Koutroulis et al. (2016) for Greece.

support measures aimed at mitigating the economic impact of the COVID-19 pandemic. According to our estimates of the Okun coefficient, the annual increase in the unemployment rate for 2020 is estimated at 2.7 pps in the euro area and 2.5 pps in the US, while it is more pronounced, namely at 4.3 pps, in Greece.

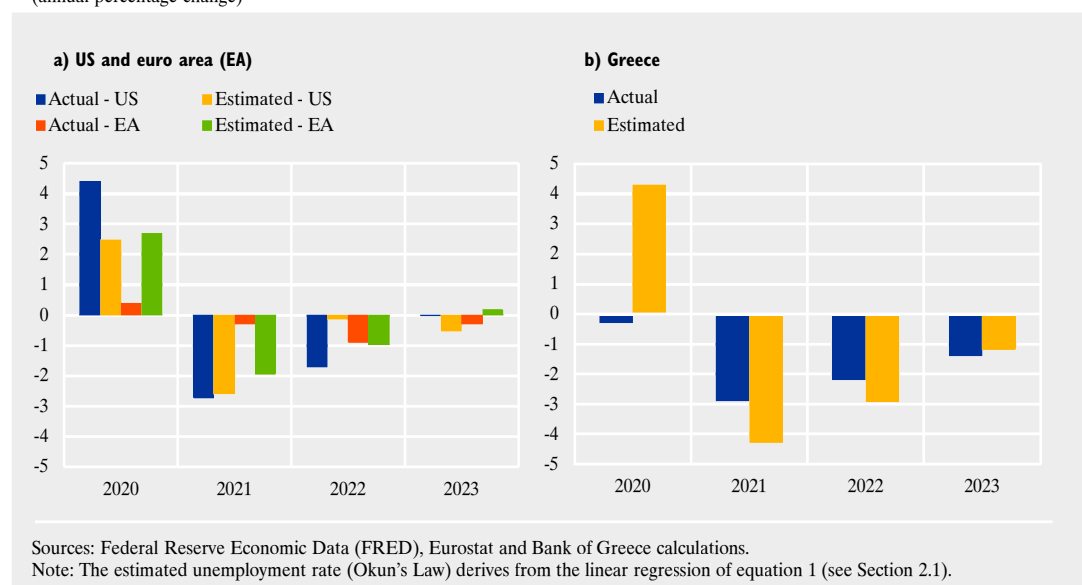
However, the actual response of the unemployment rate to the business cycle deviated from the estimated elasticities based on pre-pandemic data. In the US, direct income support, generous unemployment benefits and the relatively lower cost of temporary layoffs compared to Europe led to a 4.4 pps increase in the unemployment rate in 2020, despite a smaller annual GDP decline (-2.2%). By contrast, in the euro area, the unemployment rate in 2020 increased only by 0.4 pps, notwithstanding a deeper economic recession (-6.1%), thanks to the extensive implementation of job retention schemes. Indeed, the actual change in the unemployment rate was notably lower in the euro area and significantly higher in the US compared to long-run elasticities. In Greece, the unemployment rate in 2020 fell marginally,

although the economy contracted by 9.3% on an annual basis, probably reflecting past robust economic growth and government schemes to support employment.

In the euro area, actual changes in unemployment remained below estimates until 2022, partly due to the gradual adjustment of the labour market through increased working hours, while the unemployment rate continued to decline to historically low levels. By contrast, the decline in the US unemployment rate has been larger than expected based on pre-pandemic data, which can be explained by greater labour market flexibility and a job-rich recovery. In 2023, the unemployment rate remained historically low at 6.5% in the euro area, despite monetary policy tightening and subdued economic growth, and at 3.6% in the US (an all-time low since 1969), underscoring the resilience of the labour market in both economies. In Greece, the actual response of the unemployment rate to cyclical fluctuations had been more muted until 2022 compared to the Okun estimate (see Chart 1, panel b), which is in line with the pattern observed for the euro area, partly due to government sup-

Chart 1 Unemployment rate: actual and estimated based on Okun's Law

(annual percentage change)



port schemes aimed at protecting headcount employment.⁵ However, unemployment in Greece stood at a high level (11.1%) in 2023, indicating a less tight labour market compared to the euro area on average.

Overall, the shifts in unemployment vis-à-vis the business cycle seem to have become more aligned to pre-pandemic historical regularities in all three economies in 2023. Looking ahead, this suggests that a gradual unwinding of the labour market tightness should be expected on the back of growth moderation, notably in the euro area.

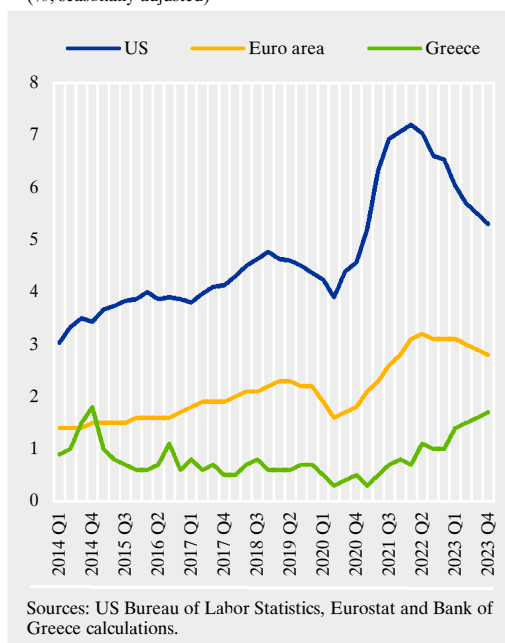
2.2 OTHER INDICATORS OF LABOUR MARKET TIGHTNESS

A more complex indicator of labour market tightness is the *vacancy-to-unemployment ratio*. A higher ratio indicates greater labour demand compared to supply and, thus, a tighter labour market. In 2019, both in the US and in the euro area, this indicator had already reached historically high levels, reflecting increased tightness. Although it significantly declined in the first half of 2020 due to the COVID-19 pandemic's impact, it remained higher than that during the 2007-2009 global financial crisis, indicating tighter labour markets during the pandemic compared to other global crises. Post-pandemic, job vacancies per unemployed person have rebounded strongly to historically high levels in both economies, largely due to the spike in job vacancies following the economies' sizeable and fast recovery.

Similarly, post-pandemic developments in the *job vacancy rate* in the US and the euro area also point to increased labour demand (see Chart 2). After peaking in the first quarters of 2022, it has gradually decelerated, though remaining historically high, which suggests a partial easing of the labour market, particularly in the US. In the euro area, the vacancy rate in the services sector is higher compared to other sectors, indicating greater labour shortages in services. By contrast, in Greece, the job

Chart 2 Job vacancy rates

(%, seasonally adjusted)



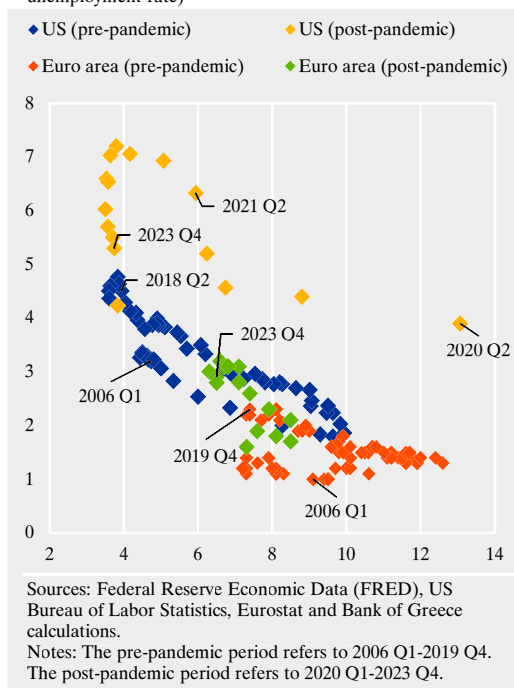
vacancy rate had been on a slight downward trend broadly until early 2021 and has been rising since, reaching historically high levels in 2023 Q4.

The increased labour demand in the Greek economy can be attributed to robust economic growth (higher than the euro area average) and strong tourism demand, as well as more favourable growth and employment prospects, partly supported by NextGenerationEU financing and the economy's return to investment grade. The steeper upward trend of the job vacancy rate as of mid-2023 could indicate rising potential mismatches between workers' skills and employers' requirements, which could weigh on firms' productivity and competitiveness. Qualitative evidence of labour market mismatch based on business survey data shows limited availability of skilled labour in the Greek labour market (Antonopoulos et al.

5 Bournakis and Christopoulos (2017) find that the growth-unemployment relationship in Greece is non-linear, namely the elasticity of unemployment is estimated at 1.5% when the economy grows at a rate above 1%, while unemployment falls by 1.2% when the economy expands at a rate below 1%.

Chart 3 US and euro area Beveridge curve (2006 Q1-2023 Q4)

(%, seasonally adjusted; y-axis: job vacancy rate; x-axis: unemployment rate)



2022). Still, the job vacancy rate in Greece remains well below the euro area average, implying a less tight labour market. A caveat of using the job vacancy rate as a proxy of labour demand developments is that it does not take into account variations in recruitment intensity among firms, while changes in recruiting technology complicate comparisons across long periods of time or business cycles (Mongey and Horwich 2023). This limitation that has been reported for the US and other economies, may be gradually coming into play in the case of Greece, explaining part of the steady rise in vacancies seen in recent years.

Besides, a negative relationship between job vacancies and the unemployment rate (Beveridge curve) is a key indicator of labour market efficiency. A decline in domestic demand increases the unemployment rate and reduces job vacancies. However, a simultaneous increase in both, namely an upward shift in the Beveridge curve, implies a worsening of job-

matching efficiency, i.e. the matching of jobs between employers and employees. At the same time, movements along the Beveridge curve indicate shifts in labour market tightness; in other words, the higher an economy stands in the vacancy-to-unemployment space, the tighter its labour market is (see, among others, Consolo and Dias da Silva 2019). In the euro area, from 2020 Q1 to 2023 Q4, the Beveridge curve shifted upwards and to the left compared to the pre-pandemic period (see Chart 3). This indicates that job vacancies remained high despite a gradual slowdown in growth, while unemployment continued to decline, thereby pointing to a tighter labour market.⁶ Empirical studies confirm that there has been no post-pandemic simultaneous increase in job vacancies and the unemployment rate in Europe, implying lack of evidence of a deterioration in job-matching efficiency. By contrast, in the US, the post-pandemic Beveridge curve has shifted up and to the right, reflecting a less efficient labour market (Kiss et al. 2022) (see Chart 3).

In Greece, the post-pandemic improvement in the labour market has been the result of both a decrease in the separation rate and an increase in the job-finding rate (Antonopoulos et al. 2022). This may reflect the positive impact of the labour market reforms undertaken over the past decade. However, signs of increased tightness are evident as of mid-2022, with the Greek Beveridge curve shifting upwards and to the left (see Chart 4). In the second half of 2023, a higher number of vacancies corresponded to a given level of unemployment, which could also imply a slight deterioration in job-matching efficiency.

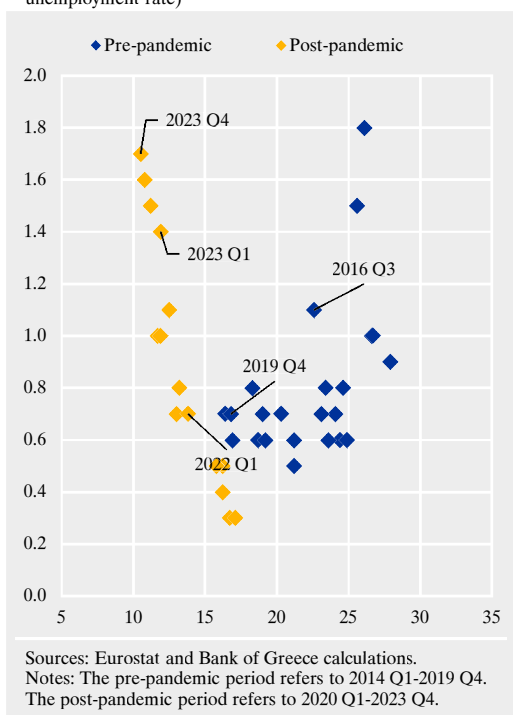
As an alternative indicator for the euro area, Eurostat's broader proxy of *labour market slack*,⁷ measured by the fraction of the

⁶ The job vacancy rate is a leading indicator of the reaction of the labour market to the economic cycle, while the unemployment rate reacts with a lag. Therefore, an increase in labour demand, for instance when economies were reopening post-pandemic, will lead to an increase in job vacancies before the unemployment rate declines.

⁷ This index includes the unemployed, part-time workers who wish to work more, people who are available to work but not looking for a job and people who are looking for a job but not immediately available to work.

Chart 4 Greek Beveridge curve (2014 Q1-2023 Q4)

(%, seasonally adjusted; y-axis: job vacancy rate; x-axis: unemployment rate)



extended labour force not fully utilised in the labour market, peaked in 2021 Q1 and has been declining since, standing below pre-pandemic levels already since 2021 Q3, which implies increased tightness. This trend primarily reflects the reduction in the number of unemployed persons. Notably, the euro area labour market exhibited greater tightness in 2019 compared to the previous decade, while the reduction in labour shortages during the pandemic was temporary. In 2023, the labour market slack in the euro area decreased at 13.1%, down from 15.2% in 2019.⁸ The corresponding decline in labour market slack for Greece was more pronounced at 16.3%, down from 25.2% in 2019, though still standing above the euro area average, implying a less tight labour market. Finally, additional indicators such as the *employment-to-working-age population ratio* have surpassed pre-pandemic levels in all three economies under examination.

3 INTERPRETING LABOUR SUPPLY AND DEMAND DEVELOPMENTS

The tightness of the labour market in many advanced economies in recent years can be attributed to various factors conducive to a decrease in labour supply, an increase in labour demand or a combination of both. These factors are linked, *inter alia*, to the policies implemented to address the pandemic (e.g. job retention schemes versus unemployment benefits and direct income support), possible shifts in workers' preferences (e.g. regarding the type and quality of jobs, work-life balance and teleworking options), skill shortages or mismatches and the structural characteristics of the respective labour markets (e.g. degree of flexibility, social safety nets and social protection institutions) (see, among others, Gomez-Salvador and Soudan 2022; Ando et al. 2022).

A general conclusion is that the post-pandemic labour market tightness in all three economies under examination is primarily driven by a significant increase in labour demand in 2022-2023 compared to 2019, more so in the euro area and Greece (see Chart 5). Developments in *labour demand* are visible in *employment growth*, which has rebounded strongly post-pandemic and has remained resilient in all three regions, as well as in the job vacancy rate, as aforementioned, which continues to hover at record highs (despite some easing in the euro area and, more notably, in the US). In the immediate aftermath of the pandemic, the strong rebound in contact- and labour-intensive services, such as tourism in Greece, has contributed to a vigorous increase in labour demand. Later in the post-pandemic period, several additional factors seem to explain the robust labour demand. First, particularly in the euro area, firms are engaging in labour hoarding, as evidenced by the decline in the per-

⁸ In the euro area, the percentage of workers transitioning to unemployment remains stable post-pandemic, reflecting the resilience of the labour market despite the gradual moderation in growth since 2022. By contrast, the percentage of unemployed persons transitioning to employment is at historically high levels.

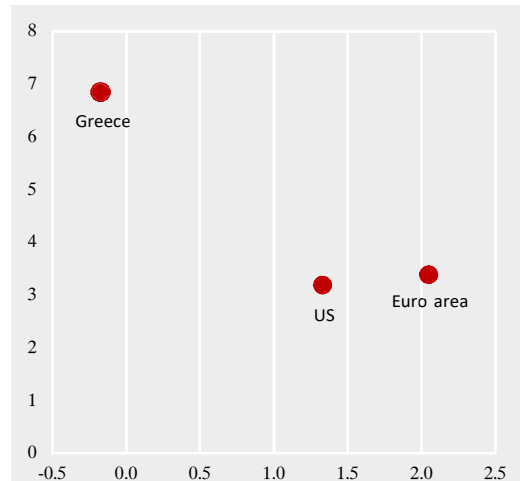
centage of workers transitioning into unemployment or the combination of lower hours worked per employee and robust employment growth rates. Firms are hesitant to resort to layoffs, due to the cost and challenges associated with rehiring or finding suitable replacements after widespread layoffs. Second, some of the new job vacancies are likely aimed at addressing medium-term staff reskilling needs rather than immediate recruitment needs. Third, the decreased cost of posting job vacancies and the easier process of online interviews encourage firms to advertise more job opportunities (Mongey and Horwich 2023).

Developments in *labour supply* are captured by the *labour force participation rate*, calculated as the proportion of employed and unemployed individuals (i.e. active participants in the labour market or, alternatively, the labour force) in the total working-age population. Following a temporary decline in 2020 due to pandemic-related restrictions, the labour force participation rate has rebounded strongly, particularly in the euro area compared to the US. In 2023 Q4, the labour force participation rate reverted to its pre-pandemic level of 68.1% in the US, supported by increased inflows of migrants (IMF 2024), while it climbed at an all-time record of 65.7% in the euro area, 1.2 pps higher compared to the pre-pandemic level of 2019 (see Chart 6). Women, older workers, highly educated persons and immigrants have contributed the most to the increase in the euro area labour force participation rate (Berson and Botelho 2023). In a similar vein, following a temporary fall during the pandemic, the labour force participation rate in Greece recovered to 59.9% in 2023 Q4, notably amid a higher participation of workers above prime age and women in recent years (Antonopoulos et al. 2022).

The more pronounced drop in 2020 and the slower recovery since then in the US participation rate compared to that in the euro area are likely related to relatively reduced immigration, health concerns, early retirement and the availability of alternative sources of

Chart 5 Labour demand and labour supply

(% change in 2022-2023 average compared to 2019; y-axis: labour demand, x-axis: labour supply)



Sources: US Bureau of Labor Statistics, Eurostat and Bank of Greece calculations.

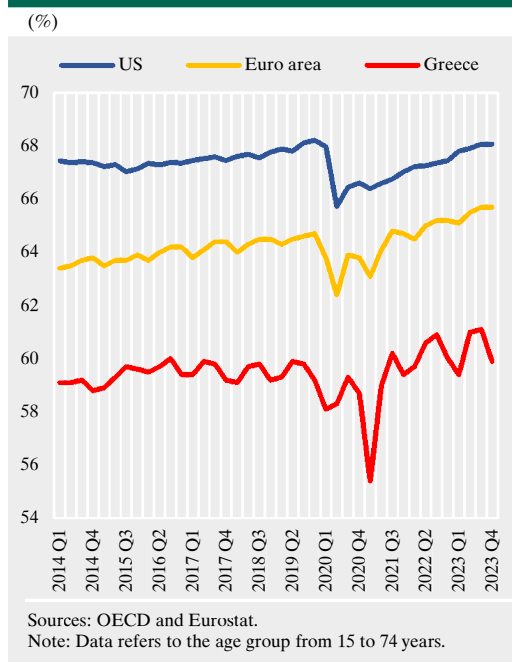
Notes: Labour demand is defined as the sum of the number of employees and job vacancies. Labour supply is defined as the total labour force.

income⁹ (see, among others, Faria e Castro and Jordan-Wood 2023; Abraham and Rendell 2023). The phenomenon of mass voluntary resignations (“Great Resignation”) in 2022 in the US turned out to be temporary and had no significant impact on the workforce, as these workers did not exit the labour market, but rather sought better-paying and higher-quality jobs amidst abundant employment opportunities (“Great Reshuffle”). Indicatively, the difference in annual pay growth between job stayers and job changers in the US peaked at 8.8 pps in April 2022, strongly incentivising worker mobility, while it fell to 2.7 pps by December 2023 (ADP 2024).

Another significant determinant of labour supply is *hours worked*. In most euro area countries, average hours worked per employee plummeted during the pandemic, unlike in the US, and have since remained below pre-pan-

⁹ Generous income support policies during the pandemic, combined with increased savings, delayed the return to work. Also, the increase in household net wealth due to very high returns on assets, such as stocks and housing, had a negative effect on the labour force participation rate.

Chart 6 Labour force participation rates



demographic levels, despite an increase and full recovery in total hours worked and employment. This post-pandemic phenomenon is primarily driven by changing preferences among workers, especially men (with young children) and young people, towards fewer working hours, is consistent with a longer-term trend and is not expected to reverse (Astinova et al. 2024).

4 IMPLICATIONS OF LABOUR MARKET TIGHTNESS FOR WAGES AND INFLATION

Labour market tightness typically exacerbates wage and inflationary pressures. High rates of job vacancies, job-to-job transitions and voluntary resignations tend to be associated with faster nominal wage growth, particularly in tight labour market conditions (Daly et al. 2012; Engbom 2022). Moreover, studies indicate that labour market tightness can amplify the inflationary impact of exogenous supply-side shocks, such as the recent energy crisis, given the non-linearity of the Phillips curve (Ball et al. 2022; Benigno and Eggertsson 2023).

Overall, the responsiveness of nominal wages to inflation hinges on cyclical and structural factors, including the prevailing level of inflation, expectations regarding inflation persistence, pension and wage indexation, and the institutional framework governing wage negotiations. Studies also indicate that non-pecuniary benefits, such as teleworking and flexible working hours, can partly constrain wage increases (Doornik et al. 2023; Maestas et al. 2023).

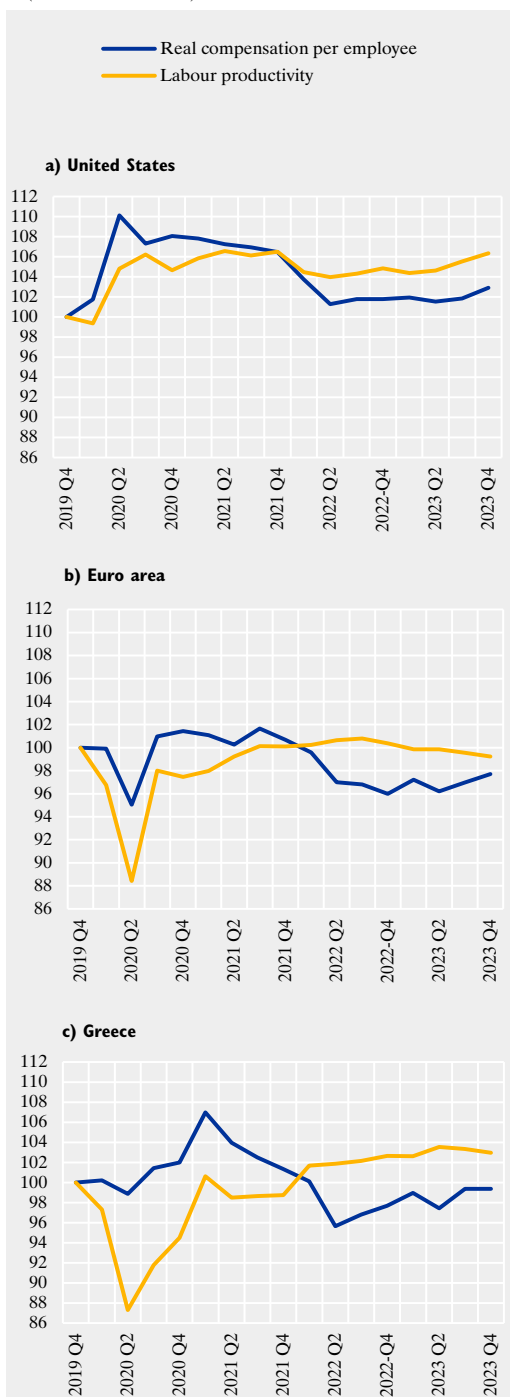
Since the onset of the war in Ukraine and the ensuing surge in energy prices and living costs, nominal compensation per employee in the US, the euro area and Greece has risen significantly to offset the loss of workers' purchasing power resulting from high inflation. In the period 2022-2023, the average annual growth of nominal compensation per employee stood at 3.5% in the US, 4.8% in the euro area and 4.2% in Greece, above the pre-pandemic growth rates, notably in Europe. Meanwhile, labour productivity growth, measured as real GDP per person employed, remained low or turned negative in some quarters, due to labour hoarding, reduced capacity utilisation and subdued economic activity.

However, annual growth in nominal compensation per employee has not kept pace with consumer price inflation. As a result, growth in real compensation per employee has been negative in the US, the euro area and Greece throughout 2022 and roughly until mid-2023. Since then, it has turned positive in all three economies and accelerated in the US and the euro area, reflecting, mainly, a moderation in inflation. The finding of wage inflation responding to past price inflation can be taken as supportive of a lag effect, leading to a lagged recovery of real wages (see, for example, Barlevy and Hu 2023).

A slowdown in nominal wage growth coupled with an increase in labour productivity growth is expected to push down unit labour costs in the coming years, thereby curbing wage-induced inflationary pressures. Interestingly, at

Chart 7 Real compensation per employee and labour productivity

(index: 2019 Q4=100)



Sources: ECB Data Portal, Eurostat, US Bureau of Labor Statistics, OECD and Bank of Greece calculations.
Note: Labour productivity is calculated as real GDP per person employed.

the end of 2023, real compensation per employee lagged labour productivity levels in the US, the euro area and Greece, and stood below its pre-pandemic levels in the euro area and Greece (see Chart 7). This suggests that the economies in question could tolerate some further real wage catch-up in the short term, without experiencing inflation. Meanwhile, the lower costs of intermediate inputs, such as energy, amid unwinding supply shocks and the sizeable profit margins accumulated post-pandemic create the space for firms to absorb part of the wage hikes, mitigating the second-round effects of wages on inflation (Cipollone 2024). To sum up, in the absence of new external shocks, the likelihood of a wage-price spiral seems less likely in the US, the euro area and Greece, as economic activity moderates, inflation dissipates and the labour market rebalances. The persistence of labour market tightness in certain sectors, particularly in labour-intensive services, may sustain high levels of services inflation for a while, delaying the deceleration of core inflation.

The inflationary risks of persistent tightness in the labour market warrant increased vigilance on the part of monetary authorities, but also a better understanding of the underlying labour dynamics, jointly assessed with other counter-vailing factors that drive inflation. The recent positive shift in real wage growth in the US, the euro area and Greece, coupled with a deceleration in inflation and a return of short-term inflation expectations to the 2% target, suggests moderating wage demands ahead. Meanwhile, there seems to be scope for some non-inflationary increases in real wages to match labour productivity. Furthermore, since changes in monetary policy have a lagged impact on aggregate domestic demand and, subsequently, on the labour market, the effects of previous monetary policy tightening are expected to become more apparent in the coming quarters. Recent studies corroborate these lagged effects of monetary policy tightening on the labour market. For instance, Bauer and Swanson (2023) demonstrate that the maximum effect of monetary policy tightening on

unemployment occurs after one year. Moreover, D'Amico and King (2023) document that the labour market effects of the current cycle of monetary policy tightening have not yet materialised for the most part, with over half of the effects still pending.

5 CONCLUSIONS

The labour market in advanced economies continues to exhibit resilience despite restrictive economic policies and an economic slowdown. Specifically, the large economies of the US and the euro area, as well as the small open economy of Greece continue to face labour market tightness, as suggested by various indicators, despite some early signs of easing. Post-pandemic tightness primarily stems from a substantial surge in labour demand, while labour supply has generally rebounded to pre-pandemic levels in all three economies. In the absence of new external shocks, the projected easing of the labour market will make monetary policy more effective in achieving price stability.

The process of labour market rebalancing in the US, the euro area and Greece is influenced in the short term by cyclical factors and

in the medium term by structural factors. The anticipated weakening of economic momentum in the US and sluggish growth in the euro area will initially dampen demand for new jobs, subsequently leading to a slight uptick in the unemployment rate towards levels more consistent with historical norms. Yet, in the medium term, initiatives such as the European recovery instrument NextGenerationEU or the Inflation Reduction Act in the US are expected to bolster labour demand through the implementation of new investment plans. At the same time, labour supply will be strengthened by structural measures aimed at enhancing the skills of the workforce, thus its employability, in anticipation of the heightened demands arising from digital transformation, the spread of new technologies (e.g. artificial intelligence) and sustainable growth initiatives. Reducing the effects of gender disparities and old-age bias in the labour force, including by mobilising pensioners, would also boost aggregate participation rates. However, a reallocation of labour across sectors due to the impacts of climate change and the greening of the economy on production, as well as a tightening of immigration regulations amid geopolitical tensions and fragmentation, may impede the process of rebalancing labour supply and demand.

REFERENCES

- Abraham, K. and L. Rendell (2023), “Where are the missing workers? Anticipated and unanticipated labor supply changes in the pandemic’s aftermath”, Spring 2023 BPEA Conference. ADP Research Institute, *Pay Insights*, March 2024.
- Anderton, R., V. Botelho, A. Consolo, A.D. da Silva, C. Foroni, M. Mohr and L. Vivian (2020), “The impact of the COVID-19 pandemic on the euro area labour market”, ECB, *Economic Bulletin*, Issue 8/2020.
- Ando, S., R. Balakrishnan, B. Gruss, J.-J. Hallaert, L.-B. F. Jirasavetakul, K. Kirabaeva, N. Klein, A. Lariau, L.Q. Liu, D. Malacrino, H. Qu and A. Solovyeva (2022), “European labor markets and the COVID-19 pandemic: Fallout and the path ahead”, IMF, Departmental Paper No. DP/2022/004, March.
- Antonopoulos, C., S. Anyfantaki, H. Balfoussia, T. Kosma, E. Papapetrou, F. Petroulakis, P. Petroulas and P. Zioutou (2022), “The Greek labour market before and after the pandemic: Slack, tightness and skills mismatch”, Bank of Greece, *Economic Bulletin*, No. 56, 45-74.
- Astinova, D., R.A. Duval, N.-J.H. Hansen, B. Park, I. Shibata and F.G. Toscani (2024), “Dissecting the decline in average hours worked in Europe”, IMF, Working Paper No. WP/2024/002, January.
- Ball, L.M., D. Leigh and P. Mishra (2022), “Understanding U.S. inflation during the COVID era”, NBER, Working Paper No. 30613, October.
- Barlevy, G. and L. Hu (2023), “Unit labor costs and inflation in the non-housing service sector”, Federal Reserve Bank of Chicago, Chicago Fed Letter No. 477, March.
- Bauer, M.D. and E.T. Swanson (2023), “An alternative explanation for the ‘Fed information effect’”, *American Economic Review*, 113(3), 664-700.
- Benigno, P. and G.B. Eggertsson (2023), “It’s baaack: The surge in inflation in the 2020s and the return of the non-linear Phillips curve”, NBER, Working Paper No. 31197, April.
- Berson, C. and V. Botelho (2023), “Record labour participation: workforce gets older, better educated and more female”, *The ECB Blog*, 8 November.
- Bournakis, I. and D.K. Christopoulos (2017), “Output and unemployment: Estimating Okun’s Law for Greece”, in Bournakis, I., C. Tsoukis, D.K. Christopoulos and T. Palivos (eds), *Political economy perspectives on the Greek crisis: Debt, austerity and unemployment*, Palgrave Macmillan, Cham, 273-287.
- Christopoulos, D., P. McAdam and E. Tzavalis (2023), “Exploring Okun’s Law asymmetry: An endogenous threshold logistic smooth transition regression approach”, *Oxford Bulletin of Economics and Statistics*, 85(1), 123-158.
- Cipollone, P. (2024), “The confidence to act: monetary policy and the role of wages during the disinflation process”, speech at an event organised by the House of the Euro and the Centre for European Reform, Brussels, 27 March.
- Consolo, A. and A. Dias da Silva (2019), “The euro area labour market through the lens of the Beveridge curve”, ECB, *Economic Bulletin*, Issue 4/2019.
- D’Amico, S. and T. King (2023), “Past and future effects of the recent monetary policy tightening”, Federal Reserve Bank of Chicago, Chicago Fed Letter No. 483, September.
- Daly, M.C., B. Hobijn and T.S. Wiles (2012), “Dissecting aggregate real wage fluctuations: Individual wage growth and the composition effect”, Federal Reserve Bank of San Francisco, Working Paper No. 2011-23, May.
- Diamond, P.A. (1982), “Aggregate demand management in search equilibrium”, *Journal of Political Economy*, 90(5), 881-894.
- Doornik, B., D. Igan and E. Kharroubi (2023), “Labour markets: what explains the resilience?”, *Bank for International Settlements Quarterly Review*, December 2023, 77-93.
- Engbom, N. (2022), “Labor market fluidity and human capital accumulation”, NBER, Working Paper No. 29698, January.

- Faria e Castro, M. and S. Jordan-Wood (2023), “Pandemic labor force participation and net worth fluctuations”, *Federal Reserve Bank of St. Louis Review*, First Quarter 2024, 106(1), 40-58.
- Gomez-Salvador, R. and M. Soudan (2022), “The US labour market after the COVID-19 recession”, ECB, Occasional Paper No. 298.
- Hagedorn, M. and I. Manovskii (2013), “Job selection and wages over the business cycle”, *American Economic Review*, 103(2), 771-803.
- IMF (2024), “*Steady but slow: Resilience amid divergence*”, World Economic Outlook, April 2024.
- Jäger, S., B. Schoefer, S. Young and J. Zweimüller (2020), “Wages and the value of nonemployment”, *The Quarterly Journal of Economics*, 135(4), 1905-1963.
- Kiss, Á., M.-C. Morandini, A. Turrini and A. Vandeplas (2022), “Slack and tightness: Making sense of post COVID-19 labour market developments in the EU”, European Commission, Discussion Paper No. 178, 7.12.2022.
- Koutroulis, A., Y. Panagopoulos and E. Tsouma (2016), “Asymmetry in the response of unemployment to output changes in Greece: Evidence from hidden co-integration”, *The Journal of Economic Asymmetries*, 13, 81-88.
- Maestas, N., K.J. Mullen, D. Powell, T. von Wachter and J.B. Wenger (2023), “The value of working conditions in the United States and the implications for the structure of wages”, *American Economic Review*, 113(7), 2007-2047.
- Mongey, S. and J. Horwich (2023), “Are job vacancies still as plentiful as they appear? Implications for the ‘soft landing’”, Federal Reserve Bank of Minneapolis, Article, 1.12.2023.
- Pissarides, C.A. (2009), “The unemployment volatility puzzle: Is wage stickiness the answer?”, *Econometrica*, 77(5), 1339-1369.
- Valadkhani, A. and R. Smyth (2015), “Switching and asymmetric behaviour of the Okun coefficient in the US: Evidence for the 1948-2015 period”, *Economic Modelling*, 50, 281-290.

WORKING PAPERS (JANUARY – JULY 2024)

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The medium-term effects of fiscal policy rules

Working Paper No. 325

Christos Chrysanthakopoulos and Athanasios Tagkalakis

Using a panel of 86 advanced and emerging market economies over the period 1985-2020, the authors investigate the short-to-medium term effects of fiscal policy rules on primary balances. They examine various types of rules (expenditure, revenue, debt and budget balance rules) and various strict and flexible characteristics of fiscal rules. The authors find that the adoption of fiscal rules leads to a fiscal easing in the medium term, with the effects being more pronounced in emerging market versus advanced economies. They find an asymmetry in the workings of the fiscal rule over the busi-

ness cycle. In times of expansion, the adoption of a rule leads to an a-cyclical or even procyclical response of the primary balance, while in times of recession fiscal rules induce a countercyclical impact response. Contrary to the baseline evidence, fiscal rules lead to a prudent fiscal policy response over the medium term when the debt ratio is high, the primary balance does not put the debt ratio on a declining path and the interest-growth rate differential is positive, as well as when the tax revenues generated by the tax system and tax administration are quite low relative to the stock of debt.

Does uncertainty matter for household consumption? A mean and a two tails approach

Working Paper No. 326

Konstantina Manou and Evangelia Papapetrou

This paper complements the existing literature on the relationship between uncertainty and private consumption expenditure for a panel of 14 euro area countries over the period 1997 to 2021. The authors account for uncertainty by employing composite, economic and financial risk indices and utilise alternative panel estimators with heterogeneous coefficients and an error term to consider cross-country heterogeneity. Further, they explore the effect of uncertainty on household consumption over its conditional distribution. In addition, considering the differences in economic and financial systems across the countries examined, they

gauge the heterogeneous effects of uncertainty on household consumption spending. The empirical evidence substantiates the impact of uncertainty on consumption expenditures and uncovers a significant effect between uncertainty and consumption expenditure along the conditional consumption distribution. Notably, this finding appears to be stronger for the lower quantiles of the consumption distribution, reckoning the presence of asymmetries in the relationship. The authors' analysis has documented the importance of uncertainty in understanding and explaining consumption behavior.

War, mobilization, and fiscal capacity: testing the bellicist theory in Greece, 1833-1939

Working Paper No. 327

Andreas Kakridis

Constructing a new dataset of Greek public revenues and expenditures for the years 1833 to 1939, this paper finds that war mobilisations

undermined tax revenues in the short run, but helped the Greek state increase its fiscal capacity in the long run. Tax revenues increased on

the heels of major spikes in defence expenditures, even in cases where mobilisations did not escalate to war. But even in normal times, changes in military expenditures had a stronger effect on taxes, compared to similar changes in

civilian outlays. This paper, thus, provides both data and evidence in support of bellicist theories of state formation for Greece, while also proposing a new approach to testing for the effects of war on fiscal capacity.

From policy to capital: assessing the impact of structural reforms on gross capital inflows

Working Paper No. 328

Christos Mavrogiannis and Athanasios Tagkalakis

Utilizing a narrative database on structural reforms in 25 OECD countries from 1985 to 2020, the authors investigate the effects of labour and product market reforms on gross capital inflows. By applying the local projection method and addressing reform endogeneity with the Augmented Inverse Probability Weighted estimator, they find that structural reforms have a positive medium-term effect on both direct and portfolio investment. In particular, reforms boost investment, especially in environments of high-quality financial

institutions and amid low public debt. Furthermore, building on a new indicator of cabinet policy orientation, the authors find that newly-elected market-oriented cabinets have a positive effect on direct investment inflows. Product market reforms are more conducive to the inflow of direct investment under cabinets that prefer a state-oriented economy. Labour market reforms significantly boost direct investment and portfolio investment under governments favouring a market-oriented economy.

Determinants of regional business cycle synchronization in Greece

Working Paper No. 329

Panagiotis Delis, Stavros Degiannakis, George Filis, Theodosios Palaskas and Chrysostomos Stoforos

In this paper, the authors assess the determinants of regional business cycles synchronisation in Greece vis-à-vis the national reference business cycle, using NUTSII annual data. The computation of the time-varying synchronisation is based on the dynamic estimate of a conditional variance-covariance model and, subsequently, a panel regression model is used to evaluate its determinants. The findings show that island regions, industrial structure, imports, savings and disposable income are the key determinants, based on the GVA business cycle synchronisation vis-à-vis the national reference cycle. The authors also assess the determinants of employment synchronisation (vis-à-vis the national employment level) and find that regions with higher disposable income and

public spending tend to drive the level of synchronisation. Turning to inter-regional synchronisation, the authors provide evidence that investments, disposable income and employment drive the GVA business cycle synchronisation, whereas the employment synchronisation is determined by the level of imports, disposable income and public spending, as well as by the status of regions as island economies. This paper further shows that the Greek economic crisis during the period 2010-2018 diminished or eliminated the effects of the aforementioned drivers, suggesting that during the said period, synchronisation was mainly driven by the wider economic conditions. These findings lead to important policy implications, which are thoroughly discussed.

Market power and profit margins in the Euro area countries in the post-pandemic period

Working Paper No. 330

Dimitrios Sideris and Georgia Pavlou

The rise in unit profits has been a major factor driving price inflation in the post-pandemic period, in most euro area economies. In the present paper, the authors attempt to analyse the factors behind this rise. One explanation provided by the literature is that the supply bottlenecks observed in the post-pandemic era, facilitated – probably temporarily – the exercise of market power by firms, which then increased their profit margins. This paper investigates empirically whether the degree of competition in the markets of the euro area economies played any role as to the extent to

which firms raised unit profits. The authors also test whether labour market regulations had any effect on the profit margins rise by keeping labour costs contained. They use annual panel data for the euro area economies for the post-pandemic years 2021 and 2022. The econometric results confirm the theoretical hypotheses. The empirical evidence implies that structural features of the product and labour markets of the euro area economies affected price formation in the euro area, at least in the post-supply shocks period, thus rendering ECB's monetary policy against inflation less effective.

ARTICLES PUBLISHED IN PREVIOUS ISSUES OF THE ECONOMIC BULLETIN

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Anastasatou Marianthi, Balfoussia Hiona, Bragoudakis Zacharias, Malliaropulos Dimitris, Migiakis Petros, Papageorgiou Dimitris and Petroulas Pavlos, “Effects of a sovereign credit rating upgrade to investment grade on the Greek economy”, No. 58, December 2023.

Flevotomou Maria, “The distributional impact of fiscal measures to compensate for consumer inflation in Greece in 2022”, No. 58, December 2023.

Georgiou A. Evangelia, “Interest rate pass-through to deposit rates in Greece”, No. 58, December 2023.

