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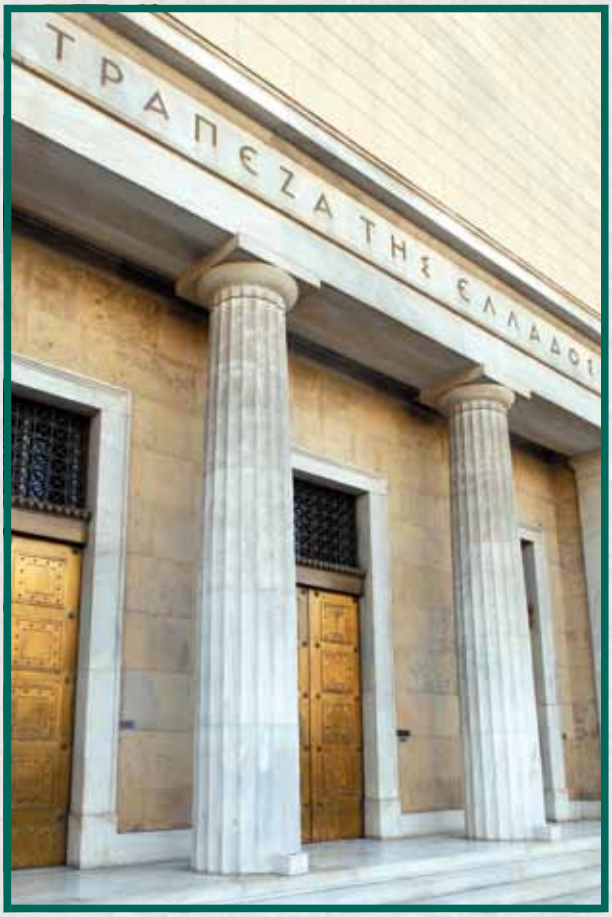

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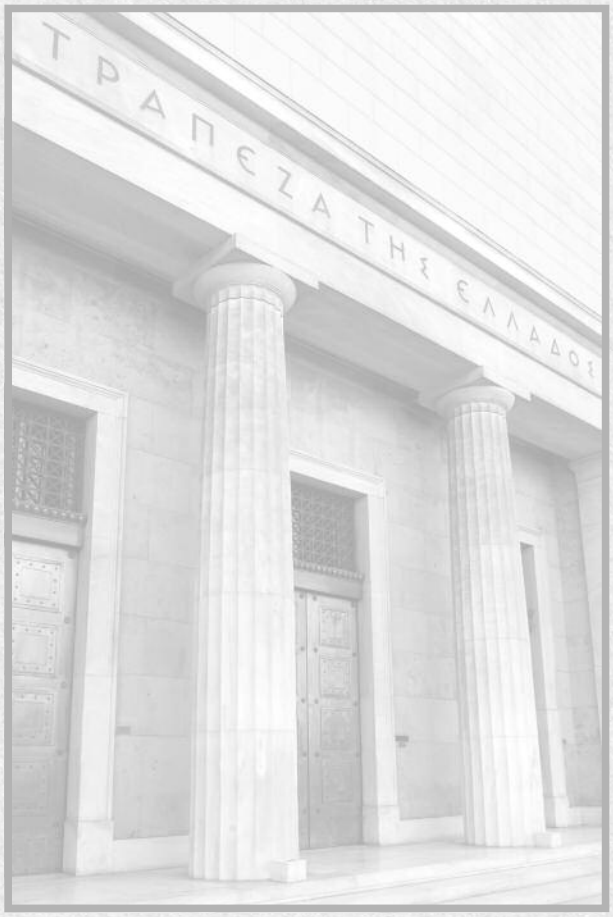

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JOB FLOWS IN GREECE DURING THE RECENT YEARS

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ABSTRACT

In this paper we study job flows in Greece using detailed data on private sector dependent employment for 2015-2017, a period characterised by brisk employment growth. We find that during the years reviewed by our study there is a significant amount of job creation and job destruction going on at the same time. Moreover, job reallocation increases with firm size, which is at odds with findings for other countries. In terms of employee age categories, job creation is the strongest for those over 44 years old. Our regression results imply that, at the sectoral level, job creation is negatively correlated with wage growth and positively correlated with capital intensity and net firm growth. By contrast, job destruction at the sectoral level is negatively correlated with net firm growth and positively correlated with export intensity, which may reflect a creative destruction process as the Greek economy is becoming more open.

Keywords: job reallocation, sectoral analysis, employment developments

JEL classification: J23, J63

ΡΟΕΣ ΑΠΑΣΧΟΛΗΣΗΣ ΣΤΗΝ ΕΛΛΑΔΑ ΚΑΤΑ ΤΗΝ ΠΡΟΣΦΑΤΗ ΠΕΡΙΟΔΟ

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ΠΕΡΙΛΗΨΗ

Στο παρόν άρθρο εξετάζουμε τις ροές απασχόλησης στην Ελλάδα χρησιμοποιώντας λεπτομερή στοιχεία για τη μισθωτή απασχόληση στον ιδιωτικό τομέα την περίοδο 2015-2017, η οποία χαρακτηρίζεται από σημαντική αύξηση της απασχόλησης. Βρίσκουμε ότι κατά τα έτη της ανάλυσής μας υπάρχει ταυτόχρονα σημαντική δημιουργία και καταστροφή θέσεων εργασίας. Επιπλέον,

η ανακατανομή των θέσεων εργασίας είναι μεγαλύτερη όσο αυξάνει το μέγεθος των επιχειρήσεων, γεγονός που δεν συμβαδίζει με τα ευρήματα μελετών σε άλλες χώρες. Ως προς τις ηλικιακές κατηγορίες των εργαζομένων, η πιο ισχυρή δημιουργία νέων θέσεων εργασίας αφορά τους εργαζομένους ηλικίας άνω των 44 ετών. Τα αποτελέσματα της οικονομετρικής μας ανάλυσης υποδηλώνουν ότι, σε επίπεδο κλάδου οικονομικής δραστηριότητας, η δημιουργία νέων θέσεων εργασίας συσχετίζεται αρνητικά με το ρυθμό μεταβολής των μισθών και θετικά με την ένταση κεφαλαίου και τη μεταβολή του αριθμού των επιχειρήσεων του κλάδου. Σε αντίθεση, η καταστροφή θέσεων εργασίας σε επίπεδο κλάδου οικονομικής δραστηριότητας συσχετίζεται αρνητικά με τη μεταβολή του αριθμού των επιχειρήσεων και θετικά με το βαθμό εξωστρέφειας του κλάδου, γεγονός που ενδεχομένως αντανακλά μια διαδικασία δημιουργικής καταστροφής καθώς η ελληνική οικονομία γίνεται πιο εξωστρεφής.

JOB FLOWS IN GREECE DURING THE RECENT YEARS[1]

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1 INTRODUCTION

Following the seminal work of Davis and Haltiwanger (1992), plenty of evidence has accumulated showing that there is significant job reallocation in all countries and sectors irrespective of the phase of the cycle (see e.g. Gómez -Salvador et al. 2004, Pisu 2008, Heuse and Saks 2009, and Haltiwanger et al. 2014). In particular, it has been shown that many jobs are simultaneously created and destroyed even when employment growth is zero. The extent of job creation and destruction has been found to depend on a number of characteristics, such as the size and age of firms, the sector of activity, labour market institutions and firms' engagement in international markets (see e.g. Gómez-Salvador et al. 2004, Pisu 2008 and references therein).

In Greece, following a deep recession that resulted in the loss of more than one quarter of its real output in the period 2009-2015, employment has started to increase at a brisk pace well ahead of the recovery of real activity. For instance, according to administrative data, the number of private sector employees grew on average by 6.7% annually in the period January 2014-November 2018.[2]

This robust employment growth in an economy that is gradually recovering from a severe recession warrants some further analysis in the context of the above mentioned literature. In particular, in this recovery process, it would be interesting to analyse the drivers of employment growth, gauge the extent of job creation and job destruction that underlie these employment developments and uncover any potential heterogeneities in the response of sectors and firms of different size.

For the purpose of our analysis we use detailed employment data for 2015-2017, disaggregated at the level of sector, firm size and employee age. The data are from the ERGANI database —an administrative data source— compiled by the Ministry of Labour, Social Security and Social Solidarity.

We find that during the years reviewed by our study there is a significant amount of job creation and job destruction going on at the same time. Moreover, job reallocation increases with firm size, which is at odds with findings for other countries. In terms of employee age categories, job creation is the strongest for those over 44 years old. Finally, our regression results imply that, at the sectoral level, job creation is negatively correlated with wage growth and positively correlated with capital intensity and net firm growth. By contrast, job destruction at the sectoral level is negatively correlated with net firm growth and positively correlated with export intensity, which may reflect a creative destruction process as the Greek economy is becoming more open.

1 We would like to thank the Ministry of Labour, Social Security and Social Solidarity for providing detailed employment micro-aggregated data from the ERGANI database, as well as Heather Gibson and Georgia Pavlou for sharing their data on sectoral characteristics. We would also like to thank Hiona Balfoussia and seminar participants at the Bank of Greece for their constructive comments. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Greece.

2 Source: Monthly reports on employment, Social Security Institute (IKA/EFKA). This data source is comparable to the ERGANI database used in our analysis. They both refer to administrative data.

The remainder of the article is structured as follows. Section 2 provides a short literature review. In Section 3 we provide a brief description of the data used as the basis for our analysis. Section 4 describes the concepts of gross job flows and the methodology used to define them, while Section 5 presents and discusses the paper's findings. The final section concludes.

2 LITERATURE REVIEW

A well-established fact in the literature is that many jobs are simultaneously created and destroyed. As detailed microeconomic data have become available in more recent years, there is ample empirical evidence shedding light on the various aspects and determinants of job creation and destruction.

In their seminal work, Davis and Haltiwanger (1992) document extensive job creation and job destruction rates within narrowly defined sectors, using US manufacturing establishment-level data. Moreover, they show that job reallocation is mainly driven by establishment-level employment dynamics, rather than between-sector employment shifts, which points to the high relevance of plant-level heterogeneity in shaping labour demand. Indeed, they find that differences in the intensity of job reallocation across establishments strongly relate to observable firm characteristics, such as age and size.

The main insights from the work of Davis and Haltiwanger (1992) were confirmed by later country-specific studies, including Konings (1995) for the United Kingdom, Abowd et al. (1999) for France and more recently Heuse and Saks (2009) for Belgium, as they all find considerable job reallocation at the establishment level. Moreover, the heterogeneity across firm job reallocation dynamics is partly accounted for by observable firm and worker characteristics, such as the sector and region of activity, firm size, type of employment contract (fixed-term or open-ended) and the distinction between blue- and white-collar workers. A further common finding among these studies is that job creation and job destruction strongly differ across firm size, being higher in smaller firms. They also tend to be higher in services, rather than in manufacturing firms. Lastly, most of the reallocation of jobs is accounted for by continuing firms, rather than firm churning.

This stream of literature has also examined the extent to which excess job reallocation is driven by participation in international trade, as predicted by trade models with firm heterogeneity, in the spirit of Melitz (2003). Early empirical studies including Davis et al. (1996) and Levinsohn (1999) showed the relevance of trade-induced job reallocation by exploiting differences in trade intensity across industries. Later studies exploited further the variation in export intensity at the firm level. For a sample of Belgian manufacturing firms, Pisu (2008) finds that up to 30% of total job reallocation is driven by the shifts of jobs from firms that do not export to those that export.

Moving to cross-country studies allows to investigate the role of institutional factors in shaping the magnitude of gross job flows. OECD (2009 and 2010) uses harmonised measures of job and worker flows for OECD economies to show that labour market institutions affect gross job flows. Specifically, lax dismissal regulations and low firing and hiring costs are associated with higher job reallocation.[3] These conclusions were further supported by the works of Gómez-Salvador et al. (2004) for European firms and Haltiwanger et al. (2014) for a sample including also emerging countries.

3 DESCRIPTION OF THE DATASET

Our analysis of gross job flows and employment growth is based on administrative data, for three years (2015-2017), on the number of

3 The variation in employment protection legislation explains up to 30% of cross-country variation in gross job flows (OECD 2010).

employees at the level of the 2-digit NACE sectors, at the end of October of each year, from the annual accounts of the ERGANI database. The ERGANI database covers the whole population of private sector employees and includes information on firm characteristics, such as the number of employees and the sector of activity, as well as on employee characteristics, such as age, gender and type of contract.[4] This database includes the information submitted annually by all private sector employers and serves as a detailed registry of the employment history of all private sector employees. The information collected is at the job/worker level starting in 2014. However, due to the recent inception of the database and the sensitivity of the data contained therein, only micro-aggregated data are currently available for research purposes.

The data used in this paper is at the following level of disaggregation: number of employees in sector *s*, working in firms of size *i* and belonging to the age category *j*. Specifically, the above information is available for 87 2-digit NACE sectors, 3 age categories (<25, 25-44, >44) and 4 firm size classes (1-10, 11-50, 51-250 and 250+).

For instance, one observation refers to the number of employees aged between 25 and 44, working in 2015 in firms of 1-10 employees in the manufacture of tobacco products (2-digit NACE sector 12). For each 2-digit NACE sector we have roughly 12 such observations per year on the number of employees at the end of October. These give us approximately 955 employment cells per year and 2,863 observations in total.

4 DESCRIPTION OF THE METHODOLOGY

In order to look deeper into the determinants of and the contributors to employment growth in Greece during the recent years, we compute job creation and job destruction rates by adopting the methodology proposed by Davis and Haltiwanger (1992) and Davis et al. (1996).

Conceptually, job creation rates refer to an appropriately weighted sum of positive employment growth rates among the various units of observation. Similarly, job destruction rates refer to the respective sum of negative growth rates.

Let the level of employment at each cell n (i.e. employment of each sector/size/age category) be defined as x_{nt} and the employment growth rate of each cell between period t and $t\text{-}1$ as $g_{nt}=\frac{x_{nt}-x_{n,\,t-1}}{X_{n,\,t-1}}$. Let us also denote total employment as $X_{t-1}=\sum_n x_{n,t-1}$ and the weight of each cell in total employment as $\frac{x_{n,\,t-1}}{X_{t-1}}$ in period $t\text{-}1$. Job creation JC_t and job destruction JD_t rates can thus be expressed as:

$$JC_t = \sum_n g_{nt}\frac{x_{n,t-1}}{X_{t-1}},\ for\ g_{nt} > 0 \qquad (1)$$

$$JD_t = \sum_n |g_{nt}|\frac{x_{n,t-1}}{X_{t-1}},\ for\ g_{nt} < 0 \qquad (2)$$

Therefore, job creation in period t is the sum of employment gains weighted by the employment share of the relevant cells in total employment in $t\text{-}1$, while job destruction refers to the sum of employment losses weighted by the employment share of the relevant cells in total employment in $t\text{-}1$.

Consequently, net employment growth in each period t is the difference between job creation and job destruction, $NE_t = JC_t - JD_t$. Job reallocation JR_t is defined as the sum of the job creation and the job destruction rates $JR_t = JC_t + JD_t$ and is a measure of the rate at which the total number of jobs is reallocated in the economy, i.e. a measure of job turnover.

If the focus of the analysis is on the contributors to total economy's employment growth, X_{t-1} refers to total employment in the economy in period $t\text{-}1$ and $\frac{x_{n,\,t-1}}{X_{t-1}}$ to the share of cell n in the economy's total employment in $t\text{-}1$. If an analysis at the sectoral level is pursued (within-sector job creation and job destruction), X_{t-1}

4 Employees working in public sector entities under private-sector contracts are also registered in this database.

Table 1 Total economy – Net employment growth and components

Year	Total job creation	Total job destruction	Net employment growth
2016	8.08%	2.21%	5.87%
2017	8.50%	1.06%	7.44%

Source: ERGANI and authors' calculations.

refers to the sector's total employment in period *t-1* and $\frac{X_{n,t-1}}{X_{t-1}}$ to the share of cell *n* in the sector's total employment in *t-1*.[5]

5 RESULTS

In 2016 and 2017, dependent employment in the private sector grew vigorously by 5.9% and 7.4%, respectively. This net employment growth is however the outcome of even stronger job creation as well as significant job destruction. Table 1 shows that the job creation rate stood at 8.1% in 2016 and 8.5% in 2017, while the job destruction rate was 2.2% and 1.1%, respectively.[6] Thus, even in a period characterised by strong employment growth there is a non-negligible magnitude of job destruction. These rates imply that about 10% of all jobs are reallocated across sectors, firm sizes and worker age groups.[7]

These aggregate numbers, however, may mask significant heterogeneity in job creation and destruction across sectors, firm size classes and age categories of the workers. Thus, in order to obtain a clearer picture of the drivers of job creation and job destruction, we exploit each dimension available in our dataset. In this exercise, we look into the contribution of each group to total economy's employment growth as well as the employment growth rates that underlie the groups' contributions.

5.1 DESCRIPTIVE RESULTS BY FIRM SIZE AND EMPLOYEE AGE CATEGORY

Table 2 presents both the contribution of each of the four firm size classes to net employment growth in each of the years of our sample as well as the changes within each group.[8] The figures presented in Table 2 should be read as follows: in the third column, the job creation rates of each of the four size categories add up to total economy's job creation rate for 2016, i.e. 8.08%. Similarly, in the fourth column they add up to the economy's job destruction rate for 2016, i.e. 2.21%, and in the fifth column they add up to net employment growth for 2016, i.e. 5.87%. Finally, columns 6-8 present the annual rates of job creation, job destruction and net employment growth within each firm size group.

It appears that, for Greece, job creation rates are fairly equally distributed among small (1-10 employees) and large firms (51-250 and 250+ employees), with job creation rates ranging from 1.7% to 1.9%. Interestingly, medium-sized firms (11-50 employees) that employ a quarter of all employees exhibit the strongest job creation activity, contributing around 2.6 percentage points to the economy-level job creation. At the same time, job destruction rates are monotonically increasing with firm size. This contrasts with a common finding in the literature that job creation and job destruc-

5 Similarly, if the focus is on job creation and destruction rates within employee age or firm size categories, X_{t-1} refers to the total employment of the group and $\frac{X_{n,t-1}}{X_{t-1}}$ to the share of cell *n* in the group's total employment in *t-1*.

6 These job creation and job destruction rates are calculated from equations (1) and (2), where X_{t-1} refers to total employment in the economy in *t-1* and $\frac{X_{n,t-1}}{X_{t-1}}$ to the share of cell *n* in the economy's total employment in *t-1*.

7 As mentioned earlier, job reallocation is the sum of job creation and job destruction and refers to the total number of jobs reallocated in the economy or group.

8 The net employment growth within each group at time *t* multiplied by the share of the group in (*t-1*) gives us the contribution of the group to total economy's net employment growth. The same holds for job creation and destruction.

Table 2 Net employment growth developments by firm size class

Year	Size	Contributions to total economy			Within-group developments		
		Job creation	Job destruction	Net employment growth	Job creation	Job destruction	Net employment growth
2016	1-10	1.89%	0.08%	1.81%	6.18%	0.26%	5.92%
2016	11-50	2.59%	0.19%	2.41%	10.54%	0.76%	9.78%
2016	51-250	1.70%	0.86%	0.84%	9.36%	4.76%	4.61%
2016	250+	1.89%	1.08%	0.82%	7.10%	4.04%	3.06%
2016		***8.08%***	***2.21%***	***5.87%***			
2017	1-10	2.18%	0.11%	2.07%	7.13%	0.36%	6.77%
2017	11-50	2.31%	0.14%	2.17%	9.07%	0.56%	8.51%
2017	51-250	1.78%	0.25%	1.54%	9.93%	1.37%	8.57%
2017	250+	2.22%	0.56%	1.66%	8.58%	2.16%	6.42%
2017		***8.50%***	***1.06%***	***7.44%***			

Employment shares: 1-10 (30%), 11-50 (25%), 51-250 (18%), 250+ (27%)

Source: ERGANI and authors' calculations.

tion rates decrease monotonically with firm size.[9] The main idea behind this decreasing relationship is that, as firms become larger and more settled in their specific economic environment, they also learn more about the demand they face, their production capabilities and their optimal employment levels. As such, they exhibit lower rates of job creation and destruction. The different findings for Greece may, however, reflect the sharp decline in economic activity during the crisis years. Indeed, the strong contraction of economic activity and the subsequent upturn have led to a significant increase in uncertainty regarding the demand faced by firms. A further source of increased uncertainty regarding demand conditions and production capabilities may emanate from the structural transformation of an economy that is gradually becoming more open. While the former source of uncertainty would be relevant for all firm sizes, the latter would affect mostly larger firms that are more export-oriented (and have become even more so in recent years). Taken together, these two sources of uncertainty would explain why we observe increasing job reallocation by firm size.

It should be noted that these contributions are driven by significant year-on-year employment dynamics within each of the individual firm size categories both in 2016 and in 2017. Medium-sized firms (11-50 employees) perform remarkably well, with net employment growth rates being around 10% and 8.5% in 2016 and 2017, respectively. At the same time, year-on-year net employment growth within the above firm size categories is the outcome of a significant reallocation of jobs within each firm size category. For instance, in 2017 job reallocation rates within bigger firms —with 51-250 and 250+ employees— stand at around 11% (sum of columns 6 and 7).

Table 3 presents job creation and job destruction in terms of employee age classes in a similar fashion. Employees below the age of 25 account for about 8% of total employees, while the relevant share of employees aged between 25 and 44 is about 60% and the share of those above the age of 44 is around 32%.

9 See e.g. Haltiwanger and Davis (1992), Gómez-Salvador et al. (2004) and Heuse and Saks (2009).

Table 3 Net employment growth developments by employee age class

Year	Age	Contributions to total economy			Within-group developments		
		Job creation	Job destruction	Net employment growth	Job creation	Job destruction	Net employment growth
2016	<25	1.14%	0.16%	0.97%	15.56%	2.24%	13.32%
2016	25-44	3.68%	1.52%	2.16%	5.88%	2.42%	3.45%
2016	44+	3.26%	0.53%	2.73%	10.86%	1.75%	9.10%
2016		***8.08%***	***2.21%***	***5.87%***			
2017	<25	0.98%	0.10%	0.87%	12.49%	1.33%	11.16%
2017	25-44	3.58%	0.73%	2.85%	5.85%	1.19%	4.65%
2017	44+	3.95%	0.22%	3.72%	12.76%	0.72%	12.04%
2017		***8.50%***	***1.06%***	***7.44%***			

Employment shares: <25 (8%), 25-44 (60%), 44+ (32%)

Source: ERGANI and authors' calculations.

In terms of net employment growth we can note that for the whole economy the contribution of the age class 44+ is similar, on average, to the contribution of the age class 25-44 (2.2% and 2.7% in 2016 and 2.9% and 3.7% in 2017, respectively).

These sizeable contributions are the outcome of robust year-on-year growth in both these categories. However, the employment growth of the age category 44+ is about three times that of the age category 25-44, i.e. around 9% and 12% in 2016 and 2017, respectively.

For the age category of <25, net employment growth is also robust, standing at about 12%, on average, per year. However, due to its low share in total employment, its contribution is fairly small.

Within-group employment developments imply that job reallocation within age categories has been most dynamic for the young (<25) and the older (44+) workers, with around 16% for the former category and about 13% for the latter group, on average. For both these categories the key driver is job creation. By contrast, job reallocation dynamics are more muted in the age category 25-44. That said, this group features the highest job destruction rate in 2016 among all age groups.

The dynamic job creation of the age categories <25 and 44+ may reflect different needs of firms. Specifically, cost considerations may be a key determinant of job creation for young employees, as they could, at the time, be employed at sub-minimum wages. Indeed, the occurrence of sub-minimum wage earners and the number of employed young workers were highly correlated.[10] By contrast, the employment of the 44+ age cohort may indicate that firms tend to also employ workers with more labour market experience, as their human capital may prove to be beneficial to their expansion process. Moreover, as the retirement age in Greece has increased significantly in recent years, older workers choose to remain in the labour force for longer.[11] The increased employment of older workers is also in line with broader developments in the euro area.[12]

Finally, exploiting further the dimensions of our dataset, we go one step further and look at the contribution of worker age classes across all

10 See Bank of Greece (2018c).
11 It may also, to some extent, reflect an added worker effect, which has been found to be significant in Greece during the crisis. See Papapetrou and Tsalaporta (2018).
12 See Bodnár (2018).

Table 4 Relative importance of age and size contributions to net employment growth in 2017

(%)

Age \ Size	1-10	11-50	51-250	250+	Sum
<25	4.2	4.2	2.1	1.3	**11.7**
25-44	**10.1**	**12.6**	8.2	7.4	**38.3**
44+	**13.5**	**12.4**	**10.4**	**13.7**	**50.0**
Sum	**27.8**	**29.2**	**20.7**	**22.4**	**100**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

firm sizes. Each entry of Table 4 presents the growth contribution (in %) for each firm size class (in columns) and worker age group (in rows) to that year's aggregate level employment growth (i.e. 100 stands for a net employment growth of 7.44% in 2017). A couple of interesting findings arise: first, across almost all firm sizes the contribution to net employment growth increases with worker age and, second, small and medium-sized firms play an important role in job creation for younger workers.

5.2 DESCRIPTIVE RESULTS AT THE SECTORAL LEVEL

Finally, we look into the sectoral dimension of job creation, job destruction and employment growth. Chart 1 presents each sector's contribution to the aggregate-level moments, thus accounting for each sector's relative importance in aggregate employment.

In terms of the sectoral contributions to the aggregate level of job creation, in Chart 1 we see that the sectors featuring the highest job creation rates are: (1) food services; (2) retail trade; (3) wholesale trade; and (4) accommodation services. Manufacturing as a whole also contributes significantly to aggregate-level employment, as it accounts for 0.7 percentage point of the 2017 net employment growth of 7.44% (see Chart A1 in the Appendix).

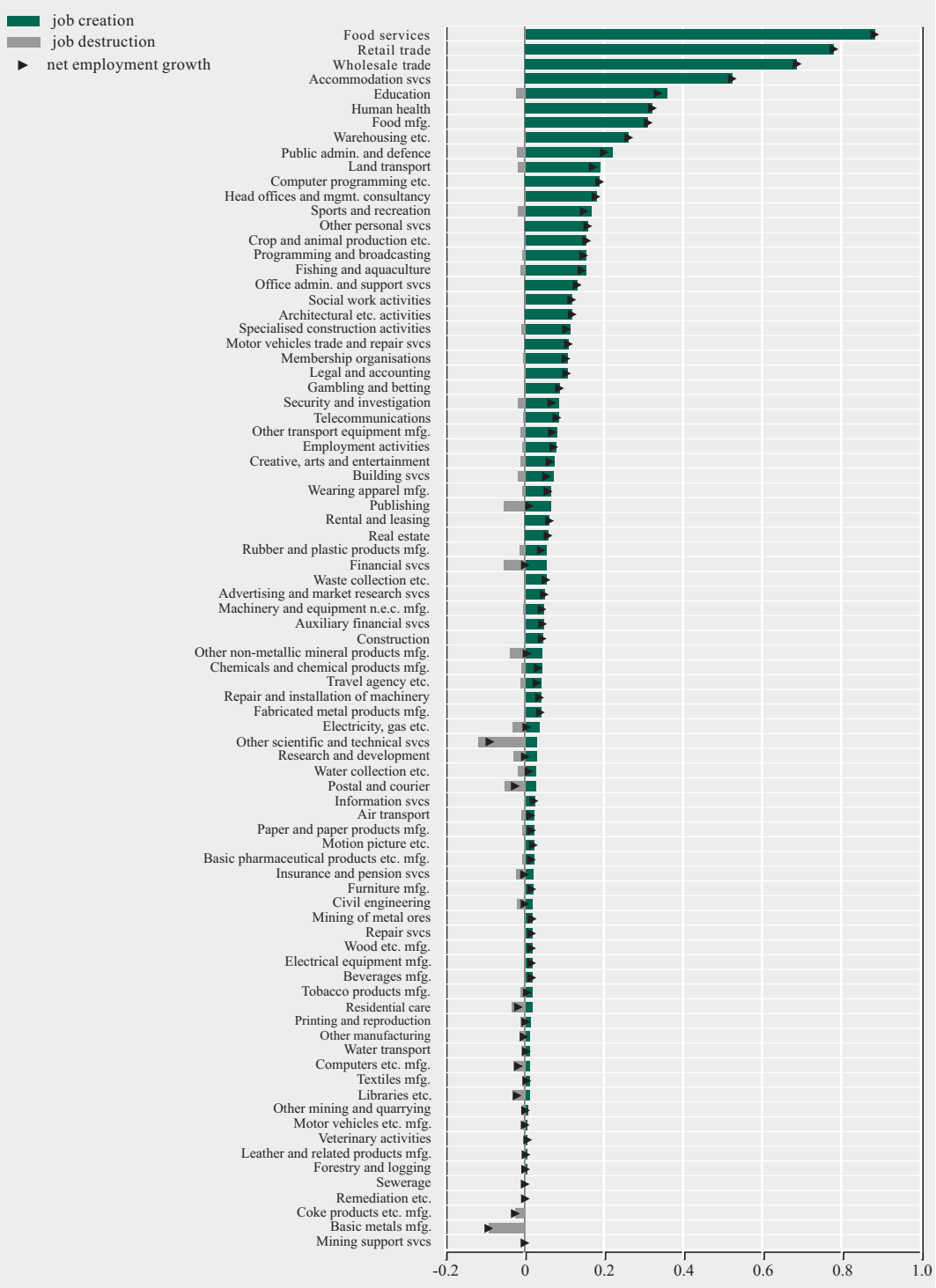
Even so, these results mask significant within-sector heterogeneity in job creation and job destruction.[13] From Chart 2 it is clear that there is a significant amount of both job creation and job destruction across most sectors of economic activity. Furthermore, there is considerable cross-sectoral variation in these moments. Indeed, overall job reallocation ranges from about 4% in the manufacturing of metal products to 64% in fishery. Interestingly, unlike the findings of earlier studies, job reallocation rates in services do not exceed job reallocation rates in manufacturing industries to a significant degree. In addition, higher job reallocation is associated with higher employment growth (82% correlation) and job reallocation is the strongest among some smaller dynamic sectors like fishery and programming and broadcasting activities.

The sectors with the largest shares in aggregate employment, namely food services, retail and wholesale trade, and accommodation services (which are highlighted in the chart), exhibit only an average degree of job creation and job destruction. By comparison, the manufacturing subsectors are distributed across the entire range of job reallocation, where some sectors such as manufacturing of other transport equipment and manufacturing of tobacco products show high rates of job reallocation as well as employment growth, while others such as manufacturing of textiles and beverages feature below average job reallocation dynamics.

13 In the analysis of within-sector developments we drop sectors with a very low number of employees (<1000), as relatively few jobs may create large variations in job creation and destruction rates. Specifically, the sectors dropped are the ones with the 2-digit NACE codes: 02, 05, 09, 37, 39, 75, 98 and 99.

Chart 1 Job creation, job destruction and net employment growth, by 2-digit NACE: contributions to total economy net employment growth (2017)

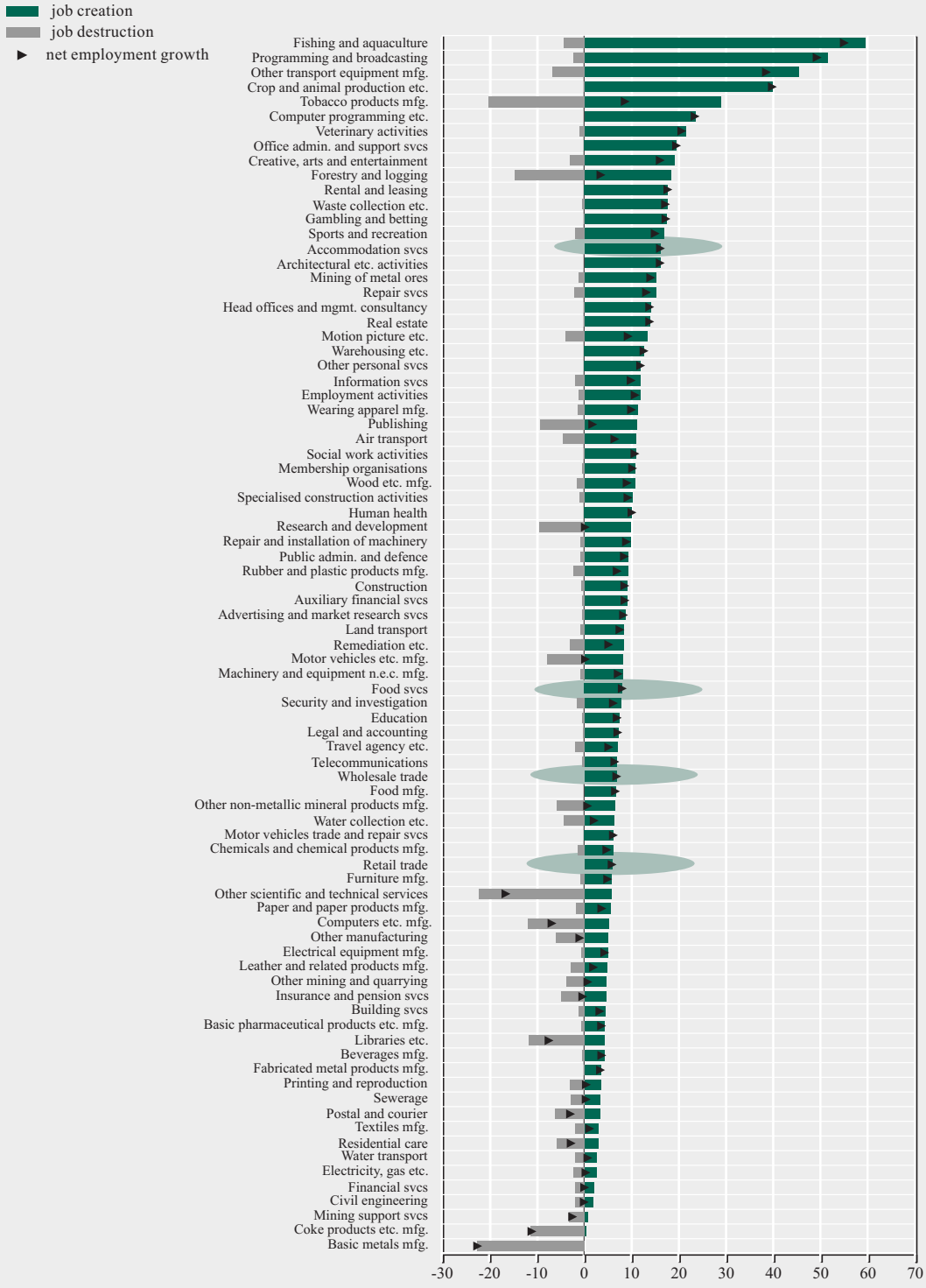
(%)



Source: ERGANI and authors' calculations.

Chart 2 Within-sector job creation, job destruction and net employment growth, by 2-digit NACE (2017)

(%)



Source: ERGANI and authors' calculations.

Table 5.1 Food services
Relative importance of age and size contributions to the year's net employment growth

(%)

Size / Age	1-10	11-50	51-250	250+	Sum
			2016		
<25	**9.66**	**19.75**	3.84	0.15	**33.40**
25-44	4.36	**33.41**	5.58	0.41	**43.76**
44+	6.49	**13.82**	2.05	0.47	**22.84**
Sum	**20.51**	**66.98**	**11.48**	**1.03**	**100.00**
			2017		
<25	8.62	**11.12**	3.70	0.96	**24.40**
25-44	**11.23**	**20.11**	9.02	2.78	**43.15**
44+	**15.58**	**12.99**	3.59	0.29	**32.45**
Sum	**35.44**	**44.22**	**16.31**	**4.03**	**100.00**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

In order to obtain a better understanding of job creation and job destruction in Greece, we take a closer look at the most important sectors, in terms of employment share. Specifically, we investigate the relative importance of firm size classes and worker age categories within each sector (food services, retail trade, wholesale trade, accommodation services and total manufacturing) in order to identify any particular differences in the drivers of employment growth.

Each of the Tables 5.1-5.5 presents the growth contribution (in %) for each firm size class (in columns) and employee age group (in rows) to that year's sectoral employment growth (e.g. the employment growth of food services in 2016 stood at 10.2% in 2016 and at 8% in 2017).

Table 5.2 Retail trade
Relative importance of age and size contributions to the year's net employment growth

(%)

Size / Age	1-10	11-50	51-250	250+	Sum
			2016		
<25	6.91	5.28	1.08	4.53	**17.79**
25-44	**13.90**	**16.24**	2.36	**13.38**	**45.88**
44+	**12.99**	**6.25**	2.59	**14.50**	**36.33**
Sum	**33.79**	**27.77**	**6.03**	**32.41**	**100.00**
			2017		
<25	5.85	4.40	0.64	0.25	**11.14**
25-44	**17.55**	**14.37**	5.30	1.02	**38.24**
44+	**18.79**	7.41	4.89	**19.54**	**50.63**
Sum	**42.19**	**26.18**	**10.82**	**20.80**	**100.00**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

Table 5.3 Wholesale trade
Relative importance of age and size contributions to the year's net employment growth

(%)

Size / Age	1-10	11-50	51-250	250+	Sum
			2016		
<25	3.25	4.35	0.05	-0.93	**6.72**
25-44	-1.50	**27.49**	3.51	**13.12**	**42.62**
44+	**16.44**	**23.98**	7.32	2.92	**50.66**
Sum	**18.19**	**55.81**	**10.88**	**15.12**	**100.00**
			2017		
<25	2.86	2.08	3.43	2.90	**11.28**
25-44	1.34	**12.50**	6.52	**10.36**	**30.71**
44+	**15.08**	**20.40**	**14.31**	8.22	**58.01**
Sum	**19.28**	**34.98**	**24.26**	**21.48**	**100.00**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

On balance, we see that young workers make a notable contribution to the food services sector's net employment growth. Indeed, we can note that the food services sector has featured the most extensive use of minimum and sub-minimum wages during 2015-2017. Moreover, food services are characterised by a large and structural turnover of employment over time.[14] These findings are consistent with the low level of skills needed in the production process of this sector. As such, cost rather than human capital considerations may be the key determinant of job dynamics and net employment growth.

Food services, retail trade and wholesale trade feature a strong relevance of small and

14 See Bank of Greece (2018b).

Table 5.4 Accommodation services
Relative importance of age and size contributions to the year's net employment growth

(%)

Size / Age	1-10	11-50	51-250	250+	Sum
			2016		
<25	-0.11	-0.99	-6.59	-2.16	**-9.84**
25-44	0.03	-9.85	**-40.21**	**-10.24**	**-60.28**
44+	1.17	-5.19	**-21.33**	-4.53	**-29.88**
Sum	**1.09**	**-16.03**	**-68.13**	**-16.93**	**-100.00**
			2017		
<25	1.68	3.78	6.84	0.99	**13.29**
25-44	6.03	**13.75**	**20.76**	6.57	**47.11**
44+	**8.87**	**11.90**	**12.86**	5.98	**39.60**
Sum	**16.58**	**29.43**	**40.45**	**13.54**	**100.00**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

Table 5.5 Manufacturing (total)
Relative importance of age and size contributions to the year's net employment growth

(%)

Size / Age	1-10	11-50	51-250	250+	Sum
			2016		
<25	3.44	4.90	2.35	0.96	**11.65**
25-44	6.17	**13.03**	7.19	4.42	**30.81**
44+	**12.62**	**19.47**	**15.13**	**10.32**	**57.54**
Sum	**22.23**	**37.40**	**24.68**	**15.70**	**100.00**
			2017		
<25	2.48	4.03	1.14	0.64	**8.28**
25-44	-2.59	8.51	5.70	3.85	**15.48**
44+	**12.35**	**21.40**	**21.38**	**21.11**	**76.24**
Sum	**12.24**	**33.93**	**28.22**	**25.61**	**100.00**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

medium-sized firms to net employment growth in 2016 and 2017, which is in line with the large concentration of small firms in these industries. Surprisingly, the most dynamic cells in the accommodation services are medium-sized enterprises and employees aged above 25. Small firms' and young workers' contributions are very small in this sector, which may in part reflect the quality upgrade of the tourism sector in Greece with significant increases in higher-end hotel capacity.[15]

In contrast with all other sectors, in manufacturing —a sector with significantly larger needs for skilled labour— net employment growth has been driven mainly by older workers across all firm sizes. Moreover, the contribution of large and very large firms is significant, and job reallocation is increasing with firm size. Specifically, while both job creation and job destruction are increasing with firm size, the positive relationship tends to be stronger in the case of job destruction. This finding may be related to the ongoing transformation of the Greek economy and the investment strategies of firms within the manufacturing sector. In particular, when manufacturing firms faced a significant decline in domestic demand, they had to find other markets for their products, i.e. foreign markets, in order to survive. However, to be able to serve foreign markets they needed to increase their competitiveness either by becoming more cost-efficient or by differentiating their products. This would require significant investment. Such investment could in many cases act as a substitute for labour. Moreover, in an environment where financial constraints prevail, not all firms are able to finance such investment projects. Usually, larger and more established firms are able to finance investment from their own funds or obtain external funding. In this context, the transformation of the production process would entail increased job reallocation during the initial phase. This reallocation would occur as firms that are not able to follow a restructuring process exit the market (or downsize) while other firms are able to expand.

5.3 ESTIMATION RESULTS

We continue our analysis by further exploring the within-sector determinants of job creation and job destruction at the 2-digit sectoral level. Following a well-established literature, we relate sectoral job creation and job destruction

15 See National Bank of Greece (2017).

to various sectoral characteristics such as wage growth, capital intensity, export intensity and firm creation (or destruction).

We conduct this exercise for job creation, job destruction and job reallocation separately in a simple employment demand setting, where employment growth (positive or negative) depends on wage growth and a variety of other sectoral characteristics. In order to avoid issues of causality and rather obtain correlations between variables which will prove informative, we choose to estimate our relationships of interest using logistic regressions.

Most of the variation in our data comes from the cross-sectional (i.e. sector-level) dimension. Our time dimension is limited, as it includes only 2016 and 2017, and is characterised by strong employment growth for the whole economy. Thus, in order to obtain a clearer picture of the sectoral dimension of job creation and job destruction, we calculate our variables of interest as differences from the sectoral median.[16] Specifically, we define our variables of interest $\widetilde{JC}_t$, $\widetilde{JD}_t$ and $\widetilde{JR}_t$ at the sectoral level as being 0 if job creation (job destruction or job reallocation, respectively) in the sector is below the median sectoral job creation (or job destruction or job reallocation) in period t, or 1 if it is equal to or above the respective sample median. Formally:

$$y_t = \begin{cases} 0, & if\ y_t < \tilde{y}_t \\ 1, & if\ y_t \geq \tilde{y}_t \end{cases} \text{ where } y_t \in \widetilde{JC}_t, \widetilde{JD}_t, \widetilde{JR}_t$$

Similarly, our matrix of explanatory variables is expressed as:

$$Z_t = \begin{cases} 0, & if\ Z_t < \tilde{Z}_t \\ 1, & if\ Z_t \geq \tilde{Z}_t \end{cases} \quad \forall z_t \in Z_t$$

That is, each explanatory variable z_t at time t is 0 if its value is below the variable's sectoral median in period t, or 1 if it is equal to or above. Thus we fit a logistic regression of the form:

$$\Pr(y_t \neq 0 | z_{it}) = \frac{\exp(z_{it}\boldsymbol{\beta})}{1 + \exp(z_{it}\boldsymbol{\beta})}$$

Our explanatory variables are: (1) median wage growth; (2) capital intensity; (3) export intensity; and (4) the change in the number of firms in each sector (i.e. net birth or death of firms).[17] The sector-level median wage and the change in the number of firms are drawn from the ERGANI database.[18] Export intensity is calculated as the share of exports in gross output at the sectoral level (in nominal terms) from the national accounts statistics which are available at the sectoral level.[19] Finally, sector-level capital intensity is from Gibson (2010) and Gibson and Pavlou (2017).[20] In order to obtain a representative magnitude of the sectoral capital intensity, we approximate the sectoral capital intensity with its pre-crisis average. The main reason is that capital intensity is calculated as the capital stock relative to output at the sectoral level. During the crisis, however, output dropped dramatically, while the capital stock moved sideways as it adjusted only with a considerable lag. As such, the implied sectoral capital intensity during the crisis and recovery years is not an appropriate measure and is thus approximated with its pre-crisis average.

The results summarised in Table 6 show that above-median wage growth at the sectoral level is —as expected— correlated with below-median job creation. However, wage growth is not related to job destruction. Above-median job creation is also positively related to above-median capital intensity and net firm growth. By contrast, job destruction is negatively related to net firm growth. Moreover, job destruction is found to be pos-

16 A similar approach is taken by Fernández et al. (2017), who also use micro-aggregated data. Moreover, by using the differences from the median rather than the mean, we do not let extreme values influence our results.

17 Additional sector-level explanatory variables used in the estimations included: value added growth, total factor productivity growth and labour productivity (gross value added per person employed). They are not presented in Table 6, as they are insignificant.

18 For each sector and year, we have data on the number of firms from ERGANI Annual Reports. As such, any changes between the years are expressed in net terms for lack of data on new entries and exits of firms in a sector.

19 The results remain unchanged if we use exports to value added at the industry level or if we use the mean wage growth of each sector.

20 National accounts data are available at the 64 NACE sectors. They were merged with the 87 (finer) ERGANI sectors by assuming that export intensity is shared among all 2-digit industries belonging to the same group in the national accounts statistics.

Table 6 Logistic regression: employment growth and sectoral characteristics

	Job creation		Job destruction		Job reallocation	
Dependent variable	Coef.	z-stat.	Coef.	z-stat.	Coef.	z-stat.
Wage growth	**-1.06**	**-2.91**	0.33	0.95	**-0.69**	**-1.88**
Export intensity	-0.22	-0.58	**1.05**	**2.98**	**1.06**	**2.73**
Capital intensity	**0.73**	**1.92**	0.32	0.92	**1.05**	**2.82**
Net firm growth	**1.56**	**4.22**	**-0.63**	**-1.81**	**1.48**	**3.86**
Constant	-0.54	-1.40	-0.53	-1.48	-1.46	-3.28
Number of obs		150		150		150
Wald $chi^2(3)$		27.66		15.01		29.62
Prob > chi^2		0.00		0.00		0.00
Pseudo R^2		0.15		0.08		0.17
Log pseudolikelihood		-88.09		-96.00		-86.04

Note: Bold numbers indicate statistically significant results.

itively related to export intensity.[21] While the former finding is plausible, the latter is somewhat counterintuitive, as Greek exports have grown strongly during the crisis years. First, we can note that this result appears to be driven mainly by a number of export-intensive sectors that are relatively small in terms of their relevance for aggregate employment (each having fewer than 5,200 workers).[22] Second, this result may be due to the fact that we can control for export intensity only at the sectoral level. In principle, when referring to export intensity, one has in mind large and dynamic firms that are growing in order to be able to serve foreign markets. Indeed, such firms would show lower volatility and more stable employment —at the firm level— due to the diversification opportunities that exporting offers. While this may be true at the firm level, at the sectoral level we can observe creative destruction. Specifically, dynamic growing firms coexist with less efficient firms that downsize or may close down. If the creative destruction effect dominates during the period of transformation, it would appear —at the sectoral level— that export intensity may be related to increased job destruction.[23]

6 CONCLUSIONS

This paper used detailed data on private sector dependent employment in Greece for the period 2015-2017 that are disaggregated at the level of sector, firm size and employee age to analyse employment growth and the determinants of job creation and destruction.

As in most studies in this field, we find that there is simultaneous job creation and job destruction and, most importantly, that aggregate net employment growth rates mask important heterogeneity across sectors of activity, firm sizes and age groups.

Interestingly, vigorous job creation for workers in the 44+ age group is an important contributor to total economy net employment

21 A similar result was found by Levinsohn (1999) using Colombian data and is discussed in Pisu (2008).

22 When using the full sample of sectors, the result is robust to inclusions of firm size variables as well as to interactions of firm size variables with export intensity. Specifically, we create the share of sectoral employment by (a) very large firms or (b) by large and very large firms, create a dummy variable which is equal to 1 if the shares belong to the 75th percentile or above and include it as a regressor.

23 This explanation is brought forward by Pisu (2008), who defines participation in international markets at the firm level. He finds that firms participating in international markets have a lower job reallocation rate than domestic ones.

growth, a development which is similar to developments in other euro area countries. Also, as expected, job creation is negatively related to wage growth and positively related to firm growth.

Contrary to the findings of the literature, we find that job reallocation in Greece during the period of our investigation increases with firm size. Furthermore, export intensity is found to be positively related to job destruction. Taken together, these findings of high job reallocation among large firms and export-intensive sectors are consistent with the job dynamics expected in the presence of creative destruction and extensive uncertainty. Both of these forces have been relevant in shaping employment dynamics during the recent years, as the recovery of activity and the increasing openness of the Greek economy gradually gained pace.

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APPENDIX

Table A1 Cross contribution of age and size to net employment growth in 2016

(%)

Size \ Age	<25	25-44	44+
1-10	0.36	**0.63**	**0.82**
11-50	0.41	**1.13**	**0.86**
51-250	0.08	0.26	0.49
250+	0.11	0.14	**0.56**

Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

Table A2 Cross contribution of age and size to net employment growth in 2017

(%)

Size \ Age	<25	25-44	44+
1-10	0.31	**0.75**	**1.00**
11-50	0.31	**0.94**	**0.92**
51-250	0.16	0.61	**0.77**
250+	0.09	0.55	**1.02**

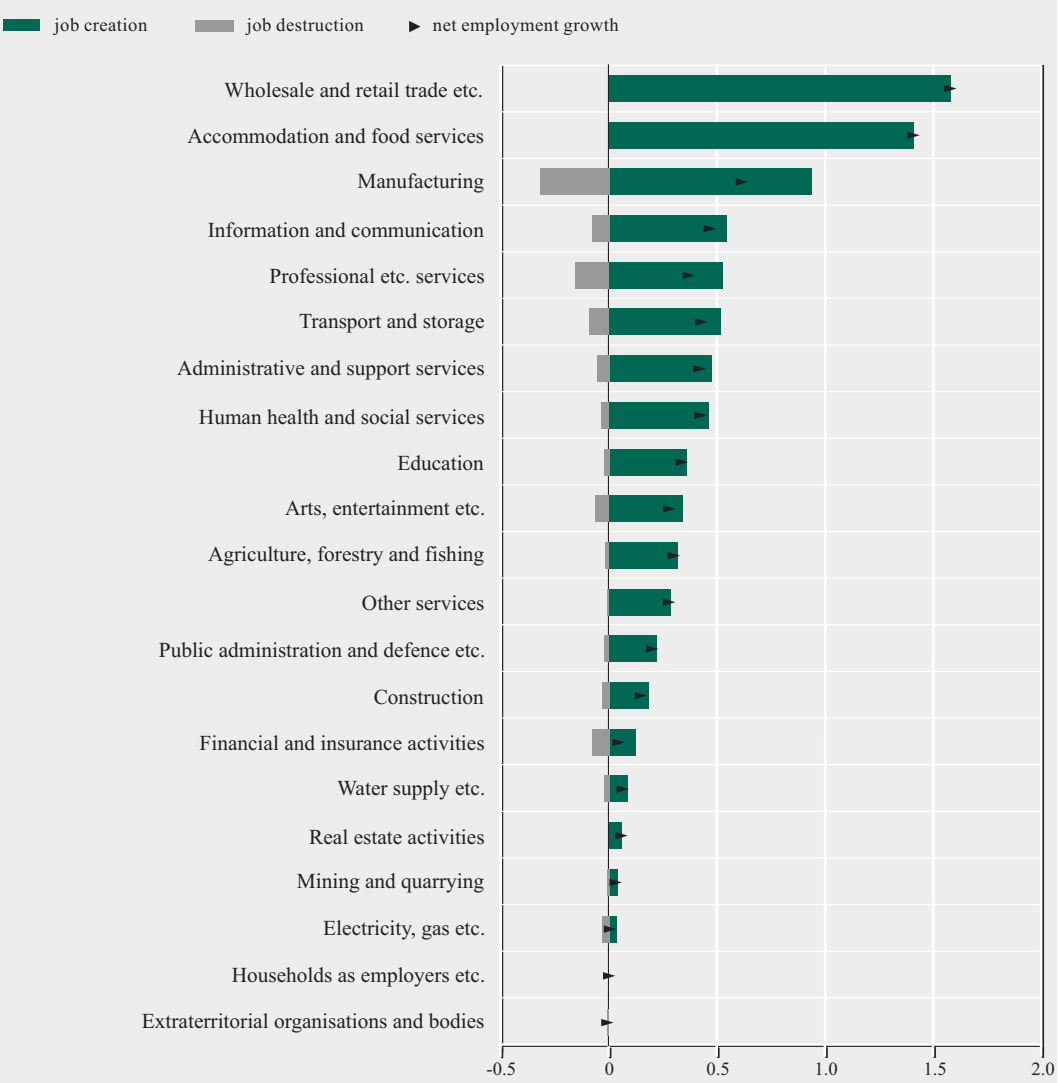
Source: ERGANI and authors' calculations.
Note: Bold numbers indicate the most important developments.

Table A3 Correlation matrix

	Above average						
Above average	Job creation	Job destruction	Job reallocation	Export intensity	Wage growth	Net firm growth	Capital intensity
Job creation	1						
Job destruction	0.12	1					
Job reallocation	0.64	0.26	1				
Export intensity	-0.05	0.21	0.08	1			
Wage growth	-0.15	0.04	-0.13	-0.04	1		
Net firm growth	0.32	-0.08	0.29	-0.17	-0.09	1	
Capital intensity	0.18	0.04	0.12	0.04	0.02	0.04	1

Chart A1 Job creation, job destruction and net employment growth, by 1-digit NACE: contributions to total economy (2017)

(%)



Source: ERGANI and authors' calculations.

THE GREEK SHIPPING ESTIMATION MODEL

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ABSTRACT

The Greek Shipping Estimation Model aims to provide a coherent statistical framework for the estimation of Balance of Payments (BoP) items related to shipping activity, based on administrative sources and commercial databases.

Given the multi-territorial nature of the shipping sector and its complex group structures, the estimation of shipping activity is one of the most challenging tasks in terms of official statistics. This is of particular importance to Greece, whose merchant fleet plays a strategic role in the transportation of commodities across the world. The statistical framework presented in this study may well be applied by other countries for BoP compilation purposes, as well as by researchers and analysts seeking to estimate revenues and expenses related to shipping activity.

The Greek Shipping Estimation Model adopts a granular-level approach, with vessel-by-vessel characterisation, involving three steps. Firstly, the cluster, the main counterparts and the types of BoP transactions that take place and can be estimated are defined. Secondly, the population is defined, including companies that are legal owners, operators or ship managers, and the vessels to be taken into account. Finally, all BoP transactions for a given vessel are estimated on a monthly basis.

The maritime cluster structure is discussed, along with guidelines on how to define the resident population in line with the economic ownership principle. A detailed statistical framework for the estimation of all shipping-related transactions is presented, including vessels' revenues, bunker costs, port expenses, manning costs, administrative costs, and other BoP items.

Keywords: shipping, maritime cluster, sea transport services, balance of payments

JEL classification: C8, F1, F23, F32, L9

ΤΟ ΥΠΟΔΕΙΓΜΑ ΕΚΤΙΜΗΣΗΣ ΤΗΣ ΕΛΛΗΝΙΚΗΣ ΝΑΥΤΙΛΙΑΚΗΣ ΔΡΑΣΤΗΡΙΟΤΗΤΑΣ

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ΠΕΡΙΛΗΨΗ

Το υπόδειγμα εκτίμησης της ελληνικής ναυτιλιακής δραστηριότητας αποσκοπεί στο να αποτελέσει ένα συνεκτικό στατιστικό πλαίσιο για την εκτίμηση των στοιχείων του ισοζυγίου πληρωμών που σχετίζονται με τη ναυτιλιακή δραστηριότητα, με βάση διοικητικές πηγές και εμπορικές βάσεις δεδομένων.

Λόγω της πολύπλοκης φύσης του ναυτιλιακού τομέα και των σύνθετων δομών των ομίλων, η εκτίμηση της ναυτιλιακής δραστηριότητας είναι μία από τις πιο απαιτητικές εργασίες στο πλαίσιο των επίσημων στατιστικών. Αυτό έχει ιδιαίτερη σημασία για την Ελλάδα, καθώς ο εμπορικός της στόλος διαδραματίζει στρατηγικό ρόλο στη μεταφορά εμπορευμάτων σε πολλές περιοχές ανά τον κόσμο. Το στατιστικό πλαίσιο που παρουσιάζεται στην παρούσα μελέτη μπορεί να εφαρμοστεί και από άλλες χώρες για τους σκοπούς της κατάρτισης του ισοζυγίου πληρωμών, όπως και από ερευνητές και αναλυτές που επιθυμούν να εκτιμήσουν τα έσοδα και τις δαπάνες που σχετίζονται με τη ναυτιλιακή δραστηριότητα.

Στο υπόδειγμα εκτίμησης της ελληνικής ναυτιλιακής δραστηριότητας ακολουθείται μια αναλυτική προσέγγιση, σε επίπεδο πλοίου. Πρώτον, προσδιορίζονται η δομή του κλάδου, οι κύριοι αντισυμβαλλόμενοι και οι συναλλαγές ισοζυγίου υπό εκτίμηση. Δεύτερον, προσδιορίζεται ο πληθυσμός, που περιλαμβάνει τις πλοιοκτήτριες εταιρίες, τις διαχειρίστριες εταιρίες, καθώς και τα πλοία που θα ληφθούν υπόψη. Τέλος, υπολογίζονται όλες οι συναλλαγές ισοζυγίου πληρωμών σε επίπεδο πλοίου και σε μηνιαία βάση.

Αναλύεται η διάρθρωση του ναυτιλιακού κλάδου, ενώ παράλληλα παρέχονται κατευθυντήριες γραμμές για τον προσδιορισμό των εταιριών που θεωρούνται κάτοικοι και των αντίστοιχων πλοίων, με βάση την αρχή της οικονομικής ιδιοκτησίας. Παρουσιάζεται ένα αναλυτικό στατιστικό πλαίσιο για την εκτίμηση όλων των συναλλαγών που σχετίζονται με τη ναυτιλιακή δραστηριότητα, συμπεριλαμβανομένων των εσόδων των πλοίων, των δαπανών για καύσιμα, των λιμενικών εξόδων, των δαπανών για πλήρωμα, των διαχειριστικών εξόδων και άλλων στοιχείων του ισοζυγίου πληρωμών.

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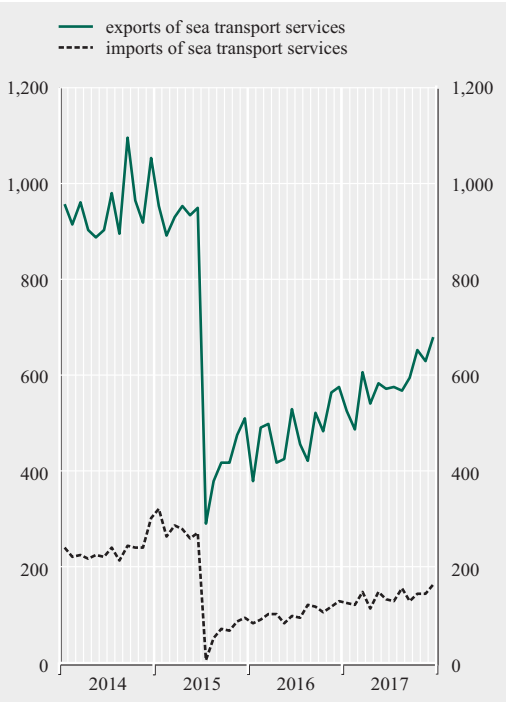
1 BACKGROUND

Starting from the reference month of September 2018, the Bank of Greece has introduced a significant change in the way sea transport accounts of the Balance of Payments (BoP) are compiled (see Bank of Greece 2018). More specifically, instead of bank settlements data used until August 2018, the Bank is now using data from international shipping databases and administrative sources. With these new sources, sea transport statistics in the BoP reflect international shipping transactions carried out within or outside the domestic banking system, in line with international BoP compilation guidelines.

This change was deemed necessary in view of an apparent sharp decrease in shipping receipts and payments from 2015 onwards, following the imposition of capital controls in Greece (Legislative Act of 18.7.2015) and the concomitant decline in the intermediation of the domestic banking system in shipping transactions (see Chart 1). Until 2015, the largest part of shipping activity passed through the domestic banking system, recording indicatively more than €130 billion in sea transport services receipts during the period 2005-2014. With the introduction of capital controls in July 2015, payments practically went to zero and receipts fell to one third, as shipping companies used foreign bank accounts to accommodate their needs for cross-border payments. Since it is rather unlikely that the economic activity of these companies, mainly involved in cross trading, fell by two thirds within one month, a statistical model had to be developed to make up for this inconsistency. It is noted that the Balance of Payments should include all transactions between residents and non-residents, irrespective of whether these transactions pass through the domestic banking system or not.

Chart 1 Evolution of exports and imports of sea transport services in the Greek BoP before the introduction of the Greek Shipping Estimation Model (January 2014-December 2017)

(EUR millions)



Source: Bank of Greece, Balance of Payments data.

The new approach enables a detailed calculation of receipts and expenses on a monthly basis, combining information from domestic administrative sources and global databases maintained by international agencies and recommended by international organisations, including the IMF, as reliable data providers.

* The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. Any errors or omissions are the authors' responsibility.

It was developed in collaboration with shipping experts from the academia and the industry, and was presented during the ECB and Eurostat mission to the Bank of Greece in November 2017, as part of the quality assurance of statistics underlying the Macroeconomic Imbalance Procedure (MIP), at meetings of Eurostat's Balance of Payments Working Group (BOP WG), and at the meeting of Eurostat's Task Force on the recording and compilation of maritime transactions in national accounts and balance of payments in April 2018.

Given the multi-territorial nature of the shipping sector and its complex group structures, the estimation of shipping activity is one of the most challenging tasks in terms of official statistics. This is of particular importance to Greece, whose merchant fleet plays a strategic role in the transportation of commodities across the world and the EU, while shipping activities turnover makes a significant contribution to Greece's current account and GDP. The statistical framework presented here may well be applied by other countries for BoP compilation purposes, as well as by researchers and analysts seeking to estimate revenues and expenses related to shipping activity.

The Greek Shipping Estimation Model adopts a granular-level approach, with vessel-by-vessel characterisation, involving three steps. Firstly, the cluster, the main counterparts and the types of BoP transactions that take place and can be estimated are defined. Secondly, the population is defined, including companies that are legal owners, operators or ship managers, and the vessels to be taken into account. Finally, all BoP transactions for a given vessel are estimated on a monthly basis.

2 THE GREEK SHIPPING CLUSTER

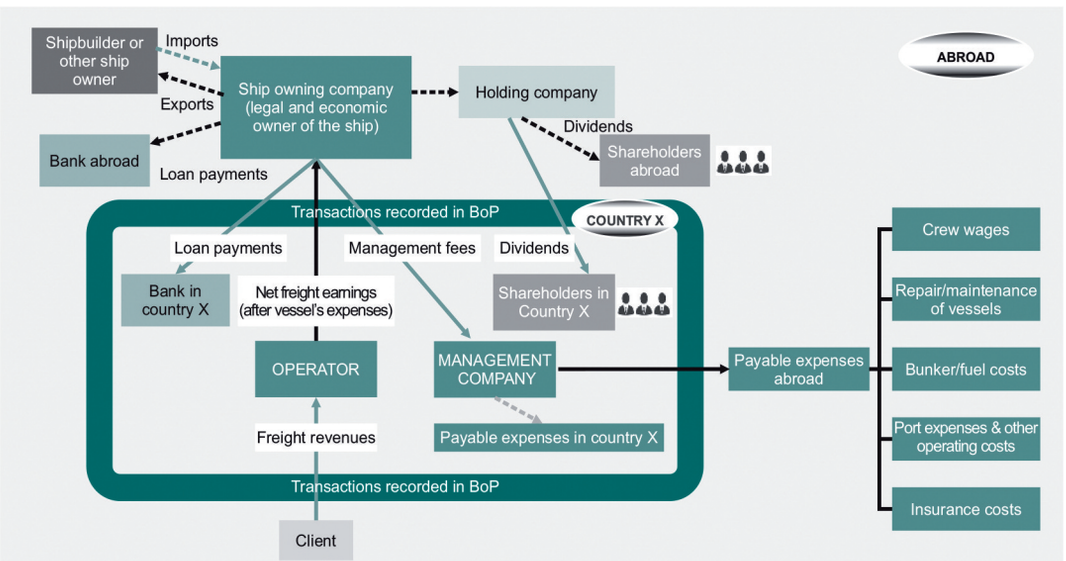
The first step is to define the structure of the shipping cluster. The structure presented in Figure 1 refers to a Standard Ship Management Agreement. This has been identified as the most common practice for the Greek shipping cluster, associated with shipping companies engaged in international carriage of goods by sea, but applies globally in the case of standard ship management agreements. The structure of the cluster has been compiled by combining information from: (a) detailed banking transaction data recorded in the BoP; (b) contacts with relevant banks, shipping experts and companies; and (c) commercial databases.

Given the complex structure of the shipping cluster, it is useful to first provide some explanation about the underlying mechanics of Figure 1. The green frame characterises BoP transactions, i.e. transactions between residents and non-residents. The green arrows denote BoP receipts for the domestic (reporting) economy, whereas the black arrows denote BoP payments from the domestic economy to the rest of the world; transactions not crossing the green borderline are not relevant for BoP statistics.

Typically, there is a ship management company (not depicted in the figure) which is legally registered abroad, with a branch/office whose main activities take place in country X. The branch performs the main activities with regard to the vessel's operation and management, as also indicated by the "country of domicile" of the commercial operator and/or the ship manager in the commercial databases (there are cases where the operator is different from the ship management company, but these are relatively few). Thus, in Figure 1 the local branch of the ship management company is denoted as the operator and the manager of the vessel.

Also, there is a fully legitimate ship owning company, often called registered owner, which is the legal owner of the vessel, most often registered abroad. It should be noted that the ship management company may manage several vessels, each belonging to a different legal owner (each ship owning company typically owns a single vessel for risk-exposure and lia-

Figure 1 Standard Ship Management Agreement and BoP transactions



bility purposes). It should also be noted that if the legal owner is incorporated under the law of country X, the respective transactions in Figure 1 are modified by moving the box of the ship owning company inside country X.

Typical examples of Standard Ship Management Agreements are the BIMCO "SHIPMAN 98" and "SHIPMAN 2009" agreements. Under the standard ship management agreement, freight revenues are received by the ship management company/operator, on behalf of the ship owner. The ship management company uses these freight revenues to pay the operating expenses of the vessel (i.e. crew costs, insurance costs, bunker costs, port expenses and other operational and non-operational costs). The rest of the freight earnings are directed to the legal owner, in the form of imports of sea transport services. The ship owning company pays management fees to the ship management company, purchases or sells the vessel and also receives the loan drawdowns and makes principal and interest repayments. Moreover, the ship owning company pays dividends to its shareholders. If a parent holding company exists, dividends are typically distributed by the parent company, after collecting the earnings from all the ship owning companies of the group.

The economic owner of the vessel (i.e. the asset, associated with imports/exports and the capital costs) is the legal owner. The ship management company acts for and on behalf of the ship owning company. However, apart from the provision of management services, the ship management company is responsible for the commercial operation of the vessel, i.e. the transport service, as well as for the commercial decisions concerning the employment of the ship.

3 DATA SOURCES

In order to define the population and estimate the relevant BoP items, we have used an exhaustive list of domestic and international databases, as well as additional valuable information from relevant maritime legislation, governmental sources and shipping experts from both the academia and the industry. The main data sources used are listed below.

- Greek Ministry of Shipping: list of the management companies established in the country, along with the vessels they manage.

- IHS Maritime and Trade: detailed monthly data (at the vessel level) on various types of ownership, vessel characteristics, new deliveries/deaths, sales, crew, etc.

- Lloyd's List Intelligence: detailed monthly data (on a vessel basis) on various types of ownership, vessel characteristics, new deliveries/deaths, port movement (at 10-day intervals), speed, draft, etc.

- Clarksons Shipping Intelligence Network: detailed monthly time charter rate data by type of vessel (tanker, bulker, etc.), deadweight and year of build.

- Drewry: data regarding operating expenses by vessel type and year of build, manning, insurance, stores and spares, maintenance, administrative costs and management fees.

- World bunker prices: Bunker Index.

- Port expenses: pricing policy of major ports worldwide.

- Banking data (direct reporting): analysing correlations and trends among shipping-related BoP items.

It is noted that whenever a variable appears in more than one database, cross-validations are performed. The above are the main data sources used for the compilation of BoP items. For the development of the Greek Shipping Estimation Model, various other databases were also consulted, including the Greek Shipping Directory, a traditional domestic database for Greek shipping; Bloomberg; Greek maritime law; BIMCO types of agreements; UNCTAD; ITF types of agreements; Petrofin Research; data collected from companies involved in the shipping sector; and other.

4 DEFINING THE POPULATION

The Greek Shipping Estimation Model is vessel-based, implying that for each vessel included in the registry, revenues and expenditures are calculated according to BoP requirements. Thus, one must select the vessels to be included in the registry, by applying the residency and economic ownership principles. For each vessel, there exist one or many linked companies, including the legal (registered) owner, the ship manager, the commercial operator, the beneficial owner and potentially the technical manager and/or the third party operator. The relationships among the different players are very complex and their roles are not always easy to identify, having in mind that the definitions and terminology used in commercial databases are not always consistent with the statistical ones.

According to BoP compilation manuals and guidelines (see Eurostat 2013, 2016 and IMF 2009, 2017) and given the Task Force on the recording and compilation of maritime transactions consultation, in the majority of cases, the economic ownership can be identified on the basis of the transport agreement between the legal ship owner and the operator/ship manager. Three representative types of agreements have been identified: the Time or Voyage Charter (Case A); the Standard Bareboat Charter (Case B); and the Standard Ship Management Agreement (Case C). As already mentioned, the Standard Ship Management Agreement (Case C) is the most common in the case of Greece.

In the cases of Time or Voyage Charter (Case A) and Standard Ship Management Agreements (Case C), the legal ship owner is considered the economic owner of the vessel. The latter receives earnings from the economic activity (in the form of a daily fee in Case A, or net freight earnings in Case C), whereas the asset (vessel) and the liabilities are attributed to the legal ship owner. Moreover, in Case C the operator/management company acts for and on behalf of the legal ship owner.

In the case of Standard Bareboat Charter Agreements, the economic ownership can be transferred by the legal ship owner to the operator (charterer) of the vessel, depending on the terms and conditions of the agreement and on whether they fulfill the indicative criteria laid down in the compilation manuals.

In view of the above, the population included in the registry relevant for the Greek Shipping Estimation Model is determined as follows:

- Cases where gross revenues and expenditures related to shipping services are included in the Greek BoP: based on the list of management companies provided by the Ministry of Shipping, we identify the companies and their vessels which are listed in commercial databases as commercial operators, with Greece as the country of domicile (checking logical coherence between databases). We exclude cases in which the third party operator is located abroad.

- Cases where the economic ownership is located in Greece and import/exports of vessels (as well as shipping services) are included in the BoP: we identify ship owning companies and their vessels, with Greece as the country of registration of the legal owner. We exclude cases in which there is bareboat chartering abroad. We include cases in which there is bareboat chartering in Greece (these are rare in the Greek case).

Furthermore, from the calculation of revenues and expenditures related to shipping services we exclude vessels that are either dead or new constructions, as well as vessels more than 30 years old, and/or for which no port movement has been recorded from 2000 onwards. It is noted that vessels which in commercial databases are marked by a status of "Converting/Rebuilding", "Laid-Up", "In Casualty or Repairing" remain in the registry, since there are specific types of monthly expenses related to them. The vessels' registry is updated on a monthly basis by incorporating new information from commercial databases.

5 ESTIMATION OF BALANCE OF PAYMENTS ITEMS

Given the population of vessels included in the shipping registry, the next step is to calculate revenues and expenditures by vessel, coded by BoP item and counterpart country. Types of expenditures that need to be calculated (see Figure 1) include bunker/fuel costs, port expenses, manning costs, insurance costs, maintenance and dry-docking costs, stores, spares and lubricants costs, flag state expenses and tonnage tax, and administrative costs. Besides, transactions between the commercial operator and the legal owner, including management fees and net freight earnings, must be calculated.

5.1 VESSELS' REVENUES

The estimation of shipping services revenues (exports of services) for each vessel involves four steps. As a first step, we identify whether the vessel is hired; if yes, as a second step, we estimate the expected revenues; as a third step, we allocate the revenues to the respective BPM6 code, and, as a fourth step, we allocate the amounts to the respective counterpart countries.

Step 1: Identify on the basis of commercial databases if the vessel is hired

Since there is no direct information about whether a vessel is hired, this can be indirectly inferred from its draft. A draft above 20%-30% of its max depth suggests that the vessel holds cargo. Besides the draft, if there is port movement and a few days later the vessel holds cargo, then it can also be assumed that it was hired. This rule appears satisfactory because it delivers utilisation rates very close to the ones encountered in the shipping industry (i.e. in the annual reports of shipping companies).

Port movement ∪ Draft = The vessel is hired

A simpler approximation, which seems to work reasonably well in terms of average utilisation rates, is to observe the draft data three times a month (i.e. every ten days); it is noted that commercial databases show movement data on

the 10th, the 20th and the last day of each month. If at least one of the three observations shows increased draft, then it can be assumed that the vessel was hired in the reference month. Also, if there is port movement and the vessel is not laid up or under repair, it can be assumed that the vessel was hired. It is noted that draft is not applicable for certain types of vessels (i.e. passenger ships, tugs).

Step 2: Estimate expected revenues for each vessel hired

For each vessel hired, we calculate expected revenues by vessel type and size (deadweight/TEU) using the respective monthly Clarksons' time charter rate. Since rates are provided for specific deadweights/TEU, we use linear percentage differences between two adjacent deadweight/TEU categories to calculate each vessel's revenues, based on the observed exact vessel's deadweight/TEU provided by commercial databases. Moreover, Clarksons' rates are provided in US dollars per day. Thus, these rates are multiplied by the number of days of each month to approximate the monthly revenues of the vessel.

Step 3: Allocate revenues to the respective BPM6 code

The revenues calculated above are allocated to one of the following categories: (a) passenger sea transport; (b) freight sea transport; (c) sea transport among third countries (cross trading); and (d) other sea transport services.

The allocation to the respective category is based on the vessel type as well as the last port visited. In more detail, ROPAX vessels' revenues are recorded under "passenger sea transport"; tug and platform supply vessels' revenues are attributed to "other sea transport services"; and, as for the remaining types of vessels (tankers, bulkers, containerships, PCTC, roll-on/roll-off, LNG and LPG carriers), if a Greek port is indicated as visited on any of the three dates on which movement is observed, their revenues are attributed to "freight sea transport", otherwise they are attributed to "sea transport among third countries". ROPAX vessels moving exclusively between national ports are not included in the "passenger sea transport" item, as their revenues from non-resident passengers are recorded in travel services.

Step 4: Allocate revenues to the respective counterpart countries

The geographical allocation of economic transactions is critical for the compilation of the BoP, since it is the first criterion for including a transaction in the BoP or not. Furthermore, the reduction of cross-country discrepancies is of primary importance for EU authorities when assessing the quality of Member States' official statistics. The counterpart country is taken to be the country of the last port that the vessel has visited, as provided by commercial databases three times a month (on the 10th day, on the 20th day and at the end of each month). Then, for a given 10-day interval, revenues are attributed to the country of the respective port. The reasoning is that the client of the shipping company who receives the cargo is most probably resident in the country where the port is located. Although this might not always be accurate, it is the best possible proxy on the basis of available information and in line with statistical guidelines.

5.2 BUNKER COSTS

To calculate bunker costs, the fuel consumption of each vessel is first calculated and then world bunker prices are used to approximate actual bunker expenses. Next, the latter are allocated to counterpart countries on the basis of the last port visited.

Commercial databases provide, for each vessel, the typical fuel consumption (in tonnes per day) at a given (cruising) speed. However, it is common practice for vessels to travel at reduced speeds for fuel economy purposes. Thus, we must also take into account the actual observed speed at a given 10-day interval.

There is a well-known theoretical formula that links fuel consumption with the third power of speed (see e.g. Ronen 2011). Given consumption F_0 at speed V_0, fuel consumption at speed V_i is equal to:

$$F_i = F_0 (V_i / V_0)^3,$$

which can be directly calculated on the basis of the variables available from commercial databases, as described above. Having calculated the actual fuel consumption (in tonnes per day) by vessel, we rely on world bunker indices to calculate monthly fuel costs.

5.3 PORT EXPENSES

To calculate port expenses, first we rely on commercial databases to identify the ports and canals worldwide which are most often visited by the vessels included in the registry. Then, we find the pricing policies of these ports, which are publicly available (usually on their websites). Main expenses include berthing (a fee when entering the port) and dockage (a fee while staying in the dock). These fees typically depend on gross/net tonnage or vessel length, and duration of stay. Duration of stay can be calculated either from commercial databases (on the basis of last arrival date and last sailed date by vessel) or using average time in port, as provided by the port itself. Related data are also available from UNCTAD (*Review of Maritime Transport*). In most cases, duration of stay averages 1-2 days.

As a final step, we examine whether a vessel has reached a port, on the basis of the last arrival date and the last port visited, available from commercial databases (observed every ten days). If an arrival at a port is recorded at a given 10-day interval of the month, then the vessel is assumed to pay port expenses, as calculated above.

As regards ports for which we have not retrieved any detailed pricing data, we use instead the average costs paid by vessels of the same type and size in ports of the same country for which we do have the relevant information. If there are no available data on the pricing policy of any port in that country, we use the global average. Finally, port expenses are allocated to the country of the port visited.

5.4 MANNING COSTS

In the first step, we attribute to each vessel the expected manning costs, depending on its type, deadweight and age. These data are drawn from Drewry and are cross-checked with the International Transport Workers' Federation "TCC" collective agreements, as well as with data obtained from crew management companies, which seem to adequately capture the average manning costs for each type of vessel.

In the second step, we derive the distribution of nationalities and officers/ratings by vessel type and size, based on data from commercial databases. As discussed in Section 5.1, Step 4, identifying the counterpart country is critical for BoP statistics; for example, manning expenses for crew of Greek nationality are excluded from the BoP. Commercial databases provide, for the majority of vessels, information about the total number of crew by nationality, as well as the number of officers and ratings. On the basis of these data, we calculate the distribution of ratings and officers by nationality and vessel type.

In the third step, we allocate the manning costs for each vessel to the respective nationality, weighted by the ratio of the rates received by officers to those received by the rest of the crew. Interestingly enough, the nationality of the crew seems to be related with the shipping segment in which the ship operates and therefore with the type of the vessel, as shipping companies tend to hire seafarers from countries with expertise in the ship's field of activity.

5.5 VESSEL INSURANCE COSTS

Drewry reports annual average insurance costs by vessel type, deadweight and age. Cross-checks are performed with results from the

annual reports of listed companies. We associate the respective expected insurance cost with each vessel in the registry on the basis of its actual characteristics.

To allocate the insurance costs to counterpart countries, we use market information and historical bank data. In the case of Greece, ITRS data show that the bulk of insurance costs abroad is traditionally attributed to the United Kingdom; other countries include Italy, Germany, Norway, the United States, and Switzerland.

5.6 MAINTENANCE AND DRY-DOCKING COSTS

Repair and maintenance costs as well as dry-docking costs by vessel type, deadweight and age are collected from Drewry. If the status of the vessel in the commercial databases is "In Service/Commission" or "Laid-Up", we assign the respective maintenance costs to the specific vessel on the basis of its characteristics. If the status of the vessel is "In Casualty or Repairing" or "Converting/Rebuilding", we assign the respective dry-docking costs to that vessel.

The country allocation of repair costs is related to the port where dry-docking and maintenance take place, which is available at 10-day intervals.

5.7 STORES, SPARES AND LUBRICANTS COSTS

Drewry also reports stores, spares and lubricants costs by vessel type, deadweight and age. We assign these costs to a vessel, provided its status is "In Service/Commission". Most of these expenses are paid to suppliers and companies that have long-term general agreements with the operator. Due to lack of further information, we assign these costs to the country of domicile of the operator.

5.8 FLAG STATE EXPENSES AND TONNAGE TAX

Average flag state expenses by vessel type and deadweight are also reported by Drewry. We allocate the respective amount, which is calculated for each vessel on the basis of its characteristics, to counterpart countries, as indicated by the vessel's flag.

In addition, vessels which are managed by a shipping company (or branch) located in Greece as well as Greek-flagged vessels pay tonnage tax to the country. This tax is allocated to all vessels for which, according to the databases, Greece is the commercial operator's or bareboat charterer's country of domicile, or the legal owner is registered in Greece, as well as to vessels flying the Greek flag. The allocation is based on gross tonnage.

5.9 ADMINISTRATIVE COSTS

Drewry reports expected administrative costs by vessel type, deadweight and age, which are available from commercial databases for each vessel in the population. Administrative costs are divided into two categories.

The first category includes expenses incurred when the vessel is in service, such as costs for waste and garbage disposal, local transport, masters' entertainment, etc. These expenses are attributed to the country of the last port visited. The second category includes administrative costs paid even when the vessel is not in service, such as classification fee, port service charges, communications, printing, IT and postage, vetting, internal auditing and inspection, training, etc. These expenses are attributed, on the basis of available information, to the country of domicile of the commercial operator.

5.10 MANAGEMENT FEES

As depicted in Figure 1, management fees are paid by the legal owner to the commercial operator. Average annual management fees by type, size and age of vessel are reported by Drewry. Thus, on the basis of commercial databases, we find the counterpart country of registration of the legal owner that pays the corresponding management fees to the commercial operator.

5.11 NET FREIGHT EARNINGS

Net freight earnings are paid by the commercial operator to the legal owner (see Figure 1). We calculate net freight earnings by subtracting from total freight revenues all the vessel's expenses that are paid by the commercial operator both inside and outside the country, i.e. manning, insurance, stores, spares and oils, maintenance and dry-docking costs, flag and tonnage tax, administrative expenses (excluding management fees, which are considered as income to the operator), bunker costs and port expenses.

Net freight earnings = Freight revenues – Vessel' s voyage and operating expenses

Then, on the basis of commercial databases, we identify the country of registration of the legal owner that receives the net freight earnings from the commercial operator. Net freight earnings enter the BoP as imports of sea transport services. Although not the typical case, net freight earnings can turn negative for specific vessels and dates. This is the case where the vessel's expenses are higher than freight revenues for the specific time period and the operator asks for extra cash (cash call) from the ship owner. In this case, net freight earnings are inflows to the country and are considered as exports of sea transport services in the BoP.

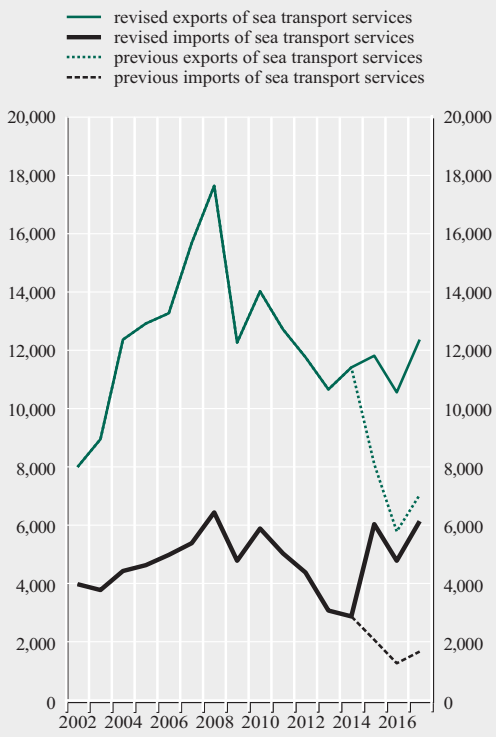
6 RESULTS

The implementation of the Greek Shipping Estimation Model has allowed us to restore continuity in the time series of sea transport services (imports and exports) after the introduction of capital controls in Greece (see Chart 2).

In annual terms for 2018, exports of sea transport services (receipts) were estimated at €14.2 billion and imports of sea transport services (payments) at €7.3 billion. The average utilisation rate (i.e. the percentage of days in a month the vessels in the population are

Chart 2 Evolution of exports and imports of sea transport services in the Greek BoP before and after the introduction of the Greek Shipping Estimation Model (2002-2017)

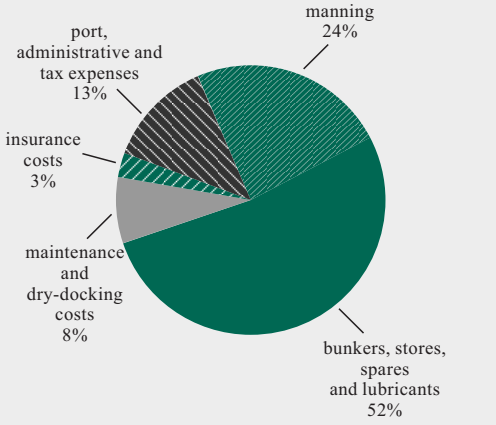
(EUR millions)



Source: Bank of Greece, Balance of Payments data.

Chart 3 Distribution of shipping operating and voyage costs paid abroad (Q4 2018)

(%)



Source: Authors' own calculations.

hired) was estimated (on the basis of movement data) at 95.4%.

With regard to the distribution of vessel operating and voyage costs (see Chart 3), in the fourth quarter of 2018, 53% of total vessel expenses paid abroad was attributed to bunkers, stores, spares and oils, 23% to crew wages, 13% to port, administrative and tax expenses, 8% to maintenance and dry-docking costs and 3% to insurance costs.

7 CONCLUSIONS AND WAY FORWARD

We have developed a comprehensive framework for calculating all BoP items related to shipping activity. The Greek Shipping Estimation Model is, to our knowledge, the first holistic methodological approach in the EU to estimate, on the basis of statistical modelling, all shipping-related BoP items, using commercial databases in combination with administrative data.

It is clear that in order to perform such a task, there were significant challenges to overcome, since a new methodological approach had to be developed, specific to each BoP item. Furthermore, in practical terms, combining information from many different and large databases required database subscriptions, advanced statistical programming and big data management. By way of illustration, detailed estimates by vessel have been produced for all vessels' revenues and expenses (by BoP item) and by counterpart country. Moreover, a detailed transaction tool has been developed to convert these estimates into approximately 200,000 transactions per month, which then have to be recorded in the BoP.

The model needs to be continuously updated to keep up with changing shipping business conditions. Besides the fact that even commercial databases change their fields over time (i.e. new indices are published and others are discontinued, or new types of vessels emerge), mobility in the shipping industry is constantly growing. As a result of increased competition from Asian countries, coupled with the new environmental framework for the shipping sector and recent developments in world trade, many shipping companies (especially ship owning companies) close and new ones open even on a daily basis, purchases, sales and conversions/rebuilds of vessels (including new eco-friendly types) have increased, new routes have opened, and high volatility has been observed in freight rates and operating expenses.

The Greek Shipping Estimation Model can be readily applied by other EU Member States, as well as non-EU countries, to estimate some or all of the BoP items related to shipping activity. We believe that the current methodological framework can set new standards in official statistics, in terms of using statistical modelling to incorporate information from commercial databases as well as with regard to the treatment of off-shore companies when there is no available information on their income and expenses. Hopefully, this study can form a basis for future research in shipping, in both the academia and the industry.

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THE DETERMINANTS OF GREECE'S EXPORT SUPPLY OF OIL

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ABSTRACT

In the last fifteen years or so Greece has emerged as an important exporter of refined oil products, which led to an increase of its share in total world exports as well as to the improvement of the country's oil balance and overall current account. This paper presents an empirical investigation of the factors that determine Greece's oil export supply contributing to the improvement of the country's export performance. The analysis focuses on the supply side considering the traditional specification of the imperfect substitute model by Goldstein and Khan, which is augmented by introducing the role of investment in the sector. The empirical estimation involves the cointegration methodology, distinguishing between long-run and short-run effects. The findings show that there exist significant stable cointegrating relationships across the traditional and the augmented specifications as well as short-run effects. Investment activity by the oil companies has been an enhancing factor of the sector's exports, revealing itself in linear and non-linear form. Furthermore, significant long-run and short-run effects stem from domestic demand and the refining margin. In particular, the negative effect of domestic demand reflects primarily the impact of the recession on oil exports. That is, falling domestic demand necessitates the channelling of excess supply to external markets, thereby mitigating the adverse effects of the recession.

Keywords: refined oil, export supply, export performance, investment in the oil sector, cointegration, recursive estimation, VECM

JEL classification: F4, C51

ΟΙ ΠΡΟΣΔΙΟΡΙΣΤΙΚΟΙ ΠΑΡΑΓΟΝΤΕΣ ΤΗΣ ΠΡΟΣΦΟΡΑΣ ΕΞΑΓΩΓΗΣ ΠΕΤΡΕΛΑΙΟΥ ΤΗΣ ΕΛΛΑΔΟΣ

Ιωάννα Μπαρδάκα
Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Χρήστος Παπάζογλου
Διεύθυνση Οικονομικής Ανάλυσης και Μελετών
και Πάντειο Πανεπιστήμιο, Τμήμα Διεθνών, Ευρωπαϊκών και Περιφερειακών Σπουδών

ΠΕΡΙΛΗΨΗ

Τα τελευταία 15 περίπου χρόνια η Ελλάδα έχει εξελιχθεί σε σημαντικό παραγωγό προϊόντων διυλισμένου πετρελαίου και έχει αυξήσει το μερίδιό της στις παγκόσμιες εξαγωγές διυλισμένου πετρελαίου, γεγονός που οδήγησε στη βελτίωση του πετρελαϊκού ισοζυγίου της χώρας και του συνολικού ισοζυγίου τρεχουσών συναλλαγών. Το παρόν άρθρο παρουσιάζει μια εμπειρική διερεύνηση των παραγόντων που καθορίζουν την προσφορά εξαγωγής πετρελαίου στην Ελλάδα συμβάλλοντας στη βελτίωση των εξαγωγικών επιδόσεων της χώρας. Η ανάλυση επικεντρώνεται στην πλευρά της προσφοράς, υιοθετώντας την παραδοσιακή προσέγγιση του υποδείγματος ατελούς υποκατάστασης Goldstein-Khan, το οποίο διευρύνεται με την εισαγωγή του ρόλου των επενδύσεων στον κλάδο. Η εμπειρική εκτίμηση περιλαμβάνει τη μεθοδολογία συνολοκλήρωσης που διακρίνει μεταξύ μακροχρόνιων και βραχυχρόνιων επιδράσεων. Τα ευρήματα δείχνουν ότι υπάρχουν σημαντικές μακροχρόνιες σταθερές σχέσεις μεταξύ των μεταβλητών της παραδοσιακής και της επαυξημένης εξειδίκευσης, καθώς και βραχυχρόνιες επιδράσεις. Από τα αποτελέσματα της εμπειρικής ανάλυσης αναδεικνύεται η σημασία των επενδύσεων ως κινητήριου μοχλού της ανταγωνιστικότητας του κλάδου, εξηγώντας σε σημαντικό βαθμό τα υψηλότερα επίπεδα εξαγωγών. Επιπρόσθετα, σημαντικό ρόλο στη διαμόρφωση της προσφοράς διυλισμένου πετρελαίου στη διεθνή αγορά διαδραματίζουν το ύψος της εγχώριας ζήτησης και το περιθώριο διύλισης. Η αρνητική επίδραση της εγχώριας ζήτησης που διαπιστώνεται αποτελεί πρωτίστως επίπτωση της ύφεσης και οδηγεί στη διοχέτευση της πλεονάζουσας προσφοράς στις αγορές του εξωτερικού. Αυτό έχει αποτέλεσμα τη βελτίωση του εμπορικού ισοζυγίου και συντελεί στο μετριασμό των αρνητικών επιπτώσεων από την κάμψη της εγχώριας ζήτησης.

THE DETERMINANTS OF GREECE'S EXPORT SUPPLY OF OIL*

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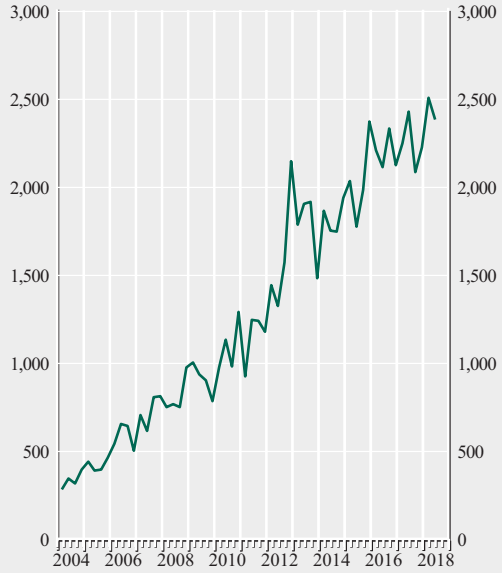
I INTRODUCTION

Greece is not a major oil or energy producing country, at least not as yet. But in the last fifteen years or so the country has emerged as an important exporter of refined oil products. That is, the Greek oil sector imports crude oil and through proper processing produces refined petroleum products, which it then makes available to domestic and foreign markets. By 2018, Greece more than doubled its share in total world exports of refined oil to 1.5% (corresponding to a value of about €11 billion), from 0.67%, or about €1 billion, in 2001.[1] This led to an improvement of the country's ranking among the world's top exporters of distilled oil by 18 places, to 19th from 37th in 2001 out of a total of 232 countries. The improvement in oil export performance had started taking place even before the outbreak of the Greek economic crisis but accelerated further during the economic downturn, as the decline in domestic demand made more urgent the need for expansion into international markets.

Chart 1 Real exports of distilled oil (2004:Q1-2018:Q2)

(EUR millions, 2010=100, seasonally adjusted data)



Sources: ELSTAT and Eurostat, SITC code 33.
Note: The series is deflated by the producer price index for exports of distilled oil, NACE code 19 from Eurostat.

The upward trend of the country's oil exports is clearly shown in Chart 1. Furthermore, according to Chart 2, exports of oil as a percentage of oil imports rose gradually from about 15% at the beginning of the past decade to almost 66% at the end of 2018. This had a favourable impact on the country's oil balance, as the corresponding deficit has been following a downward trend, thereby contributing to an overall improvement in the country's current account balance. Chart 3 depicts this decline in Greece's oil deficit, observed especially during the years of the economic crisis. Greece exports distilled oil primarily to countries outside the European Union (EU). The most important destinations during 2014-2018, on average, include Turkey, Egypt and Lebanon, while Italy and Cyprus represent the main destinations within the EU (see Chart 4).

This major shift of the refined oil industry towards foreign markets, although necessitated by the economic crisis, has undoubtedly been the result of a conscious strategic decision. This is confirmed by the substantial increase in investment planned in the industry[2] and which,

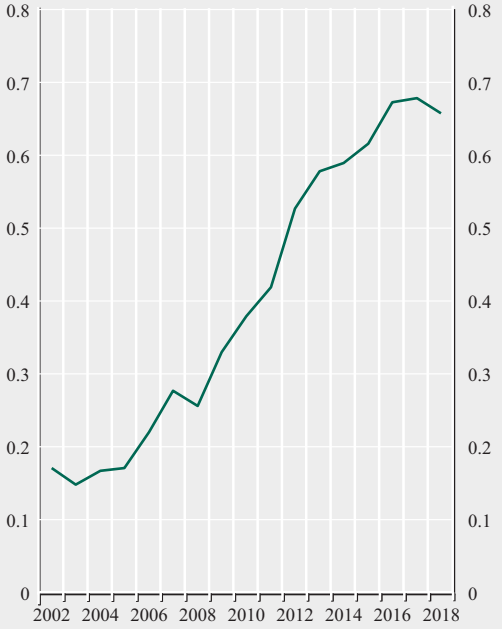
* The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. Any errors or omissions are the authors' responsibility.

1 Own calculations using data from the International Trade Center, Trade Map database (accessed in March 2019).

2 In this regard, see the Hellenic Petroleum's CEO announcement that the company's capital expenditure was expected to reach €2 billion for the 2006-2010 period (interview to Bloomberg, December 2005).

Chart 2 Oil exports (as a percentage of oil imports) (2002-2018)

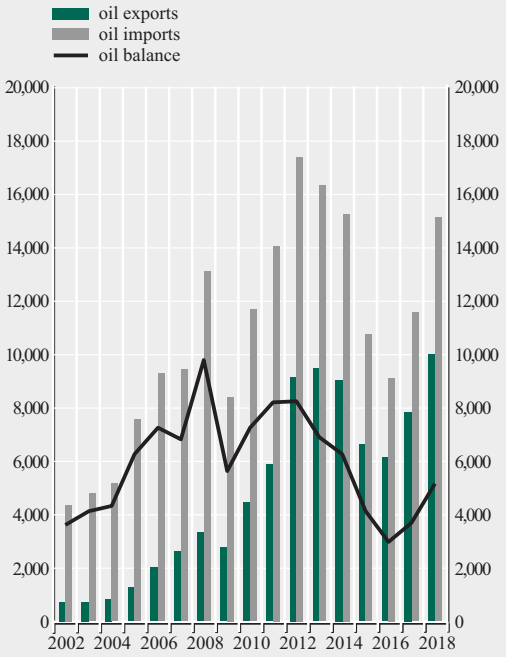
(%)



Source: Bank of Greece, Balance of Payments Statistics.

Chart 3 Oil exports, oil imports and oil balance (2002-2018)

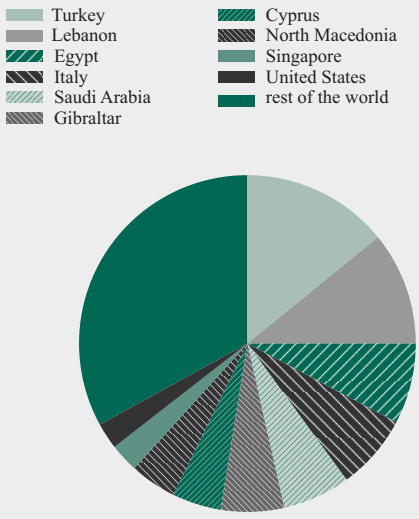
(EUR millions)



Source: Bank of Greece, Balance of Payments Statistics.

Chart 4 Destinations of Greece's exports of distilled oil (2014-2018)

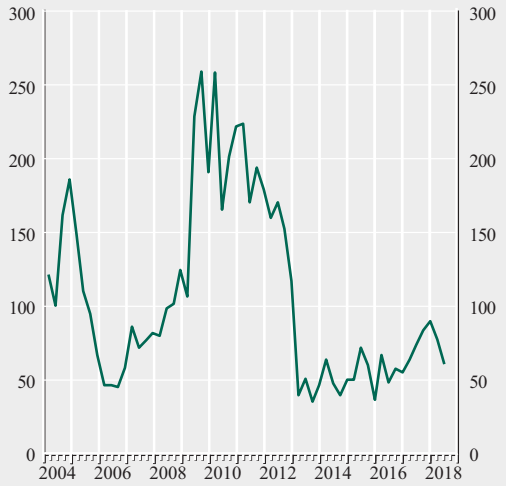
(period averages)



Source: Eurostat, SITC series 33.

Chart 5 Real investment in the Greek oil industry (2004:Q1-2018:Q2)

(EUR millions, at constant 2010 prices, seasonally adjusted)



Sources: Reuters (sum of capital expenditure of ELPE and MOTOR OIL from cash flows) and ELSTAT, National Accounts.
Note: Nominal values have been converted to real using the business expenditure deflator excluding housing and public investment.

as shown in Chart 5, did materialise primarily during the 2008-2012 period. This led to considerable technological upgrading and renewal of the industry's infrastructure and constituted the main driving force that made the shift possible and successful.

The present study attempts to estimate an export supply function for the Greek oil sector, aiming to identify the factors that determine and contribute to export activity. As pointed out and shown in Chart 2, the domestic market initially was the primary target of the oil sector, while exports represented only a small part of the overall supply. Gradually, however, exports became a strategic priority and this policy switch was accelerated further as a result of the economic crisis, while it was facilitated by higher investment. It is therefore important to independently assess and estimate the supply of Greece's refined oil exports. The empirical approach adopted is time series analysis which suggests the estimation of a long-run equation, as well as the dynamics of export supply where the short-term adjustment is compared with the longer-term adjustment, which is important from a policy perspective.

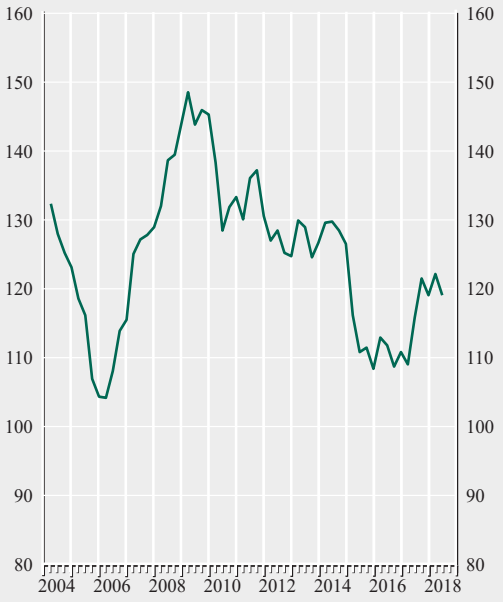
The paper is structured as follows: Section 2 discusses issues concerning the structure of the Greek oil sector, while Section 3 provides a review of the relevant literature. In Section 4 the theoretical and empirical models are specified. Section 5 presents and discusses the estimation results. Finally, Section 6 provides the conclusions and policy recommendations.

2 THE STRUCTURE OF THE REFINING SECTOR IN GREECE

Two refining companies are active in the oil refining sector in Greece, forming an oligopoly (duopoly). These are Hellenic Petroleum S.A. (ELPE), which is the largest, accounting for 57% of the country's refining capacity, and Motor Oil Hellas S.A., accounting for the remaining 43%, while, taken together, the two companies own four refineries. The companies buy raw materials (different types of crude oil and feedstock) from Saudi Arabia, Iraq, Libya, Iran and Russia and after proper processing they supply refined products (gasoline, diesel oil, fuel oil, jet fuel, etc.).

Chart 6 Refining margin in the oil industry (2004:Q1-2018:Q2)

(index, 2010=100, seasonally adjusted)



Sources: Eurostat, ELSTAT, US Energy Information Administration and Bank of Greece.
Note: Ratio of producer price index regarding exports of distilled oil, NACE code 19, to real crude oil spot price index (UK Brent spot price index converted to euro with the euro-dollar exchange rate and divided by the Greek implicit GDP deflator).

During the past decade, the oil industry experienced a sharp decline in both domestic and foreign (particularly European) demand, as well as low refining margins resulting from increasing input prices (crude oil prices were rising in the mid-2000s) and financing costs (see Chart 6). This necessitated a reorientation of oil exports towards new markets, mostly outside the EU, with the favourable results described above. As already mentioned, the main export destinations of Greek oil exports are reported in Chart 4.

In order to achieve this successful reorientation of exports, the oil sector undertook significant investment to modernise and upgrade its facilities. According to quarterly cash-flow data reported by Reuters, investment activity, approximated by capital expenditure, reached about €1 billion on a yearly average in the 2008-2012 period, while it averaged close to half a billion during the 2004-2017 period. Note that this was observed in contrast to the drastic reduction of total investment spending in Greece during the years of the economic crisis.[3]

The resulting remarkable improvement in the sector's export performance and its favourable impact on the country's trade deficit justify the importance of studying the export supply-side factors affecting the oil sector.

3 REVIEW OF THE LITERATURE

Empirical trade literature has traditionally exploited aggregate data and has less dealt with detailed data on a single sector. Despite the crucial relevance of sound trade elasticity estimates regarding the oil sector, which are useful for policy advice, scholarly research is scarce, even more so on the supply side of exports. A number of empirical studies dealing with Greece's aggregate exports exist and usually estimate aggregate demand through gravity models (see Papazoglou 2006) to examine export performance. At the moment, trade literature tells us little about the influence of factors on the exports of Greece's specific sectors, including the oil sector.

Aggregate export supply has been considered by Goldstein and Khan (1985), who review the international literature on, and estimate a supply function of, aggregate exports simultaneously with demand for eight large countries using the "imperfect substitutes" assumption. According to them, imports or exports are not complete substitutes for a country's domestic production. Export supply, based on this assumption, is determined by productive capacity, relative prices and input costs.

A relevant body of literature uses and augments this theoretical background in different aspects to estimate aggregate export supply functions for specific developing countries. In Utkulu et al. (2004), technological progress is a key determinant of Turkey's export supply, while relative prices are not important. Sajjad and Mahmood (2014) estimate an "augmented" export supply for South Asian economies and find significant effects from less traditional factors such as corruption and energy. Finally, Moniruzzaman et al. (2011) find a significant long-run relationship for aggregate export supply for Bangladesh, introducing real gross capital formation along with "traditional" variables such as relative prices and real GDP and a dummy variable for trade liberalisation in that country. They show that relative prices do not have a significant effect and that Bangladesh, given its small size, is a "price taker" in the international markets. The most significant variable is gross capital formation, indicating the importance of investment.

4 METHODOLOGY – THEORETICAL AND ECONOMETRIC SPECIFICATION

With regard to the theoretical specification of the link between exports of oil and supply-side factors, we draw evidence from Goldstein and Khan's approach and augment it by adding supply-side variables from the literature of aggregate export supply estimation. Oil firms export an (x^s) amount of their product based on price signals expressed by relative prices or else profitability or refining margins formed in this market (p_x/p_c). The refining margin is derived as the ratio of export prices received in foreign markets to the price or cost of the input, in which case crude oil. A supply-side variable that has attracted interest in previous

3 Investment in domestic manufacturing fell by about 12% between 2004 and 2017.

aggregate export supply estimations refers to real investment (i) in the sector and is introduced to augment the Goldstein and Khan's approach. Given the abovementioned observed growth in investment by the Greek oil refining firms, we expect that particular variable to exert a significant impact. Finally, real GDP at constant prices is introduced as a proxy to capture the effect of domestic demand pressures on the market. The equation to be estimated is specified in log-linear form as follows:

$$x_t^s=\beta_1+\beta_2 (p_x/p_c)+\beta_3 y+\beta_4 i, \quad (1)$$

where p_x is the export price of refined oil and p_c the UK Brent crude oil price, i is the level of real investment in the oil sector and y captures the level of real GDP.

In addition, a quadratic –with respect to investment– functional form of (1) was estimated alternatively to capture non-linearities in the effect of investment on export growth:

$$x_t^s=\beta_1+\beta_2 (p_x/p_c)+\beta_3 y+\beta_4 i+\beta_5 i^2 \quad (2)$$

The econometric specifications given by equations (1) and (2) are estimated as the long-run relationships. The Error Correction Model (ECM) representation conditional on (1) or (2) is the following:

$$\Delta x_t^s=\beta_1+\beta_2 \ \Delta x_{t-1}^s+\beta_3 \ \Delta z_{t-1}\ldots+\beta_{2k} \ \Delta x_{t-k+1}^s+ \beta_{3k}\Delta z_{t-k+1}+ \alpha_x(x_{t-k}^s-\beta_x' \ z_{t-k})+u_t \quad (3)$$

where β_x is a nxr matrix of the coefficients of the variables in the long-run relationship (cointegration vectors) and α_x is a nxr matrix of the loadings of the cointegrating vectors representing the error correcting speed of adjustment towards long-run equilibrium, r is the number of cointegrating vectors, n is the number of variables, k is the lag length of the VECM, and z_t is a vector consisting of the explanatory supply-side variables of the long-run relationship.

Data sources are described in the Appendix.

Table 1 Unit root tests

Variable	Levels	First differences
x^s	-2.503 (-2.917)	-6.607* (-2.917)
p_x/p_c	-1.505 (-2.914)	-5.765* (-2.915)
i	-1.990 (-2.914)	-8.621* (-2.915)
y	-0.356 (-2.914)	-1.948** (-1.613)

Source: Authors' own estimations.
Notes: One (two) asterisk(s) indicate(s) rejection of the null at 5% (10%) level of significance. The critical values for the ADF tests are those tabulated by MacKinnon (1991). The appropriate lag length of 10 maximum was selected in each case on the basis of the modified Swarz Criterion.

5 ESTIMATION RESULTS

5.1 TIME SERIES CHARACTERISTICS AND UNIT ROOT TEST

The time series used in this paper are at a quarterly frequency covering the period 2004:Q1-2018:Q2. Real exports of oil are increasing throughout the period, while real GDP is decreasing. The refining margin in the oil sector increases until 2009 and falls thereafter. Finally, real investment has a non-linear trend, increasing after 2008, reaching a peak in 2010 and then decreasing while remaining elevated between 2008 and 2012. This indicates the possibility of the existence of a non-linear export supply function.

In order to apply cointegration tests on the specified model, the unit root properties of the series have to be examined. The Augmented Dickey-Fuller test, which is the most widely used method, is adopted. Based on the results presented in Table 1, we fail to reject the null hypothesis of a unit root for the series in equation (1) version at 5% level of significance. Conversely, the above hypothesis is rejected when the variables are in first differences. Thus, the series are integrated of order one I(1).

Table 2 Johansen's ML test for the number of long-run relationships

		Linear	Non-linear	5% critical values
		Statistics		
		Trace		
r=0	r≥1	60.43*	78.17*	54.64
r≤1	r≥2	33.04	50.86*	34.55
r≤2	r≥3	14.22	28.24	18.17
		Maximal eigenvalue		
r=0	r=1	27.39	27.31	30.33
r≤1	r=2	18.82	22.62	23.78
r≤2	r=3	9.58	17.26	16.87

Source: Authors' own estimations.
Note: Tests are corrected for small sample bias.
* 5% significance.

5.2 COINTEGRATION ANALYSIS

In the analysis suggested by the Johansen multivariate cointegration procedure which is adopted (Johansen 1988, Johansen and Juselius 1990), the order of the VAR (the lag length) has to be determined. The Akaike Information Criterion and the Final Prediction Error (FPE) were applied to models (1) and (2) choosing the lag length where the criterion is minimised. The results are mixed for both the linear and the non-linear specifications. According to the former criterion, a VAR(1) is best and, based on the latter, a VAR(4) should be chosen. However, an inspection of the diagnostic statistics for both specifications shows that autocorrelation and heteroscedasticity are violated for lags lower than four.[4] A VAR(4) is thus chosen to be estimated for both specifications, which also seems reasonable given the quarterly frequency of the data.

The analysis continues with the determination of the number of the long-run relationships. Table 2 presents the results of the cointegration tests based on the trace and maximum eigenvalue statistics, first for the linear specification (the traditional and the augmented versions) and then for the non-linear quadratic equation. Proceeding sequentially, the hypothesis of no long-run relationship is tested. If rejected, the hypothesis of the existence of one or more long-run relationships is tested until there is no longer rejection. The likelihood ratio test statistics are corrected for sample size by multiplying the test statistic by (T-number of estimated parameters)/T, as discussed in Ahn and Reinsel (1992). Also, a deterministic logarithmic trend is incorporated in the estimation, which is included in the long-run vector under the linear model and in the short-run dynamics under the non-linear one. According to the trace statistic, there is one significant long-run relationship among the variables in equation (1) regarding both linear and non-linear specifications at 5% level of significance. The maximum eigenvalue statistic fails to reject the null hypothesis of non-existence of a long-run vector. Since the results are inconclusive, we consider other tests to validate the existence of one long-run relationship. The smaller size of the second eigenvalue, which is significantly smaller than the first in the case of the linear model, supports this argument. Moreover, since it has been shown that the trace test's power is superior to that of the

4 Non-normality is only present at VAR(4), which becomes insignificant at 1%.

Table 3 Cointegrating vectors

	Linear		Non-linear
x^s	1	1	1
p_x/p_c	0.612 (2.623)	1.401 (2.812)	0.687 (2.375)
i	-	0.360 (3.579)	2.261 (2.903)
i^2	-	-	-0.227 (-2.671)
y	-1.314 (-5.916)	-2.575 (-5.368)	-2.104 (-8.060)
log (trend)	-	0.587 (6.991)	-
		Alpha (short-run dynamics)	
Δx^s	-0.950 (3.848)	-0.726 (4.347)	-0.591 (-3.294)
$\Delta(p_x/p_c)$	0.081 (1.145)	0.091 (1.961)	0.116 (2.265)
Δi	-	0.658 (1.718)	1.133 (2.828)
Δi^2	-	-	10.06 (2.834)
Δy	0.065 (2.009)	0.031 (1.433)	0.009 (0.373)

Source: Authors' own estimations.
Note: t-statistics are in parentheses, logarithmic trend is included in the short-run dynamics in the linear equation without investment and in the non-linear equation.

maximum eigenvalue tests,[5] it is reasonable to conclude that one cointegrating relationship exists also in the non-linear specification. Thus, the rank is one in all specifications.

Table 3 reports the estimated Johansen long-run elasticities and their t-statistics after normalising on real exports. The first column gives the estimates based on the traditional specification, while the second and the third columns use equations (1) and (2), respectively. The equation-specific adjustment coefficients along with their corresponding t-statistics are also reported in the table. Overall, all the variables in the three specifications have the expected signs and are statistically significantly different from zero at the 5% level. This suggests that in terms of sign and magnitude we have attained estimates that reasonably express the true long-run equilibrium relationships. In all three long-run equations of real exports, the coefficients of the refining margin have a positive sign, indicating that favourable profit opportunities lead to higher supply of oil exports. The sign of real GDP is always negative, suggesting that downturns favour, but upturns discourage, export supply. Finally, there is a positive linear effect from real investment, an increase of which can lead to growing oil exports, and the estimates show that a non-linear effect could also be picked up. The square of real investment is significant with a negative sign, indicating a parabola which means that the rate of change in the effect is declining. This could mean that the effect of infrastructure expenditure may die out and new investment may be soon needed.

The adjustment coefficients in Table 3, which are significant in all three specifications, indicate that exports adjust negatively to a deviation from long-run equilibrium. Near complete adjustment, of 95% within a quarter, occurs in the traditional model, it is lower (73%) in the augmented linear model and it appears even lower (59%) in the augmented quadratic specification. Relative prices and investment absorb part of exports' long-run adjustment (being positive) to errors from equilibrium in the quadratic model, demonstrating endogeneity for these variables. Economic activity's

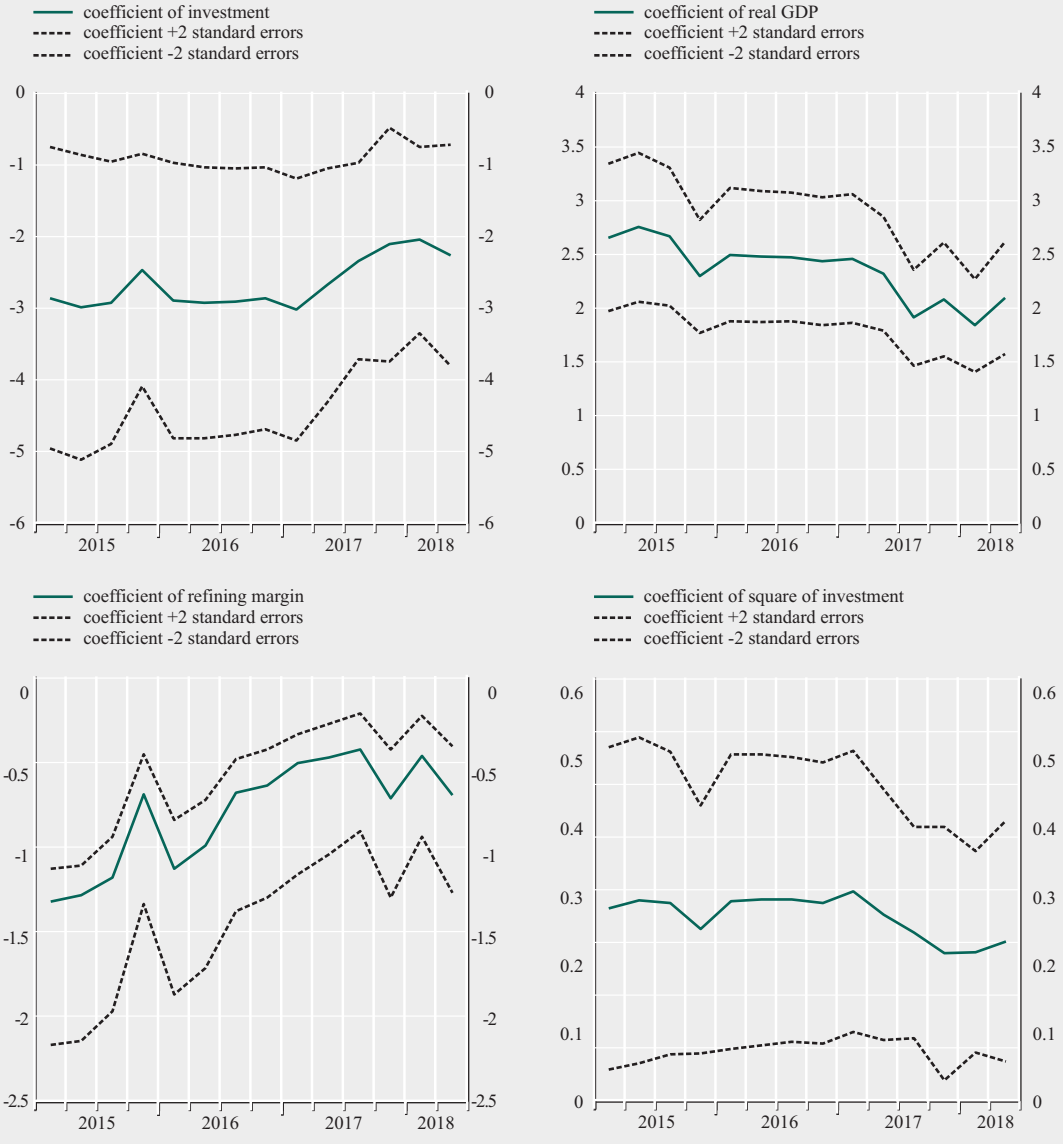
5 See Lütkepohl et al. (2004), where it is stated that it is sufficient to apply exclusively the trace statistic in cointegration analysis.

adjustment is significant and positive, but low in the traditional model.

5.3 CONSTANCY OF THE COINTEGRATION SPACE

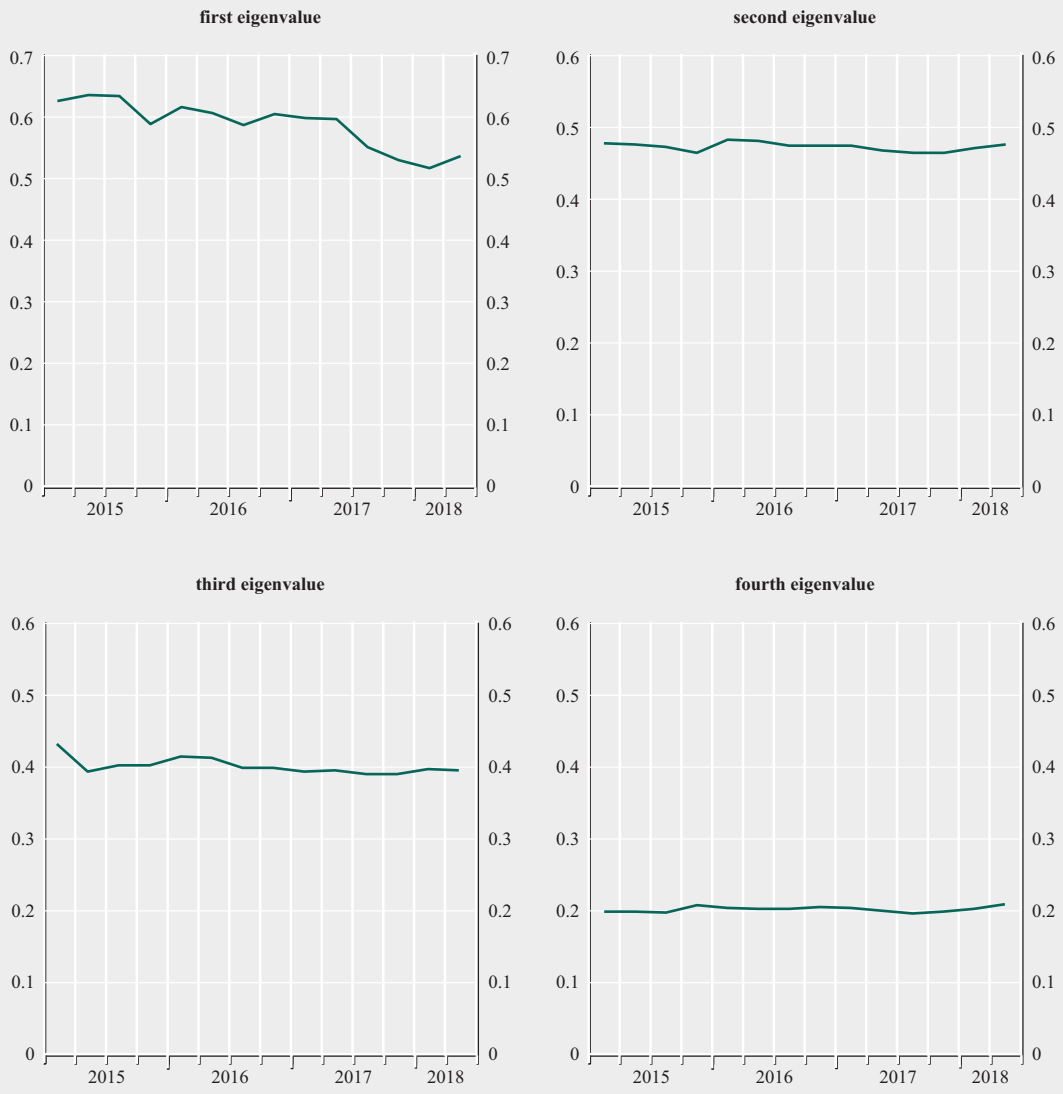
The finding that long-run relationships exist across the three alternative specifications ensures robustness concerning supply-side effects on oil exports. To further strengthen these results, we explore the stability properties of the non-linear augmented equation. The Johansen procedure is applied for the first 48 observations, which is considered as the base period 2004:Q1-2016:Q4 and then is updated recursively, adding one quarter each time. Table 4 shows the recursive trace sta-

Chart 7 Recursive estimation of the long-run coefficients of equation (2) with +/-2 standard error bands (2015:Q1-2018:Q2)



Source: Authors' own estimations.

Chart 8 Recursive eigenvalues of equation (2)
(2015:Q1-2018:Q2)



Source: Authors' own estimations.

tistic and eigenvalues, the recursive long-run elasticities of equation (2) and the resulting number of cointegrating vectors which always remains one. Eigenvalues over the subsamples and the values of the trace statistic are very close. The long-run elasticities of investment, income and relative prices over the subsamples do not present significant dissimilarities from those of the whole sample. Constancy of equation (2) can also be viewed in Charts 7, 8 and 9 that depict recursive tests using the first 40 observations as a base period. The recursive beta coefficients are presented in Chart 7 and exhibit reasonable stability, with the coefficients of investment showing the greatest stability. In Chart 8 the recursive eigenvalues are stable. Finally, the "Max likelihood function" test, which is a test for the overall constancy of the equation, is presented in Chart 9 along with the 95% quantile hori-

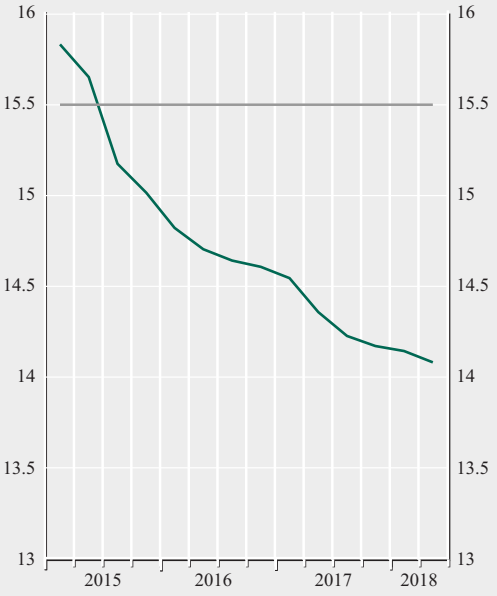
Table 4 Temporal stability tests for the non-linear cointegrating regression

		Trace				Long-run elasticities				
	Size	r=0	r≤1	r≤2	Eigen-values	*i*	i^2	*y*	p_x/p_c	# of vector
2016:Q4	48	76.07	43.95	25.96	0.61	5.22	0.50	-3.26	0.44	1
2017:Q1	49	76.45	42.69	24.05	0.60	5.02	0.49	-3.20	0.47	1
2017:Q2	50	75.29	44.50	25.73	0.60	3.42	0.34	-2.57	0.32	1
2017:Q3	51	69.98	44.51	25.20	0.55	2.42	0.25	-1.91	0.37	1
2017:Q4	52	69.77	45.83	25.87	0.53	2.05	0.20	-2.09	0.72	1
2018:Q1	53	72.85	49.00	28.06	0.52	2.00	0.21	-1.79	0.40	1
2018:Q2	54	76.30	50.16	28.15	0.54	2.26	0.22	-2.10	0.69	1

Source: Authors' own estimations.

zontal line. Since the test statistic is below the line for the whole subsample, constancy is not rejected at 5% level of significance. Thus, these results suggest that there is no significant change in the structure of the long-run parameters and there is constancy in the cointegration space.

Chart 9 Recursive loglikelihood for equation (2) (2015:Q1-2018:Q2)



Source: Authors' own estimations.

5.4 SHORT-RUN DYNAMIC ADJUSTMENT ESTIMATES OF EXPORT SUPPLY

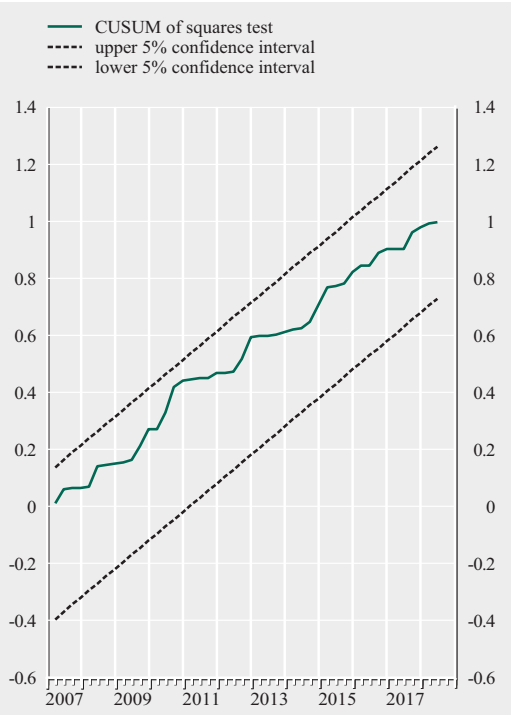
Given the long-run relationships, the conditional short-run error-correction mechanism (ECM) is estimated as expressed in (3) for each of the three models in Section 4.1. The ECMs use the residuals from the long-run relationships lagged once as error-correction terms. The coefficients of the differenced variables are the impact multipliers (short-run effects), and the coefficient of the error-correction term is the short-run adjustment effect showing how any disequilibrium in previous periods affects the adjustment in exports. Since every variable in this equation is stationary, it can be estimated with OLS. Using the general-to-specific methodology by David Hendry, the parsimonious statistically significant short-run estimates are presented in Table 5. The performance of the equations is good and the diagnostic tests find no non-normality, non-autocorrelation or heteroscedasticity. All variables have the correct sign. The size of the investment effect is smaller than that in the long run, but significant. Export growth responds to relative price changes with elasticities close to one and to real income changes with elasticities above one. The effect of the economic cycle is thus important, and an economic downturn may enhance the export supply of oil. Short-run adjustment is negative (stable) and significant.

Table 5 The short-run error correction model

Variable	Linear		Non-linear
		Coefficient	
Constant	0.040 (2.578)	0.051 (3.151)	0.040 (2.532)
Δx^s_{t-4}	-0.405 (-4.284)	-0.377 (-3.767)	-0.363 (-3.678)
$\Delta(p_x/p_c)$	0.779 (1.805)	1.104 (2.398)	0.896 (2.027)
Δi_{t-3}	-	0.101 (1.970)	0.105 (2.070)
Δy_{t-4}	-1.861 (-2.162)	-1.941 (-2.202)	-1.990 (-2.291)
ECT_{t-1}	-0.887 (-6.258)	-0.854 (-5.649)	-0.914 (-5.856)
		Statistics	
Adjusted R^2	0.56	0.55	0.57
Jarque-Bera	1.002 [0.605]	1.195 [0.550]	2.229 [0.328]
LM(4)	1.416 [0.841]	1.228 [0.874]	0.865 [0.929]
ARCH	2.045 [0.727]	1.961 [0.743]	0.977 [0.913]
Ramsey RESET	1.075 [0.305]	0.907 [0.346]	0.580 [0.450]

Source: Authors' own estimations.
Note: t statistics are in parentheses and p-values in brackets.

Chart 10 CUSUM of squares test for stability of the coefficients of the short-run error correction model (2007:Q1-2018:Q2)



Source: Authors' own calculations.

It indicates fast adjustment, which is almost complete within a quarter in all three equations. The highest significance based on t-statistics and the highest adjusted R-square appear in the quadratic equation chosen as the best specified. Chart 10, showing the CUSUM of squares test, verifies stability of the equation assuming quadratic investment effects (the chart is within the 5% error bands).

6 CONCLUSIONS

In this paper we attempted to empirically estimate supply elasticities in the long run and in the short run for the exports of the Greek oil industry. According to the study's estimates, supply-side factors affect export growth in the Greek oil sector both in the long run and in the short run across alternative specifications. The aim is to empirically test for the determinants of the oil sector's exports and derive useful policy conclusions regarding their contribution to rising export performance.

It was successfully shown that there exist significant stable cointegrating relationships

across three alternative specifications, namely one traditional and two augmented ones, exploring the role of investment. With respect to the latter, it was found that real investment activity by the oil companies has been an enhancing factor of the sector's exports during the last fifteen years, revealing itself in linear and non-linear form. That is, from the analysis it became apparent that the shift to foreign markets might not have been as successful without the increased investment activity, which contributed greatly to the improvement and modernisation of the industry's productive capacity.

Furthermore, significant long-run and short-run effects stem from domestic demand and the refining margin. The negative effect of domestic demand reflects primarily the impact of the recession on oil exports. That is, weakening domestic demand necessitated the channelling of excess supply to external markets. This, in turn, contributed to the improvement of the trade balance and provided a way to mitigate the adverse effects of the recession. In addition, the supply of exports responds positively to the refining margin. Greek oil companies act as price takers in the international oil market and simply react positively to changes in the refining margin. According to the non-linear equation, however, the impact of the refining margin appears to be rather weak. As a matter of fact, it appears that the relatively recent decline in the refining margin, which mostly occurred in the 2008-2013 period as a result of the rise in the price of crude oil, did not prevent oil exports from rising. Apparently, the significant improvement in productivity, resulting from increased investment activity, offset the adverse impact stemming from the drop in the refining margin.

From a policy standpoint, the paper reveals primarily the importance of investment in improving the export capacity of the Greek oil industry. More specifically, the expansion to foreign markets was made possible through the improvement of the existing infrastructure of the companies and the introduction of new technologies, which led to an upgrading in the quality of the product. Furthermore, the expansion of existing units and the resulting reduction of production costs, coupled with the achieved compliance with EU legislation, enhanced the industry's capacity to compete internationally by counterweighing any possible negative effects from several adverse exogenous factors such as increases in the international price of crude oil or narrower profit margins. Overall, it could be argued that, although the decline in domestic demand may have necessitated the turn to international markets by the Greek oil industry, it was largely the rise in investment and the subsequent upgrading of the facilities that made such turn feasible.

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APPENDIX

Data description

Variable	Notation	Approximation	Statistical sources
Exports of distilled oil	x^s	Value of exports of distilled oil in EUR millions	ELSTAT and Eurostat, SITC Series 33
Export prices of distilled oil	p_x	Producer price index regarding exports of distilled oil, code 19 NACE Rev. 2	ELSTAT
Real crude oil price	p_c	A real crude oil prices index (the UK Brent index, expressed in US dollars per barrel, chosen as an approximation of crude oil spot prices in Europe, is converted to euro with the euro-dollar exchange rate and divided by the Greek implicit GDP deflator)	US Energy Information Administration (EIA) and ELSTAT
Investment in the oil sector	I	Capital expenditure (in EUR millions) by ELPE and MOTOR OIL, the two Greek oil companies in the sector	Reuters
Investment deflator in the oil sector	p_{inv}	Business investment deflator (available at annual frequency and transformed to quarterly with the Denton interpolation method)	ELSTAT National Accounts
Real investment in the oil sector	i	I is converted to real using the business investment deflator	Own calculations
Greece's real Gross Domestic Product (GDP) at 2010 prices	y	In EUR millions	ELSTAT National Accounts

RAISING CAPITAL THROUGH ISSUANCE OF COMMON SHARES BY GREEK-CONTROLLED MARITIME COMPANIES IN US CAPITAL MARKETS

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ABSTRACT

Our paper reviews the equity offerings of Greek-controlled maritime companies in US capital markets. We specifically examine the percentage of equity funds raised by Greek interests compared to the overall international maritime raisings in the United States, the amount of money raised, the pricing of the offerings, the performance of the stocks when the new shares commenced trading, the offering price in relation to the initial price range, the issuance costs, the existence of overallotments, and the use of the proceeds. We break down the activity per vessel type, company type, and equity issue type.

We find that the US equity issues boosted substantially the growth of the Greek-controlled fleet over the last two decades. We also identify a more intense issuing activity at the peak of the shipping cycle, which could jeopardise the companies' capital structure when freight rates and vessel values correct downwards.

Keywords: equity issues, maritime companies, shipping cycle, world trade, financial leverage

JEL classification: G15, G24, G32

ΑΝΤΛΗΣΗ ΚΕΦΑΛΑΙΩΝ ΜΕΣΩ ΕΚΔΟΣΗΣ ΚΟΙΝΩΝ ΜΕΤΟΧΩΝ ΑΠΟ ΕΛΛΗΝΙΚΕΣ ΝΑΥΤΙΛΙΑΚΕΣ ΕΤΑΙΡΙΕΣ ΣΤΙΣ ΑΓΟΡΕΣ ΚΕΦΑΛΑΙΩΝ ΤΩΝ ΗΠΑ

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ΠΕΡΙΛΗΨΗ

Η παρούσα μελέτη εξετάζει τη δραστηριότητα άντλησης κεφαλαίων από ελληνικές ναυτιλιακές εταιρίες με προσφορά μετοχών στις κεφαλαιαγορές των ΗΠΑ. Συγκεκριμένα, εξετάζονται

το ποσοστό των κεφαλαίων που αντλήθηκαν από εταιρίες ελληνικών συμφερόντων σε σύγκριση με τα συνολικά κεφάλαια που άντλησαν διεθνείς ναυτιλιακές εταιρίες στις ΗΠΑ, το αντληθέν ποσό, οι τιμές των προσφορών, η απόδοση των μετοχών όταν ξεκίνησε η διαπραγμάτευση των νέων τίτλων, η τιμή προσφοράς σε σχέση με το αρχικό εύρος τιμών, το κόστος έκδοσης, το επίπεδο κάλυψης των προσφορών και η χρήση των προσόδων. Η εκδοτική δραστηριότητα αναλύεται κατά τύπο πλοίου, εταιρίας και έκδοσης μετοχών.

Σύμφωνα με τα ευρήματα της μελέτης, οι εκδόσεις μετοχών στις αγορές των ΗΠΑ ενίσχυσαν σημαντικά τη μεγέθυνση του ελληνόκτητου στόλου κατά την τελευταία εικοσαετία. Επίσης, διαπιστώνεται εντονότερη εκδοτική δραστηριότητα στην υψηλότερη φάση του ναυτιλιακού κύκλου, με αποτέλεσμα η κεφαλαιακή διάρθρωση των εταιριών να χαρακτηρίζεται από υπερβολική μόχλευση όταν η ναυλαγορά εισέρχεται στα χαμηλά επίπεδα του ναυτιλιακού κύκλου.

RAISING CAPITAL THROUGH ISSUANCE OF COMMON SHARES BY GREEK-CONTROLLED MARITIME COMPANIES IN US CAPITAL MARKETS*

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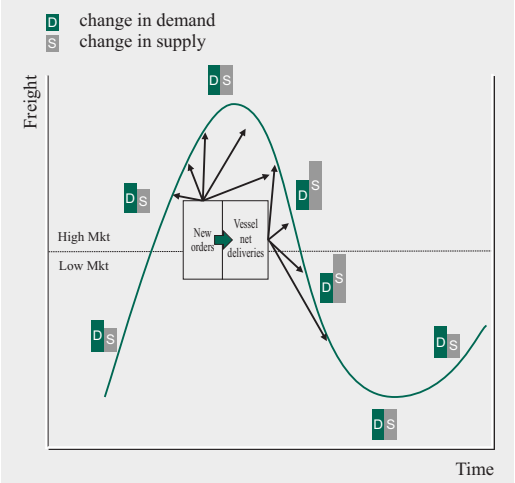
I INTRODUCTION

This article reviews the equity offerings in the US capital markets by Greek-controlled maritime companies. We examine this in the context of the total equity issues by all international maritime companies in the United States, which allows us to evaluate the participation of Greek interests in the overall capital market activity in shipping.

Shipping is a capital intensive industry, historically financed by mortgage-backed bank debt. By the turn of the 21st century, capital markets emerged as an efficient alternative source of financing to traditional mortgage loans (Syriopoulos 2010). Such financing took the form of either bonds (most of them unsecured) or equity offerings. Capital markets offered the opportunity to scale up the investments and the size of the companies to levels far beyond the financial muscles of the traditional shipping families running them. In addition, they provided the opportunity to occasionally price the equity at more attractive terms and to maintain a liquid market for the controlling shareholders. Greek maritime companies were modernised and transformed to meet the transparency and reporting standards required by the most advanced capital markets in the world, including the US market.

Our paper measures the amount of money raised, the pricing of the offerings, the performance of the stocks post-offering, and the issuance costs. In addition, we try to relate the intensity of equity issuances to the developments in the shipping cycle. It is widely acknowledged that shipping cycles are the predominant driving force in the industry (Stopford 2009). The interaction between freight rates and future developments in the fleet size fuels successive market cycles with significant volatility. In Chart 1 we summarise the mechanism through which when changes in demand outgrow changes in supply, freight rates increase, thus triggering excessive newbuilding orders, which far outpace scrapping of older tonnage (net deliveries). The surge in net vessel deliveries from the shipyards will subsequently cause supply growth to outpace demand growth, this time leading to a fall in freight rates.

Chart 1 Shipping cycle's dynamics



The implications of the abovementioned alternative source of shipping funding for the Greek economy are important. Greek shipping is a major contributor to Greece's balance of payments. Its share is historically measured at

* The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. Any errors or omissions are the authors' responsibility.

around 43% of total receipts from services (Panagiotou and Bragoudakis 2010, Bragoudakis et al. 2015, Kasimati and Veraros 2011), whereas for 2018 it was estimated at 38%. Its contribution to employment is estimated between 3.6% and 5.0% of total workforce in Greece (IOBE 2013, Harlaftis et al. 2009). An extensive body of literature (Bragoudakis and Panagiotou 2010, Bragoudakis et al. 2015, Panagiotou and Bragoudakis 2010, Kasimati and Veraros 2011) suggests that maritime receipts by the Greek economy are positively affected by high freight rates, the increased size of the Greek-controlled fleet and the availability of debt financing. Capital market proceeds, being an additional source of financing, are expected to further boost the size of the Greek fleet and accordingly the receipts accruing to the Greek economy.

Our article describes the development of equity proceeds from US capital markets, broken down into categories, as well as the pricing of the offerings and the stock performance following the issuance.

2 DATA DESCRIPTION

We derive our data on capital offerings primarily from FactSet (www.factset.com) for a period spanning from January 2004 to October 2018. We keep track of all equity issues[1] of maritime companies in US capital markets (NYSE, AMEX and NASDAQ). We do not include debt issues and at-the-market (ATM) equity offerings, which could be the subject of another study. Our total sample includes 69 companies and 232 transactions. We break down the companies based on the type of vessels that they operate, so as to analyse the shipping cycle effect on the capital market issuances. We distinguish four major vessel categories, as shown in Table 1.

We further identify those companies representing Greek interests. We define such companies as those established, managed or controlled by Greek shipping families.[2]

3 OVERALL DEVELOPMENTS

In the period under examination, maritime companies raised $30.7 billion in equity money (see Table 2). Companies maintaining fleets of dry bulk, tankers and LNG vessels accounted for 77% of total issues (see Chart 2). Greek interests accounted for $13.5 billion, or 44% of total issues, with their participation ranging from 22% in LNG vessels to 88% in dry bulk. Note that this participation significantly exceeds the overall share of the Greek-controlled fleet in the world fleet, which

1 In the equity offerings under examination we also include Special Purpose Acquisition Companies (SPACs). Such raisings accumulate cash in special vehicles with the caveat that within a specified period of time the management should identify a project for investing the cash and bring it to the shareholders for approval. If the shareholders reject it, they can claim back their cash contribution to the SPAC.

2 All the Greek-controlled companies in our study are included in the various editions of the Greek Shipping Directory since 2004 (www.greekshipping.gr), whereas the vast majority of the currently existing companies participate in the voluntary tax contribution to the Greek government, as agreed in April 2019.

Table 1 Vessel types

Type of vessel	Cargo	Capacity measurement
Dry bulk	Dry bulk cargoes such as grain, ore, coal	Deadweight tonnage (dwt)
Tankers	Crude, refined oil or chemical products	Deadweight tonnage (dwt)
Containerships	Containers (boxes)	Number of Twenty Feet Equivalent Units (TEU)
LNG vessels	Liquefied natural gas	Cubic Meters (Cbm)

Source: The Baltic Exchange (2014).

Table 2 Equity issues by maritime companies in US capital markets (2004-October 2018)

(USD millions)

	Non-Greek	Greek	Total	% of Greek
Dry bulk	915	6,549	7,464	88%
Tankers	6,315	2,648	8,963	30%
Containerships	1,544	1,139	2,683	42%
LNG vessels	5,634	1,631	7,265	22%
Other[1]	2,813	1,568	4,381	36%
Total	17,221	13,536	30,756	44%

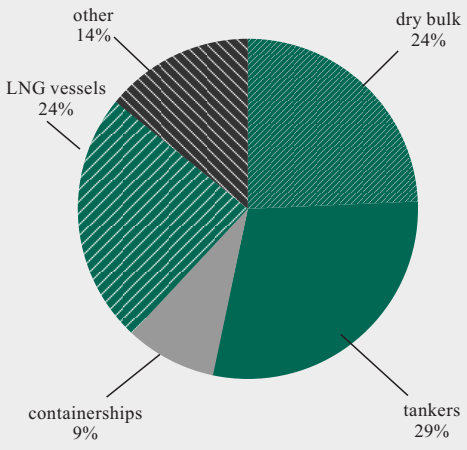
Source: FactSet and authors' calculations.
1 Other includes more specialised vessels such as river barges, drill ships, offshore support vessels and LPGs, along with some companies which maintain a very diversified mix of dry bulk, tanker, LNG and containerships and thus cannot be allocated in one specific category.

ranges between 17% in terms of gross tonnage (Clarksons 2019) and 20% in terms of deadweight (Union of Greek Shipowners 2018). As we discuss in more detail later, this significant new source of funding facilitated the expansion of the Greek-controlled fleet in the past 15 years.

We distinguish equity issuance activity into initial public offerings (IPOs), where a company is listed on the stock exchange for the first time, and follow-on offerings, where already listed companies proceed with subsequent share offerings. IPOs accounted for 31% of total proceeds, with the average size being almost twice as much as that of follow-on offerings (see Table 3). Around $25 billion, or 81% of the transactions, were associated with primary offerings, i.e. new shares were issued and the proceeds were received by the companies to finance new investments. Secondary offerings included sales of existing shares, in which case the proceeds were received by existing selling shareholders.

Chart 2 Equity issues by maritime companies, per type of vessel (2004-October 2018)

(%)



Source: FactSet and authors' calculations.

Table 3 Breakdown of types of equity issues by maritime companies in the United States

Breakdown A	USD millions	% of total	Average size
IPOs	9,597	31%	213
Follow-on	21,159	69%	113
Total	30,756		133
Breakdown B	**USD millions**	**% of total**	**Average size**
Primary	24,935	81%	123
Secondary	3,657	12%	192
Combination	2,164	7%	216
Total	30,756		133

Source: FactSet.

Table 4 Equity issues by maritime companies in the United States, MLPs versus ordinary companies (2004-October 2018)

(USD millions)

	MLP	Non-MLP	Total	% of MLPs
Dry bulk	1,098	6,366	7,464	15%
Tankers	967	7,996	8,963	11%
Containerships[1]	0	2,683	2,683	0%
LNG vessels	4,184	3,081	7,265	58%
Other	1,043	3,338	4,381	24%
Total	7,292	23,465	30,756	24%

Source: FactSet and authors' calculations.
1 Note that although the category of Containerships does not include a pure MLP listing, such kind of ships with long-term charters are observed to have been included in more diversified MLP vehicles.

An interesting distinction among the issuing companies is between Master Limited Partnerships (MLPs) and ordinary companies. The former are publicly traded entities which are taxed as partnerships and employed primarily by companies maintaining well-contracted future revenue streams that provide substantial visibility in their dividend capacity. Such companies are normally priced on a dividend yield basis, adjusted for their ability to maintain their dividend over a long period, if not to increase it further (Goldman Sachs 2019). As depicted in Table 4, MLPs account for 24% of total proceeds. However, when broken down by type of vessel category their participation surges to 58% for LNG vessels, the main reason being that such vessels normally command long-term charters. We will make use of this distinction throughout our analysis, as MLP equity issues are not expected to be similarly affected by short-term fluctuations of the shipping cycle relative to the rest of the companies, which have a significantly higher exposure to spot freight rates.

Table 5 and Chart 3 present the evolution of total maritime equity issues over time. We can observe that after 2015 the overall issuance activity subsided. Note that 2014 data are inflated due to one huge secondary offering for

Table 5 Evolution of equity issues by maritime companies in the United States over time (2004-October 2018)

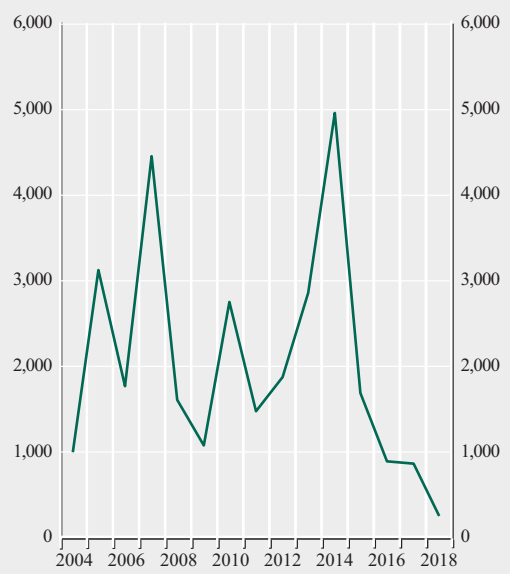
(USD millions)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Dry bulk	0	1,083	154	2,347	472	452	685	191	163	799	152	505	202	81	181	7,464
Tankers	998	373	510	982	509	357	1,244	348	244	968	884	797	193	459	98	8,963
Containerships	0	606	463	310	219	0	160	259	307	98	10	0	157	96	0	2,683
LNG vessels	0	278	0	88	155	168	0	660	859	750	3,391	394	345	179	0	7,265
Other	0	804	643	743	265	107	668	17	304	244	534	0	0	52	0	4,381
Total	998	3,143	1,769	4,470	1,620	1,083	2,756	1,474	1,877	2,859	4,971	1,695	897	866	279	30,756
Greek interests	295	1,352	573	2,909	725	452	1,526	502	863	969	1,881	860	194	253	181	13,536
% of Greek interests	30%	43%	32%	65%	45%	42%	55%	34%	46%	34%	38%	51%	22%	29%	65%	44%

Sources: FactSet and authors' calculations.

Chart 3 Total maritime equity issues in the United States (2004-October 2018)

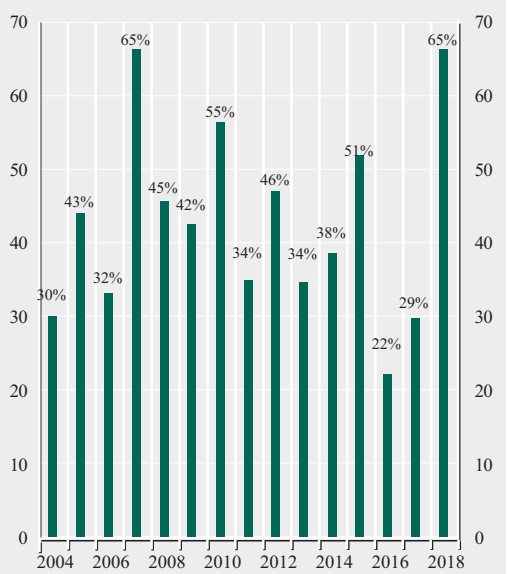
(USD millions)



Source: FactSet and authors' calculations.

Chart 5 Greek interests in maritime equity issues in the United States (2004-October 2018)

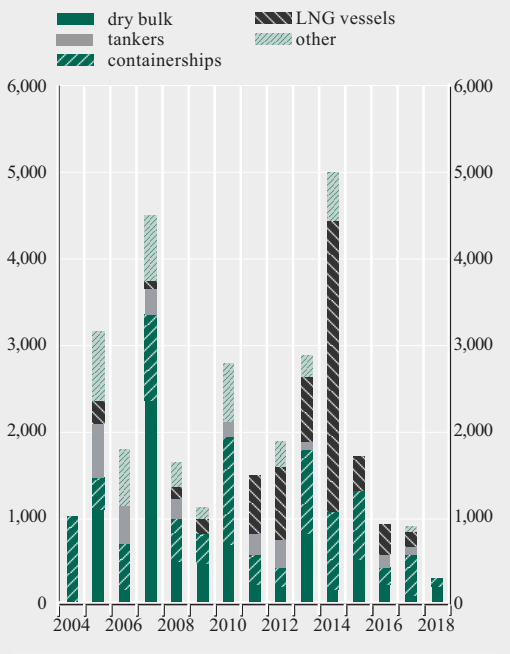
(% of total)



Source: FactSet and authors' calculations.

Chart 4 Breakdown of maritime equity issues by vessel category (2004-October 2018)

(USD millions)



Source: FactSet and authors' calculations.

existing shares of $1.6 billion by a LNG company. Chart 4 describes the participation of each sector in total issues. Dry bulk and tankers dominated in the period 2004-2010, whereas the LNG sector has taken the lead since 2011. Finally, Chart 5 suggests that the participation of Greek interests fluctuated over time around its value-weighted average of 44%.

4 MARITIME ISSUES PER VESSEL CATEGORY

As already discussed, we categorise the companies per type of vessels that they operate in order to relate developments in the relevant freight market segment to the intensity of the respective capital market activity. We exclude the issues from the MLPs which are not expected to correlate significantly with the shipping cycle. Charts 6 to 9 present our findings. In most of the market segments, high freight rates go hand-in-hand with higher activity in the capital market issues. Table 6 summarises correlation coefficients between proceeds from equity offerings and freight rate

developments in all segments, save LNGs on which we have very limited observations. In all cases the correlations are positive, ranging between 0.34 and 0.63.

In almost all vessel categories we observe that the contraction in freight rates and equity issues started in 2008-2009, which coincides with the global economic crisis of 2009 when, according to the IMF, the world economy contracted by 0.1% and the advanced economies by 3.3%. More importantly, it coincides with the surge in the supply of maritime tonnage, fuelled by the euphoria of the previous record years. Focusing on the dry bulk sector, we see in Chart 10 that newbuilding orders represented 65%-77% of the vessels on the water in the period 2008-2010. No matter how promising demand prospects might have been at that time, it is hard to anticipate that almost doubling the fleet in the following 2-3 years could provoke anything else than an overturn of the balance in the demand and supply of maritime tonnage. "The history of world shipping is fraught with examples of crises that can be blamed on excessive ordering more than any other factor" (Thanopoulou 2010). Chart 11 further demonstrates how growth in supply (fleet size) was decoupled from growth in demand (world seaborne dry bulk trade), resulting in the collapse of the dry bulk freight rates.

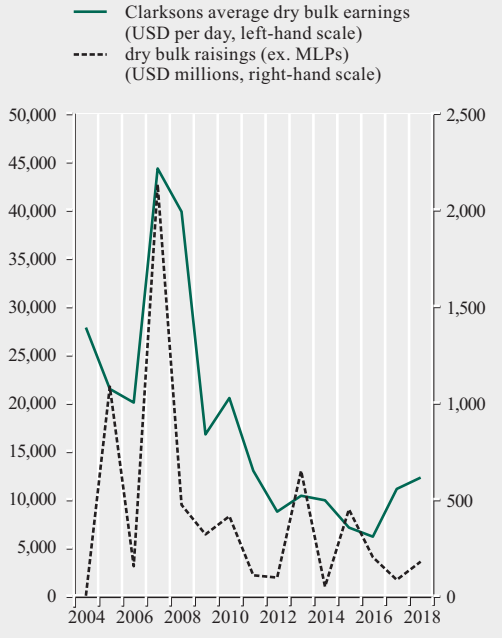
The above discussion raises the concern that most of the new equity capital accrues to mar-

Table 6 Correlation coefficients between proceeds from equity raisings and freight rate developments

Dry bulk	0.63
Tankers	0.34
Containerships	0.58

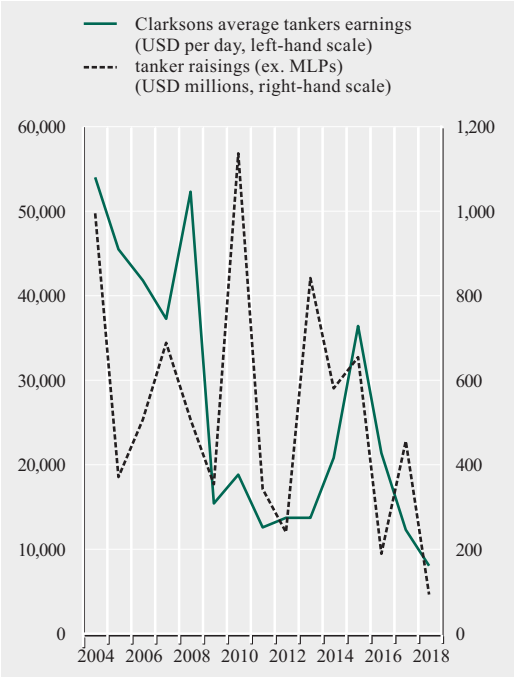
Sources: FactSet, Clarksons and authors' calculations.

Chart 6 Dry bulk equity issues versus vessels' earnings (2004-October 2018)



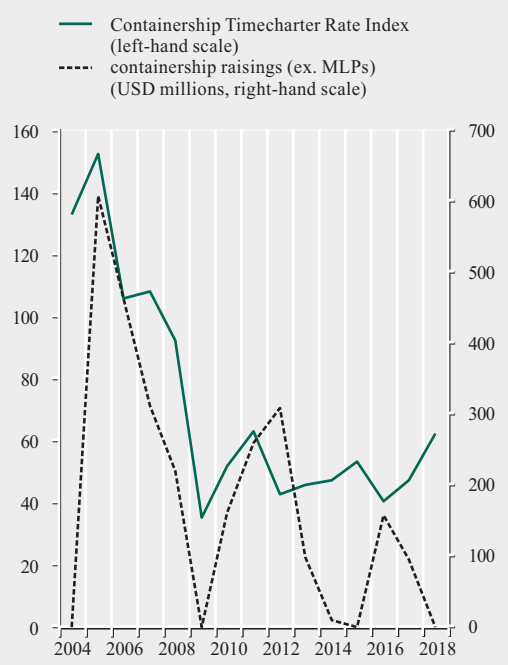
Source: FactSet and authors' calculations.

Chart 7 Tanker equity raisings versus vessels' earnings (2004-October 2018)



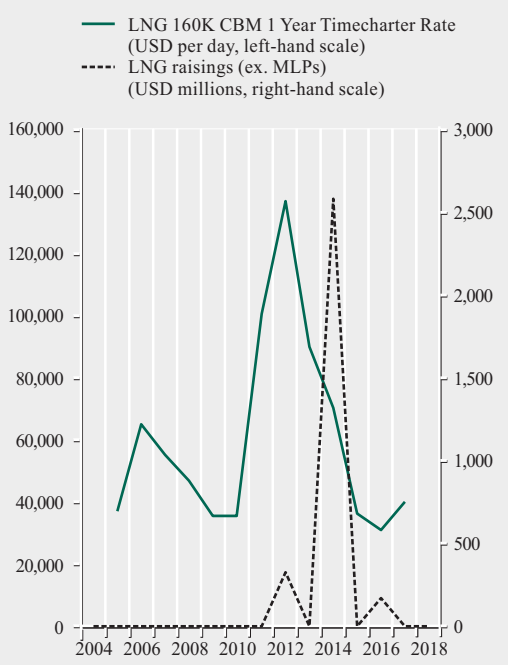
Source: FactSet and authors' calculations.

Chart 8 Container ship equity raisings versus vessels' earnings (2004-October 2018)



Sources: FactSet, Clarksons and authors' calculations.

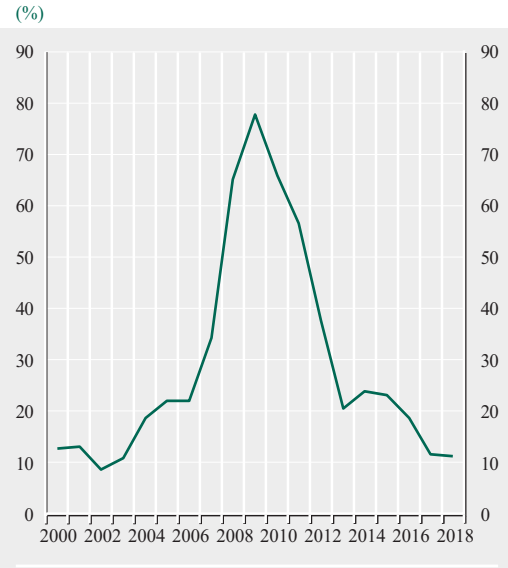
Chart 9 LNG vessel equity raisings versus vessels' earnings (2004-October 2018)



Sources: FactSet, Clarksons and authors' calculations.

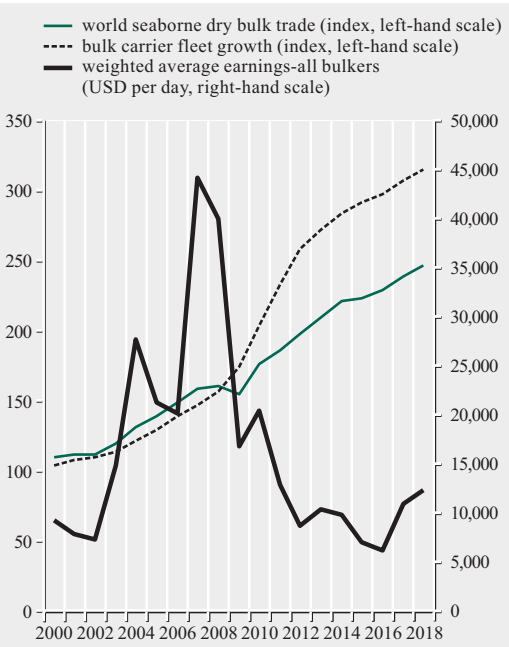
itime companies at the peak of the shipping cycle, when vessel prices are mostly inflated. As a consequence, the companies are bound to invest in new assets at rather elevated prices. In order to further elaborate on our argument, we compare the amount of annual issues in the dry bulk sector with the price of a 5-year old Capesize vessel (see Chart 12). Such vessels are the largest dry bulk carriers, able to transport around 180,000 metric tonnes (Kasimati and Veraros 2018). We selected the dry bulk sector because its capital issues have a substantial representation throughout the period under examination, during which the sector also experienced a quite intense shipping cycle. In only three years, between 2005 and 2007, the dry bulk companies raised cumulatively $3.4 billion, or approximately 53% of their total issues throughout the 15 years of our review. In the same three-year period, the price of a 5-year old Capesize vessel averaged $96 mil-

Chart 10 Dry bulk vessels orderbook as percentage of existing fleet (2000-2018)



Source: Clarksons.

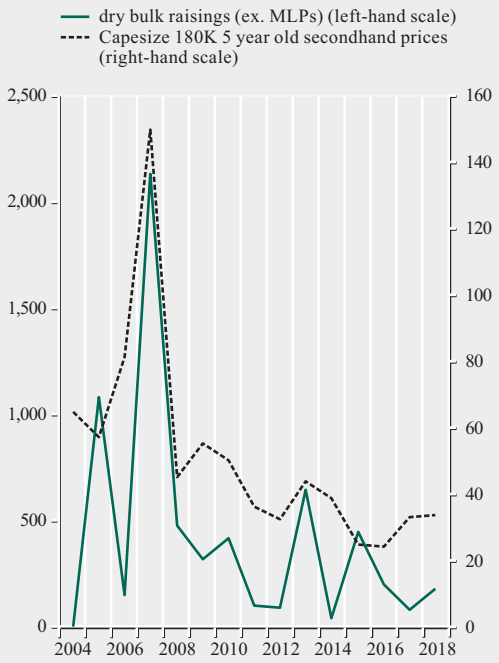
Chart 11 Dry bulk growth in supply and demand versus freight rates (2000-2018)



Source: Clarksons.

Chart 12 Dry bulk equity raisings versus vessel prices (2004-October 2018)

(USD millions)



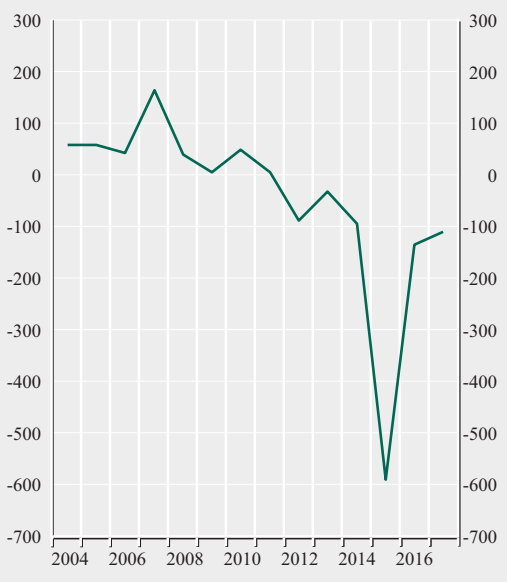
Sources: FactSet, Clarksons and authors' calculations.

Chart 13 Debt/EBITDA ratio for dry bulk companies listed in the United States (2004-2017)

Source: FactSet and authors' calculations.

Chart 14 Average net income of dry bulk companies listed in the United States (2004-2017)

(USD millions)



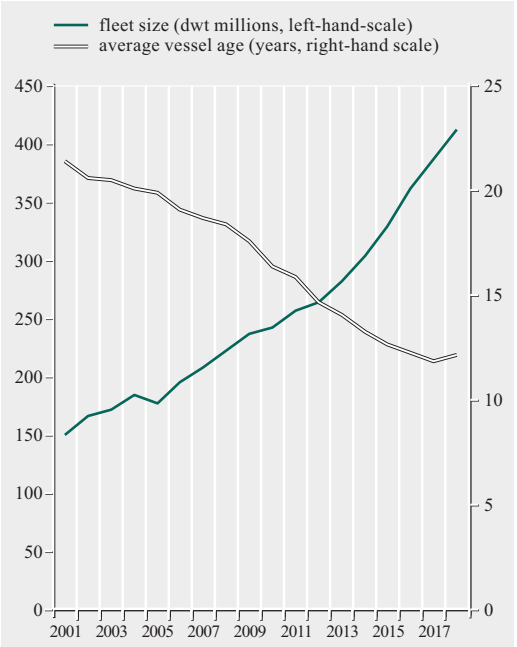
Source: FactSet and authors' calculations.

Chart 15 Amount of bank debt to Greek-controlled fleet (2001-2018)

(USD billions)

Source: Petrofin Research (2019).

Chart 16 Growth of Greek-controlled fleet (2001-2018)



Source: Petrofin Research (2019).

lion, and topped $150 million in 2007. In the period from 2008 to 2018, the average price for the same vessel declined to $38 million, whereas in the last four years it averaged only $29 million. For assets on which the industry practice is to employ debt leverage of no less than 60% to the vessel price, it is quite likely that investments at prices prevailing in 2005-2007 would have resulted in overleveraged financial structures following the downward correction of the market at the low phase of the cycle. This can be further demonstrated by Chart 13, which averages the debt/EBITDA ratio per year for all dry bulk companies of our report. It is evident that the financial leverage compared to the cash flow capacity substantially deteriorated after 2011.

It should be noted that, when asset prices reached historically attractive levels in the last four years (see Chart 12 above), the dry bulk capital issues bottomed down, since investors did not consider the companies as attractive as they did in the period 2005-2007. This could be primarily attributed to their reduced profitability, as shown in Chart 14.[3]

The surge in investments at elevated asset prices is further evidenced by Chart 15, which illustrates the amount of bank debt financing to the whole Greek shipping community. In the period 2004-2008, debt financing effectively more than doubled. The subsequent fall in freight rates and asset values described in Charts 6-9 and 12 is accompanied by a decline in debt financing, which however takes place at a much slower pace.

The significant participation of Greek interests in equity issues facilitated the expansion and modernisation of the Greek-controlled fleet, as shown in Chart 16 (Petrofin Research 2019). On the basis of the estimated value of

3 The figure for 2015 is distorted by a huge loss sustained by one dry bulk company. Nevertheless, even if we exclude this observation, the year is negative and ranks as the worst in our total time sample.

vessels controlled by Greeks in early 2019 (VesselsValue 2019), the equity proceeds of the listed Greek companies on the US market accounted for 13% of the current value of the Greek-controlled fleet as a whole. They also accounted for 25% of total outstanding debt by the end of 2017. Such a significant equity injection is certain to have played a key role in the expansion and modernisation of Greek shipping.

5 TERMS AND PERFORMANCE OF OFFERINGS

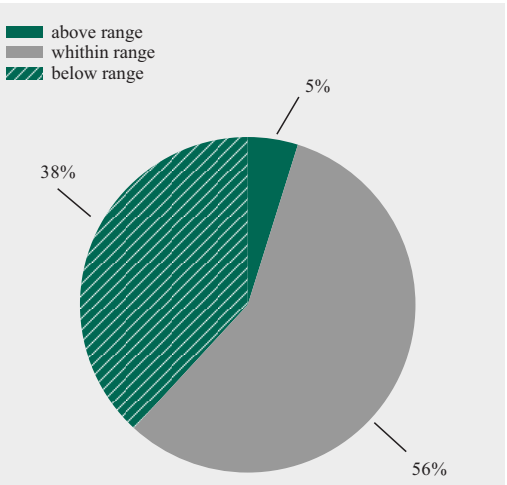
We now shift our analysis to the pricing and cost of the offerings, as well as to the trading performance of the issued shares. Chart 17 shows the extent to which the offering pricing has been within the price range marketed toward the investors before the closing date. Our analysis is limited to only 39 cases on which we have relevant information. We can see that a share of 38% was finally priced below range, indicating some softness in the selling process for those particular cases. By breaking down this share over time in Chart 18, we observe that below-range pricing increased in the second half of our review period, indicating more challenging conditions for capital issues.

Almost all of the transactions included lock-up provisions. These are restrictions prohibiting the insiders of the companies from selling or buying shares for a period of time following the capital market transaction. Chart 19 presents the distribution of lock-up periods, with the highest frequency (45%) being at 90 days. Only seven out of a total of 232 transactions did not include a lock-up restriction.

Table 7 presents the gross spread as a percentage of the amount of the total offerings. The gross spread refers to the difference between the price received by the issuing company and the actual price offered to the public. This is the amount that the underwriters are paid as fee for underwriting the deal. The average gross spread amounts to 4.88%, whereas for the IPOs it is significantly higher due to the more challenging nature of

Chart 17 Offering prices versus indicative price range of maritime equity issues in the United States

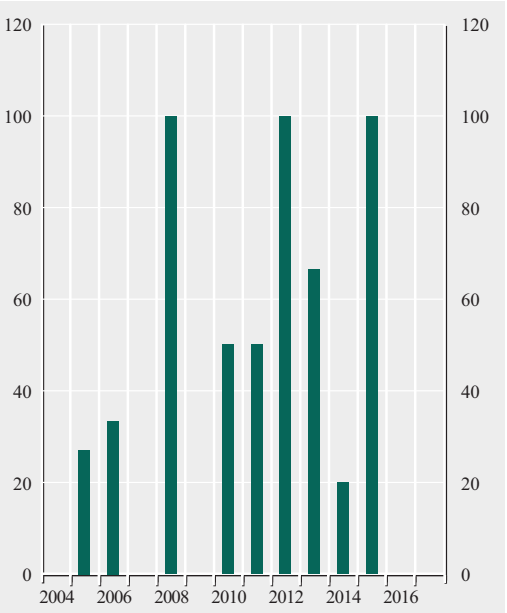
(%)



Source: FactSet.

Chart 18 Breakdown of offering prices below indicative price range of maritime equity issues in the United States

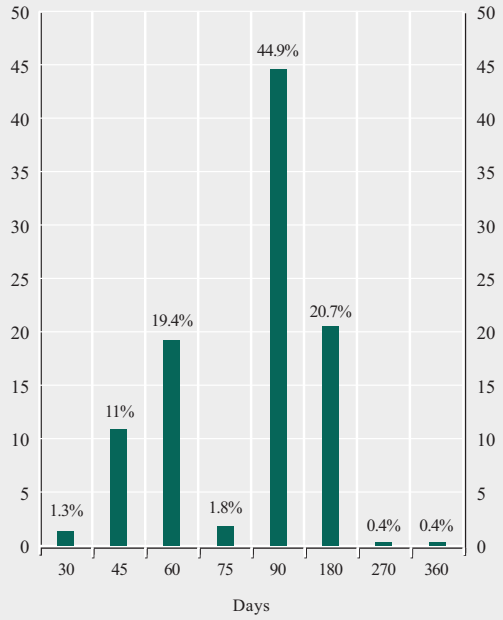
(% of total)



Source: FactSet.

Chart 19 Days of lock-up period of maritime equity issues in the United States

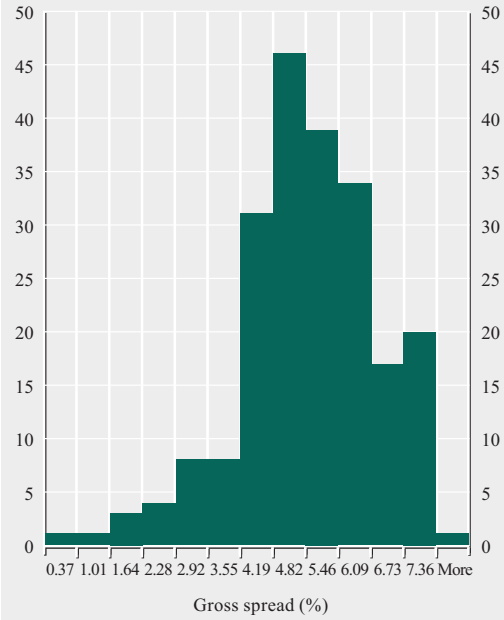
(% frequency, vertical axis)



Source: FactSet.

Chart 20 Distribution of gross spreads of maritime equity issues in the United States

(% frequency, vertical axis)



Source: FactSet.

the transaction. Chart 20 presents the distribution of such spreads for 213 transactions on which we have available data. Note that the numbers are arithmetic averages, placing equal weight on small and large transactions. If we estimate the amounts of fees on a per transaction basis (value weighted), we get an overall gross spread average of 3.4%. Lower transactions come at higher gross spreads, thus inflating the arithmetic averages discussed above.

We next examine the performance of the stocks following the equity raising. For this purpose, we measure the return one month after the date of the offering. Table 8 and Chart 21 summarise our result. As expected, the distribution of returns is quite diverse; nevertheless, the average return is positive at 3.1%, suggesting a sound performance of the new shares issued. The median is also positive, at 0.9%. The breakdown of the average return over time indicates a better performance in the

Table 7 Gross spread of maritime equity issues in the United States

	IPOs	Follow-on	Total
Average	6.48	4.45	4.88
Min	3.75	0.37	
Max	7.00	8.00	
Transactions	45	168	213

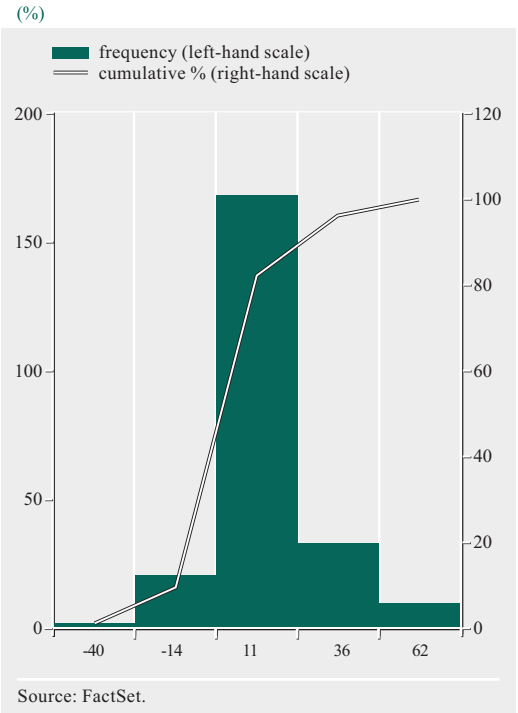
Source: FactSet.

Table 8 Stock returns one month after the equity raising

Average	3.1
Median	0.9
Min	-90.2
Max	289.1
% of negative	43%
Transactions	231

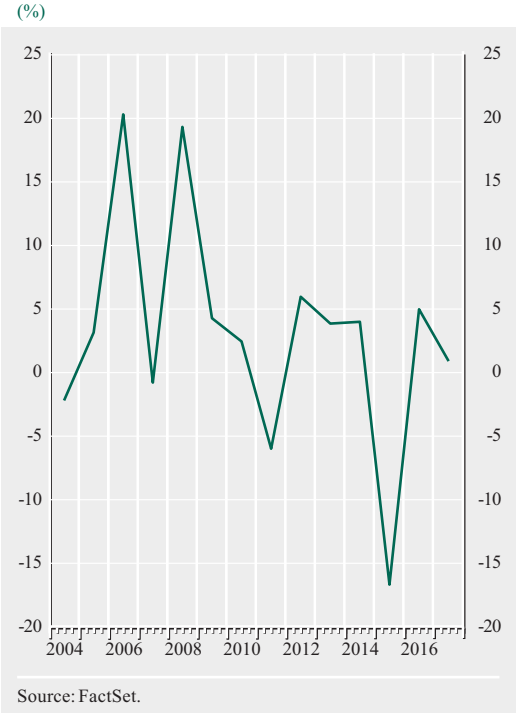
Source: FactSet.

Chart 21 Distribution of stock returns one month after the equity raising



Source: FactSet.

Chart 22 Average stock returns one month after the equity raising



Source: FactSet.

first half of the reviewed period (see Chart 22), when shipping market conditions were better. In any event, only four out of 14 years averaged a negative return.

6 CONCLUSIONS

Greek-controlled maritime companies raised $13.5 billion, or 44% of total maritime equity issues, on the US capital markets in the period January 2004-October 2018. This activity substantially facilitated the growth of the Greek-controlled fleet over the past two decades, as the vast majority of the equity proceeds were used to fund new investments.

The intensity of the equity issues was found to be positively correlated with the phase of the shipping cycle. When freight rates were high and the financial performance of the listed companies extraordinary, the ability to raise new equity was also above average. This encouraged investing at the high phase of the shipping cycle, which creates risks of overleveraging when freight rates fall.

On average, the equity issues were associated with positive stock performance one month after issuance, a value-weighted gross spread of 3.4% and lock-up restrictions of 90 days for the main shareholders. In most of the cases, the raising price was registered within the initial indicative range of prices.

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HOW DO DIGITAL TECHNOLOGIES DRIVE GREECE'S ECONOMIC GROWTH? OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Digital transformation is a driver of economic growth by improving labour productivity, increasing competitiveness and exploiting the potential of e-commerce. Digital revolution is "a game changer" as it reshapes the way production, distribution and consumption are organised within firms and across industries and markets, thus making traditional production models obsolete. By leveraging its human capital stock, Greece can catch up with the other EU-28 countries and gain multiple advantages from digital technologies, such as higher total factor productivity, enhanced competitiveness and increased extroversion. The end result will be sustainable growth. This paper aims to present the digital performance of the Greek economy and society and discusses how digital technologies can contribute to Greece's economic growth, with a particular focus on jobs, skills and the learning ecosystem. Given that FinTech is a driver of financial sector development, we also explore the implications of digitalisation for the Greek financial system. To this end, specific policy recommendations covering five policy areas are set out with a view to harnessing the emerging opportunities and ensuring that the benefits are shared by all.

Keywords: 4IR, digital technology and growth, education and skills, FinTech, Greece

JEL classification: O31, O33, L25

ΠΩΣ ΜΠΟΡΟΥΝ ΟΙ ΨΗΦΙΑΚΕΣ ΤΕΧΝΟΛΟΓΙΕΣ ΝΑ ΑΠΟΤΕΛΕΣΟΥΝ ΑΝΑΠΤΥΞΙΑΚΟ ΜΟΧΛΟ ΓΙΑ ΤΗΝ ΕΛΛΗΝΙΚΗ ΟΙΚΟΝΟΜΙΑ; ΕΥΚΑΙΡΙΕΣ ΚΑΙ ΠΡΟΚΛΗΣΕΙΣ

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Διεύθυνση Οικονομικής Ανάλυσης και Μελετών

Σοφία Ανυφαντάκη
Διεύθυνση Οικονομικής Ανάλυσης και Μελετών
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ΠΕΡΙΛΗΨΗ

Ο ψηφιακός μετασχηματισμός προσφέρει ευκαιρίες δυναμικής ανάπτυξης μέσω της βελτίωσης της παραγωγικότητας της εργασίας, της ενίσχυσης της ανταγωνιστικότητας και της εκμετάλλευσης των δυνατοτήτων του ηλεκτρονικού εμπορίου. Η ψηφιακή επανάσταση αφορά μια διαδικασία συνεχών αλλαγών στο επιχειρείν, το εμπόριο και την καταναλωτική συμπεριφορά, με αποτέλεσμα η προσκόλληση στα παραδοσιακά πρότυπα παραγωγής να έχει φθίνουσα χρησιμότητα. Η Ελλάδα, αξιοποιώντας κατάλληλα το πλούσιο ανθρώπινο κεφάλαιο που διαθέτει, μπορεί να μειώσει το χάσμα σε σχέση με τις άλλες χώρες της ΕΕ-28 και να αποκομίσει σημαντικά οφέλη από τον ψηφιακό μετασχηματισμό της οικονομίας και της κοινωνίας της, όπως αύξηση της συνολικής παραγωγικότητας μέσω της γνώσης, βελτίωση της ανταγωνιστικότητας και ενίσχυση της εξωστρέφειας. Το τελικό αποτέλεσμα είναι η διατηρήσιμη ανάπτυξη. Το παρόν άρθρο παρουσιάζει την πρόοδο της ελληνικής οικονομίας όσον αφορά τον ψηφιακό μετασχηματισμό της και εξετάζει τον τρόπο με τον οποίο η διείσδυση των ψηφιακών τεχνολογιών μπορεί να αποτελέσει βασικό αναπτυξιακό μοχλό. Έμφαση δίνεται στις αλλαγές στην αγορά εργασίας και τη σύνθεση της απασχόλησης και τονίζεται η ανάγκη απόκτησης κατάλληλων δεξιοτήτων μέσω της γνώσης, της διά βίου εκπαίδευσης και της επαγγελματικής κατάρτισης. Καθώς η υιοθέτηση των νέων τεχνολογιών μεταβάλλει το χρηματοπιστωτικό τοπίο, αναλύονται επίσης οι επιπτώσεις τους στον εγχώριο χρηματοπιστωτικό τομέα. Τέλος, προτείνονται συγκεκριμένες παρεμβάσεις πολιτικής που καλύπτουν πέντε κρίσιμους τομείς και οι οποίες κρίνονται αναγκαίες για την επιτάχυνση της διαδικασίας ψηφιοποίησης της ελληνικής οικονομίας και τη διάχυση των ωφελειών στην κοινωνία.

HOW DO DIGITAL TECHNOLOGIES DRIVE GREECE'S ECONOMIC GROWTH? OPPORTUNITIES AND CHALLENGES[1]

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1 INTRODUCTION

"In the beginning, there was data".[2] Machines can better deal with a "vast amount of data which is organized and ... crunched at blazingly fast speeds".[3] These words eloquently describe the automation and robot takeover. Thanks to artificial intelligence, machines can perform tasks that seem "intelligent" but they lack empathy and emotional intelligence. In fact, this is not actually *intelligence* but perfect memorisation and blazing first recall, meaning that in the digital world human resource is the most valuable asset of an organisation and the ultimate generator of value added (Martinez 2019). In this light, the fourth industrial revolution (4IR) does not promise the omnipotence of machines, but multifaceted human-machine interactions aimed to make human life easier, with human skills development remaining key.

The first industrial revolution was about harnessing steam power so that muscle power could be replaced by machines, the second was driven by electricity, the third was based on digital technology, personal computing and the internet, while the fourth has been shaped by a new wave of innovations such as "smart" devices and materials that compete with human intelligence in creativity, ingenuity and imagination (McAfee and Brynjolfsson 2017).

Digital revolution is a supply shock which encompasses the diffusion of information and communication technology (ICT), the growth and usage of internet-based services and more recently artificial intelligence (AI), automation and the Internet of Things (IoT). To a large extent, this evolution is driven by a huge expansion in computing power combined with lower costs. Digital revolution has already started becoming the most important source of opportunity and disruption, impacting established technologies, goods and services, and business models. Innovations such as distributed ledger technology (DLT), AI, extended reality and quantum computing[4] are revolutionising the way of doing business, opening up vast possibilities where businesses can deliver almost anything, anywhere and instantly. Technical progress in the generation of digital products leads to new, better and cheaper products and thus to direct productivity benefits. At the same time, new ICT applications facilitate production and organisational processes and/or new business models (for example, the sharing economy and the gig economy). The impact of digitalisation on economic outcomes is pervasive and stands out as a megatrend, introducing varying levels of disruption in most industries and changing the competitive environment. Technology is creating a world of customised and on-demand services, and companies must reinvent their organisation so as to view each opportunity that comes as if it were an individual market, i.e. a momentary one.

1 The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. Special thanks are due to George Hondroyiannis, Stavroula Kampouridou and Alexandros Kaliontzoglou for their comments and suggestions.
2 Whittaker, J. (2018), *Little Book of the Future*, CreateSpace Independent Publishing Platform, p. 1.
3 Whittaker, J. (2015), "Rise of the machines and the future of humanity", *Medium*, 24 June.
4 Accenture (2019a) calls all these technologies DARQ technologies.

While no part of the economy is likely to be impervious to changes by digitalisation, further efforts have to be made to better understand and measure its impact on the macroeconomy, so as to improve the monitoring of technological change and provide appropriate policy suggestions. There are widely different beliefs about what digitalisation truly means[5] and considerable intense debate remains about what policies are required to fully reap the potential gains of digitalisation, while helping workers adjust to and benefit from ongoing structural and technological changes. Research has gone deep in examining what will be the impact of rapid advances in technology on the economy and society.

In economic terms, human capital, defined as a stock of knowledge, skills and personal attributes, becomes the key factor of production. By leveraging its human capital stock, Greece can catch up with the other EU countries and gain multiple advantages from digital technologies, such as: (i) higher total factor productivity through knowledge; (ii) higher competitiveness, as transparent and fast decision-making reduces the operating cost of businesses; and (iii) increased extroversion by a shift to innovative products as a source of comparative advantage and to innovative methods of production. The end result will be sustainable growth in the medium-to-long term.

Automation and AI do not only provide opportunities, but also pose significant challenges related to changes in the labour market and in employment composition, aimed at moving from workforce planning to work planning. In particular: (a) high demand for soft skills (i.e. social and communication skills, emotional intelligence, ability to work in a team) alongside hard skills (i.e. digital skills); (b) an appreciation of the value of lifelong learning (Stournaras 2017); and (c) the necessity of social care for low-skilled and low-paid workers (see European Commission 2018c).[6]

This paper aims to present the digital performance of the Greek economy and society and discusses how digital technologies can drive Greece's economic growth in the current macroeconomic conjuncture, with a particular focus on jobs, skills and the learning ecosystem, as digitalisation is changing the task content of a large number of jobs. Given that financial technology (FinTech) and technological advances in general are drivers of financial sector development, we also explore the implications of digitalisation for the Greek financial system.

The remainder of the paper is structured as follows: Section 2 addresses the performance of Greece's ICT sector over the past few years, as well as the country's ranking in the Digital Economy and Society Index. It also discusses the impact of new technologies on the country's key macroeconomic variables. Section 3 highlights the key role of education and the learning ecosystem in achieving a well-balanced labour market capable of matching the supply of and demand for skills in an environment of rapidly changing technology, while promoting economic and social development. Section 4 focuses on the FinTech sector in Greece and discusses how new technologies not only create business opportunities but also pose challenges for the traditional players in the sector. Finally, Section 5 sets out specific policy recommendations covering five policy areas with a view to harnessing the opportunities and ensuring that the benefits are shared by all.

2 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT): DIGITAL TECHNOLOGIES AS AN OPPORTUNITY FOR RESTARTING THE ECONOMY

The diffusion of digital technologies in EU economies is one of the ten key policy prior-

5 The European Commission defines digital transformation as "a fusion of advanced technologies and the integration of physical and digital systems, the predominance of innovative business models and new processes, and the creation of smart products and services": https://ec.europa.eu/growth/industry/policy/digital-transformation_en.

6 According to the European Commission (2018a), "47% of the EU population is not properly digitally skilled, yet in the near future, 90% of jobs will require some level of digital skills".

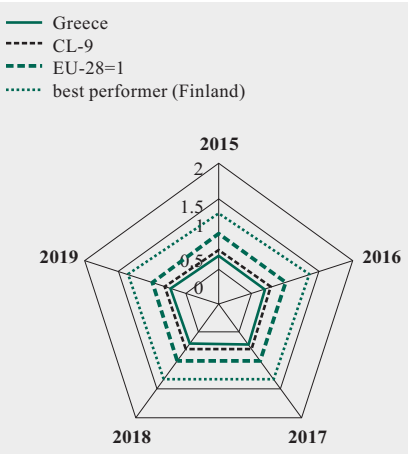
ities of the European Commission.[7] Digital transformation, as part of the 4IR, is a driver of economic growth by improving labour productivity, increasing competitiveness and exploiting the potential of e-commerce. For the laggards, the risk of marginalisation and stagnation is visible. Regarding Greece, the integration of digital technologies, as measured by the Digital Economy and Society Index (DESI), showed slow progress between 2015 and 2019, and Greece, along with Romania and Bulgaria, ranked last among the worst performers in the EU (CL-9), with its DESI score being far below the EU-28 average (see Chart 1).

ICT has been at the forefront of the 4IR. The term ICT encompasses technologies such as: two-sided platforms, the mobile and the app economy, the internet and social media, "smart" devices, AI, electric and self-driving cars, augmented reality (AR) and virtual reality (VR) platforms, interface, the IoT, big data analytics, 5G, cloud computing and blockchain, crowdsourcing, cryptocurrencies and cryptoassets, voice payments, personalised medicine and implantable drug-making cells, neuroengineering, gene drive, new home assistants (Amazon Echo, Google Home) and digital helpers (Alexa, Siri Google Assistant), 3D printing and quantum software algorithms (World Economic Forum 2018).

According to estimates from the European Commission's 2018 Predict Dataset, the value added of the ICT sector was €581 billion in 2015, accounting for 3.9% of the total value added in the EU economy; the sector also had a share of 2.5% in total employment and 15.7% in total Research and Development (R&D) business spending.[8] ICT in digitally mature markets contributes by over one-fifth to world GDP and is expected to reach one-fourth by the end of this century (Knickrehm et al. 2016).

Technological advances, with the main focus on technical interoperability at different levels of the manufacturing ecosystem and mass customisation, offer a unique opportunity for the

Chart 1 The Digital Economy and Society Index (DESI)-Greece's score versus EU-28 (2015-2019)



Source: European Commission, Digital Scoreboard, and authors' own calculations.
Notes: DESI is a composite index summarising 30 relevant indicators and measuring a country's digital performance on a scale from 0 to 100 with respect to five main areas, as shown in Chart 4. Higher scores denote better performance. CL-9: Group of nine countries (Bulgaria, Croatia, Romania, Cyprus, Slovakia, Greece, Poland, Italy and Hungary) with a lower DESI score than the EU average. The chart measures the distance to the EU average for Greece, CL-9 and the best performer (Finland). The index is based on EU-28 average = 1.

Greek economy to return to a sustainable path of growth, income and wealth generation. According to the European IT Observatory (EITO), the value of the Greek ICT market in 2018 is estimated to have grown by a marginal 0.3% to €5.5 billion, following four consecutive years of decline. In 2017, it accounted for 3.1% of Greece's GDP. ICT is emerging as a strategic driving force for restarting the economy.

Specifically:

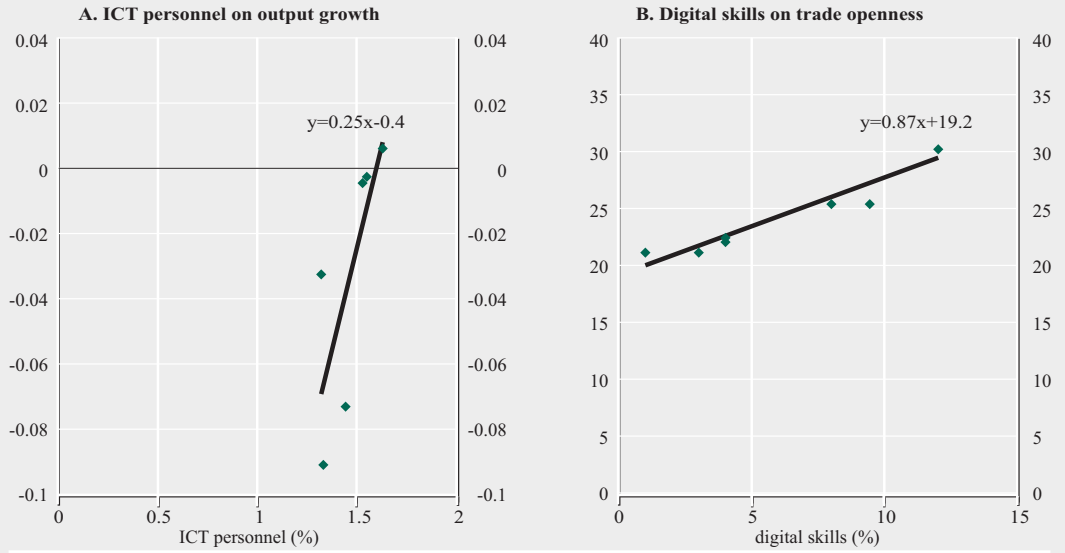
First, ICT brings about transformative changes in the behaviour of economic agents, thereby

7 Since 2015 the European Commission has included in its ten key policy priorities the creation of a Digital Single Market, with a view to removing all regulatory barriers and ensuring a level playing field, reforming the industrial sector, creating new goods, services and processes, boosting employment and increasing cybersecurity.

8 By far the largest contribution comes from the ICT services subsector. By 2020, Europe's data economy will reach €700 billion, accounting for 4% of the EU economy, and by 2025 the Digital Single Market could contribute by €415 billion annually in terms of output and create 1.3 million new jobs (European Commission 2017 and 2018f).

Chart 2 The macroeconomic impact of digital technologies: Greece

(real GDP growth rate %, vertical axis) (trade openness %, vertical axis)



Source: Eurostat and authors' own calculations.
Notes: In Chart 2A, y is the real GDP growth rate and x is the share of ICT personnel as a percentage of total employment. In Chart 2B, y is the share of exports and imports as a percentage of GDP and x is the number of individuals with advanced digital skills, i.e. those who have carried out 5 or 6 of the related internet activities, as a percentage of total population aged 16-74. Available data refer to 2005-2013 for ICT personnel, to 2005-2016 for advanced digital skills and to 2005-2018 for output growth and for exports and imports.

reshaping the way production, distribution and consumption are organised within firms and across industries and markets (Agrawal et al. 2018). Digitalisation involves a process of continuous change in business activity, commerce, consumer patterns, communication, learning and information, thus making traditional production models increasingly irrelevant. In fact, with the exponential pace of innovation as a result of emerging technologies, we are now moving towards a post-digital era, in which a firm's competitive advantage is not only determined by the degree of digitalisation of its production lines, known as SMAC practice,[9] but mainly by the availability and extensive use of digital process tools enabling it to identify early and accurately the fast-changing consumer needs and market conditions and to respond rapidly and flexibly (Accenture 2019a).

Second, the effective use of ICT requires policies that promote continuous professional development and training, adoption of innovative products and startup entrepreneurship.

Third, ICT development enables investment opportunities and, to a large extent, helps unlock the growth potential.

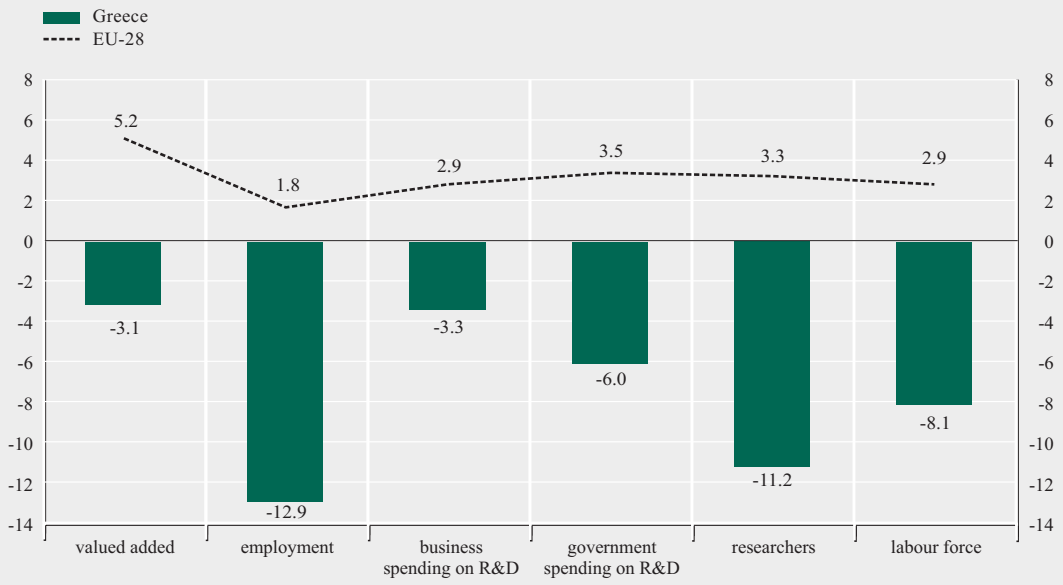
Fourth, as the scaling advantages of new technologies increase and costs in the public sector and throughout the economy are reduced, private investment initiatives are promoted as part of a national growth agenda (Elding and Morris 2018).

A first picture of the macroeconomic impact of digital technologies on the Greek economy can be drawn by simply analysing the relationship between new technologies and the country's key macroeconomic variables. As shown in Chart 2 (A, B), the relationship between digital technologies and real output growth as well as trade openness is positive. It should be stressed that the estimation of the binary relationship covers a very short period and moreover it excludes many other variables that

9 Social, mobile, analytics and cloud (SMAC).

Chart 3 ICT's performance in Greece versus EU-28 (2015)

(annual percentage change %)



Source: European Commission, *The 2018 PREDICT Key Facts Report*, and authors' own calculations.
Notes: The ICT sector includes the subsectors 261-264, 582, 61, 62, 631, 951 (NACE Rev. 2). The latest observations refer to the year 2015.

determine the trend line of real output growth. However, it may provide some evidence of how an improvement in digital skills could favourably affect the country's economic activity, which is useful for our analysis. In particular, the estimation results indicate that an increase in ICT personnel as a share of total employment by one percentage point is associated ceteris paribus with an increase in real output growth by 1/4 percentage point. Similarly, an increase in the country's population with advanced digital skills by one percentage point is ceteris paribus associated with an increase in exports and imports of goods and services as a percentage of GDP by almost one percentage point.[10,11]

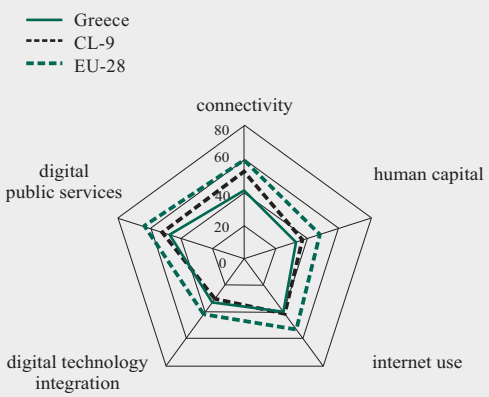
Although the economic footprint of ICT in the EU-28 is visible, the digital transformation of the Greek economy remains sluggish. As a result, the country is digitally immature, as reflected in its low position in international rankings on the basis of relevant indicators. According to the European Commission, in 2015 Greece was the only country in the EU-28 with a negative rate of change in: the value added of the ICT sector; employment; the number of ICT researchers and specialists; and business and public spending on R&D (see Chart 3). At the same time, according to the Digital Transformation Scoreboard, Greece is below the European average based on the indicator of ICT startups. However, although the share of the Greek ICT sector in GDP remains the smallest among EU countries, it shows a positive, albeit weak, trend.

On the basis of the DESI (see Chart 4), which combines quantitative data and qualitative information on five areas (connectivity,

10 We also analyse the impact of ICT personnel and digital skills on new business creation, labour productivity and compensation of employees. However, it appears to be insignificant. This might be explained by the fact that the economic crisis effect dominated in determining the variables' trend lines.

11 Given the weak growth rates and the low digital adoption rates, Accenture (2019b) provides empirical evidence on how AI can be a key transformation accelerator and a new driver of growth for Greece. It identifies three main challenges that slow down Greek entrepreneurs' AI efforts: limited skills for implementing and using AI, insufficient IT performance and low data quality. See also KPMG (2019).

Chart 4 A comparative analysis of the DESI 2019



Source: European Commission, Digital Scoreboard, and authors' own calculations.

human capital, internet use, digital technology integration and digital public services), Greece ranks third to last in the EU-28 for 2019. In almost all areas, it lags significantly behind the average of the group of the nine worst-performing countries (CL-9).

Furthermore: (i) Greece ranks fourth to last in the digital performance of its human resources, with 7 in 10 citizens being regular internet users (EU average: almost 9 in 10), while more than 4 in 10 have never used the internet. (ii) Although Greek businesses use social media extensively, the use of cloud computing and e-invoicing and e-commerce turnover remain at extremely low levels. (iii) Greece's performance in the area of digital public services remains particularly low. Finally, (iv) the country recorded a low score on the Accenture Digital Density Index, which measures the breadth and depth of the integration of new technologies into the market, businesses, production factors and society.

Based on these scores, we may draw the following conclusion about the current state of digital transformation in Greece: the digital gap of public administration discourages private investment, while low digital literacy implies failure to support businesses' digital strategies.[12] Thus, at a time of increasingly digital-led globalisation, Greece lags behind with low digitalisation and weakened momentum, which limits ceteris paribus the potential for a fragile economic recovery to translate into strong growth over the medium-to-long term.

3 JOBS, SKILLS AND THE LEARNING ECOSYSTEM

Technological progress and automation are often seen as posing a risk by making existing jobs redundant and causing unemployment. But while academic work has identified that a significant proportion of jobs will be automated making them redundant (see, for example, Brynjolfsson and McAfee 2011, Frey and Osborne 2017),[13] past experience demonstrates the opposite. Chart 5 provides supportive evidence. By looking at historical data for the US spanning two hundred years, we see that technology has led to higher job creation and has made employment more productive and efficient, resulting in better quality of consumer goods, increased leisure time and higher standards of living.

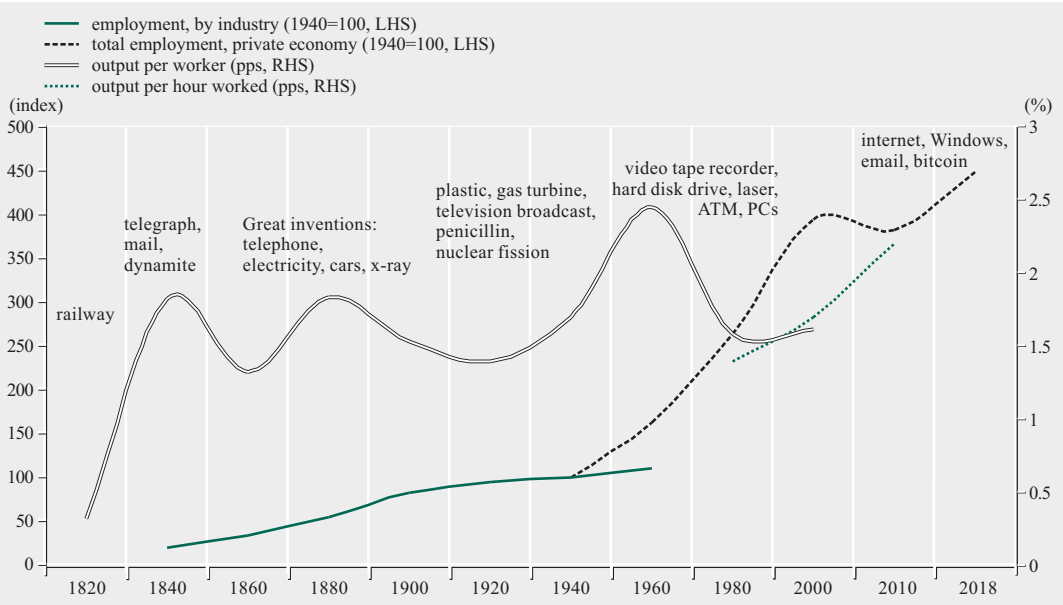
Technological progress has not only created new jobs but has also expanded possibilities for workers to engage in more interesting, productive and non-routine tasks. What is true is that besides perceived risks of future technological unemployment, automation anxiety and dominance of the substitution effect, it is most likely that digitalisation and automation will not eliminate jobs on aggregate but will rather change the task content of a large proportion of jobs.[14] In this context, Nedelkoska and Quintini

12 Regarding the digital maturity of the utilities industry, Greece ranks last in a sample of 21 countries, scoring 17.8/100 (Accenture 2017). Generally, based on a sample of 33 countries, a positive and statistically significant relationship has been found to exist between the digital maturity index and total productivity (Macchi et al. 2015).

13 Frey and Osborne (2017) examined 702 occupations in the US in 2010 and estimated that 47% of jobs are at a high risk of being automated in one or two decades. Employment is distinguished according to low, medium and high probability of computerisation.

14 Acemoglu and Restrepo (2018) point out that "similar claims have been made, but have not always come true, about previous waves of new technologies", quoting pessimistic views of some of the most prominent 20th century economists like Keynes and Leontief.

Chart 5 Technology evolves, employment and labour productivity rise: the US long record (1820-2018)



Sources: Lebergott (1966), Bureau of Labour Statistics Data Series, OECD data, and Mourmouras and Rangazas (2007). Authors' own calculations.
Notes: Labour productivity is measured as output per worker from 1820 to 2000 and as output per hour worked (total economy) from 2000 onwards. Both series refer to annualised growth rates over the previous 20-year period and are presented in percentage points. From 1840 to 1960, employment data refer to employment by industry (agriculture, fishing, mining, construction, cotton textiles, trade, railway and ocean transport) and thereafter to total employment in the private economy (annual data). Both series are indices (1940=100).

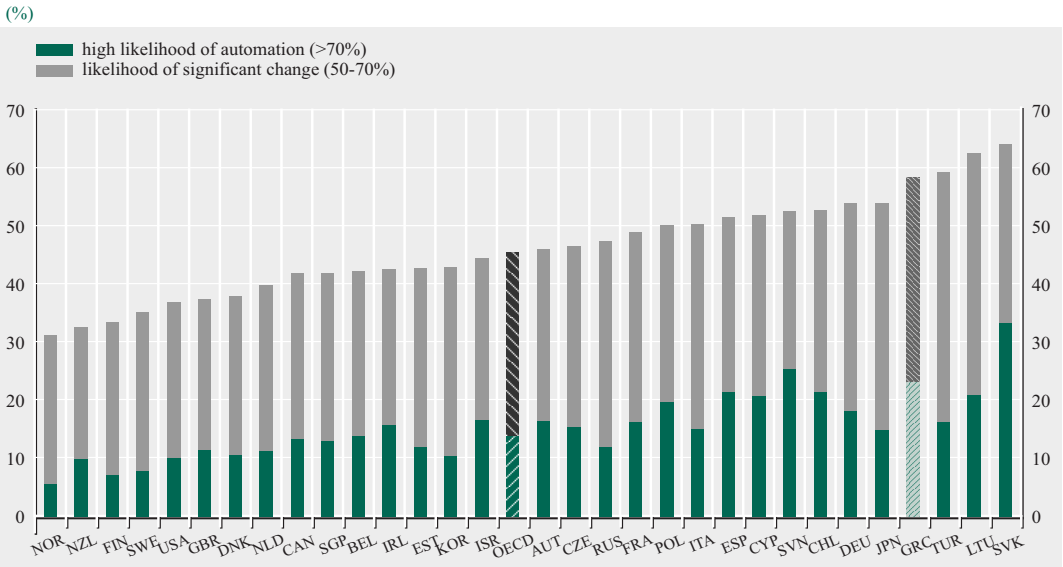
(2018) exploiting the Survey of Adult Skills[15] estimate that 14% of jobs has a probability of automation of over 70%, while another 32% of jobs has a likelihood between 50% and 70% to be automated, thereby changing the skills requirements for these jobs (see Chart 6). For Greece, these estimates are higher than the OECD average (23% and 35%, respectively).

Technological progress causes job displacement, but markets and people do adjust. Yet, in contrast with the past, adoption lags in digital revolution have considerably narrowed (see Chart 7), leading to much faster innovation cycles and increasing the importance of adjustment speed. Innovations used to take a long time from conception to commercial use, but over the last 200 years adoption lags have shortened (Comin and Mestieri 2018).

The accelerating pace of technological changes has resulted in skill-intensive jobs and has spurred a debate about the so-called "digital divide". Lower educated or lower skilled workers who are not able to adapt to the new technologies are left behind, while those that manage to adjust may capture immense opportunities. The implications of the development in AI and machine learning for jobs and skills have indeed dominated studies over the last years, and concerns about widening inequalities remain strong. It has been argued that robots tend to work in a complementary way with skilled workers, while they tend to substitute for the unskilled ones (Autor 2015), leading to job/wage polarisation. Technology can replace workers in routine tasks that are easy to automate and complement workers in non-routine tasks that require ICT-intensive

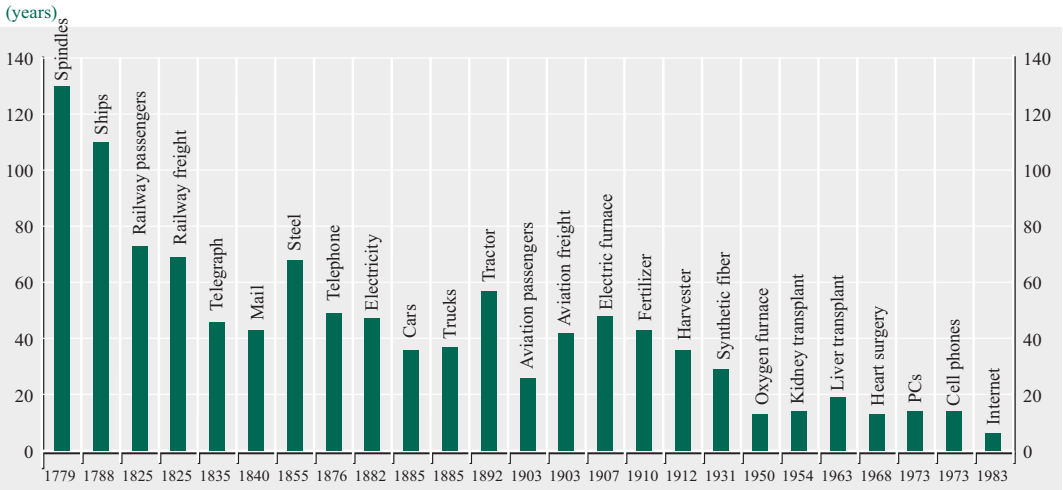
15 The Survey of Adult Skills is the major survey conducted as part of the OECD Programme for the International Assessment of Adult Competencies (PIAAC) measuring adults' proficiency in key information-processing skills – literacy, numeracy and problem solving – and gathers information and data on how adults use their skills at home, at work and in the wider economy.

Chart 6 Likelihood of automation or significant change in task content (2012 or 2015)



Source: Nedelkoska and Quintini (2018).
Notes: Jobs are at high risk of automation if their likelihood of being automated is at least 70%. Jobs at risk of significant change are those with a likelihood of being automated estimated at between 50% and 70%. The data for the following countries refer to the year 2012: Australia, Austria, Belgium (Flanders), Canada, Czech Repubic, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Japan, Korea, the Netherlands, Norway, Poland, the Russian Federation (excluding Moscow), Slovak Republic, Spain, Sweden, the United Kingdom (England and Northern Ireland) and the United States. Data for the remaining countries refer to 2015 and are sourced from the second round of the first wave of the Survey of Adult Skills.

Chart 7 Mean time of adoption of technologies



Source: Comin and Mestieri (2018).
Notes: The sample covers 25 technologies for 139 countries over 200 years. The chart shows estimates of mean adoption lags for each technology using the estimation procedure described in Comin and Mestieri (2018). The range of average adoption lags by technology goes from 6 years for the internet to 130 years for spindles.

skills as well as cognitive skills. However, robotisation is also creeping into high-skilled occupations and non-routine tasks. According to Cedefop's (2018a) European skills and jobs

survey (ESJS),[16] 47% of adult employees in the EU-28 has already seen changes in working methods or practices, while the ICT sector has seen the largest changes in technologies used in the workplace over the past five years (57% of adult employees). At the same time, as workers perform non-routine tasks more frequently, general cognitive skills (such as reading, writing and numeracy) are increasingly needed, suggesting that there are large complementarities between workers and technology (OECD 2019).

The prevailing implications of new technologies will finally depend on whether the workforce is adequately prepared for the 4IR. First, although the pace of the digital transformation and innovation of the economy and society cannot be accurately predicted, economic performance and employment opportunities largely depend on the digital skills and competence of the labour force.[17] Certain skills and qualifications, such as STEM (science, technology, engineering, mathematics) and ICT, are critical to innovation and creation of a competitive edge in knowledge-intensive economies (see, inter alia, Stournaras 2019). Demand for these skills is anticipated to increase in the short-to-medium term, since ICT is profoundly changing the skills profile of jobs. According to the Survey of Adult Skills, higher proficiency in literacy, numeracy and problem solving increases the chances of getting a job and earning a higher wage (controlling for other factors).[18]

Second, as machines increasingly take over not only routine tasks, as was the case in the past, but also non-routine tasks, e.g. financial market analyses, future jobs require not only high digital skills but also other complementary soft skills ranging from cognitive skills (such as critical thinking and good numeracy skills) through to the right socio-emotional skills (such as team work and problem solving). These soft skills make workers more resilient to change and more willing to experiment, learn quickly and work collaboratively and flexibly in fast-evolving workplaces.[19]

Acquiring skills is a lifelong process, both formal and informal, and starts at a very young age. Cognitive and socio-emotional skills are formed during the very early childhood initial learning (pre-school, primary and secondary education), while high-quality early education is the foundation for the subsequent acquisition of more complex technical skills (OECD 2019).

Reaping the full benefits of digitalisation and successfully implementing a national strategy for the digitalisation of the Greek economy and society will crucially depend on the ability to address the digital skills gap and develop a set of policies that help workers adapt to changes. In Greece, only 46% of the individuals aged 16-74 in 2017 had basic or above basic overall digital skills (EU-28: 57%).[20] Moreover, Greece shows proficiency significantly below the OECD average in all three key information-processing skills (literacy, numeracy and problem solving).[21]

16 Conducted in 2014, the ESJS collected information of about 49,000 adult workers across the EU-28 examining drivers of skills development and dynamic evolution of skills mismatch in relation to changing complexity of tasks and skills needs in jobs: http://www.cedefop.europa.eu/en/events-and-projects/projects/european-skills-and-jobs-esj-survey.

17 For the positive correlation between digitalisation and productivity, see the speech by the Vice-President of the ECB Luis de Guindos, entitled "Investment, technological transformation and skills", at the joint EIB-ECB conference on investment, digital transformation and skills, Luxembourg, 28.11.2018.

18 For example, across the 33 countries that participated in the survey, an adult who scores one standard deviation higher than another on the literacy scale is 0.8 percentage point more likely to be employed than unemployed, on average, after accounting for other factors, including education attainment. And an increase of one standard deviation in literacy proficiency is associated with a 6% increase in wages, on average, across the participating countries.

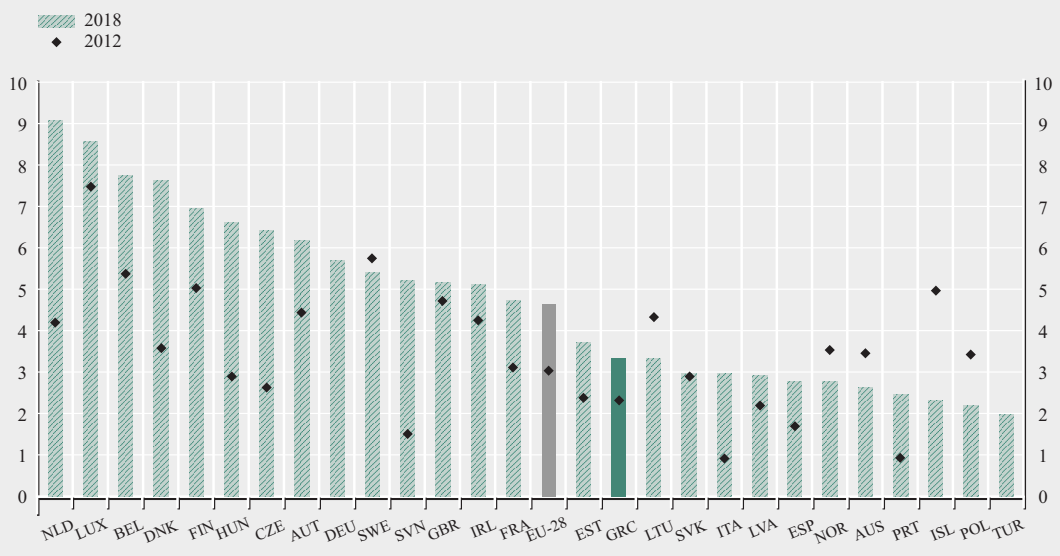
19 The World Economic Forum (2016) estimates that 65% of children entering primary school today will ultimately end up working in completely new types of jobs that do not exist yet.

20 The basic or above basic overall digital skills represent the two highest levels of the overall digital skills indicator, which is a composite indicator based on selected activities performed by individuals aged 16-74 on the internet in four specific areas (information, communication, problem solving, content creation). It is assumed that individuals having performed certain activities have the corresponding skills; therefore, the indicator can be considered as a proxy for the digital competences and skills of individuals. The indicator is based on the EU survey on the ICT usage in households and by individuals.

21 Only about one in 20 adults in Greece attains the highest levels of proficiency in literacy, compared with around one in 10 adults on average across the OECD countries that participated in the survey. 5.6% of adults in Greece attains the highest levels in numeracy, i.e. below the OECD average of 11.2%. Only 2.5% of adults in Greece attains the highest proficiency level in problem solving in technology-rich environments, i.e. below the OECD average of 5.4%.

Chart 8 Enterprises that reported hard-to-fill vacancies for ICT specialists (2018 versus 2012)

(% of all enterprises)



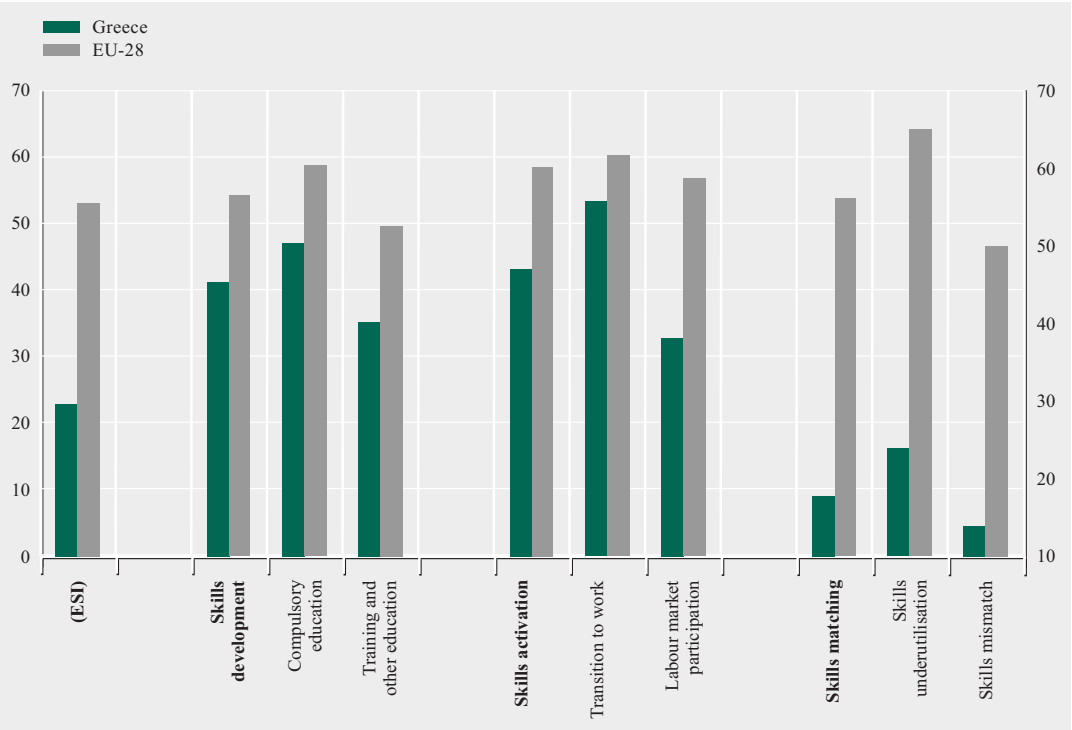
Source: OECD (2018c) and authors' own calculations.
Notes: For Australia, data refer to the fiscal year 2015/16 ending on 30 June; for Iceland, to 2017 instead of 2018; for Portugal, to 2014 instead of 2012.

Greece needs digitally "smart" people who are able not only to use, but also to lead in the usage of, new technologies.[22] In 2015, 29.2% of total enterprises in Greece reported general IT skills (EU-28: 20.8%) and 18% reported professional IT skills (EU-28: 11.5%) as the main skills needed for the development of the enterprise, according to the 2015 Eurostat Continuing Vocational Training Survey. In the Global Talent Competitiveness Index (GTCI) 2019, Greece ranks 44th among 125 countries. Specifically, Greece is a top performer (2nd) with respect to tertiary enrolment. Meanwhile, it registers the worst performance in the relevance of the education system to the economy (99th), lifelong learning (77th) and skills matching with tertiary education (48th), suggesting that, although there is a fairly good pool of graduates, there is ample room for improvement in matching labour market demand and workforce supply.

Specifically, to add to the above, according to Cedefop (2018b), in Greece the share of labour force with high-level qualifications is expected to continue increasing over the period up to 2030 (from 31% in 2016 to 41% in 2030), while the share of labour force with medium- and low-level qualifications is expected to decrease slightly (from 41% to 35% and from 28% to 24%, respectively). However, the supply of high-qualified workers is expected to exceed the corresponding demand, while the opposite is expected to hold for the medium-qualified workers, giving rise to further skills mismatch. Furthermore, the number of businesses having difficulties in filling ICT specialist roles as a percentage of all businesses increased to 3.3% in 2018 (EU-28: 4.6%) from 2.3% in 2012 (EU-28 average: 3%) (see Chart 8). According to the European Skills Index (ESI), a composite indicator that measures the performance of EU countries as regards skills and which consists of

22 In June 2016, the New Skills Agenda, adopted by the Commission, launched ten actions to make the right training, skills and support available to people in the EU: Upskilling pathways: new opportunities for adults; European qualifications framework; Digital skills and jobs coalition; Blueprint for sectoral cooperation on skills; EU Skills profile tool kit for third-country nationals; Vocational education and training (VET); Key competences; Europass; Graduate tracking; Analysing and sharing of best practice on brain flows. See https://ec.europa.eu/social/ main.jsp?catId=1223.

Chart 9 European Skills Index (ESI): Greece (2016)



Source: Cedefop and authors' own calculations.
Notes: The European Skills Index (ESI) is a composite indicator scaled between 0 and 100 which measures the performance of each country in three pillars, each of which measures a different aspect of a skills system: Skills development (Compulsory education and Training and other education), Skills activation (Transition to work and Labour market participation) and Skills matching (Skills underutilisation and Skills mismatching). A score of 100 corresponds to achieving the "frontier" and a score of 0 corresponds to a lowest-case performance. The difference between the score achieved by each country and 100 shows the remaining distance to cover until the best performance is reached.

three pillars (skills development, activation, and matching), Greece ranked 27th among the EU-28 countries in 2016, registering low performance in all three pillars and featuring last in the skills matching pillar (see Chart 9).

The continuum of skills required by digitilisation makes both upskilling and reskilling today's adult workforce far more challenging. In Greece, 56.6% of adult employees participating in the ESJS reported that it is likely to see several of their skills become outdated in the next five years (EU-28: 48.3%). This means that lifelong learning and continuous skills development are becoming even more important as the acceleration of technological change makes specific skills redundant at an even faster pace and poses the challenge of switching multiple job positions in mid-life. However, according to the results of the 2015 Eurostat Continuing Vocational Training Survey, Greek enterprises show poor performance: 21.7% of the respondents (EU-28: 72.6%) provided continuing vocational training (CVT), 15.3% had a CVT plan (EU-28: 47%) and 23.5% (EU-28: 66.6%) reported CVT of current staff as their usual practice to adapt to future skills needs.[23] As for the continuous development of ICT skills, 14% of enterprises provided training in

23 Continuing vocational training (CVT) are training measures or activities which have as their primary objectives the acquisition of new competences or the development and improvement of existing ones and which must be financed at least partly by the enterprises for their persons employed who either have a working contract or who benefit directly from their work for the enterprise such as unpaid family workers and casual workers. Planning of CVT in an enterprise is defined as having a person or unit responsible for organising CVT or having a training plan or budget including CVT.

2018 (EU-28: 23%).[24] Statistics thus show that there is a need for a more systematic replenishment of knowledge throughout working life and for continuous and on-the-job learning to become a more standard work practice.

4 FINANCIAL TECHNOLOGY (FINTECH) AND DIGITALISATION OF THE BANKING SECTOR

Financial technology (FinTech) is a broad term and refers to "firms that use technology-based systems either to provide financial services or products directly or to try to make the financial system more efficient" (see Karakas and Stamegna 2017).[25] The linkage of finance and technology is not a new phenomenon. FinTech and technological advances in general are drivers of financial sector development and there are huge opportunities in terms of access to finance, operational efficiency, cost saving and competition.

The term FinTech has exploded in popularity over the last years and is used as an "umbrella" to describe a range of innovations in the provision of financial services. There is no consensus on a standard classification of FinTech services. According to the OECD (2018a), the applications of digital technologies in financial services may be classified into eight distinct categories: payments, planning, lending and funding, trading and investment, insurance, cybersecurity, operations, and communications.[26] FinTech is a dynamic and rapidly growing sector: global investment in FinTech companies more than doubled and reached $111.8 billion in 2018, while investment in FinTech companies in Europe alone rose to $34.2 billion.[27]

In Greece, the FinTech sector is mainly concentrated on payment services. According to the Bank of Greece online lists (registered tables),[28] there are currently nine payment institutions and two electronic money institutions authorised in Greece, while there is a significant number of foreign institutions that have notified of their intention to provide services in Greece (on the basis of the "EU passport"[29]).

Banking and the provision of financial services are being reshaped by expanding customer expectations for convenience and personalisation. The FinTech revolution presents challenges and opportunities for both incumbents and startups. On the one hand, FinTech firms are earning a reputation for customer-centricity, as they leverage emerging technologies and volumes of customer data to both understand and predict behaviours and needs. New entrants are characterised by greater agility and may be subject to relatively weaker regulatory oversight. On the other hand, banks are increasingly confronted with the need to take advantage of new technologies in order to meet the evolution of their clients' expectations and to innovate with new products and services, while maintaining compliance. Incumbents usually count on brand visibility, size, scale and trust as advantages. The digital re-design of financial services ultimately brews uncertainty for all stakeholders in the ecosystem. The impact of FinTech on traditional players remains uncertain,[30] while, as evidenced by Chart 10, partnering with FinTechs is consid-

24 The indicator is based on the EU survey on the ICT usage and e-commerce in enterprises.

25 The Financial Stability Board (2017) uses an alternative definition for FinTech as "technology-enabled innovation in financial services that could result in new business models, applications, processes or products with an associated material effect on the provision of financial services".

26 It should be noted that this list is not exhaustive. Technologies cannot be studied separately since there are interdependencies among them.

27 However, quantifying the size of the market is quite challenging, given the difficulty to define the exact scope of FinTech services.

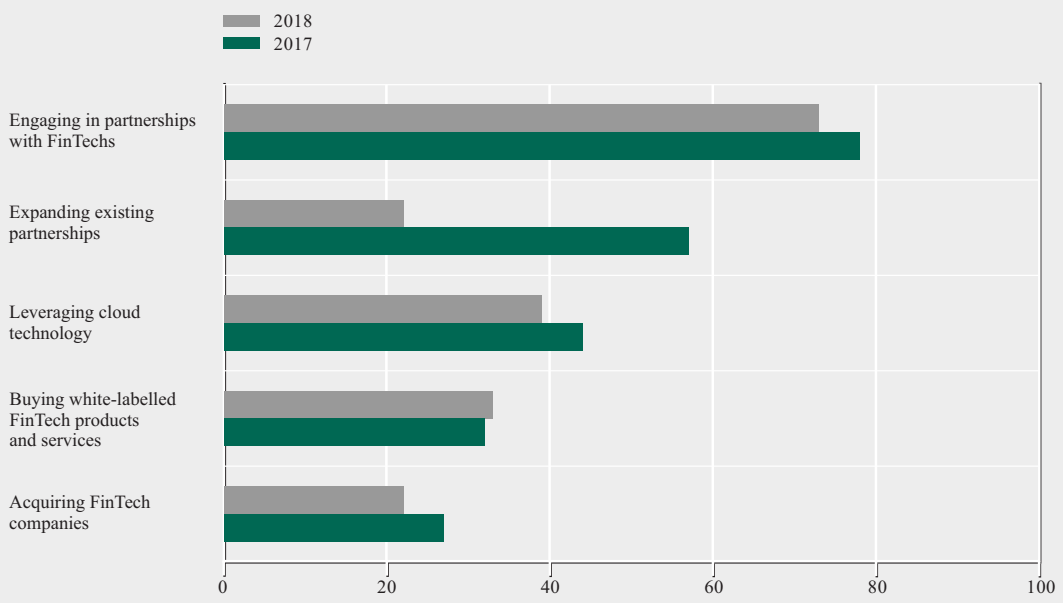
28 https://www.bankofgreece.gr/Pages/en/Supervision/SupervisedInstitutions/default.aspx.

29 The "EU passport", i.e. the freedom to provide services within the EU, with or without establishment, is based on the harmonised supervisory framework applied in each EU Member State.

30 The BIS (2017) analysed five scenarios and assessed their potential impact on the banking industry. Under the first scenario ("the better bank"), incumbent banks digitise and modernise themselves to retain the customer relationship and core banking services, leveraging enabling technologies to change their current business models. Under the second scenario ("the new bank"), incumbents cannot survive the wave of technology-enabled disruption and are replaced by new technology-driven banks. Under the third scenario ("the distributed bank"), financial services become increasingly modularised, but incumbents can carve out enough of a niche to survive. Under the fourth scenario ("the relegated bank"), incumbent banks become commoditised service providers and cede the direct customer relationship to other financial services providers, such as FinTech and BigTech companies. Under the fifth scenario ("the disintermediated bank"), incumbent banks are no longer a significant player and banks are displaced by more agile platforms and technologies which ensure a direct matching of final consumers depending on their financial needs. Under all scenarios, the current position of incumbent banks will be challenged.

Chart 10 How FinTech can help banks meet their goals (2018 versus 2017)

(% of respondents)



Source: MagnaCarta (2018).

ered as the most favourable way to meet banks' goals (see also EBA 2018).

The emergence of the internet and the use of ICT have enabled banks to offer online services. By 2018, 27% of individuals in Greece had used internet banking (EU-28: 54%), i.e. more than six times higher than in 2007 when it was only 4% (EU-28: 25%), albeit with substantial differences across age and education level.[31] Europe's Digital Economy and Society Index (DESI) provides a sub-indicator of particular relevance to financial digitalisation, namely tracking the percentage of the population using online banking services. Greece's score on this sub-indicator increased from 36% in 2017 to 38% in 2018. Nevertheless, it continues to lag behind the European average (64%). According to data from the Hellenic Bank Association, in the first quarter of 2019 more than 7 million physical and legal entities were subscribed internet banking users (compared with around 3 million subscribed users in the first quarter of 2013).[32]

All banks in Greece have largely acknowledged the need to invest in innovation and have now embarked on a digital transformation process. Besides their homeground innovation strategies (adoption of new IT architectures offering a more digital experience to customers, dealing with cybersecurity, etc.), they are using incubators and accelerators to capitalise on FinTech and are promoting an open innovation strategy. For the most part, however, banks do not appear to have optimised their innovation strategies as yet.[33]

31 Internet banking is more popular among individuals aged 25-34 (41%) and the use of internet banking tends to increase with the education level of the user, irrespective of the age group or the gender.

32 However, for the same period, the number of physical and legal entities that were subscribed mobile banking users was 2.2 million, which is lower compared with the first quarter of 2013 (around 2.5 million subscribed users).

33 According to the results of a survey on "Fintech in Greece" that was conducted by the National Bank of Greece (and presented in the 5th Digital Banking Forum) in a sample of 55 FinTech experts in Greece, the majority (35%) of the participants in the survey replied that although there was an initial interest, over the last three years FinTech in Greece did not evolve as initially expected, while 84% of them are relatively optimistic stating that they expect that in the next five years FinTech will grow in Greece, although the sector will still lag behind the EU average. The two areas reported to have seen the most important FinTech developments are Payments (91% of replies) and Blockchain and cryptocurrencies (42% of replies).

The FinTech sector could play a key role in Greece's economic growth. Digital technology can be deployed to make existing ways of finance provision more efficient. For example, the use of "open Application Programming Interfaces (APIs)" facilitates payment service improvements (Ogden 2016).[34] The rapid adoption of new technologies results in lower entry barriers and fosters competition, leading to the emergence of new business models such as P2P lending and crowdfunding. It may create more investment opportunities for smaller players and facilitate access to finance using e.g. mobile devices. A key benefit to the economy is catering to the investment needs of small and medium-sized enterprises (SMEs), contributing ultimately to higher productivity growth for the whole economy (Anyfantaki 2016). Overall, FinTech services offer potential benefits to Greek consumers, such as cost reduction, improvements in efficiency, greater transparency and increased financial inclusion. On the other hand, the main risks arise in the areas of cybersecurity, the use and control of data, consumer protection and money laundering. However, one should also consider the positive impact stemming from the activity of foreign FinTech firms in Greece and the resulting increased attraction of foreign direct investment (FDI).[35]

5 SPECIFIC POLICY RECOMMENDATIONS

Key factors increasing the risk of Greece lagging behind in the digital transformation process are: low digital literacy, insufficient digitalisation of the public sector, the long adoption time of new technologies in the domestic production structure, the small size and family character of Greek businesses which act as a disincentive for investment in new technologies and, finally, the high non-wage cost of skilled labour.[36] To address these challenges, policy interventions are needed under a framework that is aligned with the objectives of the European digital agenda.[37] In particular, these interventions concern five key areas:

Education: The response to the changes brought about by new technologies and the speed of adjustment will influence the structure of the labour market and the task content of jobs. Although the fear of technological unemployment is to some extent justified, as several low-skilled jobs will be automated, new technologies can generate employment opportunities, provided that labour can rapidly adjust to a human-centred work environment, in which knowledge, skills, personal initiative, mobility, flexibility and cooperation will play a key role.

Whether robots finally take over jobs or job creation keeps pace with job destruction will crucially depend on the policy responses. Skills development policies need to be overhauled to reduce the risk of increased unemployment and growing inequality. The aim is twofold: (i) matching the education system with the labour market needs and (ii) encouraging businesses to implement programmes for: continuous learning and lifelong training; apprenticeship to link work with education; and mobility and flexibility, such as telework and collaborative work. In this context, the reform agenda entails rethinking the way education is organised inside and outside the classroom as well as the need to readjust to changing labour demand. While skills supply is crucial to firms, more education is not necessarily the answer. Instead, there is a need that education and skills are in

34 Greek banks have already taken steps towards the implementation of open banking in line with PSD2 requirements. For details, see https://www.bankofgreece.gr/Pages/en/Supervision/PSD2info.aspx.

35 For Greece, Kourouthanassis and Doukidis (2018) estimate the value added to GDP from an increase of FinTech-provided services (these include B2C and B2B transactions) towards their EU average to be approximately 0.6%. This percentage is estimated to be even higher if Greece becomes a regional FinTech hub in South-east Europe.

36 In 2016, Greece was the only country in the EU-28 to show a negative net change in the active population of high-tech and knowledge-intensive enterprises. See National Documentation Centre (2018). It should also be stressed that the Greek brain drain was led by IT specialists.

37 The National Digital Strategy 2016-2021 (December 2016) outlines seven areas of intervention: (1) developing next generation national connectivity infrastructures (NGA Plan); (2) accelerating the digitalisation of the economy; (3) promoting the ICT industry in order to develop digital economy and employment; (4) empowering human resources with digital skills; (5) a radical review of the way Digital Public Services are provided; (6) eliminating exclusion and disseminating the benefits of digital economy; and (7) enhancing security and trust.

immediate demand in the labour market so as to improve the matching between vacancies and jobseekers. In order to equip workers with the right skills, education policy should be up-to-date. To thrive in the digital economy, ICT skills will not be enough and other complementary skills will be needed. STEM disciplines will increasingly need to converge with social sciences, since job positions will need more staff with knowledge across disciplines such as ethics, psychology, business and economics. Policy makers should encourage innovation in teaching methods, classroom practices and curricula to skill up the future workforce. The massive open online courses (MOOCs) are probably the most relevant example of how digital technology has been used to improve the accessibility and provision of education. By the end of 2018, MOOC students had reached a total of 101 million and over 800 universities around the world had announced or launched 11.4 thousand courses.[38]

Funding: A financing tool to support the digital transformation of the domestic economy is Community funding under the two new instruments envisaged in the EU's long-term budget for the period 2021-2027. These are (i) the Digital Europe programme, with a total budget of €9.2 billion, supporting the completion of the Digital Single Market, and (ii) the renewed Connecting Europe Facility, with an increased amount of €3 billion earmarked to support investments in digital connectivity and very high capacity infrastructures (see European Commission 2018d).[39] Meanwhile, the fast-developing FinTech industry is changing the face of banking and finance and may contribute in multiple ways, by offering new integrated customer-centred services that improve the access of SMEs to finance and alternative funding options such as crowdfunding, microfinance and P2P lending. In addition, in the context of the Equifund investment platform, a new financial instrument is provided, aimed to support innovation by SMEs.

Public administration: The integration of all government bodies and agencies into a single Geographic Information System (GIS) is necessary, as it will help to attract investment, by ensuring the fast approval of investment projects, transparent selection and respect for entrepreneurship.[40] The introduction of an integrated digital identification and electronic signature system (see Berryhill et al. 2018) would simplify government-citizen interaction and alleviate the administrative burden on businesses. The digitalisation of justice would contribute in the same direction, by shortening the delays in the resolution of disputes.

Taxation: The rapid expansion of digital businesses (e.g. co-operative platforms, social networking companies and internet content providers) has triggered discussions on the tax treatment of the digital economy, with the dual goal of ensuring fair corporate taxation and avoiding public revenue losses (see OECD 2018c and EY 2018). Indeed, the corporate tax rules currently applicable in the EU, which are designed for brick-and-mortar businesses, have become outdated and, as a result, conventional businesses are taxed at twice the average rate (23.2%) applicable to digital businesses (9.5%). This implies not only an uneven distribution of the tax burden, but also location-taxation mismatches, resulting in public revenue losses, as well as poten-

38 The term "open educational resources" was coined at UNESCO's 2002 Forum on Open Courseware and designates "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. Open licensing is built within the existing framework of intellectual property rights as defined by relevant international conventions and respects the authorship of the work". In 2008, the "Connectivism and Connective Knowledge" (CCK08), led by George Siemens of Athabasca University and Stephens Downes of the National Research Council, was the first to incorporate open learning with distributed content, making it the first MOOC. Subsequently, several MOOCs were developed. The top five MOOCs provided by registered users are Coursera, edX, XuetangX, Udacity and FutureLearn. See https://www.classcentral.com/report/moocs-stats-and-trends-2018/.

39 At the same time, under the National Competitiveness, Entrepreneurship and Innovation Programme, Digital Leap and Digital Steps, totalling €100 million, provide SMEs with up to 50% of their digital upgrading costs.

40 Delays in the approval and licensing of investment projects are due to a number of obstacles, mainly related to spatial planning, urban planning, environmental and archaeological regulations. A first effort to reduce these obstacles was made by Law 4014/2011 on Environmental Licensing and Law 4269/2014 on the establishment of a single geographic information system. Since then, the effort has stalled.

tial tax competition that could jeopardise the Digital Single Market.[41]

Regulation – Security: In order to alleviate concerns arising from the use of artificial intelligence, a sound regulatory framework should be established (see Scientific Advice Mechanism 2017), ensuring the human-centred character of AI and its harmonisation with moral and legal standards and values.[42] In addition, serious security and trust challenges are posed by the collection and use of personal data. The new EU regulation (GDPR), which was implemented by Greek law in May 2018, is the first step towards protecting citizens' data privacy. Greece has yet to enact an implementing law to specify certain details of the Regulation, including the sanction framework. Similarly, the regulatory framework for the free flow of non-personal data within the EU-28[43] eliminates geographical, legal or other obstacles to the movement of non-personal data and opens up new business opportunities for startups and SMEs through data-driven innovation across borders.

41 See European Commission (2018e).
42 Although several frameworks for cybersecurity and e-identity have been established in the EU, they have not yet been adopted or fully rolled out in Member States including Greece, such as TIBER-EU (Threat Intelligence-Based Ethical Red Teaming), the NIS (Network and Information Security) Directive (2016/1148/EU) and the elDAS Regulation (EU) No 910/2014.
43 Regulation (EU) 2018/1807 of the European Parliament and of the Council of 14 November 2018 on a framework for the free flow of non-personal data in the European Union, Official Journal of the European Union, L 303/59.

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WORKING PAPERS (JANUARY – JUNE 2019)

This section contains the abstracts of Working Papers authored by Bank of Greece staff and/or external authors and published by the Bank of Greece. The unabridged version of these texts is available on the Bank of Greece's website (www.bankofgreece.gr).

CONTENTS

Solidarity in the Eurozone

Working Paper No. 256
Pavlos Eleftheriadis

Proposals for Eurozone reform aim to complete its institutional architecture by securing stability without creating moral hazard. Such policy arguments inevitably rely, however, on implicit assumptions about justice, or on what is owed to whom. A common assumption is that Member States are solely responsible for what happens to them. This paper, written from the point of view of public law and legal theory, asks if this assumption is correct. The relevant idea is often considered to be that of solidarity. Yet, solidarity is a puzzling concept. Although it is mentioned in the EU treaties, it does not appear to create any clear duties of mutual assistance. Many prominent legal theorists argue that solidarity will only become relevant in the future, when new European institutions bring citizens together under a single Europe-wide political community. This paper argues, however, that these arguments are misleading. They are at least incomplete in that they miss the key role played by corrective justice. Unlike distributive justice, which applies within states but not among states, corrective justice applies to cooperative arrangements creating interdependence. Corrective justice creates a principle of redress, which requires that those who are unfairly burdened by an agreement should be compensated by those who caused the unfairness. Any state that was unfairly burdened by the Eurozone's flawed architecture may thus have a claim of redress for the losses it incurred as a result of the unfairness. It follows that the programmes of financial assistance were not merely actions of self-preservation or prudence by the Eurozone. They were also manifestations of an existing European principle of solidarity based on corrective justice.

The role of financial constraints on labour share developments: macro- and micro-level evidence

Working Paper No. 257
Elena Crivellaro and Aikaterini Karadimitropoulou

Technological advancements have been affecting labour shares through a steep decline in the relative price of investment goods. This has lowered the cost of capital allowing firms to replace labour with capital. Nonetheless, financing obstacles could obstruct investment in both labour and capital. This paper assesses the role of financial constraints in hampering the effect of relative investment prices change on labour shares, using data for up to 26 OECD countries over the period 1995-2014. We find statistically significant, economically large and robust effects of financial constraints acting as a channel to hinder the effect of relative investment prices changes on labour shares. In particular, our results reveal that: (i) there has been a global decline in the labour share that coincides with declines in the relative price of investment goods and this decline has been heterogeneous across countries with different levels of financial constraints; (ii) industries highly dependent on external finance face a lower decline in the labour share following a drop in the relative investment price than industries that are less dependent on external finance, possibly because they are more constrained in accessing funds to finance investment; (iii) industry-level investment prices affect the labour share partly through changes within firms rather than through composition effects, with smaller effects for firms that are more dependent on external finance and larger effects in less financially constrained and highly productive firms. These results are

corroborated by an estimated aggregate elasticity of substitution between capital and labour greater than one, and higher for countries that are less financially constrained.

Green Bonds as an instrument to finance low carbon transition

Working Paper No. 258
Eftichios S. Sartzetakis

The present paper examines the role that green bonds can play in financing the transition to low carbon economy. We first establish the need for central banks to respond to climate change challenges and we present the main ways in which they can get involved. We explain why green bonds should be used to instrument of choice for financing the low carbon transition, based, on the one hand, on the theoretical argument of intergenerational burden sharing and, on the other hand, on the practical need of large long-term infrastructure investments. After defining green bonds, we present their main characteristics. We then summarise the development of the green bond market in the last decade. We conclude by presenting ways in which to respond to existing challenges and barriers, so that the green bonds market develops further.

A simple return generating model in discrete time; implications for market efficiency testing

Working Paper No. 259
Alexandros E. Milionis

A linear return generating model is introduced. This model is a generalisation in discrete time of the differential equation describing dynamical systems in continuous time. The model is useful in its own right, as it provides a simplified, yet credible, quantitative description of the reality. Further, the model is used as a tool for a theoretical study of market efficiency testing. This is obtained by modelling certain market conditions under which new information is released and reflected in asset prices on the one hand, and, on the other hand, by recording what established econometric testing approaches conclude about the hypothesis of market efficiency. Amongst others it is argued that, contrary to the general belief, theoretically a random walk in asset prices, under certain conditions, could be associated with profoundly inefficient markets. Furthermore, an enhancement of the battery of statistical tests for market efficiency is proposed by the potential application of specific forms of the suggested linear dynamic model and the possible advantages over the existing techniques are discussed.

Non-performing loans, governance indicators and systemic liquidity risk: evidence from Greece

Working Paper No. 260
Dimitrios Anastasiou, Zacharias Bragoudakis and Ioannis Malandrakis

In this study we propose a new determinant of non-performing loans for the case of the Greek banking sector. We employ aggregate yearly data for the period 1996-2016 and we conduct a Principal Component Analysis for all the Worldwide Governance Indicators (WGI) for

Greece, aiming to isolate the common component and thus to create the GOVERNANCE indicator. We find that the GOVERNANCE indicator is a significant determinant of Greek banks' non-performing loans, indicating that both political and governance factors impact on the level of the Greek non-performing loans. An additional variable that also has a statistically significant impact on the level of Greek non-performing loans, when combined with WGI in the dynamic specification of our model, is systemic liquidity risk. Our results could be of interest to policy makers and regulators as a macroprudential policy tool.

Estimation of the adequate living expenses threshold during the Greek crisis

Working Paper No. 261
Eirini Andriopoulou, Apostolos Fasianos and Athanassios Petralias

The aim of this study is to present the underlying methodology behind the estimation of the Adequate Living Expenses (ALE) Threshold for the Greek population. The ALE threshold was first introduced in 2014 by the Greek authorities as a benchmark, mainly for protecting overindebted mortgage holders from foreclosure of the primary residence. In this paper, we present alternative methodological approaches and specifications considered to estimate this threshold and we report updated estimates for the year 2017. The ALE threshold is defined through expenditure for the purchase of goods and services and interpreted as the income level that the household should possess in order to cover the level of acceptable living expenses, following the median expenditure pattern of Greek households. By taking into consideration the main categories of the Greek Household Budget Survey, we examined different expenditure specifications, based on the necessity of the needs covered by gradually excluding items that could be considered as "luxury" items (four scenarios were developed). Quantile regression and linear robust regression accounting for the presence of outliers were applied, and various model specifications were tested. Our results control for household structure, degree of urbanisation and mortgage holding, and interactions among them. In 2017, for a family with two children the ALE threshold ranged from €1,196 to €1,497 per month, reduced by approximately 11.5% compared with 2012, depending on the expenditure specification. The estimated ALE threshold lies considerably above the poverty line in all cases.

Financing economic growth in Greece: lessons from the crisis

Working Paper No. 262
Helen Louri and Petros Migiakis

We examine the existence of a feedback loop between the resilience of the financial sector and Greek economic activity. A sequence of structural VARs is employed using data for bank credit, liquidity, capital, asset quality and private demand in 2001-2018 in two datasets. Namely, one in monthly frequency with which we examine the determinants of credit provision by Greek banks, and another in quarterly frequency with which we examine the finance-growth nexus for the Greek economy. We find that (a) the deterioration in the quality of Greek banks' balance sheets affected negatively the provision of credit to the economy, (b) central bank liquidity and recapitalisations of Greek banks provided only a partial remedy, and (c) the decline in credit significantly weakened economic activity. Also,

we find that there is a role for market financing of the economy but this cannot substitute for the predominantly bank-based financing. Therefore, as the Greek economy starts bouncing back, Greek banks have an important role to play, first, by solving the high NPLs problem and providing the necessary credit and, second, by improving the efficiency of capital allocation towards a sustainable growth model.

Housing wealth, household debt and financial assets: are there implications for consumption?

Working Paper No. 263
Konstantina Manou, Panagiotis Palaios and Evangelia Papapetrou

This paper evaluates the asymmetric transmission effects of housing wealth, household debt and financial assets on consumption spending in Greece over the period 1999Q4 to 2017Q4. We apply the Enders and Siklos (2001) methodology and use Stevans' (2004) modification to capture these effects in a multivariate framework. Our results show that consumption responds asymmetrically to all types of changes applied. We provide evidence for the predominance of negative changes compared to positive ones. Our empirical findings are consistent with a stronger consumption response to decreases in financial assets and housing wealth. Furthermore, our results add to the existing literature in that the driving force of the rapidly reducing consumption spending is the deleveraging change. We also check the robustness of our results by applying Hansen's (2017) kink regression model analysis. The empirical results provide evidence that consumption and wealth component data fit better a threshold model than a linear model.

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