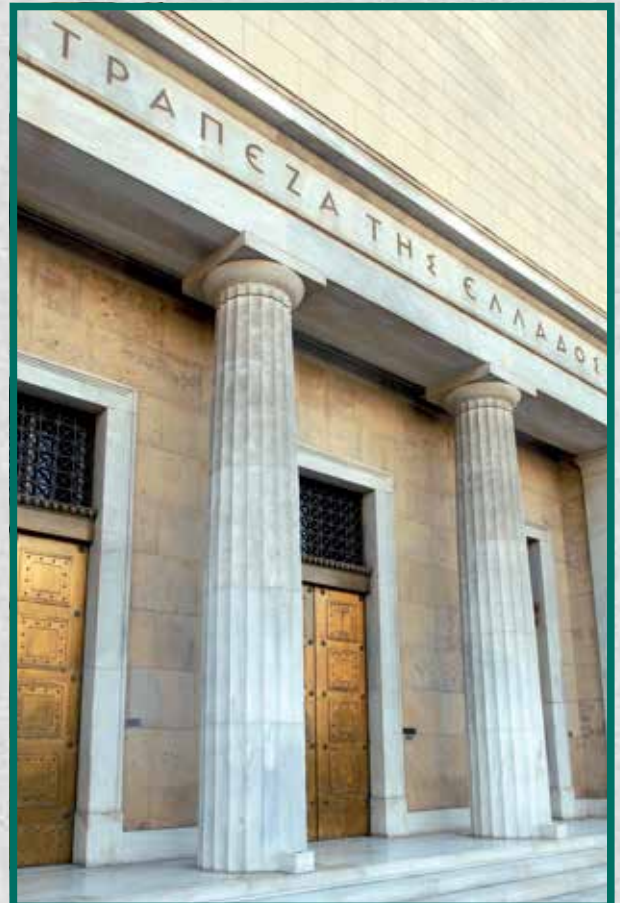


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REAL AND FINANCIAL CYCLES IN THE GREEK ECONOMY*

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I INTRODUCTION

This paper presents estimates of short- and medium-term frequency cycles for a number of key variables of the Greek economy and explores their characteristics. Eight time series are considered: real GDP; real total credit to the private non-financial sector and its household and corporate lending components; an index of residential property prices; an equity price index; nominal long-term interest rates; and the interest rate term spread. The aim is to systematically study Greek real and financial cycles at both frequencies and to examine whether they exhibit the stylised facts identified in the relevant academic literature for other countries. The interaction between the business (or real) cycle and the financial cycle is also explored, against the backdrop of the insights gained from the recent financial crisis.

The most related research is by Tsouma (2014), who dates the Greek business cycle using both turning point analysis and Markov switching. However, like most of the literature, she focuses exclusively on conventional business cycle frequencies and does not consider the interplay between real and financial cycles. Michaelides et al. (2013) consider EU and US influences on the Greek business cycle using both a Hodrick-Prescott filter and a bandpass filter, but their work is subject to the same limitations. Finally, Karfakis (2013) considers the relationship between credit and business cycles in Greece using Granger causality analysis of Hodrick-Prescott filtered series, but focuses on a single decade and on short-term business cycle frequencies. Our work goes beyond existing research, as medium frequency cyclical fluctuations have not to date been extracted for the Greek economy, nor has the interplay

between real and financial cyclical fluctuations at longer frequencies yet been studied.

According to the literature, variables associated with real economic activity such as GDP are thought to exhibit a cyclical behaviour of a short periodicity, known as a business cycle (see for example Baxter and King 1996). Conversely, financial variables such as credit tend to exhibit longer cycles, known as financial cycles (see Drehmann et al. 2012 and Claessens et al. 2012). We estimate both short and medium frequency cycles for all eight data series under consideration. Moreover, we attempt to gauge which periodicity is most dominant for each time series, by estimating what we call an “overall cycle”. Five alternative techniques are used: turning point analysis; bandpass filters; the Hodrick-Prescott (HP) filter; univariate structural time series models (STSMs); and multivariate STSMs. The extracted cycles are compared by series, methodology and frequency, and their main features and co-movement properties are discussed. Particular emphasis is placed on the relationship between financial variables and GDP.

Finally, as these empirical estimates are an extension and update of the work undertaken by the authors as part of the Team on Real and Financial Cycles of the Working Group on Econometric Modelling of the European System of Central Banks (ESCB), part of which was published in Rünstler et al. (2018), the results presented here for Greece are also set against the corresponding findings reported by Rünstler et al. (2018) for other European economies.

* The authors would like to thank Heather Gibson, Dimitris Sideris and Gerhard Rünstler for constructive discussions and comments. The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

We find that medium frequency fluctuations dominate over business cycle frequency fluctuations for all variables, including GDP. The average duration of the medium frequency cycle in GDP is found to be between 32 and 55 quarters, depending on the methodology, i.e. much longer than conventional business cycle frequencies, while those of the three credit variables are almost twice as long, confirming that financial cycles are generally much longer than real ones. Finally, we find that the medium frequency cyclical components are found to be highly correlated and that their lead-lag behaviour is in line with economic intuition.

The remainder of the article is structured as follows: Section 2 presents the data. Section 3 reports the findings obtained from the non-structural approaches, i.e. the turning point analysis and the bandpass filter at different frequencies. It also discusses the corresponding results obtained using the Hodrick-Prescott filter. Section 4 presents the univariate and multivariate structural time series model estimates of the variables' cyclical components. Finally, Section 5 concludes.

2 THE DATA

We consider eight time series in the analysis: real GDP; real total credit to the private non-financial sector; real credit to households; real credit to non-financial corporations (NFCs); real residential property prices; an equity price index; a nominal long-term interest rate; and the interest rate term spread. Data are quarterly and cover a maximum time span of 1970Q1-2017Q4. The nominal long-term interest rate is the yield on 10-year government bonds. The spread is defined as the difference between the long-term interest rate and the 3-month short-term interest rate. GDP, credit variables and residential property prices have been deflated with the GDP deflator. All series with the exception of the long-term interest rate and the spread are in logs. Details about the data are provided in Table A1 in the Appendix.

3 NON-STRUCTURAL APPROACHES

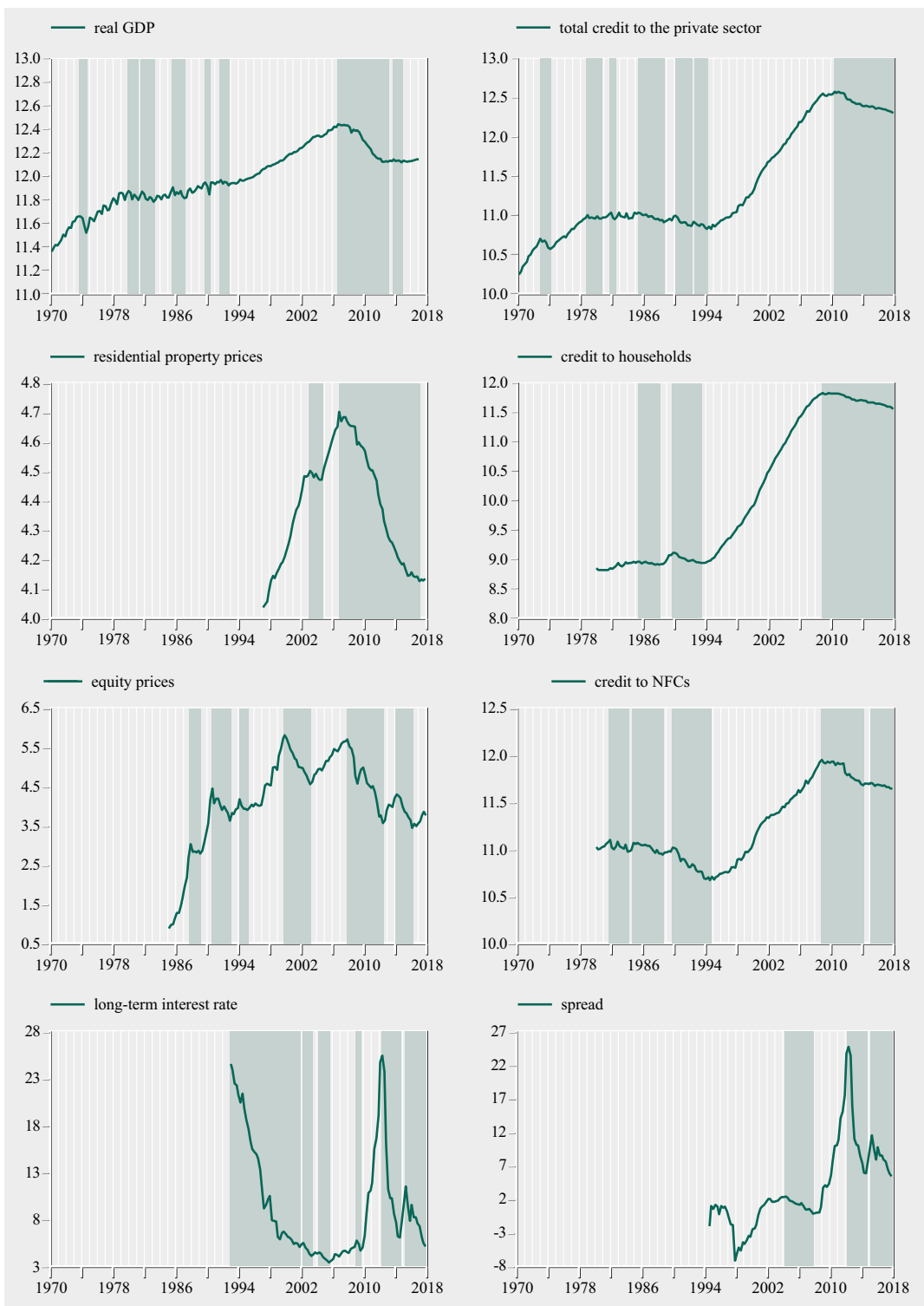
3.1 TURNING POINT ANALYSIS

Turning point analysis was originally introduced by Burns and Mitchell (1946) as a means of dating the business cycle and was subsequently modified by Bry and Boschan (1971) and Harding and Pagan (2002). It identifies cyclical peaks and troughs in a series via a two-step procedure: first, the local maxima and minima of the series are identified; subsequently they are filtered through a censoring rule, to guarantee a minimum cycle length, a minimum phase length, that peaks and troughs alternate and that a trough (peak) is lower (higher) than the preceding peak (trough).

As in Harding and Pagan (2002) and Drehmann et al. (2012), we employ two alternative parameterisations, designed to capture short and medium frequency fluctuations. For the short frequency fluctuations we define local maxima (minima) at time t as points where the value of the series is the highest (lowest) within the five-quarter window centered at t . Such points are defined as peaks (troughs) of the cycle if they fulfil two conditions, namely that each cycle has a minimum length of five quarters and each phase (expansion or contraction) is at least two quarters long. To capture cycles that are longer than what is commonly considered a business cycle frequency, we modify the algorithm to set the minimum cycle length at eight years (32 quarters) and determine local maxima and minima over an eight-quarter window. Thus, we obtain a subset of the peaks and troughs obtained with the short frequency parameterisation.

Charts 1 and 2 present the results of the turning point analysis for short-term and medium-term frequencies, respectively. In both charts, the eight data series themselves are plotted for the maximum sample available in each case. The results of the turning point analysis are presented as shaded areas. Areas in green denote downturns, while those in grey denote upswings. The peak of a cycle is the last data-

**Chart I Turning point analysis - Short-term frequencies
(1970Q1-2017Q4)**



Source: Authors' own econometric estimations.

**Chart 2 Turning point analysis - Medium-term frequencies
(1970Q1-2017Q4)**



Table 1 Turning point analysis: Duration of short-term and medium-term cycles

	Short-term cycles			Medium-term cycles		
	Expansion	Contraction	Cycle	Expansion	Contraction	Cycle
	Number of quarters			Number of quarters		
GDP	15.9	7	23.2	46	16.7	54.5
Residential property prices	9	23.5	15	40	41	-
Total credit	18	7	25	65	49	114
Credit to households	34.5	12	46.5	48.5	14	76
Credit to NFCs	17.25	16	33.25	57	51	108
Equity prices	11.2	9.5	21	19	23	32
Long-term interest rate	6.8	5	13	27	51	78
Spread	10.5	11.5	22	18	14	32

Note: The duration of a full cycle is measured from peak to peak.

point in grey and the trough is the last datapoint in green. Throughout the paper we define a full cycle as a peak-to-peak fluctuation.

The top left graph of Chart 1 presents GDP. Upturns therein denote periods of economic expansion and downturns denote recessions. A number of short-lived downturns are identified at short-term frequencies in the first half of the sample, followed by a far more protracted one during the recent crisis period. More specifically, the analysis points out six short-lived recession episodes that took place until the mid-90s and a more lengthy recession that started at the beginning of 2007 and coincided with the global financial crisis. Regarding the findings at medium-term frequencies, Chart 2 shows that the algorithm captures main peaks and troughs in GDP by eliminating short-lived fluctuations. In particular, it identifies a period of expansion during the early '80s that is followed by a stagnation period until the mid-90s, and a period of strong recovery from the mid-90s until the beginning of 2007. As regards recent developments in GDP, the results indicate a large drop in GDP since 2007 that reached its trough at the end of 2015. These results are in line with the established narrative of how the Greek economy evolved over the period under study. They closely match those documented in Tsouma (2014), who dates the Greek economic cycle, and Gogos et al. (2014),

who identify a big decline in GDP during the early '80s and until the mid-90s and a strong expansion since the mid-90s.

As Charts 1 and 2 illustrate, a number of the upswings and downturns in GDP are also mirrored in the graphs for the financial variables. Notably, the beginning of the latest major property price downturn roughly coincides with the beginning of the recent recession. However, the corresponding turning point comes somewhat later for credit variables. In general, the turning point associated with the recent financial crisis is naturally identified in all panels. It is worth noting that at short-term frequencies the peak and trough dates for total credit closely match those for GDP. At medium-term frequencies, the results reveal a drop in total credit and credit to NFCs during the '80s, followed by a large expansion in all credit variables, as well as in property prices since the mid-90s. While equity prices fluctuate a lot at short-term frequencies, their cyclical fluctuations are more protracted at medium-term frequencies. The interest rate and the spread display a similar behaviour over the sample period. Both expanded during the recent sovereign debt crisis and reached their peak in 2012.

Table 1 presents the average duration of the short- and medium-term cycles identified by

the turning point analysis of the data, as well as the respective average duration of contractions and expansions. The average duration of the short-term cycles in GDP is 23.2 quarters, close to the corresponding short frequency cycles identified for total credit, equity prices and the spread. However, overall the credit variables have substantially longer cycles than GDP, ranging from 25 to 46.5 quarters. For the vast majority of variables, expansions are longer than contractions during the period in question.

Turning to the medium-term cycles, the average duration of GDP cycles is 54.5 quarters, fairly long for a real variable, but substantially shorter than the corresponding metric for the three credit variables. For GDP and the credit variables, expansions remain much longer than contractions. It is notable that the characteristics of the medium frequency cycles detected for GDP and loans to households are very similar. On the other hand, the medium frequency fluctuations of equity prices are relatively short, just 32 quarters, as are those of the spread.

3.2 BANDPASS FILTER

3.2.1 Cycles

The second approach we employ is the bandpass filter, a more sophisticated econometric methodology increasingly used for the estimation of cycles in economic variables – see for example Comin and Gertler (2006), Drehmann et al. (2012) and Aikman et al. (2015). This methodology is designed to extract cyclical components of a specific periodicity from individual time series. Following Christiano and Fitzgerald (2003) we employ the asymmetric bandpass filter assuming a unit root with a drift, to isolate short-term cycles with a duration of between 8 and 32 quarters (i.e. 2 to 8 years) and medium-term cycles with a duration of between 32 and 120 quarters (i.e. 8 to 30 years), in line with the turning point analysis.

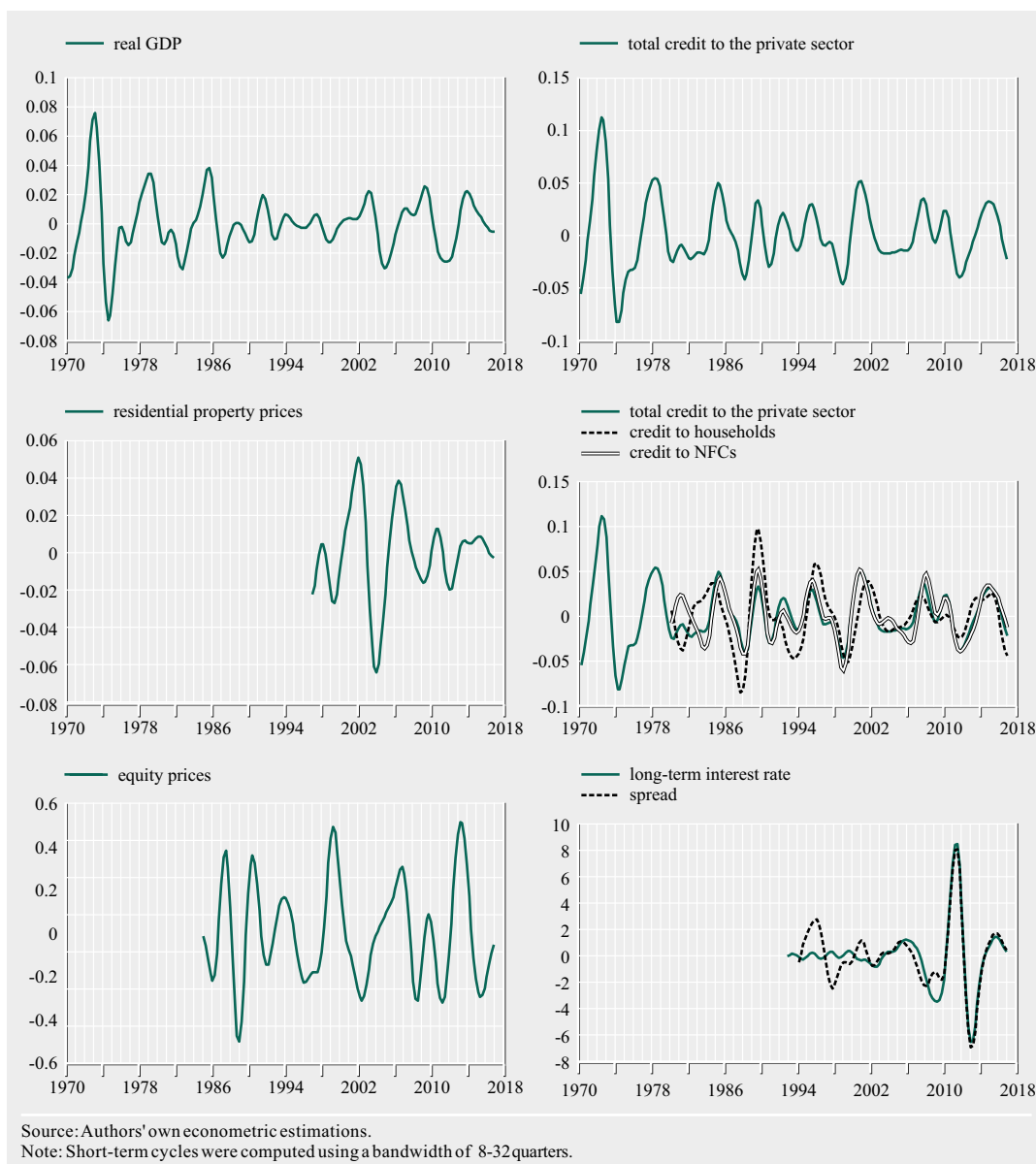
Charts 3 and 4 plot the bandpass-filtered series obtained using the short and medium fre-

quency specification, respectively. Turning first to Chart 3, a number of short frequency fluctuations appear in the GDP series. Credit series display a similar cyclical periodicity but seem to exhibit greater volatility. The short periodicity cycles of total credit and its sub-components, i.e. credit to households and credit to NFCs, are highly correlated as seen in the left-hand panel of the second column of Chart 3. The same can be said for the long-term interest rate and spread fluctuations, with the recent pronounced fluctuation reflecting interest rate and monetary policy movements during the crisis. Short frequency housing price fluctuations seem relatively smaller in terms of variance.

Chart 4 presents in solid lines the filtered series obtained using the 32-120 quarter bandpass filter specification. Here, the synchronicity of the extracted medium frequency cycles is striking for the majority of variables. Real GDP and all three credit variables seem to exhibit two major cycles, which appear very highly correlated. The residential property price index is available from 1997 onwards and thus exhibits only the second hump, capturing the pre-crisis property boom and the recent protracted decline in property prices.

Table 2 presents the standard deviation of the short- and medium-term cycles identified in the bandpass-filtered series. Regarding the variability of the cyclical components, the financial variables seem to be more volatile than GDP both at short- and medium-term frequencies. In addition, for all variables, the standard deviation of the short-term cycle is, intuitively, substantially smaller than that of the corresponding medium-term cycle. The third column presents the relative standard deviation, i.e. the ratio of the two that provides an indication of the relative importance of the periodicity of the cycle in the behaviour of the series. Notably, for residential property prices and credit variables – especially loans to households, which comprise mostly mortgages – the medium-term component seems to account for much more of the variable's vari-

**Chart 3 Bandpass filter - Short-term cycles
(1970Q2-2017Q4)**

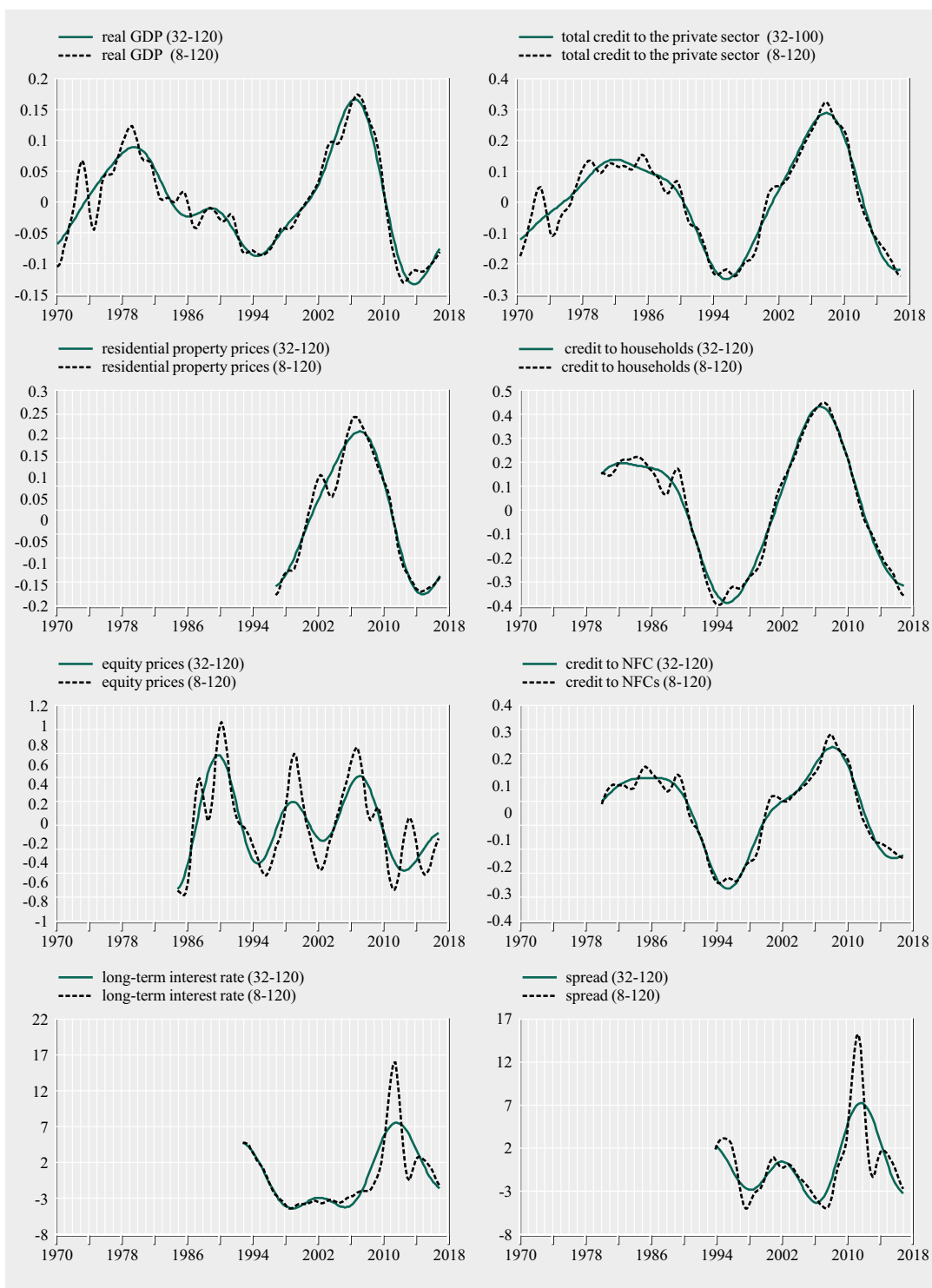


ation. The ratio of the standard deviation of the medium-term cyclical component to that of the short-term cyclical component is 5.783 for residential property prices and 7.656 for credit to households. The value of this metric for GDP is substantially lower, at 3.8, as credit and property prices are known to exhibit cycles that are larger than the business cycle. Nevertheless, it may be viewed as relatively high for a

real variable. Conversely, the two cyclical components of the spread and the long-term interest rate have a roughly similar standard deviation.

Table 3 presents the average duration of the short and medium frequency cycles, as well as the respective average duration of contractions and expansions. As before, cycle lengths are

Chart 4 Bandpass filter - Medium-term and overall cycles (1970Q2-2017Q4)



Source: Authors' own econometric estimations.

Note: Medium-term and overall cycles were computed using a bandwidth of 32-120 and 8-120 quarters, respectively.

Table 2 Properties of the filtered series: Standard deviation of short-term and medium-term cycles – Bandpass filter

	Short-term cycles	Medium-term cycles	Relative Std.	Overall cycles
GDP	0.02	0.076	3.8	0.078
Residential property prices	0.023	0.133	5.783	0.136
Total credit	0.032	0.147	4.594	0.15
Credit to households	0.032	0.245	7.656	0.247
Credit to NFCs	0.026	0.148	5.692	0.15
Equity prices	0.229	0.342	1.493	0.43
Long-term interest rate	0.024	0.04	1.667	0.047
Spread	0.025	0.033	1.32	0.043

Notes: The standard deviation for each variable is computed for the period in which data are available. The relative standard deviation is the ratio of the standard deviation of the medium-term cyclical component to the standard deviation of the short-term cyclical component. The overall cycles are extracted from a frequency band of 8-120 quarters.

defined as the average distance between the peaks of the cycles, the latter having been obtained by applying turning point analysis to the bandpass-filtered series using the aforementioned parameterisations. The phases and cycles identified in the filtered series are by and large shorter than those identified in the raw data. This is especially true of short frequency credit variable expansions. Conversely,

GDP, residential property prices and credit to households exhibit longer medium frequency downturns than those identified in the raw data. More specifically, short frequency cycles identified in GDP have an average duration of 13.8 quarters, compared to a duration of 23.2 quarters in the raw data. This duration is comparable to the corresponding metric for credit to NFCs, which is 14.9 quarters. Short

Table 3 Properties of the filtered series: Duration of short-term and medium-term cycles – Bandpass filter

	Short-term cycles			Medium-term cycles			Overall cycles		
	Expansion	Contraction	Cycle	Expansion	Contraction	Cycle	Expansion	Contraction	Cycle
	Number of quarters			Number of quarters			Number of quarters		
GDP	7.9	5.9	13.8	30.5	26	55	32.5	23.3	56
Residential property prices	10.5	7.25	17.5	43	32	-	41	33	-
Total credit	9.5	7.8	17.3	50	56	106	46	43	92
Credit to households	10.4	10.8	20.8	46	53	99	52	40	92
Credit to NFCs	6.67	8.25	14.9	52	34	90	55	37	92
Equity prices	9.67	8	17.5	18	19	35.5	45	20.5	67
Long-term interest rate	8	7.8	16.6	52	26	78	52	25	77
Spread	6.4	16	9.6	18.5	19	39	19	14	33

Note: The durations have been computed using turning point analysis in the filtered series. A full cycle is measured from peak to peak. The overall cycles are extracted from a frequency band of 8-120 quarters.

cycles in the remaining two credit variables, i.e. in equity prices and in residential property prices, are on average somewhat longer.

Turning to medium frequency cycles, the average duration of the medium frequency cycle in GDP is approximately half of the durations calculated for the three credit variables (55 quarters for the former and between 90 and 106 for the latter). Conversely, medium frequency cycles for equity prices are much shorter than the corresponding GDP cycles. Overall, the medium frequency cycle durations obtained from the bandpass filter are consistent with the findings of the turning point analysis.

The approach adopted above provides valuable insights. However, as discussed in Rünstler et al. (2018), the fact that the frequency bands have been chosen in advance on the basis of pre-existing perceptions of business and financial cycle frequencies implies a risk of partially truncating the cyclical dynamics or of obtaining spurious cycles (see Murray 2003). Moreover, when the frequency bands used for extracting short frequency (business) and medium frequency (financial) cycles do not overlap, as in our case, the resulting estimates of cycles will be uncorrelated by construction, rendering it impossible to explore whether business and financial cycles are independent or correlated. By contrast, to explore whether two cycles are interrelated, a methodology that allows us to extract correlated cycles is warranted. To address these concerns, we also extract an “overall cycle” using a much broader bandpass filter specification so as not to impose a constraint on the cycles extracted, namely a bandpass filter of 8-120 quarters (2-30 years).¹ This choice of bandwidth captures both business and medium-term frequencies, i.e. it is agnostic with respect to this distinction. We interpret this cycle as the dominant cyclical fluctuation driving each series and explore how the cycles detected in the various variables relate to each other.

The last columns in Tables 2 and 3 correspond to this broader bandwidth. The last column in

Table 2 presents the standard deviation of the overall cycle extracted using the 8-120 quarter frequency. The overall cycle of all credit variables, i.e. their dominant cyclical fluctuation, is very close in terms of standard deviation to the medium-term cycle extracted using the 32-120 quarter frequency. This is expected on the basis of the literature, which concurs that the duration of the financial cycle is long. However, the standard deviation of the overall cycle of GDP is also very close to that of its medium-term cycle. The same is true of the cycle durations presented in the last column of Table 3. This finding contradicts the idea that GDP fluctuations are always at “business cycle” frequencies. Interestingly, in the case of Greece, real economic activity seems to exhibit more protracted cyclical fluctuations (56 quarters) than the corresponding average for other European countries reported in Rünstler et al. (2018), which is about 30 quarters (though it should be noted that they use a maximum duration of 80 quarters for their medium-term bandpass filter). The GDP cycle’s standard deviation is also somewhat higher. The extracted cyclical components are plotted in Chart 4, in dashed lines, and indeed they track the corresponding medium-term cyclical components very closely.

Charts A1 and A2 in the Appendix present the bandpass-filtered series plotted against the corresponding cyclical components extracted using an HP filter. Tables A2 and A3 in the Appendix present information on the HP-filtered series derived using turning point analysis and are directly comparable to Tables 2 and 3. The only notable discrepancy between the two sets of results is the very long duration of the medium-term cycle identified in real GDP using the HP filter (114 quarters), reflecting the fact that an interim upturn is not picked up

¹ As a robustness check we also extract cycles using the 8-80 quarter band, as in Rünstler et al. (2018). The findings are available from the authors upon request. The resulting cycles are qualitatively and quantitatively similar. The only exception is credit variables, which in the case of Greece appear to exhibit a medium-term cycle of more than 80 quarters. However, credit variables are key to our analysis. Moreover, our objective is to extract cyclical components without pre-imposing limits and the main advantage of the bandpass filter methodology is that it allows us to do so. Thus, we report the results extracted using the 120-quarter upper filter bound suggested by Drehmann et al. (2012) as our main results.

by the turning point analysis algorithm. This difference notwithstanding, the results are quantitatively and qualitatively very similar.

3.2.2 Co-movements

Having extracted cyclical components from the variables using a number of alternative parameterisations, we now explore how GDP cycles are related to those of other variables in Tables 4 to 6. Table 4 presents the co-movement properties of the short-term cycles extracted using the bandpass filter, i.e. the correlation of each variable's short-term cycle shifted by $[-4, 4]$ periods, with the short-term GDP cycle in period t . This is a convenient way of examining which variable leads the other. The largest correlation in absolute terms determines the

lead-lag property of the cycle of a given series relative to that of GDP. Numbers in bold indicate the highest correlation. In the first row, we see that the short-term cyclical component of residential property prices leads that of GDP by four quarters, while credit to households leads by one. The short frequency cycle in total credit and that in credit to NFCs lag the GDP short cycle by two quarters, while equity prices (inversely) lag by a year. Conversely, short frequency fluctuations in the long-term interest rate and the spread inversely lead those in GDP by two quarters, i.e. low interest rates today forecast future booms in the GDP business cycle. This is in line with the well-known inverted leading indicator property of real interest rates documented by King and Watson

Table 4 Co-movement properties of the filtered series: Short-term cycles – Bandpass filter

	$i = -4$	$i = -3$	$i = -2$	$i = -1$	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
Residential property prices	0.4787	0.4196	0.3289	0.2196	0.1049	-0.0058	-0.1048	-0.1858	-0.2467
Total credit	0.2242	0.2715	0.3351	0.4092	0.4789	0.5232	0.5245	0.4709	0.3615
Credit to households	0.3999	0.4495	0.4825	0.4956	0.4867	0.4649	0.4089	0.3161	0.1881
Credit to NFCs	0.1508	0.2207	0.3074	0.407	0.5056	0.5808	0.6131	0.5879	0.502
Equity prices	0.1825	0.1503	0.1094	0.0509	-0.0313	-0.1401	-0.2676	-0.3995	-0.5177
Long-term interest rate	-0.5206	-0.6264	-0.6702	-0.6527	-0.5808	-0.4647	-0.3152	-0.1434	0.0379
Spread	-0.4995	-0.5738	-0.5994	-0.5767	-0.5079	-0.3954	-0.2448	-0.0665	0.126

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

Table 5 Co-movement properties of the filtered series: Medium-term cycles – Bandpass filter

	$i = -4$	$i = -3$	$i = -2$	$i = -1$	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
Residential property prices	0.8338	0.8734	0.907	0.9346	0.9559	0.9716	0.9808	0.9831	0.9782
Total credit	0.6373	0.6958	0.7491	0.797	0.8393	0.877	0.9098	0.9371	0.9584
Credit to households	0.7397	0.7853	0.8253	0.8596	0.8882	0.9133	0.9329	0.9465	0.9539
Credit to NFCs	0.5952	0.6572	0.7146	0.767	0.814	0.858	0.8973	0.9309	0.9579
Equity prices	0.7295	0.7582	0.7786	0.7903	0.793	0.7878	0.7755	0.7567	0.732
Long-term interest rate	-0.7253	-0.6765	-0.6206	-0.558	-0.4896	-0.4282	-0.3638	-0.2968	-0.2274
Spread	-0.7273	-0.6901	-0.6432	-0.5873	-0.5235	-0.4742	-0.42	-0.3613	-0.2986

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

Table 6 Co-movement properties of the filtered series: Overall cycles – Bandpass filter

	$i = -4$	$i = -3$	$i = -2$	$i = -1$	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
Residential property prices	0.82	0.8578	0.889	0.914	0.9329	0.9465	0.9537	0.954	0.9473
Total credit	0.6261	0.6842	0.7374	0.7857	0.8285	0.8664	0.8985	0.924	0.9424
Credit to households	0.7333	0.7771	0.8151	0.8474	0.8743	0.8967	0.9137	0.9248	0.9296
Credit to NFCs	0.5766	0.6381	0.6957	0.7493	0.7979	0.8419	0.8801	0.9109	0.9335
Equity prices	0.5487	0.567	0.5773	0.5786	0.5701	0.5491	0.5203	0.4853	0.4462
Long-term interest rate	-0.6446	-0.615	-0.5738	-0.5212	-0.4585	-0.3981	-0.3319	-0.261	-0.1865
Spread	-0.5842	-0.5665	-0.5359	-0.4925	-0.4374	-0.3849	-0.3275	-0.2666	-0.203

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

(1996), Beaudry and Guay (1996) and Fiorito and Kollintzas (1994).

Turning to Table 5, we explore the co-movement between the medium frequency cyclical components extracted using the bandpass filter. As already observed in Chart 4, the medium frequency cyclical components are far more correlated than those at the short frequency. In addition, all variables with the exception of the long-term interest rate and the term spread are procyclical with the GDP cycle. Residential property prices and all three credit variables now appear to lag GDP. This finding is in contrast with a growing body of evidence which indicates that the medium-term financial cycle leads the business cycle and that financial cycle downturns lead on to deep recessions. It is however intuitive in the case of Greece, as the recent deep recession was prompted not by a financial crisis but by the Greek sovereign debt crisis. Thus, contrary to other countries' experience, it was indeed GDP that declined first, leading on to the subsequent downturn in credit and property prices. Equity prices are synchronous with the output cycle while, as before, the long-term interest rate and the spread inversely lead the real cycle by a full year, in line with the aforementioned intuition. The corresponding co-movements for the HP-filtered series can be found in Tables A4 and A5 in the Appendix and present broadly similar results for both frequencies.²

Finally, Table 6 presents the co-movement properties of the “overall” cycles which were extracted by bandpass-filtering all series with an 8-120 quarter bandwidth. This is, in a sense, the most instructive of all three tables, as we do not pre-impose a limiting common bandwidth for all series, but rather we explore the co-movement between the dominant cyclical components of our variables. Nonetheless, the co-movements reflected in Table 6 are strikingly similar to those presented in Table 5 for the medium frequency cyclical components and equally intuitive, reflecting once again the correlation between the two sets of cyclical components.³

4 STRUCTURAL CYCLE ESTIMATES

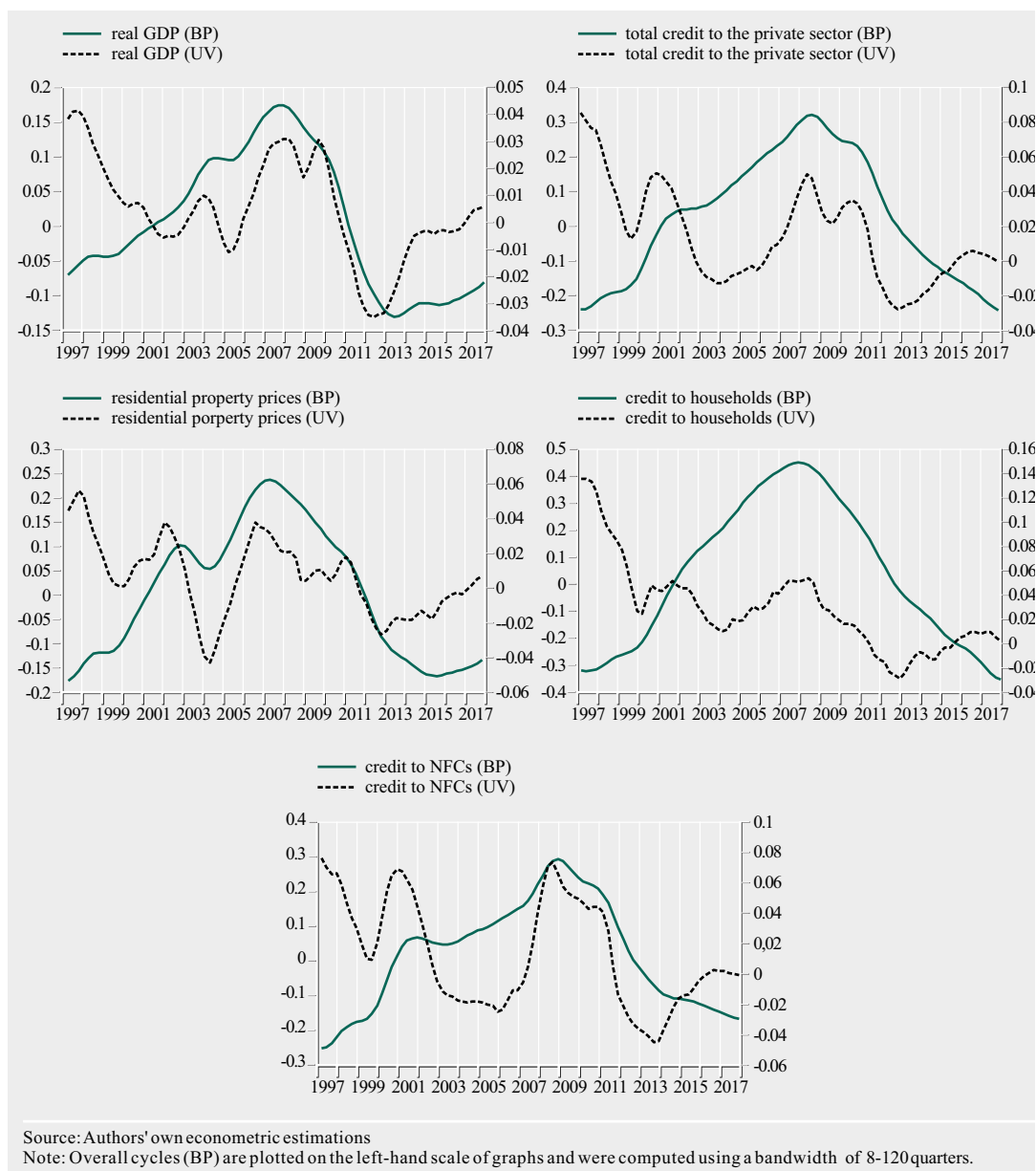
4.1 UNIVARIATE MODELS

Having employed a battery of alternative non-structural ways of extracting financial cycles, we now use a structural time series model (STSM), in both its univariate and its multi-

² To obtain cyclical components at medium-term frequencies with the HP filter, we use a smoothing parameter equal to 400,000, as in Schüler (2018).

³ We have also calculated the co-movements between the short-term cyclical component of GDP and the medium-term cyclical components of financial variables, so as to indirectly explore the validity of the premise that medium-term financial cycles are related to the business cycle and that financial crises precede deep recessions. However, the resulting correlations were very low. The results are available from the authors upon request.

**Chart 5 Univariate STSM (UV) and overall cycle (BP)
(1997Q1-2017Q4)**



variate version, to do the same. STSMs are commonly used to decompose a series or a group of series into trends and cycles, thus they are conceptually similar to the bandpass filter approach. However, with an STSM the trends and cycles are explicitly specified as parametric time series models and their parameters are directly estimated from the time series. The

estimated model is thus tailored to the observed time series, ensuring a more precise characterisation of the cycle.

To date univariate STSMs have mostly been used for the estimation of NAIRU (non-accelerating inflation rate of unemployment) and the output gap; see for example Jarocinski and

Table 7 Univariate structural time series model – Properties of cyclical components

	Std.	Cycle length (quarters)
GDP	0.012	37.03
Residential property prices	0.017	33.34
Total credit	0.02	37.74
Credit to households	0.026	44.10
Credit to NFCs	0.024	36.69

Note: Data cover the period 1997Q1-2017Q4.

Lenza (2016), Rünstler (2002) and Gerlach and Smets (1999). A small number of papers also employ STSMs to extract cyclical components from financial variables, e.g. De Bonis and Silvestrini (2013) and Galati et al. (2016).

The cyclical components extracted from the univariate STSM are directly comparable to our previously extracted cyclical fluctuations.

However, to ensure comparability between the univariate and multivariate estimation, both have been performed on the common sample which starts in 1997, when data are first available on the residential property price index. Chart 5 plots the cycles extracted from the univariate STSM against the previously extracted “overall” cycles. With the exception of the beginning of the sample, the cycle derived from the univariate STSM tracks the bandpass-filtered cycle relatively closely. However, it is substantially less smooth, as the fact that it stems from an estimated model allows it to track the variable’s dynamics more closely.

Table 7 presents the properties of the cyclical components extracted using the univariate STSM. The standard deviation of the credit variables’ cyclical components is greater than that of GDP. However, with the exception of credit to households, their cycle length is comparable. The cycle length of GDP is estimated at 37.03 quarters, longer than the commonly employed business cycle frequency.

4.2 MULTIVARIATE MODELS

Estimating STSMs in a multivariate setup allows not only the extraction of each variable’s cyclical component, but also an empirical examination of the degree of co-movement between the cyclical components of the variables included in the multivariate estimation. This approach is less common than the corresponding univariate one, but offers an advantage. The concept of an economic or financial cycle implies a degree of co-movement in the cyclical fluctuations of a number of series. A multivariate approach allows us to formally examine the concept of an economic or financial cycle by jointly modelling the cycles of several series.

We employ the multivariate STSM developed in this spirit and applied to the United States by Rünstler and Vlekke (2016) and also applied by Rünstler et al. (2018) to euro area countries.⁴ This version of the multivariate STSM is specifically aimed at modelling the joint dynamics of GDP, total credit and house prices both at business cycle and at medium-term frequencies. The model provides increased flexibility in modelling the persistence of medium-term cycles and of cyclical co-movements at different frequencies. Thus it allows us to explore the extent to which real and financial cycles co-move and which cycle, if any, leads the other.

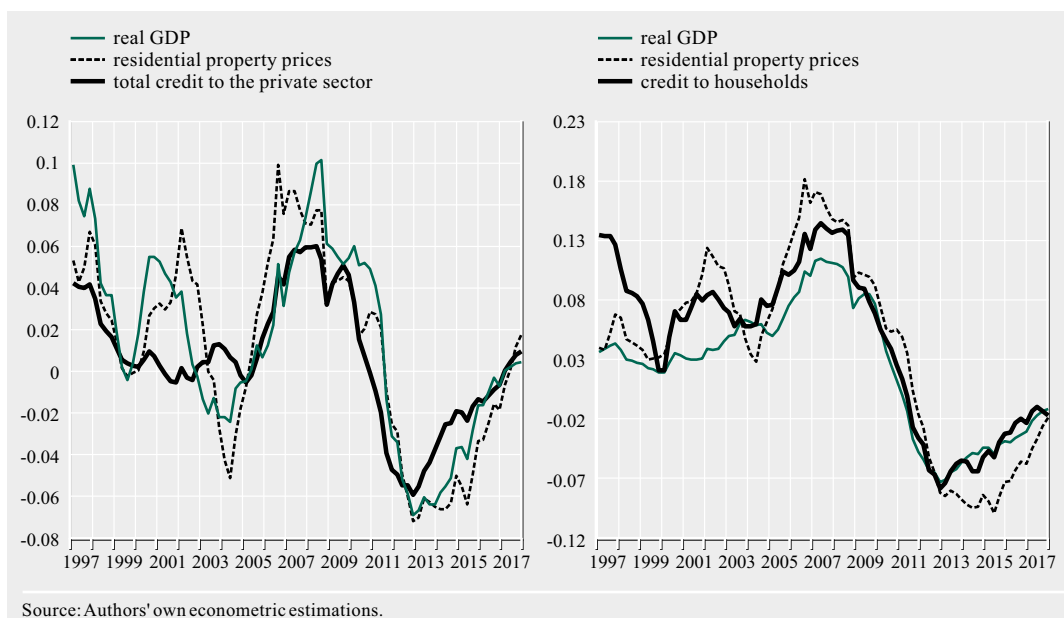
We estimate two alternative specifications. In the specification, we estimate the joint dynamics of GDP, total credit and residential property prices. In the second one, we estimate the joint dynamics of GDP, loans to households and residential property prices. Due to the relatively short length of the common sample, the models are estimated using Bayesian methods with reasonably tight priors on the cycle lengths and the smoothness of the trends.^{5,6}

⁴ See Rünstler and Vlekke (2016) for technical details on the STSM.

⁵ While the sample is sufficient for a maximum likelihood estimation of the univariate models, it proved difficult to obtain convergence in the multivariate specification.

⁶ The Bayesian code was developed by Dimitrij Kulikov of Eesti Pank.

**Chart 6 Multivariate STSM
(1997Q1-2017Q4)**



The two panels of Chart 6 present the cyclical components jointly estimated for each of the aforementioned two sets of variables with the multivariate model. Both panels indicate a high degree of co-movement between the series, implying the existence of a common cycle.

Table 8 presents the properties of the cyclical components extracted using the univariate STSM. The cyclical components of residential

property prices, total credit and credit to households have a larger standard deviation than the cyclical component of GDP. Indeed, financial variables and property prices are known to exhibit relatively higher volatility than real output variables. The three variables' cycle lengths are however found to be roughly similar in both specifications. In the first panel of Chart 8 the estimated GDP cycle length is approximately eight years, while in

Table 8 Multivariate structural time series model – Properties of cyclical components

	Std.	Cycle length (quarters)	Variance contribution > 32 quarters	Variance contribution < 32 quarters
Version with total credit				
GDP	0.028	31.96	0.72	0.29
Residential property prices	0.049	29.91	0.69	0.31
Total credit	0.046	29.85	0.69	0.31
Version with credit to households				
GDP	0.036	37.14	0.77	0.23
Residential property prices	0.052	37.04	0.77	0.23
Credit to households	0.045	36.63	0.77	0.23

Note: Data cover the period 1997Q1-2017Q4.

Table 9 Co-movement properties of the multivariate models

Version with total credit									
	$i = -4$	$i = -3$	$i = -2$	$i = -1$	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
Residential property prices	0.6648	0.7213	0.765	0.8032	0.8363	0.8246	0.805	0.7811	0.746
Total credit	0.5303	0.6203	0.701	0.7782	0.8514	0.8829	0.8975	0.8975	0.8752

Version with credit to households									
	$i = -4$	$i = -3$	$i = -2$	$i = -1$	$i = 0$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
Residential property prices	0.8498	0.8819	0.9072	0.9273	0.9422	0.9403	0.9312	0.9167	0.8964
Credit to households	0.8727	0.9004	0.9213	0.9346	0.9404	0.9355	0.923	0.9049	0.8763

Note: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period i . Correlations are computed over the period 1997Q1-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

the second one it is just over nine years, confirming the importance of medium-term fluctuations not only in financial variables but also in real economic activity. These results are broadly in line with those presented in Rünstler et al. (2018) for the rest of the euro area countries, where the three cyclical components are found to be fairly highly correlated at medium-term frequencies. However, STSM cycle lengths for Greece are somewhat shorter than the corresponding euro area averages – Rünstler et al. (2018) report 10-12 years for GDP and 13-14 years for credit and house prices. Moreover, in the findings of Rünstler et al. (2018) the average estimated GDP cycle is a couple of years shorter than that estimated cycles of the financial variables, which is not the case for Greece.

The GDP cycle estimates obtained from the STSM are clearly longer than the 13.8-quarter cycle extracted from the standard business cycle bandpass filter, though much shorter than the 55-quarter cycle extracted using the medium frequency filter (see Table 3). In other words, in terms of frequency, the extracted GDP cycle seems to fall somewhere between the notion of a traditional business cycle and that of a financial cycle. The last two columns of Table 8 present the contribution of short- and medium-term frequen-

cies to the cycle's total variance. As suggested by the results, the contribution of medium-term frequencies is substantially greater than that of short-term ones for all variables and in both specifications. The contribution of long-term frequencies appears to be larger under the estimation of credit to households, which also accounts for the longer cycles in this case.

Finally, Table 9 presents the co-movements between the GDP's cyclical component and that of each of the other two variables, for the two multivariate estimations. The highest correlation coefficient appears for contemporaneous correlation ($i=0$), indicating that the cyclical fluctuations in the two variables are found to be synchronous when jointly estimated. The same is true for the cyclical component of loans to households, a variable closely linked to mortgage credit and thus to residential property prices. This link is also manifested in the fact that the correlations reported in all columns of the lower panel are higher than the corresponding ones in the top panel. In contrast, the cyclical component of total credit lags the GDP cycle by two quarters, echoing the results presented in Tables 4-6 and contradicting yet again, for the case of Greece, the stylised fact that credit leads the cycle.

5 CONCLUSIONS

We use a battery of alternative methodologies to extract and study short and medium frequency cycles from eight key Greek economic and financial variables. Overall, we find that medium frequency fluctuations dominate over business cycle frequency fluctuations for all variables, including GDP. The average duration of the medium frequency cycle in GDP is found to be between 32 and 55 quarters, depending on the methodology, i.e. much longer than conventional business cycle frequencies. The corresponding durations calculated for the three credit variables are almost twice as long, confirming that financial cycles are generally much longer than real ones. The cyclical components of the financial variables also exhibit much greater variance than those of GDP at both frequencies.

The medium frequency cyclical components are found to be highly correlated. All except those of the long-term interest rate and the term spread are procyclical with respect to the GDP cycle. Residential property prices and the three credit variables lag GDP, despite post-crisis evidence that the medium-term financial cycle leads the business cycle. This finding is however intuitive in the case of Greece, as the recent recession was prompted not by a financial crisis but by a sovereign debt crisis, thus it was indeed GDP that declined first, before credit and property prices. Equity price cycles on the other hand seem to be synchronous with the output cycle. Finally, the long-term interest rate and the spread inversely lead the real cycle by a year, i.e. low interest rates today forecast future economic booms in line with the well-established inverted leading indicator property of real interest rates.

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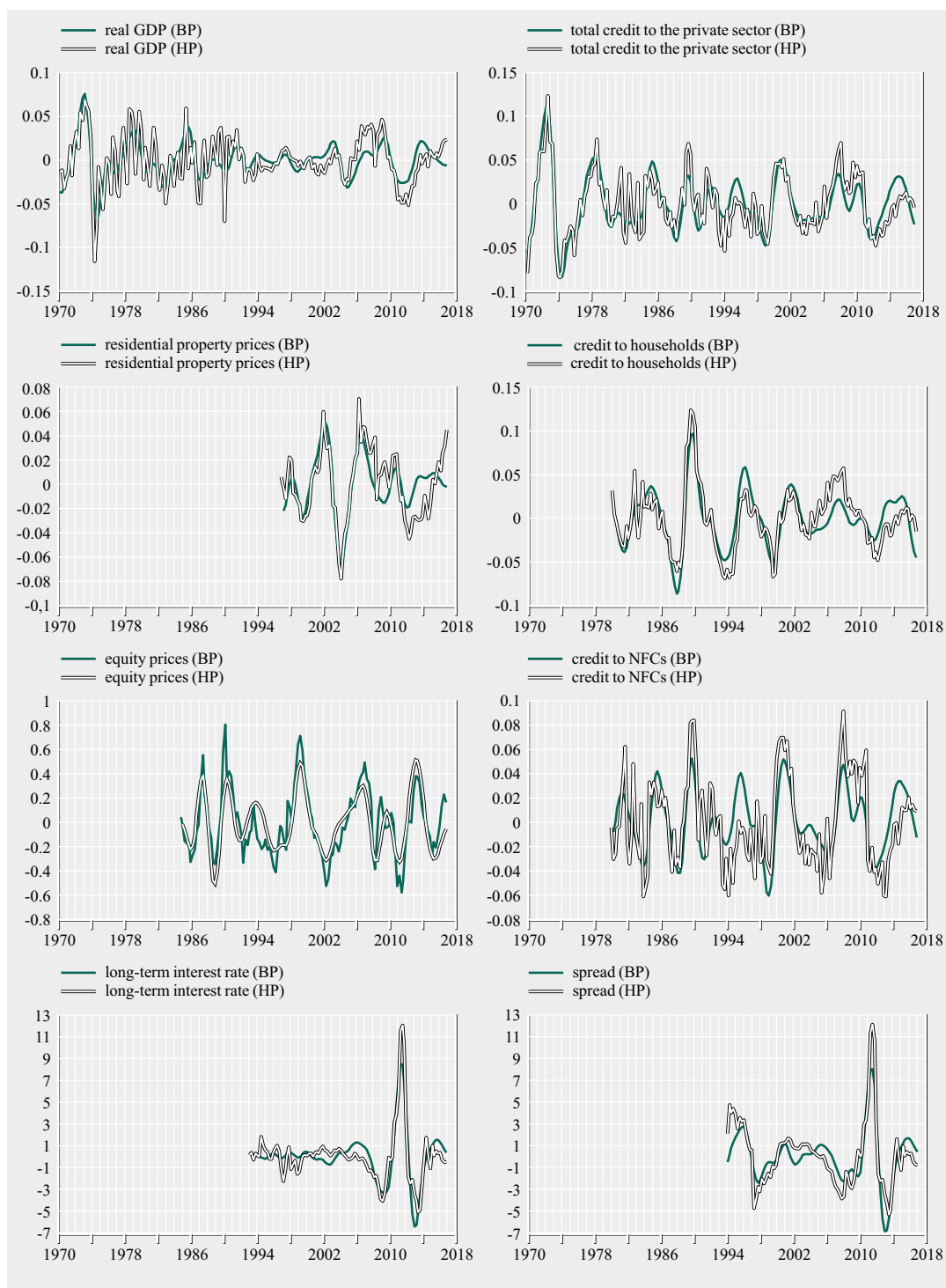
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APPENDIX

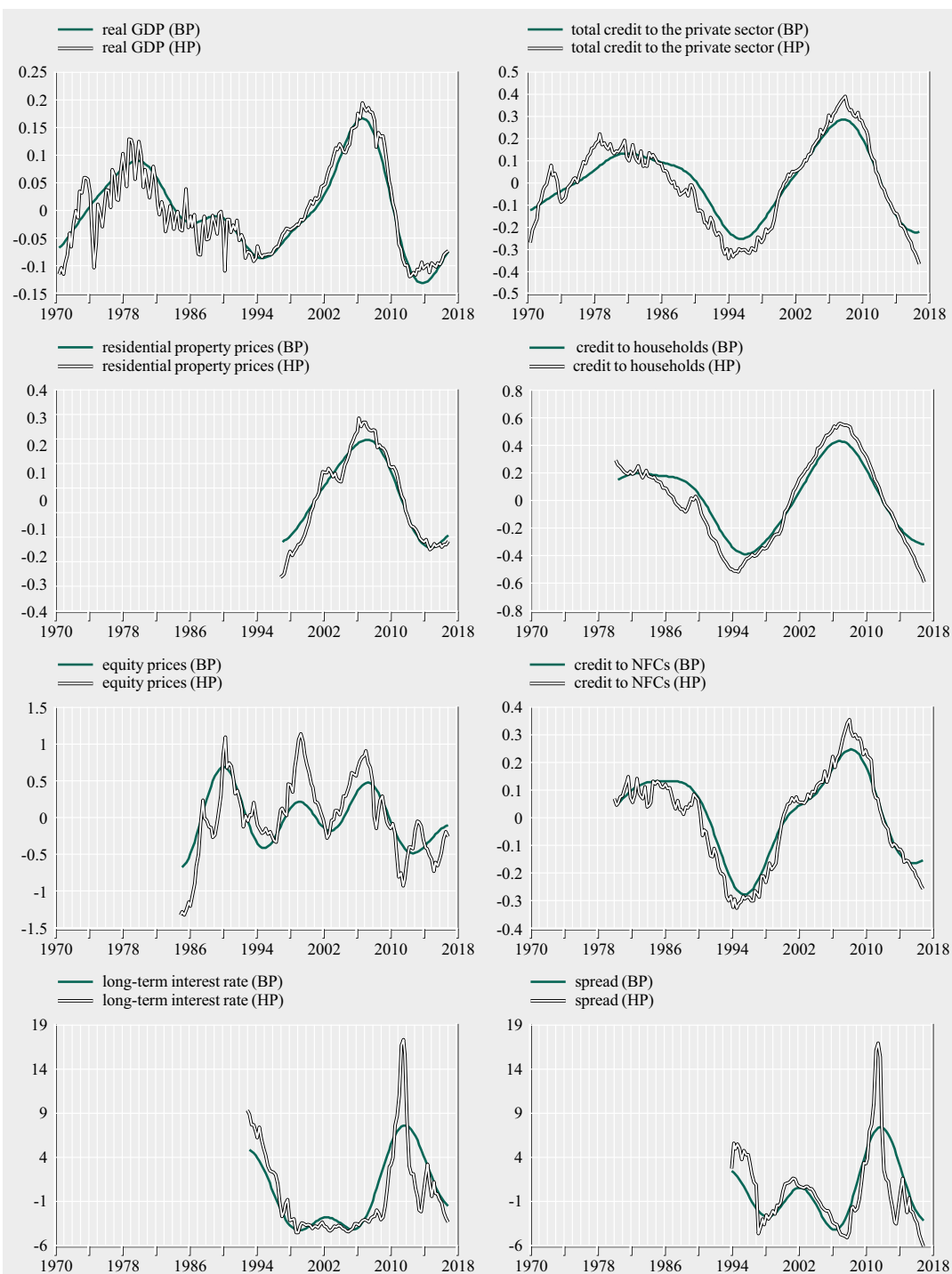
Chart A1 Bandpass filter (BP) and Hodrick-Prescott filter (HP) - Short-term cycles (1970Q1-2017Q4)



Source: Authors' own econometric estimations.

Note: For the computation of short-term cycles using the bandpass filter, a bandwidth of 8-32 quarters was employed. For the computation of short-term cycles using a Hodrick-Prescott filter, a smoothing parameter equal to 1,600 was applied.

Chart A2 Bandpass filter (BP) and Hodrick-Prescott filter (HP) - Medium-term cycles (1970Q1-2017Q4)



Source: Authors' own econometric estimations.

Note: For the computation of medium-term cycles using the bandpass filter, a bandwidth of 32-120 quarters was employed. For the computation of medium-term cycles using a Hodrick-Prescott filter, a smoothing parameter equal to 400,000 was applied.

Table A1 Data description

	Source	Time span
Real GDP	OECD.Stats	1970Q1-2017Q4
Residential property prices	ECB Data Warehouse	1997Q2-2017Q4
Total credit to the private non-financial sector	BIS	1970Q1-2017Q4
Credit to households	BIS	1980Q1-2017Q4
Credit to NFCs	BIS	1980Q1-2017Q4
Equity price index	ECB Data Warehouse	1985Q1-2017Q4
Nominal long-term interest rate	ECB Data Warehouse	1993Q1-2017Q4
3-month nominal interest rate	OECD.Stats	1994Q3-2017Q4

Notes: Series for credit to households and credit to NFCs in the BIS database are available since 1994Q4. We backcast the series and obtain data from 1980 using information from series for total loans to households and NFCs that are available since 1980Q1 from the Bank of Greece. In particular, we assume that prior to 1994Q4, the series for credit to households and NFCs grow at the same rate as the series for loans to households and NFCs, respectively. We make the same assumption in order to obtain data for 2017Q4 for total credit, credit to households and credit to NFCs.

Table A2 Properties of the filtered series: Standard deviation of short-term and medium-term cycles – HP filter

	Short-term cycles	Medium-term cycles	Relative Std.
GDP	0.027	0.081	3
Residential property prices	0.029	0.161	5.552
Total credit	0.034	0.191	5.618
Credit to households	0.035	0.315	9
Credit to NFCs	0.036	0.174	4.833
Equity prices	0.274	0.539	1.967
Long-term interest rate	0.026	0.05	1.923
Spread	0.031	0.044	1.419

Notes: The standard deviation for each variable is computed for the period in which data are available. The relative standard deviation is the ratio of the standard deviation of the medium-term cyclical component to the standard deviation of the short-term cyclical component.

Table A3 Properties of the filtered series: Duration of short-term and medium-term cycles – HP filter

	Short-term cycles			Medium-term cycles		
	Expansion	Contraction	Cycle	Expansion	Contraction	Cycle
	Number of quarters			Number of quarters		
GDP	8.1	5.8	13.3	67	35	114
Residential property prices	9.67	8	18.5	40	35	-
Total credit	6.85	6.7	13.5	57	63	120
Credit to households	10	16	17	26.5	49	99
Credit to NFCs	6	9.6	15.6	53	53	108
Equity prices	8.14	8.86	17.5	12	37.5	37
Long-term interest rate	4.75	5.63	10.38	52	26	78
Spread	10	10	17.7	16	26	41

Notes: The durations have been computed using turning point analysis in the filtered series. A full cycle is measured from peak to peak.

Table A4 Co-movement properties of the filtered series: Short-term cycles – HP filter

	<i>i</i> = -4	<i>i</i> = -3	<i>i</i> = -2	<i>i</i> = -1	<i>i</i> = 0	<i>i</i> = 1	<i>i</i> = 2	<i>i</i> = 3	<i>i</i> = 4
Residential property prices	0.3749	0.3941	0.4103	0.4074	0.4753	0.4147	0.3643	0.3498	0.3046
Total credit	0.101	0.1678	0.2507	0.3232	0.4625	0.5255	0.5624	0.6209	0.5844
Credit to households	0.5375	0.5593	0.5797	0.5767	0.6087	0.5701	0.5087	0.4952	0.4113
Credit to NFCs	-0.0017	0.0788	0.1752	0.2735	0.427	0.4955	0.538	0.6042	0.5856
Equity prices	0.2815	0.3139	0.3551	0.3914	0.366	0.2639	0.1613	0.0624	0.0174
Long-term interest rate	-0.4758	-0.5325	-0.5627	-0.5455	-0.4997	-0.4155	-0.2883	-0.1579	-0.0444
Spread	-0.5231	-0.5576	-0.5796	-0.5774	-0.5538	-0.4768	-0.347	-0.1987	-0.074

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

Table A5 Co-movement properties of the filtered series: Medium-term cycles – HP filter

	<i>i</i> = -4	<i>i</i> = -3	<i>i</i> = -2	<i>i</i> = -1	<i>i</i> = 0	<i>i</i> = 1	<i>i</i> = 2	<i>i</i> = 3	<i>i</i> = 4
Residential property prices	0.7486	0.7903	0.8265	0.8575	0.8867	0.907	0.9226	0.934	0.9363
Total credit	0.5896	0.6489	0.7035	0.7529	0.799	0.8371	0.8704	0.9	0.9219
Credit to households	0.7262	0.7696	0.8073	0.8393	0.8665	0.8893	0.9074	0.921	0.9274
Credit to NFCs	0.5623	0.6238	0.6814	0.735	0.7864	0.8281	0.864	0.8973	0.9221
Equity prices	0.6293	0.6298	0.6245	0.6119	0.588	0.5475	0.5065	0.4623	0.4192
Long-term interest rate	-0.6398	-0.6105	-0.5689	-0.514	-0.4496	-0.386	-0.3163	-0.2418	-0.1652
Spread	-0.4555	-0.4322	-0.3961	-0.3482	-0.2909	-0.2368	-0.1718	-0.1012	-0.0455

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

Table A6 Co-movements between the short-term cyclical component of GDP and the medium-term cyclical components of financial variables – HP filter

	<i>i</i> = -4	<i>i</i> = -3	<i>i</i> = -2	<i>i</i> = -1	<i>i</i> = 0	<i>i</i> = 1	<i>i</i> = 2	<i>i</i> = 3	<i>i</i> = 4
Residential property prices	0.2267	0.2298	0.2324	0.2379	0.2632	0.2812	0.2997	0.3207	0.3268
Total credit	0.0943	0.1072	0.122	0.1402	0.1716	0.2185	0.2625	0.3062	0.3286
Credit to households	0.1682	0.1649	0.1612	0.1607	0.1677	0.1964	0.2235	0.2504	0.2631
Credit to NFCs	0.0646	0.0905	0.1196	0.1542	0.2055	0.2625	0.3144	0.3686	0.3962
Equity prices	0.3576	0.3801	0.4057	0.4265	0.4079	0.3575	0.3033	0.2456	0.2107
Long-term interest rate	-0.559	-0.5889	-0.598	-0.5747	-0.5299	-0.4521	-0.3427	-0.2276	-0.1203
Spread	-0.71	-0.7345	-0.7405	-0.7214	-0.6805	-0.5882	-0.4517	-0.2977	-0.1599

Notes: The table presents the correlation of each variable's cycle shifted by $i \in [-4, 4]$ periods with the GDP cycle in period t . Correlations are computed over the period 1997Q2-2017Q4. Numbers in bold indicate the highest correlation over $i \in [-4, 4]$.

THE UTILISATION OF EU STRUCTURAL FUNDS IN GREECE¹

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I INTRODUCTION

Greece has been a net recipient of Community funds over the past 30 years, initially under the Integrated Mediterranean Programmes (1986-1989)² and subsequently under five programming periods (1st Community Support Framework (CSF) 1989-1993, 2nd CSF 1994-1999, 3rd CSF 2000-2006, National Strategic Reference Framework (NSRF) 2007-2013, and Partnership Agreement for the Development Framework (PA) 2014-2020). During the period 2000-2017, average annual inflows of structural funds from the European Union (EU) accounted for 1.6% of Greece's nominal GDP and 9.1% of the country's gross fixed capital formation.

Today, more than ever before, EU funding is of critical importance to Greece, as the protracted and deep recession of the past few years, the intensive fiscal adjustment and the unfavourable business and investment climate as a result of the crisis have limited the scope for funding from domestic sources and halted economic convergence both at the regional level and with respect to other EU Member States. By way of illustration, over a span of ten years Greece's GDP per capita in purchasing power standards (PPS) shrank from its peak of 95.6% of the EU-28 average in 2006 to just 67.6% in 2016, hitting a 20-year low.

As the Greek economy is entering a phase of recovery, EU funds may act as a catalyst for supporting economic growth, investment and employment, as well as regional convergence, without posing any major additional fiscal burden.

The objective of this article is twofold: First, to describe in a simple and coherent manner the

EU's framework and strategies for investment, in the wake of the global financial crisis and the European debt crisis. Second, to report the progress achieved so far in the implementation of the PA 2014-2020 in Greece relative to past programming periods or other EU Member States, providing at the same time more detailed information about individual operational programmes and approved projects. Furthermore, the article presents the key structural reforms that were implemented to boost investment and accelerate the absorption of EU funds, as laid out in the three economic adjustment programmes from 2010 to date. Last but not least, it seeks to evaluate the opportunities and the challenges for more effective absorption and utilisation of EU funds.

2 STRATEGIES AND INSTRUMENTS IN THE CONTEXT OF THE EU'S INVESTMENT POLICY

Regional (or cohesion) policy is the EU's main investment policy, the primary objective of which is to support economic, social and territorial cohesion within the Union. Resting upon the fundamental principles of additionality (that is, EU financing may not replace national public spending, but its contribution should add to growth) and of partnership between European and national authorities, the EU invests resources in projects and actions aimed at reducing disparities between regions, enhancing their productivity and com-

¹ The article largely draws on the analytical findings of a previous work conducted in collaboration with Giorgos Kalatzopoulos. Warm thanks are extended to Heather Gibson and Hiona Balfoussia for their comments, as well as to Vassiliki Drouka for the technical support. The views expressed in this article are of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

² The Integrated Mediterranean Programmes were incorporated into the 1st CSF after 1989.

petitiveness, promoting the development of the Single Market and reducing unemployment.

Regional policy is designed and implemented in programming periods of seven years, in line with the EU's budgetary plan (also known as the Multiannual Financial Framework – MFF)³ which finances regional policy's instruments. The most important instruments are the five European Structural and Investment Funds (ESIFs): the European Regional Development Fund (ERDF), the Cohesion Fund (CF), the European Social Fund (ESF), the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF).

As a rule, regional policy is designed at the regional level. All EU regions receive appropriations from the ESIFs; the size of receipts depends on the deviation of each region's GDP per capita from the EU average,⁴ with the exception of receipts from the CF and the EMFF for which the programming of commitment appropriations is established at the country level.⁵ Funding through the ESIFs is allocated to Member States in two main forms: (a) grants (non-repayable) and (b) loans, guarantees and equity through financial instruments. The management of grants, which account for the bulk of resources from ESIFs, is performed by the Member States themselves, but is supervised by the European Commission, which, among other things, approves the programmes included in national financing plans, pays advances or makes interim payments according to specific rules on the eligibility of expenditure, and carries out audits to ensure the legality of expenditure and address irregularities and fraud. The programmes that are financed by the ESIFs also include a national co-financing rate of 15-50%, depending on the region and the fund involved.

The current programming period of regional policy spans from 2014 to 2020. The MFF 2014-2020 sets an expenditure ceiling of EUR 1,082 billion (1% of Gross National Income

(GNI) of the EU) for the EU as a whole.⁶ Relative to the MFF 2007-2013, commitments under the current MFF were slightly reduced by around 3.5%, reflecting pressures about fiscal adjustment and spending cuts at the European and the national level (Council of the European Union 2013 and Berkowitz et al. 2015). For regional policy in particular, EUR 451 billion from the ESIFs was committed for the period 2014-2020, i.e. about 42% of total MFF expenditure, compared with 46% of total expenditure under the MFF 2007-2013.

Taking into account the impact of the financial crisis of 2008-2013, which led to a sharp decline in GDP and a rise in unemployment in many Member States, the MFF 2014-2020 included a term on the review of national allocations for the period 2017-2020 on the basis of the latest revised GDP data for 2014 and 2015. The review (European Commission 2016b) led to an increase of EUR 4 billion (at 2011 constant prices) in total available resources for those Member States where an adjustment was required.⁷ Moreover, in the case of Member States that were subject to an economic adjustment programme such as Greece, the MFF

3 The EU's MFF covers, in addition to regional policy spending, all expenditure at the EU level for different areas of activity such as the Common Agricultural Policy (CAP) or foreign and security policy, as well as the operating expenses for EU institutions. Besides, similar to any other budget, it also provides for the EU's revenue.

4 For the 2014-2020 programming period, there are three categories of regions: (1) "less developed regions", with GDP per capita less than 75% of the EU average and 50% of ESIFs' budget; (2) "transition regions", with GDP per capita between 75% and 90% of the EU average and about 10% of ESIFs' budget; and (3) "more developed regions", with GDP per capita over 90% of the EU average and 15% of ESIFs' budget. In Greece, the "less developed regions" are East Macedonia-Thrace, Central Macedonia, Thessaly, Epirus and Western Greece, the "transition regions" are Western Macedonia, the Ionian Islands, Central Greece, the Peloponnese, the North Aegean and Crete, while the only "more developed region" is Attica (Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the ESIFs, L 347/320, 20.12.2013).

5 The CF aims at Member States with Gross National Income (GNI) per capita of less than 90% of the EU average and for the period 2014-2020 it allocates resources to Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. The EMFF supports the EU's maritime and fisheries policies, and its financial allocations are determined on the basis of industry data, such as the size and the socio-economic importance of the fishing industry in each Member State.

6 At current prices.

7 The Member States that saw higher available resources on account of the review are Spain, Italy, the United Kingdom, Slovenia, Cyprus, Belgium, Denmark, Ireland, the Netherlands, Finland and Greece.

2014-2020 allowed for a higher pre-financing rate than the standard rate as well as, over the first three years of the programming period, a higher co-financing rate, with a view to facilitating national budgets at times of fiscal adjustment.⁸

At the same time, the crisis brought to the fore structural weaknesses of the EU, including the build-up of internal and external imbalances, as well as deficiencies in the economic governance framework. Against this backdrop, it was decided to revamp the framework for the supervision and coordination of economic and fiscal policies in the EU, through a reinforced Stability and Growth Pact and a closer coordination of national economic policies.⁹ A number of those reforms were integrated into the revamped framework for regional policy for the period 2014-2020, aiming to ensure a better interconnection between European policies and a more efficient and targeted use of EU available resources.

The most important changes in regional policy for 2014-2020 were, first, the new strategic approach to regional policy and, second, the rationalisation of its instruments.

Linking regional policy with other strategic priorities of the EU

The reforms for the period 2014-2020 were mainly geared towards enhancing the coordination of financing from different EU funds and better matching the broader priorities and strategies of the EU with the specific needs of Member States and regions. More specifically, direct synergies have been established between ESIFs, thematic objectives, and the goals of the EU's strategy "Europe 2020" for smart, sustainable, and inclusive growth. As a result, national plans on the absorption of funds¹⁰ and the programmes submitted by Member States for ESIF financing must now have a proven contribution to the "Europe 2020" strategy. Furthermore, they must reflect the country-specific recommendations issued in the context of the European Semester, which provides the framework for the annual coordination of eco-

nomic and fiscal policies across the EU. It is imperative that the interlinkages with the EU's broader policies and the obligations arising from the economic governance framework are maintained throughout the implementation of the programmes. If deemed necessary for the implementation of new country-specific recommendations, the European Commission may request amendments to the operational programmes.

Another major innovation was that the disbursement of ESIF funding was linked with the implementation of country-specific recommendations in the context of the European Semester, compliance with the rules of the Excessive Deficit Procedure and the Excessive Imbalance Procedure, and the implementation of economic adjustment programmes (for those Member States receiving financial assistance from the EU). In the event of a Member State's inadequate compliance with the above, the European Commission may propose to the Council the suspension of part or all of the approved ESIF commitments or payments to the Member State concerned.

The common regulatory framework for the ESIFs¹¹ also determined practical ways to create synergies between the ESIFs and other

⁸ Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the ESIFs (L 347/320, 20.12.2013) and Regulation (EU) No 2016/2135 of the European Parliament and of the Council of 23 November 2016 (L 338/34, 13.12.2016), which extended the initial deadline of June 2016 for the so-called "top-up co-financing" until 30 June of the year following the calendar year in which a given Member State stops receiving financial assistance under an adjustment programme. The rate of co-financing for Greece averages around 90%, depending on the operational programme and the category of regions (more developed, less developed or transition regions).

⁹ See also Bank of Greece (2014).

¹⁰ Under the new rules, Member States must draw up and implement strategic plans to determine their investment priorities (the so-called "Partnership Agreements" – PAs) based on receipts from the ESIFs. The prior approval of those plans by the European Commission is required for the approval of the operational and regional programmes.

¹¹ Regulation (EU) No 1303/2013 of the European Parliament and of the Council of 17 December 2013 laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund and repealing Council Regulation (EC) No 1083/2006 (L 347/320, 20.12.2013).

EU instruments and policies, e.g. by combining regional policy with European Commission funds and programmes that finance specific actions directly from the EU budget. The financial support provided by such funds and programmes may take various forms, such as grants, loans, guarantees, equity and awards, and can be complemented and/or combined with resources from the ESIFs or other funding instruments of different European organisations. The majority of such funds and programmes targets on small and medium-sized enterprises (SMEs), non-governmental organisations, the young, researchers, farmers and public bodies. Typical examples of such instruments from which Greece has received funding are the different funds for addressing the refugee crisis, the Fund for European Aid to the Most Deprived, the European programme for research and innovation “Horizon 2020”, the COSME Loan Guarantee Facility, the InnovFin SME Guarantee Facility, and the EU Programme for Employment and Social Innovation.

Perhaps the most important instrument for which the establishment of synergies with the ESIFs was promoted is the European Fund for Strategic Investments (EFSI), which lies at the heart of the Investment Plan for Europe (also known as the Juncker Plan) and which was set up by the European Commission in 2015 in response to lacking investment in Europe.¹² Investment dropped by 15% in 2015 relative to its pre-crisis levels, resulting in an investment gap that considerably hampered the implementation of infrastructure and innovation projects (European Commission 2016a). The EFSI was created in partnership with the European Investment Bank (EIB) and in 2016 its risk-taking capacity was increased in order to mobilise investment of at least EUR 500 billion in the EU by 2020. It delivers loan guarantees and equity for strategic investments mainly in infrastructure, energy, innovation and SMEs, and provides for innovative practices such as the creation of investment platforms, with a view to leveraging funds and thus increasing both available resources and the size of invest-

ment projects. Combining resources from the EFSI and the ESIFs within such kinds of instruments improves the risk/performance profile of investment projects, attracting additional private and public funds, which can even cover the national rate of co-financing for the programmes concerned. Ultimately, as a result, final available resources are set to increase and a stronger growth impact is expected (see also the analysis on financial instruments further below).

Coordination and rationalisation of regional policy instruments

The revamped regional policy framework for the period 2014-2020 placed great emphasis on improving the effectiveness of funding. For the first time ever, a common strategy for all ESIFs was developed under a single regulatory framework to ensure coordination of investments and minimise overlaps (European Commission 2015). Furthermore, clear and common priorities regarding ESIF-funded investments were determined in the form of “thematic objectives”, so that investment is concentrated on key areas with growth potential such as research and innovation, information and communication technologies, SME competitiveness, and low carbon economy.

To appropriately monitor the performance of ESIF-funded programmes, measurable milestones/targets and indicators were established, alongside a performance reserve to be allocated by the European Commission after 2018 to programmes and priorities that will have achieved their milestones. Accordingly, it was decided that the Commission has the authority to suspend all or part of an interim payment to a programme pending the completion of milestone actions.

Besides, ex ante conditionalities with regard to the legal and institutional framework or the

¹² Regulation (EU) 2015/1017 of the European Parliament and of the Council of 25 June 2015 on the European Fund for Strategic Investments, the European Investment Advisory Hub and the European Investment Project Portal and amending Regulations (EU) No 1291/2013 and (EU) No 1316/2013 – the European Fund for Strategic Investments (L 169/1, 1.7.2015).

administrative capacity of Member States were laid down, i.e. necessary conditions that should be met for receiving financing through the ESIFs. Ex ante conditionalities aim to lift horizontal and sectoral obstacles to investments in Member States, speed up structural reforms that improve the business and investment environment, accelerate the transfer of the Community acquis and reinforce the administrative capacity of the authorities involved in public investment. The establishment of ex ante conditionalities was seen as contributing to the completion of structural reforms overall and ensuring better conditions for the planning and implementation of sound public investment (European Commission 2017c).

Another important change aimed at increasing the effectiveness of regional policy resources for 2014-2020 was the strengthening and broadening of the role of financial instruments supported by the ESIFs. For all EU Member States, resources from ESIFs that were made available through the use of financial instruments almost doubled from EUR 11.8 billion in the period 2007-2013 to EUR 21.4 billion in the period 2014-2020. According to the estimations of the managing authorities, leverage through financial instruments (loans or equity) can reach 1:4. At the same time, new rules were established, offering greater flexibility in the use of financial instruments and encouraging their utilisation on the back of the following: (a) *broader scope of application*, i.e. by enabling their use for investments, irrespective of sector, contractor or type of investment, and establishing a clear-cut set of rules for their more effective coupling with other forms of funding, such as grants and the EFSI; (b) *increased possibilities to choose the level of management* (at the EU, national/regional, cross-border or even managing authority level) that corresponds to the administrative and technical capacity of Member States; and (c) *financial incentives* with the provision of a co-financing top-up in certain cases of financial instruments.

In an overall effort to increase the leverage of public resources through private funds, the European Commission placed special emphasis on the potential role of Public-Private Partnerships (PPPs). The new provisions of the PA 2014-2020 have introduced a chapter dedicated to PPPs, with a view to clarifying the possibilities provided by the ESIFs for the financial support of blended projects as well as addressing some key practical issues. This led, for instance, to simplifications in the calculation of the financing gap and to the possibility of extending the disbursement period for the respective ESIF-supported grants. In general, it should be noted that very few EU resources have been used for PPPs. Although the European Commission's policy has been encouraging the use of PPPs for some years (e.g. in the context of the Europe 2020 strategy) as a potentially effective means of delivering investment projects, the European Court of Auditors identified in a recent report (European Court of Auditors 2018) that over the period 2000-2014 only 84 PPPs, with a total project cost of EUR 29.2 billion, received EUR 5.6 billion in ESIF funding at the EU level. For the experience of Greece in this regard, see Box 1 of the present article.

Finally, for 2014-2020 the framework for the application of regional policy was simplified, among other things, by harmonising conditions on the eligibility of expenditure across the ESIFs and by reducing the administrative burden through streamlined rules on the delivery and monitoring of projects. Under the new framework, flexibility in the setting-up of programmes was enhanced, including the possibility of multi-fund programmes or projects. Moreover, the exchange of information between the managing authorities of programmes was streamlined using an electronic platform. The administrative burden on Member States and contractors was reduced further, as payments are now based on progress and results rather than on presenting accounting entries. Besides, the timely payment of beneficiaries was determined to be not later than 90 days from the date of submission of the payment claim.

Box I

EU CO-FINANCED PPPs IN GREECE¹

In Greece over the period 2000-2014, i.e. during the 3rd CSF 2000-2006 and the NSRF 2007-2013, eight projects under the Public-Private Partnership (PPP) model were carried out with co-financing from the EU, totalling EUR 6.8 billion, of which EUR 3.3 billion were EU funds (data available up to April 2016). Greece was by far the largest recipient of EU contributions to PPPs over that period (59% of total allocations).

The implementation of co-financed PPPs in Greece has been difficult, because of various conjunctural and other factors. Concessionaires' shrinking revenues from toll collection as a result of the financial crisis and the poorly prepared projects by the Greek State led to premature and eventually ineffective contracts with private concessionaires. By way of illustration, the cost per km of the three motorways assessed by the European Court of Auditors (Central Motorway – E65, Olympia Motorway, and Moreas Motorway – the Korinthos-Tripoli-Kalamata motorway and the Lefktron-Sparti section) increased by up to 69%, compared with the initial estimation, while at the same time the project scopes were reduced by up to 55%. Overall, the higher cost associated with the suspension of works and the reset of those projects after a number of years amounted to EUR 1.2 billion and was incurred mainly by the Greek State (with an EU co-financing of 36%).

As suggested by the findings of the European Court of Auditors, the implementation of successful PPP projects requires considerable administrative capability, which can only be ensured through suitable institutional and legal frameworks. Although the combination of EU funding with national resources for a PPP project entails additional requirements and uncertainties, the EU's participation can increase the affordability/feasibility of a project, lowering the levels of funding required and contributing to better risk sharing. Notwithstanding, an appropriate strategic approach is needed to promote the use of PPPs and identify the role that PPPs should play in national investment strategies, as well as to determine the sectors in which it would be advisable to commit a significant share of future budgets. In this direction, the European Commission stresses that various channels offering assistance are already available to Member States, such as JASPERS, the European Investment Advisory Hub, the European PPP Expertise Centre (EPEC) and the Structural Reform Support Service (SRSS). Furthermore, with its Communication of 3 November 2017, the Commission has introduced a helpdesk, a notification mechanism and an information exchange mechanism, aimed at helping Member States and contracting authorities to better design their large infrastructure projects and the PPPs.

¹ European Court of Auditors (2018), *Public Private Partnerships in the EU: Widespread shortcomings and limited benefits, Special Report No 09*, Luxembourg.

3 EU REGIONAL POLICY IN GREECE (PA 2014-2020)

For Greece, EUR 21 billion¹³ (at current prices) in ESIF-supported funding was earmarked for the programming period 2014-2020, compared with EUR 24.3 billion in the period 2007-2013.¹⁴

¹³ Amounts are expressed at current prices on the basis of data from the presentation of the Ministry of Development and Competitiveness entitled "Approval of the new Partnership Agreement for the Development Framework for the period 2014-2020", May 2014.

¹⁴ As a result of the technical adjustment in the Multiannual Fiscal Framework 2014-2020 that took place in 2016 using GDP data for 2014-2015 (European Commission 2016b), total allocations to Greece for the current programming period increased by about EUR 836 million at 2011 constant prices, or EUR 970 million at current prices. These additional allocations are not taken into account in the present discussion, as the revised Partnership Agreement (PA) is expected to be released soon by the Ministry of Economy and Development.

The main national plan for the utilisation of resources originating from the ESIFs is the PA (Partnership Agreement for the Development Framework) 2014-2020,¹⁵ according to which Greece's financing priorities for the reference period are the following:

- Enhancing business competitiveness and extroversion, with a focus on high value-added activities, the creation of a business-friendly environment and the promotion of research and innovation.
- Development and utilisation of human resources skills through education and lifelong learning, actions focusing on the creation of jobs, especially for young people, and actions to promote social inclusion and combat poverty.
- Transition to a more environmentally friendly economy, fostering climate change adaptation, risk prevention and the shift to a low carbon economy.
- Completion and modernisation of infrastructures for economic and social growth, with a focus on the Trans-European Transport Networks, with vertical axes and multi-modal transport, as well as on energy and broadband networks.
- Improvement of the institutional capacity and the efficiency of public administration and local governments.

The PA 2014-2020 comprises 13 regional and 7 sectoral operational programmes (OPs), the most important of which are:

(a) the OP “Competitiveness, Entrepreneurship and Innovation”, with a budget of EUR 3.8 billion or 25% of total commitment appropriations from Structural Funds, focusing on economic sectors with a comparative advantage that were seen as capable of providing a boost to the growth of the Greek economy, such as tourism, the agri-food sector, manufacturing and services of high domestic value added, as well as on export-oriented firms and innovation development;

(b) the OP “Transport Infrastructure, Environment and Sustainable Development”, with a budget of EUR 3.7 billion (about 24% of total appropriations), aimed at the modernisation of the transport system and the completion of ongoing NSRF projects as at the beginning of the programming period 2014-2020 (e.g. the core Trans-European Transport Network), as well as the attraction of investments in environmental business projects;

(c) the OP “Human Resources Development, Education and Lifelong Learning”, with a budget of EUR 2 billion (13% of total appropriations), for the implementation of actions geared towards supporting the creation of sustainable employment, promoting active inclusion in the labour market and upgrading the education system; and

(d) the OP “Public Sector Reform”, with a budget of EUR 0.4 billion (3% of total appropriations), aiming to introduce new information technologies in the public sector.

Besides, the following three programmes were designed: (a) the OP “Technical Assistance”, which aims to support the operation and implementation of all other OPs funded by the ESIFs; (b) the OP “Rural Development Programme”, which aims to develop the agri-food sector and enhance its competitiveness; and (c) the OP “Fisheries and Maritime”, which aims to improve the competitiveness of the aquaculture sector and the viability of the sea fisheries sector.¹⁶

¹⁵ Ministry of Development and Competitiveness, General Secretariat for Public Investment and NSRF, PA 2014-2020 (Partnership Agreement for the Development Framework 2014-2020), Athens, May 2014.

¹⁶ Furthermore, in the context of the EU cohesion policy, the European Territorial Cooperation (Interreg) is the key instrument to support territorial cooperation both between EU partners and with third countries. Interreg at the Member State level is implemented through programmes of cross-border, transnational and interregional collaboration. These programmes are split into bilateral and multilateral. The five bilateral programmes involve cooperation between Greece and its five neighbouring countries. Three of those countries are EU Member States (Cyprus, Bulgaria and Italy) and are financed by the ERDF, while the two other countries are EU candidate countries (Albania and FYROM) and are financed by the Instrument for Pre-Accession Assistance. The bilateral Territorial Cooperation Programmes are a key driver of growth for all participating regions, promoting the creation of a single European cooperation territory in the Balkans and along the country's western and northern borders.

4 THE IMPLEMENTATION PATH OF THE PA 2014-2020

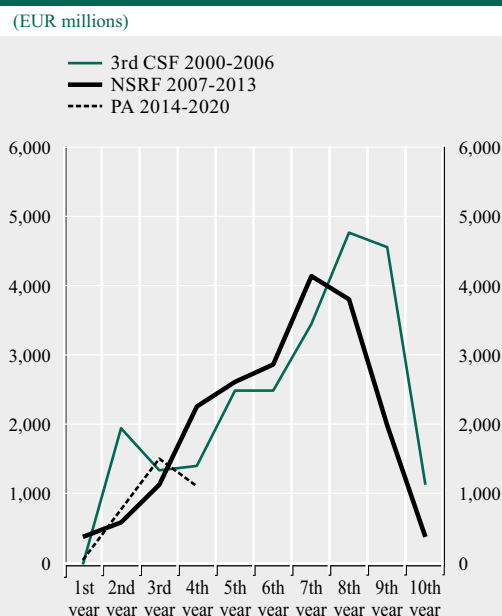
Annual and cumulative absorption:¹⁷ a comparison with past programming periods and other countries

The amount of annual receipts depends on a number of factors, such as: (a) total available structural funds per programming period, which in the case of Greece were reduced under the PA 2014-2020 relative to the previous two programming periods; (b) the automatic decommitment rule $n+2$ (or $n+3$), which allows the absorption of any amounts that were left unused beyond the end of the respective programming period; (c) the progress made in the implementation of approved projects; and (d) other extraordinary administrative or legislative decisions. More generally, as a result of the back-loaded execution of the co-financed expenditure under the Public Investment Programme in recent years, the absorption of EU funds tends to pick up in the last quarter of each year and the first quarter of the subsequent year.

According to the latest (provisional) cash data, Greece's *annual receipts* from EU Structural Funds amounted to EUR 1,252 million in 2017 (of which EUR 1,130 million originated from the PA 2014-2020), i.e. visibly lower compared with the previous years of the current programming period for the PA 2014-2020 and the respective fourth year of the past two programming periods for the NSRF 2007-2013 and the 3rd CSF 2000-2006 (see Chart 1). The subdued absorption rate continued into the first quarter of 2018, with inflows of structural funds amounting to a mere EUR 317 million.

The relatively low annual flow in 2017 may be explained by factors that had boosted receipts in 2014-2016 but are no longer effective, as well as by factors which are more directly related with the progress in the delivery of projects in 2017. Over the period 2014-2016, increased inflows of structural funds were mainly associated with the full absorption of unused resources from the NSRF 2007-2013 according

Chart 1 Annual inflows of EU resources per programming period



Source: Authors' own calculations based on Bank of Greece data. Notes: The 3rd CSF 2000-2006 comprises the Structural Funds (ERDF, ESF, CF), the European Agricultural Guidance and Guarantee Fund (EAGGF) and the Financial Instrument for Fisheries Guidance (FIFG). The NSRF 2007-2013 and the PA 2014-2020 comprise solely the Structural Funds ERDF, ESF and CF.

to the $n+3$ rule. The absorption was underpinned by the EU's extraordinary measure to increase the EU co-financing rate to 100% with retroactive effect (top-up), as well as the by the decision on the early disbursement of the final 5% of payments, which should otherwise be released upon conclusion of the operational programmes in March 2017. Increased inflows also reflect the EU's payment of an *additional initial pre-financing amount* of 3.5% of the amount of support from the three Structural Funds and the EMFF to Greece each year in 2015 and 2016,¹⁸ which corresponded to an additional EUR 500 million annually.

¹⁷ Bank of Greece calculations based on cash inflows from EU Structural Funds (provisional data). Structural Funds are defined herein as the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF) for the NSRF 2007-2013 and the PA 2014-2020, and the ERDF, the ESF, the CF, the EAGGF and the FIFG for the 3rd CSF 2000-2006.

¹⁸ Regulation (EU) 2015/1839 of the European Parliament and of the Council of 14 October 2015 amending Regulation (EU) No 1303/2013 as regards specific measures for Greece (L 270/1, 15.10.2015).

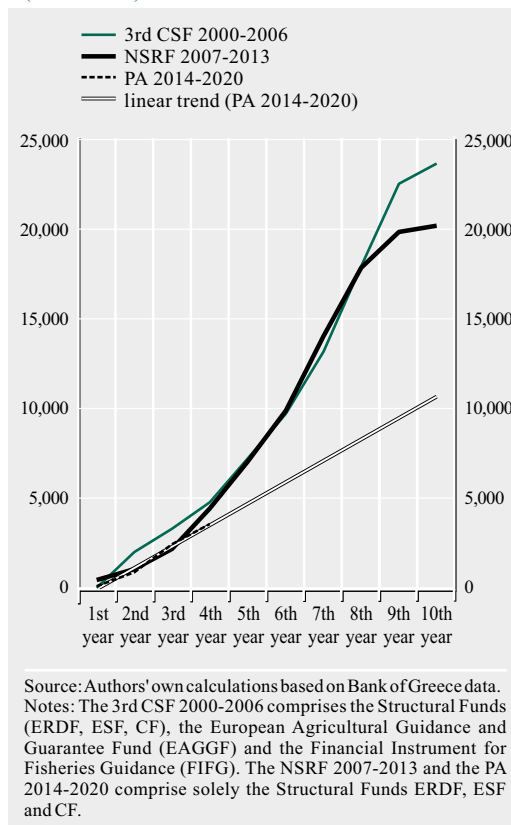
Additional financing for Greece came as an urgent measure to complement the advance payments which are envisaged in the relevant EU Regulations on the ESIFs, namely: (a) *initial pre-financing* corresponding to 1% of operational programmes, which was allocated in three instalments over the period 2014-2016 and is expected to be netted at the end of the programming period; and (b) *annual pre-financing* ranging between 2% and 3% of earmarked funding, which refers to years 2016-2023 and is netted at the end of each year. If no payment claims of an adequate level representing a certified expenditure have been submitted within the netting period, the amounts of unused advance payments shall be repaid to the Commission.

The European Commission, with these specific measures adopted in favour of Greece by way of derogation, acknowledged the consequences of the deep and protracted recession, which brought about liquidity shortages and a lack of public funds available for productive investments. Indeed, the quasi-full utilisation of additional pre-financing greatly contributed to the provision of liquidity to the economy in 2015-2016 and the smooth initiation of new programmes. Nevertheless, the relative lack of new and mature projects, as well as to a lesser extent the repayment within 2017 of the unused annual advance payments of 2016 dampened the pace of receipts in 2017. According to European Commission data,¹⁹ Greece was asked in 2017 to repay only 6% (EUR 70 million) of the total amount of additional pre-financing for years 2015-2016, but 88% (EUR 261 million) of the total amount of initial pre-financing for 2016 (including the EMFF and the Youth Employment Initiative). It should be noted that those repayments have not affected the level of available support under the PA, yet only its annual flow.

We get a fuller picture if, instead of annual receipts, we examine *cumulative flows*. Cumulative flows best capture the implementation path of the PA 2014-2020, as on the one hand they normalise any strong annual movements

Chart 2 Cumulative inflows of EU resources per programming period

(EUR millions)



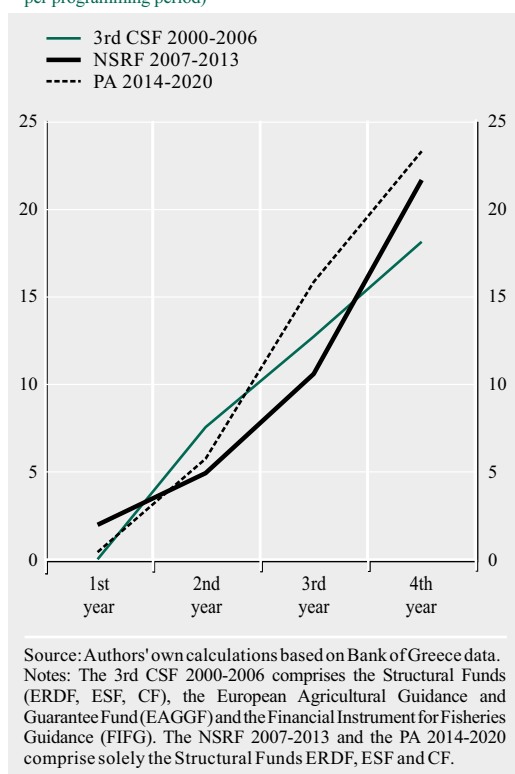
and on the other hand they isolate the effect of inflows from past programming periods. Thus, between the beginning of the current programming period in 2014 and the end of 2017, i.e. in four years, the cumulative inflow of financing from EU Structural Funds amounted to EUR 3,522 million and is lower than the cumulative inflows for the respective years of both previous programming periods (see Chart 2). This comparison is useful, as it suggests that the weakness in inflows observed in 2017 (and which appears to persist in 2018) occurs at a time when an acceleration in receipts was recorded during the past two programming periods.

However, the *absorption rate* of structural funds, which is defined as cumulative receipts

¹⁹ See <https://cohesiondata.ec.europa.eu/EU-Level/ESIF-2014-2020EU-payments-daily-update/-gayr-92qh>.

Chart 3 Absorption of EU structural funds per programming period

(period cumulative figures as % of total available structural funds per programming period)



as a percentage of the total budget of Structural Funds under the PA 2014-2020 for Greece and which stood at around 23% at end-2017²⁰ (or 25% in the first quarter of 2018), could be deemed normal on the basis of past experience. As a matter of fact, this absorption rate outperforms the respective rate that was observed in past programming periods (22% for the NSRF 2007-2013 and 18% for the 3rd CSF 2000-2006), despite the weakness observed in nominal inflows since 2017 (see Chart 3). This is largely due to the lower level of total available EU funds for the PA 2014-2020, relative to the NSRF 2007-2013 and the 3rd CSF 2000-2006 (positive outcome from a smaller denominator).

It should be noted that Greece's absorption of structural funds is higher than the EU average (15%) during the period from 2014 until the first quarter of 2018, partly reflecting the pos-

itive effect of the additional initial pre-financing provided to Greece in 2015-2016, which was significantly higher compared with other EU Member States (see Chart 4). The front-loaded inflow of structural funds in the form of advance payments seems to have helped boost projects and investment expenditure, as mirrored in the increased interim payments (certified expenditure) from the EU's three Structural Funds. Yet, for the five ESIFs as a whole, interim payments to Greece fell short of those to other Member States (France, Portugal, Sweden, Ireland, Austria and Finland) until March 2018, in spite of higher advance payments. This is mainly due to a shortfall in inflows originating from the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF).

Overall, experience has shown a strong pick-up in absorption from the fourth year until the end of each programming period, in an effort to avert losing any EU funds (see Charts 1 and 2 above). However, this was not the case for the fourth year of the PA 2014-2020, i.e. 2017, while initial signs for 2018 point to a subdued fifth year as well. Looking ahead, efforts must be stepped up to ensure a full absorption of funds (see also Section 5).

The implementation by operational programme (OP) and projects' main features

Selected projects under the PA 2014-2020²¹ until March 2018 – i.e. those projects that have been positively assessed for co-financing by the ESIFs excluding the EAFRD – corresponded to a public expenditure budget²² amounting to EUR 11 billion, or 56.7% of the total amount of available public expenditure (EUR 19.4 billion) envisaged for the period 2014-2020. The

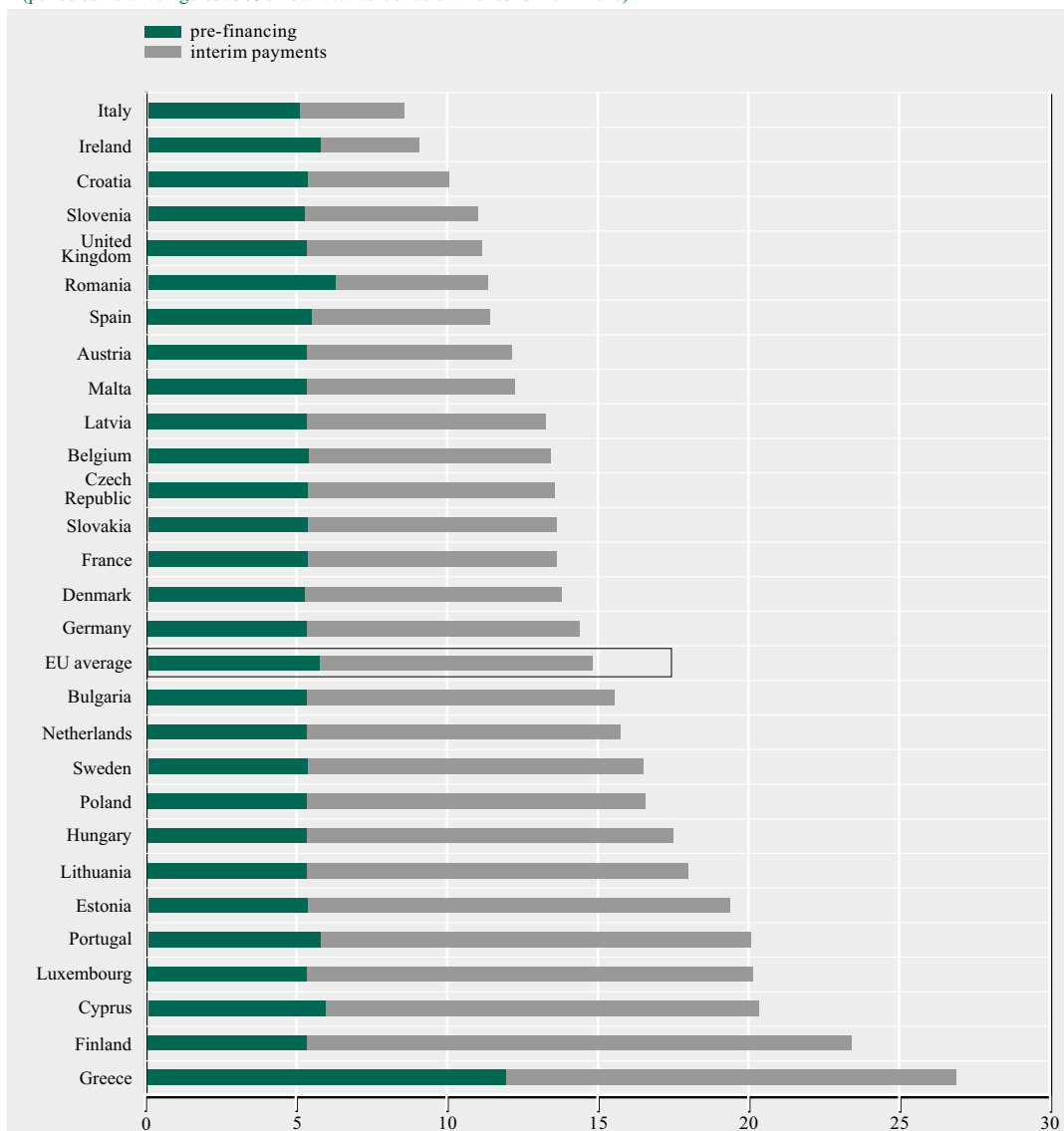
²⁰ See footnote 17.

²¹ Authors' own calculations based on data from the "List of Operations, 15/03/2018". The List of Operations is updated every six months and is released by the Integrated Information System Special Service (<https://www.espa.gr/el/Pages/ProgramsList.aspx>). It should be noted that the total budget of selected projects and the percentage of EU commitments are subject to revisions. Moreover, the List of Operations may differ in various ways from the respective list of projects and grants/aids that is available on ANAPTYXI.gov.gr. (<http://anaptyxi.gov.gr/Analiseis/Analytika2.aspx?mod=1&>).

²² Public expenditure consists of EU funds and national expenditure.

Chart 4 Absorption of structural funds per EU Member State (January 2014-March 2018)

(period cumulative figures as % of total available structural funds for 2014-2020)



Source: Bank of Greece calculations based on European Commission data (<https://cohesiondata.ec.europa.eu/>).

Notes: The calculations refer to the three EU Structural Funds: the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF). The amounts of inflows and the ensuing absorption rates of structural funds, as published in real time on the European Commission's Cohesion Data Portal, may vary slightly from Bank of Greece data, reflecting different manner and timing of recording.

percentage of public expenditure commitments varied across OPs, ranging from 28% for the OP “Fisheries and Maritime” to 94% for the OP “Technical Assistance” (see Table 1).

Looking into the number and the size of selected projects, from a total of 21,779 proj-

ects approved until March 2018, those with a budget over EUR 100,000 accounted for 21% of total projects, while projects with a budget over EUR 1 million accounted for a mere 7% (see Chart 5). Two thirds of the total budget of all selected projects concerned the three largest of the seven OPs, namely “Transport

Table I Project approval and absorption of EU resources (January 2014-March 2018)

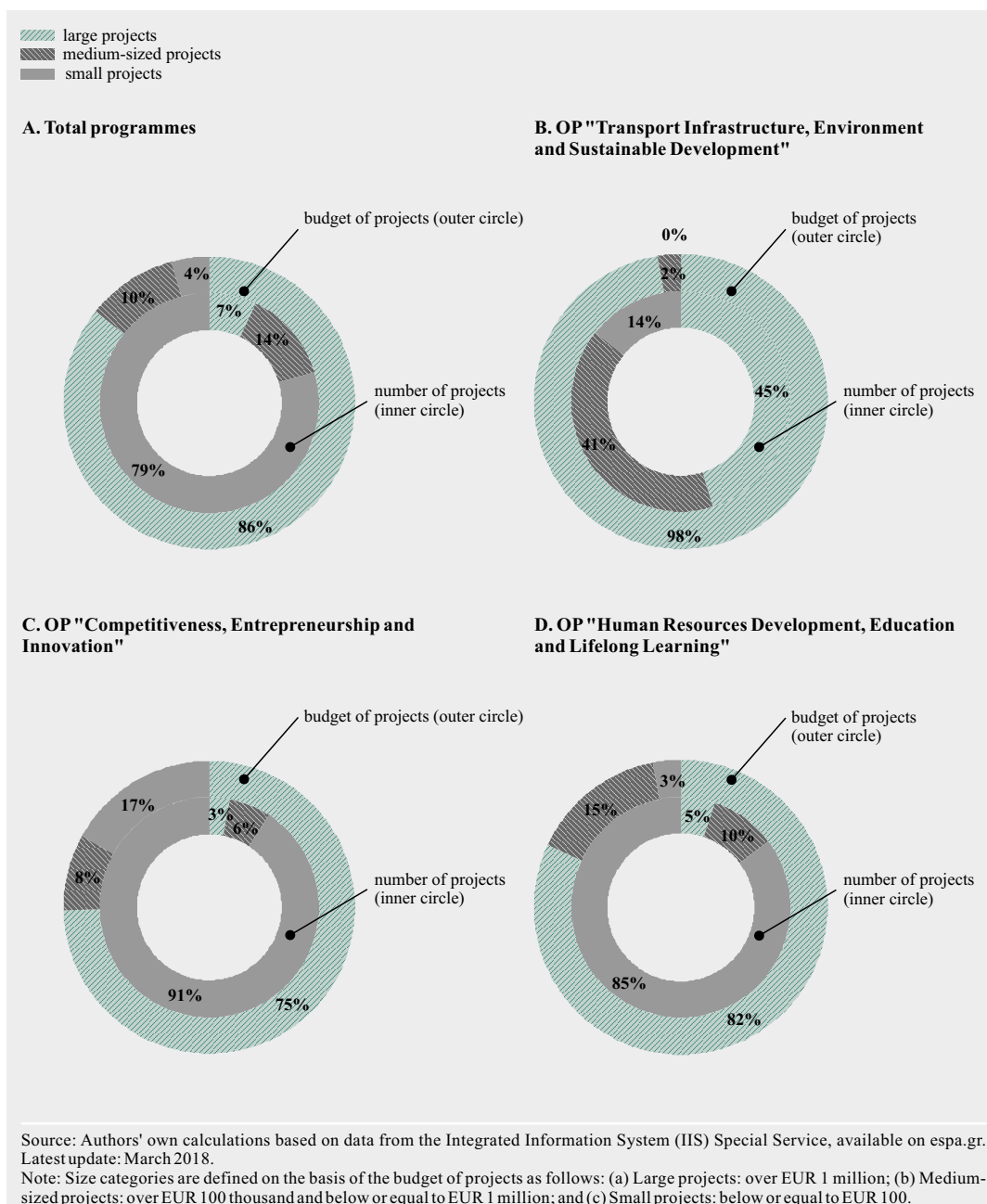
(sums in EUR)

	Approved projects: public expenditure budget for the PA 2014-2020 (1)	Total public expenditure for the PA 2014-2020 (initial estimation) (2)	Approved projects: budget as % of total public expenditure for the PA 2014-2020 (3) = (1)/(2)	Absorption of EU resources for the PA 2014-2020 (4)	Total available EU resources for the PA 2014-2020 (initial estimation) (5)	Absorption of EU resources as % of total available EU resources for the PA 2014-2020 (6) = (4)/(5)
OPERATIONAL AND REGIONAL PROGRAMMES (in descending order on the basis of the public expenditure budget)						
Transport Infrastructure, Environment and Sustainable Development	3,346,084,271.00	4,262,099,546.29	78.5%	1,134,095,464.05	3,550,585,954.04	31.9%
Competitiveness, Entrepreneurship and Innovation	2,156,616,810.00	4,557,972,863.10	47.3%	770,467,695.34	3,646,378,290.48	21.1%
Human Resources Development, Education and Lifelong Learning	1,676,522,573.00	2,631,158,171.95	63.7%	1,024,707,098.03	2,104,926,537.56	48.7%
Attica	564,175,440.00	1,366,148,364.95	41.3%	216,733,240.44	1,104,227,761.65	19.6%
Central Macedonia	562,900,355.00	1,184,728,313.77	47.5%	224,142,342.22	958,775,857.58	23.4%
Technical Assistance	369,686,134.00	391,994,442.43	94.3%	57,482,738.26	317,612,062.97	18.1%
Western Greece	273,876,417.00	535,988,225.64	51.1%	68,030,076.04	431,040,705.30	15.8%
Crete	233,883,467.00	441,051,338.80	53.0%	43,805,699.10	353,149,481.82	12.4%
Public Sector Reform	229,971,199.00	471,535,521.48	48.8%	58,975,077.67	377,228,417.18	15.6%
East Macedonia-Thrace	221,295,749.00	578,108,447.16	38.3%	48,307,889.32	466,005,213.30	10.4%
Epirus	209,856,552.00	354,991,265.54	59.1%	27,167,254.98	285,450,231.10	9.5%
Western Macedonia	192,922,888.00	352,711,288.59	54.7%	23,827,151.33	283,267,708.59	8.4%
Thessaly	183,445,656.00	488,634,697.39	37.5%	37,432,121.98	395,282,958.82	9.5%
North Aegean	161,513,376.00	315,097,869.81	51.3%	23,279,000.45	252,749,714.35	9.2%
Ionian Islands	118,163,898.00	244,571,758.24	48.3%	23,505,634.36	196,539,759.53	12.0%
Central Greece	107,517,413.00	328,728,599.90	32.7%	3,121,824.52	164,364,299.95	1.9%
South Aegean	101,523,282.00	215,204,195.18	47.2%	2,762,382.00	107,602,097.59	2.6%
Peloponnese	98,430,349.85	345,384,975.33	28.5%	23,936,035.35	280,060,112.06	8.5%
Fisheries and Maritime	93,234,549.00	333,333,333.33	28.0%	0.00	250,000,000.00	0.0%
Greece-Bulgaria	53,607,354.00	-	-	0.00	-	-
Greece-FYROM	33,688,676.21	-	-	0.00	-	-
Greece-Italy	3,671,405.00	-	-	0.00	-	-
Greece-Albania	3,276,100.00	-	-	0.00	-	-
Balkan-Mediterranean	2,913,303.00	-	-	0.00	-	-
Greece-Cyprus	2,166,354.00	-	-	919,231.02	-	-
Total	11,000,943,571.06	19,399,443,218.88	56.7%	3,812,697,956.46	15,525,247,163.86	24.6%

Source: Authors' own calculations based on data from the Integrated Information System (IIS) Special Service, the presentation of the Ministry of Development and Competitiveness entitled "Approval of the new Partnership Agreement for the Development Framework for the period 2014-2020", May 2014, and the Bank of Greece.

Notes: For column (1), last update of IIS data: March 2018. For column (4), cumulative inflows during the period January 2014-March 2018.

Chart 5 Number and budget of projects approved under the PA 2014-2020, by project size category



Infrastructure, Environment and Sustainable Development”, “Competitiveness, Entrepreneurship and Innovation” and “Human Resources Development, Education and Lifelong Learning”. As expected, the OP “Human Resources Development, Education and Life-

long Learning” comprised a larger number of projects with a lower budget compared with the other major sectoral OPs. This is also evidenced by the fact that the ten projects with the highest budget included in the OP “Human Resources Development, Education and Life-

Table 2 Overview of the progress in the approval and implementation of the three largest OPs achieved until March 2018

OPERATIONAL PROGRAMME	Approval rate	Implementation rate
Transport Infrastructure, Environment and Sustainable Development	HIGH	LOW
Competitiveness, Entrepreneurship and Innovation	LOW	MEDIUM
Human Resources Development, Education and Lifelong Learning	MEDIUM	HIGH

Source: Authors' own calculations based on data from the Integrated Information System (IIS) Special Service and the Bank of Greece.

long Learning” accounted for about 45% of public expenditure commitments for this OP, whereas for the other OPs this share averaged about 60%.

More generally, with regard to the selection of projects, data available up until March 2018 suggest that the OP “Transport Infrastructure, Environment and Sustainable Development” was moving very fast, the OP “Human Resources Development, Education and Lifelong Learning” progressed at a satisfactory pace, while the OP “Competitiveness, Entrepreneurship and Innovation” was rather sluggish.

Combining the above information about project selection pace with data on inflows of structural funds per OP,²³ a more comprehensive picture can be drawn regarding the absorption rate of the PA 2014-2020. Specifically, the OP “Competitiveness, Entrepreneurship and Innovation” had been recording until March 2018 the lowest cumulative absorption rate (21%), partly on account of lacking projects selected for implementation, followed by the OP “Transport Infrastructure, Environment and Sustainable Development” (32%), which by contrast exhibited the highest project selection pace, as mentioned above. It is only natural to expect that the highest absorption of EU funds was displayed by the OP “Human Resources Development, Education and Lifelong Learning” (49%), which combined a good degree of project selection with a high degree of project delivery (see Table 2).²⁴

The profile of absorption partly reflects the specific characteristics of each OP. The OP

“Human Resources Development, Education and Lifelong Learning” comprises a large number of smaller projects that are more or less associated with policies to address the impacts of the recession and protect the more vulnerable social groups, in the context of which actions may be easier to conclude and the related expenditure may be easier to certify. Examining the ten largest projects in terms of budget²⁵ included in this OP until March 2018, illustrative examples of successful social policy actions are the subsidised fixed-term employment programmes for the unemployed and the young, as well as the allocation of places in public and private childcare facilities, all contributing to stronger labour force participation and higher employment rates as well as to the financial support of low-income families. Conversely, the training and certification programme for unemployed persons in cutting-edge sectors lagged significantly behind.

In contrast with social policy actions, infrastructure projects usually are larger in size, take a long time to be completed and may encounter obstacles to implementation which are related with expropriations, archaeological works, local communities, the national cadastre, continuity of financing flows, etc. Infrastructure projects are often characterised by inadequate planning, ineffective management, slow political consensus process regarding the

²³ See footnote 17.

²⁴ It should be noted that absorption rates remained broadly unchanged in April and May 2018.

²⁵ Authors' own calculations based on data about the public expenditure budget and the level of payments per project, as published by ANAPTYXI.gov.gr.

programming of the projects, and disagreement between government and concessionaires (PwC 2018), leading to major delays in the delivery of projects and cost overruns. Examining the ten largest infrastructure projects in terms of budget until March 2018, it follows that huge delays were observed in the completion of construction works for the Thessaloniki metro and the expansion of the Athens metro, the construction of the Patra-Pyrgos motorway and the installation of electrification and telecommunication systems on the new railway line of Kiato-Rododafni.

However, an alarming picture was painted by the course of the OP “Competitiveness, Entrepreneurship and Innovation”, which lagged behind the other OPs in the absorption of EU funds but, most importantly, in the selection of projects aimed at supporting the country’s potential output, productivity and extroversion. With regard to the lower absorption of funds for the specific OP, this may be associated with the fact that a large part of the budget of selected projects refers to financial instruments, the use of which is more difficult than the absorption of grants, due to Greece’s limited experience in the implementation of such instruments. Therefore, the weak absorption observed in this OP could indicate the existence of obstacles to both corporate funding and the activation of the so-called “funds of funds”. Looking into the ten largest projects of this OP until March 2018 in terms of budget, projects for land mapping, for upgrading the skills of the scientific personnel in the health sector and for enhancing home energy efficiency posed serious delays, and funding from the Entrepreneurship Fund II, the Infrastructure Fund, the EquiFund and the Home Savings Programme II lagged visibly behind.

Finally, mention should be made of the fourth sectoral OP on “Public Sector Reform”. Despite its key significance for Greece, this programme lags visibly behind both in available EU structural funds (amounting to just EUR 230 million) and in the selection and implementation of projects. The absorption of

available EU structural funds stood at a mere 16% in March 2018, which is the lowest across sectoral OPs. Going through the ten largest projects of this OP in terms of budget, projects that involve reforms in the health sector (e.g. primary healthcare units and IT systems serving the National Health System) remained inactive, while the second phase of actions on the development of fast-track career executives to meet the needs of the public sector as well as actions to enhance coordination and information exchange in the area of non-performing loans (such as the setting-up and staffing of regional Service and Support Centres for Borrowers) are still pending.

5 KEY DETERMINANTS OF ABSORPTION

The above analysis of OPs and experience from past programming periods clearly reveal that what is required for a full absorption of available resources under the PA 2014-2020, apart from a faster maturation of ongoing projects, is a rationalisation of OPs through the approval and implementation of new projects, alongside the termination of inactive ones. It goes without saying that delays in the completion of projects that were carried over from the previous NSRF 2007-2013 or in the approval of new projects imply slower absorption of EU funds and lower investment levels. In the light of the above, 2018 and 2019 are seen as critical years for the implementation path of the PA 2014-2020, in order to reverse the subdued trend in absorption observed throughout 2017 (as well as in the first months of 2018) and ensure a convergence of annual absorption rates of the current programming period to those of the past two periods, so as to avert the loss of funds.

Factors which are expected to contribute to the fast absorption of EU funds are: (a) the high rates of EU co-financing, which in some cases reach up to 90% of the budget of the co-funded investment; (b) the envisaged annual advance payments until 2013 and the escrow account that secures advances to beneficiar-

ies without letter of credit; (c) the recent institutional interventions geared towards a more effective implementation of programmes, such as demarcation between political and administrative tasks, enhanced coordination of funds, intensification of anti-fraud measures, simplification of projects' payment cycle and launch of new financial instruments supported by the ESIFs; and (d) the latest legislative acts on modernising and streamlining investment-related procedures in public administration.

Nevertheless, despite the sustained efforts of the EU and Greek authorities over the past few years to lift any administrative and organisational rigidities at various stages of the PA 2014-2020 (i.e. the specification of actions, calls for tenders, selection of final beneficiaries, approval and implementation of projects, payments), obstacles or delays still remain in practice. An illustrative example is the coordination and completion of actions on land uses (e.g. forest maps), the cadastre, expropriations and licensing, which have a combined and multi-faceted effect on project implementation.

Due to its great relevance, the problematic absorption of EU structural funds in Greece was included in all three economic adjustment programmes and in the main agenda of the Task Force for Greece (TFGR). The three economic adjustment programmes attempted to address the issue of EU funds absorption in a holistic way, focusing on the structural weak-

nesses along the planning and implementation chain of a co-financed project. The actions included in the economic adjustment programmes involved the procedures, structures, instruments and personnel that were directly associated with the management of EU structural funds in Greece, as well as broad-ranging issues regarding the cadastre, archaeological works, environmental permits, public procurement and contract enforcement, which may hamper the materialisation of an investment.

The most important actions towards a more effective and faster absorption of EU structural funds, as laid down in the economic adjustment programmes and implemented in part with the assistance of the TFGR, are described in Box 2 of the present article.

In sum, problems appear to be concentrated in the following areas: (a) an across-the-board application of primary and secondary legislation; (b) the creation and operation (including the optimisation, integration and interconnectedness) of IT systems and digital tools that are related with the planning, execution and monitoring of an investment; (c) upgrading the administrative and managerial capacity and expertise of the staff involved in the PA (especially in the field of financial instruments); and (d) reducing bureaucracy during the examination of operations and the payment of final beneficiaries that often is long delayed compared with what is provided for in the relevant Regulation on the ESIFs.

Box 2

ACTIONS IN THE AREA OF EU STRUCTURAL FUNDS AND INVESTMENT

The most important actions in the area of EU structural funds and investment, as captured by the three economic adjustment programmes for Greece, are the following:

- Quantitative targets were determined regarding the payment claims from EU Structural Funds submitted by the Greek authorities to the European Commission for the years 2010-2014, which in their majority have been met.

- A list of 181 “priority projects” under the NSRF 2007-2013 was drawn up, while a fast-track project production system and a close monitoring system were launched to ensure completion by 2015. For the programming period 2014-2020, the Greek authorities agreed with the European Commission on a list of 15-20 “emblematic” projects, including timelines from approval to completion. Under the Supplemental Memorandum of Understanding that was signed in March 2018, the establishment of a close steering process for such major projects is foreseen.
- Efforts were stepped up to streamline organisational structures and the tasks of staff involved in the management of projects through a mapping of job descriptions, the elimination of unnecessary intermediate stages, the setting of reasonable deadlines and the merging of administrative functions, where needed. At the same time, the use of electronic payments to final recipients was introduced via the information system of the Public Investment Programme, while a summary of payments is posted online (Programme “Diavgeia”).
- A strategy to fight fraud relating to resources from EU Structural Funds was designed.
- An effective inter-service consultation system, which is supported by the necessary electronic interconnection of all public entities involved, was established, with increased responsibilities to cover the entire project maturity cycle.
- An inter-ministerial committee for large-scale projects was set up, entrusted with the task to suggest solutions when the projects come up against obstacles.
- A registry of experts was created in 2018 for the supervision of co-financed projects, especially in smaller municipalities with inadequate technical capability.
- The role of a Technical Consultant was foreseen in new contracts of municipal construction projects.
- Managerial positions were announced for all managing entities of EU Structural Funds in Greece and ministerial decisions were signed regarding the assessment and the mobility of managers.
- In 2017, an Integrated Monitoring System for Indicators 2014-2020 was approved (by Decision of the General Secretary) for the monitoring of Operational Programmes and in the context of Annual Implementation Reports and the PA 2014-2020 Progress Reports.
- Legislation was enacted with a view to shortening time limits and simplifying procedures for the award of public works contracts, also providing for faster and more effective contract enforcement and dispute resolution. Furthermore, the supporting documents for participation in tenders for public works were standardised and the required actions for the set-up and use of electronic tools, such as the National System of Electronic Public Procurement and the Central Electronic Public Procurement Registry, were gradually concluded, enhancing the transparency, sound management, accountability and oversight of the Greek public procurement system.
- In 2010, a centralised database was created for the monitoring of compensation costs and of the time that has elapsed until the conclusion of expropriations. Over the past two years, efforts have been stepped up to streamline the expropriation procedures under a new unified legislative framework. An action in this direction involved the submission of a proposal to the General

Secretariat of Digital Policy regarding an integrated geospatial and cadastral information system, aimed at a more effective management and monitoring of expropriations and the ensuing costs.

- At the same time, under Law 4512/2018 the public company “Hellenic Cadastre”, which is responsible for ensuring the reliability, publication and availability of spatial and legal information relating to real estate ownership, the organisation and maintenance of digital geospatial data as well as the compilation, maintenance, updating and operation of the National Cadastre. According to the latest Compliance Report (July 2018), forest maps are foreseen to be completed and ratified by 30 June 2021.
- The legislation regarding provisions on archaeological research and works was codified and then simplified. The law stipulates that, during the environmental impact assessment¹ of large-scale public projects, a Detailed Archaeological Documentation Report is drafted, whose level of specification and drafting deadline as well as the time needed for a permit to be issued are clearly determined in Law 4512/2018.
- By Law 4512/2018 a Central Electronic Monitoring System for Civil Engineering Works (KHSPATE) was set up, with a view to ensuring transparency, expediting administrative procedures, economising public resources and rationalising output costs for public and private projects. The law provides for the interconnection of KHSPATE with several other electronic registries and monitoring systems for civil engineering works throughout their planning and implementation.
- An electronic platform for the notification of business activity commencement in several sectors was activated, which simplifies the procedures for the establishment and licensing of new enterprises.

In tandem with the economic adjustment programmes, a Task Force for Greece (TFGR) was set up in 2011 to coordinate technical assistance to Greece and remained operational until July 2015 when it was replaced by the new Structural Reform Support Service, which now coordinates administrative and structural reforms at the EU level. One of the TFGR’s key roles was to accelerate the absorption of EU funds through recommendations regarding the legislative, regulatory and administrative measures already in place and, where needed, through a (re)planning of measures. The technical assistance initiatives coordinated by the TFGR were mainly provided at the request of the Greek authorities.

According to a special report published by the European Court of Auditors in 2016,² support to accelerate the take-up of EU funds was properly structured and the TFGR provided Greece with a comprehensive support package in the field of Structural Funds. The measures covered both horizontal issues, such as monitoring of projects, simplification of procedures and organisation of the land register, as well as specific support for the implementation of designated priorities (e.g. motorway concessions, waste management, energy, tourism). The TFGR assisted the Greek authorities in developing an information system for the monitoring of individual projects and contributed to profound reforms in the management and control system, e.g. through clear

1 The environmental licensing of public and private sector projects and activities is subject to the provisions of Law 4014/2011 “Environmental licensing of projects and activities, retrospective planning permission in relation to the creation of an environmental balance, and other provisions falling within the remit of the Ministry of the Environment” (Government Gazette A 209/21.9.2011), <http://www.ypeka.gr/Default.aspx?tabid=804>.

2 European Court of Auditors, *Special Report No 19/2015: More attention to results needed to improve the delivery of technical assistance to Greece*, 16.2.2016.

demarcation between political and administrative tasks.³ Moreover, it helped to enhance transparency and beneficiaries' (especially SMEs') access to information about the various sources of funding available, to advise public bodies on risk management issues and to build capacity in operational planning at the local government level.

³ European Commission, *Task Force for Greece, Seventh Activity Report*, July 2014.

6 FINANCIAL INSTRUMENTS VERSUS GRANTS: NEW OPPORTUNITIES

Financial instruments (FIs) are an effective way of utilising EU resources, as they promote: (a) synergies with other forms of financing such as grants; (b) technology transfer from financial institutions to public bodies and programme managers; (c) incentives for better performance on the basis of purely private economy criteria and increased transparency; and (d) innovative ways of funding, limiting traditional reliance on grants.

As already mentioned above, over the programming period 2014-2020 a more extensive and intensive use of FIs over grants was envisaged. The EU encourages the use of equity, loans and guarantees in different areas that are mainly related with SME support, low carbon economy, resource efficiency, sustainable transport, research and innovation, and information and communication technologies. ESIFs' national managing authorities may set up a fund of funds to pool ESIF resources (along with national public and/or private co-financing), which will then finance specific funds managed by selected intermediate financial organisations. Alternatively, national managing authorities may opt for the direct contribution of resources from the OPs of the ESIFs to a specific fund. Greece has so far chosen to set up funds of funds.

According to the European Commission's report published in December 2017 (European Commission 2017a) on the progress made in implementing the financial instruments, EU Member States' overall planned allocations of the ERDF and the CF to FIs amounted to

about EUR 20 billion in the period 2014-2020. Greece planned to allocate 9% of total ERDF and CF commitments through FIs, i.e. a percentage which is marginally higher than the EU average (8%) but substantially lower relative to 17% in Portugal, 18% in Slovenia and 20% in the UK (see Chart 6).

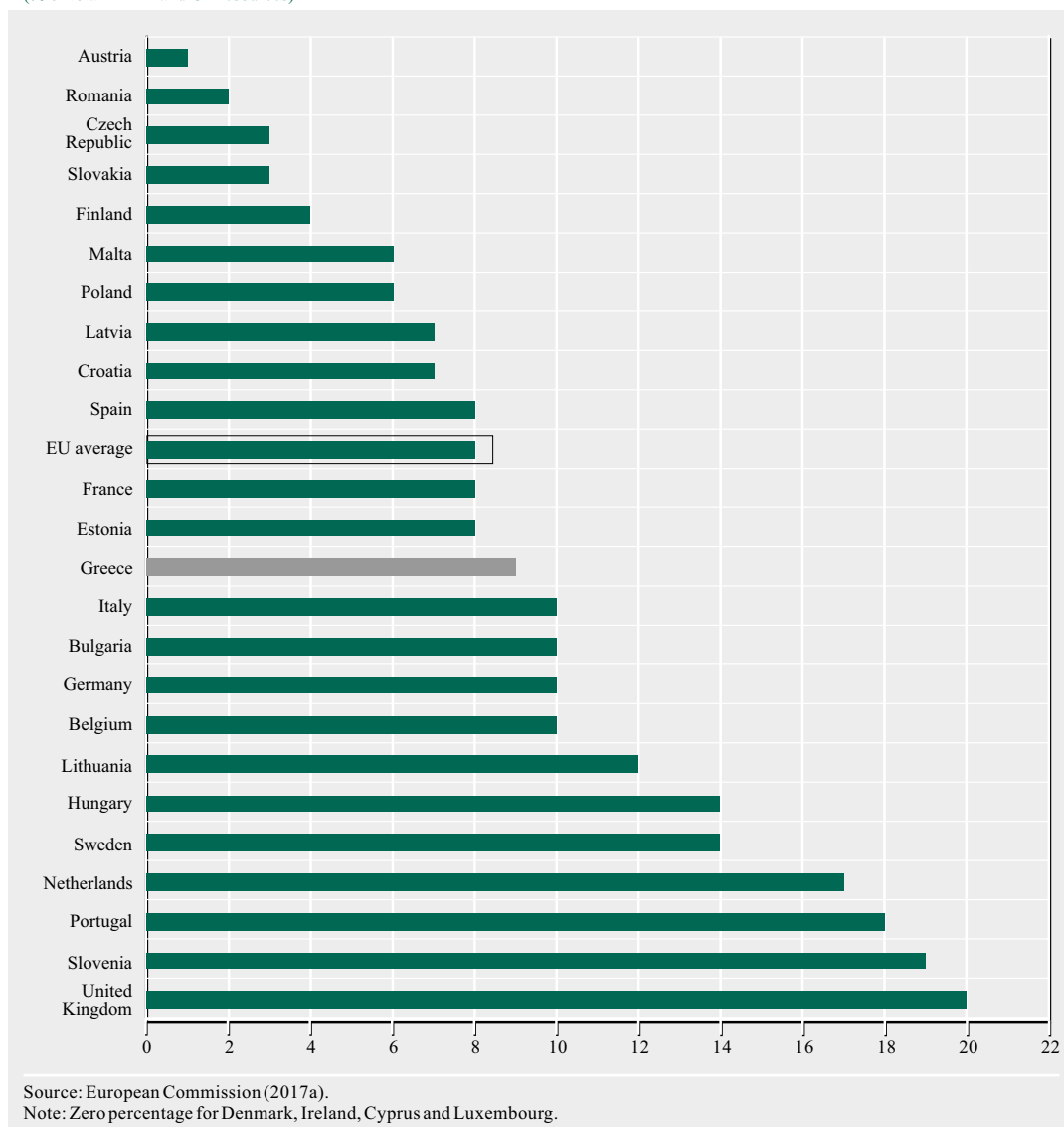
Compared with the first such report published by the European Commission in November 2016 (referring to 2015 data), a substantial progress was observed overall in setting up new FIs across EU Member States in 2016, as well as a rapid progress in the active utilisation of FIs immediately after their set-up. The largest number of FIs was reported in Poland (39), Germany (36) and Italy (26).

In nominal terms, the total amount committed by EU Member States to FIs by the end of 2016 stood at EUR 12.8 billion, of which EUR 9.9 billion came from the ERDF and the CF. Respectively, at end-2016 Greece had committed to FIs EUR 668 million, of which EUR 522.4 million was ERDF and CF resources. The amounts paid to set up FIs in Greece accounted for 25% of committed allocations, with zero disbursement to final recipients, as these funds of funds had just been set up.

The active utilisation of a growing number of FIs and of the advantages they present over grants can maximise the growth impact of EU funds available for investment in the Greek economy. FIs provide opportunities for: mobilising and blending funds from various EU, public, or private sources; revolving funds for the financing of other investment; and leveraging additional public and private resources. In this manner, the final amount of financing

Chart 6 Available ERDF and CF commitments to financial instruments over the period 2014-2020

(% of total ERDF and CF resources)



allocated to investments can turn out to be much larger than the initially available EU funds, creating a multiplier effect for the real economy.

7 THE OUTLOOK FOR THE NEW PROGRAMMING PERIOD 2021-2027

Although the EU economy has embarked on a recovery path over the past five years, the

effects of the crisis are still felt. Income per capita and employment in several regions continue to stand below their pre-crisis levels, while the process of economic convergence has been halted, with the economies of the less developed and transition regions growing at a slower pace than the EU average (European Commission 2017b). Globalisation and the shift towards a digital economy are likely to further widen regional disparities, with possible adverse effects in the long run on economic

growth, social cohesion and political stability in Europe (Iammarino et al. 2017).

Meanwhile, the UK's withdrawal from the EU (Brexit) creates a fiscal gap in the EU-27 budget, which is expected to bring about amendments to the level of Member States' contributions and/or of envisaged expenditure allocations.

The European Commission's proposed budget for the Multiannual Financial Framework (MFF) 2021-2027, which was released on 2 May 2018 (European Commission 2018a), envisages an expenditure ceiling of EUR 1,279 billion, or 1.11% of GNI of the EU-27.²⁶ The Commission proposes a combination of measures on both the revenue and the expenditure side, namely higher contributions, savings and redistributions across areas of financing, as well as optimisation in the uptake of allocations, focusing on sectors in which EU resources can have a stronger impact than national public expenditure (the so-called "European added value").²⁷

The European Commission's plan for the new MFF proposes a re-allocation of expenditure towards: (a) technology; (b) investment in the economy's digital transformation and in networks; and (c) programmes for the youth as well as for the environment and the climate. At the same time, it proposes reductions in transfers under the Common Agricultural Policy and in the programmes of the Common Fisheries Policy. The ESIFs remain the key regional policy tools with a redistribution of allocations to the ERDF and the ESF and away from the EAFRD and the CF, as a result of the desirable strong shift towards the financing of sectors that enhance the EU's productive capacity and of programmes offering high European added value (such as the Connecting Europe Facility). Furthermore, as proposed by the European Commission, regional policy is set to play an increasingly important role in supporting structural reforms and the long-term integration of migrants.

More generally, with regard to the spending side of the MFF, the field of security and defence is significantly reinforced, as the envisaged allocations for the management of migration, external borders and asylum, and for the establishment of a European Defence Fund are proposed to be tripled.

More specifically, with respect to regional policy, total available resources will be reduced under the proposed MFF 2021-2027, although they remain elevated, accounting for 36% of expenditure.²⁸ Moreover, the European Commission's proposal seeks to revamp and modernise regional policy, with a view to better meeting the new priorities and challenges for the EU.²⁹ A major change that is proposed concerning the determination of the level of ESIF allocations to Member States is that, apart from GDP per capita which remains the main eligibility criterion, other factors will be taken into account, such as unemployment (especially youth unemployment), climate change and the reception/integration of migrants. Besides, a raise in national co-financing rates for ESIF investments is proposed.

For Greece, the available resources from Structural Funds (i.e. ERDF, CF and ESF) that have been proposed for the period 2021-2027 amount to EUR 21.7 billion (current

²⁶ The EU-27 excludes the United Kingdom, which is set to withdraw in 2019.

²⁷ Up until the current MFF, the revenues of the EU budget originated from customs duties and Member States' contributions on the basis of value added tax (VAT) and gross national income (GNI). The European Commission suggests the introduction of a new "basket" of own resources that will comprise: (a) 20% of the Emissions Trading System revenues; (b) a 3% call rate applied to the relaunched Common Consolidated Corporate Tax Base; and (c) a national contribution calculated on the amount of non-recycled plastic packaging waste in each Member State.

²⁸ Bank of Greece calculations based on European Commission data (current prices) (European Commission 2018a). Including envisaged expenditure from the five ESIFs. By way of illustration, compared with the previous periods, such expenditure accounted for 42% under the MFF 2014-2020 and 46% under the MFF 2007-2013.

²⁹ Those priorities are: (1) a safe and secure Europe, where all citizens can move freely, with secured external borders and an efficient migration policy; (2) a prosperous and sustainable Europe, promoting sustained and sustainable growth and with a strong Single Market; (3) a social Europe which fights unemployment, discrimination, social exclusion and poverty; and (4) a stronger Europe on the global scene, further developing existing partnerships, building new ones and strengthening its common security and defence (Council of the European Union 2017).

prices) (European Commission 2018c), which at constant prices is equivalent to an increase of around 8% in available resources from Structural Funds to Greece.³⁰

Finally, the European Commission also promotes the set-up of three new instruments that will complement the ESIFs to boost investment and support economic convergence and financial stability:

(a) InvestEU: it is a new investment fund, building on the experience gained from the success of the EFSI in mobilising private resources from a relatively limited amount of public resources. The InvestEU aims at pooling all centrally managed financial instruments within the EU in a single, streamlined structure that will reduce overlaps and administrative burden. With a total envelope of EUR 15.2 billion, it is expected to help leverage additional investment.

(b) Reform Support Programme: with an overall budget of EUR 25 billion, it is proposed to be complementary to the ESIFs offering technical and financial support for reforms at the national level. It is designed to include a Reform Delivery Tool providing financial incentives across all Member States for key reforms, as well as a Convergence Facility to support non-euro area Member States seeking to adopt the single currency.

(c) European Investment Stabilisation Function: offering back-to-back loans of up to EUR 30 billion guaranteed by the EU budget, it will provide the necessary funding for national budgets in times of strain, complementing the European Stability Mechanism (ESM), and, where needed, in order to maintain national investment levels. The loans will be available to Member States complying with strict eligibility criteria for sound fiscal and economic policies.

To become effective, the proposed MFF 2021-2027 must be endorsed by the Council, acting by unanimity, with the consent of the European

Parliament. To ensure a smooth transition from one programming period to another, as well as the timely start of programmes, the European Commission recommends the conclusion of the process by May 2019.

8 CONCLUSIONS AND CHALLENGES

The present article attempts a combined and holistic evaluation of the implementation path of the PA 2014-2020 in Greece, focusing, apart from the absorption of funds, on a more comprehensive assessment of the progress achieved in the implementation of projects, an overview of the institutional and technical weaknesses that have occasionally been identified, and the challenges facing the EU's regional policy in fulfilling its objectives. The analysis suggests that some generic conclusions can be drawn regarding the effective utilisation of funds and the attainment of the PA 2014-2020 targets.

Turning to total inflows of ESIF resources for the current programming period, Greece's performance is characterised as normal compared with both past programming periods and the EU average. Nevertheless, this performance, which was actually underpinned by the additional pre-financing provided to Greece by the European Commission in the early years of the PA 2014-2020, appears to have weakened in 2017 and in the first quarter of 2018, which points to problems in either the selection or the maturity and execution of projects. Should this weak performance continue, it might lead to slower absorption of EU funds throughout the programming period, entailing the risk of losing Union funds. It should be noted that, at the current juncture, PA resources, coupled with funding from the EFSI (in the context of the Juncker Plan)³¹, are the main source of

³⁰ See press release of the Ministry of Economy and Development, "Increased resources to Greece in the European Commission's proposal for the PA after 2020", 30 May 2018.

³¹ According to European Commission data up until May 2018, Greece ranked first among EU Member States on the basis of total investments as a percentage of GDP that are expected to be mobilised with the support of the EFSI. In absolute terms, EFSI funding to Greece amounts to EUR 2.6 billion and is set to mobilise investments totalling EUR 10 billion.

investment financing in Greece and a key driver of growth.

At the operational programme level, despite the remarkable performance of the OP “Transport Infrastructure, Environment and Sustainable Development” in terms of projects approved, the analysis has identified a number of potential weaknesses or distortions in the planning and implementation of this OP. Inflows of resources for infrastructure projects appear to be delayed, despite the selection of sizeable projects which are potentially ready to finance. Although this delay may arise from a reasonable time lag between the start of a project and the execution of payments, on account of the large size and the longer completion horizon of infrastructure projects, it may also reflect broader deficiencies in the projects per se or in the construction industry. The investigation into any such shortcomings falls beyond the scope of this article.

Besides, the clear prevalence of this OP over all other OPs is likely to be due to the authorities’ failure to plan and implement more complex projects that can generate higher added value. The preference of the NSRF/PA planners for infrastructure projects, which has also been observed in the past, was found to be due, on the one hand, to the fact that the personnel involved had enough technical and managerial expertise to run such projects and, on the other hand, to the fact that these projects had clear and measurable outputs, as perceived by recipient local communities, thereby generating a concrete political dividend (Liargovas et al. 2016). The examination of the list of the most important projects selected under the OP “Transport Infrastructure, Environment and Sustainable Development” of the PA 2014-2020 seems to confirm the relative difficulty in designing more complex projects, as shown by the lack of appropriate emphasis on and the allocation of sufficient resources into infrastructure projects which can change the country’s production model and optimise privatisation gains. A typical example of such projects would be the transnational transport, energy

and telecommunications networks. Similarly, it can be observed that for the remaining OPs of the PA 2014-2020 the projects more or less aim to meet current needs rather than secure a more lasting structural benefit in a systematic fashion.

The development of the skills and technical adequacy of the personnel working for the planning and managing authorities is of paramount importance for an efficient use of EU funds. For the decentralised management of projects (i.e. at the local government level) to deliver, the capacity of municipal and regional authorities must be enhanced both in terms of quality and as an institution (Liargovas et al. 2016). Furthermore, it is important that the activities of different management functions are supported and coordinated by the central government through clear guidance, appropriate assignment and effective linking of their work to a coherent strategy for the PA and a national investment plan.

Another area that could be negatively affected by inadequate expertise is the use of financial instruments, in which Greece lags behind other EU countries.

In general, the successful implementation of EU regional policy requires the effective functioning of the State and its institutions. Good governance creates the conditions for a targeted and flawless design of projects, in line with national and local needs, as well as for their timely delivery, placing greater emphasis on their growth impact on the real economy rather than on the quantitative and cash-driven goal of full absorption. However, it should be acknowledged that, despite the introduction of targets and milestones under the revamped rules for EU regional policy in the period 2014-2020, the actual outcomes of projects are not always immediately visible and measurable, due to the lagged effects of some projects even after their completion.

In the light of the above and taking account of assessments in the context of the economic adjustment programmes, the question arises

whether the (envisaged) technical assistance is in fact intensively and effectively used with a view to transferring expertise from abroad in all of the aforementioned areas.

It is also worth pointing out that the efforts to streamline structures and procedures for the implementation of co-financed projects and investments in general are not characterised at all times by the required technical soundness. The fragmentation of information systems, digital registries and electronic databases hampers the transition to a functional and easy-to-use automated environment, which ensures interconnection and cooperation among all stakeholders. In this vein, a more intensive use of resources and an in-depth design of digital governance programmes under the OP “Public Sector Reform” are warranted.

At the EU level, the trend of regional policy, as suggested by the European Commission’s proposal for the programming period 2021-2027, will continue to be directed towards an increasing shift to specific strategic sectors, such as information and communication technologies, research and innovation, and sustainable growth, and away from a resource allocation practice that is based on each region’s income per capita. Therefore, the challenge and the opportunity for Greece, in the context of both the implementation of the current PA and the design of the following PA, is to be in sync with this trend, by adopting a strategy that will place emphasis on thematic objectives, thus supporting the utilisation of regions’ comparative advantages as well as the long-term structural transformation of the national economy.

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THE ENERGY SECTOR: DEVELOPMENTS AND PROSPECTS*

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I INTRODUCTION

The crisis that hit the Greek economy over the 2008-2016 period made clear that Greece's growth model was characterised by structural weaknesses. The preceding economic boom was almost entirely led by domestic demand, underpinned by low-cost credit. During the current transition period, it is imperative to develop a new growth paradigm that will help the economy to embark on a vigorous and sustainable growth track.

This new growth model must rely on exports of tradable goods and services, import substitution and capital inflows, mainly investment.¹ With regard to investment, the bulk of available resources should be channelled into the tradable sectors to enhance economies of scale, expertise and international competitiveness. Therefore, those sectors with a major comparative advantage for the country need to be fully exploited. Such sectors are tourism, shipping, energy, logistics, and the primary sector (see for instance DiaNEOsis 2016, Karavias and Anastasatos 2018, and McKinsey 2011).

Against this background, the energy sector is a key driver of transition to sustainable and export-led growth. It comprises the generation, transmission, distribution and supply of electricity; the import, refining and trading of petroleum products; and the import, storage and distribution of natural gas.² According to national accounts data published by ELSTAT, the sector's contribution in 2016 was small in terms of Gross Value Added (GVA) (3.6%) and employment (0.8%).³

Nevertheless, the energy sector can greatly improve Greece's economic prospects, as it has

three major comparative advantages (see among others Vettas 2016): (1) Significant sources of energy and natural resources, namely renewable energy sources (RES) such as solar and wind energy. (2) A strategic position that is key to the deployment of trans-European energy interconnection and transmission grids. (3) A fairly clear regulatory framework, actually due to the transposition of EU regulations into Greek law, which creates a relatively stable business environment.

At the current juncture, the Greek energy sector is still marked by considerable weaknesses, such as high energy consumption per unit of GDP, strong dependency on energy imports, limited use of RES, and high energy prices. Consequently, any policy measure addressing those weaknesses is expected to have multiple positive effects on economic activity.

The development of the energy sector is expected to contribute to the improvement of the trade balance, as: (1) The use of domestic resources in energy production, coupled with higher energy efficiency, is expected to lead to a reduction in energy imports. At the same time, in the long run, the use of domestic resources is expected to affect favourably energy exports.

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

1 This process is already under way, given that exports as a percentage of GDP have risen over the 2009-2017 period, mainly on account of the strong negative impact of the recession on domestic demand; yet this shift must be further supported and sustained in the long term (see Bank of Greece 2016a and 2018).

2 The broader energy sector also refers to activities related to the construction, installation and maintenance of energy production and distribution equipment, as well as the provision of energy saving and energy efficient products and services.

3 Calculations take into account GVA and employment in sub-sectors that are related to coal and lignite mining, natural gas extraction, manufacture of coke and refined petroleum products, and supply of electricity, gas, steam and air conditioning.

(2) A secondary effect coming from the use of domestic resources and the energy market deregulation is a decrease in energy prices. Given that energy constitutes the main input in all production activities, low energy prices are expected to be reflected in low production costs. This translates into competitiveness gains for the Greek tradable goods and services, which in turn will make exports to increase and imports to decrease. In other words, the development of the energy sector will have an additional positive effect on the trade balance. Low energy prices also have a favourable downward effect on households' cost of living.

In addition, the sector's development based on the country's comparative advantages and under the European regulatory framework is expected to attract investment with positive effects on the production capacity of the Greek economy.

A positive coincidence is that the development of the energy sector is currently being promoted by the European Union (EU), as it is in line with its core objectives. The three main aims of the EU's energy policy are the following: (1) sustainable development, aimed at changing the energy mix to address climate change; (2) security of energy supply; and (3) energy market deregulation in an effort to reduce production costs in the EU and raise its competitiveness. The EU has pursued a number of legislative interventions and operational programmes and has clearly defined these three aims of its energy policy, which are also referred to as sustainability, energy security, and competitiveness, since as early as 2007.

Actually, especially with regard to the first objective of sustainable development, the EU has assumed a leading role in addressing climate change, having set concrete energy and climate targets for 2020, 2030 and 2050. The targets to be met by 2020 are: to cut greenhouse gas (GHG) emissions by at least 20% below 1990 levels; to raise the share of RES in energy consumption to 20%; and to improve energy efficiency by 20%. The targets for 2030

refer to: at least 40% cuts in GHG emissions; a minimum 27% share for RES; 27%-30% improvement in energy efficiency; and electricity interconnection of at least 15% (i.e. 15% of the electricity produced in an EU country should be able to be transmitted across its borders to neighbouring EU countries). Finally, the 2050 target involves reducing GHG emissions by 80%-90% below 1990 levels (see EKKE 2017).

The present article explores the potential of the energy sector to act as a driver of growth and to lead to a new production model for the Greek economy. Section 2 analyses the comparative advantages of the sector, while Section 3 documents the weaknesses of the sector in the recent period. Section 4 discusses the targets to be met for the sector's transformation and growth, and sets forth the recent policy measures towards this direction. The final section summarises and concludes.

2 COMPARATIVE ADVANTAGES OF THE GREEK ENERGY SECTOR

The energy sector in Greece is characterised by: (a) the available natural resources; (b) the country's geographic location; and (c) the regulatory framework. More specifically:

(a) The country has a strong potential for RES (solar and wind energy, in particular), which makes it a privileged place for systematic exploitation and a major pull factor for investment funds that are active in this field. For this reason, financing and investment in the energy sector declined less than in other sectors during the crisis. The country has also untapped hydropower and geothermal energy potential. In addition, hydrocarbon exploration points to possible petroleum prospects that may be exploited in the future.⁴ The possibility to exploit different sources of energy brings

⁴ The country also boasts lignite reserves. However, as the use of lignite for energy production purposes is very harmful to the environment, it tends to be replaced with less polluting sources, in line with the EU's aims.

Greece to the fore as regards the security of energy supply in the EU.

(b) The country's geographic location plays a strategic role in the design of new energy interconnection routes between the EU and natural gas and electricity producing countries, in the context of the EU's energy security objective. The positive outcome from the selected route of the Trans Adriatic Pipeline (TAP) transporting natural gas from Azerbaijan to Western Europe via Greece, Albania, the Adriatic Sea and Italy is expected to have a significant growth impact. Similarly, the project to transport natural gas and electricity from Israel, Cyprus and Greece, via Crete, to the rest of Europe is estimated to play an important role (see also Karavias and Anastasatos 2018). The integration of domestic grids (e.g. of the islands) with international grids will further support energy security and help reduce energy intensity and energy costs in Greece.

(c) With regard to the regulatory framework: (1) As part of the efforts to save energy and address climate change, binding targets have been set to increase the use of RES and reduce GHG emissions. (2) Greece must harmonise its regulatory framework and increase the interconnections of its energy markets in order to ensure energy security. (3) A number of measures aim to the deregulation of the electricity and natural gas markets in an effort to reduce production costs.

3 PERFORMANCE, SHORTCOMINGS AND PROBLEMS OF THE ENERGY SECTOR

Although some of its features have improved markedly, the energy sector continues to exhibit major weaknesses, namely: (a) High energy intensity: high ratio of energy consumption to GDP. (b) High energy dependence: a high share of energy consumption is imported from abroad. (c) Low use of RES, considering the country's resources. (d) High prices: in consumer terms, energy prices are subject to heavy indirect taxes and excise

duties. On top of that, the monopoly structure of the energy markets (of the electricity market in particular) has a substantial cost-increasing effect.

3.1 HIGH ENERGY INTENSITY

High energy intensity is a measure of an economy's energy efficiency. It is defined as energy consumption per unit of GDP. Electricity consumption in Greece steadily increased up until 2008 (56.6 TWh), before starting to fall for five consecutive years from 2009 to 2013 during the economic crisis.⁵ Since 2014, consumption has recovered slightly to reach 53.4 TWh of electricity in 2016.

Energy intensity largely reflects the structure of the economy. Service economies exhibit relatively low energy intensities, whereas industrial economies exhibit higher intensities. In Greece, the bulk of energy is consumed by households and other sectors (78.5%, against an EU average of 61.3%), which is consistent with the production model of a service-based economy (see Charts 1 and 2).

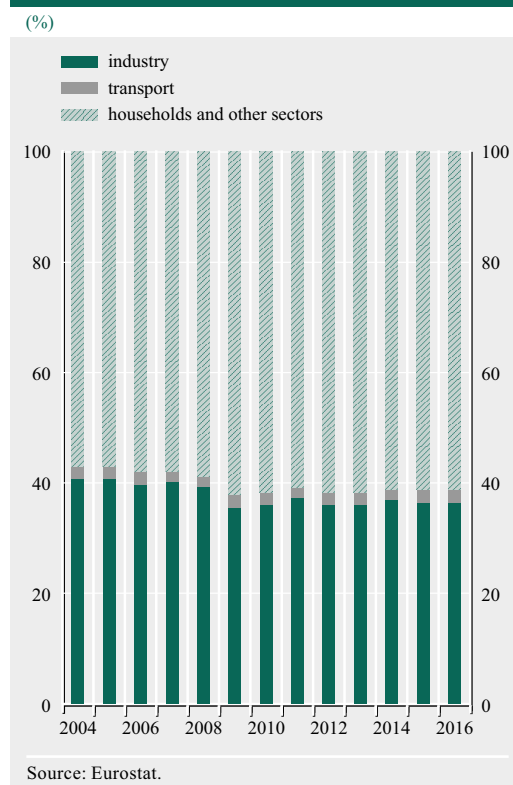
By consequence, on the basis of the economic production model, low energy intensity would have been anticipated for the Greek economy, relative to the EU. This was actually the case for the period up until 2010 (see Chart 3), but not for the years of the crisis (2011-2016), possibly indicating the decline in productivity during the crisis: although production units remained active, they had to reduce their output in response to falling demand. This may also reflect a waste of resources in energy production, distribution and consumption, which might be due to (a) obsolete grids, (b) old and

⁵ It refers to electricity consumption in industry, transport and households/services, and stands for final energy consumption. This means that consumption in industry covers all industrial sectors except the energy sector, e.g. power stations, oil refineries, coke ovens and all other plants converting energy products into another form. Final energy consumption in transport covers mainly the consumption by railways and electrified urban transport systems. Final energy consumption in households/services covers quantities consumed by private households, small-scale industry, crafts, commerce, administrative bodies, and services, with the exception of transportation, agriculture and fishing.

**Chart 1 Electricity consumption by sector:
Greece**



**Chart 2 Electricity consumption by sector:
EU-28**



(non-green) energy consuming buildings, and (c) low use of mass transportation. Besides, it reflects the fact that energy saving was achieved across the EU as a whole over that same period, i.e. the energy intensity of each national economy was lowered.⁶

3.2 HIGH ENERGY DEPENDENCE

The fact that Greece relies on imports to meet its energy needs is mirrored in its energy dependence rate, which is extremely elevated and notably higher than the European average (see Chart 4). Energy dependence was seen to moderate in the early years of the crisis, 2008-2013, possibly reflecting a recession-induced reduction in consumption, but thereafter it embarked on an upward path and reached its pre-crisis levels in 2016.

The recent rise in the energy dependence of the Greek economy is also verified by the pat-

tern of the electricity trade balance: the 2005-2013 period was marked by an improvement in the electricity trade balance; however, a reversal of this trend was observed in 2014-2015 (see Chart 5).⁷

3.3 LOW USE OF RENEWABLE ENERGY

3.3.1 Energy production in Greece and the EU

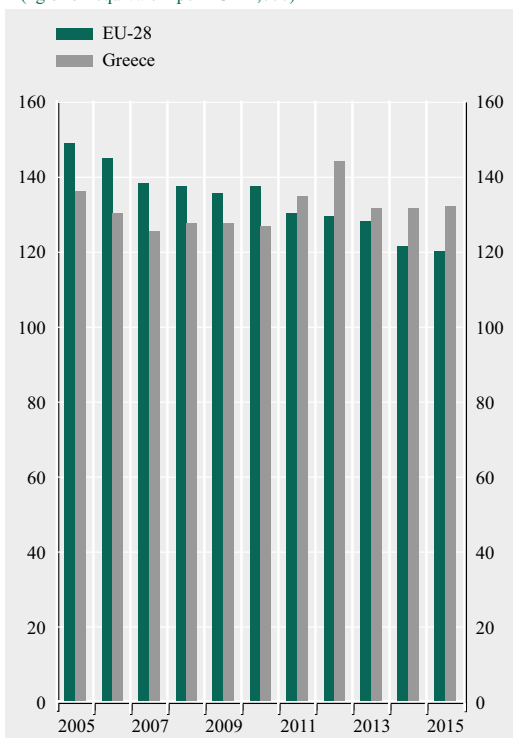
Greek energy production continues to rely on polluting sources, e.g. lignite and oil, with the production share of those two sources being considerably higher than in the EU. Nevertheless, a rise in generation by RES has been observed lately (see Chart 6).

⁶ Between 2005 and 2015, energy savings were delivered in every EU Member State (the energy intensity of each Member State was reduced). Greece, however, posted the smallest decrease (-3.1%) (see Eurostat 2018).

⁷ Net imports of electricity to Greece in 2015 originated mostly from Bulgaria, Turkey, FYROM and Italy. Greece mainly exports to Italy and Turkey.

Chart 3 Energy intensity¹: EU-28 and Greece²

(kg of oil equivalent per EUR 1,000)



Source: Eurostat.

1 Gross inland energy consumption per GDP.

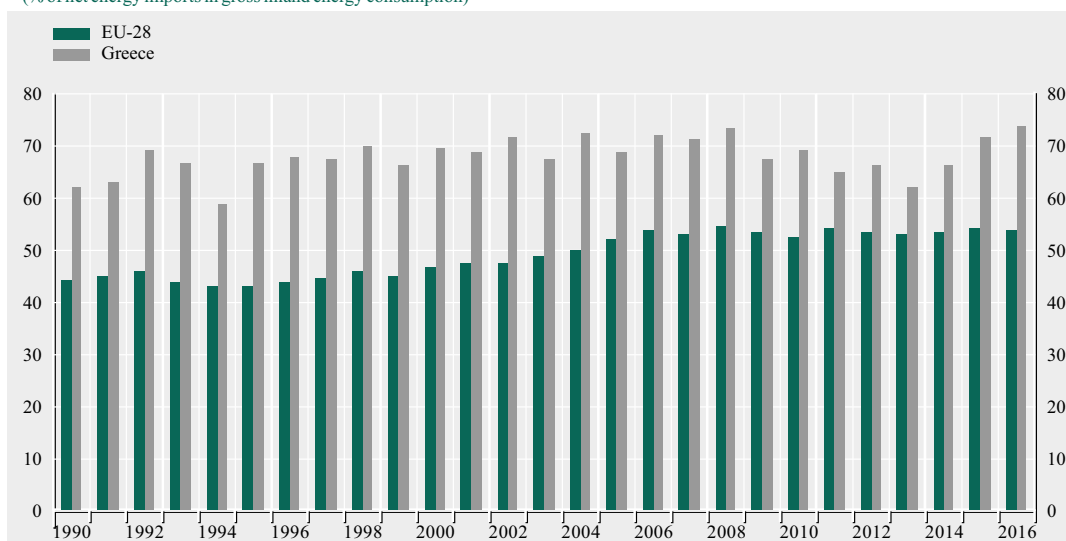
2 From 2011 onwards, data for Greece are provisional.

With regard to the EU, RES were at first seen as unstable and unsuitable sources of energy, too costly to rival the existing coal-fired power stations and nuclear power plants. Resolute political initiatives, coupled with the active involvement of new business agents, supported the growth of RES during the post-1990 period. Against this backdrop, the European electricity system underwent an extensive transformation, which led to a rise in the shares of RES from 2005 onwards (see Chart 7). Notwithstanding, the crisis has dealt a heavy blow to investment in renewables at the European level, with financing conditions and regulatory reforms emerging as key determinants of the development of RES (see among others Midttun and Piccini 2015).

The observed increase in the share of renewable energy was also underpinned by grants provided by several Member States, which are often devised to promote less mature technologies. In Finland, investment grants and subsidies are the only support available at the national level. Tax incentives or exemptions often complement other types of renewable energy incentive programmes. A wide range of tax incentives are present in the EU. Some

Chart 4 Energy dependence: EU-28 and Greece

(% of net energy imports in gross inland energy consumption)



Source: Eurostat.

Chart 5 Electricity trade balance: Greece

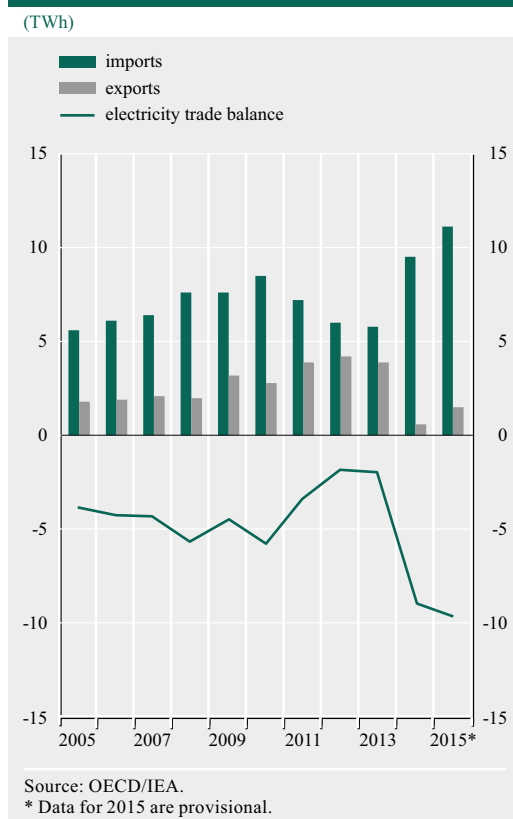


Chart 6 Primary production of energy by source: Greece



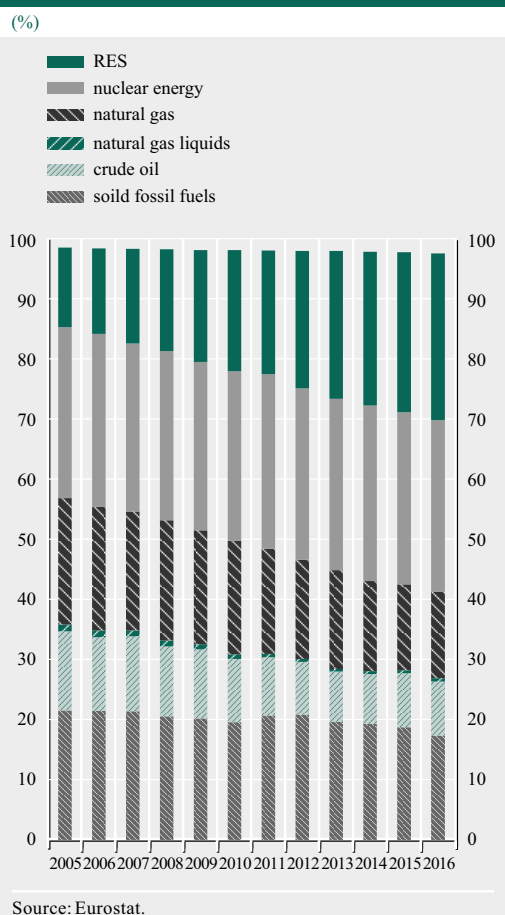
Member States (Spain, the Netherlands, Finland and Greece) provide tax incentives related to investments, while others (Latvia, Poland, Slovakia, Sweden and Hungary) have devised production tax incentives that reduce operational costs (see Kanellakis et al. 2013). With respect to the contribution of nuclear energy to Europe's electricity generation, the observed stabilisation of the share of nuclear power (see Chart 7) is associated with the accident in Fukushima, Japan, in March 2011, as many countries called off the expansion of their nuclear power programmes.

3.3.2 Electricity production in Greece and the EU

With regard to electricity production, Greece succeeded in raising its share of renewable energies markedly, even relative to the EU as a whole (see Charts 8 and 9), with renewables reaching 30% of electricity production in 2016.

Greece enjoys on average 300 days of sunshine a year and boasts high wind potential, especially on its islands. Nevertheless, the renewable energy system is only viable if sufficient plants are in place, flexible enough in their generation capacity. Furthermore, the exploitation of the islands' wind potential calls for their connection to the mainland power grid, as well as for economies of scale in order to make such projects competitive. Upon completion of the envisaged main interconnection of the islands, significant potential for exploiting renewable energy will be created (see also Karavias and Anastasatos 2018), while the interconnection is likely to contribute to a further increase in the share of renewables in electricity generation.

Chart 7 Primary production of energy by source: EU-28



3.3.3 Renewable energy sources by category

The evolution of RES by category in Greece over the 2004-2016 period is illustrated in Charts 10 and 11. Installed renewables increased more than tenfold, while renewable energy generation rose eightfold, albeit from a very low starting point (see also EIA 2017). In the 2010-2015 period the cumulative growth rate in wind and solar photovoltaic power generation stood at 300%.

The development of renewables relied heavily on an increase in solar photovoltaic (PV) power plants (see Chart 10). In 2016 Greece boasted the second (after Spain) highest share in solar power plants, relative to total installed electricity generation capacity among member

countries of the International Energy Agency (see IEA 2017). This success story is attributable to generous feed-in tariffs and lower technology costs. Compared with other countries, Greece was quick to adopt the tool of feed-in tariffs (as early as 1994), with a view to boosting investment in this field. Furthermore, a new legal framework to support electricity generation from renewable sources was established. Speeding up and streamlining the complex licensing procedures also made a positive contribution. In 2009, under EU Directive 28/2009, the Greek government, together with the other Member States, announced the launch of the “Helios” project, which promoted the development of solar PV parks by incentivising investors. The objective was for Greece to export electricity generated from renewable sources to the EU. The installed capacity of solar PV plants increased from 11 MW in 2009 to 2,074 MW in 2013, while their share as a percentage of renewables came from 4% in 2009 to 54% in 2014. However, the exceptionally high feed-in tariffs on solar PV plants (higher than in most European countries, see EREF 2009), as well as the declining cost of PV systems caused market distortions in favour of PVs (and against wind turbines) on account of a wide discrepancy in subsidies. Such distortions led to a secondary market for licensing and to a deficit in LAGIE, the Greek electricity market operator (see also Diakoulaki 2014). The institutional framework changed after 2012. Solar PV energy purchase prices on the part of the Public Power Corporation (PPC) were deemed costly. In August 2012 the licencing of new PV installations was suspended, while the law of October 2013 revised renewable energy prices, modified the criteria on energy prices from new PVs and stipulated new provisions regarding the relocation of renewable energy plants. The corrective measures taken by the State since 2012 have basically led to a freezing of investment in solar PVs. Indeed, installed capacity of solar PVs has remained stable at its 2014 level (see Chart 10).

Wind power capacity also increased significantly over the 2010-2015 period, although it

Chart 8 Electricity generation by source: Greece

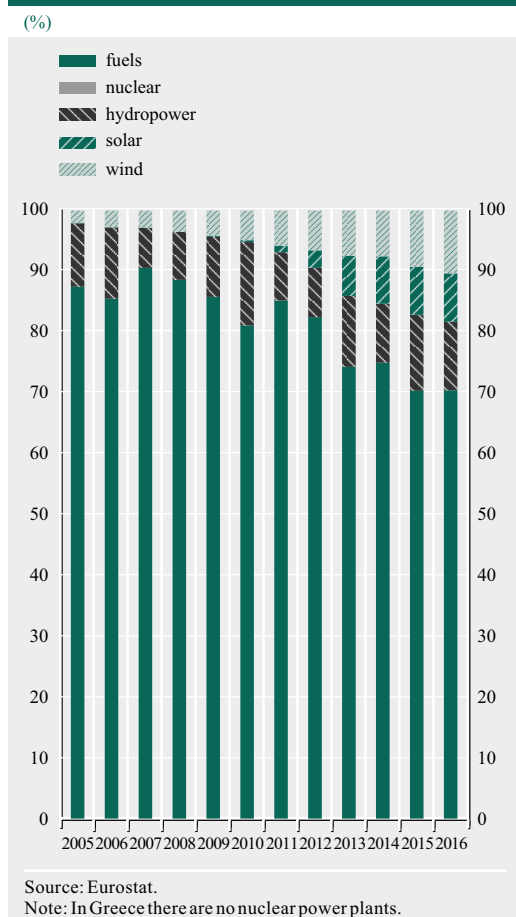
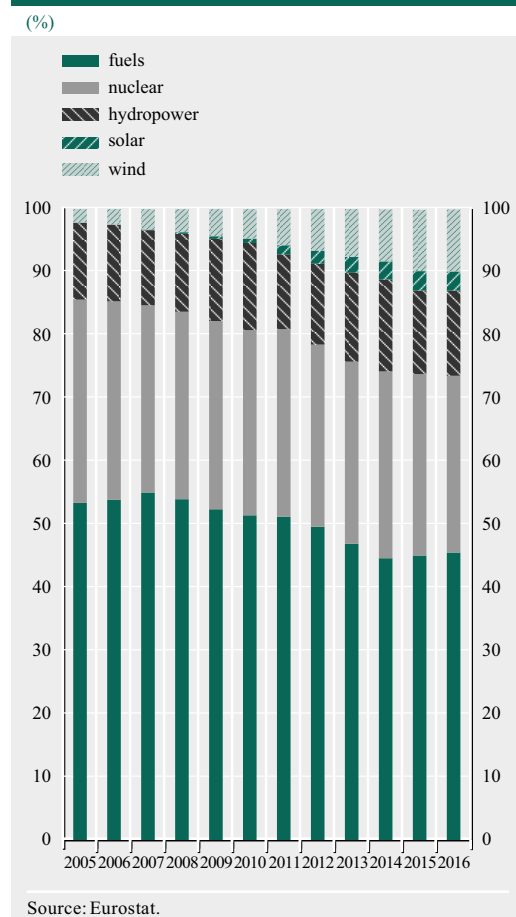


Chart 9 Electricity generation by source: EU-28



stood below the expectations set previously (average annual growth: 12%). Nevertheless, it continues to grow at a relatively higher rate (14%) after 2015 (see Chart 10). In 2017 the share of wind power generation in total renewable energy generation reached 54%, followed by a solar power generation share of 37%.

3.4 HIGH PRICES

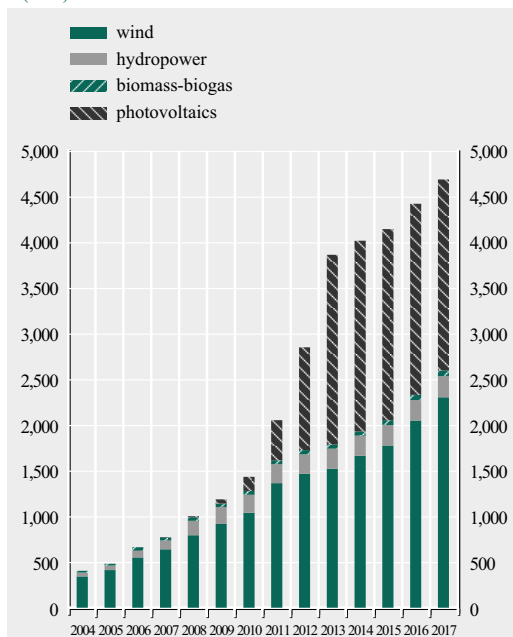
Energy is a key input to any productive activity. Against this backdrop, the constant aim of improving productivity and competition conditions in the energy sector, with a view to reducing energy costs, is a prerequisite for competitiveness gains and economic growth. With respect to households, improved competition conditions mean satisfactory living

standards, on the back of uninterrupted, high-quality and affordable energy supply, as well as a vast array of available options for consumers.

Increased energy costs in recent years reflect a considerable rise in both wholesale and retail energy prices. The prices of oil products, electricity and natural gas were elevated, also as a result of sizeable tax hikes and other charges. In particular, electricity prices for households rose by 150% approximately over the 2005-2016 period to reach 0.17 EUR/KWh in 2016, from 0.07 EUR/KWh in 2005 (see Chart 12). Although they are still lower than the EU average, their substantial increase suggests the soaring cost of living in Greece during that period.

Chart 10 Installed capacity by RES category in Greece

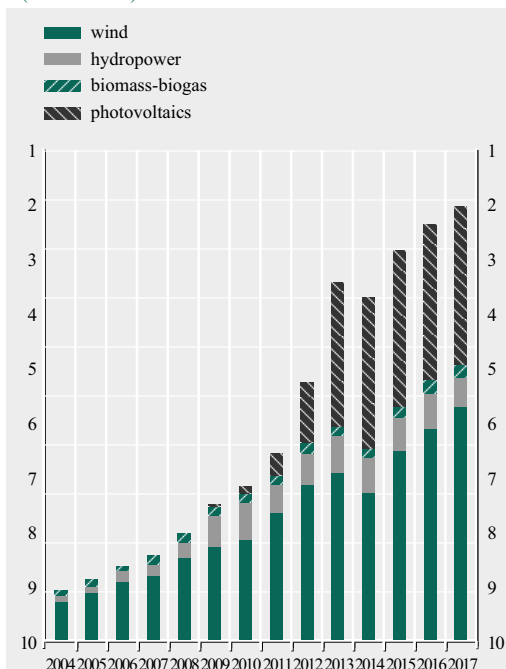
(MW)



Source: LAGIE.

Chart 11 Energy output by RES category in Greece

(million MWh)



Source: LAGIE.

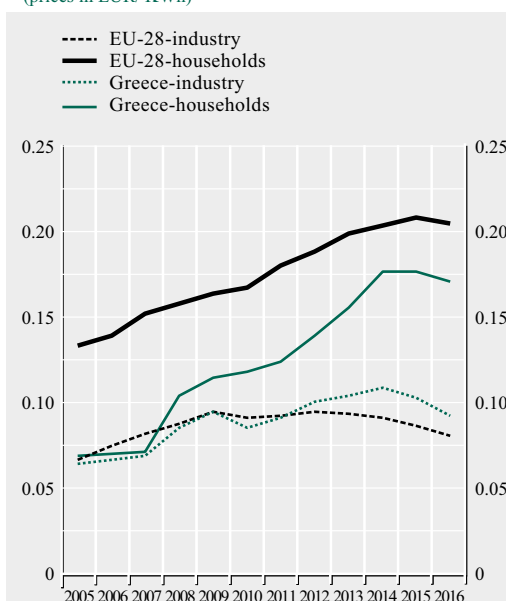
Electricity prices in industry also surged (by 44%) to 0.09 EUR/KWh in 2016 from 0.06 EUR/KWh in 2005, outgrowing the EU average (see Chart 12). As a result, in 2016 electricity prices for the Greek industrial sector (0.093 EUR/KWh) turned out to be higher than the European average (0.081 EUR/KWh), and thus acted as a counterincentive to productive investment in Greece compared with the EU and as a drag to the competitiveness of domestically produced goods.

3.4.1 High prices – the role of the market structure

An important factor behind high prices is the structure of the domestic electricity market. The market was characterised by monopoly structures, which led to competition distortion and posed barriers to new entrants. The vertically integrated State-controlled electricity company “Public Power Corporation S.A.” (PPC) had the exclusive right to produce electricity from lignite and hydro units, as well as to operate the electricity transmission and dis-

Chart 12 Electricity prices: EU-28 and Greece

(prices in EUR/ KWh)



Source: Eurostat.

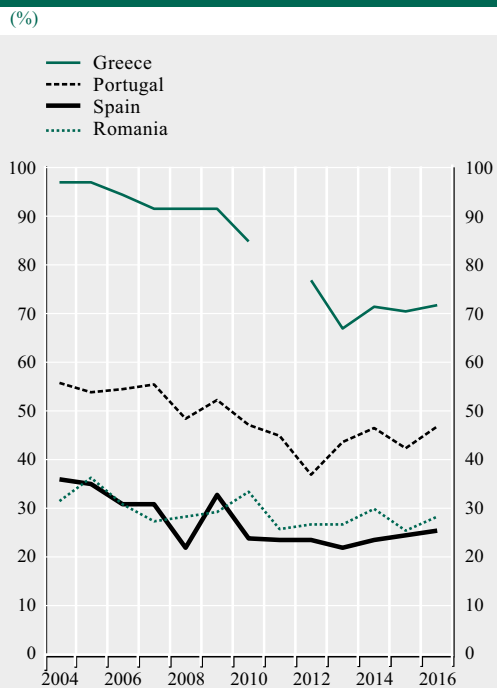
tribution grids. Lack of competition in electricity production and supply has heavily weighed on the domestic market, limiting the available choices for lower prices and better services (see Bank of Greece 2016b).

PPC continues to dominate electricity production. It accounts for 79% of the installed thermal generation capacity and about 75% of thermal electricity generation. PPC's share in the retail market also remains fairly elevated, despite the decline that was observed following the 2013 measures. Specifically, its share reached 88% in 2016. Furthermore, 17 suppliers were active in the retail market, with the second-largest supplier market share coming to a mere 2.9% in 2016 (see also IEA 2017). PPC's share is the highest across the EU, even relative to EU countries with less deregulated markets such as Spain, Portugal and Romania (see Chart 13).

It should be noted that for a significant part of PPC customers it would not be easy to switch to an alternative supplier. Such customers include farmers, who are offered low tariffs by PPC, large industrial customers, who enjoy discounts, and organisations that are housed in public buildings (see also Bank of Greece 2016b). Besides, the remaining customers have hardly used the possibility to switch supplier. A reason for this consumer behaviour may be the misconception about possible financial gains and the complexity of the switching process. Difficulty in understanding the electricity bill, which includes several non-electricity related items like municipal tax and television charges, has also been identified as a possible barrier to change suppliers.

The market share of PPC should be reduced under the Economic Adjustment Programme. In consultation with the European Commission, the Greek government resorted to an alternative mechanism to reduce PPC's market share: the NOME⁸ auctions, under the electricity market law of 2016 (Law 4389/2016), allow for bilateral agreements between electricity producers and distributors (actually, new entrants into the retail market can buy elec-

Chart 13 Market share of the leading electricity supplier: Greece and selected EU-28 countries



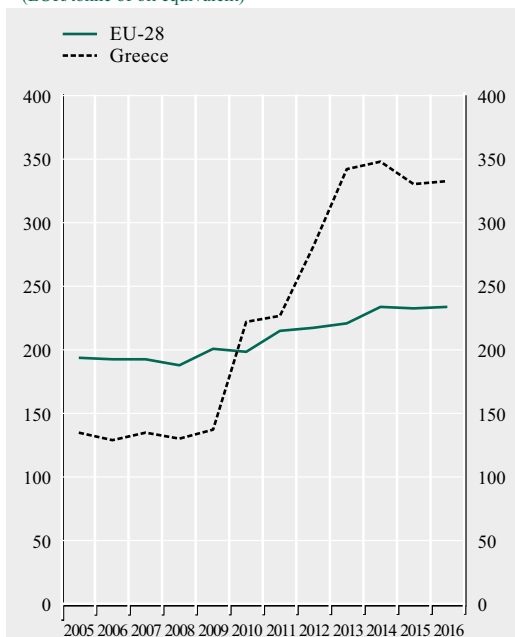
Source: Eurostat.
Note: For 2011 there are no available data on Greece.

tricity from PPC). The Regulatory Authority for Energy (RAE) determines the annual quantity of electricity that will be made available through auction sales of forward electricity products, while the electricity market operator (LAGIE) conducts the auctions. In the auctions, PPC is expected to sell around 40% of its production from lignite-fired and hydro plants (over which it has a monopoly). The NOME auctions and the increasing number of market participants are the first positive signs of a liberalised and competitive energy market, which offers better services and lower prices to consumers (see IEA 2017).

⁸ The NOME auctions (Nouvelle Organisation du Marché de l'Électricité) ensure a level playing field for alternative suppliers to access PPC's electricity production from lignite and hydro units. With the NOME auctions, private suppliers relying on power generation from natural gas may purchase energy at competitive prices, which will then be resold to industrial customers, firms and households. The quantities of electricity produced from PPC lignite and hydro units to be auctioned and the starting price of the auctions are determined on the basis of LAGIE data and following a recommendation by RAE to the relevant ministry.

Chart 14 Excise duty on energy: EU-28 and Greece

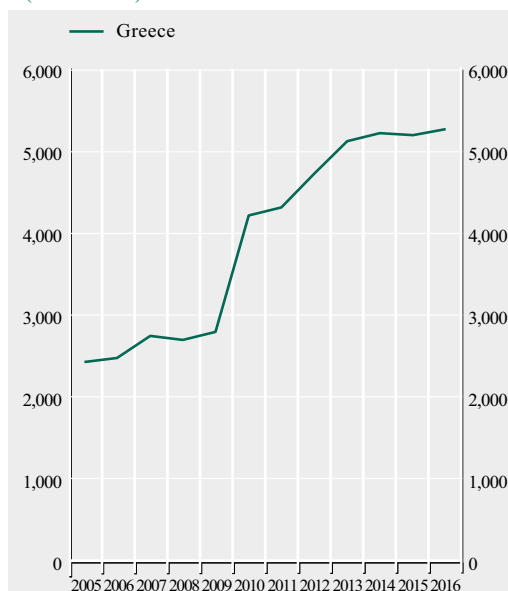
(EUR/tonne of oil equivalent)



Source: Eurostat.

Chart 15 Energy tax revenue: Greece

(EUR millions)



Source: Eurostat.

3.4.2 High prices – the role of taxation

The sizeable hikes in electricity prices are, to a large extent, the result of high taxation. The excise duty on energy was significantly raised in 2010 and actually ended up to be higher than the EU average, reversing the situation that prevailed until then (see Chart 14).

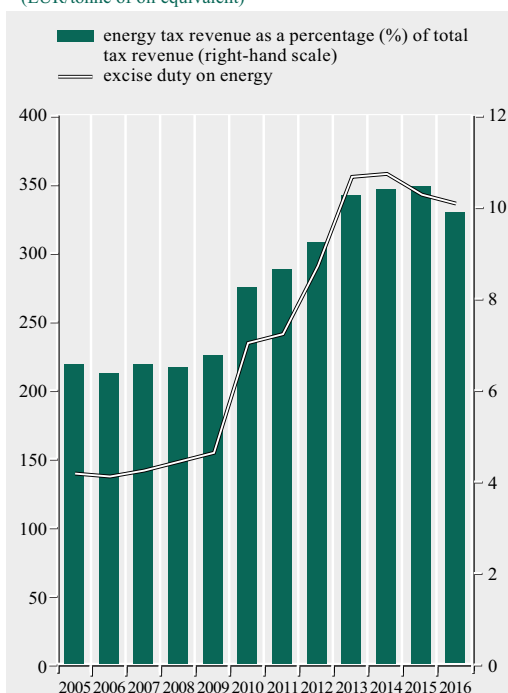
The tax hike in 2010 raised energy tax revenue, as well as its share in total tax revenue (see Charts 15 and 16). For the time being and on the basis of the targets for fiscal adjustment and fiscal revenues, excise duties on energy are not expected to decrease.

4 ENERGY POLICIES IN GREECE

The recent measures as well as the suggested policies are aimed at addressing deficiencies in the energy sector, as described in the previous section. They can be grouped into four main pillars: policies to (1) reduce the energy inten-

Chart 16 Excise duty on energy and energy tax revenue

(EUR/tonne of oil equivalent)



Source: Eurostat.

Chart 17 Share of RES in gross final energy consumption

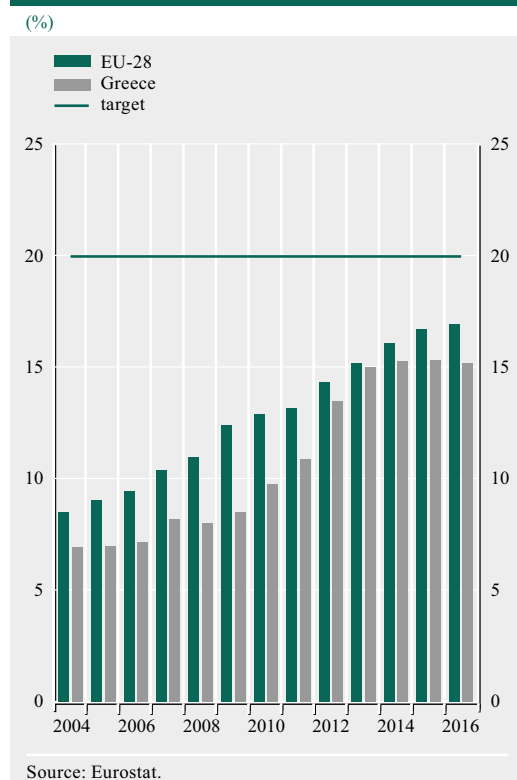
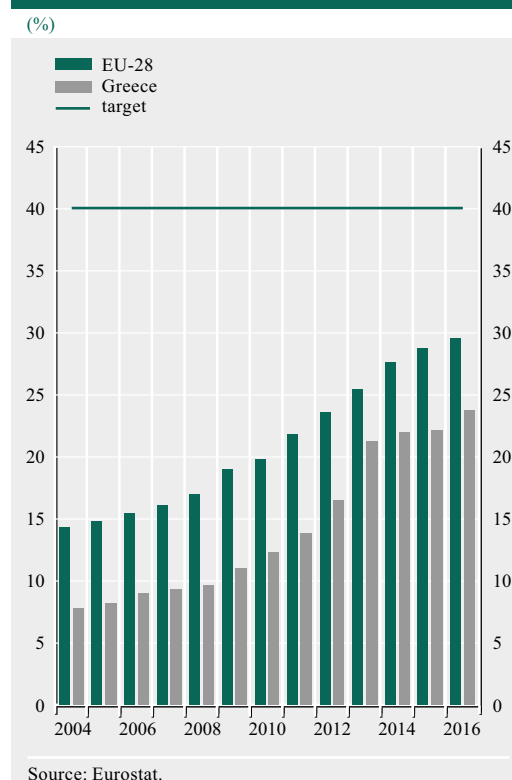


Chart 18 Share of RES in gross electricity consumption



sity of the Greek economy; (2) reduce energy dependence through higher penetration of renewables into energy generation; (3) cut energy costs; and (4) boost investment in the energy sector⁹.

4.1 RECENT MEASURES

(1) To reduce energy intensity

In 2015 a national indicative target was set for total final energy consumption in 2020 not to be higher than 18.4 million tonnes of oil equivalent (Mtoe).¹⁰ In 2017 the Greek Regulation on the Energy Performance of Buildings¹¹ was revised, laying down the cost-optimal minimum requirements on energy efficiency and endorsing the specifications regarding Nearly Zero-Energy Buildings.

(2) To reduce energy dependence – increase the penetration of renewables

Concrete targets for the penetration of renew-

ables into final energy consumption were determined. However, amid the economic crisis the penetration of renewables into the energy mix has slowed to 15.2% in 2016 (Eurostat data), against a target of 20% in 2020¹² (see Charts 17 and 18). The targets for electricity consumption and transport energy consumption are difficult to be met by the deadline (see Chart 19).

(3) To cut energy costs

With regard to the electricity market

With a view to enhancing competition, the unbundling of the transmission and distribution grid from production was introduced. In

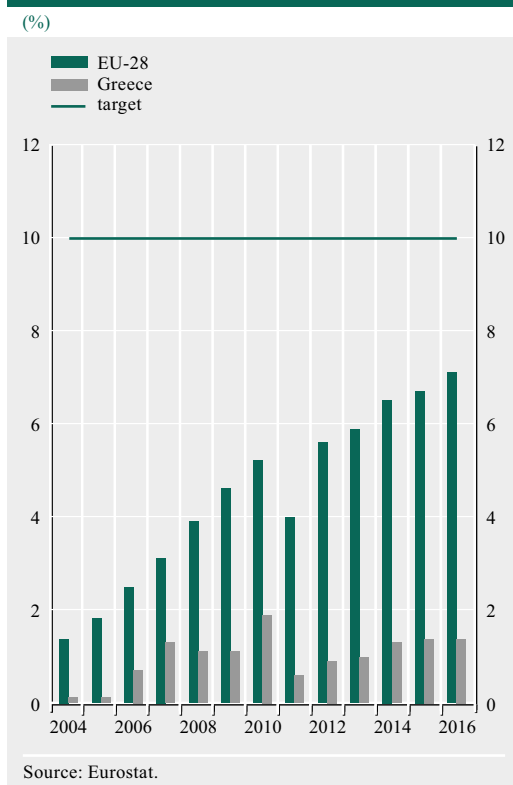
⁹ On the basis of the measures adopted and the agreements signed to bring the sector in line with the EU targets, several investment opportunities have emerged on a small and/or large scale.

¹⁰ Under Law 4342/2015, transposing Directive 2012/27/EU on energy efficiency into Greek law.

¹¹ In line with the requirements of the Directive 2010/31/EU on the energy performance of buildings.

¹² Under Law 3851/2010.

Chart 19 Share of RES in transport fuel consumption



2011¹³ the Independent Power Transmission Operator (ADMIE) and the Hellenic Electricity Distribution Network Operator (HEDNO) were established as PPC subsidiaries. In 2017 the ownership unbundling of ADMIE was completed.¹⁴ In 2016 the NOME auctions were introduced to help reduce the retail and wholesale market share of PPC below 50% by 2020. In April 2018, 40% of PPC's lignite capacity was decommissioned through the sale of two lignite units in Megalopoli as well as through the sale of one lignite unit and the construction permit for a second one in Meliti, Florina.¹⁵

With regard to the natural gas market

By the end of 2016 the unbundling of supply and distribution activities of Gas Supply Companies (EPA) was completed. The natural gas market was fully liberalised on 1 January 2018 and ever since consumers can freely choose their supplier. In April 2018 the tender for the

sale of a 66% stake in the National Natural Gas System Operator (DESFA) was completed.¹⁶ The expansion of the domestic natural gas distribution network, namely the existing networks in Attica, Thessaly and Thessaloniki, as well as the construction of distribution networks in new regions (Central Greece, Central Macedonia and East Macedonia-Thrace) are scheduled to be completed by 2021. Besides, the deployment of compressed natural gas (CNG) distribution infrastructure across selected areas is envisaged for the supply of remote consumers and natural gas fuelling stations.

Growth in natural gas usage is also underpinned by reforms in the retail market, such as the unbundling of the integrated distribution and supply companies. The deregulation of the gas retail market is expected to allow more participants in the supply chain and create a more competitive environment to the benefit of consumers.

(4) To boost investment

As regards consumption, two co-financed programmes have been implemented (Save Energy at Home I and II), which provide incentives for an energy upgrade of houses. Around 50 thousand households benefited from the first programme. The second one was implemented in March 2018 and the funds that were made available for Greece have already been absorbed. Measures are envisaged to upgrade the energy performance of public buildings, improve the energy efficiency of SMEs, support and develop teleheating projects. A mandatory quota in the procurement of energy-efficient vehicles in the public sector has also been determined (see Ministry of Finance 2018).

In the field of interconnection and transmission, a large part of cross-border pipelines is planned to pass through the Greek territory. Greece is expected to benefit from large-scale

¹³ Under Law 4001/2011, in compliance with Directive 2009/72/EC.

¹⁴ A 24% stake of ADMIE was sold to State Grid Europe Limited, while 51% was transferred to ADMIE Holding and 25% to DES ADMIE.

¹⁵ Under Law 4533/2018.

¹⁶ To the Snam-Enagàs-Fluxys consortium for an amount of EUR 535 million.

investment projects that are co-financed by foreign funds and European resources (see Karavias and Anastasatos 2018). Such investment projects include:

(I) Projects with a short timeline for completion (by 2020), such as: (1) The Trans Adriatic Pipeline (TAP), which will cross Northern Greece, Albania and the Adriatic Sea to connect to the Italian natural gas network (investment worth EUR 2 billion for the Greek segment). (2) The Interconnector Greece-Bulgaria (IGB), which will connect the Greek and the Bulgarian natural gas networks (investment worth around EUR 80 million for Greece). (3) The upgrade of the LNG terminal station in Revithoussa (EUR 40 million is remaining to be invested). (4) The floating LNG reception, storage and regasification unit in Alexandroupoli (amounting to EUR 300 million).

(II) Projects with a longer timeline for completion (by around 2025): (1) The East Mediterranean pipeline (East Med), which will connect Israel to Cyprus, Greece, Italy and the rest of Europe (investment worth around EUR 3 billion for the Greek segment). (2) The Interconnector Greece-Italy (IGI) (amounting to EUR 500 million). (3) The interconnection of Greek islands (Cyclades and Crete) to the mainland power grid (amounting to about EUR 420 million). (4) The EuroAsia Interconnector, which will connect Israel to Attica via Cyprus and Crete (amounting to about EUR 1 billion for the Greek segment).

In the field of production, the authorised auctions for new wind and solar power stations will translate into new wind and photovoltaic parks installed in mainland Greece, Crete and the Aegean islands (a private investment of around EUR 1.2-3 billion is expected) (see Karavias and Anastasatos 2018).

4.2 MEASURES IN THE CONTEXT OF THE FOURTH REVIEW

The aforementioned pillars also include the measures provided for in the fourth review

(Supplemental Memorandum of Understanding – Fourth Review of the ESM Programme, DRAFT – 23.5.2018). These measures aim to:

(1) Improve energy efficiency

In line with the EU's aim of a fully integrated European energy market to ensure energy sufficiency and energy security, the Greek authorities will launch the Target Model, which will harmonise the regulatory framework of the Greek energy market with that of the European market.

(2) Reduce energy dependence – increase the penetration of renewables

As a prior action, the renewable energy supporting supplier surcharge will be reduced.

(3) Cut energy costs

Measures aimed at the deregulation of the electricity market:

The decision to sell PPC's lignite-fired plants in Florina and Megalopoli to private investors was confirmed (Law 4533/2018) and the divestment will be completed by end-2018. In June 2018 the authorities will revise the reserve price of the NOME auctions to incorporate updated data on PPC production costs.

Measures aimed at the deregulation of the natural gas market:

The authorities will move forward with the overall corporate restructuring of Public Gas Corporation (DEPA), while the quantities to be auctioned in 2018 will amount to 17% of DEPA's annual natural gas supply.

4.3 SUGGESTED POLICIES

(1) To reduce energy intensity

Policy measures regarding the production, transmission and final consumption of energy. In energy production, the main suggested policies involve the divestment of obsolete plants. With regard to the electricity transmission and distribution network, projects to upgrade networks and expand interconnections nationwide are warranted in order to connect the

islands' separate systems to the mainland grid. In the area of final consumption, the potential to save energy in buildings and transport, which together account for 80% of final energy consumption, is very high. Buildings are a top priority, given that almost 70% of Greece's building stock was constructed prior to 1980, i.e. before the first Thermal Insulation Rules were issued. Furthermore, the promotion of energy saving interventions in buildings could help the construction industry to get back on a growth track.

(2) To reduce energy intensity

Policies that encourage the utilisation of the country's resources, including RES. The large-scale penetration of RES also requires the development of energy saving technologies, as well as flexible power plants which would offset fluctuations in power generation at a low cost.

(3) To cut energy costs

Measures aimed at the deregulation of the electricity and natural gas markets, the reduction of excise duties on energy and the expansion of the natural gas network.

(4) To boost investment

Long-term planning regarding: (a) renewable energy production with the establishment of business incentives; (b) energy transmission via the expansion of networks (integration with cross-border natural gas pipelines and electricity interconnectors) and the islands' interconnection to the main grid; (c) the expansion of a less energy-consuming transport system; and (d) the reduction in consumption through the upgrading of buildings.

In general, the aforementioned obstacles can be overcome by promoting effective actions in three main directions: (1) A comprehensive energy plan, which outlines the desired future structure of the energy system and designs the roadmap to meet the targets. (2) Institutional arrangements, which guarantee market stability and ensure the removal of distortions and a level playing field for all energy producers

and technologies. (3) Actions to encourage entrepreneurship, with a view to consolidating investors' confidence on the back of energy planning and stable market rules. (4) To raise public awareness – especially in small communities, which often oppose the implementation of certain environmental policies.

However, persistent red tape rigidities, lacking coordination among stakeholders and reduced incentives to invest in renewables may weigh on the investment environment. Other major barriers to investment in the energy sector are the lack of funds, the high cost of financing and the reduced availability of domestic private capital.

5 CONCLUSIONS

The energy sector can emerge as a key sector to the new, export-based growth model of the Greek economy. In the field of energy, Greece has significant comparative advantages: (1) noteworthy renewable energy sources, which are also in line with the aim of sustainable development; (2) a strategic position that is key to the deployment of trans-European energy transmission grids; and (3) a well-defined regulatory framework.

The development of energy production relying on domestic resources leads by default to lower import dependency, with direct positive results for the trade balance. Greece's geographic location makes the country a major energy hub for electrical interconnectors and natural gas pipelines that are essential to the connection of the EU to other energy producing countries, in the context of the EU's energy security strategy. The EU's sought interconnection is expected to have positive secondary effects, as it is expected to lead to the interconnection of the Greek energy market per se and to a less wasteful energy sector. The interconnection of the Greek energy market (actually the islands' interconnection) is estimated to create a multiplier effect for the sector, as it will allow the full exploitation of the islands' solar and

wind potential. Further cuts in energy costs thanks to the use of cheap and environment-friendly resources as well as the opening of the electricity and natural gas markets are expected to have secondary effects on the cost of production and the competitiveness of Greek products, which in turn is expected to affect positively Greek exports.

The conjuncture is all the more favourable, given that the sector's development based on the country's comparative advantages is consistent with the aims of the EU. The three main aims of the EU's energy policy are: (1) sustainable development, aimed at changing the energy mix in an effort to tackle climate change; (2) security of energy supply; and (3) the opening of the energy market in an effort to reduce production costs in the EU.

Against this backdrop, all policy measures taken in the context of bringing Greece's regulatory framework in line with the aims of the EU positively affected the Greek economy. (1) Improvements were observed in the energy mix in favour of RES. (2) Investment in RES increased despite the overall decline in investment in Greece during the crisis. Notwithstanding, the Greek economy is still far from meeting the EU's targets for the penetration of RES in energy production. (3) The energy

(electricity and natural gas) market has to a great extent opened up (see also IEA 2017), although energy prices have not yet dropped considerably, given that they incorporate high tax rates.

The recent policy measures continue to be geared towards the targets of changing the energy mix, ensuring energy supply security and the opening of the energy markets. To this end, further opportunities are created for small and large-scale investment projects in Greece. Large-scale investment refers to participation in the construction of cross-border energy interconnectors, under projects that have already been initiated or are bound to start in the coming years. Small-scale investment mainly refers to participation in power generation and upgrading the energy performance of buildings. The regulatory framework also provides for and recommends the option of co-financing by European investment organisations. The present juncture is favourable. What is warranted on the Greek part is to make the most out of these policies: (a) by creating a tendering system that is characterised by transparency and less red tape, so as to attract investors, and (b) by raising public awareness about the aims and the benefits of the policies, so that the Greek society takes full ownership of the policies.

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ARE PRICE ADJUSTMENTS ASYMMETRIC IN BASIC FOOD CATEGORIES? THE CASE OF THE GREEK FOOD MARKET*

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I INTRODUCTION

Asymmetric price transmission is of particular relevance when it comes to commodities, food in particular, because of the incommensurate impact on low-income consumers, who tend to spend a higher share of their income on basic food items. To the extent that consumer prices respond faster to rises in producer prices than to decreases, profit margins for producers widen and a higher producer surplus is recorded to the detriment of consumers. The more competitive an industry/sector is, the more likely it is for price transmission from producers to final consumers to be direct and symmetric. In reality though, wholesalers and retailers, who represent the intermediate links of the food supply chain, strongly affect the effective functioning of the market and the price transmission mechanism.

By “positive asymmetry” it is understood that retail prices adjust to a greater degree or at a faster pace to a rise in (wholesale) producer prices than to a respective decline, while “negative asymmetry” refers to the case where retail prices adjust to a greater degree or at a faster pace to a decline in producer prices than to a respective rise. Thus, negative asymmetry favours final consumers, as it increases consumer surplus, whereas positive asymmetry harms them, reducing consumer surplus to the benefit of producers and/or wholesalers.

Most empirical studies suggest that price adjustment asymmetries are caused by the monopoly power of firms operating in the food supply chain, i.e. the strongly oligopolistic structure of the wholesale and retail markets (Peltzman 2000; Meyer and von Cramon-Taubadel 2004).

The main objective of this paper is to empirically investigate the existence of asymmetries

in the speed of retail price adjustment to a long-run equilibrium, focusing on a group of basic food commodities. The food categories under examination are cereals, meat and meat products, dairy products, fruit, and vegetables. This group of foods was chosen for the following reasons: (a) there is evidence that these food industries are characterised by imperfect competition conditions and exhibit high concentration, leading to oligopoly pricing; and (b) it carries increased weight in the average consumer “basket”. Thus, any changes in the prices of this food group greatly affect the disposable income and the living standards of the average consumer.

To this end, an error correction model (ECM) with threshold autoregressive (TAR) cointegration was applied. Data refer to the period from January 2002 to June 2016. This paper draws on the fullest and most recent sample of available monthly observations for the variables examined, compared with any other study on the Greek food market.

The remainder of the paper is structured as follows: Section 2 provides a brief literature review on price adjustment in the Greek food market. Section 3 outlines the main causes of asymmetric adjustment of food prices. Section 4 documents the importance of the basic food group for the average household and estimates the Herfindahl-Hirschman Index (HHI), measuring market concentration in the respective food industries. The data used are presented in Section 5. Section 6 describes the econometric methodology. Section 7 reports the empirical findings. Finally, Section 8 summarises and concludes.

* The views expressed in this article are of the author and do not necessarily reflect those of the Bank of Greece. Warm thanks are extended to D. Sideris, E. Kondelis, H. Balfoussia, Th. Kosma and I. Papadogeorgis for their constructive remarks. Any errors or omissions are the author's responsibility.

2 LITERATURE REVIEW

There is a relatively limited literature on the Greek food market. Such studies provide a brief description of the food industry or of individual food categories, explore the price transmission mechanism and note imperfect competitive conditions. More specifically:

Reziti (2004) studied empirically the market for lettuce, oranges, potatoes and meat in Greece over the period 2000-2003, using monthly data. Empirical results in the short run support the existence of asymmetries (with the exception of the orange market) in price transmission. In the event of falling producer prices, retailers delay lowering their prices, while conversely, when producer prices rise, retailers are quick to directly pass on increases to consumers.

Reziti and Panagopoulos (2006; 2008) studied empirically the food, vegetable and fruit markets, using monthly data for the period 1994-2005. Empirical results corroborate the existence of speed asymmetries in price transmission from producers to consumers in the cases of food and vegetables, but not in the case of fruit.

Tsakistara et al. (2008) studied the milk market, using annual data for the period 1990-2008, and concluded that oligopoly conditions prevail in this market, indirectly confirming an alleged milk cartel.

The Hellenic Competition Commission (2011) conducted a sectoral survey for the period 2005-2011 on fruit and vegetables, focusing on a sample of seven products (apples, oranges, peaches, potatoes, cucumbers, and lettuce) on the basis of their respective shares in the so-called “housewife’s shopping basket”. The results point to significant asymmetric response to both positive and negative price changes along the fruit and vegetable supply chain. Such asymmetries refer to the speed of changes’ transmission as well as to the size and the persistence of adjustment to the new levels.

Rezitis and Reziti (2011) carried out an empirical study on the milk market, using monthly data for the period 1989-2009. Empirical findings suggest an asymmetric speed of transmission between producer and consumer prices. Consumer prices rise faster than producer prices to restore the long-run equilibrium between consumer and producer milk prices.

Reziti (2014; 2016) investigated the transmission mechanism between producer and consumer prices in the milk market, employing monthly data for the period from January 1998 to August 2014. Empirical evidence shows that the price transmission mechanism is asymmetric, implying that dairy companies and big retailers have the power to shape price dynamics at the expense of both milk producers and consumers.

3 CAUSES OF ASYMMETRIES IN THE FOOD MARKET

The literature has empirically shed light on possible factors behind the asymmetric adjustment of food retail prices.

The most plausible explanation is thought to be the monopoly power of firms, which urges them to engage in a tacit collusion (cartels) to systematically maintain higher profit margins (Brown and Yücel 2000; Miller and Hayenga 2001; Peltzman 2000; Meyer and von Cramon-Taubadel 2004).

Second, asymmetric price transmission is also due to the perishability of some food items (e.g. milk, fresh fruit and vegetables). Ward (1982) argues that producers-farmers and resellers (wholesalers and retailers) holding perishable products may choose not to raise their prices when input prices rise to avoid the risk of accumulating spoiled goods.

Third, adjustment or re-pricing costs as a result of movements in input prices play an important role for firms. Higher input prices are more likely to lead to adjustments in the retail price

of the end product than lower input prices. Some inflation-induced increases are inevitable because of lower actual profit margins (Ball and Mankiw 1994; Buckle and Carlson 2000).

Fourth, government intervention setting price floors may lead to asymmetric price transmission, if it urges wholesalers or retailers to expect that the decrease in agricultural product prices will only be temporary. This occurs because they anticipate that the State will intervene to support producer prices (Kinnucan and Forker 1987).

Fifth, information asymmetries are also observed between firms. Larger firms are typically better informed of developments in input prices during the production process, such as developments in international oil or grain prices. Besides, they can acquire key raw materials faster and at a lower cost than their competitors, allowing them greater freedom of adjusting the retail prices of their products (Bailey and Brorsen 1989).

4 THE IMPORTANCE OF BASIC FOOD ITEMS AND THE DEGREE OF CONCENTRATION ACROSS SECTORS

This section attempts to highlight the particular relevance of the food group under examination (dairy products, meat, cereals, fruit, and vegetables) for the consumption pattern of the average household. Moreover, the Herfindahl-Hirschman Index (HHI), which measures the degree of concentration in the food industries under review, is estimated (Herfindahl 1950; Hirschman 1964; Rhoades 1993).

According to the results of the Household Budget Survey 2015 that were released in July 2016, households' average monthly expenditure on goods and services in 2015 amounted to EUR 1,419.57. Households' average monthly expenditure on food items (food and non-alcoholic beverages) was EUR 293.30, or 20.7% of total household average monthly

expenditure, and constitutes the main expenditure of households over time (see Table 1). Expenditures on housing (EUR 189.21, or 13.3%) and transport (EUR 181.64, or 12.8%) follow suit.

It can be seen that, while the average monthly expenditure of households according to the Household Budget Survey 2010 stood at EUR 1,956.42, in 2015 it fell by 27.4% (or EUR 536.85) to EUR 1,419.57. On the other hand, household average monthly expenditure on food items over the same period (2010-2015) dropped by only 16.6% (or EUR 58.37), suggesting consumers' inelastic income demand. It should also be pointed out that the share of food items in average monthly expenditure grew over time, from 18% in 2010 to 20.7% in 2015.

In 2015, as well as throughout the period 2010-2015, this food group (dairy products, meat, cereals, fruit, and vegetables) has an increased weight in households' average monthly expenditure on food items (see Table 2).

Expenditure on the reviewed food group accounts for 75% (EUR 218) of households' average monthly expenditure on food items (EUR 293.30). Meat, with a share of 22.4% (EUR 65.56), accounts for the bulk of households' expenditure on food, followed by dairy products with 17.6% (EUR 51.52), flour, bread and cereals with 15.3% (EUR 44.84), vegetables with 12.1% (EUR 35.62), and fruit with 7.2% (EUR 21.26). Therefore, the degree of market efficiency for those basic food items strongly affects households' disposable income and living standards.

The Herfindahl-Hirschman Index (HHI),¹ which measures the degree to which a small number of firms represents a large segment of the market, confirms high market concentration in all food industries under review. The

¹ The HHI is used as a potential indicator of market power or of competition among firms. When firms' market shares do not add up to 100, the ensuing deviation is taken into account in the calculation of the HHI as unknown market share.

Table I Household average monthly expenditure on goods and services

Goods and services	Household Budget Survey (HBS)													
	2010		2011		2012		2013		2014		2015		Changes	
	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)
Average monthly expenditure (total)	1,956.42	100.0	1,824.02	100.0	1,637.10	100.0	1,509.39	100.0	1,460.52	100.0	1,419.57	100.0	-536.85	-27.4
Food	351.67	18.0	355.05	19.5	328.57	20.1	307.33	20.4	299.79	20.5	293.30	20.7	-58.37	-16.6
Alcoholic beverages, tobacco	68.7	3.5	66.52	3.6	62.71	3.8	62.8	4.2	58.8	4.0	57.27	4.0	-11.43	-16.6
Clothing and footwear	140.84	7.2	112.51	6.2	95.34	5.8	87.38	5.8	85.7	5.9	83.06	5.9	-57.78	-41.0
Housing	228.82	11.7	230.16	12.6	227.07	13.9	206.99	13.7	195.29	13.4	189.21	13.3	-39.61	-17.3
Durables	130.47	6.7	110.05	6.0	94.97	5.8	83.94	5.6	72.76	5.0	66.49	4.7	-63.98	-49.0
Health	124.43	6.4	114.58	6.3	104.71	6.4	104.44	6.9	105.76	7.2	107.06	7.5	-17.37	-14.0
Transport	264.87	13.5	240.05	13.2	209.88	12.8	189.19	12.5	184.82	12.7	181.64	12.8	-83.23	-31.4
Communications	78.46	4.0	73.69	4.0	68.19	4.2	61.91	4.1	60.08	4.1	58.46	4.1	-20	-25.5
Recreation, culture	91.6	4.7	85.72	4.7	72.87	4.5	68.82	4.6	68.71	4.7	67.95	4.8	-23.65	-25.8
Education	64.21	3.3	63.71	3.5	57.33	3.5	50.83	3.4	50.84	3.5	46.7	3.3	-17.51	-27.3
Hotels, cafes, restaurants	209.75	10.7	189.11	10.4	160.47	9.8	145.55	9.6	143.49	9.8	141.05	9.9	-68.7	-32.8
Miscellaneous goods and services	202.61	10.4	182.89	10.0	154.98	9.5	140.19	9.3	134.49	9.2	127.37	9.0	-75.24	-37.1

Source: ELSTAT.

Table 2 Average monthly expenditure on food

Food and non-alcoholic beverages	HBS 2015		HBS 2014		HBS 2015/2014	HBS 2015/2014
	Value (in EUR)	Distribution (%)	Value (in EUR)	Distribution (%)	Changes in value (%)	Differences in percentage distribution (%)
Total	293.30	100	299.79	100	3.9	
Flour, bread, cereals	44.84	15.3	46.99	15.7	-4.6	-0.4
Meat	65.56	22.4	68.06	22.7	-3.7	-0.3
Fish	21.16	7.2	21.6	7.2	-2.2	0.0
Dairy products and eggs	51.52	17.6	54.24	18.8	-5.0	-0.5
Oils and fat	17.74	6.0	17.59	5.9	0.9	0.1
Fruit	21.26	7.2	21.39	7.1	-0.6	0.1
Vegetables	35.62	12.1	35.36	11.8	0.7	0.3
Sugar, jams, honey, chocolate, confectionery	14.57	5.0	13.76	4.6	5.9	0.4
Food products n.e.c.	6.10	2.1	4.92	1.6	24.0	0.5
Coffee, tea and cocoa	6.21	2.1	6.68	2.2	-7.0	-0.1
Mineral water, soft drinks, fruit and vegetable juices	8.72	3.0	9.21	3.1	-5.3	-0.1

Source: ELSTAT.

HHI is a measure of market concentration, calculated by squaring the market share of each firm in the sector/industry and then summing the resulting numbers. The formula for the HHI is the following:

$$HHI = \sum_{i=1}^n (s_i)^2 = s_1^2 + s_2^2 + s_3^2 + \dots + s_n^2$$

where s_i is the market share of firm i , with a total number of firms n in the market. When the HHI is lower than 1,000, market concentration is characterised as low; when it ranges between 1,000 and 1,800, concentration is considered to be medium; and a HHI above 1,800 denotes high market concentration. The HHI takes the maximum value of $10,000=100^2$ if there is a monopoly, i.e. the firm has a 100% market share. Conversely, the HHI takes a very low value close to zero, if the market operates under perfect competition.

Table 3 presents the number of firms by food sector, the respective market shares and the Herfindahl-Hirschman Index (HHI) in 2014.

In the cereals sector, in the industry of bread and bakery products in particular, two firms held a combined market share of 24% in terms of turnover (sales) and of 8% in terms of employment, while eleven firms accounted for 42% of total sales and employed 21% of the sector's total workforce. The HHI was calculated at 2,926 ($>1,800$), indicating high market concentration. With regard to the flour mill industry, 17 firms accounted for 75% of total sales in 2013, with a high HHI of 8,200 ($>1,800$).

Turning to the sector of meat and meat products, market concentration was also strong, since four very large firms and 17 large firms were active, with the industry of cured meat products exhibiting a very high concentration index of 5,822 ($>1,800$).

In the sector of dairy products, only four firms accounted for more than 53% of total sales in 2013. The HHI was calculated at 4,094 ($>1,800$), indicating high market concentration.

Table 3 The concentration index Herfindahl-Hirschman (HHI)

	Firms	Very large		Large		Small and medium-sized		Total of firms in the sample		Market concentration index Herfindahl-Hirschman (HHI)	Conclusion
		Sales over EUR 250 million		Sales between EUR 50 million and 250 million		Sales between EUR 2 million and 50 million					
		Number of firms	Market share	Number of firms	Market share	Number of firms	Market share	Number of firms	Market share		
Food sectors											
Cereals and cereal products ¹											
Bakery and confectionery products		2	24%	11	42%	80	19%	93	85%	2926	High concentration
Flour mill industry				1		17		18	90%	8200	High concentration
Meat and meat products		4		17		1,514 ²					High concentration
Cured meat products				3	74%	5	11%	8	85%	5822	High concentration
Dairy products and eggs		4	53%	5		56		65	86%	4094	High concentration
Fruit and vegetables		2 ³	20%	59	25%		35%		90%	2350	High concentration

Source: Author's own calculations based on data from Grant Thornton and IELKA.

1 Four firms have a combined share of around 50% in the Greek bread and bakery market, while 17 firms accounted for 75% of the flour mill industry in 2013.

2 256 industrial firms and 927 commercial firms, of which 162 industrial and 179 commercial firms were medium-sized.

3 Central markets are organised wholesale points, mainly consisting of: (a) the Athens Central Market Organisation S.A. (OKAA), with 550 active wholesalers of fresh fruit and vegetables, and (b) the Thessaloniki Central Market S.A. (KATH), which comprises 280 shops. According to ICAP (2015), the two central markets hold a market share of 20%, wholesalers outside central markets a 35% share, super markets a 25% share and farmers' markets the remaining 20%.

With respect to the fruit and vegetable sector, the country's two central markets (OKAA and KATH)² held a market share of 20%, followed by wholesalers outside central markets with 35%, super markets with 25% and farmers' markets with the remaining 20%. The HHI was calculated at 4,050 (>1,800), indicating the sector's high concentration.

5 THE DATA

The data used in the empirical investigation are producer price indices and retail price indices for the main food categories: cereals and cereal products; meat and meat products; dairy products and eggs; fruit; and vegetables.

Data refer to the period from January 2002 to June 2016. Data sources are Eurostat statistics, the Hellenic Statistical Authority (ELSTAT) and the Bank of Greece. In greater detail, food retail prices are reflected in the respective sub-indices of the Harmonised Index of Consumer Prices (HICP), while food producer prices are captured by the respective categories of the Producer Price Index (PPI) of the domestic market.

To ensure the robustness of empirical results, the HICP and the PPI must refer to the same basket of goods to the extent possible. As

2 OKAA: Athens Central Market Organisation S.A., with 550 active wholesalers of fresh fruit and vegetables; and KATH: Thessaloniki Central Market S.A., which comprises 280 shops.

Table 4 Consistency between HICP and PPI classification codes

HICP (2015=100)	PPI (2010=100)
Food categories	
Cereals and cereal products	Mill and cereal products, starches and starch products
Meat (in general)	Cured meat and meat products
Dairy products and eggs	Dairy products
Fruit (in general)	Prepared and preserved fruit and vegetables
Vegetables (in general)	

Source: ELSTAT.

shown in Table 4, there is indeed great consistency between classification codes referring to price indices for the specific food groups.

Nevertheless, the present study encountered a number of problems with regard to data, as described below:

First, in the fruit and vegetable category, the HICP comprises two separate series, whereas the PPI has only one consolidated series. Second, in the cereals category, in order to ensure greater consistency between the HICP and the PPI, two separate sub-indices of the PPI were consolidated into one weighted sub-index. The weighted sub-index comprises mill and cereal products, starches and starch products on the one hand and bread/bakery and flour products on the other hand. Third, the base year of the PPI is adjusted from 2010 to 2015 to ensure consistency with the HICP.³ Fourth, while account is also taken of the value added tax (VAT) when measuring prices on the basis of the HICP, for the PPI basic prices are collected, i.e. prices minus VAT or similar deductible taxes that are directly associated with turnover and minus duties or other taxes on products, but plus subsidies on products. For this reason, VAT is excluded from the HICP to ensure harmonisation with the PPI.⁴ Fifth, food indices (mainly fruit and vegetables) that are measured using the methodology for the compilation of either the HICP or the PPI are characterised by

strong seasonality. Seasonality, which can be attributed to weather conditions and/or seasonal patterns of consumption behaviour, hinders the investigation into possible asymmetric price responses that are due to the oligopolistic structure of those sectors. Against this backdrop, all indices in the study are seasonally adjusted using the X-12 ARIMA filter.

6 THE ECONOMETRIC METHODOLOGY

To empirically investigate whether there is asymmetric adjustment of food prices to their long-run equilibrium, an error correction model (ECM) with threshold autoregressive (TAR) cointegration is employed, as proposed by Enders and Siklos (2001). In the event that retail prices and producer prices follow a long-run equilibrium relationship, the latter can be expressed as follows:

$$r_t^r = \alpha_0 + \beta_1 r_t^w + u_t \quad (1)$$

where r_t^r denotes the retail price of a food item in period t , while r_t^w denotes the producer price of the item over the same period t . Relationship (1) is expressed in logs. The log-transformation of the series normalises the effect of any squared trends in the evolution of the series and, besides, the estimations of the equation parameters are directly expressed in elasticities. Parameter α_0 represents a constant cost, while parameter β_1 reflects the degree of retail price adjustment to producer price movements and indirectly captures the intensity of market competition. The more intense the competition, the larger the expected degree of adjustment and the narrower the expected profit margin. u_t symbolises the error term with constant mean and variation, which reflects short-term deviations from the long-run equilibrium relationship. When prices r_t^r and r_t^w reach their long-run equilibrium, residuals are

³ Different base years create problems in the estimation of models, as differences are transferred to the fixed term, distorting its estimation. This issue is addressed through base year adjustment. As a rule, the most recent reference year is opted for.

⁴ Comparing prices or indices excluding taxes with prices or indices at constant taxes distorts the outcomes (IOBE 2009).

expected to be zero. By contrast, if prices deviate from the long-run relationship, the error term u_t may be either positive, when the price r_t^r is higher than its long-run equilibrium, or negative otherwise.

If the adjustment to the long-run equilibrium is asymmetric, suggesting that the autoregressive behaviour of residuals in the long-run relationship $\hat{u}_t$ is conditional upon the sign of exogenous shocks, then the traditional Dickey-Fuller (1979) tests as well as their augmented versions for cointegration using the two-step procedure by Engle and Granger (1987) are misspecified, because they assume a symmetric adjustment of residuals to the long-run equilibrium (Enders and Granger 1998; Enders and Siklos 2001). In line with this technique, the typical Dickey-Fuller (1979) test equation for cointegration, which is given by the following relationship:

$$\Delta \hat{u}_t = \rho \hat{u}_{t-1} + v_t \quad (2)$$

is augmented, incorporating a functional importance indicator I_t , according to which the residuals of the long-run relationship (1) are split into two components with a time lag and which is given by the following relationship:

$$\Delta \hat{u}_t = I_t \rho_1^{up} \hat{u}_{t-1}^{up} + (1 - I_t) \rho_2^{down} \hat{u}_{t-1}^{down} + v_t \quad (3)$$

If after the estimation of relationship (3) some form of autocorrelation is observed, then the appropriate number of time lags is inserted $\Sigma \Delta \hat{u}_{t-j}$.

The functional importance indicator I_t is given by relationship (4):

$$I_t = \begin{cases} 1 & \text{if } \hat{u}_{t-1}^{up} \geq \hat{\tau} \\ 0 & \text{if } \hat{u}_{t-1}^{down} < \hat{\tau} \end{cases} \quad (4)$$

where the value of the point (or threshold) is stochastic and denoted with the letter $\hat{\tau}$. $\{v_t\}$ denotes the residual series of relationship (3) with a mean of zero and constant variance, so that the vector $\{v_t\}$ is independent of $\hat{u}_t$. The combination of relationships (3) and (4)

is the threshold autoregressive (TAR) model. Allowing the parameters ρ_1^{up} and ρ_1^{down} to take different values, the model acknowledges that positive and negative deviations from equilibrium can be corrected at different adjustment speeds.

The cointegration test can be performed using the critical values of the distributions t-Max and Φ^* , as suggested by Enders and Siklos (2001). Furthermore, Tong (1982; 1983; 1990) showed that in the event of a threshold autoregressive cointegration, i.e. if the hypothesis $H_0: \rho_1^{up} = \rho_1^{down} = 0$ is rejected, the parameters ρ_1^{up} and ρ_1^{down} of relationship (3) that were estimated using the least squares method follow an asymptotic multi-variate normal distribution, which allows to test for the hypothesis $H_0: \rho_1^{up} = \rho_1^{down} = 0$ using a typical F test (e.g. Wald test), to check whether the adjustment is symmetric. In reality, the true value of the threshold is unknown and must be estimated. To determine the threshold value $\hat{\tau}$ where a statistically significant asymmetry is likely to emerge, Enders and Siklos (2001) propose the application of a search method that is widely known in the literature as “Chan’s approach”. Chan (1993) showed that under certain typical circumstances the OLS method yields a super-consistent estimator of the true threshold value. More specifically, according to this grid search procedure, the vector values of the residuals $\hat{u}_t$ resulting from the cointegration relationship (1) are identified as potential threshold values. The residual vector $\{\hat{u}_t\}$ is sorted in ascending order as follows, $\{\hat{u}_1^r < \hat{u}_2^r < \dots < \hat{u}_T^r\}$ where T denotes the number of usable observations. From the distribution of threshold values sorted in ascending order, the highest and the lowest 15% of values (outliers) are discarded and the remaining (central) 70% of residual values are considered possible thresholds. For each one of those possible thresholds belonging to 70% of the values, relationship (3) is successively estimated using the specification of the importance indicator in relationship (4). The value of the residual $\hat{u}_t$ that was estimated using relationship (3) and which yields the lowest residual sum of squares (RSS) is deemed to be the appropriate threshold $\hat{\tau}$.

If a TAR cointegration is verified, an error correction model with a long-run asymmetric equilibrium can then be estimated, which in its generic form is described by the following relationship (5):

$$\Delta r_t^r = \mu_0 + \sum_{i=1}^{k_1} \beta_{1,i} \Delta r_{t-i}^r + \sum_{i=0}^{k_2} \beta_{2,i} \Delta r_{t-i}^w + a_1^{up} u_{t-1} + a_2^{down} u_{t-1} + e_t \quad (5)$$

where $\hat{u}_{t-1}^{up} = I_t \hat{u}_{t-1}$ and $\hat{u}_{t-1}^{down} = (1 - I_t) \hat{u}_{t-1}$.

On the basis of the specification of relationship (5), the adjustment speed of retail prices is a_1^{up} , if $\hat{u}_{t-1}$ is above the long-run equilibrium, and a_2^{down} , if $\hat{u}_{t-1}$ is below the long-run equilibrium. To test for long-run symmetry, i.e. whether the coefficients a_1^{up} and a_2^{down} are statistically equal, the $H_0: a_1^{up} = a_2^{down}$ hypothesis of model (5) is controlled. The asymmetric mean adjustment lag (MAL) is calculated using the following formulas (Hendry 1995):

$$MAL^{up} = (\sum_i^{k_1} \beta_{2i} - 1) / \alpha_1^{up} \quad (6)$$

and

$$MAL^{down} = (\sum_i^{k_2} \beta_{2i} - 1) / \alpha_2^{down} \quad (7)$$

Relationship (6) measures the mean adjustment lag MAL^{up} in months during which food retail prices are above their equilibrium level. Respectively, relationship (7) measures the mean adjustment lag MAL^{down} in months during which food retail prices are below their equilibrium level.

7 EMPIRICAL RESULTS

Prior to the cointegration tests, the presence of unit root $I(1)$ in food price variables is examined performing the Augmented Dickey-Fuller (ADF) (1979; 1981), Phillips-Perron (PP) (1988) and DF-GLS (Elliot et al. 1996) tests. The series are log-transformed for all variables. Unit root tests show that, while the unit

root hypothesis cannot be rejected as to the levels of the series, their first differences were found to be stationary. Thus, the series of both food retail prices and producer prices are integrated of order one, $I(1)$.⁵

The estimation of relationship (1) is carried out using the FMOLS (Fully Modified OLS) method.⁶ The cointegration tests reject the null hypothesis of no cointegration (see Table 5).

If the reviewed food industries did operate under perfect competition, the degree of adjustment should be expected to be 100%, i.e. elasticity would be $\beta_0 = 1$. This would mean that producer price movements would be fully passed through to food retail prices. The estimations of the long-run relationships suggest that the values of the coefficient β_0 across the reviewed food categories are statistically less than unity, with the exception of the dairy products category where the coefficient is inferred to be equal to unity. The finding that the estimated values of the degree of adjustment are less than unity, i.e. indicating that imperfect competition conditions prevail in the reviewed industries, does not necessarily imply a long-run asymmetric adjustment of retail prices as well.

The results of the TAR model estimation, which are presented in Table 6, suggest that the consistent value of the threshold $\hat{\tau}$ for each individual food category is different. A positive threshold value implies that the current food retail price r_t^r is above the long-run equilibrium, as determined by the cointegration relationship (1), which in turn indicates an environment of expanded profit margins. By contrast, a negative threshold value points to an environment of compressed profit margins. In other words, the critical point beyond which the residuals respond and change their speed

⁵ The results of unit root tests on individual series are not presented in this article for the sake of brevity, but are available upon request.

⁶ The FMOLS method yields super-consistent estimators and the ensuing residuals denote stochastic (unpredictable) shocks. The FMOLS method is preferable to the OLS method because it increases effectiveness and reduces small sample bias compared with the OLS estimate (Phillips and Hansen 1990). Moreover, the FMOLS method yields an asymptotic unbiased and effective estimator, thereby allowing reliable statistical testing.

Table 5 Estimation of the long-run relationship for food price equations and cointegration testing

Long-run relationships	Price equations									
	Cereals		Meat		Dairy products		Fruit		Vegetables	
Adjusted sample size	January 2002 - June 2016									
Total observations	174		174		150		138		126	
α_0	1.098**	(5.123)	0.386**	(2.681)	0.159	(1.288)	1.647**	(3.570)	2.251**	(4.079)
β_1	0.734**	(13.971)	0.917**	(28.800)	0.965**	(28.936)	0.650**	(19.328)	0.505**	(4.158)
Adjusted R ²	0.987		0.968		0.985		0.633		0.285	
Standard error of regression	0.012		0.012		0.006		0.043		0.041	
Engle-Granger cointegration tests										
Null hypothesis of cointegration H ₀										
Engle-Granger tau-statistic	-4.607**	[0.018]	-5.604**	[0.000]	-4.956**	[0.001]	-5.300**	[0.000]	-4.878**	[0.000]
Engle-Granger z-statistic	-37.657**	[0.015]	-44.948**	[0.000]	-43.313**	[0.000]	-44.365**	[0.000]	-40.278**	[0.000]

Conclusion: the series are cointegrated

Source: Author's econometric estimations.

Notes: t statistics in parentheses and P-values in square brackets. ** denotes statistical significance at 5%. Critical values for the cointegration test are provided by MacKinnon (1996). The lags of the Engle-Granger cointegration tests were obtained using the Schwarz information criterion (SBC).

of adjustment to the long-run equilibrium is different for each food category, yet very close to zero.

According to the estimations of the TAR model, the residual convergence coefficients of the long-run relationship ϱ_1^{up} and ϱ_2^{down} are statistically significant on the basis of the critical values of t-Max* statistics and have the expected negative sign across all food categories. It should be noted that in all food categories the absolute value of the coefficient ϱ_2^{down} is higher than that of ϱ_1^{up} , implying a faster adjustment of deviations when residuals are below the consistent threshold $\hat{\tau}$ (profit margin compression) than when they are above it (profit margin expansion).

The test for the hypothesis of a symmetric adjustment in deviations towards their mean $\varrho_1^{up} = \varrho_2^{down}$ for all food categories, except for meat, shows that residuals symmetrically adjust to their attractor.

The existence of threshold autoregressive cointegration allows the estimation of the ECM

with TAR cointegration, which in its generic form is described by relationship (5). In this way, the nature of the long-run adjustment is explored, i.e. whether food retail prices exhibit an asymmetric response to their long-run equilibrium. The results of these estimations are presented in Table 7.

In all food categories, the estimations of the coefficients measuring asymmetric adjustment to the long-run equilibrium appear to vary.

The values of the coefficients measuring the speed of adjustment when retail prices are below their equilibrium (compressed profit margins) are higher in all food categories than what is the case when retail prices are above their equilibrium (expanded profit margins). Against this backdrop, it can be assumed that, when profit margins are compressed, retailers exhibit a higher tendency to raise food prices after a rise in producer prices. Conversely, when profit margins are expanded, retailers are less inclined to lower prices after a drop in producer prices.

Table 6 TAR tests for threshold autoregressive cointegration

Adjusted sample size		Feb. 2002-June 2016 (n=173)		Feb. 2002-June 2016 (n=173)		Feb. 2002-June 2016 (n=149)		Feb. 2002-June 2016 (n=137)		Feb. 2002-June 2016 (n=128)	
		Cereals		Meat		Dairy products		Fruit		Vegetables	
		P-value		P-value		P-value		P-value		P-value	
Estimation method: OLS		$\tau = -0.012288$		$\tau = 0.008340$		$\tau = 0.006592$		$\tau = -0.013076$		$\tau = -0.023808$	
Threshold	Enders-Siklos, t-MAX*	ρ_1^{up}	-0.148** (-2.496) [0.013]	-0.166** (-2.176) [0.030]	-0.231** (-2.120) [0.035]	-0.292** (-4.299) [0.000]	-0.255** (-3.101) [0.002]				
	Enders-Siklos, t-MAX*	ρ_2^{down}	-0.238** (-3.657) [0.000]	-0.402** (-5.678) [0.000]	-0.341** (-4.638) [0.000]	-0.351** (-3.162) [0.001]	-0.397** (-3.776) [0.000]				
Testing for TAR cointegration	Statistic Enders-Siklos Φ^*	$H_0: \rho_1^{up}=\rho_2^{down}=0$	9.805** [0.000]	17.874** [0.000]	13.008** [0.000]	14.244** [0.000]	11.942** [0.000]				
Testing for symmetry	Wald F-test	$H_0: \rho_1^{up}=\rho_2^{down}$	1.048** [0.307]	5.441 [0.020]	0.693** [0.406]	0.227** [0.634]	1.122** [0.291]				
Conclusions			Cointegration Symmetric adjustment of residuals	Cointegration Asymmetric adjustment of residuals	Cointegration Symmetric adjustment of residuals	Cointegration Symmetric adjustment of residuals	Cointegration Symmetric adjustment of residuals				
Source: Author's econometric estimations.											
Notes: t statistics in parentheses and P-values in square brackets. ** denotes statistical significance at 5%. The maximum lag length is obtained using the AIC (1973) and SBC (1978) information criteria. Critical values for TAR cointegration testing are provided by Enders and Siklos (2001) and Wane (2004). The critical values of Φ^* statistics (with threshold) without lags are 6.95 (with 100 observations) and 6.93 (with 250 observations) at a 5% level of significance. The critical values of t-Max* statistics without lags are -1.85 (with 100 observations) and -1.84 (with 250 observations) at a 5% level of significance. To test the hypothesis of symmetry, F-values are used, provided that there is TAR cointegration.											

Source: Author's econometric estimations.
 Notes: t statistics in parentheses and P-values in square brackets. ** denotes statistical significance at 5%. The maximum lag length is obtained using the AIC (1973) and SBC (1978) information criteria. Critical values for TAR cointegration testing are provided by Enders and Siklos (2001) and Wane (2004). The critical values of Φ^* statistics (with threshold) without lags are 6.95 (with 100 observations) and 6.93 (with 250 observations) at a 5% level of significance. The critical values of t-Max* statistics without lags are -1.85 (with 100 observations) and -1.84 (with 250 observations) at a 5% level of significance. To test the hypothesis of symmetry, F-values are used, provided that there is TAR cointegration.

Table 7 Error correction model (ECM) with TAR cointegration

Estimation method: OLS (HAC standard errors & covariance)		ECM with TAR cointegration									
Adjusted sample size (n = number of observations)		Feb. 2002-June 2016 (n = 173)		Feb. 2002-June 2016 (n = 149)		Feb. 2002-June 2016 (n = 137)		Feb. 2002-June 2016 (n = 128)			
Error correction models	Coefficients	Cereals		Meat		Dairy products		Fruit		Vegetables	
			p-value		p-value		p-value		p-value		p-value
Fixed term	μ_0	0.000 (0.800)	[0.424]	0.000 (1.448)	[0.149]	0.001 (0.291)	[0.771]	-0.004 (-1.182)	[0.239]	-0.001 (-0.245)	[0.806]
$\Delta(r^i)_{t-1}$	$\beta_{1,1}$	0.266** (7.615)	[0.000]			0.224** (2.439)	[0.016]			0.084 (1.043)	[0.298]
$\Delta(r^i)_{t-2}$	$\beta_{1,2}$					0.098** (1.414)	[0.159]				
$\Delta(r^i)_{t-3}$	$\beta_{1,3}$										
$\Delta(r^i)_{t-5}$	$\beta_{1,5}$					0.137** (1.906)	[0.058]	0.215** (2.772)	[0.006]		
$\Delta(r^w)_t$	$\beta_{2,0}$					0.328** (2.264)	[0.025]	0.651* (1.881)	[0.062]		
$\Delta(r^w)_{t-1}$	$\beta_{2,1}$	0.153** (3.271)	[0.001]	0.203** (5.253)	[0.000]						
$\Delta(r^w)_{t-2}$	$\beta_{2,2}$			0.035** (1.781)	[0.076]					0.600** (1.993)	[0.048]
$\hat{u}_{t-1}^{up}$	α_1^{up}	-0.017 (-0.546)	[0.585]	-0.047 (-1.058)	[0.291]	-0.151** (-2.111)	[0.036]	-0.268** (-4.175)	[0.000]	-0.225** (-2.207)	[0.029]
$\hat{u}_{t-1}^{down}$	α_2^{down}	-0.143** (-4.392)	[0.004]	-0.113** (-2.808)	[0.005]	-0.260** (-3.025)	[0.003]	-0.320** (-2.902)	[0.004]	-0.424** (-3.362)	[0.001]
Wald F-statistic	$\alpha_1^{up} = \alpha_2^{down}$	7.206 df(1.165)	[0.008]	5.472 df(1.164)	[0.026]	0.934** df(1.139)	[0.335]	0.125** df(1.130)	[0.723]	1.136** df(1.118)	[0.288]
Main conclusion		Rejection of symmetry		Rejection of symmetry		Verification of symmetry		Verification of symmetry		Verification of symmetry	
Adjusted R ²		0.810		0.360		0.421		0.330		0.244	
DW statistic		2.16		2.000		2.010		2.075		1.976	
LM(6), Breusch-Godfrey Serial Correlation Test		1.966 Prob. F-stat (6.159)		0.928 Prob. F-stat (6.158)		1.002 Prob. F-stat (6.133)		1.220 Prob. F-stat (6.124)		0.615 Prob. F-stat (6.112)	

Source: Author's econometric estimations.
Notes: t statistics in parentheses and P-values in square brackets. ** and * denote statistical significance at 5% and 10%, respectively. The maximum lag length was obtained using the AIC (1973) and SBC (1978) information criteria.

Table 8 Mean adjustment lag

Mean adjustment lag		Cereals	Meat	Dairy products	Fruit	Vegetables
MAL ^{up}	Months	49.8	16.2	4.5	1.3	1.8
MAL ^{down}	Months	5.9	5.7	2.6	1.1	0.9

Source: Author's econometric estimations.

With regard to the cereals category, the coefficient measuring adjustment when the retail prices of cereal products are above their equilibrium (thereby suggesting a decreasing trend) takes the value $\rho_1^{up} = -0.017$, but is statistically insignificant. In other words, it is presumed to be equal to zero, even though it bears the expected sign. On the basis of the available sample of observations, -0.017 is considered to be the most likely value for this parameter. If the value of the term ρ_1^{up} is not in reality other than zero, this implies that expanded profit margins are not corrected and that the values r_t^w and r_t^r are not cointegrated. Nevertheless, the tests performed suggest a cointegration between both series. Studies with similar findings, such as von Cramon-Taubadel (1998) and Reziti (2014), rested upon the same assumption, i.e. that the estimated value $\rho_1^{up} = -0.017$, although it is assumed to be zero, is the most likely value for this parameter on the basis of the specific sample of observations. In other words, it can be deduced that either expanded profit margins are not corrected or that the adjustment is very slow. The coefficient measuring adjustment when retail prices are below their equilibrium (thereby suggesting a rising trend) takes the value $\rho_2^{down} = -0.143$ and is statistically significant. That is, when deviations from long-run equilibrium are negative, the retail prices of cereal products move upwards to converge towards their equilibrium, whereas positive deviations from long-run equilibrium do not affect the retail prices of cereals, which remain sticky. A typical Wald test ($F(1.165) = 7.206$, $P\text{-value} = 0.008$) rejects the equality of the adjustment coefficients $\rho_1^{up} = \rho_2^{down}$, at a 5% level of statistical significance. Asymmetric speeds of adjustment to long-run equilibrium

also determine the mean adjustment lag (MAL). As shown in Table 8, the mean adjustment lag, when the retail prices of cereals are above equilibrium, is $MAL^{up} = 49.8$ months, implying a marginally zero adjustment and therefore the adjustment of the deviation from the original shock is very slow. By contrast, when retail prices are below equilibrium, $MAL^{down} = 5.9$ months. The empirical findings lead to the conclusion that there is a positive asymmetric adjustment of the retail prices of cereals to their long-run equilibrium, at the expense of consumers.

For the meat category, the findings are similar with those for the cereals category. That is, the coefficient measuring adjustment when meat retail prices are above equilibrium takes the value $\rho_1^{up} = -0.047$ and is statistically insignificant, whereas the respective coefficient measuring adjustment when prices are below equilibrium takes the value $\rho_2^{down} = -0.133$ and is statistically significant. MAL^{up} is 16.2 months (marginally zero adjustment) and therefore the deviation from the original shock corrects at a very slow speed, taking too long to fully adjust. By contrast, when retail prices are below equilibrium, $MAL^{down} = 5.7$ months.

The empirical findings provide evidence that there is an asymmetric adjustment of meat retail prices to their long-run equilibrium.

In the cases of dairy products, fruit, and vegetables, the coefficients measuring the speeds of adjustment are statistically significant under both premises and, although they are seemingly divergent, the tests performed support the equality of coefficients.

More specifically, with respect to the category of dairy products and eggs, there appears to be a divergence of $\rho_1^{up} = |-0.151| < \rho_2^{down} = |-0.260|$ between the coefficients measuring the speed of long-run adjustment, probably suggesting asymmetries in the speed of price adjustment. The adjustment coefficients are statistically significant and a typical Wald test ($F(1.139) = 0.934$, P-value = 0.335) for $\rho_1^{up} = \rho_2^{down}$ showed that the equality hypothesis cannot be rejected at a 5% level of statistical significance. When the retail prices of dairy products are above equilibrium, MAL^{up} is 4.5 months, while MAL^{down} is 2.6 months when prices are below equilibrium (see Table 8).

For the fruit category, the coefficients measuring the speed of long-run adjustment also seem to be divergent, as $\rho_1^{up} = |-0.268| < \rho_2^{down} = |-0.320|$.

The adjustment coefficients are statistically significant and a Wald test ($F(1.130) = 0.125$, P-value = 0.723) for $\rho_1^{up} = \rho_2^{down}$ showed that the equality hypothesis cannot be discarded at a 5% level of significance. When fruit retail prices are above equilibrium, MAL^{up} is 1.3 month, while MAL^{down} is 1.1 month when prices are below equilibrium.

For the category of vegetables, price adjustment is broadly the same as for the category of fruit. The coefficients measuring the speed of long-run adjustment are seen to be different, since $\rho_1^{up} = |-0.225| < \rho_2^{down} = |-0.424|$. The adjustment coefficients are statistically significant and a Wald test ($F(1.118) = 1.136$, P-value = 0.288) showed that the hypothesis of coefficients equality $\rho_1^{up} = \rho_2^{down}$ cannot be rejected at a 5% level of significance. When vegetable retail prices are above equilibrium, MAL^{up} is 1.8 month, while MAL^{down} is 0.9 month when prices are below equilibrium.

8 CONCLUSIONS

Asymmetric price transmission is of particular relevance when it refers to food commodities, as it has an incommensurate impact on low-

income consumers, who tend to spend a higher share of their income on basic food items.

The main objective of this paper was to empirically investigate the existence of asymmetries in the speed of retail price adjustment to long-run equilibrium, focusing on a group of basic food categories. The food categories examined were cereals, meat and meat products, dairy products, fruit, and vegetables.

The key factor behind food price adjustment asymmetries that is cited in the literature is the monopoly power of firms or the degree of concentration in a sector, which enables firms to engage in a tacit collusion (cartels) to systematically maintain high profit margins. Measuring concentration in the sectors reviewed on the basis of the Herfindahl-Hirschman Index (HHI) for 2014 attested to high market concentration in all sectors, and particularly so in those of cereals and meat. Other reasons mentioned in the literature are the perishability of some food items, re-pricing costs, government-mandated minimum prices, and information asymmetries.

To empirically investigate whether there is an asymmetric adjustment of food retail prices relative to producer price movements, an error correction model (ECM) with threshold autoregressive (TAR) cointegration was employed. The empirical findings support a TAR cointegration for each of the reviewed food categories.

The empirical investigation into a possible asymmetric behaviour of retail prices using the estimations of the ECM-TAR models provides strong evidence that there are in fact such asymmetries in the categories of cereals and meat. The empirical findings of retail price asymmetric adjustment in the categories of cereals and meat may be associated with the oligopolistic structure of those sectors, where firms tend to keep prices relatively unchanged (rigid) in times of declining producer prices, while rushing to raise them in times of rising producer prices. Price adjustment asymmetries

for the categories of cereals-flour products and meat are consistent with the high concentration ratio of those sectors on the basis of the Herfindahl-Hirschman Index (HHI).

Conversely, turning to the categories of dairy products, fresh fruit, and vegetables, the divergences in the coefficients of long-run adjustment cannot justify a rejection of symmetrical adjustment. The recommendations contained in the OECD Toolkit (OECD 2014a; 2014b;

2016), which were to a great extent adopted by the Greek government with Laws 4254/2014, 4336/2015 and 4441/2016, contributed to a more effective functioning of those specific markets.⁷

⁷ The most important measure in this direction was to extend the shelf life of fresh milk as well as to broaden the scope of its definition. Under the previous framework, the maximum lifetime of fresh milk was limited to 5 days. This restriction hampered imports, undermined competition and raised return costs. Under Law 4336/2015 the definition “pasteurised milk” was instead adopted and the five-day restriction was abolished, but both the pasteurisation and the expiry dates must be clearly indicated.

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WORKING PAPERS (JANUARY – JUNE 2018)

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Export pricing at the firm level with panel data

Working Paper No. 241

Sofia Anyfantaki, Sarantis Kalyvitis, Margarita Katsimi and Eirini Thomaidou

In this paper, the growing empirical literature dealing with the determinants of export prices is reviewed, a topic that has up to now received relatively less attention compared with other strands that have examined exporting decisions at the firm level (for instance, the entry/exit choice into/from the export market, or the determinants of total value and volume of exports). Stylised facts show that exporters have a different pricing behaviour compared with firms that serve only the domestic market. Export prices, defined as the ratio of export value over quantity for a given firm/product/destination category (also referred to as “unit values”), are differentiated depending on the

characteristics of the destination country and firm attributes. The study first presents evidence from empirical studies that links firm export pricing to destination characteristics (gravity-type models). The main implications of channels that can generate price differentiation, namely quality customisation, variable markups and exchange rate pass-through, as well as financial frictions, are then explored. A newly compiled panel dataset from Greek exporting firms is used to present evidence from regressions, with export price as the dependent variable, and shows how the main economic hypotheses derived from theoretical models are nested in empirical specifications.

Foreign ownership and market power: the special case of European banks

Working Paper No. 242

Panayotis D. Alexakis and Ioannis G. Samantas

This study investigates the effect of foreign ownership on the market power of European financial institutions. The sample comprises bank-level data to derive the Lerner index, while the estimation of the cost function comes through the Robinson’s double residual semi-parametric methodology. The sample employed comprises 11,761 observations corresponding to 949 banks over the period 1995-2013, which is then matched with the dataset of Claessens and van Horen (2014) on banks’ ownership. The results show robustness to the impact of bank foreign ownership on the evolution of monopolistic pricing of well-capitalised foreign banks. On the contrary,

the degree of market penetration from foreign banks fails to exhibit stability in the significance of its negative bearing. However, the underlying spillover effect does not seem to materialise through the domestic banking sector, but only through the operation of foreign banks. In addition, there is moderate indication that foreign presence leads to competitive conditions in markets where restrictions on information transparency are less stringent. Heterogeneity in the behaviour of too-big-to-fail financial institutions is traced in times of higher GDP growth rates, as well as in markets of tighter regulations on capital adequacy and with increased foreign presence.

A combined statistical framework for forecasting default rates of Greek financial institutions’ credit portfolios

Working Paper No. 243

Anastasios Petropoulos, Vasilis Siakoulis, Dionysios Mylonas and Aristotelis Klamargias

Credit risk modelling remains an important research topic both for financial institutions

and the academic community, due to its significant contribution to the issue of banks’ cap-

ital adequacy. In this paper, the authors build macro models for the default rates of Greek banks' loan portfolios. Modelling is performed at two levels: first, they use common techniques such as regime switching regression, Bayesian regression averaging and linear regression; subsequently, they combine the forecasts of the three statistical techniques. This results in increasing performance accuracy and minimising model risk. Their main goal is twofold. First, they attempt to investigate the determinants and the sensitivities of default rates in the Greek banking system

where non-performing loans (NPLs) have risen sharply, due to the sovereign debt crisis which led to a decrease of 25% in GDP from 2007 to 2016. Second, the suggested statistical models can serve as a basis for projecting Greek loan portfolio dynamics under various macro scenarios. The authors find that dynamic forecasting combinations exhibit higher predictive accuracy than individual methods. This may provide practitioners with significant insight and policy tools for the banking supervision division in order to enhance monitoring efficiency and support informed decision making.

Diversification, integration and cryptocurrency market

Working Paper No. 244

Sofia Anyfantaki, Stelios Arvanitis and Nikolas Topaloglou

In this study, the authors investigate the degree to which cryptocurrencies provide diversification benefits to an investor. They manage to do so by employing a stochastic dominance (SD) approach. The Mean-Variance (M-V) dominance criterion is questionable for portfolio selection, if investment returns are not normally distributed, or the utility functions are not quadratic. SD presents a further generalisation that accounts for all moments of the return distributions without assuming a particular family of distributions and can be seen as a model-free alternative to M-V dominance. In a similar manner, the concept of stochastic spanning, introduced by Arvanitis et al. (2017), can be perceived as a model-free alternative to M-V spanning (Huberman and Kandel 1987). Spanning occurs if introducing new securities or relaxing investment constraints does not

improve the investment possibility set uniformly over a given class of investor preferences. In an empirical application using actual market data, the authors test whether a portfolio set originating from a traditional asset universe spans the same set augmented with cryptocurrencies. They use a stochastic spanning methodology to construct optimal portfolios with and without cryptocurrencies, evaluating their comparative performance both in- and out-of-sample. Empirical analysis seems to indicate that the expanded investment universe with cryptocurrencies dominates the traditional one with stocks, bonds and cash, yielding potential diversification benefits and providing better investment opportunities for some risk-averse investors. The authors further explain their results by documenting that cryptocurrency markets are segmented from the equity and bond markets.

Fiscal adjustment and debt sustainability: Greece 2010-2016 and beyond

Working Paper No. 245

Nicholas E. Karavitis

This is a comprehensive analysis with a three-fold perspective: it examines the main fiscal

factors that led to the sovereign debt crisis, then it investigates the effectiveness of the fis-

cal adjustment programmes and, finally, it assesses the conditions and policies that may lead to a sustainable debt ratio in the long run.

The main findings of the study include, inter alia, the following: the fiscal crisis was the result of a substantial swell of primary spending which was not met by tax revenues. Most notably, the pre-crisis period was characterised by a sur-benchmark increase of social transfers and a profligate wage bill. After seven years of adjustment programmes, in 2016 Greece still presented an oversized public sector relative to the euro area average, which, however, was mostly the result of the denominator effect. The effectiveness of the fiscal adjustment policies was poor, especially regarding expenditure cuts, in

no case more than 55%. Income losses in the public sector were lower compared with those in the private sector. Fiscal adjustment was responsible for only about 40% of the GDP losses. Fiscal multipliers seem to be higher than unity, with tax multipliers being higher than spending multipliers (-1.4 compared with 1.2, on aggregate). As a result, reducing taxation should take priority over increasing spending in the process of the recovery of the economy. Greek public debt may be rendered sustainable in the long run. This will require significant smoothing out and extending maturities to 2080 (for EFSF/ESM and bilateral country loans, with no debt relief à la 2012), as well as a long-run primary surplus of at least 1% and a long-run nominal growth rate of at least 2.8%.

Time series with interdependent level and second moment: statistical testing and applications with Greek external trade and simulated data

Working Paper No. 246

Alexandros E. Milionis and Nikolaos G. Galanopoulos

Over the last five decades a vast volume of research work, at both the theoretical and the applied level, has been devoted to time series with time-varying second moment. This non-constancy in the second moment may be due to various reasons. This study deals with the case in which the variance is functionally related to the level and the latter is non-stationary (which most often is indeed the case with economic-financial time series), hence the variance is not constant both conditionally and unconditionally. In such a case, the process is non-homogeneously non-stationary in the sense of Box and Jenkins and cannot be made stationary by simply differencing it.

In spite of its importance for time series modelling, there is not much work on the detection and correction of non-constancy in the variance owing to its dependence on a non-stationary mean level.

This study aims to fill this existing gap in the literature. To this end, a new statistical testing

procedure is introduced with some considerable advantages over the existing ones, as it combines detection of non-homogeneous non-stationarity, correction and robustness. Amongst others, it is argued that the existing statistical tests are insufficient and sometimes lead to biased results.

This is of value in its own right, as it results in better univariate time series modelling. Furthermore, the effect of the application of this methodology on some crucial elements of time series modelling, such as outlier detection and seasonal adjustment, is examined through case studies conducted on a comparative basis using both the new methodology and an established one, specifically TSW programme. TSW stands for TRAMO-SEATS for Windows, a Windows version of the DOS programmes TRAMO and SEATS. It is freely available by the provider (Bank of Spain) and is currently used by many NCBs and NSIs, as well as many other academic and international institutions.

The dataset comprises time series on monthly external trade statistics for Greece. The choice of the particular data was made not only owing to their obvious importance given the recent economic crisis in the country, but also because these time series have recently undergone revisions so as to reflect the IMF's new definition of goods, now fully based on the "change of ownership" principle.

Overall, the resulting empirical evidence favours the new approach. The severe consequences of the improper treatment of the type of time-varying second moment dealt with in this study are

evidenced and emphasised. It is documented that the consequences of falsely transforming a time series that is originally variance stationary do exist, but are less severe than the consequences of falsely not transforming an originally variance non-stationary series. This empirical evidence is supported by theoretical arguments.

Further supporting evidence is provided by the application of the new methodology to simulated data. The results using such data also show that indeed there is a bias in TSW and it was possible to identify one of the possible sources responsible for this bias.

Monetary policy under climate change

Working Paper No. 247

George Economides and Anastasios Xepapadeas

The paper studies monetary policy under climate change in order to answer the question of whether monetary policy should take into account the expected impacts of climate change. The setup is a new Keynesian dynamic stochastic general equilibrium model of a closed economy in which a climate module that interacts with the economy has been incorporated, and the monetary authorities follow a Taylor rule for the nominal interest

rate. The model is solved numerically using common parameter values and fiscal data from the euro area. The results, which are robust to a large number of sensitivity checks, suggest non-trivial implications for the conduct of monetary policy under climate change, especially when climate policies include a carbon tax. Therefore, monetary policymaking should be adjusted accordingly when climate change impacts are taken into account.

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