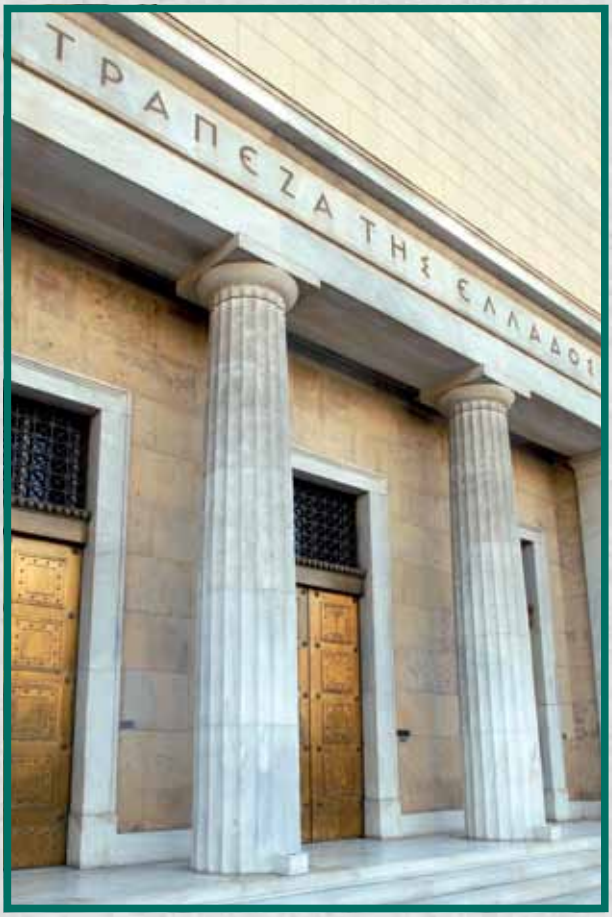
ECONOMIC BULLETIN

No 46

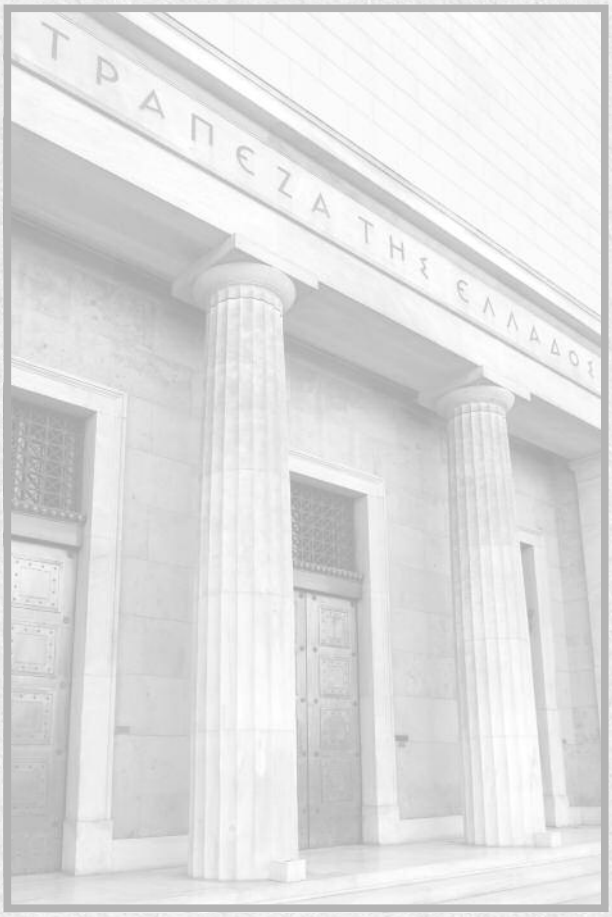


DECEMBER
2017

BANK OF GREECE
EUROSYSTEM

ECONOMIC BULLETIN

No 46



DECEMBER
2017

BANK OF GREECE
EUROSYSTEM

BANK OF GREECE
21, E. Venizelos Avenue
GR-102 50 Athens

www.bankofgreece.gr

Economic Analysis and Research Department - Secretariat
Tel. +30 210 320 2393
Fax +30 210 323 3025

Printed in Athens, Greece
at the Bank of Greece Printing Works

ISSN 1105 - 9729

CONTENTS

THE MACROECONOMIC EFFECTS OF UNCONVENTIONAL MONETARY POLICY IN THE EURO AREA USING NON-LINEAR MODELS*

Dimitrios Louzis
Economic Analysis and Research Department

1 INTRODUCTION

The global financial crisis of 2007-2009 and the subsequent debt crisis in the euro area led the European Central Bank (ECB) to adopt an accommodative monetary policy stance, with a view to maintaining price stability in the euro area.[1] By way of illustration, in the context of monetary accommodation, the ECB has lowered its key interest rate on the main refinancing operations (MROs) by 425 basis points (b.p.) over the past ten years (2007-2016), from 4.25% in July 2007 to 0% in March 2016. However, as key interest rates approach the so-called zero lower bound (ZLB), there is no room for monetary policy to boost the economy, and central banks resort to non-standard or unconventional monetary policy tools in order to counter the risks to economic and financial stability.[2]

As early as in October 2008, the ECB had announced and implemented a series of non-standard monetary policy (NSMP) measures which were mainly aimed at addressing dysfunctions in money and capital markets, with a view to restoring the smooth functioning of the (conventional) monetary policy transmission mechanism through the strengthening of banks' lending capacity and the subsequent continued financing of the real economy. In general, the literature distinguishes non-standard monetary policy measures into three categories: (i) forward guidance, which provides information about the future level of key interest rates; (ii) quantitative easing (QE), which is mainly related to an increase in the size of central bank balance sheets; and (iii) credit easing, which entails changes in the composition of central bank balance sheets (Bernanke and Reinhart 2004; Bernanke et al. 2004). Since 2008 ECB has been conducting unconventional monetary policy by implementing a combination of measures from all of the above three categories, depending on the overall economic and financial conditions prevailing in the euro area (see Section 2 for a more detailed presentation of NSMP measures). The NSMP measures that were implemented in the euro area brought about an increase in the banking system's liquidity that was tantamount to the expansion of the ECB's balance sheet (see Bank of Greece 2015a). Chart 1, which depicts the evolution of the size of the ECB's balance sheet over time, clearly shows the upward trend observed especially from 2008 onwards. In particular, in times when policy rates approach their effective lower bounds, changing the size of central bank balance sheets basically replaces interest rates as the main monetary policy instrument (Gambacorta et al. 2014).

Overall, the literature on the effectiveness of NSMP measures mainly focuses on the impact that these have on money markets, such as the recent study by Rompolis (2017) for the euro area.[3] By contrast, the purpose of this study is to explore the macroeconomic effects of the NSMP measures that were implemented in the euro area roughly over the past ten years. More specifically, the analysis seeks to examine the effect of an exogenous positive shock on the ECB's assets, i.e. the effect of an accommodative NSMP shock on the level of real income (GDP) and the price level in the euro area. The econometric analysis employs a structural vector autoregressive (structural

* Warm thanks are extended to Heather Gibson, Hiona Balfoussia and Leonidas Rompolis for their constructive comments and pertinent remarks. The views expressed in this article are those of the author and do not necessarily reflect those of the Bank of Greece. Any errors are the responsibility of the author.

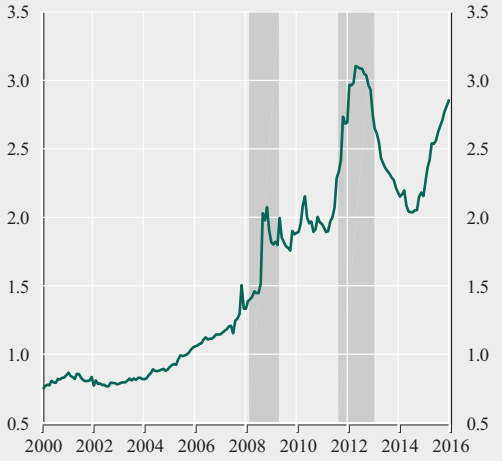
1 The primary objective of the ECB's monetary policy is to maintain price stability over the medium term. In this context, price stability is defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) of below, but close to, 2% over the medium term. For further details on the ECB's monetary policy, see http://www.bankofgreece.gr/Pages/en/MonetaryPolicyEurosystem/monetary.aspx.

2 Non-standard or unconventional measures are associated with significant changes in the operational framework, i.e. instruments and procedures, for conducting monetary policy (see Bank of Greece 2010).

3 See also the references therein.

Chart 1 The ECB's total assets

(EUR trillions)



Source: ECB.
Note: Shaded areas correspond to periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee (Centre for Economic Policy Research).

VAR) model, under which the parameters as well as the volatility of the residuals vary with time (hereinafter TVP-VAR model) (Primiceri 2005).[4] In a similar study for the euro area, Gambacorta et al. (2014) use VAR models, albeit with fixed parameters, to investigate the macroeconomic effects of NSMP measures over the 2008-2011 period.

TVP-VAR models are quite flexible and have the ability to account for the structural changes that occur over time in the transmission of shocks. Given that during the period under examination (2007-2016) the euro area economy passed through different phases of the business cycle[5] and different stages of monetary policy (conventional and unconventional), the use of TVP-VAR models will help us explore any structural changes in the transmission of NSMP shocks. In addition, it is possible to assess from a macroeconomic perspective the impact of the various NSMP measures that have been implemented by the ECB over time, such as the public sector purchase programme (PSPP) with which the ECB actually initiated its quantitative easing (QE) policy.

The use of non-linear models in studying the macroeconomic effects of unconventional monetary policy is not new in the literature. Baumeister and Benati (2013) and Kapetanios et al. (2012) examine the macroeconomic effects of unconventional monetary policy using non-linear models with time-varying parameters for the United Kingdom and the United States, respectively. More recently, Michaelis and Watzka (2017) investigated the effectiveness of the various quantitative easing (QE) programmes in Japan using TVP-VAR models. Notwithstanding, this study is, to our knowledge, the first to employ TVP-VAR models in order to explore the macroeconomic effects of unconventional monetary policy in the euro area.

Another point that differentiates this study from the aforementioned ones is the choice of the variables used for the identification, i.e. the distinction, of economic shocks. So far, a large strand of the literature (see e.g. Baumeister and Benati 2013) has focused on ten-year government bond yields or risk spread in order to identify NSMP shocks and scrutinise their macroeconomic effects. The rationale behind this is that a NSMP shock would lead to lower ten-year government bond yields or spreads via a decline in uncertainty and a normalisation in financing conditions. Nevertheless, the identification of a NSMP shock on the basis of government bond yields alone may be inadequate, all the more so if central bank assets are not included in the model (Bork 2015). Furthermore, it is clear that NSMP measures are broadly aimed at normalising financing conditions rather than merely addressing dysfunctions in the government bond market. Against this background, the present study identifies NSMP shocks using as variables the ECB's assets as well as an indicator of implied volatility in euro area stock markets, which can successfully synopsise the overall

4 The term TVP-VAR, which stands for "Time-Varying Parameter Vector Autoregressions with Stochastic Volatility", is extensively used in the international literature.
5 See for instance the shaded areas in Chart 1, which correspond to the periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee.

financial conditions in the economy (Gamabcorta et al. 2014; Bork 2015).

The rest of the study is structured as follows: Section 2 provides an overview of the Eurosystem's interventions in the context of the NSMP measures implemented between 2008 and 2016. The econometric model is presented in Section 3, while Section 4 describes the empirical results of the study. Lastly, Section 5 summarises and concludes.

2 AN OVERVIEW OF THE EUROSYSTEM INTERVENTIONS IN THE CONTEXT OF NON-STANDARD MONETARY POLICY MEASURES

This section briefly presents the ECB's interventions in the context of its NSMP measures. More specifically, Table 1 provides a timeline of the most important unconventional monetary policy measures that were implemented between October 2008 and December 2016.[6,7]

In general terms, the NSMP measures introduced and implemented by the ECB are adopted on the basis of the economic, monetary and financial conditions prevailing each time in the euro area. Thus, from 2008 to date, we can broadly distinguish three periods or phases of NSMP measures, which are presented below.[8]

In greater detail, the **first phase** refers to those NSMP measures that were implemented from the onset of the global financial crisis to mid-2010 (until May 2010, to be precise – see Table 1). The set of measures that were implemented during the first phase was designed to provide "enhanced credit support" to the euro area economy, with forthcoming liquidity arrangements for the banking system. The measures were aimed at: (i) ensuring that interbank and lending rates reflect the ECB's monetary policy, and (ii) maintaining the flow of funds from the financial system to the real economy to a larger extent than what would have been possible to achieve only with key interest rate cuts (ECB 2010b).

The **second phase** comprises NSMP measures which were designed to address the debt crisis and the subsequent banking crisis in the euro area and were implemented from May 2010 to mid-2014. During this phase, namely from early 2010 onwards, severe strains were observed in government bond markets amid concerns about the fiscal positions of some Member States. The ECB intervened in bond markets by introducing specific measures such as the Securities Markets Programme and Outright Monetary Transactions (see Table 1), with an aim to ensure sufficient depth, increase liquidity and remove market dysfunctions that hamper the smooth transmission of monetary policy (see Bank of Greece 2010b). Furthermore, the introduction of the three-year longer-term refinancing operations (3-year LTROs) made a decisive contribution to improving banks' liquidity over the medium term and thereby preserving their lending capacity. It should be noted that as from autumn 2011 and on account of European banks' exposure to government bonds, the national banking systems came under pressure, which hindered banks' access to money markets for refinancing their short-term obligations. The sizeable decline in deposits also contributed to a worsening in liquidity in some of the national banking systems (Cour-Thimann and Winkler 2013).

The **third phase**, starting from mid-2014, comprises the NSMP measures under the

6 It should be noted that the table refers to the dates on which a measure was first implemented or established, while due to space and time considerations the dates on which the implementation of a measure was renewed or extended are omitted.

7 From August 2007 until the collapse of Lehman Brothers in mid-September 2008 severe strains were observed in the euro area money market, resulting in liquidity constraints in the interbank market and upward pressures on interbank interest rates. With a view to averting the risk of a systemic financial crisis as well as to ensuring the smooth functioning of the monetary policy transmission mechanism, the ECB expanded and differentiated liquidity provision to credit institutions, mainly by increasing the frequency and the maturity of open market operations (for further details, see Cour-Thimann and Winkler 2013; ECB 2010a; Bank of Greece 2008a and 2008b). With regard to these particular interventions, the ECB did not have to change the structure of the operational framework for the conduct of monetary policy (Bank of Greece 2008b) and therefore they are not seen as NSMP measures.

8 See also Cour-Thimann and Winkler (2013) for a categorisation of NSMP measures until 2013 in the same vein.

Table 1 The Eurosystem's non-standard monetary policy measures (2008-2016)

Date	Non-standard monetary policy measures
October 2008	– All **regular open market operations** for the provision of liquidity to banks (against collateral) are conducted at a **fixed rate** and **with full allotment** (that is, all bids are fully satisfied). In contrast with the ECB's standard policy, the interest rate is not determined as the minimum bid rate but is fixed for all banks. – Establishment of **longer-term refinancing operations (LTROs) with a maturity of six (6) months**. No maximum allotment amount is determined and no variable rate tender is carried out. – **Expansion of the list of assets eligible as collateral** and of credit institutions eligible as Eurosystem counterparties. – **US dollar liquidity-providing operations** with full allotment at a fixed rate, against Eurosystem-eligible collateral or liquid assets in euro.
June 2009	Establishment of **longer-term refinancing operations (LTROs) with a maturity of twelve (12) months.** The extension of the maturity of LTROs aims to support the provision of liquidity to banks on favourable terms over the medium term and to keep the respective interbank interest rates at low levels.
July 2009	– **First covered bond purchase programme (CBPP1).** The objectives of the programme are: (i) to reduce the term rates on covered bonds; (ii) to increase transaction volumes with third parties with a view to enhancing depth and liquidity in the secondary covered bond market; (iii) to improve banks' liquidity through the issuance of new covered bonds; and (iv) to increase lending to relatively safe borrowers, so that banks use those loans as a cover pool for the issuance of new covered bonds. **Duration:** July 2009-June 2010. **Total value**: EUR 60 billion. – The **European Investment Bank (EIB) becomes an eligible counterparty** in the Eurosystem's credit operations.
May 2010	Establishment of the **Securities Markets Programme (SMP)**. Purchases of government bonds and private sector debt securities on the secondary market (and on the primary market for private sector debt securities). **Objective:** to ensure depth and liquidity in malfunctioning segments of the debt securities markets. **Duration:** May 2010-September 2012. **Total value:** EUR 201 billion.
November 2011	**Second covered bond purchase programme (CBPP2).** Purchases of covered bank bonds on the primary or secondary market. **Duration:** November 2011-December 2012. **Total value:** EUR 16 billion.
December 2011	**First longer-term refinancing operation (LTRO) with a maturity of 36 months**
January 2012	**Reduction in the reserve ratio** from 2% to 1%. **Objective:** (i) to support activity in the money market and (ii) to reduce banks' reliance on the Eurosystem for liquidity and thereby the amount of collateral to be mobilised.
September 2012	Introduction of **Outright Monetary Transactions (OMTs)**. Purchases of government bonds with a maturity of 1-3 years on the secondary market with full allotment.
July 2013	The Governing Council of the ECB begins using **forward guidance**. **Objective:** guidance of economic agents' expectations about the future path of short-term interest rates.
June 2014	Launch of **targeted longer-term refinancing operations (TLTROs)**. The Eurosystem's liquidity provision to credit institutions is linked to the volume of their loans (other than for house purchase) to non-financial corporations and households (fixed rate). **Objective:** (i) to enhance the banking system's liquidity and (ii) to encourage new lending. Duration: up to 4 years.
October 2014	**Third covered bond purchase programme (CBPP3)**
November 2014	**Asset-backed securities purchase programme (ABSPP)**
March 2015	**Private sector purchase programme (PSPP)**
March 2016	Launch of a **second series of targeted longer-term refinancing operations (TLTRO II)**
March 2016	**Corporate sector purchase programme (CSPP)**

Sources: Bank of Greece and ECB.

expanded asset purchase programme, which marks the adoption of a quantitative easing (QE) policy by the ECB.[9] Although, in practice, the asset purchase programme was considerably expanded in early 2015 to include government debt securities and other securities issued by the public sector in the euro area (see Table 1), the markets had already anticipated since mid-2014 that the Eurosystem would conduct large-scale purchases of government debt securities, with a view to preventing deflationary conditions from taking hold in the euro area (see Bank of Greece 2015a, Box III.1, p. 37). Thus, it is reasonable to assume that any positive effects of the programme are likely to have spread to the entire economy quite earlier than the time of the official introduction and implementation of quantitative easing.

Although the third phase of NSMP measures also comprises other significant interventions on the ECB's part (see Table 1),[10] the success of these measures depends to a great extent on the progress of the public sector purchase programme, given the size of government bond markets. The ultimate goal of almost all NSMP measures, and of QE policies in particular, is to ensure that changes in key interest rates pass through to the real economy. Yet, this is achieved at a first stage through the improvement of financing conditions in the economy.[11]

At this point, it should be stressed that the aforementioned distinction of the ECB's extraordinary measures is by no means definite, since several measures, particularly of the first phase, are still in place even today. The new NSMP measures that have been adopted by the ECB impact on the economy as a complement to standard measures (as evidenced by the empirical results presented further below). Besides, it is noted that on occasion and depending on the financial conditions prevailing in the euro area each time (e.g. in December 2009), the ECB has decided to phase out some of the non-standard measures only to reinstate them shortly thereafter (May 2010) or has replaced some of them with other more effective ones.[12]

3 THE ECONOMETRIC MODEL

The econometric analysis rests upon a time-varying parameter vector autoregressive model with stochastic volatility (TVP-VAR). Such models can accurately capture macroeconomic relations as well as the volatility of macroeconomic shocks, which may vary strongly across time. A reduced-form TVP-VAR model is defined as follows:

$$y_t = c_t + B_{1,t}\, y_{t-1} + \ldots + B_{p,t}\, y_{t-p} + u_t \qquad (1)$$

$$u_t \sim N(0, \Omega_t) \qquad (2)$$

where y_t is the $n\times1$ vector of the endogenous variables of the model for $t=1,\ldots,T$. c_t is the $(n\times1)$ vector of fixed terms, $\{B_{i,t}\}_{i=1}^{p}$ are the $n\times n$ matrices of the dynamic coefficients and p is the number of lags. u_t are the disturbance terms of the reduced-form model of equation (1), which are distributed as normal distribution with a mean 0 and a variance-covariance matrix, Ω_t. The Ω_t matrix is factored following the standard practice in the literature, that is:

$$Var(u_t) \triangleq \Omega_t = A_t^{-1} H_t (A_t^{-1})' \qquad (3)$$

where H_t is a diagonal matrix, whose main diagonal consists of the stochastic volatility of the residuals, u_t:

$$H_t \overset{\text{def}}{=} \begin{bmatrix} h_{1,t} & 0 & 0 & 0 \\ 0 & h_{2,t} & 0 & 0 \\ 0 & 0 & \ddots & 0 \\ 0 & 0 & 0 & h_{n,t} \end{bmatrix}$$

Respectively, A_t is a lower triangular matrix that models the contemporaneous interactions

9 For an assessment of any negative effects from the ECB's very accommodative monetary policy under the QE programme, see Bank of Greece (2015b), Box III.

10 For further details on the targeted longer-term refinancing operations (TLTROs), the asset-backed securities purchase programme (ABSPP) and the third covered bond purchase programme (CBPP3), see Bank of Greece (2014), Box III.1, p. 35.

11 The mechanisms through which non-standard monetary policy measures have a favourable effect on banks' lending capacity are discussed in Box III.1 of the report on *Monetary Policy 2014-2015* (Bank of Greece 2015a).

12 For example, the Securities Markets Programme was replaced with the introduction of Outright Monetary Transactions (for further details, see Bank of Greece (2012), p. 60).

of the endogenous variables, with the elements of the main diagonal consisting of units:

$$A_t \overset{\text{def}}{=} \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21,t} & 1 & 0 & 0 \\ \vdots & \vdots & \ddots & 0 \\ a_{n1,t} & \dots & a_{nn-1,t} & 1 \end{bmatrix}$$

As can easily be understood, the subscript t in matrices (or vectors) suggests that these vary over time, so that in each point in time t we have a different (varying) estimation for the coefficients of the equation as well as for the volatility of macroeconomic shocks.

Next, in order to facilitate both the estimation and the presentation of the models, we collect the elements of c_t and $\{B_{i,t}\}_{i=1}^{p}$ in the ϑ_t vector, the elements of the main diagonal of the H_t matrix in the h_t vector and the non-zero and non-one elements of the A_t matrix in the α_t vector. Adopting the usual practice (see Primiceri 2005), we assume that ϑ_t and α_t follow a driftless random walk, that is:

$$\vartheta_t = \vartheta_{t-1} + \upsilon_t, \quad \upsilon_t \sim N(0, Q) \tag{4}$$

and

$$\alpha_t = \alpha_{t-1} + \zeta_t, \quad \zeta_t \sim N(0, S) \tag{5}$$

The h_t vector is modelled as a geometric random walk:

$$lnh_t = lnh_{t-1} + \eta_t, \quad \eta_t \sim N(0, W) \tag{6}$$

Finally, we assume that the vector of disturbance terms $[\varepsilon_t, \upsilon_t, \zeta_t, \eta_t]'$, where ε_t comes from $u_t = A_t^{-1} H_t^{\frac{1}{2}} \varepsilon_t$, is distributed as Normal with a mean 0 and a variance-covariance matrix:

$$Var\left(\begin{bmatrix} \varepsilon_t \\ \upsilon_t \\ \zeta_t \\ \eta_t \end{bmatrix}\right) = \begin{bmatrix} I_n & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & W \end{bmatrix} \tag{7}$$

where I_n is the unit matrix with dimensions $n \times n$ and the S matrix is a block diagonal matrix, i.e. the coefficients $\alpha_{ij,t}$ which belong to the same equation (i.e. the row of the S matrix) are assumed to evolve over time independently from the corresponding coefficients in other equations. This assumption facilitates the model estimation in computational terms (Primiceri 2005).

4 EMPIRICAL ANALYSIS

4.1 CHOICE OF THE VARIABLES

In this section, we present the variables used to empirically investigate the macroeconomic effect of NSMP shocks. Specifically, the y_t vector of the model in equation (1) includes the following endogenous variables: the growth rate of euro area real GDP, the rate of change in the euro area Harmonised Index of Consumer Prices (HICP), the rate of change in the ECB's assets, the MRO rate, and the implied volatility index Vstoxx. All time series are of a monthly frequency and the sample spans the period from February 2000 to December 2016.[13] Chart 2 depicts the five endogenous variables of the model.

It can be observed for all variables that during the recent economic crisis periods, which correspond to the shaded areas, there is a sharp rise in volatility, justifying the use of stochastic volatility models.[14] Moreover, Chart 2 vividly captures the impact of the economic crisis on key macroeconomic variables, i.e. GDP and price level negative growth rates, as well as the heightened uncertainty in the economy, as reflected in the Vstoxx index. The path of the MRO rate confirms the ECB's very accommodative monetary policy especially over the past three years, when the level of the interest rate approached zero. Finally, the impact of NSMP measures on the ECB's assets is better illustrated in Chart 1 of Section 1.

13 Quarterly GDP has been converted into monthly using the Chow-Lin interpolation method. Industrial production and the volume of retail sales in the euro area are the key indices of a monthly frequency, on which the above conversion was based (see Gambacorta et al. 2014).

14 The shaded areas in Chart 2 reflect the periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee.

Chart 2 The time series of the model's endogenous variables

(%)

Sources: Eurostat, ECB and Thomson Reuters Datastream. Author's own calculations.
Notes: For the variables Total assets, Real GDP and HICP, the rates of change are calculated as log first differences. All the aforementioned variables are seasonally adjusted. The MRO rate and the Vstoxx index are kept unchanged. Shaded areas correspond to periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee (Centre for Economic Policy Research).

It is clear that the choice of the variables serves the purposes of this analysis, in line with the recent studies by Gambacorta et al. (2014) and Bork (2015).[15] In greater detail, GDP and the price level are the variables that synopsise the macroeconomic conditions in the euro area, while the MRO rate is the main tool of con-

15 Besides, it should be pointed out that the use of TVP-VAR models imposes certain restrictions as to the number of the variables used, as we should also take into account any computational limitations arising from the estimation of such a model that includes a large number of parameters considerably reducing the available degrees of freedom. Against this backdrop, the use of more variables for the identification of the various shocks (see Section 4.3) in TVP-VAR models is rather prohibitive (see for instance the study by Baumeister and Benati (2013), in which the authors use four (4) variables for the identification of NSMP shocks).

ventional monetary policy.[16] Conversely, the ECB's assets constitute the main instrument of unconventional monetary policy and are used to approximate the effects of the various NSMP measures that were described in Section 2 (see also the discussion in Section 1). As already mentioned, such measures are aimed at addressing the turmoil in money and capital markets, thereby reducing risk spreads and facilitating the bank financing of the economy. For this reason, Baumeister and Benati (2013) and Kapetanios et al. (2012) use ten-year government bond spreads to identify NSMP shocks.[17]

Given that several NSMP measures also aim at markets other than the government bond market (e.g. money markets or corporate bond markets) as well as at an overall improvement in financing conditions, we chose to use a broader measure as a proxy for financial conditions in the euro area, such as the Vstoxx index (Gambacorta et al. 2014; Bork 2015; Rompolis 2017). In general, implied volatility indices, which are also known as "fear indices", have the ability to capture uncertainty levels in money markets, and their use is of critical importance for identifying the exogenous structural shocks of unconventional monetary policy. This is the case because the expansion of the ECB's balance sheet is the reaction of the central bank to heightened financial risks, as captured by the Vstoxx index (Gambacorta et al. 2014).

4.2 ESTIMATION OF THE MODEL

The estimation of the TVP-VAR model described in equations (1) through (7) is performed using Bayesian methods, namely the Gibbs sampler which is proposed by Primiceri (2005) and Del Negro and Primiceri (2015).

The first steps in Bayesian analysis are to determine the prior distributions of the model's parameters and then, using Bayes' theorem, to estimate the posterior distributions of the parameters on which the statistical inference will be based.[18] More specifically, to elicit the prior distributions we rely on the estimations of the parameters of a VAR model with fixed coefficients, which is estimated using the first seven years of the sample (i.e. the first 84 observations). Thus, taking also into account lags, the TVP-VAR model is estimated for the period April 2007-December 2016, which corresponds to 117 monthly observations (about 10 years) and coincides with the period that we are interested in reviewing with regard to NSMP measures.

For the estimation of the model and following the common practice in the literature, we use two lags, i.e. p=2 (see Primiceri 2005). Moreover, the estimation relies on 15,000 draws for the parameters, which are obtained from the conditional posterior distributions using the Gibbs sampler. Out of a total of 15,000 draws, the first 10,000 are discarded, while out of the next 5,000 draws we keep 1 in every 10 draws in order to ensure the convergence of the algorithm and reduce the autocorrelations of the draws.

4.3 IDENTIFICATION OF STRUCTURAL SHOCKS

In this paper, the empirical investigation of macroeconomic effects from NSMP measures is based on impulse response functions – hereinafter IRFs, which are functions of the TVP-VAR model's parameters, providing a summary of the key findings resulting from its estimation. In greater detail, IRFs enable us to investigate how a variable of interest (in our case, we are interested in GDP and the price level in the euro area) reacts to an exogenous structural shock, ε_t, on the economy.[19] The

16 Gambacorta et al. (2014) have not included the policy rate in their baseline model, since they believe that, when the interest rate reaches the zero lower bound, it is replaced by a central bank balance sheet policy. Notwithstanding, to our belief, the policy rate should be included in the model, as the sample comprises periods during which the MRO rate is far from approaching the zero lower bound. In addition, the use of non-linear time-varying models enables us to take account of this change in the levels of the policy rate.

17 However, in these studies the authors have not used the size of the central bank's assets to identify NSMP shocks. With regard to the methodology for identifying NSMP shocks, see also Section 4.3.

18 For more details on the model's estimation and prior distributions, see Primiceri (2005) and Del Negro and Primiceri (2015).

19 For the computation of the IRFs we rely on the fact that a VAR model may be written as a vector moving average (VMA) model, i.e. as an infinite sum of weighted structural shocks (see for example Lütkepohl 2005).

Table 2 Restrictions on the impulse response functions (IRFs) for the identification of structural shocks

Variables	ε_t^{NSMP}	ε_t^{CMP}	ε_t^{AD}	ε_t^{AS}
Total assets	+	?	?	?
MRO rate	0	-	+	?
GDP	+	+	+	+
HICP	+	+	+	-
Vstoxx	-	?	?	?

Notes: The HICP variable is the Harmonised Index of Consumer Prices. ε_t^{NSMP}, ε_t^{CMP}, ε_t^{AD} and ε_t^{AS} are the structural shocks of non-standard monetary policy, conventional monetary policy, aggregate demand and aggregate supply, respectively. The question mark (?) denotes restrictions on the IRF of that variable.

application of a non-linear time-varying model also allows us to explore whether the diffusion of the various shocks to the economy varies over time. As already mentioned in Section 3.1 and equation (7), for structural shocks it holds true that $E(\varepsilon_t)=0$, $E(\varepsilon_t \varepsilon_{t-j}')=0 \forall t$ and j ($j \neq 0$) and $E(\varepsilon_t \varepsilon_t')=I_n$ and that they are associated with reduced-form shocks, u_t, as follows: $\varepsilon_t=\left(A_t^{-1}H_t^{\frac{1}{2}}\right)^{-1} u_t=C_{0,t}^{-1} u_t$.[20] The identification of the structural economic shocks, that is the methodology for distinguishing an economic shock (e.g. an aggregate demand shock) from another (e.g. an aggregate supply shock), basically leads to the identification of a structural VAR model, while at the same time it is a highly active field of research in the international literature (see Fry and Pagan 2011).[21]

In this study, we choose to identify structural shocks and hence the structural TVP-VAR model, employing restrictions on IRFs (Canova and De Nicolo 2002; Uhlig 2005; Mountford and Uhlig 2009; Arias et al. 2014). That is, we choose the IRFs so that they have those signs or values which are dictated by economic theory or economic reasoning. In general, the identification of structural shocks using restrictions on IRFs rests upon the methodology for generating several alternative models through orthogonal rotations, whereby we keep only those models that satisfy the restrictions imposed on IRFs (see Fry and Pagan 2011 for a more detailed analysis).

More specifically, in the light of the above, it follows that $\Omega_t=C_{0,t}\, C_{0,t}'$, suggesting that for each orthogonal matrix R (given that $RR'=I$) we can write $\Omega_t=C_{0,t}\, R\, R' C_{0,t}'=\widetilde{C}_{0,t}\, \widetilde{C}_{0,t}'$. This means that for each R we have a new set of structural shocks, $\widetilde{\varepsilon}_t=\widetilde{C}_{0,t}^{-1} u_t$, which can be utilised to check whether our restrictions on IRFs are satisfied. In many cases, the identification of structural shocks is facilitated by the introduction of zero restrictions on IRFs. Therefore, this study adopts the methodology by Arias et al. (2014), who propose a fast algorithm for the estimation of those IRFs that satisfy zero and sign restrictions. Table 2 provides an overview of the restrictions which are imposed on IRFs for the identification of structural shocks, as discussed further below.

Overall, in identifying NSMP shocks and in setting restrictions on IRFs we follow Baumeister and Benati (2013), Gambacorta et al. (2014) and Bork (2015). In greater detail, an exogenous accommodative NSMP shock is assumed to increase the ECB's assets and at the same time lead to an improvement of the overall financial conditions, thereby easing uncertainty, as captured by the Vstoxx index.

20 The main difference between structural economic shocks and reduced-form shocks is that the former are uncorrelated (mutually orthogonal), in contrast with the latter.

21 A structural VAR model uses the economic theory to determine the contemporaneous relationships between variables (Stock and Watson 2001), whereas, according to Fry and Pagan (2011), a reduced-form model summarises the information obtained from the data and a structural model provides an economic interpretation of the data.

Reduced uncertainty and improved bank financing of the economy are expected to boost economic activity and bring about a rise in the general price level. Yet, in order to distinguish a NSMP shock from a conventional monetary policy shock, it should additionally be assumed that the policy rate does not react (at least initially) to a NSMP shock (zero restriction) (Baumeister and Benati 2013).

On top of that, following the practice widely used in the literature, we identify three additional accommodative shocks, namely (i) a conventional monetary policy shock, (ii) an aggregate demand shock, and (iii) an aggregate supply shock, using sign restrictions (Baumeister and Benati 2013). The identification of additional shocks helps both to identify with greater accuracy the shocks which are of interest to us (in this case, NSMP shocks) (Uhlig 2005) and to tackle the "multiple models problem" (Fry and Pagan 2011). Furthermore, on the basis of Chart 2 it follows that all restrictions are mutually exclusive, which helps us to distinguish between each one of the shocks. Lastly, following Gambetti and Musso (2016) and Bijsterbosch and Falagiarda (2015), restrictions on IRFs are imposed only during the first period (i.e. for $t=0$), allowing the IRFs to evolve without restrictions over the subsequent periods.

4.4 EMPIRICAL RESULTS

This section presents the empirical results of the study, with a focus on the estimations of the IRFs regarding NSMP shocks. The IRFs have been normalised to reflect the impact of an accommodative NSMP shock, which corresponds to a 1% increase in the ECB's assets.

4.4.1 The average effect of NSMP shocks

In this section, we outline the average estimated effects of a NSMP shock, taking account of the entire sample from April 2007 through December 2016. Specifically, Chart 3 shows the average value of the IRFs in terms of t, which enables us to examine how the model's variables react, on average, to a NSMP shock under the reviewed sample.[22]

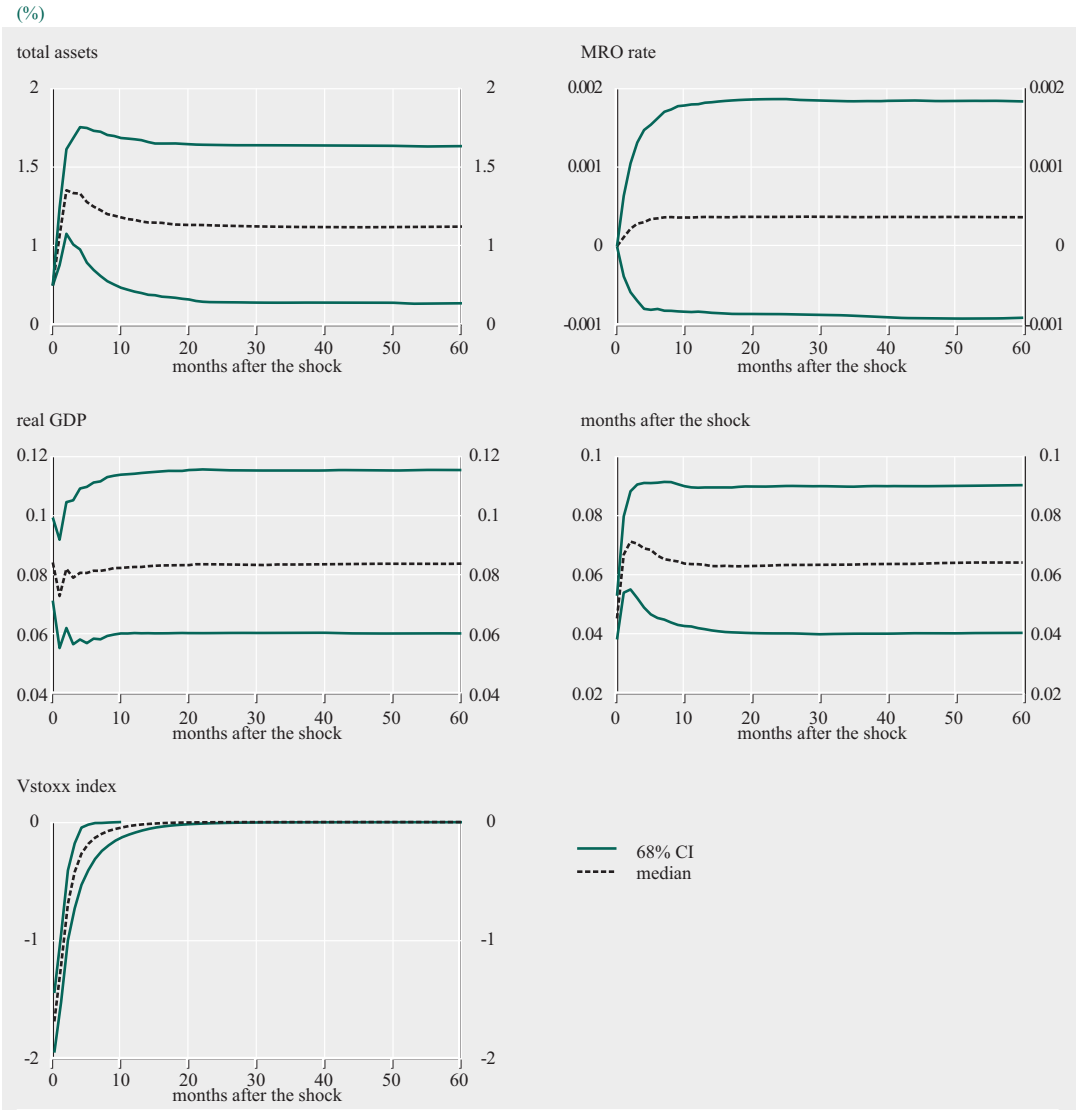
The empirical findings that are outlined in Chart 3 are broadly in line with the results by Gambacorta et al. (2014) for the euro area, as well as with other studies for different economies (see for example Michaelis and Watza 2017; Baumeister and Benati 2013; Weale and Wieladek 2016). Turning to the macroeconomic effects, which are the focal point of this study, we observe that the NSMP measures which were implemented by the ECB over the past ten years are very effective. In detail, an increase of 1% in the ECB's assets will bring about, on average over the 2007-2016 period, a rise of 0.07% in the general price level after about 3 months, as well as a maximum increase of 0.08% in real GDP (see the green line in Chart 1).[23] Moreover, as regards the effect on money markets, a 1% increase in the ECB's assets will immediately bring down the implied volatility index Vstoxx by 1.5%. The effect on Vstoxx is weakening and persists for the next 10 months more or less. It should be noted that the range of confidence intervals is quite narrow, implying that the estimated effects are statistically different from zero.

Concluding, we can argue that the above empirical findings highlight the necessity of NSMP measures over the 2008-2016 period, as an expansionary exogenous NSMP shock will lead, on average, to a statistically significant rise in the general level of prices and boost the real economy in terms of GDP. In this way, not only was the main objective of NSMP measures in that period achieved, i.e. to avert deflationary pressures, but also the broader inflation target of below, but close to, 2% through the smooth transmission of monetary

22 In particular, the average value of the IRFs has been calculated as follows: for each draw of the model's parameters from the posterior distribution we calculate the IRFs based on the restrictions set for each t. Next, we calculate the average value of the IRFs in terms of t. After the process of successive sampling from the posterior distributions we obtain 500 observations of the average IRFs, based on which we estimate the median as well as the 16th and the 84th quantile (i.e. the 68% confidence interval shown in Chart 3).

23 On an annual basis, the rates of increase are 0.84% and 0.96%, respectively.

Chart 3 Impulse response functions (IRFs) of a NSMP shock



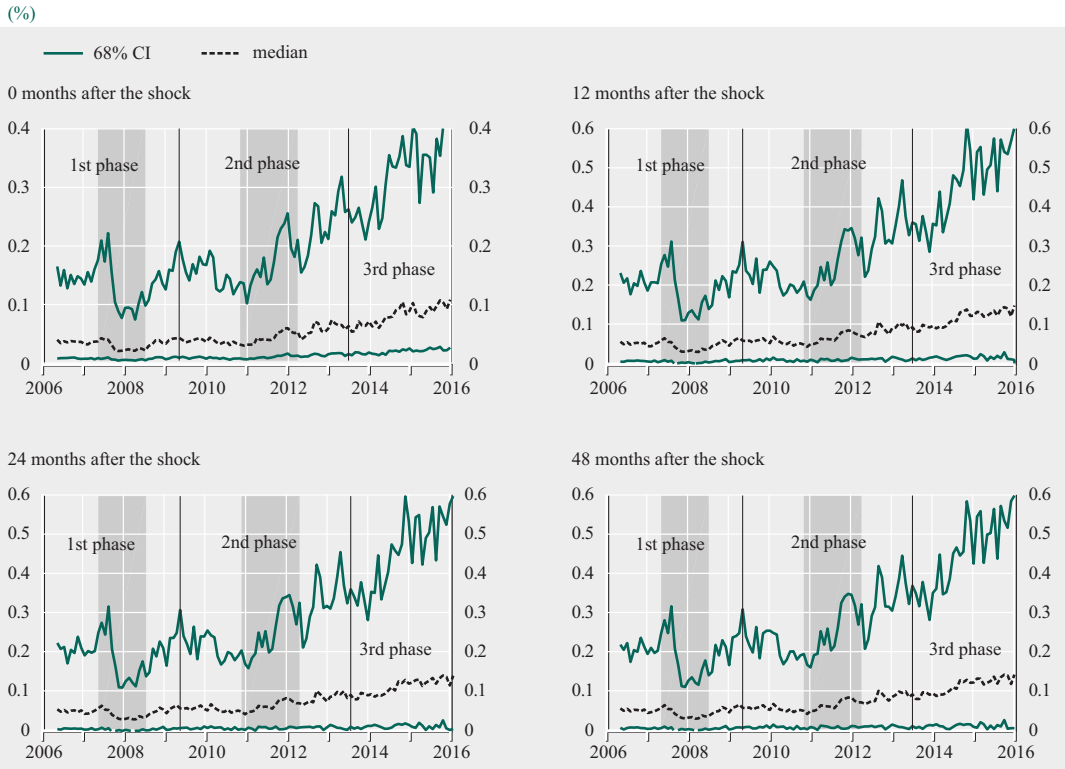
Sources: Eurostat, ECB and Thomson Reuters Datastream. Author's own calculations.
Notes: Sample average (April 2007-December 2016). For the variables Total assets, Real GDP and HICP, the cumulative IRFs are presented. CI: confidence interval.

policy accommodation. In this respect, it should be pointed out that the attainment of NSMP targets should always be seen in a relative context; that is, compared with what would have been the price level or the economic growth rate in the euro area if such measures had not been adopted and implemented. In the following section we explore the evolution of macroeconomic effects from NSMP measures over time, relying on the fact that under a TVP-VAR model the coefficients vary across time.

4.4.2 The evolution of effects from NSMP shocks over the 2007-2016 period

Charts 4 and 5 depict the development of the effects from a NSMP shock on the general level of prices and on GDP, respectively, throughout the sample (April 2007-December

Chart 4 The effect of a 1% increase in the ECB's assets on the price level over time

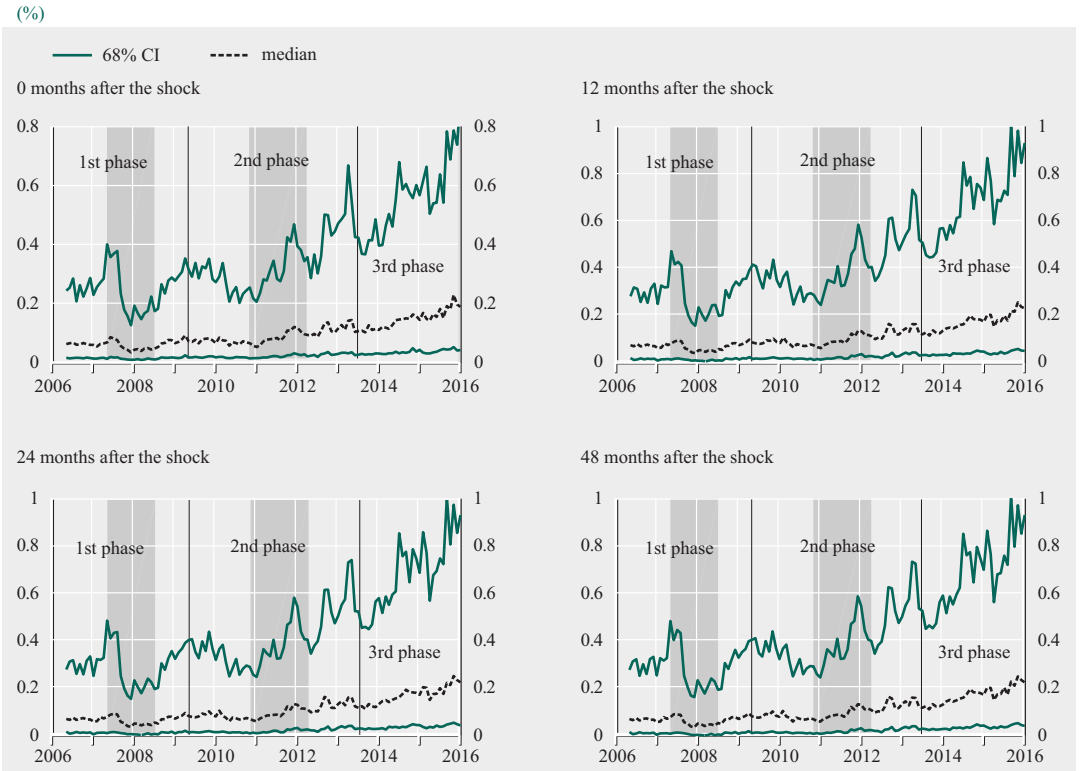


Notes: The chart shows the evolution of the impact on the price level from a NSMP shock throughout the sample (April 2007-December 2016) for 4 selected periods: immediate effect (0 months after the shock), 12, 24 and 48 months after the shock. Shaded areas correspond to periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee (Centre for Economic Policy Research). The black lines denote the three phases of NSMP measures, as determined in Section 2. CI: confidence interval.

2016) over four selected time horizons: immediate effect (0 months after the shock), 12, 24 and 48 months after the shock. The charts illustrate the recessionary periods, the three phases of NSMP measures, as determined in Section 2, and the 68% confidence interval.

The main feature of both charts is that they point to a statistically significant upward trend throughout the reviewed period, particularly during the last phase of the implemented QE policy. For instance, looking at the immediate effect (0 months after the shock) on HICP from an increase of 1% in the ECB's assets, we can see that the effect stands at levels below 0.05% at the beginning of the sample, whereas towards the end of 2016 it has almost doubled to around 0.1%. Likewise, the effect of a NSMP shock on GDP doubles towards the end of the sample (from 0.1% to 0.2%). A similar picture is painted by all other periods depicted in Charts 4 and 5. It is obvious that the NSMP measures which were introduced and implemented by the ECB throughout the past decade actually doubled the positive effects of a change in the size of the ECB's balance sheet on the price level and on GDP. This finding could be attributed to two factors (or a combination thereof): (a) a qualitative shift in NSMP measures, such as the launch of quantitative easing or forward guidance (see also the analysis in the following paragraphs), and (b) the possible cumulative effect of the various NSMP measures on euro area economic activity over time. It should be recalled that, as mentioned above, several measures dating back to the first phase are still in place. Therefore, the effect of new measures that are intro-

Chart 5 The effect of a 1% increase in the ECB's assets on GDP over time



Notes: The chart shows the evolution of the impact on GDP from a NSMP shock throughout the sample (April 2007-December 2016) for 4 selected periods: immediate effect (0 months after the shock), 12, 24 and 48 months after the shock. Shaded areas correspond to periods of recession in the euro area, as defined by the CEPR Euro Area Business Cycle Dating Committee (Centre for Economic Policy Research). The black lines denote the three phases of NSMP measures, as determined in Section 2. CI: confidence interval.

duced over the years may be complementary to that of the already existing measures.

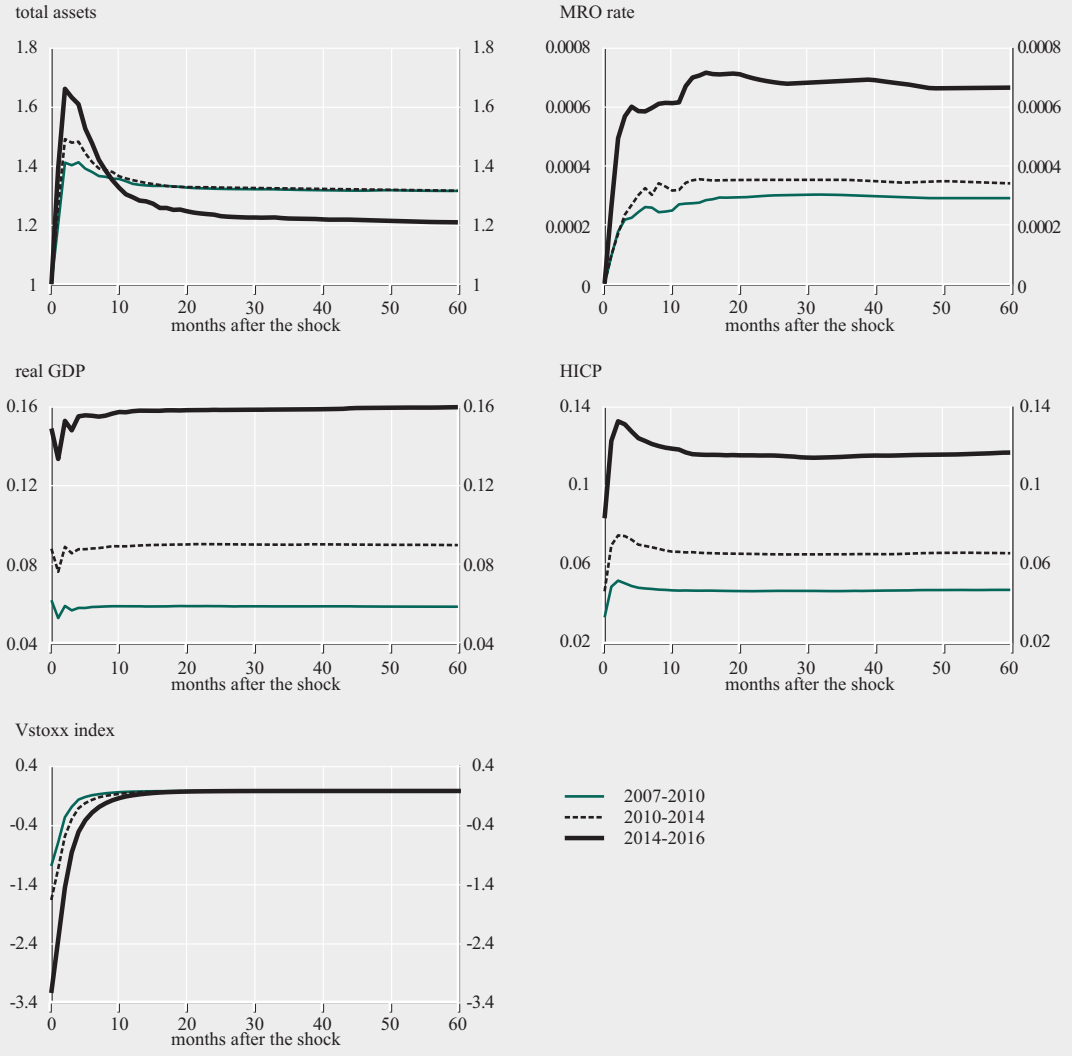
The next step in our analysis is to compare the three phases of NSMP measures, as determined in Section 2. To this end, we calculate the average value of the IRFs for the respective periods of the three phases. The median of the IRF distribution for the three phases of NSMP measures is featured in Chart 6.

Chart 6 reveals the cumulative effect of NSMP measures during the three NSMP phases, as defined in Section 2. The third phase of NSMP measures, which comprises the quantitative easing (QE) measures, appears to have, on average, the strongest positive effect on both the price level and GDP. More specifically, during the first phase of NSMP measures a 1% increase of the ECB's assets could lead to a maximum rise of 0.05% in HICP, whereas during the second and the third phase of NSMP measures these rates increase to 0.07% and 0.13%, respectively.[24] Accordingly, the maximum effects on GDP come to 0.06%, 0.09% and 0.16% in the three phases of NSMP measures under review.[25] The empirical results clearly reveal that the adoption of QE policies by the ECB, with the expansion of the asset purchase programme from mid-2014 until early 2015, contributed greatly to a shift in the diffusion of an exogenous NSMP shock. In particular, during the third NSMP phase the effect of a positive change in the ECB's

24 On an annual basis, the rates of increase stand at 0.60%, 0.84% and 1.56%, respectively.
25 On an annual basis, the rates of increase stand at 0.72%, 1.08% and 1.92%, respectively.

Chart 6 Average estimated effect of a 1% increase in the ECB's assets during the three phases of NSMP measures

(%)



Sources: Eurostat, ECB and Thomson Reuters Datastream. Author's own calculations.
Note: For the variables Total assets, Real GDP and HICP, the cumulative IRFs are presented.

assets on the price level and on income has nearly doubled relative to the averages of the two previous phases.

Nevertheless, it should be noted that a respective escalation in the effects of a NSMP shock is also observed for the Vstoxx index, which, as already mentioned, captures the level of uncertainty in money markets. This outcome is largely due to the fact that since mid-2013 the ECB has been providing forward guidance about the future path of both its conventional and unconventional monetary policy.[26] In times when conventional monetary policy ceases to be effective, i.e. when key interest rates are close to their effective lower bound, the forward guidance provided by a central

26 Forward guidance takes the form of announcements on the part of the ECB regarding the level of key interest rates in the near future or in the long term. The ECB may also announce its intentions about NSMP measures (Coenen et al. 2017) (see for example https://www.ecb.europa.eu/press/pr/date/2016/html/pr161208.en.html).

bank constitutes a key NSMP tool, immediately influencing expectations and affecting uncertainty in money markets (Cœuré 2017, Coenen et al. 2017). In a recent paper, Coenen et al. (2017) stress that the effectiveness of the ECB's announcements in easing uncertainty greatly hinges upon the transparency of their content and the details they provide to the general public. Overall, forward guidance communication must be formulated very carefully, depending on the degree of commitment that the central bank wishes to express regarding specific policies.[27] Forward guidance announcements entailing a stronger commitment are seen as more effective NSMP tools, but this depends to a large extent on their (imperfect) interpretation by economic agents (Coenen et al. 2017).

It can be observed that the ECB's unconventional monetary policy interventions have delivered the desirable outcomes over time, thereby averting deflation and stimulating the economy as well as reducing uncertainty in the economy, as captured by the implied volatility index. At this point, it should be underscored that, according to Eggertsson (2011) and Krugman (2000), in times when key interest rates are close (or equal) to zero, the central bank's policies are effective in stimulating the real economy, so long as (see also the analysis by Michaelis and Watzka 2017): (1) the attempted monetary expansion, i.e. money growth, is viewed by market participants as permanent and (2) the central bank does not return to its standard policies for price stabilisation as soon as the economy exits the crisis period. Against this background, apart from the making of unconventional monetary policy, strong commitment and resolve are warranted on the part of the central bank that NSMP measures will remain in place for as long as necessary to boost the economy. As already mentioned, central bank communication about various policies also plays a key role in markets' perception of the central bank's degree of commitment to a concrete plan or strategy. The more transparent and clear forward guidance is, the more likely it is for money market uncertainty to decline. Therefore, the empirical results of this study show not only that the framework of the ECB's interventions moved in the right direction, but also that the ECB issued clear messages to market participants about the nature and the duration of its interventions.

5 SUMMARY – CONCLUSIONS

In this study, we examined the effectiveness of the ECB's non-standard monetary policy (NSMP) measures in boosting the euro area economy over the 2007-2016 period. In particular, we investigated the effect of an increase in the ECB's assets, which represents a positive NSMP shock, on GDP and the price level in the euro area. The econometric investigation relied on non-linear time-varying models, which are more flexible and have the ability to take into account the structural changes that took place in the euro area economy in the period under review (2007-2016).

Overall, the empirical findings of the study are consistent with the findings of the extant literature. More specifically, an increase of 1% in the ECB's assets could lead, on average over the 2007-2016 period, to an annual rise of 0.84% in inflation and of 0.96% in GDP, confirming the appropriateness of the ECB's policies to address the economic crisis in the euro area. Yet, the most important finding of the study is that the macroeconomic effect of a NSMP shock has changed substantially as a result of the adoption of quantitative easing (QE) policies by the ECB. In greater detail, from mid-2014 through December 2016 an exogenous NSMP shock that brings about a 1%

27 According to Campbell (2013), forward guidance can be split into two categories: (i) announcements that express the central bank's strong commitment to a specific, state-contingent plan on a future reaction (for this type of announcements the term "Odyssean forward guidance" has prevailed, alluding to Odysseus who had himself bound to the mast of his ship to resist the Sirens' call), and (ii) announcements that communicate the central bank's forecast about the likely course of monetary policy without committing to a future plan (for this type of announcements the term "Delphic forward guidance" has prevailed, alluding to the pronouncements from the oracle of Delphi in ancient times) (see also Coenen et al. 2017).

increase in the ECB's assets could result, on average, in an annual increase of 1.56% in the price level and of 1.92% in GDP. These rates are nearly double the respective averages of the 2007-2014 period and demonstrate the positive contribution of QE policies to stimulating the euro area economy. This conclusion is the outcome of time-varying econometric models, which underlines their usefulness in the investigation of NSMP effects.

Concluding, the empirical results of the study corroborate the success of the ECB's overall strategy of unconventional monetary policy interventions. A decisive contribution was made by the expansion of the asset purchase programme and the ECB's strong commitment to pursuing interventions for as long as necessary in order to meet the target of inflation and safeguard economic and financial stability. A further investigation of the macroeconomic effects from unconventional monetary policy in the euro area is warranted to the extent that we wish to explore the effects of the ECB's policies on Member States' national economies. In this respect, possible asymmetries in the intertemporal diffusion of NSMP shocks among Member States could be identified and valuable conclusions about future strategy making could be drawn.

REFERENCES

Arias, J.E., J.F. Rubio-Ramírez and D.F. Waggoner (2014), "Inference Based on SVARs Identified with Sign and Zero Restrictions: Theory and Applications", *International Finance Discussion Papers*, No. 1100, Board of Governors of the Federal Reserve System.

Bank of Greece (2008a), *Monetary Policy 2007-2008*, June.

Bank of Greece (2008b), *Monetary Policy – Interim Report 2008*, December.

Bank of Greece (2010), *Monetary Policy 2009-2010*, June.

Bank of Greece (2012), *Monetary Policy – Interim Report 2012*, December.

Bank of Greece (2014), *Monetary Policy – Interim Report 2014*, December.

Bank of Greece (2015a), *Monetary Policy 2014-2015*, June (in Greek).

Bank of Greece (2015b), *Monetary Policy – Interim Report 2015*, December (in Greek).

Baumeister, C. and L. Benati (2013), "Unconventional Monetary Policy and the Great Recession: Estimating the Macroeconomic Effects of a Spread Compression at the Zero Lower Bound", *International Journal of Central Banking*, 9(2), 165-212.

Bernanke, B. and V. Reinhart (2004), "Conducting monetary policy at very low short-term interest rates", *American Economic Review*, 94, 85-90.

Bernanke, B., V. Reinhart and B. Sack (2004), "Monetary policy alternatives at the zero bound: an empirical assessment", *Brookings Papers on Economic Activity*, 35(2), 1-100.

Bijsterbosch, M. and M. Falagiarda (2015), "The Macroeconomic Impact of Financial Fragmentation in the Euro Area: Which Role for Credit Supply?", *Journal of International Money and Finance*, 54, 93-115.

Bork, L. (2015), "A Large-Dimensional Factor Analysis of the Federal Reserve's Large-Scale Asset Purchases", SSRN Working Paper.

Campbell, J. (2013), "Odyssean forward guidance in monetary policy: a primer", *Economic Perspectives*, 37(4), Federal Reserve Bank of Chicago.

Canova, F. and G. De Nicolo (2002), "Monetary Disturbances Matter for Business Fluctuations in the G-7", *Journal of Monetary Economics*, 49(6), 1131-1159.

Coenen, G., M. Ehrmann, G. Gabbalo, P. Hoffmann, A. Nakov, S. Nardelli, E. Persson and G. Strasser (2017), "Communication of monetary policy in unconventional times", ECB Working Paper No. 2080.

Cœuré, B. (2017), "Central bank communication in a low interest rate environment", ECB.

Cour-Thimann, P. and B. Winkler (2013), "The ECB's non-standard monetary policy measures. The role of institutional factors and financial structure", ECB Working Paper No. 1528.

Del Negro, M. and G. Primiceri (2015), "Time Varying Structural Vector Autoregressions and Monetary Policy: A Corrigendum", *The Review of Economic Studies*, 82(4), 1342-1345.

ECB (2010a), "The ECB's Monetary Policy Stance during the Financial Crisis", *Monthly Bulletin*, January.

ECB (2010b), "The ECB's Response to the Financial Crisis", *Monthly Bulletin*, October.

Eggertsson, G.B. (2011), "What Fiscal Policy is Effective at Zero Interest Rates?", in: Acemoglu, D. and M. Woodford (eds), *NBER Macroeconomics Annual 2010*, vol. 25, University of Chicago Press, 59-112.

Fry, R. and A. Pagan (2011), "Sign Restrictions in Structural Vector Autoregressions: A Critical Review", *Journal of Economic Literature*, 49(4), 938-960.

Gambacorta, L., B. Hofmann and G. Peersman (2014), "The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis", *Journal of Money, Credit and Banking*, 46(4), 615-642.

Gambetti, L. and A. Musso (2016), "Loan Supply Shocks and the Business Cycle", *Journal of Applied Econometrics*, 32(4), 764-782.

Kapetanios, G., H. Mumtaz, I. Stevens and K. Theodoridis (2012), "Assessing the economy-wide effects of quantitative easing", *The Economic Journal*, 122(564), F316-F347.

Krugman, P. (2000), "Thinking about the liquidity trap", *Journal of the Japanese and International Economies*, 14(4), 221-237.
Lütkepohl, H. (2005), *New Introduction to Multiple Time Series Analysis*, Springer, Berlin, Heidelberg.
Michaelis, H. and S. Watzka (2017), "Are there Differences in the Effectiveness of Quantitative Easing at the Zero-Lower-Bound in Japan Over Time?", *Journal of International Money and Finance*, 70, 204-233.
Mountford, A. and H. Uhlig (2009), "What are the Effects of Fiscal Policy Shocks?", *Journal of Applied Econometrics*, 24(6), 960-992.
Primiceri, G. (2005), "Time varying structural vector autoregressions and monetary policy", *Review of Economic Studies*, 72(3), 821-852.
Rompolis, L.S. (2017), "The effectiveness of unconventional monetary policy on risk aversion and uncertainty", Bank of Greece Working Paper No. 231.
Stock, J.H. and M.W. Watson (2001), "Vector Autoregressions", *Journal of Economic Perspectives*, 15(4), 101-115.
Uhlig, H. (2005), "What are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure", *Journal of Monetary Economics*, 52(2), 381-419.
Weale, M. and T. Wieladeck (2016), "What are the Macroeconomic Effects of Asset Purchases?", *Journal of Monetary Economics*, 79, 81-93.

RESEARCH AND INNOVATION IN GREECE*

Maria Albani
Bank of Greece, Economic Analysis and Research Department

Sofia Anyfantaki
Bank of Greece, Economic Analysis and Research Department, and Athens University of Economics and Business

1 INTRODUCTION

In the context of a global competitive market, the promotion of research and innovation is of particular relevance for an economy to keep pace with international developments. As rightly pointed out by the European Commission, science, technology and innovation are the key drivers of Europe's economic growth. Meeting the targets of the "Europe 2020" strategy for smart, sustainable and inclusive growth hinges upon research and innovation. The European Union's flagship initiative "Innovation Union" comprises a number of action points, which, among other things, aim to boost investment in research and development (R&D), transform innovation policies towards addressing societal challenges, and strengthen the links between basic research and the labour market, so that research outcomes turn into new goods and services.

Research, innovation and competitiveness are inextricably linked with each other. Competitiveness largely relies on the methods of technology used and more accurately on the direction and the speed of technological development, i.e. technological change. In turn, technological change is directly associated with innovation. Technology, technological change and innovation depend to a great extent on information, research and knowledge. Knowledge is generated through learning, and learning is obtained through formal education and experience.

Technological progress is no longer a privilege reserved to wealthy and advanced economies. The aim of this study is to present the features of the Greek research and innovation system, as well as its potential to improve the country's competitiveness. In the context of the Greek economic crisis, a major challenge is to enhance convergence and close the long-standing productivity and technology gaps relative to the other advanced countries (see Giannitsis and Kastelli 2014). Investment in research and innovation does not necessarily lead to growth. For a more effective use of both human and knowledge capital, it is imperative to encourage and foster research, ensure the diffusion of technology and boost entrepreneurship. Investing in all those three components provides the necessary background for the emergence of a knowledge-based economy.

A long-term national strategy involves the implementation of an effective innovation system, which will help the Greek economy to catch up to the technological frontier. Such a system contributes to the development of a simple framework for business research activity, rests upon interaction among stakeholders and promotes networking between knowledge creators and knowledge commercialisers.

This study is structured as follows: Section 2 outlines the theoretical background and provides a brief literature review. Section 3 investigates the key determinants of the Greek innovation system, the role of tertiary education and the current business conditions. The performance of national innovation systems is difficult to measure. In this study we present a number of indicators, acknowledging that they do not fully capture the effectiveness of a national

* Warm thanks are extended to Heather Gibson and Hiona Balfoussia, as well as to all participants in the Economic Analysis and Research Department meetings for their very useful remarks and comments. The views expressed in this article are those of the authors and do not necessarily reflect those of the Bank of Greece. The authors are responsible for any errors or omissions.

innovation system. The qualitative and quantitative assessment of research, innovation and entrepreneurship is a precondition for the necessary institutional interventions and the formulation of policies that are adapted to the specific needs and conditions of the Greek economy. Furthermore, it can be useful for the evaluation of the support policies already in place for small and medium-sized enterprises, in the context of the new knowledge-intensive business environment. The last section puts forward some conclusions and policy suggestions.

2 THEORETICAL BACKGROUND AND LITERATURE REVIEW

Economic growth and its interlinkage with technological development are at the heart of economics, as they impact on the welfare and the wealth of nations and their citizens. Economic growth is a combined outcome of both the quantity and the quality of human and physical capital, as well as of technological progress. Classical economists such as Smith (1776), Malthus (1798) and Ricardo (1817) were pioneers of the very concept of economic growth.

Schumpeter (1934), among others, built upon the work of classical economists on economic growth and stressed the importance of entrepreneurship and innovation, underlining at the same time the role of research and development (R&D) and of education. This approach highlights and defines more clearly the concept of innovation, while promoting competition and education as key drivers of economic growth. Later, Solow (1956) and Swan (1956) developed the exogenous growth theory. Using a neoclassical production function, which assumes an exogenous saving rate, constant returns to scale, diminishing returns to factors of production, and a positive elasticity of substitution, they attributed growth to the presence of exogenous technological innovations.

In the 1980s, Romer (1986) and Lucas (1988) moved along a new path and formulated the endogenous growth theory. Romer argued that the diffusion of new technologies, which result from investment in R&D and human capital, creates endogenous forces that ensure sustained economic growth, while Lucas highlighted the importance of human capital for increasing a country's per capita income.

Overall, there is a vast literature on the role of R&D, which is perceived as perhaps the most crucial type of investment and a prerequisite to sustainable growth. More specifically, the development of the knowledge-based economy is among the top priorities of modern society (see Melnikas 2011).

In sum, a knowledge- and innovation-based economy rests upon the following premises:

(a) an effective innovation ecosystem that encompasses businesses, research centres, universities and other public organisations promoting innovation (see Verspagen 2006);

(b) well-educated and high-skilled labour force that constantly invests in upskilling in order to be able to generate and effectively utilise new knowledge;

(c) development of the institutional framework for an effective generation, diffusion and implementation of both existing and newly acquired knowledge (see Anderlini et al. (2013) for the relationship between legal framework, innovation and growth, and Tebaldi and Elmslie (2013) for the relationship between institutions and innovation).

Empirical studies that stress the relationship between research, innovation and economic growth use both macroeconomic and microeconomic data. For example, Ulku (2004), using panel data from 20 OECD countries and 10 non-OECD countries for 1981-2017, shows that innovation has a positive effect on gross domestic product (GDP) per capita in both advanced and emerging market economies over the period under review. A study by Westmore (2013) explores the determinants of R&D spending and patent applications, as well

as the relationship between innovation and economic growth. Using a sample of 19 OECD countries for 1980-2008, the author finds that tax incentives, public R&D expenditure and intellectual property rights encourage innovation activities in the business sector, leading to high productivity growth.

Moreover, according to the literature, the role of innovation becomes pivotal in firms' potential to build sustained competitive advantages (see Barney 1991). Employing microdata at the firm level for Italy, Cainelli et al. (2004) show that innovating firms in the services sector outperform non-innovating firms in terms of productivity. In a similar study for 63 countries, Dabla-Norris et al. (2012) conclude that innovation, in a broader sense, has a strong impact on firm performance —as it increases productivity— and countries with well-developed financial sectors reap the maximum benefits. Czarnitzki and Toivanen (2013) show that, in the cases of Germany and Belgium, public R&D subsidies stimulate private investment in R&D, while the results vary with the innovation capacity and labour productivity of firms. More recently, Galindo and Mendez (2014) examine the links between innovation, entrepreneurship and economic growth by applying the Schumpeterian approach.

The role of innovation and knowledge in the effectiveness and competitiveness of modern productive systems proves to be all the more significant, accounting to a large extent for divergent growth rates at the international level (e.g. see Boyer (2014) for the so-called North-South divide). Besides, most empirical studies cite R&D and innovation activities as key factors in the capability building process of an economy (see Verspagen 1991), along with investing in human capital (see Nelson and Phelps 1966), international openness and the adoption of international specialisation standards (see Howitt and Mayer-Foulkes 2005 and Acemoglu et al. 2006).

On the basis of the above empirical results, innovation policies have increased substantially in the past few years, with considerable effects on R&D expenditure levels. From an economics perspective, the strengthening of public expenditure on R&D is supported by the existence of positive externalities. Knowledge spillovers from a firm, industry and/or country to another feature in a large strand of the literature. The use of the new knowledge that is acquired thanks to R&D spending contributes to the creation of a new technology, which may be applied in new goods and services, depending of course on the type of research (see Cohen and Levinthal 1989, Nadiri 1993 and Rodríguez-Pose and Crescenzi 2008).

With regard to the evaluation of national innovation systems and the determinants of national innovative capacity, the literature distinguishes between three broad categories. First, national innovative capacity is conditional on the presence of a strong innovation system. Among other things, the national innovation system comprises a country's overall policy for science and technology, i.e. the mechanisms applied to support basic research and higher education, as well as the cumulative "stock" of technological knowledge, which forms the basis for the development of new ideas and their subsequent commercialisation. Second, a country's innovative capacity depends on the general innovation environment that prevails in each industry or sector. As stressed by Porter (1992), firms' decision to innovate relies upon their competitive environment and the microeconomic conditions. Third, national innovation capacity hinges on how strong the linkages between the innovation system and businesses are. The effectiveness of a national innovation system increases when specific mechanisms or institutions, such as sound domestic tertiary education and funding mechanisms for startups, transfer new ideas from research to commercial practice.

The knowledge paradox (or "European paradox", initially known as "Swedish paradox" – see Dosi et al. 2006) underlines the fact that high levels of investment in new knowledge do not necessarily and automatically induce the

expected levels of competitiveness and economic growth (see Audretsch and Keilbach 2008). Therefore, according to the new theory of the knowledge-based society, entrepreneurship is one of the key mechanisms contributing to the diffusion of knowledge (see Audretsch and Thurik 2001 and Audretsch et al. 2006). For instance, Braunerhjelm and Borgman (2004) find a positive relationship between entrepreneurship and economic growth using Swedish data.

Indeed, Gibbons et al. (1994) argue that knowledge generation stems from the university-industry-government interaction (also known as the "Triple Helix Model" – see Etzkowitz and Leydesdorff 1995 and 2000), while several empirical studies attempt to identify the critical factors behind the effectiveness of knowledge diffusion in this interaction (for example, see Landry et al. 2007, González-Pernía et al. 2013, and Ramaciotti and Rizzo 2014). It is likely that new knowledge is underutilised. A possible explanation is that firms are not willing to assume the risk inherent in new products or processes for a number of reasons that are associated with the underlying conditions in the industry (see Audretsch 1995).

An underutilisation of research outcomes also emerges if research activity in universities and research institutions does not translate into new goods or services. The two main missions of universities are research and teaching rather than the capitalisation of generated knowledge. Their direct contribution to the economy through research alliances with businesses, as well as an active strategy for the transfer of scientific research results to the production process should perhaps be the third mission of universities (see Etzkowitz and Leydesdorff 2000). Against this backdrop, a potential vehicle for the commercialisation of academic research, as already suggested and studied by the literature, is the establishment of collaborations between universities and firms (see Rosenberg and Nelson 1994, Meyer 2003, Arundel and Geuna 2004, and Huang and Chen 2017). It is clear that the creation of academic spinoffs is a highly complex process involving many factors inside and outside universities (see O'Shea et al. 2007 and Rasmussen and Borch 2010). In a recent study, Fini et al. (2017) conclude that changes in the institutional framework at both the national and the university level are conducive to the creation of more spinoffs, but that the increase in quantity is at the expense of the quality of these firms.

3 THE GREEK CASE

Databases, statistics and composite indicators compiled by international organisations afford comparisons between national innovation systems and countries' innovative performance. The theoretical background, as outlined in the previous section, can provide some guidance about the assessment of the innovation system in Greece. For example, it underscores the importance of funding composition for the performance of the innovation system. Thus, although R&D public spending contributes to the strengthening of the innovation system, R&D business spending rather reflects the quality and the content of innovation.

This section presents a number of key indicators that describe the main characteristics of the Greek R&D system, such as the share of researchers in total employment, R&D expenditure as a percentage of GDP, the number of scientific publications and the number of patents filed.

Besides, the productive structure of the Greek economy provides evidence on the possible weaknesses of the innovation system. Given that the structure of an economy inevitably affects its growth potential, it should not be overlooked when examining the effectiveness of innovation policies. Finally, over the past two decades, as already mentioned in the literature review, a series of empirical studies, analysing the main sources of knowledge creation and the channels of knowledge diffusion, show that the stock of knowledge can only have a positive contribution to growth, if there are

adequate mechanisms in place for the diffusion of knowledge and innovation to the entire production system. For this reason, we present some key elements of the business framework and competitiveness in Greece.

3.1 INDICATORS OF RESEARCH & DEVELOPMENT AND INNOVATION

3.1.1 Expenditure on R&D and sources of funds

Expenditure on R&D helps an economy to integrate more knowledge and technology into its goods and services and of course to produce at the lowest possible cost, thereby increasing its competitiveness. The sectors in which R&D activities are performed are the following: the business enterprise sector, the government sector, the higher education sector, and the private non-profit sector. The allocated amounts to research and innovation in total economy are largely determined by national planning as well as by private initiatives, but also depend on access to funding and any fiscal constraints.

In Greece, despite the recent sizeable contraction of macroeconomic aggregates as a result of the economic crisis, national spending on R&D increased on the back of funds from National Strategic Reference Framework (NSRF) programmes. In absolute terms, expenditure on R&D in Greece amounted to €1.7 billion in 2016, i.e. up by 1.7% and by 24.6% compared with 2015 and 2011, respectively (see Table 1).[1]

1 According to preliminary data on the key indicators of R&D expenditure for 2016 in Greece, R&D expenditures amount to €722.9 million in the business enterprise sector (up by 28.7% relative to 2015), to €428.9 million in the government sector (down by 10.5%), to €566.6 million in the higher education sector (down by 12%) and to €14.8 million in the private non-profit sector (down by 22.6%).

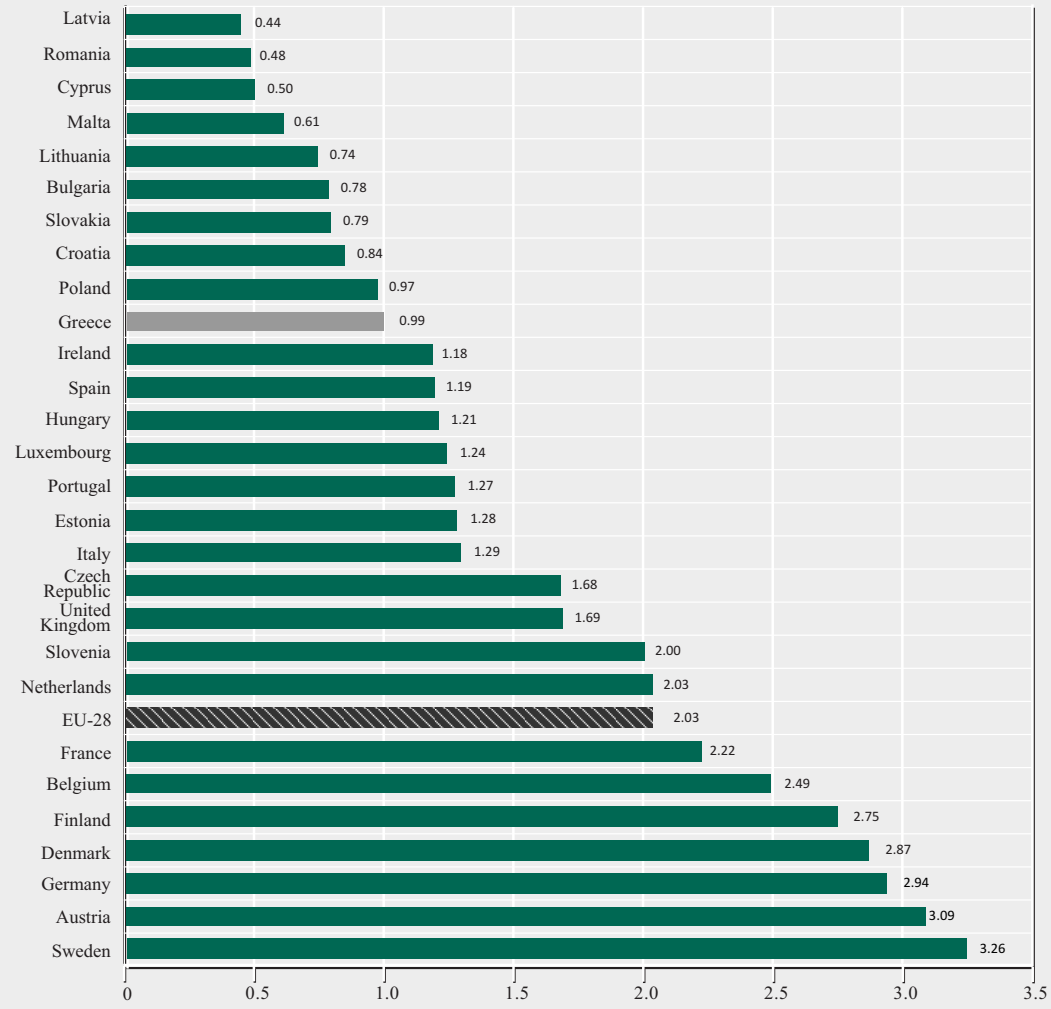
Table 1 R&D expenditure and intensity for the period 2011-2016 (total economy and by sector of performance)

	2011	2012	2013	2014	2015	2016
R&D expenditure (EUR millions)						
EU-28	259,893.08	269,978.70	273,996.50	285,084.24	300,598.16	302,220.06
Greece	1,391.16	1,337.60	1,465.67	1,488.74	1,703.82	1,733.09
R&D intensity (R&D expenditure/GDP)						
EU-28	1.97	2.01	2.02	2.03	2.03	2.03
Greece	0.67	0.70	0.81	0.83	0.97	0.99
Business enterprise sector						
EU-28	1.24	1.27	1.28	1.30	1.31	1.32
Greece	0.23	0.24	0.27	0.28	0.32	0.42
Government sector						
EU-28	0.25	0.25	0.25	0.24	0.24	0.23
Greece	0.16	0.17	0.23	0.23	0.27	0.25
Higher education sector						
EU-28	0.46	0.47	0.47	0.47	0.46	0.46
Greece	0.27	0.28	0.30	0.31	0.37	0.33
Private non-profit sector						
EU-28	0.02	0.02	0.02	0.02	0.02	0.02
Greece	0.01	0.01	0.01	0.01	0.01	0.01

Source: Eurostat, authors' own calculations.

Chart 1 R&D intensity (2016)

(R&D expenditure as % of GDP)

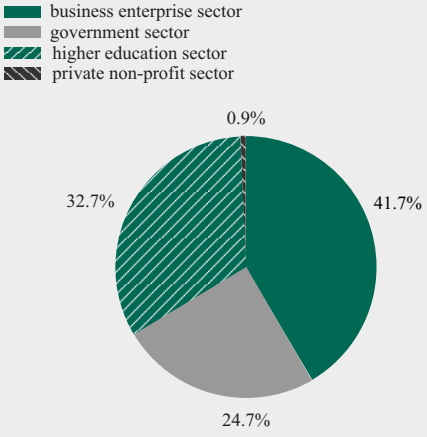


Source: Eurostat, authors' own calculations.
Note: Data on France refer to 2015.

In 2016, R&D intensity, as defined on the basis of R&D expenditure as a percentage of GDP, came to 0.99% (from 0.67% in 2011). The respective average for the Member States of the European Union (EU) was 2.03%, while R&D intensity in Sweden, which is considered to be the EU innovation leader, was 3.26% (see Chart 1). The R&D intensity indicator, despite its flaws, is still considered to be a valid tool for drawing cross-country comparisons (see the Frascati Manual, OECD 2015). The target of the "Europe 2020" strategy for R&D investments is 3% of GDP for the EU-28 average and 1.2% of GDP for Greece. Despite any past efforts which mostly relied on the utilisation of resources from EU structural funds, Greece continues to lag behind relative to the EU-28 average, while the comparison with the other 27 EU Member States still reveals the country's low ranking (19th in 2016). If the research-generated new knowledge is an engine of growth, for Greece it is very poor, with a respectively weak effect on the domestic economy's total productivity.

A second characteristic, with perhaps larger implications for the functioning and effectiveness of the R&D system, is the limited participation of the business enterprise sector. In Greece, R&D expenditure by sector of performance remains relatively stable over time, with the higher education sector accounting for 37.5% of total expenditure, on average, in 2011-2016. The business enterprise sector follows with 35% over the same period. However, private expenditure is concentrated in a limited number of larger corporations. It should be noted that, on the basis of the European Commission's Industrial R&D Investment Scoreboard for 2017 (see European Commission 2017c), only three Greek firms were among the top 2,500 companies worldwide and five among the top 1,000 firms in the EU investing the largest sums in R&D. Furthermore, EU-28 average business enterprise sector expenditure, as a percentage of GDP, in 2011-2016 was almost double (64%), revealing the critical importance that the European business community assigns to the development of innovative activities. Lastly, Greek government sector expenditure does not exceed 30%, on average, over the period under review (see Chart 2).

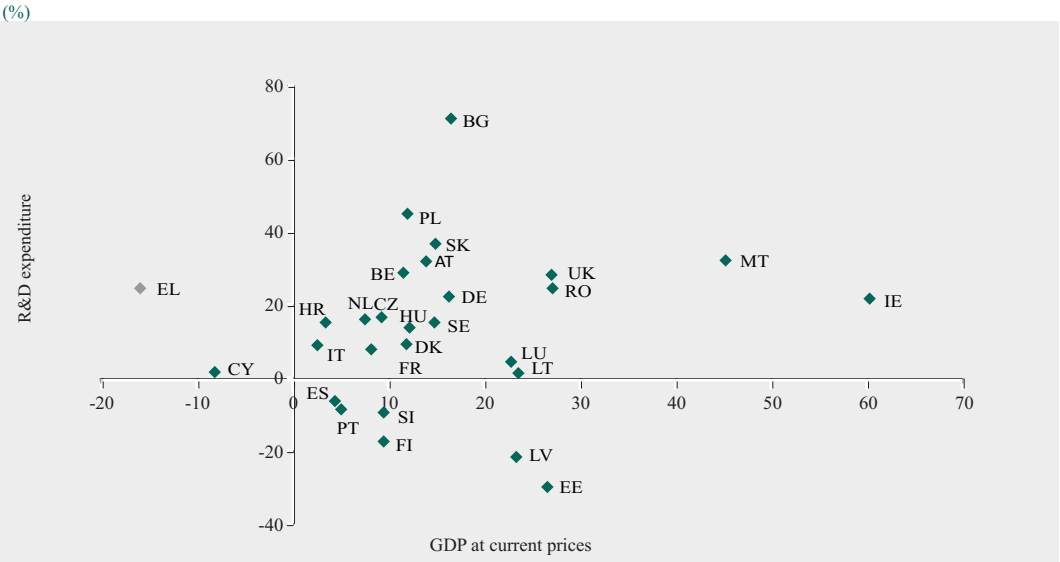
Chart 2 R&D expenditure in Greece by sector of performance (2016)



Source: Eurostat, authors' own calculations.

Even though the causality between gross domestic expenditure on R&D (GERD) and GDP falls beyond the scope of this study,

Chart 3 Average annual changes in GDP (current prices) and in R&D expenditure over the period 2011-2016

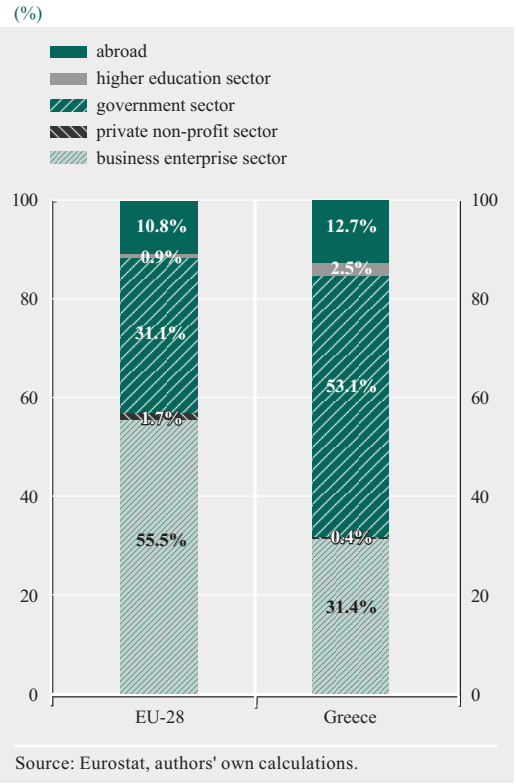


Source: Eurostat, authors' own calculations.
Note: R&D expenditure data on France refer to 2015.

according to the extant literature, research and innovation are among the key factors contributing to economic growth. Besides, it is known that GDP increases with the funds that are allocated to research activities. The positive correlation between R&D expenditure and GDP across EU-28 countries between 2011 and 2016 is illustrated in Chart 3. Nevertheless, this is not the case for Greece, as over the aforementioned period Greek GDP declined by more than 15% (in nominal terms), while a concurrent increase in R&D expenditure of about 25% was observed.

Turning to funding, according to 2015 data (see Chart 4), the main source of funds for total R&D expenditure is the government sector with a share of 53.1%. This category also includes funding from the ordinary budget of the Greek Ministry of Education, Research and Religious Affairs, funds from the Public Investment Programme and transfers through EU structural funds (NSRF programmes). In the transition effort towards a knowledge-based economy, the active involvement of the business enterprise sector as well as its collaboration and interaction with the broad domestic research community are warranted for the production of new knowledge. In Greece, the contribution of the business enterprise sector (private firms and businesses from the wider public sector) reached 31% in 2015. The respective EU-28 average was almost double (55.5%). The bulk of funding from the business enterprise sector is allocated into firms' R&D expenditures and only a small percentage goes to R&D funding in universities and research institutions. Besides, with regard to business enterprise R&D expenditure by sector of economic activity, services received the largest share of R&D expenditure (69.9% of total expenditures in 2015), in particular the financial sector, followed by manufacturing (27%), mainly pharmaceuticals, while increased levels of expenditure were also recorded in the industries of metal products, computers, and machinery and electrical equipment.

Chart 4 Total R&D expenditure by source of funds (2015)



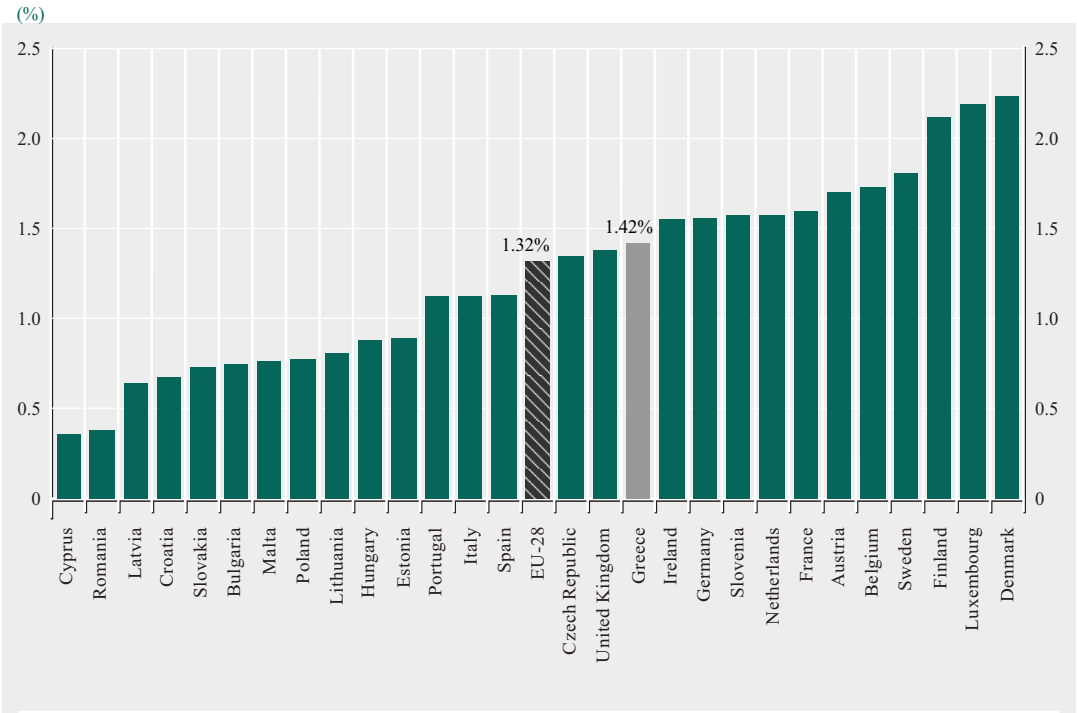
Source: Eurostat, authors' own calculations.

Thus, the dominant role of the government in the funding of the research and innovation system is visible. More specifically, in the higher education sector the main source of funds for R&D expenditure is the government, accounting for over 70% in 2015. The share of funding from abroad (about 15%) is also sizeable, mainly from EU programmes and to a lesser extent from foreign firms (foreign direct investment). Funding from businesses comes to around 7%, which clearly demonstrates the loose linkages between the business enterprise sector and the academic community.

3.1.2 R&D personnel

The sustainable economic growth that will be based on knowledge and innovation requires investment in human capital. Researchers are seen as a main source of new ideas, and high-quality labour force is estimated to play a critical part in the production and spillover of

Chart 5 R&D personnel as a percentage of total employment (2015)



Source: Eurostat, authors' own calculations.
Notes: In full-time equivalents (FTEs). Data on France refer to 2014.

knowledge. As already mentioned, the third characteristic of the innovation system is precisely the quality of human capital.

In recent years, Greece has witnessed an increase in R&D personnel.[2] As a percentage of total employment, R&D personnel (in full-time equivalents – FTEs) now exceeds the EU-28 average (Greece: 1.42%, EU-28: 1.32% in 2015; see Chart 5). In 2015, total R&D personnel came to 49,658 FTEs (up by 14.6% relative to 2014), while the number of researchers came to 34,708 FTEs (up by 16.2% relative to 2014). The majority of R&D personnel is employed in the higher education sector (56.4% of total R&D personnel; see Chart 6), followed by the government sector (27%) and the business enterprise sector (16%). Compared with the EU-28 average (31.6%), the share of R&D personnel working in higher education institutions could be characterised as fairly high.

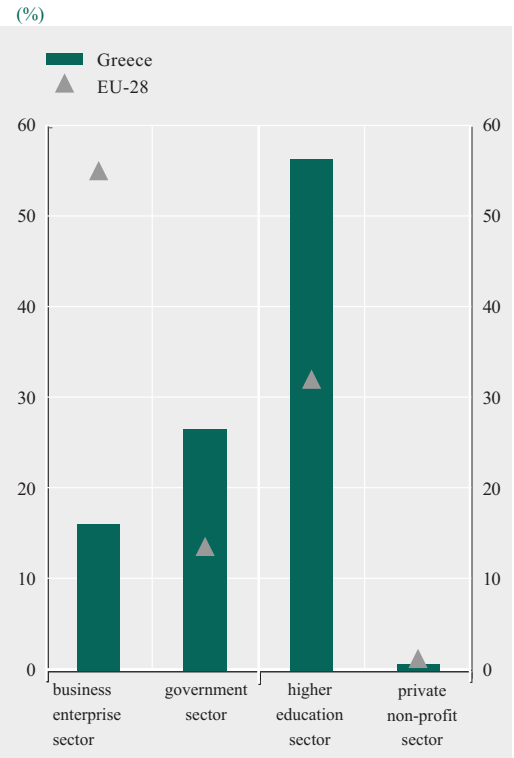
3.1.3 Innovation

Innovation activities have a direct effect on competitiveness and productivity. In the case of product innovations, by acquiring a patent, a firm enjoys monopoly power. In the case of process innovations that improve productivity, a firm has a cost advantage over its competitors, thus allowing it to expand its market share and seek profit.

The results of the statistical survey on innovation in Greek enterprises (Community Innovation Survey)[3] suggest that the percentage of innovating Greek firms is higher than the EU average, especially in the area of the so-called

2 R&D personnel comprises all persons who make a direct contribution to R&D activities and is split into two main categories: researchers and other R&D personnel.
3 This nationwide survey was conducted by the Greek National Documentation Centre (EKT), in conjunction with the Hellenic Statistical Authority (ELSTAT), in the context of the EU-wide official statistical survey on the innovativeness of enterprises (Community Innovation Survey) for the 2012-2014 period.

Chart 6 Total R&D personnel by sector of performance (2015)



Source: Eurostat, authors' own calculations.

non-technological innovation, i.e. in organisational and marketing aspects. In greater detail, over the 2012-2014 period 51% of Greek firms innovate in one or more types of innovation (EU average: 48.9%). Greece ranks 12th in terms of product and/or process innovations[4] (38.7%) and 8th in terms of organisational and marketing innovation[5] (40.7%) among EU Member States. However, product innovations are those that generate high value added, create high-skilled jobs and lead to market expansion and export promotion. In the industrial sector (54.5% of total innovating firms), 55% of innovating firms are active in manufacturing, i.e. basic pharmaceutical products and pharmaceutical preparations (78.3%), electrical equipment (72.7%) and computers, electronics and optical products (70.3%). At the same time, Greece's ranking on the Global Innovation Index has improved considerably since the onset of the crisis, despite a recent modest decline, as the country now ranks 44th among 127 countries (against 63rd in 2011).

The above positive elements led to an improvement of economic performance in several sectors, but failed to narrow the gap between the EU-28 average and Greece, with the latter still being characterised as a moderate innovator. According to the European Innovation Scoreboard, Greece ranked 22nd in 2016, against 20th in 2011, among the EU-28 countries. The weaknesses are observed in intellectual assets (patent, trademark and design applications), while the strengths are recorded in research systems and in human resources (see Chart 7). It should also be noted that based on data from the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO), Greece lags significantly behind in patenting innovative digital technologies. In 2016 the EPO issued only 39 Greek patents, which confirms that the entrepreneurial-productive structure of the Greek economy focuses on low-technology and low knowledge-intensive activities.

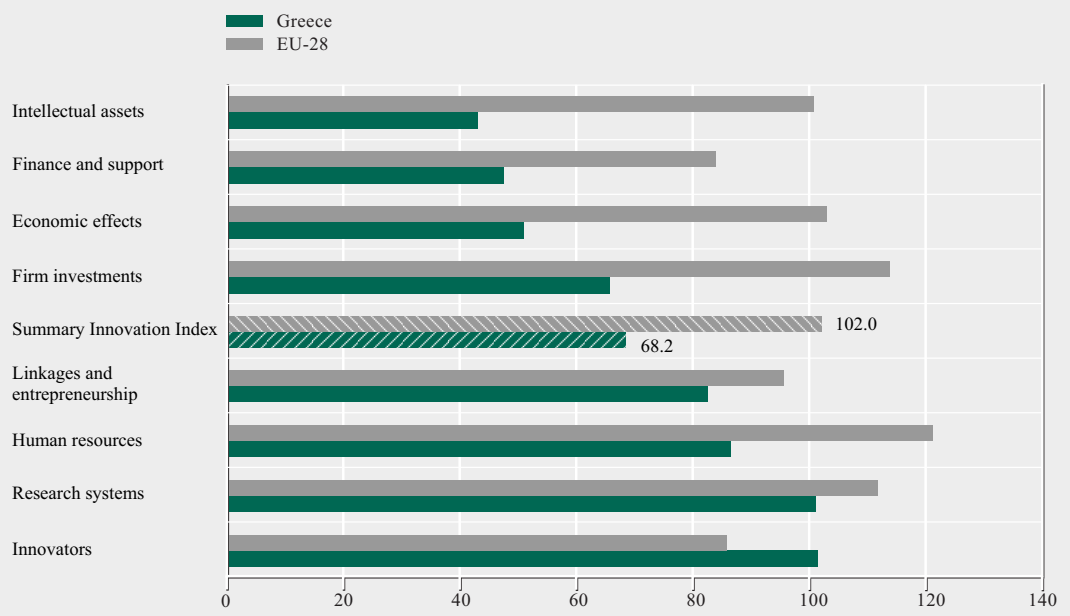
3.2 TERTIARY EDUCATION AND LINKAGES WITH THE LABOUR MARKET

Higher education institutions are the major producers of research in Greece, with a share among the highest across the EU. Basic research takes the lion's share in university research expenditures (54% in 2013, which ranks Greece at the 11th place among the EU-28 Member States), followed by applied research (37%, which brings the country to the 15th position among the EU-28 Member

4 Product innovation is the market introduction of a product (good or service) that is either new or a substantially improved or redesigned version of a previous product. Process innovation is the implementation of a new or significantly improved production or delivery method, or ancillary supporting activity for the goods or services offered by the enterprise (see OECD/Eurostat 2005, Oslo Manual).

5 Organisational innovation: new business practices, new methods in workplace organisation and decision making, new organisational methods in external relations. Marketing innovation: new product design or packaging, new means or techniques in product promotion, placement or sales, changes in product pricing (see OECD/Eurostat 2005, Oslo Manual).

Chart 7 European Innovation Scoreboard indicators (2016)



Source: European Innovation Scoreboard, authors' own calculations.
Note: Relative to EU-28 in 2010.

States).[6] Most publications are produced by tertiary education institutions (84% in 2014)[7] and, respectively, universities have the largest share of most cited scientific publications (84.5% in 2010-2014). Nevertheless, the percentage of academic publications in collaboration with the business sector is relatively low, attesting to the introversion of Greek universities. In 2015, according to the European Innovation Scoreboard, just 7.9 publications per 1 million population were public-private co-publications.

Greece displays one of the highest employment rates in university research activities worldwide. At the same time, Greece boasts a large number of specialised, high-skilled labour force (7.3 doctorate holders per 1,000 economically active population) and ranks 9th among the 22 countries participating in the International Survey on Careers of Doctorate Holders, for which there are available data (EKT 2015).[8] The main employer of doctorate holders are universities (57%), while the business sector features at the 3rd place (8.7%). Moreover, the contribution of Greek universities to PhD theses is significant, as the vast majority of doctorate holders (86%) have obtained their doctorate degrees from Greek universities.[9]

6 Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view. Applied research is original investigation undertaken in order to acquire new knowledge, which is directed primarily towards a specific practical aim or objective. Experimental development is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices; to installing new processes, systems and services; or to improving substantially those already produced or installed (see Eurostat, Statistics Explained, http://ec.europa.eu/eurostat/statisticsexplained/ index.php/Category:Science_and_technology_glossary).

7 Natural sciences prevail in Greek publications (about 40% of total publications in 2014).

8 The International Survey on Careers of Doctorate Holders (CDH) was conducted in Greece by the National Documentation Centre. It is the official statistical survey aimed at collecting data on doctorate holders worldwide and is coordinated by the OECD. According to the methodological guidelines of the CDH survey, for reference year 2013 the target population comprises all doctorate holders who were resident in Greece on 1 December 2013 (permanently or not), were aged below 70 years and had acquired their doctorate degree between 1990 and 2013, irrespective of their citizenship and employment status (active or inactive).

9 On the basis of Eurostat data, the number of new doctorate recipients stood at 1,601 for academic year 2013-2014.

Nevertheless, the phenomenon of "brain drain" is an alarming trend and gradually leads to human capital depreciation and to the deterioration of the Greek R&D ecosystem as a whole. It is estimated that over the 2008-2013 period 427 thousand Greeks, aged 15-64, left the country in search of employment abroad (see Lazaretou 2016). Therefore, policies and concrete actions geared towards creating an attractive environment for young scientists are warranted, with structures and functions that will put into optimal use the capabilities and the knowledge of the high-skilled labour force.

As suggested by data on Greek researchers' scientific publications, which are indicative of the research output, the performance of domestic human capital is quite satisfactory both in terms of the number of publications (although a slower growth rate since 2009 and a decline from 2013 onwards have been observed)[10] and in terms of their impact via cross-citations, relative to other EU Member States and OECD countries (close to their averages).

Greece's performance is also good with regard to participation in EU co-funded programmes. According to the National Documentation Centre in the context of Greece's participation in the "Horizon 2020" programme for research and innovation, in 2014-2016 the success rate of proposals stood below the EU-28 average (13.5%), namely at 12.6%. But with regard to its performance in the various programme parts, Greece in most cases posted a higher success rate of proposals than the total average.[11]

Against this background, two positive and interconnected features of the Greek innovation system are the high quality and the competitiveness of researchers.

R&D activities are to businesses, universities and the other research institutions a vehicle for generating new knowledge. However, it is increasingly acknowledged that innovation rests upon interactive initiatives and knowledge spillovers. New knowledge constitutes a critical factor for innovation and becomes valuable to the market if converted into novel products and processes. Businesses perform R&D on their own, or through synergies with other businesses, universities and research centres, or by outsourcing their R&D activities. As a result, research institutions and universities can also partake in the commercialisation of newly acquired knowledge.

In Greece, despite the dominance of higher education institutions in the production of knowledge, their contribution to the production of innovation is small, as evidenced by the limited participation of Greek universities in patenting at the domestic level (see Stournaras 2017). According to OECD data, in 2013 a mere 2% of total patents was filed by universities and research institutions (see OECD 2016). Two major weaknesses in the Greek innovation system are the weak ties between stakeholders and the inadequate infrastructure for the diffusion of information and knowledge. Interaction between businesses as well as between businesses and the scientific community is limited, as suggested by the small share of business enterprise sector funding of university R&D activities that was presented in the previous section. The above finding is also corroborated by the Global Competitiveness Index of the World Economic Forum (*Global Competitiveness Report 2017-2018*), where Greece's ranking in 2016 worsened in the area of university-industry collaboration in R&D (129th among 138 countries), as well as in R&D expenditure of the business sector (87th).

10 Compared with R&D expenditure, the number of Greek publications is fairly high, as in 2014 7.2 publications corresponded to €1 billion of R&D expenditure. Yet the picture changes with the number of publications per researcher and/or the number of publications per 1,000 population.

11 The success rates of proposals per programme part are presented herein, also featuring the respective EU-28 averages in parentheses: "Future and Emerging Technologies – FET" 5.9% (4.5%), "Marie Sklodowska-Curie" 14.2% (12.8%), "European Research Council – ERC" 5% (12.4%), "Health, Demographic Social Change and Well-being" 10.6% (9.5%), "Information and Communication Technologies – ICT" 11.2% (8.1%) and "Secure, Clean and Efficient Energy" 12.4% (11%). See National Documentation Centre, press release of 27.6.2017, http://www.ekt.gr/el/press-releases/20093.

University-industry collaboration for the development of innovative products is an international practice that is very often cited in the literature. On the back of this collaboration, universities and research centres can secure sizeable funds, along with technological equipment. Universities and research centres are considered to be the main sources of new knowledge, while many believe that, if it were not for academic research, a large number of inventions either would never have emerged or would have emerged much later (see Kumral et al. 2006). In the United States, in the field of biotechnology for example, 60% of new pharmaceutical products and biodiagnostic applications result from startups and spinoffs, which are founded in universities/research centres and work together with domestic private companies. In Europe, the respective percentage is 30%, while in Greece there are few such partnerships (see Gravanis 2017). The Evaluation report on the PRAXE Programme – Spinoffs Phase B notes that the programme failed to meet the desirable targets-values which were initially set in terms of both the number of funded projects (33 instead of 40 spinoffs) and the creation of new jobs, which should be more than 240.

3.3 THE SUPPLY SIDE

3.3.1 Business conditions

Greece's strongest asset according to the European Commission's Digital Transformation Scoreboard (see European Commission 2017a) is its entrepreneurial culture (with a 10% higher score than the EU average in 2016). The findings of the survey conducted by the Foundation for Economic and Industrial Research (see IOBE 2017a) on entrepreneurship confirm a strong entrepreneurial culture. More specifically, the survey notes that the percentage of population aged 18-64 which in 2015 was at the early stages of entrepreneurial activity dropped to 6.7% from 7.8% in 2014 (this rate is below the average level of "innovation-driven economies", 8.5%), but taking into consideration the high share of established entrepreneurs, it is clear that Greece outperforms European countries in terms of total entrepreneurship rates (20% of population aged 18-64).

The results of the Small Business Act for Europe (SBA) Fact Sheet (see European Commission 2017d) also indicate that Greece's performance in entrepreneurship for 2016 is close to the EU average, although Greece remains one of the most difficult countries to set up a business. It is suggestive that the Greek economy exhibits a high entrepreneurship rate (of around 14.1%, against an EU-28 average of 6.7%). In any event, it should be noted that according to data from the IOBE survey on entrepreneurship, in 2016 the share of population aged 18-64 that has shut down, discontinued or quit a business came to 3.8%, which is substantially higher than the average level of the innovation-driven economies (1.9%).

The creation of an appropriate framework for entrepreneurship, under which economic activity is not hindered and investment is encouraged, is therefore a necessary condition for long-term growth. Lately, the regulatory framework in Greece has become business-friendlier. On the basis of the World Bank's Ease of Doing Business index, Greece ranked 67th in 2017 among 190 countries, with Germany standing at the 20th position and Spain at the 28th. Two useful sub-indices reflecting the business environment in Greece are "Starting a Business" (37th) and "Getting Credit" (90th).[12]

Notwithstanding, the Greek business environment continues to be more unfavourable relative to most European countries in several aspects. The structural competitiveness of the Greek economy, which takes into account a number of international competitiveness parameters other than prices, after its

12 The "Starting a Business" sub-index captures all procedures required or typically implemented in practice for an industrial or commercial business to start up and formally operate, as well as the time and the cost needed for the completion of those procedures, and the paid-in minimum capital. The "Getting Credit" sub-index assesses access to finance and borrowers' legal rights.

improvement in 2013-2014, is now showing signs of stagnation and/or regression, as suggested by the key composite global competitiveness indicators (see Bank of Greece, *Monetary Policy 2016-2017*, p. 80). In greater detail, according to the latest *Global Competitiveness Report 2017-2018* (World Economic Forum), Greece's structural competitiveness has worsened. In 2016 Greece fell to the 87th place among 138 countries, from 85th in 2015. On the basis of the indices relating to the effective functioning of institutions (efficiency of government spending, efficiency of legal framework, transparency, public trust in politicians, corporate governance, etc.), Greece's performance has remained stagnant and/or has deteriorated. In some cases, the country even features among the lowest-ranked performers (133rd on efficiency of legal framework in settling disputes). High tax rates are seen as the most problematic feature for doing business in Greece, followed by inefficient government bureaucracy and economic policy instability.

3.3.2 Small and medium-sized enterprises

Small and medium-sized enterprises (SMEs)[13] are regarded by many academic researchers as a key driver of economic growth (see Lee et al. 2012) and attract the interest of economic policy makers. The Greek economy is marked by a large number of very small (micro), small and medium-sized enterprises. SMEs in Greece outnumber those in other European countries, with a greater contribution to the Greek economy in terms of both employment and gross value added. More specifically, according to the European Commission's SBA Fact Sheet, in 2016 99.9% of Greek non-financial corporations are characterised as SMEs, while 96.2% are micro enterprises with less than ten employees. Furthermore, 86.9% of the workforce is employed in SMEs, generating 73.2% of value added in the economy. The respective shares for the EU-28 average are 99.8% as to the number of enterprises, 66.6% as to the number of persons employed and 56.8% as to the value added (see Table 2).

SMEs can play a pivotal role in the economy as a source of skills and innovation. According to the European Innovation Scoreboard (see European Commission 2017b), in 2016 the share of SMEs that developed product/process innovations in Greece was 34.6%, against 30.9% for the EU-28 average, while the share of those that developed marketing/organisation innovations was 40.1%, against an average of 34.9% in the EU-28. In the light of the above, it is clear that the developments and prospects of the Greek economy are inextricably linked with the course of SME entrepreneurship and its capacity to achieve sustainable output growth and job creation. Special emphasis must be placed on the evolution of the structure of small, family-run businesses into high-value-added entrepreneurship that will be characterised by a high degree of innovation, extroversion and growth potential.

It is generally accepted that SMEs have much different needs and are faced by much different challenges and financing constraints, compared with large corporations. Thus, they rely to a much greater extent on other sources of financing, such as bank financing and other financing tools. In Greece, bank financing waned for SMEs following the sovereign debt crisis. In 2009 new lending contracted considerably, while the downward trend continued throughout the years that followed.

As suggested by the survey on the access to finance of enterprises (SAFE) in the euro area, which is conducted by the European Central Bank and the European Commission, over the April-September 2017 period, access to finance remains a major problem for Greek SMEs. More specifically, about 23% of Greek SMEs reports access to finance as their

13 According to the European Commission's definition (Commission Recommendation 2003/361/EC), the category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding €50 million, and/or an annual balance sheet total not exceeding €43 million. Within the SME category, a micro enterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or balance sheet total does not exceed €2 million.

Table 2 The role of SMEs in Greece for the period 2013-2016

	2013		2014		2015		2016	
	SMEs	of which micro	SMEs	of which micro	SMEs	of which micro	SMEs	of which micro
Number of enterprises								
Greece	99.9%	96.2%	99.9%	96.7%	99.9%	96.8%	99.9%	96.2%
EU-28	99.8%	92.4%	99.8%	92.7%	99.8%	92.8%	99.8%	93.0%
Number of persons employed								
Greece	85.8%	55.2%	86.9%	58.7%	87.3%	59.1%	86.9%	57.3%
EU-28	66.9%	29.1%	66.9%	29.2%	66.8%	29.5%	66.6%	29.8%
Value added								
Greece	72.1%	33.1%	74.8%	37.4%	75.1%	35.9%	73.2%	34.3%
EU-28	58.1%	21.6%	57.8%	21.1%	57.4%	21.2%	56.8%	20.9%

Source: European Commission's SBA Fact Sheet, authors' own calculations.
Note: Data refer to the non-financial business economy.

most important problem, relative to the respective EU average of 7%. This is also confirmed by a recent survey of the Small Enterprises' Institute of the Hellenic Confederation of Professionals, Craftsmen and Merchants (see IME GSEVEE 2017). Lack of liquidity for small and micro enterprises is even more pronounced if account is taken of the fact that 30% of such enterprises raises liquidity through bank loans.

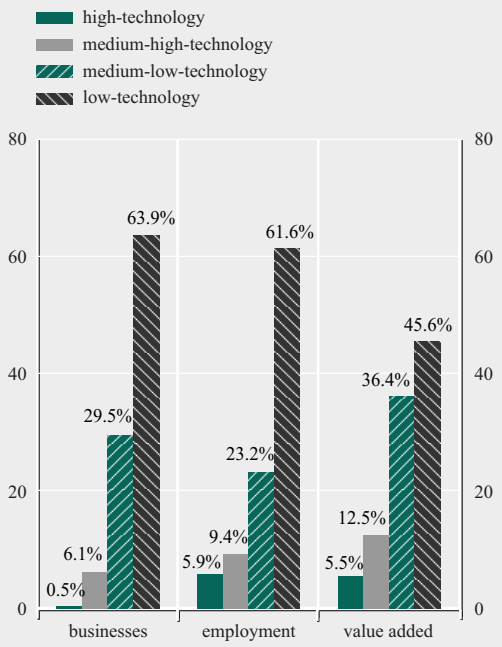
During the most recent period when bank lending shrank significantly, firms resorted to alternative sources of external financing, such as loans by domestic non-banking financial institutions or loans from abroad (see Bank of Greece, *Monetary Policy 2016-2017*, pp. 93-98). Moreover, despite the economic crisis, in the past few years there is an increasing supply of new financing tools aimed at boosting entrepreneurship. Apart from traditional sources of financing (banks, self-financing), new mechanisms for raising business funds have now been developed, such as equity financing, peer-to-peer (P2P) lending, crowdfunding, microfinance, etc. Nevertheless, SMEs' access to alternative sources of financing remains limited. Therefore, an overall effort is warranted to deal with the financing constraints faced by Greek SMEs.

3.3.3 Output, exports and competitiveness

Today, the production structure of the Greek economy remains unchanged and domestic output still lacks sufficient knowledge-intensive characteristics (see Stournaras 2017). The bulk of Greek manufacturing is concentrated in low- and medium-low-technology activities (see Chart 8). Besides, according to Eurostat data, in 2014 in Greece the number of high-technology firms in manufacturing and of high-technology, knowledge-intensive firms in services dropped to 12,401 (from 14,200 in 2008), with their value added amounting to €3,572 million (down from €6,959 million in 2008). Furthermore, Greek exports mainly consist of low- and medium-low-technology goods, while exports of medium-high- and high-technology goods, which have the most dynamic presence in world trade, accounted for only 22.7% of total Greek exports in 2015, with the EU average standing at 56.2% (European Innovation Scoreboard 2017).

Therefore, on the basis of the above data, it is obvious that the technology intensity of Greek exports can be improved so as to fully reap the benefits of global demand for rapidly developing high-technology products. However, there is a need for promoting innovative and

Chart 8 Structure of Greek manufacturing (2014)



Source: Eurostat, authors' own calculations.
Note: Data on employment refer to 2016.

internationally competitive industrial sectors, as well as for supporting large firms with high value added and high-skilled jobs. It is worth noting that, according to a recent study by the Hellenic Federation of Enterprises (see SEV 2017), in Greece the largest, most organised, innovative and extroverted enterprises have exhibited higher resilience to the crisis and have better prospects of recovery.[14]

In addition, through access to networks, international markets, funds, knowledge and technology, participation in global value chains can be the first step towards economic growth. In 2011 the OECD's global value chain participation index for Greece was 43%, compared with 63% for Hungary, 66% for Slovakia and 50% for Portugal. Competitiveness in global value chains requires investment in human capital, skills and infrastructure of high quality. Reducing barriers to investment greatly contributes to a country's participation in global value chains.

4 CONCLUSIONS AND POLICY SUGGESTIONS

The pivotal role of research, innovation and technological change in economic growth has been studied and stressed repeatedly in the literature. In the light of the above, it is apparent that, although the Greek research and innovation ecosystem has made progress in recent years, some lasting weaknesses hinder its evolution into a factor that will play a leading role in the transformation process of the Greek economy.

First, close linkages between all stakeholders are yet to be achieved, with a view to ensuring that the assets of the Greek research and innovation system are effectively utilised and that research activity is embedded in the production process. Collaborations between businesses and universities or research centres yield in most cases positive results. Therefore, Greek higher education institutions, through an overhaul of their curricula to better meet changing requirements and needs, as well as through the upgrading of their organisation and functioning, should develop actions aimed at linking education to the labour market and seek collaborations with research centres and businesses.

To this end, the various national initiatives to support R&D in the business enterprise sector are seen as a good practice. For instance, the Danish Industrial PhD Programme offers funding to PhD candidates wishing to be employed by companies in order to work on projects of mutual interest. Other international practices include grants for postgraduate dissertations or doctoral theses on subjects that are relevant to businesses' needs.

Moreover, the research community itself should follow a bottom-up approach to basic and applied research, which is a necessary condition for high-quality, innovative applications with high potential scientific and commercial

14 The results of the survey suggest that 36% of enterprises which are categorised as being on a growth track mainly consists of larger and well-organised, export-oriented and innovative firms.

value added. The priorities of scientific research should be the outcome of continuous consultation among all stakeholders of the innovation ecosystem (businesses, universities and research centres, ministries, etc.). Actions in this direction include: the establishment of hubs for the transfer of know-how and the protection of intellectual property rights; regular meetings and seminars with the participation of both new and established entrepreneurs; organising innovation and entrepreneurship competitions within universities; collaboration between universities and the business sector on the provision of executive postgraduate programmes and grants for internships; promoting applied research at the Greek tertiary education institutions; etc.

In the case of Greece in particular, incentives should be given to researchers to remain in the country, thereby contributing to human capital retention and halting the trend of brain drain (see Kougiou 2016). The scientific diaspora can play a decisive part in supporting innovation and research, as Greek scientists living abroad are familiar with good international practices and are very often well-connected to the international scientific community. Against this background, research projects between researchers of the diaspora and researchers working in Greece, visiting fellowship schemes in domestic research institutions, seminars and exchange programmes are examples of good practices towards developing linkages with the research community that lives and works abroad. Brain regain may be challenging at the current juncture; therefore, fostering partnerships is a desirable option. The creation of favourable conditions for international partnerships also requires the resolution of legal issues such as the transportation of research equipment, intellectual property agreements, etc. Good practices for brain circulation are being applied by the Swiss National Science Foundation, which each year subsidises postdoctoral research activity and gives grants to researchers across scientific disciplines to conduct research at foreign universities.

Second, several empirical studies have associated the growth model with "smart growth", stressing that innovation-driven growth may be sustainable. The production structure of the Greek economy should be based on those sectors which make the most out of the country's comparative advantages. But in order to achieve sustainable growth, a shift of traditional sectors, such as manufacturing and agriculture, towards a more systematic use of innovation technologies and human capital utilisation is warranted (see Stournaras and Albani 2008). Furthermore, digital entrepreneurship via the adoption of information and communication technology (ICT) by businesses facilitates their internationalisation. By way of illustration, in the food and beverages industry, increasing demand for quality products and consumers' requirements for diversified products highlight the need to use innovations with a view to increasing productivity and meeting consumer needs. New and improved technologies in food preservation, processing and packaging will enhance the exportability of traditional and local products, thereby contributing to economic growth. However, the basis of the comparative advantage needs to be broadened, given that exports of medium- and high-technology products typically increase an economy's growth potential, as already mentioned in this study and elsewhere.

Third, rigidities in the business environment act as a drag on the development of business innovation. International assessments clearly show that various institutional obstacles weigh on economic activity, including innovative initiative. A coherent and understandable legal and regulatory framework can save both time and resources for a new business. The creation of a predictable economic environment is bound to increase confidence and expected return on investment.

Therefore, a series of policies aimed at supporting the existing business activity as well as at encouraging new entrepreneurship are warranted. Such policies include to strengthen programmes subsidising young entrepre-

neurs, with a view to reducing the cost to start a new business, to provide support to businesses that already use new technologies, to establish the appropriate tax regime, etc. Key factors for the development of startups are the formation of more venues that help new businesses such as business incubators and accelerators, as well as the increase in investment funds and the easier access of startups to such funds, e.g. crowdfunding, business angels, venture capital, etc.

At the same time, innovation can also be underpinned by the establishment of clusters such as science and technology parks. These are organisations housing startups that are usually located in the proximity of universities and constitute a source of new business ideas and products. Technology parks are inextricably linked with the very concept of innovation, and the activities pursued there mainly involve high-technology goods and services.

In conclusion, innovation and entrepreneurship policies should not be seen as standalone initiatives, but should rather be part of a comprehensive strategy for economic growth. Bearing in mind the large numbers of small and medium-sized enterprises and self-employed people in Greece, the envisaged growth policy should focus on fostering entrepreneurship by cutting red tape and lifting any obstacles. The Greek economy needs long-term strategy in order to catch up to the technological frontier and ensure sustainable growth.

REFERENCES

Acemoglu, D., P. Aghion and F. Zilibotti (2006), "Distance to frontier, selection and economic growth", *Journal of the European Economic Association*, 4(1), 37-74.

Anderlini, L., L. Felli, G. Immordino and A. Riboni (2013), "Legal Institutions, Innovation and Growth", *International Economic Review*, 54, 937-956.

Arundel, A. and A. Geuna (2004), "Proximity and the use of public science by innovative European firms", *Economics of Innovation and New Technology*, 13(6), 559-580.

Audretsch, D.B. (1995), "Innovation, growth and survival", *International Journal of Industrial Organization*, 13(4), 441-457.

Audretsch, D.B. and M. Keilbach (2008), "Resolving the knowledge paradox: Knowledge-spillover entrepreneurship and economic growth", *Research Policy*, 37(10), 1697-1705.

Audretsch, D.B., M.C. Keilbach and E.E. Lehmann (2006), *Entrepreneurship and Economic Growth*, Oxford University Press, Oxford.

Audretsch, D.B. and R. Thurik (2001), "Linking Entrepreneurship to Growth", *OECD Science, Technology and Industry Working Papers*, 2001/02, OECD Publishing.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, 17(1), 99-120.

Boyer, R. (2014), "The unsustainable divergence of national productive systems", in: Teixeira, A., E. Silva and R. Paes Mamede (eds), *Structural change, competitiveness and industrial policy. Painful lessons from the European periphery*, London and New York: Routledge.

Braunerhjelm, P. and B. Borgman (2004), "Geographical concentration, entrepreneurship and regional growth: Evidence from regional data in Sweden, 1975-99", *Regional Studies*, 38(8), 929-947.

Cainelli, G., R. Evangelista and M. Savona (2004), "The impact of innovation on economic performance in services", *The Service Industries Journal*, 24(1), 116-130.

Cohen, W.M. and D.A. Levinthal (1989), "Innovation and learning: the two faces of R&D", *The Economic Journal*, 99(397), 569-596.

Cornell University, INSEAD and WIPO (2017), *The Global Innovation Index 2017: Innovation Feeding the World*, Ithaca, Fontainebleau and Geneva.

Czarnitzki, D. and O. Toivanen (2013), "Innovation Policy and Economic Growth", *Economic Papers*, 482, European Commission.

Dabla-Norris, E., E.K. Kersting and G. Verdier (2012), "Firm productivity, innovation, and financial development", *Southern Economic Journal*, 79(2), 422-449.

Dosi, G., P. Llerena and M.S. Labini (2006), "The relationships between science, technologies and their industrial exploitation: An illustration through the myths and realities of the so-called 'European Paradox' ", *Research Policy*, 35(10), 1450-1464.

EKT (2015), *Careers and Mobility of Doctorate Holders in Greece*, Athens: National Documentation Centre (in Greek).

EKT (2016), *Business demography in the high-technology sector in Greece. Analysis of births and deaths over the period 2011 to 2015*, Athens: National Documentation Centre.

EKT (2017a), *Innovation in Greek entreprises 2012-2014*, Athens: National Documentation Centre.

EKT (2017b), *Research and Development Expenditure and Personnel in Greece in 2015 – Main Indicators*, Athens: National Documentation Centre.

Etzkowitz, H. and L. Leydesdorff (1995), "The Triple Helix – university-industry-government relations: a laboratory for knowledge-based economic development", *EASST Review*, 14(1), 14-19.

Etzkowitz, H. and L. Leydesdorff (2000), "The dynamics of innovation: from National Systems and 'Mode 2' to a Triple Helix of university–industry–government relations", *Research Policy*, 29(2), 109-123.

European Central Bank (2017), *Survey on the Access to Finance of Enterprises in the euro area (SAFE): October 2016 to March 2017*.
European Commission (2017a), *Digital Transformation Scoreboard 2017*.
European Commission (2017b), *European Innovation Scoreboard, Country Profile: Greece*.
European Commission (2017c), *The 2017 EU Industrial R&D Investment Scoreboard*.
European Commission (2017d), *2017 SBA Fact Sheet: Greece*.
Eurostat (2017), *Digital economy and society in the EU*.
Fini, R., K. Fu, M.T. Mathisen, E. Rasmussen and M. Wright (2017), "Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study", *Small Business Economics*, 48(2), 361-391.
Galindo, M.Á. and M.T. Méndez (2014), "Entrepreneurship, economic growth, and innovation: Are feedback effects at work?", *Journal of Business Research*, 67(5), 825-829.
Giannitsis, T. and I. Kastelli (2014), "Industrial policy in times of crisis: The case of Greece", in: Teixeira, A., E. Silva and R. Paes Mamede (eds), *Structural Change, Competitiveness and Industrial Policy. Painful lessons from the European periphery*, London and New York: Routledge.
Gibbons, M., C. Limoges, H. Nowotny, S. Schwartzman, P. Scott and M. Trow, (1994), *The new production of knowledge: The dynamics of science and research in contemporary societies*, Sage.
González-Pernía, J.L., G. Kuechle and I. Peña-Legazkue (2013), "An assessment of the determinants of university technology transfer", *Economic Development Quarterly*, 27(1), 6-17.
Gravanis, A (2017), "Academic entrepreneurship in biotechnology", *Elefthero Pnevma newspaper*, 28.5.2017 (in Greek).
Howitt, P. and D. Mayer-Foulkes (2005), "R&D, implementation, and stagnation: a Schumpeterian theory of convergence clubs", *Journal of Money, Credit and Banking*, 37(1), 147-177.
Huang, M.H. and D.Z. Chen (2017), "How can academic innovation performance in university–industry collaboration be improved?", *Technological Forecasting and Social Change*, 123, 210-215.
IME GSEVEE (2017), *Biannual Bulletin of SME Economic Sentiment: IME GSEVEE Six-month Survey on economic sentiment in small enterprises*, Small Enterprises' Institute of the Hellenic Confederation of Professionals, Craftsmen and Merchants (in Greek).
IOBE (2017a), *Annual Entrepreneurship Report 2016-2017: Early stage entrepreneurship rates decrease*, Foundation for Economic and Industrial Research.
IOBE (2017b), *Tertiary education in Greece: Impact of the crisis and challenges*, Foundation for Economic and Industrial Research (in Greek).
Kougiou, S. (2016), "International cooperation in research and innovation by capitalizing on the Greek diaspora: Turning brain drain into brain gain", ELIAMEP Policy Paper No 25, Hellenic Foundation for European and Foreign Policy (in Greek).
Kumral, N., S. Akgungor and A. Lenger (2006), "National industry clusters: The case of Turkey", Ege University, Department of Economics, Working paper No. 0612.
Landry, R., N. Amara and M. Ouimet (2007), "Determinants of knowledge transfer: evidence from Canadian university researchers in natural sciences and engineering", *The Journal of Technology Transfer*, 32(6), 561-592.
Lazaretou, S. (2016), "The Greek brain drain: the new pattern of Greek emigration during the recent crisis", *Economic Bulletin*, 43, Bank of Greece, July.
Lee, Y., J. Shin and Y. Park (2012), "The changing pattern of SMEs' innovativeness through business model globalization", *Technological Forecasting and Social Change*, 79(5), 832-842.
Lucas, R. (1988), "On the mechanics of economic development", *Journal of Monetary Economics*, 22(1), 3-42.
Malthus, T. R. (1798), *An Essay on the Principle of Population, as It Affects the Future Improvement of Society*, London: J. Johnson.

Melnikas, B. (2011), "The global transformations, sustainable development and the knowledge based society creation: the perspective theoretical approach", *Transformations in Business and Economics*, 10(2).
Meyer, M. (2003), "Academic entrepreneurs or entrepreneurial academics? Research-based ventures and public support mechanisms", *R&D Management*, 33(2), 107-115.
Nadiri, M.I. (1993), "Innovations and technological spillovers", NBER Working Paper No. 4423, National Bureau of Economic Research.
Nelson, R.R. and E. Phelps (1966), "Investment in Humans, Technological Diffusion, and Economic Growth", *American Economic Review*, 56(1), 69-75.
OECD/Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd Edition, OECD Publishing, Paris.
OECD (2015), *Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific, Technological and Innovation Activities*, OECD Publishing, Paris.
OECD (2016), *OECD Science Technology and Innovation Outlook 2016*, OECD Publishing, Paris.
OECD (2017a), *Entrepreneurship at a Glance 2017*, OECD Publishing, Paris.
OECD (2017b), *Main Science and Technology Indicators*, Volume 2016, Issue 2, OECD Publishing, Paris.
OECD (2017c), *OECD Science, Technology and Industry Scoreboard 2017: The digital transformation*, OECD Publishing, Paris.
O'Shea, R.P., T.J. Allen, K.P. Morse, C. O'Gorman and F. Roche (2007), "Delineating the anatomy of an entrepreneurial university: the Massachusetts Institute of Technology experience", *R&D Management*, 37(1), 1-16.
Porter, M. (1992), *The Competitive Advantage of Nations*, Oxford: OUP.
Ramaciotti, L. and U. Rizzo (2014), "The determinants of academic spin-off creation by Italian universities", *R&D Management*, 45(5), 501-514.
Rasmussen, E. and O.J. Borch (2010), "University capabilities in facilitating entrepreneurship: A longitudinal study of spin-off ventures at mid-range universities", *Research Policy*, 39(5), 602-612.
Ricardo, D. (1817), *On the Principles of Political Economy and Taxation*, London: John Murray.
Rodríguez-Pose, A. and R. Crescenzi (2008), "Research and development, spillovers, innovation systems, and the genesis of regional growth in Europe", *Regional Studies*, 42(1), 51-67.
Romer, P. (1986), "Increasing returns and long-run growth", *The Journal of Political Economy*, 94(5), 1002-1037.
Rosenberg, N. and R.R. Nelson (1994), "American universities and technical advance in industry", *Research Policy*, 23(3), 323-348.
Schumpeter, J. (1934), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*, Harvard University Press, Cambridge, MA.
SEV (2017), *Digital Greece: The path to growth*, Hellenic Federation of Enterprises: http://www.sev.org.gr/uploads/Documents/Digital_Greece_060517_full_hi_res.pdf (in Greek).
Smith, A. (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, London: Methuen & Co., Ltd.
Solow, R.M. (1956), "A Contribution to the Theory of Economic Growth", *The Quarterly Journal of Economics*, 70(1), 65-94.
Stournaras, Y. (2017), "Linkages between universities, research centres and enterprises in Greece: present and future", speech at the PRO.PAIDEIA Workshop on "Universities, Research, Innovation, Entrepreneurship and Growth" held at the Bank of Greece, 23 May (in Greek).

Stournaras, Y.A. and M. Albani (2008), *Greece after the crisis – In search of a new growth model*, Athens: IOBE (in Greek).
Swan, T.W. (1956), "Economic Growth and Capital Accumulation", *The Economic Record*, 32(2), 334-361.
Tebaldi, E. and B. Elmslie (2013), "Does institutional quality impact innovation? Evidence from cross-country patent grant data", *Applied Economics*, 45(7), 887-900.
Ulku, H. (2004), "R&D, Innovation, and Economic Growth: An Empirical Analysis", IMF Working Paper No 4-185, International Monetary Fund.
Verspagen, B. (1991), "A new empirical approach to catching up or falling behind", *Structural Change and Economic Dynamics*, 2(2), 359-380.
Verspagen, B. (2006), "University research, intellectual property rights and European innovation systems", *Journal of Economic Surveys*, 20(4), 607-632.
Westmore, B. (2013), "R&D, Patenting and Growth: The Role of Public Policy", *OECD Economics Department Working Papers*, No 1047, OECD Publishing, Paris.

THE IMPACT OF REFORMS ON THE SECTORS OF TRADABLE GOODS AND SERVICES

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

Michail Vasileiadis
Foundation for Economic and Industrial Research (IOBE)

Manos Papadakis
Council of Economic Advisors, Ministry of Finance, and Foundation for Economic and Industrial Research (IOBE)

Konstantinos Peppas
Foundation for Economic and Industrial Research (IOBE)

1 INTRODUCTION

Well before the start of the domestic fiscal crisis, the Greek economy had already started to show serious weaknesses in the production process. Many of those weaknesses were due to regulatory restrictions imposed on the functioning of its goods and services sectors, as well as to distortions, which are associated with the role that the public sector was playing in the economy.

The domestic fiscal crisis of 2010 led to the implementation of Economic Adjustment Programmes, which, apart from fiscal adjustment measures, comprised structural reforms in several goods and services sectors, as well as in the labour market, with a view to ensuring the transition of the Greek economy to the economic structure of advanced countries. Within this framework, during the period 2010-2014, a number of regulatory and legal interventions took place in order to restructure the growth model of the Greek economy through the transfer of inputs from non-tradable to tradable sectors.

Given the above, the importance of structural reforms highlights the need not only to enact such reforms but also to monitor their actual implementation and assess their effects. In this context, IOBE (2017)[1] conducted a study to explore the impact of reforms that took place in specific tradable sectors in Greece. In particular, the study estimates, for each sector, the technical efficiency of the firms, that is, their ability to combine available inputs (capital, labour) and the given level of technology, in order to produce maximum output, and compares it with their efficiency under the former regulatory framework. In other words, the study focused on the effects of structural reforms on the level of technical efficiency of those sectors.

In addition, the study estimates the effects on the technical efficiency of these sectors from reforms affecting several other sectors of the Greek economy, i.e. the so-called "horizontal" reforms (e.g. increasing labour market flexibility, starting a business facilitation, etc.). The study also estimates the effects of firm-specific (e.g. firm age, exporting performance) and macroeconomic characteristics (e.g. the impact of recession and of credit expansion or credit shrinkage) on technical efficiency level.

For the assessment of the effects on technical efficiency from "vertical" and "horizontal" reforms and from firm-specific and macroeconomic characteristics, a stochastic frontier model was estimated with the use of a Translog production function.

1 Study entitled "The impact of reforms on the sectors of tradable goods and services", conducted by the Foundation for Economic and Industrial Research (IOBE) on behalf and with the support of the Bank of Greece.

This article is structured as follows: Section 2 outlines the changes in the regulatory framework of each tradable sector under review, as well as the reforms affecting several sectors. Section 3 provides the definition of technical efficiency and provides a literature review on the alternative methodologies that can be used for the estimation of technical efficiency. Section 4 presents the technical efficiency model applied in this study and describes both the variables and the data used. Section 5 discusses the econometric results regarding the evolution of technical efficiency over time and how it has been affected by the recent reforms, the macroeconomic environment and firm-specific characteristics. The last section summarises the findings of the study.

2 STRUCTURAL REFORMS IN TRADABLE SECTORS

2.1 CRUISE AND YACHTING SERVICES

The first sector, for which changes in the legal framework are presented herein, is Cruise and yachting services (class 50.10 "Sea and coastal passenger water transport" according to the Hellenic Statistical Authority's statistical classification of economic activities (STAKOD 2008). This sector is considered as tradable, since it falls under the tourism sector, which in Greece mainly provides tourism services to visitors from abroad.

Regarding the legal framework of the cruise and yachting services sector, under the Code of Public Maritime Law (Legislative Decree 187/1973) only Greek-owned passenger ships were authorised to execute cruises. Legislative Decree 344/2003 extended this right to include passenger ships with European Union (EU) or European Economic Area (EEA) flags, insofar as these ships are registered in the registry of another EU Member State or EEA member country. Under Law 3872/2010 the cruise and yachting services sector was further deregulated, as the right to execute cruises was also expanded to third country ships, under certain conditions. Law 4072/2012 lifted most of the remaining restrictions under Law 3872/2010.

2.2 ROAD PASSENGER TRANSPORT

Road passenger transport (class 49.39 according to STAKOD 2008),[2] similar to the abovementioned sector, is closely linked to the tourism sector, as many non-residents visiting Greece, mainly tourists, use such services for their transfer from the points of entry into the country (airports, sea ports) to their accommodation and vice versa, for their visits to sites of interest, for their transfer to conference venues, for excursions around the country, etc.

With respect to the regulatory framework for tourist coaches, the first relevant law (Law 711/1977)[3] authorised the Secretary General of the Greek National Tourism Ogranisation (EOT) to suspend indefinitely or temporarily the approval of licences for new tourist coaches, which suggests an indirect administrative determination of the number of licences, thereby creating barriers to entry for newcomers and undermining competition. Legislative Decree 346/2001 transferred directives of the Council of the European Union into Greek law. These directives determined the requirements for accessing the profession and are related to the good repute, the financial adequacy and the professional competence of individuals or legal entities wishing to pursue the occupation of road passenger transport operator. Law 4002/2011 abolished the requirements relating to the level of turnover and the proving documents for issuing a tourist coach licence. In addition, the abolition of the EOT Secretary General's power to determine indirectly the number of licences is seen as a major contribution to the deregulation of the sector. Notwithstanding, restrictions on the operation of firms active in this sector continue to exist, as tourist coaches are still not allowed

2 According to STAKOD 2008, this sector comprises scheduled long-distance bus services; charters, excursions and other occasional coach services; operation of school buses and buses for transport of employees; and airport shuttles. City/intercity bus services and taxis are excluded.
3 As amended by Laws 2446/1996 and 3446/2006.

to stop and pick up passengers, as opposed to intercity buses (KTEL). Moreover, KTEL buses may provide tourism services, if no tourist coaches operate in their prefecture.

2.3 ROAD FREIGHT TRANSPORT

Road freight transport (class 49.41 according to STAKOD 2008) is an important sector of the Greek economy, as it plays a key role in the transportation of all kinds of products, thereby contributing to the economy's growth. Road freight transport in Greece involves both domestic and cross-border transport services, with the first category accounting for the bulk of the sector's business. Greece's geographic location enables international transport operations to grow further, as the country is an emerging transit trade hub between European countries and Middle Eastern and Asian countries. Therefore, road freight transport is a sector with great potential for expanding its business.

Turning to the legal framework for road freight transport, until 1967 there was no law or legal provision determining the procedure and criteria for issuing licences. The relevant minister had the authority to grant licences without prior examination of the need to grant them. Emergency Law 183/1967 allowed the granting of road freight transport licences to professional drivers who were registered and insured in the Greek Professional Drivers' Pension Fund. Those new licences were personal and transferable only to professional drivers. Legislative Decree 1060/1971 distinguished road freight transport services into interregional, national and international, and permitted the establishment of firms that provide national and international road freight transport services. At the same time, the minimum gross vehicle weight required for the establishment of a firm that provides national and international road freight transport services was administratively determined. Under Law 383/1976, the Minister for Transport and Communications determined the maximum gross vehicle weight required for the provision of road freight transport services within national borders, which suggests an indirect administrative determination of the number of licences. In addition, by the same Law, the Ministers for Coordination-Planning, Trade, and Transport set the maximum and the minimum freight rates. The easing of the restrictions regarding the road freight transport sector came with Law 3887/2010. Under this law, free access to the occupation was granted under certain qualitative conditions and financial requirements. Furthermore, the administrative determination of both the number of licences and the freight rate limits was abolished.

2.4 ELECTRIC POWER GENERATION, TRANSMISSION AND DISTRIBUTION

The bulk of the output of the Electric power sector (class 35.1 according to STAKOD 2008) is absorbed by the domestic market. Only a small part is transmitted to neighbouring countries in order to meet increased local demand for electricity during peak hours. However, Greece has enormous potential to turn into an energy hub for the broader Southeast Mediterranean region, through interconnections with existing electricity transmission grids in other countries of the region, as well as through any new future grids.

With regard to the regulatory framework governing the Greek electric power sector, its gradual deregulation started earlier, as opposed to the other sectors under review. Specifically, Law 2773/1999 determined the framework for the functioning of the electricity market and established the legal framework of the Greek Regulatory Authority for Energy (RAE). Further, by Legislative Decree 328/2000 the Hellenic Transmission System Operator (DESMIE) was set up, and Ministerial Decision D5/HL/B/F1/7705 granted to DESMIE concession rights to the Greek electricity transmission system. Law 4001/2011 provided for the establishment of the Independent Power Transmission Operator (ADMIE), to which the ownership of the electricity trans-

mission system was transferred, and the Operator of Electricity Market (LAGIE), which carries out daily energy scheduling. The legal acts aimed to foster competition at the sectoral level were Law 4237/2014,[4] which introduced the ownership unbundling of ADMIE from the Public Power Corporation (PPC), with the sale-transfer of 66% of its share capital to an investor, as well as Law 4389/2016, which envisages the reduction of PPC's retail market share below 50% by 2019. An action that further accelerated the deregulation of the energy market was the sale of 25% of ADMIE's share capital to the Chinese firm "State Grid" against €320 million in December 2016.

2.5 GAMBLING ACTIVITIES-CASINOS

The gambling market is rapidly growing at the global level. According to the Hellenic Gaming Commission (HGC), the global industry generates gross profits exceeding €300 billion per year, with 95% of them coming from offline gambling. Nevertheless, a sharp increase in the use of online gambling has been observed over the past few years. This implies the possibility of attracting players both from abroad and from Greece, through the creation of online gambling games, particularly if account is taken of the fact that so far the utilisation of the internet for gambling purposes has been limited at the domestic level. The gambling sector also includes casinos, which also attract foreign players, mostly tourists, and can thus contribute to expanding the provision of services to non-residents. Thus, the Gambling activities-casinos sector is a tradable (services) sector, with great prospects to further enhance its extroversion.

A key law governing gambling activities and casinos (class 92 according to STAKOD 2008) is Law 4002/2011. Under this law, the authority responsible for licensing, certification, supervision, and auditing of gambling activities and casinos is the Hellenic Gaming Commission (HGC). The same law provides for the operation of 35 thousand video lottery terminals (VLTs) in Greece, 16.5 thousand of which will be operated and exploited by the Hellenic Football Prognostics Organisation (OPAP) and the remaining 18.5 thousand by concessionaires. Key actions towards the deregulation of the sector were Law 3986/2011 and Decision 193/2011 by the Interministerial Committee for Restructuring and Privatisation on the transfer of 33% of OPAP shares held by the Greek State to the Hellenic Republic Asset Development Fund (TAIPED). This share was sold on 11 November 2013 to Emma Delta Hellenic Holdings Limited, which thus became the main shareholder of OPAP. With Law 4338/2015, the horse racing betting activities were awarded to Hellas Horse Races S.A. for a period of 20 years. Finally, a structural characteristic of the Gambling activities-casinos sector which showcases competition conditions is that the Aigaio, Achaia, Thessaloniki, Thraki, Corfu, Loutraki, Athens (Mont Parnes), Rodos and Halkidiki casinos are privately owned.

2.6 "HORIZONTAL" REFORMS

As already mentioned in the introduction, for the assessment of the effects of reforms on the technical efficiency of tradable sectors, account must also be taken of reforms affecting several sectors of the Greek economy. Such reforms are often referred to as "horizontal" reforms in the public debate. The reforms examined by this study deal with two crucial issues of entrepreneurship: the procedure for starting a business and the functioning of the labour market.

As far as the procedure for starting a business is concerned, Law 3853/2010 allowed the establishment of new firms through the "one-stop-shop", which significantly reduces the time required to set up a new business. Setting up a new firm was also facilitated by Law 4072/2012, which introduced a new legal form, namely the Private Company (IKE). A Private Company can be established within a much shorter period of time than other legal forms and at a much lower cost, since the minimum

4 Following Cabinet Act 15/24.7.2013.

initial capital required has been set at one euro.

Extensive reforms have taken place in the Greek labour market since 2010. Specifically, under Law 3899/2010, firm-level agreements prevailed over industry-level or occupation-level collective agreements, unconditionally,[5] while the extension of industry-level or occupation-level agreements to firms that did not participate in negotiations was abolished. Subsequently, Law 3986/2011 introduced employment contracts for young people aged 18-25 with minimum wages that are 20% lower than the current minimum wage. At the same time, it provided for the possibility of signing firm-level agreements also by "groups of employees" (associations of persons), where there is no trade union. Under Law 4046/2012, minimum monthly wage was cut by 22% for workers aged 25+ and by 32% for young workers under 25. In addition, this law stipulates that arbitration requires the consent of both employees and employers, and suspends the automatic salary increases, either by law or under collective agreements, due to "seniority". Lastly, Law 4093/2012 introduced lower remunerations in case of dismissal, especially in cases where the employee has been notified in written by the employer at least one month prior to dismissal. The same law specified that in future the minimum wage shall be determined by the government rather than by negotiations between employees and employers.

3 THE CONCEPT OF TECHNICAL EFFICIENCY AND LITERATURE REVIEW

For many years, the economic analysis relied on estimations of production, profit and cost functions, under the assumption that firms operate along those functions. However, experience has shown that very often firms failed to maximise output/profit and minimise cost. The estimation of the distance between the actual point of production/profit/cost and the maximum possible output/profit and the lowest possible cost, respectively, was the driving force for the development of applied econometrics dealing with Stochastic Frontier Analysis (SFA).

The development of this field largely rested upon the theoretical work on productive efficiency, which dates back to the 1950s, with the seminal studies by Debreu (1951), Koopmans (1951), Shephard (1953) and Farrell (1957). More specifically, Farrell (1957), influenced by Koopmans and Debreu, was the first to empirically estimate productive efficiency using a frontier production function. According to Farrell, the activity of each firm should be compared to optimal activity, which is captured by the production function.

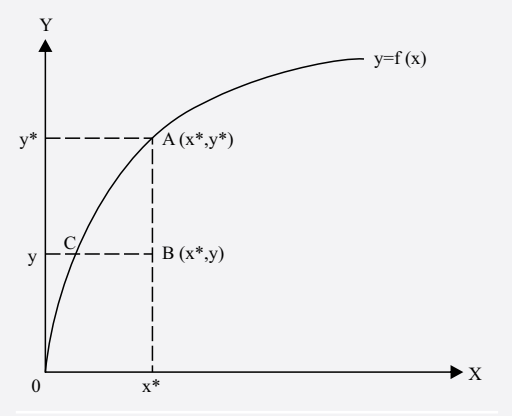
Adopting the approach by Farrell (1957), "technical efficiency" is defined as a firm's ability to produce maximum output, y^*, using a specific quantity of inputs, x^*, and with a given level of technology (point $A(x^*, y^*)$ in Chart 1). In this respect, each combination (x, y) along the frontier production function represents points of maximum technical efficiency. Conversely, the combination $B(x^*, y)$ shows that the firm is technically inefficient, because it fails to produce the maximum possible output (y^*) given the available inputs and the level of technology. Instead, it produces lower output, y.

The estimation of technical efficiency using a stochastic frontier model has already been studied extensively since the 1970s. The studies by Aigner and Chu (1968), Afriat (1972) and Richmond (1974) suggested for the first time the existence of disturbance factors that leads to a deviation of actual output from the maximum possible. This deviation may be captured by a disturbance term.

Then, Schmidt (1976) incorporated into the technical efficiency estimation model a one-sided disturbance term, which follows a strictly positive distribution (exponential or half-nor-

5 E.g. with regard to the minimum size that a firm should have to sign such employment contracts.

Chart 1 Technical efficiency



mal), and estimated it using the maximum likelihood method.

Next, Aigner et al. (1977) suggested a different structure of the disturbance term, adopting a composite error structure, because the difference between actual and maximum feasible output may be due to factors that are under the firm's control, as well as to factors beyond its control.

The major weakness in the above approaches was that they estimated the average technical efficiency of a sample of firms rather than the technical efficiency of each firm. Solution to this estimation issue was given by Jondrow et al. (1982), who developed an appropriate methodology for estimating technical efficiency at the firm level.

Pitt and Lee (1981) extended cross-sectional estimation techniques by developing a technical efficiency estimation model for panel data and assuming that technical efficiency varies across firms, but remains constant over time for each firm (time-invariant technical efficiency).

In the context of such models, the literature developed two separate categories: fixed effects models, in which the technical efficiency term is correlated with the independent variables (regressors) of the production frontier, and random effects models, in which the technical efficiency term is uncorrelated with the regressors.

Moreover, Cornwell et al. (1990) and Kumbhakar (1990) were perhaps the first to develop a stochastic production frontier model for panel data, under which technical efficiency varies over time (time-varying technical efficiency).

In addition, Kumbhakar et al. (1991) developed the first model that incorporates the effects of exogenous factors on technical efficiency level (one-step estimation), while Huang and Liu (1994) developed a model which allows the correlation of exogenous variables with inputs.

In contrast with the above authors who used cross-sectional data to estimate the effects of exogenous factors on technical efficiency, Battese and Coelli (1995) developed a model which they estimated using panel data.

Caudill and Ford (1993) further developed technical efficiency models, assuming the presence of heteroskedasticity in the technical efficiency component, while Hadri (1999) assumed the presence of heteroskedasticity in both the random error and the technical efficiency term.

Finally, Wang (2002) developed a model in which the effect of exogenous factors on technical efficiency may be non-monotonic, i.e. exogenous factors may have a positive effect up to a certain level and a negative effect from that level onwards, or vice versa.

4 DESCRIPTION OF THE TECHNICAL EFFICIENCY ESTIMATION MODEL, VARIABLES AND DATA

In order to estimate the technical efficiency level of the tradable sectors, the study

employed a stochastic frontier model where the production function has a Translog form.

Alternatively, technical efficiency could be estimated with the use of Data Envelopment Analysis (DEA). Yet, this approach has certain disadvantages: it assumes that total deviation from the production frontier is solely due to the firm's inefficiency rather than to random factors beyond the firm's control, while statistical inference is not possible.

In addition, a cost frontier analysis could also be applied. However, in order to employ this methodology, it is important to have data on factor prices, and such data are not available for Greece either at the firm or at the sectoral level.

Another model that could also be used for estimating the impact of reforms is a Total Factor Productivity model. Although, this model provides information about the trend of total factor productivity, it does not provide information on whether firms' performance has (or has not) improved compared with the production frontier.

Besides, the use of a stochastic production frontier model has several advantages. First of all, it does not assume, as other models do, that all firms are efficient. In this respect, it includes an error term which varies across firms. At the same time, it is a parametric method used to estimate technical efficiency and random errors, which means that deviation from the maximum possible output is not exclusively attributable to technical inefficiency. This methodology was also adopted for technical reasons, such as the adequacy of the available data used in the estimations.

With regard to the functional form of the production function, the Translog form has both advantages and disadvantages. The first advantage is that the Translog production function is a second-order Taylor expansion, which incorporates first-order and second-order terms across inputs. Moreover, its functional form ensures the closest proximity to the actual structure of a production process, among alternative production functions. Furthermore, it is linear with respect to parameters and can be estimated using the least squares method. Last but not least, it has a flexible functional form, since it imposes fewer restrictions on output elasticities and elasticities of substitution compared with other functional forms, such as the Cobb-Douglas function. On the other hand, the large number of parameters to be estimated and the difficulty in interpreting them, coupled with the fact that sometimes curvature conditions may be violated, are among the drawbacks of this functional form. Besides, there is a possibility of existence of collinearity among explanatory variables.

In the model used in this study, it was assumed that technical efficiency varies across firms, but remains constant through time for each firm (time-invariant technical efficiency model). Moreover, it was assumed that the technical efficiency term is randomly distributed with constant mean and variance, and is uncorrelated with the regressors and with random error, i.e. the random effects approach was applied.

According to Greene (2005), a major drawback of the random effects model is the fact that firm-specific heterogeneity is not taken into account in the estimation of each firm's technical efficiency. To address this problem, a "true" random effects model was employed, as proposed by Greene (2005). In line with this approach, a random firm-specific effect variable was included in the model to take into account firm-specific heterogeneity in the estimation of technical efficiency.

In addition, the sample used in the estimations includes many firms. In cases where the number of the parameters to be estimated changes with the number of firms, the fixed effects estimators, apart from posing computational challenges, fail to satisfy the necessary statistical properties (large and small sample properties).

As a consequence, the estimations are inconsistent. All the above justify both the choice of the random effects approach and the choice not to perform the Hausman test.

It should be noted that in the estimation of technical efficiency of each firm the approach of Jondrow et al. (1982) to convert the inefficiency score into an efficiency score was employed.

Taking into account the above, it was assumed that each firm of the sample produces output Y, using two inputs, capital K and labour L, while the production is also affected by time trend T, given the quantity of inputs and the level of available technology used by each firm. Thus, the Translog production function has the following form:

$$\ln Y=\beta_0+\beta_L \ln L+\beta_K \ln K+\beta_T T+1/2\beta_{LL}\,(\ln L)^2+1/2\beta_{KK}(\ln K)^2+1/2\beta_{TT}(T)^2+\beta_{LK}(\ln L)(\ln K)+\beta_{LT}\,(\ln L)(T)+\beta_{KT}\,(\ln K)(T)+v-u,$$

which can be written in the following general form:

$$y_{it}=(\alpha+w_i)+x'_{it}\beta+v_{it}-u_{it},$$

where $i=1,\ldots,n$ is the number of firms, $t=1,\ldots,T_i$ is time in years, y_{it} is the logarithm of output (nominal value in euro), α is the constant term, w_i is the random firm-specific effect, x_{it} is the vector of the logarithm of labour (number of firm's employees) and capital (book value of firm's fixed capital in euro) and time trend, and β is the vector of the parameters of the independent variables to be estimated. The term v_{it} is the random error, with $v_{it} \sim N(0,\sigma_v^2)$. Moreover, u_{it} is a non-negative random variable that represents technical inefficiency and is a function of exogenous variables, that include "vertical" reforms, "horizontal" reforms, firm-specific characteristics and the macroeconomic environment characteristics, with $u_{it} \sim N^+ (\mu_{it},\sigma_u^2)$ and with $\mu_{it}=z_{it}\delta$, where z_{it} is the vector of exogenous variables affecting the level of technical efficiency of each firm.

The exogenous variables used in the model and representing reforms at the sectoral level ("vertical reforms") are the following:

- **Cruise and yachting services (cruise):** dummy variable equal to 1 over the 2012-2014 period (following the implementation of Law 4072/2012).

- **Road passenger transport (bus):** dummy variable equal to 1 over the 2011-2014 period (following the implementation of Law 4002/2011).

- **Road freight transport (roadfreight):** dummy variable equal to 1 over the 2010-2014 period (following the implementation of Law 3887/2010).

- **Road freight transport (OECDlandtransport):** continuous variable used as an alternative to the dummy variable "roadfreight". Higher values denote stricter market regulation and vice versa.

- **Electric power generation, transmission and distribution (electr):** dummy variable equal to 1 over the 2004-2014 period. 2004 is also the first year of operation of the first private firm that produces electric power in Greece, which benefited from the deregulation of the specific sector.

- **Electric power generation, transmission and distribution (OECDelectr):** continuous variable used as an alternative to the dummy variable "electr". Higher values denote stricter market regulation and vice versa.

- **Gambling activities-casinos (game):** dummy variable equal to 1 over the 2011-2014 period (following the implementation of Law 4002/2011).

The exogenous variables used in the model and representing reforms that affect many sectors ("horizontal" reforms), and not only the tradeable sectors under review, are the following:

- **Increased labour market flexibility (labour):** dummy variable equal to 1 over the 2011-2014

period, during which reforms took place in the labour market.

• **Increased labour market flexibility (OECD-regularlabourindex and OECDtemplabour-index):** continuous variables used as alternatives to the dummy variable "labour". The variable OECDregularlabourindex focuses on the degree of regulation in the labour market with regard to permanent employment contracts. The variable OECDtemplabourindex captures the degree of regulation in the labour market with regard to temporary employment contracts. Higher values of both variables denote stricter regulation and vice versa.

• **Faster procedure for starting a business (ike):** dummy variable equal to 1 over the 2012-2014 period (following the implementation of Law 4072/2012).

The exogenous variables at the firm level and those capturing the macroeconomic environment are the following:

• **Firm age (age):** difference between the year for which there are available data on a firm and its year of establishment, plus one year.

• **Exporting activity (exp):** dummy variable equal to 1 when in a specific year a firm exports goods or services.

• **Location (dtown):** dummy variable equal to 1 if the firm's headquarters are located in one of the two largest regions of Greece, i.e. Attica and Thessaloniki.

• **Credit expansion (credit):** continuous variable which was calculated on the basis of the annual percentage change in outstanding credit to domestic firms by Monetary Financial Institutions (MFIs), excluding the Bank of Greece.

• **Economic crisis (recession):** dummy variable equal to 1 over the 2008-2013 period, during which the Greek economy experienced a decline in Gross Domestic Product (GDP).

The data used in estimations are unbalanced panel data, covering the 2001-2014 period, and refer to 601 firms of all sizes (micro, small, medium-sized, large) in terms of turnover. It should be noted that, where needed, data were distinguished between parent companies and subsidiaries, so as to include in the sample only those firms which are active in the sectors under review. On the other hand, in very few cases, it was not possible to break down turnover by activity, in cases where a firm has revenue not only from its main activity but also from other activities (the same holds for both fixed capital and number of employees).

The data used in the estimations were drawn from various sources. Data on firms' turnover, fixed capital, number of employees, name, year of establishment, location, legal form and tax identification number were drawn from Infobank Hellastat S.A., ICAP S.A. and balance sheets published online. The Bank of Greece is the source of data regarding the rate of change in bank credit to total domestic firms, while the OECD is the source for the time series on regulation indices in the Electric power sector, the Road freight transport sector and the labour market.

5 ESTIMATION RESULTS

Before presenting the estimation results, it should be noted that in the estimation process the "general-to-specific" approach was adopted. Furthermore, in each estimation the combination of dummy variables regarding "vertical" and "horizontal" reforms was carefully chosen, in order to avoid identification issues. The results of each estimation were evaluated using the Akaike and the Bayesian information criteria, as well as the level of statistical significance (p-values). We addressed the problem of the small number of observations in some sectors by using the simulated maximum likelihood method.

Tables 1 and 2 in the Appendix present the estimations results. Table 1 shows the estima-

tions for the Electric power and the Road passenger transport sectors, while Table 2 presents the estimations for the remaining three sectors (Road freight transport, Cruise and yachting services, and Gambling activities-casinos).

Taking into consideration that the model includes a technical inefficiency term (u_{it}) which has a negative sign and is a function of exogenous variables (z_{it}), a negative effect of the exogenous variables on technical inefficiency implies a negative sign of the corresponding estimated coefficients of exogenous variables. For instance, given that "vertical" and "horizontal" reforms are expected to facilitate business establishment and operation, their coefficients are expected to have negative sign. This means that they will reduce technical inefficiency (u_{it}) and as a consequence they will increase technical efficiency.

Starting with firm-level exogenous variables, as the firm ages (variable age), its experience regarding the domestic and international market conditions increases. As a result, the firm adapts its production activity to the prevailing conditions, and thus increases its efficiency. This means that the coefficient of this variable is expected to have a negative sign because, as the firm ages, inefficiency decreases, or in other words efficiency increases.

Through their exporting activity (exp), firms participate in international markets, where competition is usually more intense than in the domestic market. Such conditions put pressure on firms to follow international competition and try to adapt the quality of the goods and services they produce/offer. As a result, exporting activity may reduce their inefficiency level, which means that the coefficient of the variable is expected to have a negative sign.

Location choice depends on factors such as firms' accessibility to resources, proximity to transport hubs/freight centers or to destination markets, etc. In the light of the above, the location of a firm in the regions of Attica or Thessaloniki (dtown) does not affect in the same way the efficiency level of the sectors under review. For example, some sectors, such as the Road passenger transport sector, benefit from choosing these regions as their location, because of the large number of tourists who use these regions as a point of entry into Greece. In such cases, the coefficient of the dummy variable will have a negative sign, i.e. it will negatively affect firms' inefficiency or in other words it will positively affect their technical efficiency.

Credit expansion from the banking system (credit) provides the necessary liquidity to firms to finance their operating needs, the maintenance, upgrading or even replacement of their equipment, etc. Therefore, we expect a positive effect of credit expansion on firms' efficiency, i.e. a negative sign of the corresponding coefficient.

The unexpected recession of the Greek economy (recession), in terms of duration and magnitude, is expected to have negatively affected the efficiency level of most firms. The sharp drop in turnover led to considerable production capacity depreciation as well as to job losses. As a result, the sign of the coefficient of this variable is expected to be positive. Nevertheless, it is also possible that the unfavourable economic environment may have pushed firms to use more efficiently their fixed capital and human resources, with positive effects on their technical efficiency level.

Estimates have shown that the effects of "*vertical*" *reforms* in the efficiency level of the reviewed sectors are not the same and have not always been statistically significant.

In greater detail, the estimation results regarding "vertical" reforms in the sectors of Cruise and yachting services (cruise) and Gambling activities-casinos (game) were statistically insignificant. In the first sector, this result may be due to the fact that reforms were aimed at increasing the number of foreign cruise ships visiting Greece, rather than enhancing the cre-

ation of new firms in the country. In the second sector, the statistically insignificant result may be attributable to the fact that during the period under review reforms had probably not matured yet to affect the efficiency level, because they took place in 2011-2013 and the period reviewed in this study ends in 2014.

In the Road freight transport sector, when a dummy variable was used as a proxy for the effects of structural reforms (roadfreight), the results were also statistically insignificant. However, when this variable was replaced in the estimations with the OECDlandtransport continuous variable, the result became statistically significant. Thus, it was estimated that deregulation, which corresponds to a lower value of the continuous variable, leads to a decline in the sector's technical inefficiency, i.e. to an increase in its technical efficiency level. In this context, initiatives to promote competition seem to have enabled firms to increase their output using a given quantity of inputs and a given level of technology, relative to the past.

The estimations for the Electric power sector show that "vertical" reforms proxied by the dummy variable "electr" have a statistically significant and negative effect on the sector's technical efficiency. This result may be partly explained by the considerable downward adjustments in feed-in tariffs for photovoltaic and other renewable energy source projects. With this reduction the marginal cost of capital became higher than the marginal revenue (price) and, as a result, made production inefficient for several firms. The result with the use of the "OECDelectr" dummy variable was statistically insignificant.

In the case of the Road passenger transport sector, structural reforms had a positive effect on technical efficiency level, as suggested by the negative and statistically significant coefficient of the dummy variable "bus".

Turning to the effects of "*horizontal*" *reforms* on technical efficiency, it was estimated that labour market reforms (labour) positively affected the technical efficiency in three out of the five sectors under review (Electric power generation, transmission and distribution, Road passenger transport, and Road freight transport). Thus, firms active in these sectors were allowed to use their human resources in a more flexible way and thus increased their efficiency. However, in the Cruise and yachting services and Gambling activities-casinos sectors, "horizontal" labour market reforms were estimated to have statistically insignificant effects.[6]

The use the of "OECDregularlabourindex" and "OECDtemplabourindex" dummy variables for the degree of labour market regulation gave statistically insignificant results in most cases.[7] In the Road freight transport sector, the magnitude of the coefficients of these two variables reveals that the combined effect of the various labour market reforms on the efficiency level will have the same direction as that resulting from the use of the dummy variable "labour", i.e. it will positively affect technical efficiency. More specifically, the estimated coefficient of the "OECDregularlabourindex" dummy variable was positive, which means that the easing of labour market regulation for permanent employment contracts has a positive effect on the sector's technical efficiency. Moreover, it was much higher in absolute value than the coefficient of the dummy variable "OECDtemplabourindex", which has a negative sign, thereby indicating a negative effect in efficiency from lifting rigidities in temporary employment contracts. In the Cruise and yachting services sector, a statistically significant and positive effect on efficiency was estimated for the variable "OECDtemplabourindex". This result can be explained by the sector's labour-specific characteristics, because the majority of crews are

6 As it is not possible to include in the Appendix the results of all estimations of the technical efficiency model, the results regarding those two sectors are not presented in the tables and are available upon request.

7 As already mentioned in the previous footnote, the results from both dummy variables are not presented for the Electric power, Road passenger transport and Gambling activities-casinos sectors, but are available upon request.

persons of different nationalities, seasonally employed, with contracts governed by foreign law which usually contain more flexible terms of employment.

The other "horizontal" reform, i.e. faster procedure for starting a business (ike), was estimated to have a positive and statistically significant effect on the technical efficiency of the Road freight transport sector. This can largely be attributed to the extremely low minimum capital requirement for starting a Private Company (1 euro), since it gives newcomers the opportunity to use the funds saved into productive purposes, thereby increasing technical efficiency. Conversely, this reform was found to have a negative effect on the technical efficiency of the Road passenger transport sector. Faster business start-up procedures from 2011 onwards have enabled newcomers to enter the sector, but the economic slowdown that followed, especially during the 2012-2013 period, adversely affected the sector's overall efficiency. The coefficient of the "ike" dummy variable was statistically insignificant in the case of the Electric power sector, because firms in this sector must be either Societes Anonymes (S.A.) or Limited Liability Companies (L.L.C.), with a share capital of at least €600,000 or €60,000, respectively (under Law 4001/2011), and not Private Companies. As a result, they are not affected by this reform.

Estimations with the dummy variable "ike" were not performed for the Cruise and yachting services and Gambling activities-casinos sectors. In the Cruise and yachting services sector, firms usually have the legal form of a Societe Anonyme because of high fixed capital requirements and increased business risk. In the Gambling activities-casinos sector, the operation of a firm mostly depends on obtaining an authorisation from the corresponding authority (Hellenic Gaming Commission), rather than on easier start-up procedures and lower minimum capital required.

As far as *firm-specific variables* is concerned, firm age (age) exerts a positive effect on the technical efficiency of all sectors under review, except for the Cruise and yachting services sector, in which the result for the specific variable was statistically insignificant. As the firm ages, it becomes more experienced in the production process and obtains better knowledge of the market characteristics. As a result, it can properly adjust its output to changes in demand, in technology level and in sectoral conditions.

Exporting activity (exp) was estimated to negatively affect the technical efficiency of the Electric power sector. This negative effect may be due to the fact that a dummy variable rather than a continuous variable was used to approximate exporting activity. We used a dummy variable because there are no such data available at the firm level for the reviewed sectors. In the case of the Road freight transport sector, the result was statistically insignificant, whereas for the remaining three sectors no estimations were performed, as in two of them (Road passenger transport and Gambling activities-casinos) no exporting activity was observed in 2001-2014 period, while in the Cruise and yachting services sector only one firm showed exporting activity during the same period.

The establishment of firms in the regions of Attica and Thessaloniki (dtown) was estimated to have a positive effect on the technical efficiency of the Cruise and yachting services and Road passenger transport sectors. Taking into account that the Greek ports with the largest cruise ship capacity are those of Piraeus and Thessaloniki and that a high share of foreign visitors in Greece usually use those cities as a point of entry into the country, firms from both sectors which are located in, or closer to, those regions minimise distance from their location to their clients' embarkation/disembarkation points. Thus, they can improve their efficiency.

In the other three sectors, the establishment of firms in the regions of Attica and Thessaloniki has a statistically significant and negative effect on the technical efficiency level. In the Electric power sector, if a firm is located close to a large urban area (such as Athens and Thes-

saloniki), it is farther away from the sources of raw materials it uses in the production of electric power (e.g. lignite, water), with negative effects on the technical efficiency level. In the Road freight transport sector, if a firm is located in those two regions (Attica or Thessaloniki), it is away from major transport hubs/freight centres, which are usually located outside large urban areas (e.g. ports of Patras and Igoumenitsa, Astakos hub). As a result, it faces increased operating costs (fuel, cost of warehouse rental, cost of parking spots, etc.), with negative effects on its efficiency. Finally, in the Gambling activities-casinos sector, the negative effect is probably due to the fact that casinos are usually located in tourist areas, outside large urban areas, so that they can attract visitors, both Greeks and foreigners.

As suggested by the estimation results for the credit expansion variable (credit), it positively affects firms' efficiency in three sectors (Electric power generation, transmission and distribution, Road freight transport, and Cruise and yachting services), possibly because it enables firms to finance their investment projects (e.g. construction and/or upgrade of electricity plants, purchase of vehicles, construction of ships) and their liabilities (e.g. distribution, administrative and finance expenses, capital expenditure).

In the case of the Road passenger transport sector, credit expansion was estimated to negatively affect technical efficiency. Perhaps from 2010 onwards, when credit started to shrink in Greece, firms used more rationally the limited available funds from the banking system. Last but not least, in the Gambling activities-casinos sector, credit expansion exerts no statistically significant effect on technical efficiency.[8]

The effect of the economic downturn (recession) on technical efficiency was estimated to be negative in three out of five sectors (Road passenger transport, Road freight transport, and Gambling activities-casinos). However, the economic recession was found to have a positive effect on the Cruise and yachting services sector. Probably, the recession prompted firms to use available inputs more efficiently. In the case of the Electric power generation, transmission and distribution sector, the effect of recession on technical efficiency was statistically insignificant.

If we compare the average technical efficiency level of the sectors under review, we observe that the Road passenger transport sector exhibits the highest score (0.82)[9] over the 2001-2014 period (see the charts in the Appendix). Then, the Cruise and yachting services and Road freight transport sectors follow, with similar average technical efficiency levels (0.77 and 0.76, respectively). Finally, the Electric power and Gambling activities-casinos sectors exhibit the lowest level of average technical efficiency, which are also similar (0.46 and 0.44, respectively).

The annual average technical efficiency by sector over the 2001-2014 period is also presented in the charts in the Appendix. In the Electric power sector, we observe a downward trend in technical efficiency throughout the reviewed period. Its variance is partly explained by the exogenous variables used, because the effects of recession (recession) and of faster business start-up procedures (ike) were statistically insignificant. Furthermore, the effect of sectoral-level reforms (electr) was negative (level of significance 10%) or statistically insignificant (OECDelectr), whereas labour market reforms (labour) had either a positive effect (level of significance 10%) or a statistically insignificant effect (OECDregularlabourindex, OECDtemplabourindex).

In the Road passenger transport sector, the trend of annual average technical efficiency since 2008 is explained from the effects of the

8 This estimation results are not presented in the Appendix, but are available upon request.

9 In other words, the sector's overall technical efficiency during the period under review averaged 82%. This result reveals that firms could increase, on average, their output by 18% of maximum technical efficiency at the sectoral level (=100%-82%), in order to reach 100%, using the same inputs and the same technology. The average values of technical efficiency for the remaining industries can be read in the same way.

exogenous variables. During the 2008-2010 period, efficiency declined, as a result of the recession (recession) and credit expansion (credit), which were estimated to negatively affect technical efficiency. By contrast, efficiency followed an upward trend in 2011-2013, due to structural reforms at the sectoral level (bus), labour market reforms (labour), and firms' experience (age).

In the Road freight transport sector, the evolution of annual average technical efficiency between 2009 and 2014 is explained from the exogenous variables. During the 2008-2010 period, efficiency followed a downward trend, due to recession (recession), which was estimated to negatively affect technical efficiency. During the 2011-2014 period, technical efficiency was positively affected from sectoral-level (OECDlandtransport) and labour market reforms (labour, OECDregularlabourindex), from the opportunity to start a business within a short period of time and at a very low cost (ike) and from the experience acquired by firms over time (age).

In the Cruise and yachting services sector, the trend of annual average technical efficiency, which was downward in 2006-2013 and upward ever since, can be partly explained by the estimated effects of the exogenous variables. Sectoral-level (cruise) and labour market reforms (labour, OECDregularlabourindex) had statistically insignificant effects. Moreover, the effects of the recession (recession) and credit expansion (credit) were positive and statistically significant.

Finally, in the Gambling activities-casinos sector, the trend of technical efficiency, which moves downwards during the 2006-2012 period and increases afterwards, is not explained by the exogenous variables. Reforms in the sector (game) and in the labour market (labour, OECDregularlabourindex, OECDtemplabourindex), as well as credit expansion (credit) had statistically insignificant effects, while the combined effect of all statistically significant variables (positive for age, and negative for location and recession) is inconsistent with the evolution of the sector's technical efficiency.

6 CONCLUSION

The aim of the paper was to estimate the effects of "horizontal" and "vertical" reforms on the technical efficiency level of five internationally tradable sectors of the Greek economy.

As suggested by the econometric estimations, sectoral-level ("vertical") reforms had different effects. In the sectors of Road passenger transport and Road freight transport, the effects were positive for technical efficiency, in contrast with the sector of Electric power generation, transmission and distribution where reforms exert a negative effect on the technical efficiency level. As far as the other two sectors are concerned (Cruise and yachting services, and Gambling activities-casinos), the reforms had statistically insignificant effects on technical efficiency.

Turning to "horizontal" reforms, the effect of labour market reforms on technical efficiency was estimated to be statistically significant for some of the reviewed sectors. In those sectors in which the effect was statistically significant, the reforms positively affect firms' technical efficiency (Electric power, Road passenger transport and Road freight transport). In the case of the procedures for starting a new firm, estimations showed that they positively affect the technical efficiency of the Road freight transport sector but negatively affect that of the Road passenger transport sector.

Regarding the remaining exogenous variables, we should note: the positive effect of age on the technical efficiency level of all sectors but the Cruise and yachting services sector (statistically insignificant effect); the negative effect of the recession in most sectors except the Electric power sector (statistically insignif-

icant effect) and the Cruise and yachting services sector (positive effect); as well as the positive effect of credit expansion on technical efficiency for the Cruise and yachting services, Road freight transport, and Electric power sectors. Turning to exports, estimations show that they exert a negative and statistically significant effect only in the case of the Electric power sector, while location in the regions of Attica and Thessaloniki positively affects the technical efficiency of tourism-related sectors (Cruise and yachting services and Road passenger transport) and negatively affects the technical efficiency of all other sectors.

As far as the ranking of the sectors with respect to technical efficiency is concerned, the Road passenger transport sector has the highest performance (0.82) during the 2001-2014 period, followed by Cruise and yachting services (0.77), Road freight transport (0.76), Electric power generation, transmission and distribution (0.46), and Gambling activities-casinos (0.44).

When assessing the effects of reforms on technical efficiency, it should be emphasised that the time that has elapsed from their implementation to the end of the reviewed period is relatively short and is likely to be insufficient for the reforms to work fully. As a result, a future re-examination of the impact of the reforms, perhaps under better macroeconomic conditions compared with the 2008-2014 period, could produce results that would reflect the full spectrum of their effects. In any case, such a study is of high importance, as structural reforms aiming to promote competition and improve the extroversion of the Greek economy are pivotal for its transition to a new growth model, which will be characterised by stronger competition, production of more tradable goods and services, higher exports and reduced reliance on domestic demand.

REFERENCES

Afriat, S.N. (1972), "Efficiency Estimation of Production Functions", *International Economic Review*, 13(3), 568-598.

Aigner, D.J. and S.F. Chu (1968), "On Estimating the Industry Production Function", *American Economic Review*, 58(4), 826-839.

Aigner, D.J., C.A.K. Lovell and P. Schmidt (1977), "Formulation and Estimation of Stochastic Frontier Production Function Models", *Journal of Econometrics*, 6(1), 21-37.

Battese, G.E. and T.J. Coelli (1995), "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data", *Empirical Economics*, 20(2), 325-332.

Caudill, S.B. and J.M. Ford (1993), "Biases in Frontier Estimation Due to Heteroscedasticity", *Economic Letters*, 41(1), 17-20.

Cornwell, C., P. Schmidt and R.C. Sickles (1990), "Production Frontiers with Cross-Sectional and Time-Series Variation in Efficiency Levels", *Journal of Econometrics*, 46(1), 185-200.

Debreu, G. (1951), "The Coefficient of Resource Utilization", *Econometrica*, 19(3), 273-292.

Farrell, M.J. (1957), "The Measurement of Productive Efficiency", *Journal of the Royal Statistical Society*, Series A (General), 120(3), 253-290.

Greene, W.H. (1997), *Econometric Analysis*, Third Edition, Prentice Hall.

Greene, W.H. (2005), "Reconsidering Heterogeneity in Panel Data Estimators of the Stochastic Frontier Model", *Journal of Econometrics*, 126(2), 269-303.

Hadri, K. (1999), "Estimation of a Doubly Heteroscedastic Stochastic Frontier Cost Function", *Journal of Business and Economics Statistics*, 17(3), 359-363.

Huang, C.J. and J.T. Liu (1994), "Estimation of a Non-Neutral Stochastic Frontier Production Function", *Journal of Productivity Analysis*, 5(2), 171-180.

IOBE (2017), "The impact of reforms on the sectors of tradable goods and services", Foundation for Economic and Industrial Research, Athens, www.iobe.gr.

Jondrow, J., C.A.K. Lovell, I.S. Materov and P. Schmidt (1982), "On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model", *Journal of Econometrics*, 19(2), 233-238.

Koopmans, T.C. (1951), "An Analysis of Production as an Efficient Combination of Activities", in T.C. Koopmans (ed.), *Activity Analysis of Production and Allocation*, Cowles Commission for Research in Economics, Monograph No. 13, New York, Wiley.

Kumbhakar, S.C., S. Ghosh and J.T. McGuckin (1991), "A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in U.S. Dairy Farms", *Journal of Business and Economics Statistics*, 9(3), 279-286.

Pitt, M.M. and L.F. Lee (1981), "The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry", *Journal of Development Economics*, 9(1), 43-64.

Richmond, J. (1974), "Estimating the Efficiency of Production", *International Economic Review*, 15(2), 515-521.

Schmidt, P. (1976), "On the Statistical Estimation of Parametric Frontier Production Functions", *Review of Economics and Statistics*, 58(2), 238-239.

Shephard, R.W. (1953), *Cost and Production Functions*, Princeton: Princeton University Press.

Stevenson, R.E. (1980), "Likelihood Functions for Generalized Stochastic Frontier Estimation", *Journal of Econometrics*, 13(1), 57-66.

Wang, H.J. (2002), "Heteroscedasticity and Non-Monotonic Efficiency Effects of a Stochastic Frontier Model", *Journal of Productivity Analysis*, 18(3), 245-253.

APPENDIX

Table 1 Estimations for firms active in the sectors of Electric power generation, transmission and distribution, and Road passenger transport

	Electric power generation, transmission and distribution				Road passenger transport			
Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
β_L	**1.614***** (0.238) [0.000]	**0.815***** (0.283) [0.00397]	**3.422***** (0.475) [0.000]	**2.178***** 0.328 [0.000]	**-0.0324** (0.759) [0.966]	**0.282** (0.603) [0.639]	**-0.0297** (0.715) [0.967]	**0.179** (0.617) [0.771]
β_K	**-0.207** (0.204) [0.309]	**-0.330** (0.218) [0.130]	**-2.290***** (0.332) [0.000]	**-0.795***** 0.275 [0.00383]	**-1.328***** (0.491) [0.00683]	**-0.904**** (0.410) [0.0273]	**-1.354**** (0.537) [0.0116]	**-1.164**** (0.456) [0.0107]
β_T	**0.429***** (0.0952) [6.51e-06]	**0.331***** (0.107) [0.00190]	**0.211** (0.140) [0.132]	**-0.128** 0.131 [0.330]	**0.0631** (0.136) [0.643]	**0.112** (0.0912) [0.219]	**-0.0340** (0.120) [0.777]	**0.0144** (0.105) [0.891]
β_{LK}	**-0.101***** (0.0182) [2.86e-08]	**-0.0626***** (0.0194) [0.00126]	**-0.228***** (0.0322) [0.000]	**-0.141***** 0.0232 [0.000]	**-0.0116** (0.0602) [0.848]	**-0.0489** (0.0487) [0.315]	**-0.0275** (0.0572) [0.631]	**-0.0415** (0.0499) [0.405]
β_{LT}	**0.0186***** (0.00574) [0.00122]	**0.0264***** (0.00621) [2.15e-05]	**0.0155*** (0.00920) [0.0917]	**0.00463** 0.00866 [0.592]	**0.0198** (0.0198) [0.317]	**-0.0179** (0.0124) [0.150]	**-0.0156** (0.0143) [0.273]	**-0.0189** (0.0133) [0.155]
β_{KT}	**-0.0221***** (0.00601) [0.000244]	**-0.0144**** (0.00628) [0.0215]	**-0.00142** (0.00899) [0.875]	**0.0190**** 0.00834 [0.0226]	**-0.00300** (0.0122) [0.806]	**0.00572** (0.00773) [0.459]	**0.0129** (0.00999) [0.197]	**0.00995** (0.00872) [0.254]
β_{LL}	**0.0708**** (0.0307) [0.0211]	**0.141***** (0.0316) [7.7e-06]	**0.270***** (0.0486) [2.90e-08]	**0.243***** 0.0357 [0.000]	**0.183** (0.117) [0.118]	**0.305***** (0.0821) [0.000203]	**0.319***** (0.0950) [0.000784]	**0.315***** (0.0880) [0.000349]
β_{KK}	**0.0636***** (0.0164) [0.000103]	**0.0623***** (0.0165) [0.000163]	**0.202***** (0.0247) [0.000]	**0.0857***** 0.0199 [0.000]	**0.116***** (0.0413) [0.00506]	**0.0895***** (0.0341) [0.00862]	**0.112**** (0.0439) [0.0108]	**0.104***** (0.0369) [0.00481]
β_{TT}	**-0.00380** (0.00407) [0.351]	**-0.00878**** (0.00403) [0.0293]	**-0.0194***** (0.00502) [0.000117]	**-0.0170***** 0.00473 [0.000325]	**-0.0107**** (0.00525) [0.0415]	**-0.0129***** (0.00427) [0.00251]	**-0.0114**** (0.00491) [0.0204]	**-0.00987**** (0.00459) [0.0314]
β_0	**9.612***** (1.254) [0.000]	**11.80***** (1.601) [0.000]	**28.69***** (2.451) [0.000]	**21.78***** 2.449 [0.000]	**24.65***** (3.261) [0.000]	**17.51***** (2.798) [0.000]	**21.83***** (3.638) [0.0001]	**19.83***** (3.137) [0.000]
z_{age}	**-0.0335***** (0.0103) [0.00109]	**-0.0617***** (0.0135) [5.13e-06]	**-1.395***** (0.306) [5.23e-06]	**-0.937***** 0.137 [0.000]	**-0.0972*** (0.0526) [0.0645]	**-0.0146** (0.0474) [0.758]		
z_{exp}				**5.089***** 0.657 [0.000]				
z_{dtown}	**0.863***** (0.220) [8.75e-05]		**0.0128** (1.036) [0.990]		**-2.899***** (0.796) [0.000273]	**-3.109***** (0.923) [0.000759]	**-4.793***** (1.642) [0.00351]	**-4.434*** (2.271) [0.0509]
z_{credit}	**-5.593***** (1.365) [4.16e-05]	**-4.517***** (0.814) [2.85e-08]	**-9.944*** (5.466) [0.0689]	**-5.580** 5.123 [0.276]	**14.03**** (6.619) [0.0340]	**2.826** (3.077) [0.358]	**0.761** (2.404) 0.752	
$z_{recession}$	**-0.152** (0.290) [0.599]			**0.844** 1.171 [0.471]		**2.445***** (0.809) [0.00251]		
z_{bus}							**-1.770**** (0.844) [0.0360]	
z_{electr}		**0.748*** (0.393) [0.0567]						
z_{labour}			**-2.715*** (1.539) [0.0776]					**-1.749*** (1.042) [0.0933]
z_{ike}		**0.216** (0.155) [0.164]			**4.394**** (1.819) [0.0157]			
z_0	**-0.0421** (0.347) [0.903]	**0.0272** (0.406) [0.947]	**6.222***** (1.139) [4.73e-08]	**2.854**** 1.248 [0.0222]	**-1.858*** (1.018) [0.0679]	**-3.170***** (0.996) [0.00145]	**0.150** (0.412) [0.715]	**-1.050***** (0.397) [0.00823]
Vsigma constant	**-4.443**** (1.825) [0.0149]	**-3.053***** (0.271) [0.000]	**-0.655***** (0.0606) [0.000]	**-0.761***** 0.0599 [0.000]	**-3.585***** (0.336) [0.000]	**-3.417***** (0.226) [0.000]	**-3.169***** (0.198) [0.000]	**-3.229***** (0.224) [0.000]

Source: IOBE.
Notes: Standard error in parentheses. Level of statistical significance in square brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 1 Estimations for firms active in the sectors of Electric power generation, transmission and distribution, and Road passenger transport *(continued)*

	Electric power generation, transmission and distribution				Road passenger transport			
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
Theta constant	**1.409***** (0.0575) [0.000]	**1.204***** (0.0421) [0.000]	**0.906***** (0.0791) [0.000]	**0.709***** 0.0512 [0.000]	**0.515***** (0.113) [0.0005]	**0.616***** (0.105) [0.000]	**0.605***** (0.108) [0.000]	**0.618***** (0.106) [0.000]
Mu constant			**4.623** (0)	**6.682***** 1.264 [0.000]	**3.667** (0.0001) [0.000]			
Observations	918	918	918	918	132	132	132	132
Number of firms	221	221	221	221	22	22	22	22
Country FE	NO	NO	NO	NO	NO	NO	NO	NO
Time varying	NO	NO	NO	NO	NO	NO	NO	NO
Simulations	5,000	6,000	5,000	5,000	6,000	6,000	6,000	6,000
Simulations kept	3,000	4,000	3,000	3,000	4,000	4,000	4,000	4,000
AIC	2,345	2,350	2,533	2,489	151.2	131.1	155.1	136.8
BIC	2,427	2,432	2,615	2,576	200.2	180.1	201.3	180.1

Source: IOBE.
Notes: Standard error in parentheses. Level of statistical significance in square brackets. *** p<0.01. ** p<0.05. * p<0.1.

Table 2 Estimations for firms active in the sectors of Road freight transport, Cruise and yachting services, and Gambling activities-casinos

	Road freight transport			Cruise and yachting services		Gambling activities-casinos	
Variables	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(1)**	**(2)**
β_L	**0.106** (0.183) [0.565]	**0.141** (0.172) [0.412]	**0.114** (0.172) [0.508]	**4.684***** (0.730) [0.000]	**1.478***** (0.589) [0.0122]	**3.181***** (0.826) [0.000118]	**8.745***** (0.665) [0.000]
β_K	**-0.988***** (0.178) [0.000]	**-1.374***** (0.128) [0.000]	**-1.197***** (0.142) [0.000]	**-3.493***** (0.505) [0.000]	**-2.153***** (0.219) [0.000]	**-3.184***** (0.254) [0.000]	**-5.349***** (0.172) [0.000]
β_T	**0.161***** (0.0306) [0.000]	**0.227***** (0.034) [0.000]	**0.268***** (0.0405) [0.000]	**-0.173** (0.141) [0.220]	**-0.214**** (0.0931) [0.0215]	**-0.258** (0.184) [0.160]	**0.703***** (0.157) [7.71e-06]
β_{LK}	**0.00156** (0.0167) [0.926]	**0.00418** (0.0162) [0.797]	**0.00351** (0.0165) [0.831]	**-0.389***** (0.0509) [0.000]	**-0.126***** (0.0395) [0.00140]	**-0.0361** (0.078) [0.643]	**-0.572***** (0.0325) [0.000]
β_{LT}	**-0.00105** (0.00406) [0.796]	**0.000349** (0.00461) [0.449]	**0.00739** (0.00503) [0.142]	**0.0350**** (0.0143) [0.0142]	**0.0102** (0.00861) [0.236]	**-0.0354** (0.0239) [0.139]	**0.106***** (0.0305) [0.000516]
β_{KT}	**-0.00580**** (0.00275) [0.0349]	**-0.0114***** (0.00304) [0.000167]	**-0.0128***** (0.00338) [0.000163]	**0.0198**** (0.00861) [0.0213]	**0.0102*** (0.0059) [0.0827]	**0.0304**** (0.0154) [0.0475]	**-0.0751***** (0.0136) [2.93e-08]
β_{LL}	**0.0790**** (0.0309) [0.0107]	**0.0331** (0.0339) [0.329]	**0.0325** (0.0355) [0.361]	**0.733***** (0.124) [0.000]	**0.337***** (0.0710) [0.000]	**-0.431*** (0.252) [0.087]	**0.144** (0.157) [0.360]
β_{KK}	**0.0903***** (0.0161) [0.000]	**0.126***** (0.0118) [0.000]	**0.112***** (0.0125) [0.000]	**0.304***** (0.0372) [0.000]	**0.190***** (0.0183) [0.000]	**0.215***** (0.0386) [0.000]	**0.560***** (0.0221) [0.000]
β_{TT}	**-0.0116***** (0.00133) [0.000]	**-0.0136***** (0.00157) [0.000]	**-0.0189***** (0.00225) [0.000]	**-0.0360***** (0.00717) [0.000]	**0.000606** (0.00502) [0.904]	**-0.0223***** (0.0073) [0.00225]	**-0.00286** (0.00883) [0.746]
β_0	**18.66***** (1.034) [0.000]	**20.73***** (0.795) [0.000]	**19.62***** (0.932) [0.000]	**32.46***** (3.737) [0.000]	**25.16***** (1.578) [0.000]	**33.24***** (2.015) [0.000]	**35.07***** (2.327) [0.000]

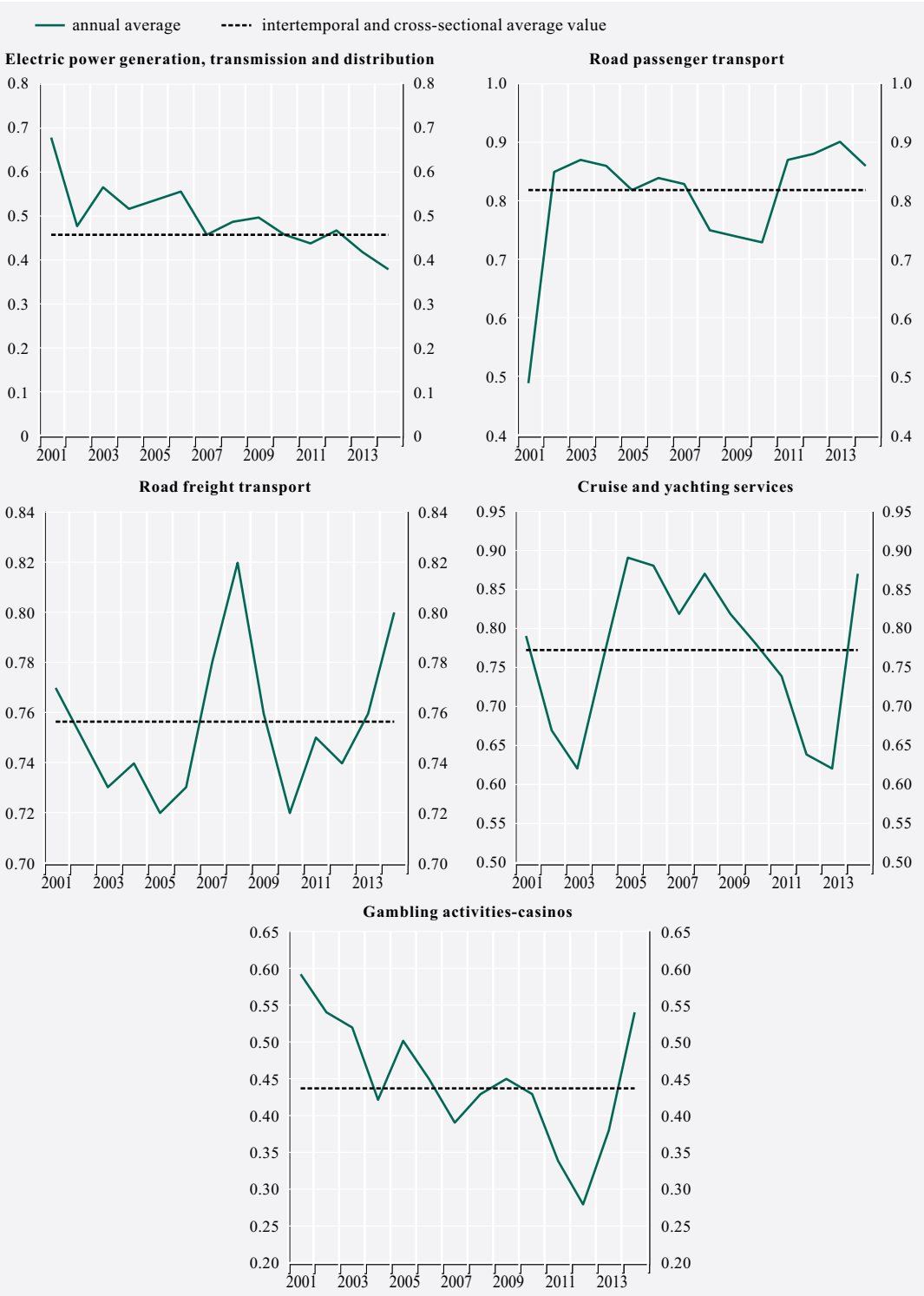
Source: IOBE.
Notes: Standard error in parentheses. Level of statistical significance in square brackets. *** p<0.01. ** p<0.05. * p<0.1.

Table 2 Estimations for firms active in the sectors of Road freight transport, Cruise and yachting services, and Gambling activities-casinos *(continued)*

	Road freight transport			Cruise and yachting services		Gambling activities-casinos	
Variables	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(1)**	**(2)**
z_{age}	**-0.0172**** (0.00742) [0.0207]	**-0.0435***** (0.0123) [0.00042]	**-0.0331***** (0.00918) [0.000314]	**0.0263** (0.226) [0.244]	**0.00242** (0.0186) [0.897]	**-0.0276** (0.0345) [0.422]	**-0.693***** (0.210) [0.000959]
z_{exp}	**-2.384** (2.811) [0.396]	**-2.493** (2.636) [0.344]	**-3.731** (5.495) [0.497]				
z_{dtown}	**1.208***** (0.222) [0.000]	**1.495***** (0.247) [0.000]	**1.824***** (0.335) [0.000]	**-0.866*** (0.495) [0.0803]	**0.360** (0.606) [0.553]	**4.725*** (2.709) [0.0811]	**18.89** (1.278) [0.988]
z_{credit}	**-2.174**** (0.954) [0.0226]	**-0.0576** (1.509) [0.970]	**-1.144** (0.879) [0.193]	**-2.266** (2.828) [0.423]	**-11.65***** (3.404) [0.000619]		
$z_{recession}$		**0.106** (0.148) [0.476]	**0.563***** (0.227) [0.0133]	**-1.311***** (0.453) [0.00377]	**-1.457***** (0.562) [0.0095]	**1.795**** (0.799) [0.0246]	
z_{cruise}				**-0.964** (1.093) [0.378]	**0.322** (0.647) [0.619]		
$z_{roadfreight}$		**0.406** (0.373) [0.276]					
$z_{OECDlandtransport}$			**0.397***** (0.0962) [0.000]				
z_{game}						**0.0578** (1.044) [0.956]	
z_{labour}		**-1.303***** (0.249) [0.000]		**-0.956** (0.865) [0.269]			
$Z_{OECDtemplabourindex}$			**-0.373***** (0.131) [0.00442]		**0.864***** (0.190) [0.000]		
$Z_{OECDregularlabourindex}$			**2.245***** (0.619) [0.000286]		**-0.0879** (1.457) [0.952]		
z_{ike}	**-0.677***** (0.239) [0.00459]		**-0.575*** (0.303) [0.0581]				
z_0	**-2.877***** (0.262) [0.000]	**-1.949***** (0.332) [0.000]	**-9.518***** (1.855) [0.000]	**0.279** (0.786) [0.723]	**-3.219** (4.195) [0.443]	**-6.710***** (2.374) [0.0047]	**-12.50** (1.278) [0.992]
Vsigma constant	**-3.182***** (0.0913) [0.000]	**-2.809***** (0.0997) [0.000]	**-2.866***** (0.120) [0.000]	**-1.698***** (0.205) [0.000]	**-3.530***** (0.265) [0.000]	**-2.287***** (0.743) [0.00208]	**-1.407***** (0.198) [0.000]
Theta constant	**0.676***** (0.0371) [0.000]	**0.671***** (0.0341) [0.000]	**0.699***** (0.0363) [0.000]	**1.007***** (0.149) [0.000]	**0.746***** (0.0831) [0.000]	**0.924***** (0.240) [0.000121]	**0.486***** (0.140) [0.000517]
Mu constant							**4.854***** (1.406) [0.000558]
Observations	1,531	1,531	1,393	320	310	113	113
Number of firms	277	277	252	61	59	16	16
Country FE	NO	NO	NO	NO	NO	NO	NO
Time varying	NO	NO	NO	NO	NO	NO	NO
Simulations	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Simulations kept	4,000	4,000	4,000	4,000	4,000	4,000	4,000
AIC	1,760	2,040	1,865	687.9	473.2	227.1	269.1
BIC	1,856	2,147	1,980	759.5	547.9	268.0	315.4

Source: IOBE.
Notes: Standard error in parentheses. Level of statistical significance in square brackets. *** p<0.01. ** p<0.05. * p<0.1.

Annual average technical efficiency and intertemporal and cross-sectional average value of technical efficiency across sectors (2001-2014)



Source: IOBE.

REGIONAL HOUSEHOLD ACCOUNTS FOR THE YEARS 2000-2014

Aikaterini Chaireti*
Economic Analysis and Research Department

1 INTRODUCTION

This study reviews the evolution of Greek regional household accounts for the period 2000-2014.

The period under review can be divided into two subperiods: 2000-2007 and 2008-2014. The criterion behind this division is that the first year of each subperiod marks a significant change in Greece's economic performance: 2000 is the last year of preparations for entry into the euro area (which took place in 2001) and the first year of data availability, while 2008 marks the start of the economic crisis.

The purpose of this study is to conduct inter-regional comparisons per account, with a view to highlighting (to the extent possible) the evolution of the aggregates reviewed in relation to the degree of sectoral specialisation of each region. To this end, the aggregates reviewed are examined together with key regional account aggregates, such as gross value added and employment. Also, data on foreign arrivals at the airports of the different regions as well as population data are provided, helping to investigate the contribution of non-residents to domestic household disposable income and consumption expenditure. Finally, data on declared income and personal income tax for each region and for total economy over the period 2004-2010 are provided, in order to support the conclusions drawn.[1]

The study comprises two parts. The first part outlines the concept, structure, methodology, sources and purpose of regional household accounts. The second part presents the economic data, in particular the absolute figures at the average level per subperiod, the average annual growth rates, the percentage shares of regional aggregates in the respective economy-wide aggregates and the percentage shares of selected sectors/industries in the respective region-wide aggregates.

2 CONCEPT, STRUCTURE, METHODOLOGY, SOURCES AND PURPOSE OF REGIONAL HOUSEHOLD ACCOUNTS

Concept. Regional accounts are the accounts compiled at the regional level, similarly as national accounts are compiled for a country as a whole. Regional household accounts, in particular, refer to the households that are resident in a region, but they do not have a national counterpart, as the concept of "household accounts" does not exist at the national level. They are income distribution accounts and, unlike national accounts, do not include production or income generation data; in this respect, they are part of the more general category of distributive transactions.

Structure. Regional household accounts are structured around two main categories. The first category refers to the allocation of primary income account, reflecting how the income arising from the production process (profit and compensation of employees) or from the ownership of property is allocated to households. The second category refers to the secondary distribution of income account, i.e. redistribution of primary household income among households, between households and government, as well as between households and non-profit institutions serving households (NPISHs). Each account has two sides: (i) "resources", i.e. transactions that increase the economic value of the units or sectors; and (ii) "uses", i.e. transactions that reduce the economic value of the units or sectors.

* The views expressed in this study do not necessarily reflect those of the Bank of Greece. Any errors or omissions are the author's responsibility. The author would like to thank Ms Heather Gibson and Ms Hiona Balfoussia for their comments and suggestions.

1 The study draws on data from the Hellenic Statistical Authority (ELSTAT), the Greek Ministry of Finance and the Hellenic Civil Aviation Authority. All prices in euro are expressed at 2010 constant prices.

Methodology. Regional household accounts are compiled in line with the European System of Accounts (ESA) methodology, which is governed by two key principles: (a) the double-entry principle, stating that a transaction must be recorded twice, once as "resource" and once as "use"; and (b) the accruals principle, whereby transactions are recorded at the time when a claim or obligation is generated, transformed or extinguished.

There are two methods for the compilation of regional accounts. The first entails constructing a complete system of accounts, showing the links of each regional economy with the economies of other regions and the rest of the world. These accounts would be the equivalent of the rest-of-the-world accounts in national accounts. The second method is via "regionalisation", i.e. by allocating the transactions that appear in national accounts to the different regions, based on assumptions. Clearly, the more complete the data collected directly, the smaller the scope for assumptions. As mentioned in the relevant Regulation of the European Union (EU),[2] "the lack of sufficiently complete, timely and reliable regional information requires assumptions in compiling regional accounts. This implies that some differences between regions are not necessarily reflected in regional accounts".

In theory, the first method would be the most appropriate, but its implementation is subject to constraints. A region is clearly delineated as an administrative unit, but not as an economic one, since it is not a "closed area" as the national territory is. For this reason, the development of a regional system of accounts corresponding to the national accounts system is not feasible, thus the second method is the necessary choice.

In the context of this second method, there are two approaches to regionalising transactions: (i) the bottom-up approach, i.e. by collecting statistical data which, when aggregated at the regional level, can be used to determine the regional breakdown of the transaction; and (ii) the top-down approach, whereby the national figure from national accounts is distributed using a regional indicator which is as close as possible to the variable to be estimated. The advantage of the first approach is that it uses data which are closely linked with the variables examined at the regional level, while its disadvantage is that it does not ensure in advance consistency between statistical data and estimates of household accounts. The advantage of the second approach is that, by design, it ensures consistency between national and regional data, as the latter derive from the former based on an allocation key. Its disadvantage is that regional estimates do not always arise from data closely related to the variables examined and the households concerned. Overall, the use of the first approach is seen as more appropriate. In practice, the two methods of regionalisation are used in combination.

Sources. Primary data sources are income distribution statistics, household budget surveys, tax sources, housing surveys, regional social security statistics, private pension schemes, demographic data and regional accounts of local government.

Purpose. The officially stated purpose of compiling EU regional household accounts is to determine regional levels of households' disposable income and consumption expenditure and to make interregional comparisons of these variables.[3] However, given the detailed information provided by these accounts, interregional comparisons can also be made in terms of other variables, such as wages, taxes, social security contributions, etc.

3 SECTORAL SPECIALISATION OF REGIONS

3.1 THE QUOTIENT OF LOCATION

As already mentioned, accounts are analysed in order to identify regional patterns. The

2 Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union.
3 Eurostat, Regional Accounts Methods: Household Accounts.

regions are classified according to their sectoral specialisation.

Sectoral specialisation is determined using the quotient of location (QL),[4] based on the region's share in the gross value added of a given sector of activity (at constant prices). The quotient of location enables interregional and intersectoral comparisons to be made in an indirect manner, i.e. by reference to national figures, and is given by the relationship:

$$QL = \frac{Air/Ain}{Ar/An}$$

where A_{ir}= the activity of sector i in region r,

A_r= total activity in region r,

A_{in}= the activity of sector i in the country as a whole, and

A_n= total activity in the country as a whole.

The interpretation of the location quotient is as follows: If QL=1, activity in sector i is developed in region r as much as in the country as a whole; if QL>1, activity in sector i is more developed in region r than in the country as a whole; and if QL<1, activity i is less developed in region r than in the country as a whole.

It should be noted that the quotient of location can also be used to measure the spatial concentration of employment, gross fixed capital formation and other economic variables within regions.

On the basis of this quotient, Greek regions are classified below in five (out of a total of ten) sectors of production; manufacturing is also mentioned separately, although it is included as part of the secondary sector. The respective quotients are provided in parentheses only when they are higher than one, implying specialisation.

3.2 LOCATION QUOTIENTS IN THE SUBPERIOD 2000-2007

Agriculture-Forestry-Fishing: Thessaly (2.46), Western Greece (2.31), Peloponnese (2.18), Central Greece (2.12), East Macedonia-Thrace (2.03), Epirus (1.94), Crete (1.91), North Aegean (1.59), Western Macedonia (1.56), Central Macedonia (1.45).

Secondary sector (excluding construction): Western Macedonia (2.82), Central Greece (2.38), Peloponnese (1.46), East Macedonia-Thrace (1.14), Central Macedonia (1.12), Thessaly (1.09).

Manufacturing (part of the secondary sector): Central Greece (2.90), Peloponnese (1.44), Central Macedonia (1.29), Thessaly (1.28), East Macedonia-Thrace (1.10).

Construction: Epirus (1.52), Western Greece (1.22), Crete (1.16), South Aegean (1.12), Western Macedonia (1.12), Ionian Islands (1.05), Central Greece (1.04), Thessaly (1.03).

Wholesale and retail trade, vehicle repair, transportation and storage, accommodation and food service activities: South Aegean (1.92), Ionian Islands (1.91), Crete (1.34), North Aegean (1.25), Central Macedonia (1.03).

Financial and insurance activities: Attica (1.47).

3.3 LOCATION QUOTIENTS IN THE SUBPERIOD 2008-2014

Agriculture-Forestry-Fishing: Thessaly (2.71), Western Greece (2.45), Peloponnese (2.24), Central Greece (2.16), Epirus (2.06), East Macedonia-Thrace (1.94), Crete (1.76), Western Macedonia (1.67), Central Macedonia (1.49), North Aegean (1.37).

Secondary sector (excluding construction): Western Macedonia (3.22), Central Greece (2.46), Peloponnese (1.51), Thessaly (1.20), East Macedonia-Thrace (1.18), Central Macedonia (1.14).

Manufacturing (part of the secondary sector): Central Greece (2.83), Peloponnese (1.49),

4 See Papadaskalopoulos (2000) and McCann (2001).

Thessaly (1.43), Central Macedonia (1.32), East Macedonia-Thrace (1.20).

Construction: Epirus (1.75), South Aegean (1.41), Western Greece (1.40), Crete (1.34), Ionian Islands (1.33), Peloponnese (1.29), North Aegean (1.17), Central Greece (1.15), Thessaly (1.09), Western Macedonia (1.08), Central Macedonia (1.02).

Wholesale and retail trade, vehicle repair, transportation and storage, accommodation and food service activities: South Aegean (1.96), Ionian Islands (1.83), Crete (1.36), North Aegean (1.13), Central Macedonia (1.01).

Financial and insurance activities: Attica (1.44).

It should be noted that an association of QLs with the accounts under review cannot provide accurate estimates, but only serves to illustrate the general trends prevailing in each region: the QLs measure the weight of a given sector in total regional economy, while regional accounts depict the level of transactions among households and between households and government in a region, without a sectoral breakdown of income.

It should also be noted that where a region has specialisation in more than one sector, the sector with the highest QL is shown. For example, the region of Thessaly has specialisation in three sectors of activity, but its primary orientation is clearly towards agriculture.

4 REGIONAL HOUSEHOLD ACCOUNTS

4.1 PRIMARY INCOME DISTRIBUTION ACCOUNT: RESOURCES

4.1.1 Operating surplus – Mixed income

Operating surplus includes the profits of enterprises other than those divided by shares, minus compensation of employees and taxes on production, plus subsidies. For small unincorporated enterprises, this profit is called mixed income, as it also includes the proprietor's unpaid labour. It is calculated as net operating surplus/mixed income, i.e. subtracting consumption of fixed capital.

As can be seen from Table 1 in the Appendix,[5] which shows the resources and the uses of the primary income distribution account in 2000-2007 in absolute figures (period averages), in percentage shares (also period averages), and in average annual growth rates by region, the average annual growth rates of operating surplus/mixed income were positive in all regions except for Western Macedonia and Central Greece. Significantly higher growth rates than in the country as a whole (2.9%) are observed in those regions that are major tourist destinations, namely the South Aegean (6.1%), Crete (5.3%) and the Ionian Islands (4.6%). For lack of data at the sectoral level, those percentages are compared with the high share of gross value added in the accommodation and food service sector (which refers to all business units and not only to households) as well as with airport arrivals during the same period. As can be seen in Chart 1 and Table 2a, which show the percentage contribution of gross value added by sector in each region to total gross value added in the same region, gross value added in the accommodation and food service sector reaches 49.1%, 34.5% and 48.8%, respectively, of total gross value added in the regions of the South Aegean, Crete and the Ionian Islands, against 25.4% for the country as a whole.[6] Given that services which are directly related to tourism are incorporated in a sector that also includes non-tourism-related activities, the gross value added of accommodation and food services is not fully captured.

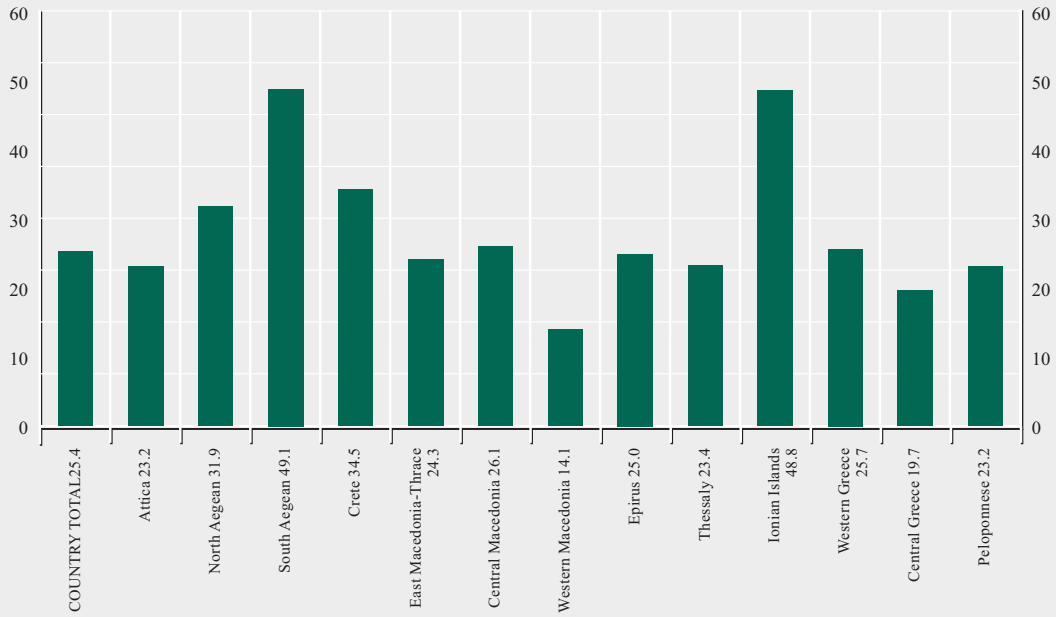
A clearer picture of the source of income is given by airport arrivals from abroad. As shown in Table 3, which captures foreign

5 All the tables referenced in this analysis are provided in the Appendix.

6 Complete data on sectoral shares in total value added of each region are provided in Table 2a, and the respective average annual growth rates are provided in Table 2b.

Chart 1 Shares of gross value added of "wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage, accommodation and food service activities" in total gross value added, by region (2000-2007)

(%, annual averages, region=100, 2010 constant prices)



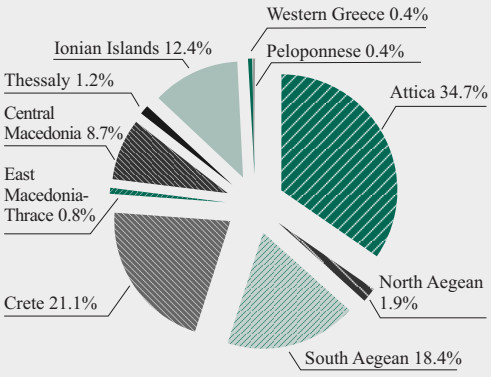
Source: ELSTAT, author's own calculations.

arrivals, population and the ratios of foreign arrivals to population per region for both sub-periods, at average levels (absolute numbers and percentage shares), as well as in Table 9, which depicts per capita expenditure by non-residents per trip for the years 2004-2014, foreign arrivals at the airports of the North Aegean amounted to 2,274,337 (eight-year average) when the population of the region were only 320,998 (eight-year average). The ratio of arrivals to population is 7.1. In the regions of Crete and the Ionian Islands, the respective ratios are 4.3 and 7.4, while for the country as a whole the corresponding ratio is only 1.1. Chart 2 shows the breakdown of foreign passengers' arrivals by region for the years 2000-2007 (averages).

However, a particularly high (the highest) growth rate of operating surplus/mixed income is observed (see Table 1) in the Peloponnese as well (7.0%). The region of the Peloponnese may not rank first in any sector, but it has a good position in all three sectors of the economy (primary, secondary, tertiary)

Chart 2 Breakdown of foreign arrivals at the country's airports by region (2000-2007)

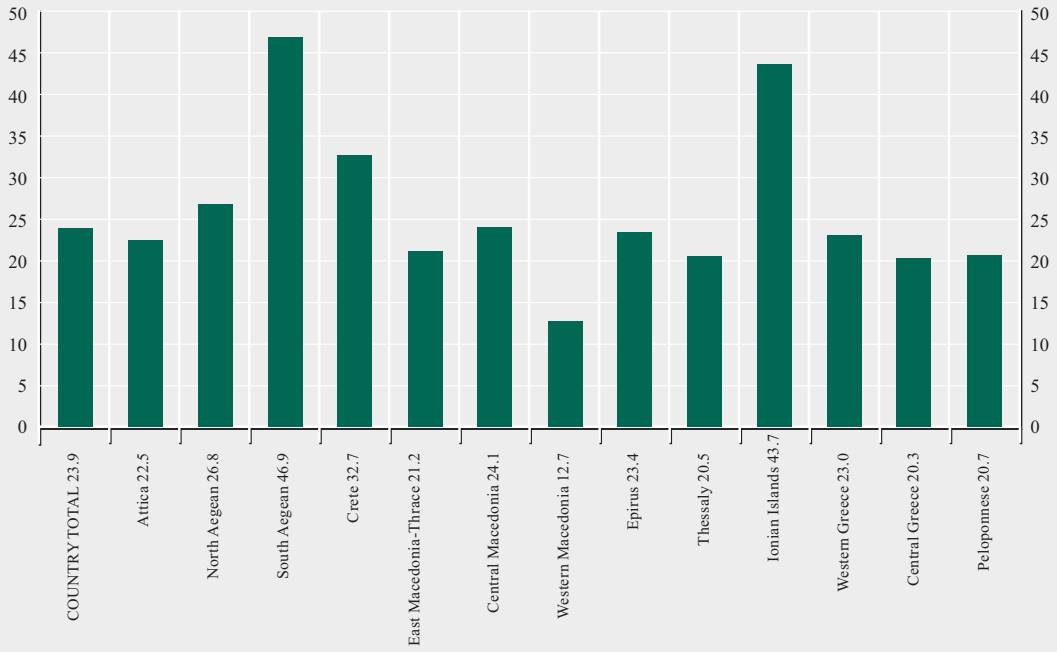
(annual averages, country total=100, 2010 constant prices)



Source: Hellenic Civil Aviation Authority, author's own calculations.
Note: The regions of Western Macedonia and Epirus are not featured in the chart, due to zero foreign arrivals.

Chart 3 Shares of gross value added of "wholesale and retail trade, repair of motor vehicles and motorcycles, transportation and storage, accommodation and food service activities" in total gross value added, by region (2008-2014)

(%, annual averages, region=100, 2010 constant prices)



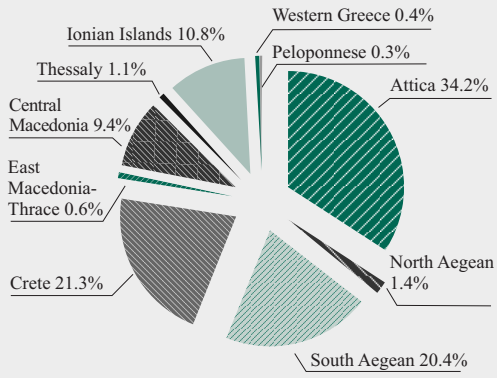
Source: ELSTAT, author's own calculations.

and, besides, it is the top olive-growing region in the country, which is in turn the third olive oil producer worldwide. The very high growth rate of this aggregate is likely to involve more than one sector.

In 2008-2014 there is a noticeable decline in operating surplus/mixed income in eleven out of the 13 regions (see Table 4, which has been drawn up just like Table 1 but refers to the subperiod 2008-2014). The strongest declines are observed in the regions of Western Greece (-11.4%), Thessaly (-10.2%), East Macedonia-Thrace (-9.5%) and Epirus (-8.9%), while a relatively more modest decline (-4.9%) is seen in the region of Western Macedonia, which had the highest contribution to the secondary sector over that period. At the country level, the growth rate of operating surplus/mixed income is negative and stands at -7.6%. However, one region, i.e. the North Aegean, exhibits a positive growth rate (1.5%), while another, that of the Ionian Islands, posts a negative yet low growth rate (-1.5%). Turning to the shares in the gross added value of the sector that includes accommodation and food services by region, the South Aegean and the Ionian Islands continue to hold the top two places during the crisis, with 46.9% and 43.7% respectively, against a country total of 23.9% (see Chart 3 and Table 2a). In the light of the above, it appears that profits and incomes have been resilient during the crisis in regions where the sector of tourism-related services is particularly developed. Nevertheless, in one region, i.e. Crete, where the tourism sector has the third highest share (32.7%) in total gross value added, operating surplus/mixed income declined strongly (-7.4%), probably because increased or unchanged profits and incomes from the tourism sector were offset by reduced profits and incomes from other sectors of the economy.

Chart 4 Breakdown of foreign arrivals at the country's airports by region (2008-2014)

(annual averages, country total=100, 2010 constant prices)



Source: Hellenic Civil Aviation Authority, author's own calculations.
Note: The regions of Western Macedonia and Epirus are not featured in the chart, due to zero foreign arrivals.

Chart 4 shows the arrivals of foreign passengers at Greek airports, broken down by region in the subperiod 2008-2014. Compared with the previous subperiod, arrivals have increased in the South Aegean and, albeit significantly less, in Crete, whereas in the Ionian Islands arrivals have decreased (full data are provided in Table 3).

4.1.2 Compensation of employees, receivable

This is the income from dependent employment, including employers' social contributions, in cash and in kind.

As shown in Table 1, over the subperiod 2000-2007 this aggregate under review grew in average annual terms in twelve out of the 13 regions of the country, for the total of which the respective growth rate was 5.2%. The most pronounced increases are observed in the regions with the two largest urban centres of the country, namely Attica and Central Macedonia, where average annual growth rates reached 6.8% and 7.3%, respectively, while relatively high rates of increase are also seen in the Peloponnese, 6.4%, Thessaly, 5.2%, the North Aegean, 5.1%, and Western Greece, 4.7%, i.e. in regions with significant activity in the primary sector.

In six regions the positive growth rates were outpaced by the respective rate for the country as a whole, with visibly lower rates for the regions of Crete and East Macedonia-Thrace, both 3.1%, as well as Central Greece, 2.1%. Conversely, the regions of the South Aegean and the Ionian Islands witnessed negative rates of change (-1.4% and -1.0%, respectively).

The particularly weak growth rates of compensation of employees in regions with a developed tourism-related services sector is in stark contrast to the strong growth rate of profits and incomes in those same regions.

In one region, that of Western Macedonia, compensation of employees declined visibly, -3.3%.

Given that, as shown in Table 5a which presents average annual employment growth by sector and region for the subperiod 2000-2007, the number of employees did not rise significantly and total employment grew by a mere 1.5%, in average annual terms, at the country level, while at the regional level the respective rates ranged between 0.6% and 2.5%. The divergent growth rates of compensation of employees across regions may be due mainly to differences in the bargaining power of workers in different sectors.

It is noted that this bargaining power is particularly weak in regions with a thriving tourism sector, i.e. the Ionian Islands and the South Aegean, whereas it appears to be quite strong in regions with large urban centres and a high concentration of workers in sectors with a long history in industrial action. For instance, as shown in Table 5b that depicts employment shares by sector in Greece, the banking and insurance sector, which is characterised by strong trade union power, accumulates in Attica 60.7% of the sector's total employees over the period under review, as well as senior executives, who can claim higher remuneration

on the back of their expertise and specialised skills (Attica and Central Macedonia). The fact that the average size of enterprises is considerably larger in urban centres may also play an important role, whereas in the country's periphery there is a higher concentration of micro enterprises with comparatively more limited access to finance.

A significant increase in compensation of employees is also observed in most regions which are mainly active in the primary sector (Peloponnese, Thessaly, North Aegean and Western Greece). This visible rise is not due to better pay demands on the part of farm workers' labour unions, but rather to higher wages offered by employers in order to attract labour force into the primary sector. It is known that in 2000-2007 construction activity boomed in Greece and, according to Labour Force Survey estimations, more than 50% of male immigrants were employed in construction during that period, which led to labour shortages in the agricultural sector. This category of male workers shifted to urban areas most probably together with their families, thereby also reducing the supply of female labour in the primary sector.

A different picture is painted during the subperiod 2008-2014, which witnessed (see Table 4) a relatively strong negative growth in compensation of employees in Attica (-7.5%, compared with -7.1% for the country as a whole), while in the remaining regions negative growth rates ranged between -6.1% (Epirus) and -7.1% (Western Macedonia). Growth rates are broadly similar across regions as they are measured on the basis of nation-wide changes, which makes it difficult to draw conclusions for the reviewed period in this account category.

However, it should be noted that, as was also the case in the previous period under examination, the high average annual negative growth rate of compensation of employees in the South Aegean (-6.9%) and the Ionian Islands (-6.2%), i.e. in the country's two most popular tourist destinations, is not consistent with the respective growth rate of operating surplus-mixed income (see Table 4), which was positive (1.5%) in the South Aegean and negative but visibly lower than that of compensation of employees (-1.4%) in the Ionian Islands. This inconsistency is observed only in these two regions, as in all other regions the negative average annual growth rates of operating surplus-mixed income stood either at the same or at a lower level relative to compensation of employees (with the exception of Western Macedonia, where the average annual growth rates of compensation of employees and of operating surplus-mixed income were -7.1% and -4.9%, respectively). More specifically, in the typically agricultural regions, i.e. the Peloponnese and Thessaly, the declines in operating surplus-mixed income (-8.7% and -10.2%, respectively) correspond to considerably weaker declines in compensation of employees (-6.7% and -6.6%, respectively).

Needless to say, firms' operating surplus-mixed income and compensation of employees worsened during the crisis, yet this change was not symmetric but was directly associated with workers' bargaining power, as it is clear that in both regions that are the country's most popular tourist destinations, wages declined, while operating surplus-mixed income either increased or declined less than in all other regions (despite a marked decrease in total gross value added, at constant prices, in those same regions).

4.1.3 Property income, receivable

Receivable property income (see Table 1) comprises interest on deposits, debt securities and accounts receivable, the distributed income of corporations, reinvested earnings on foreign direct investment, property income attributed to insurance policy holders, and rents on land and subsoil assets. Income from renting real estate (houses, offices, etc.) is excluded, as it is regarded as fee for services and is classified as renters' intermediate consumption or consumption expenditure.

It should be pointed out that this is a very small aggregate compared with those already reviewed, as well as that, according to data from the non-financial accounts of institutional sectors for households and NPISHs published by ELSTAT (at the national level, as presented in Table 6 in absolute averages and average percentage shares, as well as in average annual growth rates for both subperiods under review), in 2000-2007 the bulk of this income category consists of interest (61.5%) and distributed income of corporations (34.6%). Rents on land and subsoil assets come next (2.8%), followed by property income attributed to insurance policy holders (1.0%). The average annual growth rates for the same subperiod are: interest -5.4%; distributed income of corporations 5.1%; rents on land and subsoil assets 2.4%; and property income attributed to insurance policy holders 78.9%. The average annual growth rate of total property income, receivable, in Greece stood at -1.9%.

Over the subperiod 2008-2014 (see Table 6), the percentage shares for each sub-category are as follows: interest 67.5%; distributed income of corporations 27.6%; rents on land and subsoil assets 3.0%; and property income attributed to insurance policy holders 1.9%. The respective average annual growth rates come to -13.6%, -7.6%, -4.3% and -4.9%, while the average annual growth rate of total property income, receivable, has declined to -11.3%.

Given that there are no available data with such analysis at the regional level, some generic observations can only be made with regard to the evolution of the total aggregate.

Attica has the lion's share, accounting for 41.4% of the country's total property income over the subperiod 2000-2007 (see Table 1). This share becomes even more pronounced in the subperiod 2008-2014, reaching 49.9%. The respective percentage shares in terms of population are 36.0% and 35.8%, respectively. An increase is also observed in Central Macedonia, as its percentage share has grown from 13.3% in 2000-2007 to 14.7% in 2008-2014; notwithstanding, the shares continue to be lower than its respective population shares for both subperiods under review, and the same holds for the remaining regions, whose percentage shares in the country's total property income are also found to be lower than their corresponding population shares.

Turning to average annual growth rates, over the subperiod 2000-2007 (see Table 1) property income increased considerably, by 5.2%, in Attica, but declined in all other regions. The highest negative growth rate is observed in the North Aegean, -18.0%, a region with specialisation in the primary sector, followed by the South Aegean, which, as repeatedly stressed throughout the analysis, is the most important tourist destination of the country, with a rate of -14.2%. The regions of Western Macedonia, Epirus, the Ionian Islands and Central Greece follow with -11.6%, -11.3%, -10.7% and -9.2%, respectively, while the regions of Crete and Thessaly have posted average annual negative growth rates of -6.8 and -6.3%, respectively. The smallest declines are observed in the Peloponnese (-4.9%), East Macedonia-Thrace (-2.9%) and Central Macedonia (-2.1%).

Over the following subperiod under review, i.e. during the crisis period (see Table 4), the landscape changes drastically, with the annual growth rate of property income for Attica turning strongly negative, -12.7%. A very strong decline is also observed in Central Macedonia, -11.8%. The highest negative growth rate is recorded in Thessaly, -17.0%, followed by Western Greece, -13.0%. In the remaining regions the rates range from -3.3% (East Macedonia-Thrace) to -9.9% (Ionian Islands). In between, the regions of the North Aegean, Crete, the Peloponnese, Western Macedonia, Central Greece and Epirus feature with rates of -5.0%, -5.4%, -5.5%, -5.8%, -6.3% and -6.3%, respectively.

Given that, as already mentioned, a regional breakdown of this income category is not avail-

able, since it is important to know whether e.g. the substantial decline in Thessaly during the crisis period mainly refers to income from interest or rents on land (as a result of its specialisation in the primary sector), the only possible generic estimation that can be made is that during the crisis property income, receivable, shrank markedly in regions with large urban centres (Attica, Central Macedonia, Western Greece) and to a lesser extent in the remaining regions (with the exception of Thessaly).

4.2 USES OF ALLOCATION OF PRIMARY INCOME

4.2.1 Property income, payable

Property income payable (see Table 1) consists of: interest paid and rents on land and subsoil assets paid by the lessee to the land owner.

According to data from the non-financial accounts in institutional sectors for households and NPISHs published by ELSTAT (at the national level), over the subperiod 2000-2007 (see Table 6) the bulk of this income category refers to interest (66.2%), followed by rents on land subsoil assets (33.8%). The average annual growth rates for this subperiod are: interest 9.8% and rents on land and subsoil assets 2.5%, while the respective rate of increase in total property income payable stands at 8.6%.

Over the subperiod 2008-2014 (see Table 6), the percentage shares for each subcategory are as follows: interest 84.0% and rents on land and subsoil assets 16.0%, while the average annual growth rates declined to -15.1% and -3.2%, respectively. For total property income payable the average growth rate comes to -13.2%. The highest negative growth rate for this income category is also observed in Thessaly (-18.9%), followed by Western Greece (-14.9%).

In this income category as well, Attica has the lion's share (see Table 1), accounting for 47.4% of the country's total property income payable in 2000-2007; this share becomes even more pronounced in 2008-2014 (see Table 4), as it increased further to 50.1%. Similarly, the percentage share of Central Macedonia in the country total also rose, from 12.5% in 2000-2007 to 14.6% in 2008-2014. The remaining regions saw their percentage shares either rise slightly or decrease slightly.

The fact that, although property income payable in 2008-2014 is, on average, markedly higher than in 2000-2007 (i.e. up by 86.2%), its average annual growth rate during the crisis period is visibly negative, is due to the fact that property income in 2008 stood at a very much higher level than in 2014, thereby resulting in a steep decline. The higher average level of this aggregate is attributable (as suggested by the breakdown in its components) to increased interest, i.e. up by 138.8% on average in 2008-2014, compared with the previous subperiod, whereas rents on land and subsoil assets shrank by 13.9% (see Table 6).

Looking at annual data on interest paid,[7] it appears that in 2005 this aggregate surged from €21 million to €408 million year on year, a development which continued through 2006, 2007 and 2008, with interest amounting to €1,739 million, €3,783 million and €4,409 million, respectively. Interest paid embarked on a downward path in 2009 (€1,734 million) to rise again sharply in 2010 and 2011 (€2,988 million and €3.252 million, respectively). In 2012 it started to fall once more (€2,459 million) and this decline continued through 2013 and 2014 (€2,097 million and €1,653 million, respectively).

The development of this aggregate is consistent with the upward trend of the real estate market and the subsequent granting of housing loans in 2005-2008 and should, to a great extent, reflect interest on housing loans. The question that arises is what explains the resurge in 2010 and 2011. In 2010 Law 3869 (the so-called Katseli law) was enacted, providing

7 Detailed, yearly data from the Annual Non-Financial Sector Accounts-Households and NPISHs are available on the following website: http://www.statistics.gr/en/statistics/-/publication/SEM95/-.

households-borrowers with the possibility to resort to out-of-court settlement solutions vis-à-vis credit institutions, which probably urged a large number of borrowers to make mass repayments of loan instalments. Besides, it also seems to be in line with movements in lending rates over the same period. Given that many loans are floating-rate loans, this might be a key determinant of the reviewed aggregate.

Otherwise, the remark made in the previous income category still holds, i.e. that there are no available data with such breakdown at the regional level, thereby making it difficult to estimate the factors behind divergences in interest for both subperiods under review (2000-2007 and 2008-2014) across regions.

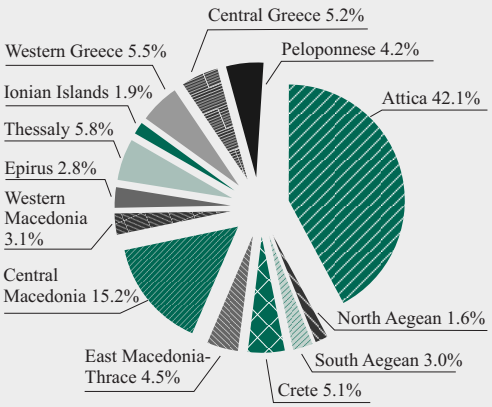
4.2.2 Primary income balance

The primary income balance consists of operating surplus-mixed income plus compensation of employees receivable plus net property income. It is recorded on the "uses" side of the allocation of primary income account as a rebalancing item.[8] At the country level (see Chart 5 and Table 1) an average annual growth rate of 3.3% is observed in 2000-2007. At the regional level the highest rates are seen in the Peloponnese (5.3%), Attica (5.0%), Central Macedonia (3.8%) and Thessaly (3.1%). Lower average annual growth rates are recorded in East Macedonia-Thrace, Crete, the North Aegean and Western Macedonia (2.7%, 2.5%, 1.3% and 1.3%, respectively), while the lowest rates are observed in Epirus and the South Aegean (0.5% and 0.2%, respectively). In two regions, i.e. the Ionian Islands and Central Greece, the growth rates are marginally negative (-0.1% and -0.5%, respectively).

Over the subperiod 2008-2014 (see Chart 6 and Table 4) the average annual growth rate of the primary income balance at the country level has turned strongly negative (-7.5%); similarly, negative growth rates are recorded for all regions. The highest average negative growth rates can be seen in Western Greece (-9.2%), Thessaly (-9.0%) and Attica (-8.0%), while somewhat lower, yet clearly negative, rates are recorded in Central Greece and the Peloponnese (-7.5%), East Macedonia and Central

Chart 5 Breakdown of primary income by region (2000-2007)

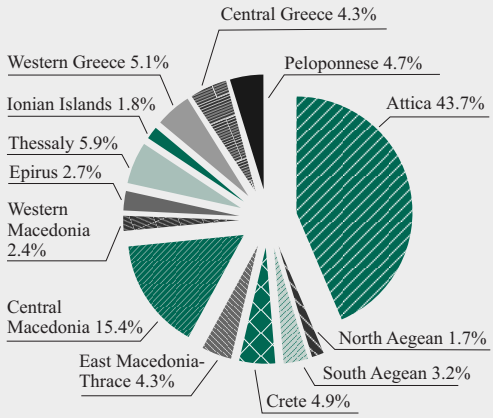
(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

Chart 6 Breakdown of primary income by region (2008-2014)

(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

8 Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union, and Eurostat, Regional accounts methods, Household accounts.

Macedonia (-7.3%), Epirus, the North Aegean and Western Macedonia (-7.2%, -6.8% and -6.1%, respectively). The lowest rates are observed in the South Aegean and the Ionian Islands (-2.1% and -3.9%, respectively), i.e. in regions with major tourism activity. As evidenced by the review of the first two accounts, the high growth rates of enterprises' profits and incomes (operating surplus-mixed income) counterbalance the low growth rates of compensation of employees in regions with high shares of tourism in gross value added and foreign arrivals.

4.3 RESOURCES OF THE SECONDARY DISTRIBUTION OF INCOME ACCOUNT

4.3.1 Primary income balance

The primary income balance is recorded on the "resources" side of the secondary distribution of income account as a rebalancing item.

4.3.2 Social benefits other than social benefits in kind, receivable

This heading includes social security benefits in cash (pensions and other than pensions), other social insurance benefits (pensions and other than pensions) and social security assistance in cash.

It should be stressed that the region of Attica has the lion's share in this account category as well; specifically, in 2000-2007 Attica, with a population corresponding to 36.0% of the country's total population,[9] accounts for 48.1% of social benefits (see Table 7). All other regions in the country exhibit shares in social benefits which are either lower than or broadly at the same level as their percentage shares in the country's total population. However, in terms of average annual growth rates, Attica appears to lag behind all other regions, as, compared with an average annual growth rate of 6.4% for the country as a whole, its 3.9% rate is the lowest among regions, whose growth rates range from 6.3% to 10.0%. The highest growth rates are found for Central Macedonia (10.0%), Epirus (9.7%), Thessaly (9.5%) and the Peloponnese (9.2%), followed by Western Macedonia (8.9%), East Macedonia (8.8%), Crete (8.7%), Western Greece (8.4%), the South Aegean (6.7%), the Ionian Islands (6.6%), the North Aegean (6.4%) and Central Greece (6.3%).

The high percentage share of Attica in social benefits, especially in 2000-2007, is clearly due to the fact that there is high concentration of people working for specific industries in Athens, such as persons employed in media and communication (63.6% of the industry's total workforce), bank and insurance employees (60.7% of total), persons employed in professional, scientific, technical, administrative and support service activities (53.5% of total), persons employed in real estate activities (59.8% of total), civil servants (42.0% of total), etc. Those are industries where insured employment prevails, thus accounting for relatively high shares in social benefits.

A similar picture is drawn when looking into the subperiod 2008-2014 (see Table 8), as, although a considerably higher share relative to population is again observed (35.8% of total population and 41.1% of total social benefits), the negative growth rate for Attica is stronger than the respective rate for the country as a whole (-4.2%, against -3.3%), on account of shrinking social benefits during the crisis period. The second highest negative growth rate refers to the South Aegean (-4.0%), while in the remaining regions negative growth rates vary from -3.0% to -1.2%.

4.3.3 Other current transfers, receivable

This heading comprises non-life insurance claims, current transfers between households (remittances by emigrants or workers permanently settled in other regions or abroad to members of their family living in their region or country of origin), transfers of households to students who are member of the family but

9 Population data are presented in Table 3.

constitute their own households, payments of compensation by government, bonus payments on savings, sponsoring by corporations, winnings from lotteries and gambling. In 2000-2007 a negative average annual growth rate in other current transfers is recorded at the country level (-3.3%). The highest positive growth rates are observed in the regions of East Macedonia-Thrace (6.1%), Thessaly (4.5%) and Epirus (3.9%), while fairly lower growth rates are witnessed in the regions of Central Macedonia (2.3%), the Peloponnese (0.3%) and Western Greece (0.2%). Markedly negative growth rates are observed in Attica (-8.4%, i.e. the highest rate), the Ionian Islands (-4.8%), the North Aegean (-4.4%) and the South Aegean (-3.3%). Negative albeit weaker rates are seen in Western Macedonia and Central Greece (-1.9% and -1.3%, respectively), while Crete witnessed a marginally negative rate (-0.2%).

According to data from the Non-Financial Sector Accounts – Households and NPISHs published by ELSTAT (see Table 6), in 2000-2007, 17.9% of this heading under review refers to non-life insurance claims and the remainder (82.1%) refers to miscellaneous current transfers, which include several sub-items, thereby making it difficult to draw any conclusions. The very strong positive growth rate in East Macedonia-Thrace may be due to a rise in remittances by Greek Muslim emigrants working abroad[10] to their families. Moreover, it could also be assumed that the strong positive growth rate in Thessaly is attributable to an increase in compensation payments for crop damage or VAT refunds to farmers.

Over the subperiod 2008-2014 (see Table 6) strongly negative growth rates are observed both at the country level (-8.1%) and at the regional level (from -8.4% to -7.5%).

Given that negative growth rates across regions are broadly similar, it is difficult to draw any conclusions other than a generic estimation that the sharp decline in other current transfers is due to the crisis.

4.4 USES OF SECONDARY DISTRIBUTION OF INCOME

4.4.1 Current taxes on income-wealth, payable

Current taxes on income, wealth, capital gains, etc. cover all compulsory, unrequited payments, in cash or in kind, levied periodically by general government and by the rest of the world on the income and wealth of institutional units, and some periodic taxes which are assessed neither on the income nor on the wealth. Taxes on inheritances, gifts and production, as well as one-off levies on capital and wealth are not included.

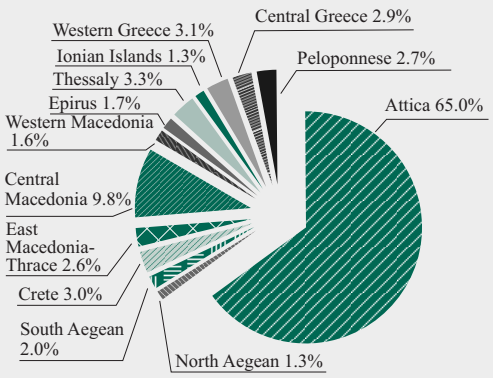
The Attica region has clearly the lion's share of current taxes on income-wealth (see Chart 7 and Table 7) in 2000-2007, accounting for 65.0% of the country total, when its population reaches 36.0% of the country total (as repeatedly stressed throughout the analysis). The reasons are evident, since Attica gathers the head offices of a large number of enterprises and many high-paid and insured corporate executives and employees who account for high shares in total taxable income and real estate. More specifically and on the basis of data from the Ministry of Finance's General Secretariat of Information Systems (GSIS) on declared incomes for financial years 2004 to 2007,[11] the region of Attica accounted, on average, for 39.0% of total taxpayers (see Chart 8) and 46.7% of total declared incomes (see Tables 10a-10b). The percentage shares of Attica in the country's total by income category are the following: 51.4% of total income from construction, 47.6% of total income from securities, 42.2% of total income from trade and manufacturing, 5.2% of total income from agriculture, 47.5% of total employee income, 54.0% of total self-employment income and 27.3% of total income earned abroad. Also, on the basis of GSIS data for the same period (see

10 As evidenced by declared income data from the Greek Ministry of Finance for the years 2004-2007 (data are provided in Tables 10a-10b in absolute averages, average percentage shares and average annual growth rates), the region of East Macedonia-Thrace posts the highest ratio of total income earned abroad to population.

11 Data on 2000-2003 are not available with regional breakdown.

Chart 7 Breakdown of current taxes on income-wealth, payable, by region (2000-2007)

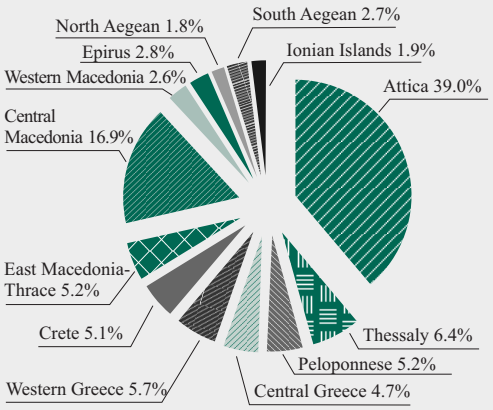
(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

Chart 8 Breakdown of total taxpayers by region (2004-2007)

(annual averages, country total=100, 2010 constant prices)



Source: Ministry of Finance, author's own calculations.

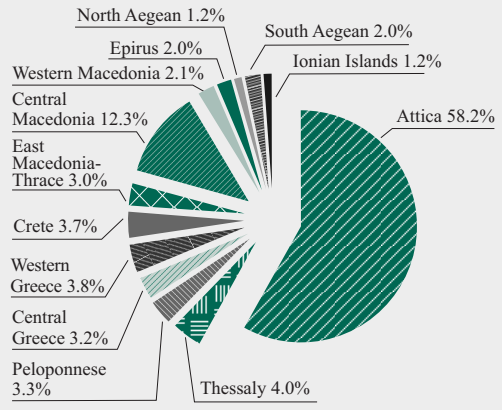
Chart 9 and Tables 11a-11c), total tax for the region of Attica represented 58.2% of country total and, if broken down by taxpayer category, it was as follows (based on taxpayers' main source of income, given that taxpayers may have incomes from different sources but taxes are calculated on total income): 70.7% of the country's total tax on rentiers, 50.0% of total tax on traders-industrialists-small-scale manufacturers-self-employed, 28.6% of total tax on farmers-livestock breeders-fishermen-foresters, 60.9% of total tax on employees, 61.6% of total tax on sole proprietors and 58.7% of total tax on pensioners.

With regard to all other regions of the country, on the basis of ELSTAT's household account data by region, as analysed herein (see Table 7), strong mismatches between population and payable taxes are observed, as the ratios of current taxes payable to population (see Table 12, which shows the percentage shares of each region in total current taxes on income-wealth, social security contributions and other current transfers payable, as well as the percentage shares of each region in total population and the relationship between them, i.e. the ratios of each aggregate to population for both subperiods under review) are far below unity (1) and are as follows: Attica 1.81, North Aegean 0.72, South Aegean 0.68, Crete 0.56, East Macedonia-Thrace 0.47, Central Macedonia 0.57, Western Macedonia 0.61, Epirus 0.54, Thessaly 0.49, Ionian Islands 0.68, Western Greece 0.48, Central Greece 0.57 and Peloponnese 0.50. It can be seen that the ratios for the North Aegean, the South Aegean and the Ionian Islands are the highest, while the lowest ratios are recorded for East Macedonia-Thrace, Western Greece, Thessaly and the Peloponnese. An overall trend of higher tax-paying capacity is found in the touristic regions in contrast with the agricultural regions, which lag behind as a result of tax-exempt subsidies. The particularly low ratios in Central Macedonia and Western Greece stand out, given that the two biggest urban centres after Athens are located in these regions.

The examination of this aggregate in terms of average annual growth rates for the subperiod 2000-2007 (see Table 7) reveals a marked negative growth rate in Attica (-2.3%, against 1.1% for the country as a whole) and a marginally negative growth rate in the Ionian Islands (-0.5%). In all other regions, growth rates are positive yet uneven, ranging between 0.1% and 12.1%.

Chart 9 Breakdown of total tax levied by region (2004-2007)

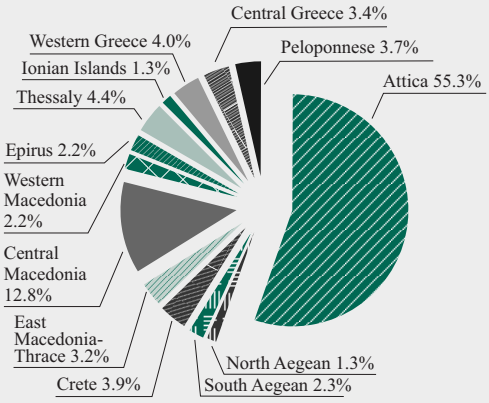
(annual averages, country total=100, 2010 constant prices)



Source: Ministry of Finance, author's own calculations.

Chart 10 Breakdown of current taxes on income-wealth, payable, by region (2008-2014)

(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

The highest growth rates of current taxes on income-wealth are seen in Western Macedonia (12.1%), Central Macedonia (10.6%), Western Greece (9.7%), the Peloponnese (9.6%) and Crete (9.2%), followed by Thessaly (8.6%), East Macedonia-Thrace (7.8%), Epirus (7.8%) and Central Greece (5.1%). A substantially lower growth rate is observed in the South Aegean (1.6%) and a marginally positive rate is recorded for the North Aegean (0.1%). The relatively high growth rates in the majority of agricultural regions (East Macedonia-Thrace, Central Macedonia, Western Greece, the Peloponnese, Thessaly, Epirus and Crete) can be explained by reduced subsidies as a result of a reform of the Common Agricultural Policy in 2000-2007 (subsidies on quantities produced were significantly cut and have been replaced mostly by direct payments), which pushed upwards farmers' tax obligations, as lower subsidies on quantities brought about a decline in subsidies overall. The relatively weak positive growth rate for the country's major touristic region (South Aegean) and the marginally negative growth rate for the second most important touristic region (Ionian Islands) are probably accounted for by the negative rates of change in non-residents' spending per trip that were observed in 2004-2007,[12] as the average spending per trip by non-residents declined at an average annual rate of -4.8% (see Table 9), while foreign arrivals at the airports of the South Aegean and the Ionian Islands either increased or decreased marginally (by 0.5% and by -0.5%, respectively), resulting in relatively small increases in the earnings and tax obligations of tourism entrepreneurs.

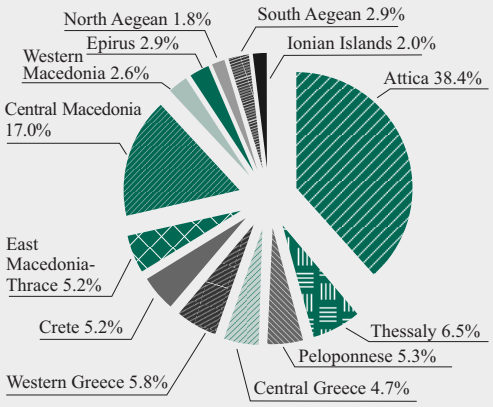
Over the following subperiod under review, 2008-2014, Attica's "gigantism" appears to have moderated somewhat, as, with an average share of 35.8% in the country's total population, this region accounted for 55.3% of total current taxes, while its ratio of current taxes payable to population decreased to 1.60 (see Chart 10 and Table 8). On the basis of the Ministry of Finance's GSIS data on declared incomes for financial years 2008-2010,[13] the Attica region accounted, on average, for 38.4% of total taxpayers and 45.9% of total

12 Data from the Bank of Greece *Bulletins of Conjunctural Indicators* of December 2007, 2008, 2009, 2012 and 2015. There are no available data on years 2000-2003.

13 These data cannot be cross-checked for the entire period under review, as the breakdown by income category and by region is discontinued in 2010 (from 2011 onwards, only data on the number of tax returns, the amount of taxable income and the corresponding tax are released). Besides, they refer to declared incomes. They are presented herein because they demonstrate Attica's "gigantism".

Chart 11 Breakdown of total taxpayers by region (2008-2010)

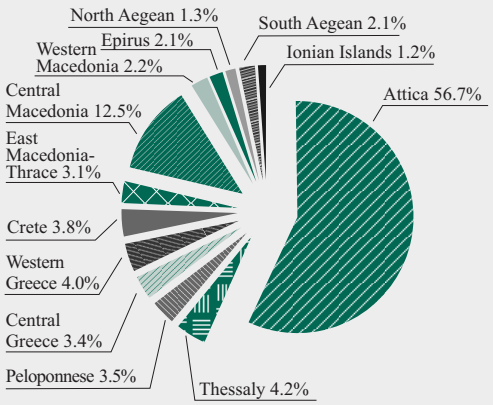
(annual averages, country total=100, 2010 constant prices)



Source: Ministry of Finance, author's own calculations.

Chart 12 Breakdown of total tax levied by region (2008-2010)

(annual averages, country total=100, 2010 constant prices)



Source: Ministry of Finance, author's own calculations.

declared incomes (see Chart 11 and Tables 13a-13b). The shares of the Attica region in the country total by income category are as follows: 51.5% of total income from construction, 43.0% of total income from securities, 40.1% of total income from trade and manufacturing, 5.0% of total income from agriculture, 46.6% of total employee income, 52.9% of total self-employment income and 26.9% of total income earned abroad. Moreover, on the basis of GSIS data for the same period, Attica accounted for 56.7% of the country' s total taxes payable; the breakdown by category of taxpayer is the following: 69.9% of total tax on rentiers, 47.6% of total tax on traders-industrialists-small-scale manufacturers-self-employed, 25.9% of total tax on farmers-livestock breeders-fishermen-foresters, 60.6% of total tax on employees, 59.8% of total tax on sole proprietors and 55.2% of total tax on pensioners (see Chart 12 and Tables 14a-14c).

In all other regions, over the subperiod 2000-2007, the ratios of current taxes payable to population (see Table 12) remain low (below unity), albeit at a higher level than over the previous subperiod reviewed, which is probably due to internal migration flows from Athens to the periphery (as confirmed also by population data).

The examination of this aggregate in terms of average annual growth rates for the subperiod 2008-2014 (see Table 8) points to a relatively sharp decline in Attica (-4.2%, against -3.3% for the country as a whole), which corroborates the internal migration flows from Athens into the periphery. The regions of Western Macedonia (-4.1%), Western Greece (-3.3%) and Central Greece (-2.7%) come next. In the remaining regions the average (overall negative) growth rates in current taxes on income-wealth range from -0.4% (Ionian Islands) to -2.3% (Epirus), with the South Aegean (-1.0%), East Macedonia-Thrace (-1.6%), the North Aegean (-1.7%), Crete and the Peloponnese (-1.8%) and Central Macedonia (-2.1%) featuring in between. Once again, the relative resilience of taxpaying capacity is manifest primarily in the touristic regions and secondarily in the agricultural regions, which is in line with the higher gross value added of the primary sector during the crisis.

4.4.2 Social contributions, payable

Social contributions, payable, consist of actual (pension and non-pension) contributions by

employers, employees and self-employed (paid directly to social security organisations), employers' imputed (pension and non-pension) social contributions (paid directly to employees and former employees) and households' social contribution supplements (which are classified under the property income attributed to households by pension funds in the primary income allocation account, but which are treated in the secondary distribution of income account as a refund by households to pension funds, given that in practice this income is retained).

Over the subperiod 2000-2007 (see Table 7) slightly increased ratios of social contributions payable to population are observed for the regions of Attica and Central Macedonia (1.04 and 1.10, respectively; see Table 12) and markedly elevated ratios are recorded for the regions of the South Aegean, the Ionian Islands and Western Macedonia (1.28, 1.57 and 1.24, respectively). In all other regions the ratios are below unity, with the lowest ones in the Peloponnese (0.73) and in Thessaly (0.80).

The average annual growth rates of social contributions payable (see Table 7) were fairly high in most regions, with Attica posting the highest rate (11.6%, against 5.1% for the country as a whole) and the Peloponnese the second highest (7.2%), followed by Thessaly (4.7%), East Macedonia-Thrace (4.5%), Crete (3.9%) and the North Aegean (3.6%). One region (Central Greece) posted a zero growth rate, while in the two touristic regions, i.e. the South Aegean and the Ionian Islands, the growth rates were negative (-1.2% and -1.6%, respectively).

The above indicate a contraction in social contributions payable for the touristic regions, as opposed to the agricultural regions which witnessed very high growth rates. It should be noted that, similar to the aggregate of compensation of employees receivable, the negative growth rates of social contributions for the touristic regions are not consistent with the corresponding growth rates of operating surplus-mixed income (conversely, the negative growth rates of both social contributions and compensation of employees seem to be broadly similar). Shrinking social contributions may be partly explained by the fact that a large number of tourism enterprises are family-run businesses and, therefore, contributing unpaid family workers are not recorded as employed persons. By contrast, a positive relationship between operating surplus, compensation of employees and social contributions is observed in the agricultural regions, especially in the Peloponnese and in Thessaly, for reasons that have already been pointed out by the analysis regarding the compensation of employees aggregate.

Furthermore, considerable divergences in the growth rates of social contributions (11.6%), operating surplus-mixed income (3.2%) and compensation of employees (6.8%) stand out for the region of Attica. The very high growth rate of contributions payable may be due to an increase in optional insurance (self-insurance), i.e. the right granted to insured workers who have discontinued their business activity or are no longer employed under dependent labour contracts to remain insured and pay contributions without earning any income and without receiving compensation as employees, and/or in private insurance schemes.

Over the following subperiod, 2008-2014 (see Table 8), the ratio of social contributions payable to population dropped considerably (see Table 12) in the regions of the South Aegean[14] (from 1.28 to 1.00), Crete (from 0.95 to 0.87) and the Ionian Islands (from 1.57 to 0.91), as well as in the regions of Western Macedonia (from 1.24 to 0.89), Central Macedonia (from 1.10 to 0.92) and Epirus (from 0.92 to 0.84), while weaker declines are recorded in the North Aegean (from 0.99 to 0.92), East Macedonia-Thrace (from 0.82 to

14 For the region of the South Aegean in particular, the figure provided in the relevant table by ELSTAT for year 2014 was not taken into account, as it deviates strongly year on year, and is most probably bound to be significantly revised. Instead, the respective figure for year 2013 is used.

0.80) and Western Greece (from, 0.85 to 0.80). In three regions, namely Attica, Thessaly and the Peloponnese, the ratio has risen (from 1.04 to 1.24, from 0.80 to 0.85 and from 0.73 to 0.87, respectively).

The average annual growth rates (see Table 8) are negative in all regions without exception, ranging in twelve out of the 13 regions from -2.5% (Western Macedonia) to -6.9% (Ionian Islands). In one region, i.e. the South Aegean, the negative growth rate was as high as -11.3%. Given that in this very region the growth rate of operating surplus-mixed income is 1.5% in 2008-2014 (i.e. the only positive growth rate nationwide during the crisis period), while the growth rates of compensation of employees and of the number of employees stand at -6.9% and -2.0%, respectively, it is clear that the decline in social contributions payable is associated with large-scale uninsured dependent labour and uninsured self-employment in the region. In the remaining regions, it was found that the decline in social contributions was slower than the declines in both operating surplus-mixed income and compensation of employees (apparently, this was also the case for 2000-2007, on account of optional insurance and/or personal insurance coverage), with the exception of the Ionian Islands where the rates of decline came to -6.9% in social contributions, -6.2% in compensation of employees and -1.4% in operating surplus-mixed income.

4.4.3 Other current transfers, payable

This heading comprises net non-life insurance premiums, remittances by emigrants, workers or households permanently settled in a region or to members of their family living in other regions or abroad, transfers of households to students who are members of the family but constitute their own households, regular subscriptions paid by households to trade unions and political, sporting, cultural and similar organisations classified in the NPISH sector, and refunds by households of expenditure incurred on their behalf by social welfare organisations.

In 2000-2007, with regard to this heading, the Attica region accounts for a markedly high share of the country total (55.7%, ratio of other current transfers payable to population 1.55; see Tables 7 and 12). Conversely, the respective percentage shares of the other regions relative to population lag visibly behind, except for those of the South Aegean and the Ionian Islands (ratio of current transfers payable to population, 1.01 and 1.13, respectively). In average annual terms (see Table 7), high growth rates for other current transfers payable are observed in the Peloponnese (12.4%), the South Aegean (12.1%), Crete (11.5%), East Macedonia-Thrace (10.9%), Central Greece (10.7%) and Thessaly (9.8%). The Ionian Islands exhibited a modest growth rate (5.3%), while the North Aegean a significantly lower one (2.2%). In one region, i.e. Western Macedonia, the growth rate is strongly negative (-6.0%), while in two other regions, namely Attica and Epirus, growth rates were marginally negative (-0.2%). At the country level, the average annual growth rate of other current transfers payable stood at 3.2%.

During the following subperiod reviewed, 2008-2014 (see Tables 8 and 12), the ratio of other current transfers payable to population dropped slightly in Attica (1.40), but strengthened in the North Aegean and the Ionian Islands (1.34 and 1.20, respectively). The ratios in the Peloponnese and Central Greece appear to have risen considerably (from 0.78 and 0.74 to 1.15 and 1.05, respectively), while in Thessaly the below-unity ratio has improved from 0.53 to 0.60. In the remaining regions the ratios are relatively stable. In average annual terms (see Table 8), the (throughout) negative growth rates in other current transfers payable range between -3.4% (South Aegean) and -6.1% (Western Macedonia).

According to data from ELSTAT's non-financial sector accounts for households and NPISHs (which, as already mentioned, are published at the national level, are not broken down by region and are presented in Table 6), in 2000-2007 the smallest share of other current trans-

fers payable refers to non-life insurance premiums (33.8%) and the bulk (66.2%) refers to transfers other than premiums. The respective average annual growth rates are 3.8% and 3.0%. In 2008-2014 (see Table 6), the composition has changed considerably, as insurance premiums shrank to 22.2% and miscellaneous current transfers increased to 77.8%, while their average annual growth rates came to -4.5% and -5.1%, respectively. The fact that the share of insurance premiums has shrunk but their average annual decline is lower than that of miscellaneous transfers is due to the fact that, in absolute terms, miscellaneous transfers were quite elevated in 2008, thereby declining at a much stronger rate than premiums, although, on average, they have increased.

In general, it can be observed that the very high growth rates in the South Aegean, Thessaly, Central Greece and the Peloponnese in 2000-2007 point to a satisfactory path of this aggregate in the regions with the highest specialisation in tourism, agriculture and manufacturing, respectively, while the improved ratios of other current transfers payable to population for the same regions in 2008-2014 attest to a relative resilience during the crisis.

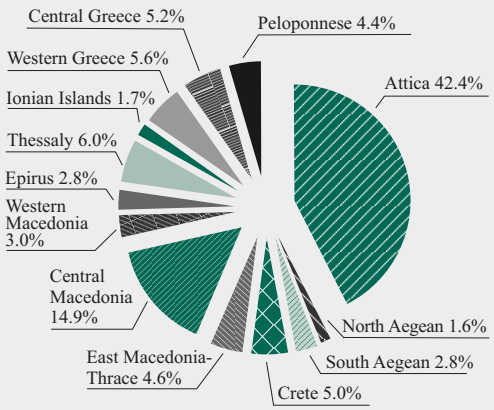
4.4.4 Disposable income

It refers to gross primary income balance, plus social benefits (other than social transfers in kind) and net other current transfers (resources less uses), minus current taxes. It is classified under the secondary distribution of income account as a rebalancing item (see Charts 13-14 and Tables 7-8, as well as Table 15, which shows the percentage shares of disposable income and final consumption expenditure by region, the percentage shares of population by region and the relationships between them, i.e. the ratios of each aggregate to population but also the ratio of final consumption expenditure to disposable income for both subperiods under review).

In 2000-2007, considerably high rates of increase in disposable income are observed for

Chart 13 Breakdown of disposable income by region (2000-2007)

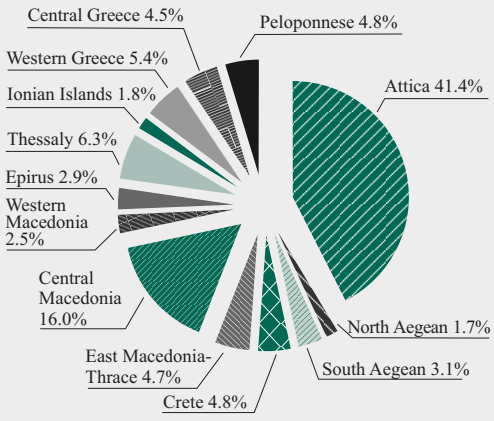
(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

Chart 14 Breakdown of disposable income by region (2008-2014)

(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

Attica (see Table 7) (4.3%, against 3.5% for the country as a whole), as well as for Central Macedonia (5.4%), the Peloponnese (5.3%) and Thessaly (3.8%), followed by East Macedonia-Thrace, Crete and Western Greece (3.5%, 2.7% and 2.4%, respectively) and the North Aegean, the Ionian Islands and the South Aegean (1.8%, 1.2% and 1.1%, respec-

tively). The lowest increase is recorded for the region of Central Greece (0.3%).

The strongest increases are thus recorded in the regions with the two largest urban centres of the country or with specialisation in the primary sector, followed by those with specialisation in the tourism sector, which post weaker growth rates.

In the following subperiod under review, 2008-2014 (see Table 8), disposable income growth shifts to negative territory in twelve out of the 13 regions of the country, ranging between -3.3% (Ionian Islands) and -8.7% (Thessaly and Western Greece). The regions of Attica (-8.3%), Central Greece (-7.3%), East Macedonia-Thrace (-6.9%), Central Macedonia, Thessaly and Peloponnese (-6.8%) stand in the middle, followed by the North Aegean, Western Macedonia and Crete (-6.3%, -6.2% and 6.1%, respectively). For the country as a whole, the negative growth rate comes to -7.3%. The only region posting a positive growth rate is the South Aegean (1.0%).

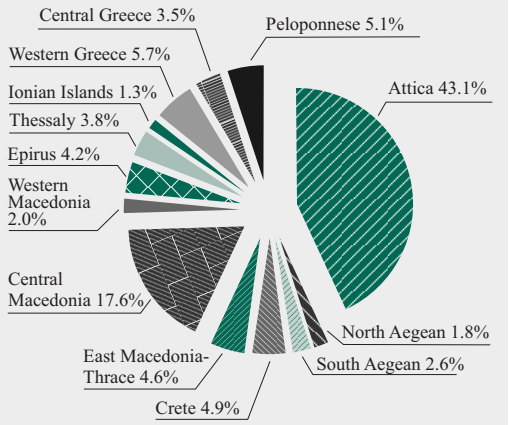
Although in 2000-2007 broadly positive growth rates are recorded in all regions (clearly led by those with specialisation in the primary sector), during the crisis period (2008-2014) (see Chart 14 and Tables 8 and 12) only one region, with the highest specialisation in tourism, posts a robust average rate of increase in disposable income.

4.4.5 Final consumption expenditure[15]

This heading comprises expenditure on goods and services that are used by households to meet individual and collective needs, excluding the following: social transfers in kind, items that are treated as intermediate consumption (such as households' own-account consumption of outputs produced by unincorporated enterprises owned by households) or gross fixed capital formation (such as house purchase, expenditure on valuables), purchases of land, taxes, subscriptions and contributions to NPISHs, voluntary transfers in cash or in kind.

Chart 15 Breakdown of final consumption expenditure by region (2008-2014)

(annual averages, country total=100, 2010 constant prices)



Source: ELSTAT, author's own calculations.

Final consumer expenditure is one of the two components of the "uses" side on the disposable income account of households (the other component is saving, which is recorded on the "uses" side of the disposable income account as a rebalancing item, i.e. the differential between disposable income and consumption). As a result, it cannot be included in the distribution and redistribution of income accounts and is examined independently. It should be noted that it is practically impossible to measure final consumption expenditure relative to disposable income for a specific period. It should also be noted that it is very difficult to determine final consumption expenditure referring to households-residents of a region, and this will become apparent further below.

As shown in Chart 15 and in Tables 8 and 15, relatively high ratios of final consumption expenditure to population are observed in Epirus, Attica, Central Macedonia and the North Aegean (1.37, 1.20, 1.02 and 1.01, respectively). In all other regions the ratios are less than one.

15 Data are available only for the subperiod 2008-2014.

In average annual growth rates (see Table 8), a decline in final consumption expenditure is recorded in twelve out of the 13 regions of the country; the decline is very sharp for Epirus (-17.6%), much lower but fairly pronounced for the North Aegean (-10.8%), the Peloponnese (-9.3%), Central Greece (-8.2%) and Central Macedonia (-7.8%), and weaker for Attica (-5.5%), East Macedonia-Thrace (-4.8%), the South Aegean (-4.2%), the Ionian Islands (-3.5%), Western Macedonia (-3.4%), Western Greece (-2.4%) and Crete (-2.0%). In one region, i.e. Thessaly, a particularly robust positive growth rate can be seen (4.1%). At the national level, the rate of decline reaches -5.9%.

It should be pointed out that the two regions where the country's two biggest cities are located (Attica and Central Macedonia) account for high shares in total final consumption expenditure during the crisis period. Besides, the relatively weak (below the country average) declines for the regions with specialisation in the tourism sector should be underlined once more (given that, as already mentioned, the low compensation of employees is offset by the high operating surplus-mixed income, thereby resulting in a weaker rate of decline in consumption expenditure for those regions). With regard to the regions specialised in the primary sector, developments are uneven, as the positive growth rate for the region with the highest specialisation in agricultural activities (Thessaly) is not consistent with the strongly negative growth rate for the remaining agricultural regions.

Furthermore, it should be noted that the region of Epirus accounts for a high share of final consumption expenditure, which is however coupled with a much higher negative growth rate over the same period. This reveals that the markedly high ratio of consumption expenditure to population was only conjunctural and is attributable to the fact that Epirus for a number of years had been a gateway for immigrants from Albania who consumed but were not registered in the population of the region. Today, because of the crisis, things have changed, and many immigrants have returned to their home country, whose economy is currently on a growth track. Epirus witnessed a steep drop in consumption expenditure (-47.6%, compared with -9.2% for the country as a whole) in 2012, i.e. when the effects of the crisis had already been felt.

5 SUMMARY OF FINDINGS

As already mentioned, the objective of this study is to draw cross-regional comparisons with regard to disposable income, consumption expenditure, compensation of employees, tax-paying capacity, social contributions and other aggregates, to the extent that there is availability of data.

The accounts analysed were compiled using the method of regionalisation (breakdown of the national aggregate at the regional level based on a distribution key) and drawing on data collected using either the bottom-up or the bottom-down approach.

Operating surplus-mixed income increased considerably in 2000-2007 and showed resilience in 2008-2014 in the regions with major tourism activity, i.e. the South Aegean and the Ionian Islands. Besides, in 2000-2007, these regions witnessed a low growth rate of compensation of employees, which turned strongly negative in 2008-2014 and was inconsistent with the resilience of business income.

Turning to the regions with specialisation in the primary sector, i.e. Thessaly, Western Greece, the Peloponnese, East Macedonia-Thrace, Crete, the North Aegean and Central Macedonia, operating surplus-mixed income also increased considerably in 2000-2007, but showed no resilience in 2008-2014. Against this backdrop, it is found that during the crisis business income shrank in all regions with specialisation in agriculture, despite a higher gross value added in the primary sector, apparently as a result of changes in the calculation of subsidies, which were decoupled from out-

put volumes and have now taken the form of an income to support farmers. Nevertheless, in contrast with the regions with a well-developed tourism sector, a slower rate of decline in compensation of employees was observed, on account of weak labour supply in the primary sector.

Taxpaying capacity across regions appears to be significantly high in Attica for both subperiods under review (the share has shrank considerably during the crisis period, but remains fairly elevated), because a large number of enterprises and high-paid executives are concentrated in this region. A relatively high taxpaying capacity is also recorded in the two major touristic regions, i.e. the South Aegean and the Ionian Islands (yet both significantly lagging behind, relative to Attica), for both subperiods reviewed.

The regions that are characterised by high taxpaying capacity also had a large share in total social contributions in 2000-2007. However, during the crisis period, this share was sustained (and in fact has strengthened) only for Attica. In the touristic regions the ratio of social contributions to population has declined visibly. In the South Aegean in particular, the average annual rate of decline was very strong (-11.3%, compared with -5.2% for the country as a whole), although compensation of employees declined at a much weaker pace relative to the country total. The decline in social contributions, which was not coupled with a concurrent decline in compensation of employees, points to a rise in uninsured employment, which has most probably occurred during the crisis in the touristic regions of the country (it should be borne in mind that the decline in social contributions may also reflect a rise in self-employment; yet this cannot be established on the basis of the accounts under review).

With regard to to disposable income in 2000-2007, the region of Attica is a clear leader (ratio of disposable income to population 1.18), followed by Western Macedonia and Central Greece, i.e. the regions with the highest specialisation in the secondary sector and in manufacturing, respectively (ratios of disposable income to population 1.14 and 1.03, respectively). The South Aegean, i.e. the region with the highest specialisation in tourism-related services, comes next (0.96). Over the subperiod 2008-2014, the situation for the region of Attica remained broadly unchanged (the ratio of income to population declines slightly to 1.16), while this ratio was visibly lower for Western Macedonia and Central Greece (0.97 and 0.98, respectively). The South Aegean witnessed some improvement (1.03), as well as the Ionian Islands (0.97). In the regions with specialisation in the primary sector, the ratios of disposable income to population during the crisis period have either improved or remained unchanged at their 2000-2007 levels.[16]

Lastly, with regard to consumption expenditure (available data cover only the subperiod 2008-2014), the highest ratios of consumption expenditure to population are observed in Epirus (1.37), Attica (1.20) and Central Macedonia (1.02), followed by the North Aegean (1.01), the Peloponnese (0.95) and Western Greece (0.91). It should be noted that for all regions with specialisation in the primary sector the ratio of consumption expenditure to population is below unity, but this is clearly due to the fact that a large part of consumer needs are met with own-account production by consumers, especially in the food sector, rather than with market products. The high ratios of the two regions where the two biggest cities (Athens and Thessaloniki) are located are attributed to the fact that consumers in large cities cannot do otherwise but purchase every-

16 Similar conclusions are drawn by the following studies: (a) Papapetrou and Manou (2016), who draw on statistical data from the European Central Bank's database to find that between early 2008 and early 2016 households' net financial wealth in Greece decreased by 37.5%, as well as that between the first quarter of 2010 and the first quarter of 2016 disposable income shrank by 32.8%, while actual consumption expenditure fell by 25.7%; and (b) Charalambakis (2017), who uses data from the two waves of the Eurosystem's Household Finance and Consumption Survey that were conducted in 2009 and 2014 and finds that the median value of household net wealth during the crisis declined by 40%, household median income by 26% and median total annual food consumption by 27%.

thing that has to do with food. Furthermore, large urban centres accumulate a big number of students, employees, or internal migrants who live and consume there but are registered in the population of their region of origin. As a result, consumption expenditure is overestimated relative to population. In any event, this is not the case for the region of Epirus, which posts the highest ratio of consumption expenditure to population. Most likely, this is accounted for by the fact that Epirus has been for several years a gateway for immigrants from Albania, who stayed in Greece and consumed but were not registered in the population of this region, either because they lived there as undeclared workers or because they stayed for a short period of time before moving on to other regions of the country. It was only natural that continuous inflows to the region, even if immigrants stayed for just two or three days, amplified total consumption expenditure. It should be noted that in 2000-2007 as well as in 2008-2014 Epirus exhibited the highest specialisation in construction, a branch in which immigrants from Albania were predominantly employed, having a large contribution to the region's consumption expenditure, either in transit or as construction workers. The relatively high ratio of consumption expenditure to population in the North Aegean may also be attributable to the fact that this region too has been a gateway for immigrants by sea (albeit to a much lesser extent than Epirus).

REFERENCES

Charalambakis, E. (2017), "How did the Greek financial crisis impact on households? A comparison between the two waves of the HFCS", Bank of Greece, *Economic Bulletin*, 45.

Eurostat (1996), "Regional accounts methods, Household accounts", Statistical Office of the European Communities, Office for Official Publications, Luxembourg.

Eurostat (2013a), "European system of accounts", Eurostat Manuals and Guidelines, Publications Office of the European Union, Luxembourg.

Eurostat (2013b), "Manual on regional accounts methods", Eurostat Manuals and Guidelines, Publications Office of the European Union, Luxembourg.

Isard, W. (1962), *Methods of Regional Analysis, An introduction to Regional Science*, The Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A.

McCann, P. (2001), *Urban and Regional Economics*, Oxford University Press.

Papadaskalopoulos, A. (2000), *Methods of Regional Analysis*, Papazisis Publishers (in Greek).

Papapetrou, E. and K. Manou (2016), "The economic behaviour of households in Greece: recent developments and prospects", Bank of Greece, *Economic Bulletin*, 44.

Regulation (EU) No 549/2013 of the European Parliament and of the Council of 21 May 2013 on the European system of national and regional accounts in the European Union, Official Journal of the European Union L 174/1.

DATA SOURCES

Hellenic Civil Aviation Authority, Air traffic statistics by airport for the years 2000-2014.

Hellenic Statistical Authority (ELSTAT), Regional accounts, Household regional accounts, 2000-2014.

Ministry of Finance, General Secretariat of Information Systems, Public data, Statistical bulletins of tax data for the years 2004-2010.

APPENDIX

Table 1 Regional household accounts (2000-2007)

(%)

	Allocation of primary income account				
	Resources			Uses	
	Operating surplus – Mixed income	Compensation of employees, receivable	Property income, receivable	Property income, payable	Primary income balance
	Averages				
	Region's percentage share in country total				
Country total	100	100	100	100	100
Attica	40.3	44.0	41.4	47.4	42.1
North Aegean	1.6	1.5	2.5	2.0	1.6
South Aegean	3.0	2.8	3.7	2.6	3.0
Crete	5.2	4.8	6.0	4.7	5.1
East Macedonia-Thrace	4.4	4.6	4.4	5.3	4.5
Central Macedonia	16.1	14.8	13.3	12.5	15.2
Western Macedonia	2.8	3.4	2.8	2.5	3.1
Epirus	2.9	2.6	3.2	2.3	2.8
Thessaly	6.0	5.6	5.6	5.2	5.8
Ionian Islands	1.8	1.8	2.4	1.9	1.9
Western Greece	6.0	5.1	5.4	4.8	5.5
Central Greece	5.4	5.0	4.8	4.5	5.2
Peloponnese	4.4	4.0	4.4	4.4	4.2
	Average annual growth rates				
Country total	2.9	5.2	-1.8	8.9	3.3
Attica	3.2	6.8	5.2	14.0	5.0
North Aegean	4.0	5.1	-18.0	-8.7	1.3
South Aegean	6.1	-1.4	-14.2	-1.8	0.2
Crete	5.3	3.1	-6.8	9.9	2.5
East Macedonia-Thrace	3.9	3.1	-2.9	4.4	2.7
Central Macedonia	2.3	7.3	-2.1	11.4	3.8
Western Macedonia	-3.5	-3.3	-11.6	-2.0	-4.4
Epirus	0.4	4.2	-11.3	3.7	0.5
Thessaly	3.5	5.2	-6.3	4.2	3.1
Ionian Islands	4.6	-1.0	-10.7	0.4	-0.1
Western Greece	0.6	4.7	-8.1	3.9	1.3
Central Greece	-1.0	2.1	-9.2	-1.0	-0.5
Peloponnese	7.0	6.4	-4.9	3.9	5.3

Source: ELSTAT, author's own calculations.
Note: Data for all years are provisional.

Table 2a Gross value added by sector

(%)

	Agriculture, forestry and fishing		Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities				Construction	
			Total		Manufacturing			
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Sector's percentage share in region total (region = 100)							
Country total	3.7	3.5	14.0	11.8	10.2	8.5	6.0	3.9
Attica	0.3	0.4	11.2	9.1	8.4	6.9	5.4	3.1
North Aegean	5.9	4.7	6.2	5.5	3.7	3.1	6.0	4.5
South Aegean	2.3	2.6	7.2	5.8	2.8	2.3	6.8	5.5
Crete	7.2	6.1	8.2	7.9	4.9	5.0	7.1	5.2
East Macedonia-Thrace	7.6	6.7	16.1	13.9	11.2	10.3	5.9	3.8
Central Macedonia	5.4	5.2	15.8	13.5	13.1	11.3	5.8	3.9
Western Macedonia	5.9	5.9	39.8	38.7	4.0	4.5	6.7	4.2
Epirus	7.3	7.1	10.8	9.7	6.8	7.0	9.2	6.7
Thessaly	9.3	9.4	15.5	14.2	13.2	12.2	6.3	4.2
Ionian Islands	3.5	3.4	4.2	4.0	2.6	2.2	6.3	5.1
Western Greece	8.8	8.5	12.9	10.4	10.1	8.0	7.4	5.4
Central Greece	8.0	7.6	33.9	29.3	29.9	24.4	6.3	4.5
Peloponnese	8.2	7.8	20.7	17.9	14.8	12.7	6.0	5.0

	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities		Information and communication		Financial and insurance activities		Real estate activities	
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Sector's percentage share in region total (region = 100)							
Country total	25.4	23.9	3.6	3.7	4.1	4.7	12.0	17.1
Attica	23.2	22.5	5.6	5.5	6.0	6.7	15.2	20.7
North Aegean	31.9	26.8	2.2	2.0	2.6	2.8	11.4	15.5
South Aegean	49.1	46.9	1.3	1.2	1.9	2.1	8.6	13.0
Crete	34.5	32.7	1.8	2.1	2.7	3.1	8.8	13.1
East Macedonia-Thrace	24.3	21.2	1.8	1.7	2.5	2.7	7.4	11.5
Central Macedonia	26.1	24.1	2.0	2.4	3.0	3.4	9.1	13.7
Western Macedonia	14.1	12.7	1.2	1.2	1.9	2.2	6.6	9.4
Epirus	25.0	23.4	1.6	1.6	2.4	2.8	10.2	15.3
Thessaly	23.4	20.5	1.4	1.3	2.2	2.5	9.3	13.7
Ionian Islands	48.8	43.7	1.3	1.3	1.8	2.4	9.9	15.7
Western Greece	25.7	23.0	2.3	2.9	2.5	2.8	10.6	15.5
Central Greece	19.7	20.3	1.2	1.3	1.6	2.0	7.6	12.4
Peloponnese	23.2	20.7	2.0	1.9	2.3	2.5	11.6	17.2

Source: ELSTAT, author's own calculations.

Table 2α Gross value added by sector *(continued)*

(%)

	Professional, scientific and technical activities; administrative and support service activities		Public administration and defence; compulsory social security; education; human health and social work activities		Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies		Total gross value added	
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Sector's percentage share in region total (region = 100)							
Country total	5.9	5.5	20.9	21.8	4.4	4.2	100	100
Attica	8.4	7.9	20.2	20.0	4.5	4.1	100	100
North Aegean	3.3	3.1	27.5	32.1	3.0	2.9	100	100
South Aegean	2.8	2.4	16.6	17.1	3.5	3.5	100	100
Crete	4.4	4.0	21.2	21.1	4.1	4.6	100	100
East Macedonia-Thrace	3.7	2.6	26.7	32.3	4.0	3.5	100	100
Central Macedonia	4.9	4.1	22.8	25.0	5.1	4.8	100	100
Western Macedonia	2.7	2.8	17.3	19.6	3.7	3.1	100	100
Epirus	3.2	2.8	26.2	27.0	4.0	3.6	100	100
Thessaly	3.6	2.5	24.6	27.3	4.5	4.5	100	100
Ionian Islands	3.2	3.2	16.9	16.0	4.0	5.0	100	100
Western Greece	3.0	2.7	22.3	24.1	4.5	4.8	100	100
Central Greece	2.3	2.1	16.2	17.4	3.0	3.1	100	100
Peloponnese	3.1	2.6	18.7	19.8	4.1	4.6	100	100

Source: ELSTAT, author's own calculations.

Table 2b Gross value added by sector

(%)

	Agriculture, forestry and fishing		Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities				Construction	
			Total		Manufacturing			
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Average annual growth rates							
Country total	-3.7	2.4	3.0	-5.8	2.8	-6.0	6.2	-11.8
Attica	0.1	1.6	3.8	-7.1	3.4	-5.8	6.5	-12.5
North Aegean	-5.9	2.9	6.5	-2.7	6.9	-4.6	8.0	-6.1
South Aegean	-0.4	0.9	1.8	-3.6	4.3	-8.2	2.8	-4.5
Crete	-2.5	-0.8	3.1	-2.3	3.2	-3.1	7.7	-14.2
East Macedonia-Thrace	-4.3	2.5	2.3	-6.3	3.0	-6.0	1.7	-10.2
Central Macedonia	-3.5	1.8	1.8	-6.8	1.8	-6.0	9.9	-14.4
Western Macedonia	-2.8	4.1	3.1	2.8	4.7	-3.1	1.6	-12.0
Epirus	-4.7	5.0	3.8	-4.8	4.7	-2.3	5.1	-7.1
Thessaly	-5.9	4.0	6.5	-6.4	7.1	-6.1	7.5	-10.5
Ionian Islands	-2.7	2.9	6.5	-6.5	6.3	-6.8	7.9	-12.5
Western Greece	-3.2	2.6	7.9	-7.7	8.7	-8.4	4.9	-13.5
Central Greece	-6.2	2.9	-0.8	-5.9	-0.8	-7.1	3.4	-12.7
Peloponnese	-1.7	2.4	1.9	-5.1	1.1	-6.0	3.2	-7.5

	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities		Information and communication		Financial and insurance activities		Real estate activities	
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Average annual growth rates							
Country total	4.1	-7.3	8.1	-30.3	-7.1	-8.5	3.3	2.2
Attica	4.5	-6.2	7.9	-24.6	-6.9	-8.5	3.3	2.0
North Aegean	5.0	-11.1	8.9	-37.2	-7.8	-8.7	3.2	2.3
South Aegean	4.1	-6.6	7.8	-47.3	-8.4	-9.4	3.6	2.9
Crete	3.7	-6.1	10.3	-40.8	-7.5	-8.5	3.5	2.4
East Macedonia-Thrace	3.7	-8.7	7.5	-36.5	-7.2	-8.3	2.9	3.0
Central Macedonia	3.6	-8.2	8.3	-36.7	-6.7	-7.7	3.8	2.3
Western Macedonia	2.9	-10.0	7.7	-34.9	-7.2	-8.1	3.1	2.0
Epirus	4.0	-7.7	7.2	-38.6	-6.6	-7.4	3.3	2.3
Thessaly	3.8	-10.0	7.4	-38.2	-8.1	-8.1	3.1	2.1
Ionian Islands	4.5	-8.5	7.4	-45.4	-9.4	-10.6	3.6	2.6
Western Greece	3.8	-9.1	10.0	-35.1	-8.1	-10.0	3.2	2.3
Central Greece	4.2	-8.9	7.8	-38.6	-8.2	-9.1	3.4	2.4
Peloponnese	3.8	-7.7	8.0	-35.3	-7.9	-8.8	3.5	2.5

Source: ELSTAT, author's own calculations.

Table 2b Gross value added by sector *(continued)*

(%)

	Professional, scientific and technical activities; administrative and support service activities		Public administration and defence; compulsory social security; education; human health and social work activities		Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies		Total gross value added	
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Average annual growth rates							
Country total	6.4	-10.5	3.7	-3.4	4.4	-5.3	3.8	-4.6
Attica	7.6	-10.6	3.3	-3.4	6.2	-7.4	4.7	-4.5
North Aegean	4.1	-1.9	7.3	-2.7	-2.8	0.3	4.6	-4.7
South Aegean	3.4	-7.4	4.9	-5.1	6.5	-5.1	3.4	-4.6
Crete	6.3	-9.2	4.6	-5.5	4.4	0.3	3.6	-4.5
East Macedonia-Thrace	4.5	-15.7	3.9	-2.4	1.8	-3.8	2.6	-4.7
Central Macedonia	3.9	-10.7	4.5	-3.6	2.4	-3.4	3.5	-5.1
Western Macedonia	3.6	-8.6	4.5	-2.9	2.5	-9.4	2.7	-1.2
Epirus	2.8	-11.0	0.2	-2.3	0.2	-3.1	2.2	-3.9
Thessaly	3.1	-14.6	3.6	-1.1	1.0	-4.7	3.1	-4.5
Ionian Islands	5.2	-8.0	1.3	-5.0	-0.1	-4.3	3.3	-5.8
Western Greece	3.4	-6.3	4.1	-2.4	4.8	-0.1	3.7	-4.8
Central Greece	2.7	-11.2	3.1	-4.5	3.7	-6.9	1.0	-5.0
Peloponnese	3.3	-14.2	3.4	-3.8	4.0	-2.1	2.7	-4.0

Source: ELSTAT, author's own calculations.

Table 3 Airports - Passenger arrivals

	Domestic-Foreign arrivals		Foreign arrivals		Population*		Foreign arrivals/ population	
	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014	2000-2007	2008-2014
	Averages (in persons)							
Country total	17,929,904	19,583,043	12,359,603	13,725,165	10,959,175	11,059,313	1.1	1.2
Attica	6,827,729	7,361,783	4,291,641	4,699,256	3,942,204	3,960,924	1.1	1.2
North Aegean	630,984	611,231	233,020	196,960	199,078	199,693	1.2	1.0
South Aegean	3,058,068	3,676,153	2,274,337	2,805,543	320,998	333,173	7.1	8.4
Crete	3,265,660	3,637,631	2,604,024	2,916,825	598,929	624,580	4.3	4.7
East Macedonia-Thrace	303,343	248,746	103,139	79,217	596,057	609,446	0.2	0.1
Central Macedonia	1,813,195	2,068,171	1,080,889	1,296,125	1,876,014	1,915,114	0.6	0.7
Western Macedonia	5,101	3,349	46	1	287,573	284,258	0.0	0.0
Epirus	70,445	49,551	401	194	342,630	344,522	0.0	0.0
Thessaly	159,112	162,210	149,056	146,602	743,023	744,182	0.2	0.2
Ionian Islands	1,700,508	1,651,367	1,529,422	1,482,666	207,151	208,372	7.4	7.1
Western Greece	46,568	54,460	46,258	54,007	699,767	688,280	0.1	0.1
Central Greece	-	-			557,313	559,313	0.0	0.0
Peloponnese	49,191	58,392	47,371	47,769	588,439	587,457	0.1	0.1
	Region's percentage share in country total (%)							
Country total	100	100	100	100	100	100		
Attica	38.1	37.6	34.7	34.2	36.0	35.8		
North Aegean	3.5	3.1	1.9	1.4	1.8	1.8		
South Aegean	17.1	18.8	18.4	20.4	2.9	3.0		
Crete	18.2	18.6	21.1	21.3	5.5	5.6		
East Macedonia-Thrace	1.7	1.3	0.8	0.6	5.4	5.5		
Central Macedonia	10.1	10.6	8.7	9.4	17.1	17.3		
Western Macedonia	0.0	0.0	0.0	0.0	2.6	2.6		
Epirus	0.4	0.3	0.0	0.0	3.1	3.1		
Thessaly	0.9	0.8	1.2	1.1	6.8	6.7		
Ionian Islands	9.5	8.4	12.4	10.8	1.9	1.9		
Western Greece	0.3	0.3	0.4	0.4	6.4	6.2		
Central Greece	-	-	-	-	-	-		
Peloponnese	0.3	0.3	0.4	0.3	5.4	5.3		

Source: Hellenic Civil Aviation Authority, author's own calculations.
* Population data source: ELSTAT (population estimate as of 1 January each year).

Table 4 Regional household accounts (2008-2014)

(%)

	Allocation of primary income account				
	Resources			Uses	
	Operating surplus-Mixed income	Compensation of employees, receivable	Property income, receivable	Property income, payable	Primary income balance
	Averages				
	Region's percentage share in country total				
Country total	100.0	100.0	100.0	100.0	100.0
Attica	39.7	45.9	49.9	50.1	43.7
North Aegean	1.8	1.6	1.3	1.3	1.7
South Aegean	4.6	2.3	2.3	2.3	3.2
Crete	5.2	4.7	4.2	4.2	4.9
East Macedonia-Thrace	4.3	4.4	3.7	3.7	4.3
Central Macedonia	16.0	15.0	14.7	14.6	15.4
Western Macedonia	2.3	2.5	1.8	1.8	2.4
Epirus	2.8	2.7	2.2	2.2	2.7
Thessaly	5.9	5.8	6.1	6.1	5.9
Ionian Islands	2.3	1.5	1.5	1.5	1.8
Western Greece	5.2	5.0	4.8	4.8	5.1
Central Greece	4.5	4.2	3.5	3.5	4.3
Peloponnese	5.2	4.3	4.0	4.0	4.7
	Average annual growth rates				
Country total	-7.6	-7.1	-11.3	-13.3	-7.5
Attica	-7.9	-7.5	-12.7	-14.6	-8.0
North Aegean	-7.7	-6.4	-5.0	-7.1	-6.8
South Aegean	1.5	-6.9	-8.3	-10.3	-2.1
Crete	-7.4	-6.3	-5.4	-7.6	-6.7
East Macedonia-Thrace	-9.5	-6.2	-3.3	-5.5	-7.3
Central Macedonia	-7.4	-6.8	-11.8	-13.8	-7.3
Western Macedonia	-4.9	-7.1	-5.8	-7.9	-6.1
Epirus	-8.9	-6.1	-6.3	-8.4	-7.2
Thessaly	-10.2	-6.6	-17.0	-18.9	-9.0
Ionian Islands	-1.4	-6.2	-9.9	-11.9	-3.9
Western Greece	-11.4	-7.0	-13.0	-14.9	-9.2
Central Greece	-8.2	-7.2	-6.3	-8.4	-7.5
Peloponnese	-8.7	-6.7	-5.5	-7.6	-7.5

Source: ELSTAT, author's own calculations.
Note: Data for all years are provisional.

Table 5a Employment by region and sector (2000-2007)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
						Average annual growth rates					
Country total	-3.7	0.4	4.0	1.6	3.1	0.5	11.1	5.1	3.0	3.7	1.5
Attica	-10.9	0.5	4.4	1.1	5.3	0.7	11.0	4.8	1.9	4.8	2.0
North Aegean	-0.3	0.1	5.9	1.6	4.7	3.3	11.0	0.9	5.9	1.4	2.5
South Aegean	-0.1	1.0	1.0	2.7	-1.5	2.6	11.4	7.2	3.3	1.2	2.4
Crete	-5.5	2.4	5.5	0.8	0.9	-0.8	11.3	10.8	3.4	3.3	0.8
East Macedonia-Thrace	-3.6	-0.1	-0.1	1.0	4.6	3.5	10.6	7.0	4.4	6.1	0.6
Central Macedonia	-4.9	-0.2	7.5	2.1	-1.7	-1.0	11.6	5.0	4.0	1.7	1.5
Western Macedonia	-0.7	-0.4	-0.2	0.6	3.6	3.8	10.8	1.6	3.4	0.1	0.7
Epirus	-0.3	0.9	3.1	1.7	-1.6	1.1	11.0	0.0	1.5	0.7	1.2
Thessaly	-3.0	1.7	5.3	2.5	0.1	-2.9	10.9	4.9	5.1	2.4	1.7
Ionian Islands	-6.2	-0.9	6.3	4.2	4.0	2.2	11.4	-0.2	-1.1	3.9	1.0
Western Greece	-5.8	0.9	2.9	3.2	-1.1	-0.3	11.0	7.7	3.5	2.5	0.8
Central Greece	-1.2	0.4	1.5	1.5	-1.7	2.6	11.2	5.9	3.7	7.2	1.4
Peloponnese	-1.3	1.0	1.3	1.3	-2.0	0.7	11.3	5.3	2.5	1.7	0.7

Source: ELSTAT, author's own calculations.

Table 5b Employment by region and sector (2000-2007)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
						Region's and sector's percentage share in country total					
Country total	100	100	100	100	100	100	100	100	100	100	100
Attica	2.5	39.0	37.2	40.9	63.6	60.7	59.8	53.5	42.0	53.4	38.1
North Aegean	2.1	0.9	1.6	1.7	1.0	1.2	1.3	1.0	1.9	1.0	1.6
South Aegean	1.3	2.0	4.2	4.3	1.8	1.9	2.3	2.4	2.3	2.1	2.9
Crete	10.7	3.8	6.4	6.6	2.9	4.0	3.5	4.2	5.1	4.0	6.0
East Macedonia-Thrace	11.8	5.3	4.4	4.0	2.2	2.8	2.4	3.2	5.3	3.2	5.3
Central Macedonia	17.5	20.9	13.7	16.3	14.3	11.4	10.4	16.4	15.9	15.5	16.5
Western Macedonia	3.1	3.7	3.0	1.6	0.5	1.2	1.3	1.5	2.4	1.3	2.3
Epirus	4.4	2.4	3.9	2.5	1.4	1.7	1.9	2.0	3.5	1.9	2.9
Thessaly	12.8	6.0	6.0	5.5	2.7	3.9	4.0	4.6	6.7	4.8	6.6
Ionian Islands	2.8	0.8	2.2	2.6	0.8	1.0	1.5	1.7	1.4	1.4	2.0
Western Greece	11.4	4.0	6.6	5.5	3.6	3.5	4.2	3.8	5.5	4.6	5.9
Central Greece	6.6	7.2	5.8	4.4	2.3	3.2	3.1	2.5	3.7	3.0	4.7
Peloponnese	13.0	3.9	4.9	4.1	2.7	3.5	4.1	3.1	4.2	3.8	5.2

Source: ELSTAT, author's own calculations.

Table 5c Employment by region and sector (2008-2014)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
	Average annual growth rates										
Country total	-1.3	-5.8	-11.2	-3.1	-0.6	-4.5	-2.0	-0.8	-2.1	-1.5	-3.2
Attica	-2.3	-6.4	-12.6	-3.3	-0.1	-4.8	-2.1	-0.6	-1.6	-2.6	-3.4
North Aegean	-2.1	-5.2	-9.0	0.1	0.9	-4.9	-1.9	2.1	-3.0	5.3	-1.8
South Aegean	2.7	-2.6	-6.6	-3.1	0.3	-2.1	-1.3	2.2	0.1	-1.2	-2.0
Crete	-1.5	-3.9	-8.9	-2.6	-0.9	-5.3	-1.8	-2.6	-3.1	2.2	-2.9
East Macedonia-Thrace	0.2	-7.0	-10.0	-2.9	-1.1	-5.2	-1.3	-1.6	-0.9	-1.8	-2.4
Central Macedonia	-1.0	-7.6	-14.0	-3.4	-2.8	-2.9	-1.9	-1.7	-2.5	-1.4	-3.8
Western Macedonia	-3.0	-3.6	-8.7	-2.8	-0.3	-3.7	-2.2	3.9	-2.7	-0.8	-3.1
Epirus	-1.9	-5.4	-9.3	-1.5	-4.5	-5.8	-1.9	2.2	-2.9	-5.6	-3.0
Thessaly	-0.3	-4.8	-8.5	-4.0	-0.8	-4.9	-2.1	0.2	-3.2	-2.0	-3.1
Ionian Islands	-3.2	-2.7	-7.7	-3.8	-1.4	-4.0	-1.6	1.3	1.1	-1.3	-2.8
Western Greece	-1.2	-4.5	-13.2	-3.3	1.9	-3.9	-1.9	-5.0	-4.0	0.4	-3.6
Central Greece	-1.3	-3.0	-12.8	-2.3	-5.3	-4.3	-1.8	-0.6	-3.5	1.4	-3.0
Peloponnese	-3.4	-5.0	-6.4	-1.5	-1.0	-3.8	-1.7	0.2	-0.9	3.8	-2.3

Source: ELSTAT, author's own calculations.

Table 5d Employment by region and sector (2008-2014)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
						Region's and sector's percentage share in country total					
Country total	100	100	100	100	100	100	100	100	100	100	100
Attica	3.0	39.5	34.5	40.0	70.0	60.4	59.1	53.0	41.4	52.3	38.5
North Aegean	1.7	1.0	1.9	1.7	1.1	1.3	1.3	1.2	2.1	1.0	1.6
South Aegean	2.0	2.2	4.8	4.6	1.4	1.7	2.4	2.4	2.7	2.2	3.2
Crete	9.4	4.3	7.2	6.7	2.7	3.9	3.6	4.9	5.0	4.1	6.0
East Macedonia-Thrace	11.6	4.5	4.5	3.9	2.4	3.0	2.6	3.3	5.7	2.9	5.1
Central Macedonia	17.2	18.5	13.9	16.4	11.3	12.5	10.7	16.3	15.5	15.0	16.1
Western Macedonia	3.3	3.9	2.6	1.8	0.5	1.1	1.2	1.3	2.3	1.6	2.2
Epirus	4.7	2.5	4.0	2.7	0.8	1.6	1.9	2.0	3.2	1.9	2.9
Thessaly	12.5	6.5	6.2	5.6	2.5	3.5	3.9	4.6	7.1	4.7	6.6
Ionian Islands	2.8	0.9	2.7	2.7	0.8	1.1	1.6	1.7	1.5	1.7	2.0
Western Greece	10.7	4.2	6.6	5.5	2.8	3.5	4.2	3.7	5.7	4.9	5.8
Central Greece	7.7	7.9	5.7	4.2	1.8	3.3	3.2	2.7	3.8	3.4	4.8
Peloponnese	13.4	4.0	5.5	4.3	2.1	3.2	4.2	2.9	4.1	4.4	5.2

Source: ELSTAT, author's own calculations.

Table 5e Employment by region and sector (2000-2007)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
	Sector's percentage share in region total (region = 100)										
Country total	13.1	11.8	7.5	31.3	1.9	2.4	0.1	6.4	19.6	6.0	100
Attica	0.9	12.1	7.3	33.6	3.1	3.8	0.2	9.0	21.6	8.4	100
North Aegean	16.9	7.0	7.6	33.9	1.2	1.8	0.1	4.0	23.8	3.8	100
South Aegean	6.0	8.1	10.8	46.9	1.2	1.5	0.1	5.3	15.9	4.3	100
Crete	23.1	7.5	7.8	34.0	0.9	1.5	0.1	4.5	16.5	4.0	100
East Macedonia-Thrace	29.3	11.8	6.2	23.5	0.8	1.3	0.1	3.8	19.6	3.6	100
Central Macedonia	13.8	14.9	6.2	30.9	1.6	1.6	0.1	6.4	18.9	5.6	100
Western Macedonia	17.8	19.5	9.9	22.3	0.4	1.2	0.1	4.3	21.0	3.6	100
Epirus	19.5	9.6	10.1	26.5	0.9	1.4	0.1	4.4	23.7	3.8	100
Thessaly	25.3	10.7	6.8	26.1	0.8	1.4	0.1	4.5	20.0	4.4	100
Ionian Islands	18.5	4.9	8.5	41.4	0.8	1.2	0.1	5.7	14.5	4.4	100
Western Greece	25.2	7.9	8.3	29.2	1.1	1.4	0.1	4.1	18.1	4.6	100
Central Greece	18.3	17.9	9.2	29.3	0.9	1.6	0.1	3.4	15.5	3.8	100
Peloponnese	32.7	9.0	7.0	24.7	1.0	1.6	0.1	3.8	15.9	4.4	100

Source: ELSTAT, author's own calculations.

Table 5f Employment by region and sector (2008-2014)

(%)

	Agriculture, forestry and fishing	Mining and quarrying; industry; electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities; administrative and support service activities	Public administration and defence; compulsory social security; education; human health and social work activities	Arts, entertainment, recreation and other service activities; activities of households as employers; undifferentiated goods- and services-producing activities of households for own use; activities of extraterritorial organisations and bodies	Total employment
	Sector's percentage share in region total (region = 100)										
Country total	11.6	10.5	6.2	31.7	2.0	2.2	0.2	7.6	21.1	6.9	100
Attica	0.9	10.8	5.5	32.9	3.6	3.5	0.3	10.4	22.7	9.4	100
North Aegean	12.4	6.2	7.1	33.7	1.4	1.8	0.2	5.5	27.5	4.1	100
South Aegean	7.2	7.3	9.3	45.5	0.8	1.2	0.2	5.8	17.8	4.9	100
Crete	18.2	7.6	7.5	35.6	0.9	1.5	0.1	6.2	17.7	4.8	100
East Macedonia-Thrace	26.3	9.3	5.5	24.3	0.9	1.3	0.1	4.9	23.5	3.9	100
Central Macedonia	12.4	12.1	5.4	32.3	1.4	1.7	0.1	7.7	20.4	6.5	100
Western Macedonia	17.1	18.3	7.0	25.2	0.4	1.1	0.1	4.3	21.5	4.9	100
Epirus	18.7	8.9	8.4	28.9	0.5	1.2	0.1	5.2	23.5	4.6	100
Thessaly	22.1	10.4	5.8	26.7	0.7	1.2	0.1	5.3	22.7	5.0	100
Ionian Islands	16.2	4.5	8.2	41.7	0.8	1.2	0.2	6.4	15.1	5.7	100
Western Greece	21.3	7.7	7.0	30.1	0.9	1.4	0.2	4.8	20.8	5.8	100
Central Greece	18.7	17.4	7.3	28.1	0.7	1.6	0.1	4.3	16.7	5.0	100
Peloponnese	29.8	8.1	6.6	26.4	0.8	1.4	0.2	4.2	16.6	5.9	100

Source: ELSTAT, author's own calculations.

Table 6 Annual non-financial sector accounts for households and NPISHs (2000-2014)

Resources	Allocation*		Average annual growth rate (%)		Change between subperiods (%)
	2000-2007	2008-2014	2000-2007	2008-2014	
Output	**100**	**100**	**3.0**	**-6.6**	**-16.7**
Compensation of employees	**100**	**100**	**5.2**	**-7.1**	**-3.1**
Subsidies	**100**	**100**	**29.6**	**-2.1**	**146.8**
Other subsidies on production	100	100	29.6	-2.1	146.8
Property income	**100**	**100**	**-1.9**	**-11.3**	**-16.7**
Interest	61.5	67.5	-5.4	-13.6	-8.6
Distributed income of corporations	34.6	27.6	5.1	-7.6	-33.7
Reinvested earnings on direct foreign investment	0.0	0.0	-	-	-
Property income attributed to insurance policy holders	1.0	1.9	78.9	-4.9	61.1
Rents on land and subsoil assets	2.8	3.0	2.4	-4.3	-12.4
Social contributions and benefits	**100**	**100**	**5.8**	**-4.9**	**15.3**
Social contributions	0.0	0.0	-	-	-
Social benefits other than social transfers in kind	54.7	60.0	6.4	-3.3	26.3
Social transfers in kind	45.3	40.0	5.1	-7.2	2.0
Other current transfers	**100**	**100**	**-3.3**	**-8.0**	**-30.8**
Non-life insurance claims	15.9	17.9	3.8	-4.4	-22.5
Miscellaneous current transfers	84.1	82.1	-4.5	-8.7	-32.4
Capital transfers	**100**	**100**	**-43.6**	**-0.6**	**21.1**
Investment grants and other capital transfers	100	100	-43.6	-0.6	21.1
Uses	**2000-2007**	**2008-2014**	**2000-2007**	**2008-2014**	**Change between subperiods (%)**
Intermediate consumption	**100**	**100**	**2.9**	**-6.5**	**-21.6**
Final consumption expenditure	**100**	**100**	**3.5**	**-5.6**	**-2.1**
Individual consumption expenditure	100	100	3.5	-5.6	-2.1
Actual final consumption	**100**	**100**	**3.8**	**-6.1**	**-1.9**
Actual individual consumption	100	100	3.8	-6.1	-1.9
Gross capital formation	**100**	**100**	**6.3**	**-25.3**	**-48.4**
Gross fixed capital formation	96.2	103.3	5.5	-24.1	-44.6
Changes in inventories	2.9	-4.0	-206.0	**	-169.9
Acquisitions less disposals of valuables	0.8	0.7	22.4	-29.4	-57.3
Compensation of employees	**100**	**100**	**6.3**	**-6.1**	**2.8**
Taxes on production and imports	**100**	**100**	**-0.3**	**7.4**	**78.4**
Other taxes on production	100	100	-0.3	7.4	78.4
Property income	**100**	**100**	**8.6**	**-13.2**	**86.2**
Interest	66.2	84.0	9.8	-15.1	138.8
Reinvested earnings on foreign direct investment	0	0	-	-	-

Source: ELSTAT, author's own calculations.
* Allocation by primary account.
** The average annual growth rate cannot be calculated, as one of the two figures compared is negative.

Table 6 Annual non-financial sector accounts for households and NPISHs (2000-2014) *(continued)*

Uses	Allocation*		Average annual growth rate (%)		Change between subperiods (%)
	2000-2007	2008-2014	2000-2007	2008-2014	
Property income attributed to insurance policy holders	0	0	-	-	-
Rents on land and subsoil assets	33.8	16.0	2.5	-3.2	-13.9
Current taxes on income, wealth, etc.	100.0	100.0	1.1	-3.3	-1.2
Social contributions and benefits	**100**	**100**	**4.5**	**-4.3**	**2.0**
Social contributions	87.9	86.4	5.1	-5.2	0.3
Social contributions other than social transfers in kind	0	0	-	-	-
Social transfers in kind	12.1	13.6	0.2	2.0	14.0
Other current transfers	**100**	**100**	**3.2**	**-4.9**	**17.9**
Non-life insurance premiums	33.8	22.2	3.8	-4.5	-22.5
Miscellaneous current transfers	66.2	77.8	3.0	-5.1	38.5
Capital transfers	**100**	**100**	**-8.1**	**-23.2**	**-31.9**
Capital taxes	100	100	-8.1	-23.2	-31.9
Investment grants and other capital transfers	0	0	-	-	-
Consumption of fixed capital	**100**	**100**	**6.8**	**-1.8**	**5.9**
Acquisitions less disposals of non-produced non-financial assets	**100**	**100**	**4.6**	**-32.7**	**-31.5**

Source: ELSTAT, author's own calculations.
* Allocation by primary account.

Table 7 Regional household accounts (2000-2007)

(%)

	Secondary distribution of income account							
	Resources			Uses				
	Primary income account	Social benefits other than social transfers in kind, receivable	Other current transfers, receivable	Current taxes on income-wealth, payable	Social contributions, payable	Other current transfers, payable	Disposable income	Final consumption expenditure*
	Averages-Region's percentage share in country total							
Country total	100	100	100	100	100	100	100	-
Attica	42.1	48.1	43.3	65.0	37.3	55.7	42.4	-
North Aegean	1.6	1.6	1.9	1.3	1.8	1.4	1.6	-
South Aegean	3.0	2.3	3.0	2.0	3.7	3.0	2.8	-
Crete	5.1	4.1	5.1	3.0	5.2	4.5	5.0	-
East Macedonia-Thrace	4.5	4.3	4.2	2.6	4.4	2.2	4.6	-
Central Macedonia	15.2	14.9	14.6	9.8	18.8	11.3	14.9	-
Western Macedonia	3.1	2.2	2.5	1.6	3.3	1.7	3.0	-
Epirus	2.8	2.3	2.5	1.7	2.9	2.0	2.8	-
Thessaly	5.8	5.3	5.4	3.3	5.4	3.6	6.0	-
Ionian Islands	1.9	1.8	2.0	1.3	3.0	2.1	1.7	-
Western Greece	5.5	4.8	5.8	3.1	5.4	4.6	5.6	-
Central Greece	5.2	4.4	4.8	2.9	4.9	3.8	5.2	-
Peloponnese	4.2	3.9	4.8	2.7	3.9	4.2	4.4	-
	Average annual growth rates							
Country total	3.3	6.4	-3.3	1.1	5.1	3.2	3.5	-
Attica	5.0	3.9	-8.4	-2.3	11.6	-0.2	4.3	-
North Aegean	1.3	6.4	-4.4	0.1	3.6	2.2	1.8	-
South Aegean	0.2	6.7	-3.3	1.6	-1.2	12.1	1.1	-
Crete	2.5	8.7	-0.2	9.2	3.9	11.5	2.7	-
East Macedonia-Thrace	2.7	8.8	6.1	7.8	4.5	10.9	3.5	-
Central Macedonia	3.8	10.0	2.3	10.6	0.8	10.4	5.4	-
Western Macedonia	-4.4	8.9	-1.9	12.1	-4.6	-6.0	-2.8	-
Epirus	0.5	9.7	3.9	7.8	0.1	-0.2	2.0	-
Thessaly	3.1	9.5	4.5	8.6	4.7	9.8	3.8	-
Ionian Islands	-0.1	6.6	-4.8	-0.5	-1.6	5.3	1.2	-
Western Greece	1.3	8.4	0.2	9.7	0.8	1.2	2.4	-
Central Greece	-0.5	6.3	-1.3	5.1	0.0	10.7	0.3	-
Peloponnese	5.3	9.2	0.3	9.6	7.2	12.4	5.3	-

Source: ELSTAT, author's own calculations.
Note: Data for all years are provisional.
* There are no data available for 2000-2007.

Table 8 Regional household accounts (2008-2014)

(%)

	Secondary distribution of income account							
	Resources			Uses				
	Primary income account	Social benefits other than social transfers in kind, receivable	Other current transfers, receivable	Current taxes on income-wealth, payable	Social contributions, payable	Other current transfers, payable	Disposable income	Final consumption expenditure*
	Averages-Region's percentage share in country total							
Country total	100	100	100	100	100	100	100	100
Attica	43.7	41.1	35.9	55.3	44.4	50.0	41.4	43.1
North Aegean	1.7	1.8	1.8	1.3	1.7	1.3	1.7	1.8
South Aegean	3.2	2.1	3.0	2.3	3.0	4.0	3.1	2.6
Crete	4.9	4.5	5.6	3.9	4.9	6.2	4.8	4.9
East Macedonia-Thrace	4.3	5.0	5.5	3.2	4.4	2.3	4.7	4.6
Central Macedonia	15.4	16.5	17.3	12.8	15.9	11.6	16.0	17.6
Western Macedonia	2.4	2.6	2.6	2.2	2.3	1.0	2.5	2.0
Epirus	2.7	3.0	3.1	2.2	2.6	1.8	2.9	4.2
Thessaly	5.9	6.7	6.7	4.4	5.7	4.0	6.3	3.8
Ionian Islands	1.8	1.6	1.9	1.3	1.7	2.3	1.8	1.3
Western Greece	5.1	5.6	6.2	4.0	5.0	3.9	5.4	5.7
Central Greece	4.3	4.6	5.0	3.4	4.2	5.3	4.5	3.5
Peloponnese	4.7	4.9	5.3	3.7	4.6	6.1	4.8	5.1
	Average annual growth rates							
Country total	-7.5	-3.3	-8.1	-3.3	-5.2	-4.9	-7.3	-5.9
Attica	-8.0	-4.2	-8.4	-4.2	-4.5	-5.2	-8.3	-5.5
North Aegean	-6.8	-2.5	-7.9	-1.7	-5.0	-5.2	-6.3	-10.8
South Aegean	-2.1	-4.0	-7.7	-1.0	-11.3	-3.4	1.0	-4.2
Crete	-6.7	-1.2	-7.5	-1.8	-5.1	-3.8	-6.1	-2.0
East Macedonia-Thrace	-7.3	-2.5	-7.8	-1.6	-4.1	-5.4	-6.9	-4.8
Central Macedonia	-7.3	-3.0	-7.9	-2.1	-6.1	-5.5	-6.8	-7.8
Western Macedonia	-6.1	-3.0	-8.4	-4.1	-2.5	-6.1	-6.2	-3.4
Epirus	-7.2	-1.6	-8.1	-2.3	-3.1	-4.8	-6.8	-17.6
Thessaly	-9.0	-2.9	-8.0	-2.0	-4.1	-5.1	-8.7	4.1
Ionian Islands	-3.9	-2.6	-7.9	-0.4	-6.9	-3.9	-3.3	-3.5
Western Greece	-9.2	-2.8	-8.3	-3.3	-4.4	-4.8	-8.7	-2.4
Central Greece	-7.5	-2.9	-7.8	-2.7	-4.1	-4.4	-7.3	-8.2
Peloponnese	-7.5	-2.5	-7.9	-1.8	-6.2	-4.1	-6.8	-9.3

Source: ELSTAT, author's own calculations.
Note: Data for all years are provisional.
* For the region of the South Aegean in particular, the subperiod 2008-2013 has been taken into account, as the figure for 2014 is probably incorrect.

Table 9 Expenditure per trip by non-residents in 2004-2014 for the country as a whole

(expenditure in euro, 2010 constant prices)

Years	Expenditure	Year-on-year changes
2004	895.8	-
2005	874.0	-2.4
2006	847.2	-3.1
2007	772.9	-8.8
2008	773.7	0.1
2009	730.2	-5.6
2010	640.4	-12.3
2011	618.9	-3.4
2012	587.5	-5.1
2013	581.4	-1.0
2014	538.1	-7.5
Averages		**Average annual growth rates (%)**
2004-2007	847.5	-4.8
2008-2014	638.6	-5.9

Source: Bank of Greece, *Bulletin of Conjunctural Indicators*, December 2007, 2008, 2009, 2012 and 2015, author's own calculations.

Table 10a Number of taxpayers and declared income by income source (2004-2007)

(%)

	Percentage share in country total								
	Number of taxpayers	Total incomes	Income from construction	Income from securities	Income from trade and manufacturing	Income from agriculture	Employee income	Self-employment income	Income earned abroad
Country total	100	100	100	100	100	100	100	100	100
Attica	39.0	46.7	51.4	47.6	42.2	5.2	47.5	54.0	27.3
Thessaly	6.4	5.6	4.5	5.1	5.6	12.5	5.5	5.1	3.4
Peloponnese	5.2	4.2	4.0	1.7	4.9	10.6	4.1	3.1	1.8
Central Greece	4.7	4.2	2.9	4.9	4.3	9.5	4.3	3.2	1.1
Western Greece	5.7	4.9	4.1	4.4	5.0	11.1	4.9	4.2	1.7
Crete	5.1	4.7	4.5	4.9	5.1	8.8	4.5	5.3	2.1
East Macedonia-Thrace	5.2	4.3	3.5	5.7	4.3	9.4	4.2	3.4	19.9
Central Macedonia	16.9	15.1	14.8	20.1	15.8	20.2	14.9	13.5	31.1
Western Macedonia	2.6	2.3	1.8	1.2	2.2	3.0	2.4	1.6	3.8
Epirus	2.8	2.5	2.0	2.0	2.6	2.9	2.5	2.3	5.0
North Aegean	1.8	1.6	1.8	0.7	1.6	2.4	1.6	1.1	0.7
South Aegean	2.7	2.5	2.9	1.2	4.1	2.7	2.2	1.9	1.4
Ionian Islands	1.9	1.6	1.7	0.5	2.3	1.6	1.5	1.4	0.8
	Percentage share in region total (region = 100)								
Country total	100	100	8.9	0.0	10.1	2.0	74.2	4.4	0.3
Attica	100	100	9.8	0.0	9.1	0.2	75.5	5.1	0.2
Thessaly	100	100	7.3	0.0	10.2	4.5	73.7	4.0	0.2
Peloponnese	100	100	8.3	0.0	11.6	5.1	71.5	3.3	0.2
Central Greece	100	100	6.1	0.0	10.3	4.5	75.6	3.3	0.1
Western Greece	100	100	7.4	0.0	10.3	4.6	73.9	3.7	0.1
Crete	100	100	8.6	0.0	11.1	3.8	71.2	5.1	0.2
East Macedonia-Thrace	100	100	7.2	0.0	10.0	4.4	73.2	3.5	1.6
Central Macedonia	100	100	8.8	0.0	10.6	2.7	73.3	4.0	0.7
Western Macedonia	100	100	7.1	0.0	9.7	2.7	77.0	3.0	0.6
Epirus	100	100	7.0	0.0	10.7	2.3	75.1	4.1	0.7
North Aegean	100	100	10.2	0.0	10.4	3.1	73.2	3.0	0.1
South Aegean	100	100	10.5	0.0	16.9	2.2	66.8	3.3	0.2
Ionian Islands	100	100	9.8	0.0	14.8	2.1	69.2	3.9	0.2

Source: Ministry of Finance, author's own calculations.

Table 10b Number of taxpayers and declared income by income source (2004-2007)

(%)

	Average annual growth rates								
	Number of taxpayers	Total incomes	Income from construction	Income from securities	Income from trade and manufacturing	Income from agriculture	Employee income	Self-employment income	Income earned abroad
Country total	2.0	4.4	3.2	4.4	3.2	3.1	3.2	-0.9	4.9
Attica	1.1	3.6	3.1	-0.2	0.6	-1.2	4.1	3.2	8.2
Thessaly	2.1	4.9	2.2	15.0	4.0	-3.7	5.8	5.5	4.9
Peloponnese	3.6	6.5	4.5	-28.4	8.8	1.4	6.8	5.5	1.4
Central Greece	2.5	5.1	3.6	-28.9	4.6	-1.1	5.8	2.7	5.1
Western Greece	2.5	5.1	3.5	-19.5	4.7	0.3	5.6	4.9	9.2
Crete	3.0	6.1	4.5	-12.2	6.3	1.6	6.4	7.5	7.3
East Macedonia-Thrace	2.2	4.4	1.9	-23.8	4.2	-1.5	5.0	6.1	2.4
Central Macedonia	2.2	4.7	2.6	65.4	3.6	-2.2	5.3	5.1	2.0
Western Macedonia	2.1	5.0	1.2	29.9	4.2	-2.4	5.8	2.1	5.1
Epirus	3.4	5.5	3.2	19.9	4.6	0.3	6.0	5.1	4.8
North Aegean	3.1	5.6	4.0	55.3	8.3	-1.8	6.0	2.1	2.8
South Aegean	3.0	5.9	5.1	-0.1	7.6	0.6	5.7	7.2	10.0
Ionian Islands	2.8	5.8	5.3	70.5	6.8	2.8	5.7	5.1	11.6

Source: Ministry of Finance, author's own calculations.

Table 11a Number of taxpayers – Total tax by region and occupational category (2004-2007)

(%)

	Percentage share in country total													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	39.0	58.2	41.3	70.7	35.2	50.0	8.6	28.6	46.0	60.9	46.1	61.6	37.2	58.7
Thessaly	6.4	4.0	5.5	2.4	6.2	4.6	10.4	6.9	5.3	3.9	6.2	3.7	7.3	4.2
Peloponnese	5.2	3.3	4.7	1.8	5.3	4.1	11.5	9.2	4.1	2.9	3.3	2.4	5.4	3.4
Central Greece	4.7	3.2	3.1	1.3	4.7	3.7	8.2	10.2	4.3	3.1	3.8	2.2	5.1	3.2
Western Greece	5.7	3.8	4.4	2.0	5.6	4.2	10.2	6.2	5.0	3.6	4.7	3.7	6.2	4.1
Crete	5.1	3.7	3.4	1.7	5.7	4.4	10.2	10.9	4.8	3.1	5.9	3.6	4.3	3.5
East Macedonia-Thrace	5.2	3.0	5.6	1.8	4.9	3.8	8.4	4.1	4.3	3.0	4.3	3.0	5.7	2.6
Central Macedonia	16.9	12.3	19.2	12.4	17.7	13.8	17.1	10.1	15.8	11.7	15.9	12.3	17.2	12.4
Western Macedonia	2.6	2.1	3.1	1.1	2.8	2.0	3.1	3.2	2.1	2.6	2.3	1.5	2.8	1.9
Epirus	2.8	2.0	2.7	1.1	3.1	2.3	3.9	2.7	2.3	1.8	2.9	2.3	3.0	2.0
North Aegean	1.8	1.2	1.8	0.8	1.9	1.4	3.6	4.3	1.3	1.0	1.3	0.9	2.0	1.4
South Aegean	2.7	2.0	3.0	1.9	4.1	3.9	2.5	2.2	2.9	1.5	1.9	1.6	2.1	1.6
Ionian Islands	1.9	1.2	2.2	1.1	2.8	1.9	2.3	1.6	1.7	0.9	1.4	1.0	1.8	1.2
Country total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Ministry of Finance, author's own calculations.

Table 11b Number of taxpayers – Total tax by region and occupational category (2004-2007)

(%)

	Percentage share in region total (region = 100)													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	100	100	11.4	8.8	11.3	19.2	1.6	1.7	42.7	45.3	7.2	21.6	25.7	18.4
Thessaly	100	100	9.2	4.2	12.2	25.4	12.0	6.0	30.0	41.7	5.9	18.8	30.7	18.8
Peloponnese	100	100	9.9	4.0	12.9	28.1	16.6	9.9	28.7	39.2	3.9	14.7	28.1	19.0
Central Greece	100	100	7.1	2.9	12.5	26.1	13.1	11.2	33.0	42.4	5.0	14.1	29.3	18.3
Western Greece	100	100	8.3	3.9	12.3	24.9	13.4	5.8	31.5	40.6	5.1	20.2	29.4	19.6
Crete	100	100	7.2	3.3	13.9	27.1	14.9	10.4	34.2	36.5	7.1	20.1	22.7	17.6
East Macedonia-Thrace	100	100	11.7	4.3	11.8	27.7	12.1	4.7	29.9	42.5	5.0	20.2	29.5	15.6
Central Macedonia	100	100	12.3	7.3	13.1	25.0	7.6	2.9	33.8	41.1	5.8	20.4	27.4	18.4
Western Macedonia	100	100	12.9	3.6	13.4	21.0	8.9	5.4	30.1	54.1	5.4	14.6	29.3	16.1
Epirus	100	100	10.6	4.0	13.8	25.6	10.3	4.8	30.4	38.5	6.4	23.9	28.5	18.2
North Aegean	100	100	10.8	4.5	13.5	25.2	15.0	12.5	27.0	36.0	4.4	15.8	29.4	20.9
South Aegean	100	100	12.0	6.8	18.7	42.6	6.8	3.8	37.9	32.2	4.1	15.7	20.4	14.0
Ionian Islands	100	100	12.5	6.8	17.8	36.2	8.8	4.8	31.4	31.7	4.5	17.7	25.0	17.9

Source: Ministry of Finance, author's own calculations.

Table 11c Number of taxpayers – Total tax by region and occupational category (2004-2007)

(%)

	Average annual growth rates													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	1.1	9.0	1.7	4.6	0.0	1.2	2.8	13.6	0.5	9.8	3.0	7.7	1.8	20.0
Thessaly	2.1	13.0	3.4	6.7	1.7	5.2	-2.6	14.6	2.4	14.6	2.2	10.5	3.7	25.1
Peloponnese	3.6	14.4	7.2	11.7	2.4	11.5	1.3	16.5	3.2	12.6	1.2	12.5	5.3	24.4
Central Greece	2.5	12.9	5.7	9.5	1.9	6.8	-1.0	14.0	2.9	12.4	-0.6	12.0	3.7	25.1
Western Greece	2.5	12.8	5.1	7.8	1.4	6.0	0.3	17.6	2.6	12.4	0.4	12.6	3.5	23.8
Crete	3.0	13.4	5.7	7.7	2.6	7.6	1.1	16.0	3.0	13.5	2.5	12.9	4.0	23.6
East Macedonia-Thrace	2.2	11.7	4.5	7.0	1.6	5.3	-2.3	14.4	0.9	11.2	6.0	12.2	4.2	26.4
Central Macedonia	2.2	11.6	3.4	5.7	1.1	4.5	-2.7	14.4	1.8	12.3	3.5	11.6	3.8	23.2
Western Macedonia	2.1	12.3	2.7	2.0	-0.1	6.2	-1.3	19.2	2.6	12.2	1.8	10.3	3.6	23.9
Epirus	3.4	13.1	4.0	3.3	1.6	5.6	3.3	20.8	2.5	13.3	3.8	12.7	5.2	25.8
North Aegean	3.1	13.8	9.9	8.8	2.7	11.3	0.4	15.0	2.6	12.3	0.6	8.6	3.5	25.1
South Aegean	3.0	11.4	6.2	6.1	3.5	7.3	0.0	16.1	1.6	10.7	6.2	14.8	3.8	24.8
Ionian Islands	2.8	12.0	6.8	10.2	3.8	6.6	0.5	14.0	1.9	11.6	2.3	12.6	2.5	24.3
Country total	2.0	10.5	3.3	5.2	1.2	3.7	-0.4	15.1	1.4	10.9	2.8	9.3	3.1	21.7

Source: Ministry of Finance, author's own calculations.

Table 12 Ratios of current taxes on income-wealth, social contributions and other current transfers, payable, to population

	2000-2007			2008-2014		
Current taxes on income-wealth, payable/population						
Country total	100	100	1.00	100	100	1.00
Attica	65.0	36.0	1.81	55.3	35.8	1.54
North Aegean	1.3	1.8	0.72	1.3	1.8	0.74
South Aegean	2.0	2.9	0.68	2.3	3.0	0.75
Crete	3.0	5.5	0.56	3.9	5.6	0.70
East Macedonia-Thrace	2.6	5.4	0.47	3.2	5.5	0.58
Central Macedonia	9.8	17.1	0.57	12.8	17.3	0.74
Western Macedonia	1.6	2.6	0.61	2.2	2.6	0.85
Epirus	1.7	3.1	0.54	2.2	3.1	0.69
Thessaly	3.3	6.8	0.49	4.4	6.7	0.65
Ionian Islands	1.3	1.9	0.68	1.3	1.9	0.69
Western Greece	3.1	6.4	0.48	4.0	6.2	0.65
Central Greece	2.9	5.1	0.57	3.4	5.1	0.68
Peloponnese	2.7	5.4	0.50	3.7	5.3	0.69
Social contributions, payable/population						
Country total	100	100	1.00	100	100	1.00
Attica	37.3	36.0	1.04	44.4	35.8	1.24
North Aegean	1.8	1.8	0.99	1.7	1.8	0.92
South Aegean	3.7	2.9	1.28	3.0	3.0	1.00
Crete	5.2	5.5	0.95	4.9	5.6	0.87
East Macedonia-Thrace	4.4	5.4	0.82	4.4	5.5	0.80
Central Macedonia	18.8	17.1	1.10	15.9	17.3	0.92
Western Macedonia	3.3	2.6	1.24	2.3	2.6	0.89
Epirus	2.9	3.1	0.92	2.6	3.1	0.84
Thessaly	5.4	6.8	0.80	5.7	6.7	0.85
Ionian Islands	3.0	1.9	1.57	1.7	1.9	0.91
Western Greece	5.4	6.4	0.85	5.0	6.2	0.80
Central Greece	4.9	5.1	0.96	4.2	5.1	0.84
Peloponnese	3.9	5.4	0.73	4.6	5.3	0.87
Other current transfers, payable/population						
Country total	100	100	1.00	100	100	1.00
Attica	55.7	36.0	1.55	50.0	35.8	1.40
North Aegean	1.4	1.8	0.76	1.3	1.8	0.71
South Aegean	3.0	2.9	1.01	4.0	3.0	1.34
Crete	4.5	5.5	0.83	6.2	5.6	1.10
East Macedonia-Thrace	2.2	5.4	0.41	2.3	5.5	0.42
Central Macedonia	11.3	17.1	0.66	11.6	17.3	0.67
Western Macedonia	1.7	2.6	0.65	1.0	2.6	0.40
Epirus	2.0	3.1	0.64	1.8	3.1	0.57
Thessaly	3.6	6.8	0.53	4.0	6.7	0.60
Ionian Islands	2.1	1.9	1.13	2.3	1.9	1.20
Western Greece	4.6	6.4	0.72	3.9	6.2	0.63
Central Greece	3.8	5.1	0.74	5.3	5.1	1.05
Peloponnese	4.2	5.4	0.78	6.1	5.3	1.15

Source: ELSTAT, author's own calculations.

Table 13a Number of taxpayers and declared income by income source (2008-2010)

(%)

	Number of taxpayers	Total incomes	Income from construction	Income from securities	Income from trade and manufacturing	Income from agriculture	Employee income	Self-employment income	Income earned abroad
Percentage share in country total									
Country total	100	100	100	100	100	100	100	100	100
Attica	38.4	45.9	51.5	43.0	40.1	5.0	46.6	52.9	26.9
Thessaly	6.5	5.6	4.4	5.4	5.8	11.7	5.6	5.5	3.5
Peloponnese	5.3	4.4	4.1	1.1	5.2	11.0	4.2	3.3	1.8
Central Greece	4.7	4.3	3.0	2.9	4.5	9.5	4.4	2.9	1.1
Western Greece	5.8	5.0	4.1	2.7	5.1	11.5	5.0	4.4	1.9
Crete	5.2	4.8	4.7	5.0	5.2	9.1	4.6	5.3	2.1
East Macedonia-Thrace	5.2	4.3	3.3	3.0	4.4	8.8	4.2	3.3	19.5
Central Macedonia	17.0	15.1	14.5	32.4	15.8	19.9	14.9	13.9	30.9
Western Macedonia	2.6	2.3	1.7	2.0	2.2	3.1	2.5	1.6	4.1
Epirus	2.9	2.6	2.0	1.3	2.9	3.3	2.6	2.3	5.5
North Aegean	1.8	1.6	1.8	0.4	1.8	2.4	1.6	1.1	0.6
South Aegean	2.9	2.6	3.1	0.3	4.6	2.9	2.3	2.0	1.5
Ionian Islands	2.0	1.6	1.8	0.4	2.3	1.7	1.5	1.4	0.8
Percentage share in region total (region = 100)									
	Number of taxpayers	Total incomes	Income from construction	Income from securities	Income from trade and manufacturing	Income from agriculture	Employee income	Self-employment income	Income earned abroad
Country total	100	100	8.8	0.0	9.0	1.7	75.8	4.4	0.3
Attica	100	100	9.9	0.0	7.8	0.2	76.8	5.1	0.2
Thessaly	100	100	6.8	0.0	9.2	3.5	76.0	4.3	0.2
Peloponnese	100	100	8.3	0.0	10.7	4.3	73.2	3.4	0.1
Central Greece	100	100	6.1	0.0	9.3	3.8	77.7	3.0	0.1
Western Greece	100	100	7.2	0.0	9.3	3.9	75.5	3.9	0.1
Crete	100	100	8.8	0.0	9.9	3.3	73.0	4.9	0.1
East Macedonia-Thrace	100	100	6.9	0.0	9.2	3.5	75.5	3.4	1.5
Central Macedonia	100	100	8.5	0.0	9.4	2.3	75.1	4.1	0.7
Western Macedonia	100	100	6.3	0.0	8.5	2.3	79.4	2.9	0.6
Epirus	100	100	6.8	0.0	10.0	2.2	76.3	4.0	0.7
North Aegean	100	100	10.0	0.0	10.2	2.5	74.1	3.0	0.1
South Aegean	100	100	10.7	0.0	16.0	1.9	67.7	3.5	0.2
Ionian Islands	100	100	10.2	0.0	13.0	1.8	71.0	3.8	0.2

Source: Ministry of Finance, author's own calculations.

Table 13b Number of taxpayers and declared income by income source (2008-2010)

(%)

	Average annual growth rates								
	Number of taxpayers	Total incomes	Income from construction	Income from securities	Income from trade and manufacturing	Income from agriculture	Employee income	Self-employment income	Income earned abroad
Country total	0.9	0.7	1.1	23.3	-7.6	-4.8	1.9	-0.5	5.4
Attica	0.5	0.5	0.9	2.0	-8.7	-6.5	1.4	0.0	5.7
Thessaly	1.4	1.6	0.6	55.2	-5.5	-5.2	3.0	0.5	3.1
Peloponnese	1.0	1.3	2.7	27.7	-5.3	-3.7	2.5	0.4	23.9
Central Greece	1.0	0.3	1.9	148.2	-6.0	-6.3	1.3	0.2	1.7
Western Greece	1.2	1.2	1.7	23.2	-5.8	-4.8	2.3	1.9	6.3
Crete	1.0	0.2	2.0	121.2	-10.5	-5.0	2.1	-4.9	5.2
East Macedonia-Thrace	1.0	0.8	0.5	27.0	-6.9	-6.2	2.3	-3.6	4.2
Central Macedonia	0.9	0.4	0.5	30.9	-8.1	-4.8	1.7	-0.2	4.4
Western Macedonia	0.9	2.0	-1.2	44.3	-5.3	-0.5	3.3	-4.1	8.7
Epirus	1.8	2.4	2.2	21.1	-4.6	-0.1	3.5	0.2	8.2
North Aegean	1.0	1.3	1.4	37.4	-5.1	-3.0	2.6	-4.0	6.0
South Aegean	1.9	1.1	3.0	44.1	-5.5	-4.1	2.8	-2.8	-1.0
Ionian Islands	1.4	0.0	1.8	29.6	-8.6	-6.7	2.0	-6.4	8.8

Source: Ministry of Finance, author's own calculations.

Table 14a Number of taxpayers - Total tax by region and occupational category (2008-2010)

(%)

	Percentage share in country total													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	38.4	56.7	40.8	69.9	34.2	47.6	8.4	25.9	45.1	60.6	45.6	59.8	36.4	55.2
Thessaly	6.5	4.2	5.2	2.4	6.4	4.7	10.0	6.8	5.4	4.0	6.5	3.9	7.4	4.6
Peloponnese	5.3	3.5	4.7	2.1	5.5	4.6	11.8	10.0	4.2	3.1	3.4	2.6	5.5	3.7
Central Greece	4.7	3.4	3.2	1.4	4.8	3.9	8.1	10.4	4.4	3.2	3.3	2.3	5.1	3.5
Western Greece	5.8	4.0	4.5	2.2	5.7	4.4	10.6	6.8	5.0	3.5	4.9	4.1	6.2	4.4
Crete	5.2	3.8	3.6	1.9	5.8	4.6	10.3	10.8	5.0	3.2	5.6	3.8	4.3	3.8
East Macedonia-Thrace	5.2	3.1	5.6	1.8	5.0	3.9	8.1	4.2	4.2	2.9	4.4	2.9	5.8	3.0
Central Macedonia	17.0	12.5	19.5	12.1	17.6	13.9	16.5	10.1	15.7	11.6	16.6	12.8	17.5	13.1
Western Macedonia	2.6	2.2	2.8	1.0	2.7	2.1	3.2	3.8	2.2	2.7	2.4	1.6	2.8	2.1
Epirus	2.9	2.1	2.7	1.1	3.2	2.5	4.3	3.3	2.4	1.8	2.9	2.3	3.0	2.2
North Aegean	1.8	1.3	1.8	0.8	2.0	1.6	3.7	4.1	1.4	1.0	1.3	1.0	1.9	1.4
South Aegean	2.9	2.1	3.2	2.2	4.3	4.3	2.6	2.2	3.0	1.6	1.9	1.7	2.2	1.7
Ionian Islands	2.0	1.2	2.4	1.2	2.9	1.9	2.3	1.7	1.7	0.9	1.4	1.1	1.8	1.3
Country total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Ministry of Finance, author's own calculations.

Table 14b Number of taxpayers - Total tax by region and occupational category (2008-2010)

(%)

	Percentage share in region total (region = 100)													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	100	100	11.4	7.5	10.9	14.2	1.5	1.5	42.0	41.0	7.5	18.9	26.6	20.5
Thessaly	100	100	8.7	3.5	12.0	18.7	10.8	5.3	30.0	36.4	6.4	16.6	32.1	22.9
Peloponnese	100	100	9.6	3.6	12.7	21.9	15.6	9.4	28.8	33.3	4.1	13.3	29.2	22.1
Central Greece	100	100	7.4	2.6	12.3	19.7	12.0	10.2	33.5	36.7	4.4	12.3	30.5	22.1
Western Greece	100	100	8.5	3.3	12.1	18.5	12.8	5.7	31.1	34.3	5.3	18.6	30.2	23.2
Crete	100	100	7.5	2.9	13.8	20.3	13.8	9.3	34.6	32.1	6.8	18.1	23.5	20.8
East Macedonia-Thrace	100	100	11.6	3.6	11.7	21.3	10.9	4.5	29.1	36.5	5.3	17.2	31.5	20.5
Central Macedonia	100	100	12.3	5.9	12.7	18.8	6.8	2.7	33.1	35.7	6.2	18.4	28.9	22.1
Western Macedonia	100	100	11.6	2.7	12.8	16.2	8.5	5.6	30.8	46.5	5.8	12.7	30.5	19.8
Epirus	100	100	10.1	3.3	13.4	20.1	10.3	5.2	30.3	32.3	6.4	20.0	29.6	22.5
North Aegean	100	100	10.4	4.0	13.6	21.4	14.3	10.6	27.4	30.1	4.5	14.2	29.9	23.2
South Aegean	100	100	12.0	6.2	18.6	34.5	6.3	3.4	37.6	28.1	4.2	14.5	21.3	17.0
Ionian Islands	100	100	12.8	5.9	17.6	27.1	8.2	4.6	31.3	27.6	4.6	16.0	25.5	22.5

Source: Ministry of Finance, author's own calculations.

Table 14c Number of taxpayers - Total tax by region and occupational category (2008-2010)

(%)

	Average annual growth rates													
	Total occupations		Rentiers		Traders-industrialists-small-scale manufacturers-self-employed		Farmers-livestock breeders-fishermen-foresters		Employees		Sole proprietors		Pensioners	
	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax	Number of taxpayers	Total tax
Attica	0.5	-2.1	5.6	-2.4	-2.2	-12.3	-2.2	-3.6	-1.1	-0.8	0.5	-2.5	2.0	3.5
Thessaly	1.4	0.5	3.9	-1.6	-0.7	-9.6	-0.7	2.3	1.8	1.5	-2.6	-0.4	2.6	8.3
Peloponnese	1.0	1.1	3.5	5.0	-0.8	-7.4	0.1	2.4	0.4	2.7	-0.2	-1.3	2.1	8.2
Central Greece	1.0	-1.5	7.7	1.3	-0.8	-9.9	-1.4	-2.1	-0.1	-1.6	-0.5	-2.7	2.4	7.2
Western Greece	1.2	0.6	7.6	-2.9	-0.6	-8.8	0.7	3.4	-0.4	1.2	1.1	0.7	2.2	7.8
Crete	1.0	-1.2	8.3	0.4	-0.9	-14.7	0.8	1.5	0.2	1.2	-5.4	-1.0	3.2	8.1
East Macedonia-Thrace	1.0	-1.0	3.4	-1.7	-0.6	-11.4	0.4	2.7	0.2	0.9	-7.8	-4.4	3.2	9.5
Central Macedonia	0.9	-1.4	5.2	-3.6	-1.4	-12.3	-0.3	1.7	-0.7	0.4	-1.8	-2.4	2.7	7.0
Western Macedonia	0.9	2.3	1.7	-8.5	-1.3	-5.3	3.5	6.7	0.6	3.0	-6.2	-4.2	2.3	12.0
Epirus	1.8	0.9	3.9	2.4	-0.7	-8.1	1.7	5.5	2.1	2.0	-5.0	-1.6	3.4	8.9
North Aegean	1.0	-0.2	2.8	-2.8	0.0	-8.5	-0.2	1.3	1.2	3.4	-7.4	-5.7	2.5	6.4
South Aegean	1.9	-2.0	5.2	-0.9	0.3	-8.7	-1.5	0.4	1.8	2.1	-3.3	-5.8	3.6	8.3
Ionian Islands	1.4	-2.5	6.2	0.5	-1.0	-12.8	-0.3	-0.4	1.8	3.3	-9.2	-9.1	2.6	8.1
Country total	0.9	-1.4	5.3	-2.2	-1.3	-11.3	-0.1	0.4	-0.3	0.0	-1.4	-2.4	2.4	5.5

Source: Ministry of Finance, author's own calculations.

Table 15 Ratios of disposable income and final consumption expenditure to population and ratio of final consumption expenditure to disposable income

	2000-2007*			2008-2014		
Disposable income/population						
Country total	100	100	1.00	100	100	1.00
Attica	42.4	36.0	1.18	41.4	35.8	1.16
North Aegean	1.6	1.8	0.90	1.7	1.8	0.96
South Aegean	2.8	2.9	0.96	3.1	3.0	1.03
Crete	5.0	5.5	0.92	4.8	5.6	0.86
East Macedonia-Thrace	4.6	5.4	0.85	4.7	5.5	0.85
Central Macedonia	14.9	17.1	0.87	16.0	17.3	0.92
Western Macedonia	3.0	2.6	1.14	2.5	2.6	0.97
Epirus	2.8	3.1	0.89	2.9	3.1	0.93
Thessaly	6.0	6.8	0.88	6.3	6.7	0.94
Ionian Islands	1.7	1.9	0.88	1.8	1.9	0.97
Western Greece	5.6	6.4	0.88	5.4	6.2	0.87
Central Greece	5.2	5.1	1.03	4.5	5.1	0.88
Peloponnese	4.4	5.4	0.81	4.8	5.3	0.91
Final consumption expenditure/population						
Country total	-	-	-	100	100	1.00
Attica	-	-	-	43.1	35.8	1.20
North Aegean	-	-	-	1.8	1.8	1.01
South Aegean	-	-	-	2.6	3.0	0.85
Crete	-	-	-	4.8	5.6	0.86
East Macedonia-Thrace	-	-	-	4.6	5.5	0.84
Central Macedonia	-	-	-	17.6	17.3	1.02
Western Macedonia	-	-	-	2.0	2.6	0.76
Epirus	-	-	-	4.3	3.1	1.37
Thessaly	-	-	-	3.7	6.7	0.55
Ionian Islands	-	-	-	1.3	1.9	0.69
Western Greece	-	-	-	5.7	6.2	0.91
Central Greece	-	-	-	3.5	5.1	0.69
Peloponnese	-	-	-	5.1	5.3	0.95
Final consumption expenditure/disposable income						
Country total	-	-	-	100	100	1.00
Attica	-	-	-	43.1	41.4	1.04
North Aegean	-	-	-	1.8	1.7	1.05
South Aegean	-	-	-	2.6	3.1	0.82
Crete	-	-	-	4.8	4.8	1.00
East Macedonia-Thrace	-	-	-	4.6	4.7	0.99
Central Macedonia	-	-	-	17.6	16.0	1.10
Western Macedonia	-	-	-	2.0	2.5	0.79
Epirus	-	-	-	4.3	2.9	1.47
Thessaly	-	-	-	3.7	6.3	0.59
Ionian Islands	-	-	-	1.3	1.8	0.72
Western Greece	-	-	-	5.7	5.4	1.05
Central Greece	-	-	-	3.5	4.5	0.78
Peloponnese	-	-	-	5.1	4.8	1.05

Source: ELSTAT, author's own calculations.
* There are no available data on final consumption expenditure by region for 2000-2007.

WORKING PAPERS (JULY – DECEMBER 2017)

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

232. Do creditor rights and information sharing affect the performance of foreign banks?
Emmanuel C. Mamatzakis and Antonios Kalyvas

233. Labour market adjustment in Europe during the crisis: microeconomic evidence from the Wage Dynamics Network survey
Mario Izquierdo, Juan Francisco Jimeno, Theodora Kosma, Ana Lamo, Stephen Millard, Tairi Rõõm and Eliana Viviano

234. The Greek Great Depression: a general equilibrium study of its drivers
George Economides, Dimitris Papageorgiou and Apostolis Philippopoulos

235. Fiscal policy with an informal sector
Harris Dellas, Dimitris Malliaropulos, Dimitris Papageorgiou and Evangelia Vourvachaki

236. Milton Friedman and the case for flexible exchange rates and monetary rules
Harris Dellas and George S. Tavlas

237. Group affiliation in periods of credit contraction and banks' reaction: evidence from the Greek crisis
Panagiotis Avramidis, Ioannis Asimakopoulos, Dimitris Malliaropulos and Nickolaos G. Travlos

238. Advanced economies and emerging markets: dissecting the drivers of business cycle synchronization
Aikaterini Karadimitropoulou

239. Current account and the real exchange rate: disentangling the evidence
Matthieu Bussière, Aikaterini Karadimitropoulou and Miguel A. León-Ledesma

240. Measuring the systemic importance of banks
Georgios Moratis and Plutarchos Sakellaris

Do creditor rights and information sharing affect the performance of foreign banks?

Working Paper No. 232
Emmanuel C. Mamatzakis and Antonios Kalyvas

This paper examines the effect of host economy creditor rights and information sharing on the profit performance of foreign banks vis-à-vis domestic banks for a global sample of commercial banks over the 2005-2009 period. To this end, we employ the recent foreign bank ownership dataset of Claessens and Van Horen (2014) and measure performance as profit efficiency using the alternative profit function. Results from the Battese and Coelli (1995) stochastic frontier analysis model show that creditor rights exert a positive effect on efficiency that strengthens for foreign banks. On the other hand, information sharing exerts a negative effect on profit efficiency which strengthens for foreign banks. The results for information sharing show some variability across different levels of development of the host economy. Moreover, the transparency of the host economy moderates the effect of creditor rights and information sharing on foreign bank efficiency. We also examine the effect of "institutional distance" in creditor rights and information sharing between the home and the host economy on foreign bank efficiency. The effect of creditor rights' "institutional distance" on foreign bank efficiency is negative, while it turns positive for information sharing. These findings highlight the importance of strong creditor rights for foreign bank performance and are useful for both regulators in host economies and foreign bank managers.

Labour market adjustment in Europe during the crisis: microeconomic evidence from the Wage Dynamics Network survey

Working Paper No. 233
Mario Izquierdo, Juan Francisco Jimeno, Theodora Kosma, Ana Lamo, Stephen Millard, Tairi Rõõm and Eliana Viviano

Against the backdrop of continuing adjustment in EU labour markets in response to the Great Recession and the sovereign debt crisis, the European System of Central Banks (ESCB) conducted the third wave of the Wage Dynamics Network (WDN) survey in 2014-2015 as a follow-up to the two previous WDN waves carried out in 2007 and 2009. This third wave sampled about 25,000 firms in 25 European countries with the aim of assessing how firms adjusted wages and employment in response to the various shocks and the labour market reforms that took place in the EU during the period 2010-2013. This paper summarises the main results of WDN3. As expected, negative demand shocks are highly correlated with a negative adjustment in employment —especially in permanent employment and, to a lesser extent, in temporary employment— and in hours worked per employee. In the case of wages, although negative shocks also increase the probability of wage adjustments, downward nominal wage rigidity was still prevalent during the period 2010-2013. Nominal base wage cuts were extremely rare among EU firms except for firms in countries where GDP declined by 10% or more. This applies to Estonia in the period 2008-2009 and to Greece and Cyprus in 2010-2013, where a significant share of firms had cut wages. Regarding recent labour market reforms, the composition of measures adopted by the various countries differed, reflecting not only heterogeneity in response to shocks but also differences in institutions. The largest and most wide-ranging reforms were implemented in the South European countries (i.e. Greece,

Spain and Portugal) that suffered the most severe shocks in terms of GDP and unemployment. A substantial percentage of firms in these countries found it easier to adjust both employment and wages in 2013 than in 2010, and attributed this ease to reforms and changes in labour laws. Finally, with regard to remaining obstacles to employment creation, WDN3 showed that economic uncertainty and high payroll taxes are major obstacles to hiring workers on open-ended contracts for a significant share of firms in many EU countries. Skill shortages that relate to other structural policies such as education also appear to be an obstacle to hiring workers on open-ended contracts in many EU countries.

The Greek Great Depression: a general equilibrium study of its drivers

Working Paper No. 234
George Economides, Dimitris Papageorgiou and Apostolis Philippopoulos

This paper provides a quantitative study of the main determinants of the Greek Great Depression since 2010. We use a medium-scale DSGE model calibrated to the Greek economy between 2000 and 2009. Then, departing from 2010, we simulate the model by using the actual package of fiscal consolidation implemented in Greece over the period 2010-2015. Our simulations show that the fiscal policy mix adopted, jointly with the deterioration in institutional quality and, specifically, in the degree of protection of property rights, can explain essentially the total loss in GDP between 2010 and 2015 (around 26%). In particular, the fiscal policy mix led to a reduction in output by 14%, while the deterioration in property rights reduced output by another 8%. It thus naturally follows that a less distorting fiscal policy mix and a stronger protection of property rights are necessary conditions for economic recovery in this country.

Fiscal policy with an informal sector

Working Paper No. 235
Harris Dellas, Dimitris Malliaropulos, Dimitris Papageorgiou and Evangelia Vourvachaki

Macroeconomic models that omit the shadow economy systematically misforecast and mismeasure the effect of fiscal —in particular tax— policy on economic activity and tax revenue. We add an informal sector to the Bank of Greece DSGE model and use the actual package of fiscal consolidation implemented in Greece over the period 2010-2015 to evaluate the role of the black economy. In the data, official Greek GDP declined by about 26%, budget deficits proved larger and more persistent, and tax rates increased by much more and tax revenue by much less than predicted. The model replicates the official output decline but implies a true output decline that is less than two thirds of that in recorded output. The discrepancy is even more pronounced for employment. The model also implies that the size of fiscal adjustment and the drop in economic activity could have been considerably milder had the informal sector been curtailed (it instead increased by about 50%). The underground economy seems to have been a key factor in Greece's failure to achieve orderly debt consolidation while avoiding economic depression.

Milton Friedman and the case for flexible exchange rates and monetary rules

Working Paper No. 236
Harris Dellas and George S. Tavlas

Milton Friedman was a strong proponent of flexible exchange rates accompanied by a domestic monetary rule. He believed that such a combination would deliver superior economic performance and would also be more consistent with democratic principles than a regime based on fixed exchange rates and discretionary monetary policy. John Taylor's recent proposal of a rules-based international monetary system —based on flexible exchange rates and a Taylor rule for each country— is very much in that spirit and represents a modern rendition of Friedman's views. Under both the Friedman and Taylor proposals, instead of policy coordination among countries there would be policy harmonisation.

Group affiliation in periods of credit contraction and banks' reaction: evidence from the Greek crisis

Working Paper No. 237
Panagiotis Avramidis, Ioannis Asimakopoulos, Dimitris Malliaropulos and Nickolaos G. Travlos

Using a data set of bank loans to Greek firms during the period of the Greek sovereign crisis, we provide empirical evidence that firms affiliated with groups are less likely to default on their bank loan during a credit crunch, compared to stand-alone firms. We show that the lower default risk of affiliated firms is due to access to the internal capital market in the form of intra-group loans and to enhanced access to the restricted external financing. Furthermore, we provide empirical evidence that banks evaluate positively the group membership and that they collect private information about the delinquent affiliated firms from other firms that belong to the group. Finally, we find that banks are more likely to show forbearance against affiliated firms with non-performing loans, in order to delay additional loan charge-offs and to preserve their relationship with the rest of the group.

Advanced economies and emerging markets: dissecting the drivers of business cycle synchronization

Working Paper No. 238
Aikaterini Karadimitropoulou

What are the divers of business cycle synchronisation within and between advanced and emerging economies at the sector level? This question is addressed by analysing international co-movements of value added (VA) growth in a multi-sector dynamic factor model. The model contains a world factor, region factors, sector factors, country factors, and idiosyncratic components. The model is estimated using Bayesian methods for 9 disaggregated sectors in 5 developed economies (G5) and 19 emerging economies for the 1972-2009 period. The results suggest that, while there exists a common "regional business cycle" in

the G5, fluctuations in sectoral VA growth are dominated by country-specific factors in the emerging markets. Despite that, the international factor (the sum of world and sector factors) is more important than the region factor, suggesting that the emerging markets are more synchronised with the G5. A simple regression shows that: (i) the world factor is more important the larger the share of agriculture in output; (ii) in more open economies the sector factor is more important in explaining sectoral VA growth fluctuations; (iii) the region factor is more important, the richer and the less volatile the economy. Finally, a comparison of the variance of sectoral VA growth accounted for by each factor from the pre- to the post-globalisation period shows convergence of the business cycles within the G5 and the emerging markets, respectively. The changes in the contribution of the world, sector and region factor are due to changes in the importance of those factors within sectors. However, for the emerging markets, the fall in the importance of the country factors is dominated by changes in the structural composition of the economies. Therefore, the evolution of the structural composition in the emerging markets could be an important driver of more synchronised business cycles at the regional and the international level.

Current account and the real exchange rate: disentangling the evidence

Working Paper No. 239
Matthieu Bussière, Aikaterini Karadimitropoulou and Miguel A. León-Ledesma

We study the main shocks driving current account fluctuations for the G6 economies. Our theoretical framework features a standard two-goods intertemporal model, which is specifically designed to uncover the role of permanent and temporary output shocks and the relation between the real exchange rate and the current account. We build a SVAR model including the world real interest rate, net output, the real exchange rate, and the current account and identify four structural shocks. Our results suggest four main conclusions: (i) there is substantial support for the two-goods intertemporal model with time-varying interest rate, since both external supply and preference shocks account for an important proportion of current account fluctuations; (ii) temporary domestic shocks account for a large proportion of current account fluctuations, but the excess response of the current account is less pronounced than in previous studies; (iii) our results alleviate the previous puzzle in the literature that a shock which explains little about net output changes can explain a large proportion of current account changes; and (iv) the nature of the shock matters to shape the relationship between the current account and the real exchange rate, which explains why it is difficult to understand the role of the real exchange rate for current account fluctuations.

Measuring the systemic importance of banks

Working Paper No. 240
Georgios Moratis and Plutarchos Sakellaris

Macroprudential policy is still in its infancy. Much work is still needed on developing good and timely analysis, effective policy instrument tools, and effective implementation. Our paper makes a contribution on the dimension of analysis and measurement. The key aim of

macroprudential policy is to address externalities and spillovers among financial institutions in an effort to safeguard financial stability. These interactions are complex. We provide a tool that clarifies and quantifies these interactions expressing them in a single score. Our measure can guide appropriate macroprudential policies that aim to internalise these externalities. We measure the systemic importance of all banks that issue publicly traded CDS contracts among the world's biggest 150.

Systemic importance is captured by the intensity of spillovers of daily CDS movements. This measure captures institutional externalities such as "too big to fail", or "too correlated to fail." Our new empirical tool uses Bayesian VAR to address the dimensionality problem and identifies banks that may trigger instability in the global financial system, while it identifies separately the degree of externalities originating in a bank from its vulnerability to the system. In particular, we find that more systemically important banks display relatively higher externalities than vulnerability to the global system. This decomposition better allows the macroprudential supervisor to differentiate the "cure" according to the individual bank's systemic "disease". The "cure" usually consists of a combination of capital requirements, quantitative restrictions, and supervisory review actions.

Arguably, our decomposition facilitates an improved approach to safeguarding financial stability. For the period January 2008-June 2017, we find the following: A bank's systemic importance is not adequately captured by its size. In addition, a considerable number of banks officially designated as G-SIBs are not ranked high in terms of our novel measure of systemic importance. European banks have been the main source of global systemic risk with strong interconnections to US banks. Looking at the time dimension for global systemic risk, we identify periods of increased interconnections among banks, during which systemic and idiosyncratic shocks are propagated more intensely via the network. Using principal components analysis, we identify a single dominant factor associated with fluctuations in CDS spreads. Individual banks' exposure to this factor is related to their government's ability to support them and to their retail orientation but not to their size. In particular, regarding the bank-sovereign nexus, our evidence is consistent with fiscally strong sovereigns insulating their large banks from this dominant factor throughout this period.

ARTICLES PUBLISHED IN PREVIOUS ISSUES OF THE ECONOMIC BULLETIN

Boutos Yannis, "Economic stabilisation and growth prospects", No. 3, February 1994.
Papademos Lucas, "Growth with stability: the role of monetary policy", No. 5, March 1995.
Voridis Hercules, "The special nature of banks and the transmission mechanism of monetary policy: A review of recent literature", No. 5, March 1995.
Filippides Anastasios, Kyriakopoulos Panayotis and Moschos Dimitrios, "Bank of Greece monetary policy instruments", No. 6, November 1995.
Haralabides Michael, Hardouvelis Gikas and Papageorgiou George, "Changeover to the single currency: Prospects and challenges for credit institutions in Greece", No. 6, November 1995.
Karabalis Nikos, "Harmonisation of Consumer Price Indices in EU countries", No. 7, March 1996.
Public Sector Accounts Department, Studies, Planning and Operations Development Office, "Government Securities Markets", No. 7, March 1996.
Saccomanni Fabrizio, "Opportunities and challenges in the process of European monetary integration", No. 7, March 1996.
Papademos Lucas, "Challenges facing monetary policy on the road to EMU", No. 8, November 1996.
Information Systems and Organisation Department, "Developments in EU Payment Systems: TARGET and the Hellenic system Hermes", No. 8, November 1996.
Brissimis Sophocles and Gibson Heather, "Monetary policy, capital flows and Greek disinflation", No. 9, March 1997.
Sabethai Isaac, "From contractual earnings to labour costs: incomes policy, collective bargaining and inflation (1991-1996)", No. 9, March 1997.
Hall S.G. and Zonzilos Nicholas, "The output gap and inflation in Greece", No. 9, March 1997.
Pantelidis Evangelos, "The methodology of the new balance of payments compilation system of the Bank of Greece", No. 9, March 1997.
Papademos Lucas, "The globalisation of financial markets and the conduct of economic and monetary policy", No. 10, December 1997.
Brissimis Sophocles and Kastrisianakis Efstratios, "Is there a credit channel in the Greek economy?", No. 10, December 1997.
Gibson Heather, "The relationship between the financial system and the real economy", No. 10, December 1997.
Hondroyiannis George and Papapetrou Evangelia, "The causal relationship between consumer and wholesale prices in Greece", No. 10, December 1997.
Hardy Daniel and Simigiannis George, "Competition and efficiency of the Greek banking system", No. 11, June 1998.
Brissimis Sophocles and Gibson Heather, "What can the yield curve tell us about inflation?", No. 11, June 1998.
Pantazidis Stelios, "Inflation, investment and economic growth in Greece", No. 11, June 1998.
Mitrakos Theodoros, "The contribution of income sources to overall inequality", No. 11, June 1998.
Garganas Nicholas, "Greece and EMU: prospects and challenges", No. 12, December 1998.
Brissimis Sophocles, Sideris Dimitris and Voumvaki Fragiska, "Purchasing power parity as a long-run relationship: an empirical investigation of the Greek case", No. 12, December 1998.
Manassaki Anna, "European Union transfers to Greece: historical background and prospects", No. 12, December 1998.
Lazaretou Sophia, "The drachma on the metallic monetary standards: lessons from the past", No. 13, July 1999.
Hondroyiannis George, "The causality between government spending and government revenue in Greece", No. 13, July 1999.
Mitrakos Theodoros and Tsakloglou Panos, "The distributional impact of excise duties", No. 13, July 1999.

Dellas Harris, "ECB monetary policy strategy and macroeconomic volatility in Greece", No. 13, July 1999.
Papazoglou Christos, "The real exchange rate and economic activity: is the hard-drachma policy necessarily contractionary?", No. 14, December 1999.
Gibson Heather and Lazaretou Sophia, "Leading inflation indicators for Greece: an evaluation of their predictive power", No. 14, December 1999.
Karapappas Andreas and Milionis Alexandros, "Estimation and analysis of external debt in the private sector", No. 14, December 1999.
Papademos Lucas, "From the drachma to the euro", No. 15, July 2000.
Zonzilos Nicholas, "The Greek Phillips curve and alternative measures of the NAIRU", No. 15, July 2000.
Pantazidis Stelios, "The sustainability of the current account deficit", No. 15, July 2000.
Hondroyiannis George, "Investigating causality between prices and wages in Greece", No. 15, July 2000.
Sabethai Isaac, "The Greek labour market: features, problems and policies (with emphasis on labour market flexibility and on combatting unemployment in the context of non-inflationary growth)", No. 16, December 2000.
Brissimi Dimitra and Brissimis Sophocles, "The problem of unemployment in the European Union", No. 16, December 2000.
Bardakas Joanna, "Financial deregulation, liquidity constraints and private consumption in Greece", No. 16, December 2000.
Lazaretou Sophia and Brissimis Sophocles, "Fiscal rules and stabilisation policy in the euro area", No. 17, July 2001.
Lolos Sarantis-Evangelos, "The role of European structural resources in the development of the Greek economy", No. 17, July 2001.
Papazoglou Christos, "Regional economic integration and inflows of foreign direct investment: the European experience", No. 17, July 2001.
Garganas Nicholas, "The future of Europe and EMU", No. 18, December 2001.
Brissimis Sophocles and Papadopoulou Dafni-Marina, "The physical introduction of euro banknotes and coins in Greece", No. 18, December 2001.
Zonzilos Nicholas, "The monetary transmission mechanism – the ECB experiment: results for Greece", No. 18, December 2001.
Brissimis Sophocles, Kamberoglou Nicos and Simigiannis George, "Bank-specific characteristics and their relevance to monetary policy transmission", No. 18, December 2001.
Tsaveas Nicholas, "Exchange rate regimes and exchange rate policy in South Eastern Europe", No. 18, December 2001.
Demenagas Nicholas and Gibson Heather, "Competition in Greek banking: an empirical study for the period 1993-1999", No. 19, July 2002.
Hondroyiannis George, "Economic and demographic determinants of private savings in Greece", No. 19, July 2002.
Gatzonas Efthymios and Nonika Kalliopi, "Eligible assets and management of collateral in the context of central bank monetary policy operations", No. 19, July 2002.
Voridis Hercules, Angelopoulou Eleni and Skotida Ifigeneia, "Monetary policy in Greece 1990-2000 through the publications of the Bank of Greece", No. 20, January 2003.
Kaplanoglou Georgia and Newbery David, "The distributional impact of indirect taxation in Greece", No. 21, July 2003.
Papapetrou Evangelia, "Wage differentials between the public and the private sector in Greece", No. 21, July 2003.
Athanasoglou Panayiotis and Brissimis Sophocles, "The effect of mergers and acquisitions on bank efficiency in Greece", No. 22, January 2004.

Lazaretou Sophia, "Monetary system and macroeconomic policy in Greece: 1833-2003", No. 22, January 2004.
Karabalis Nikos and Kondelis Euripides, "Alternative measures of inflation", No. 22, January 2004.
Papaspyrou Theodoros, "EMU strategies for new Member States: the role of Exchange Rate Mechanism II", No. 23, July 2004.
Mitrakos Theodoros, "Education and economic inequalities", No. 23, July 2004.
Papapetrou Evangelia, "Gender wage differentials in Greece", No. 23, July 2004.
Gibson Heather, "Greek banking profitability: recent developments", No. 24, January 2005.
Athanasoglou Panayiotis, Asimakopoulos Ioannis and Georgiou Evangelia, "The effect of merger and acquisition announcement on Greek bank stock returns", No. 24, January 2005.
Mitrakos Theodoros and Zografakis Stavros, "The redistributional impact of inflation in Greece", No. 24, January 2005.
Theodossiou Ioannis and Pouliakas Konstantinos, "Socio-economic differences in the job satisfaction of high-paid and low-paid workers in Greece", No. 24, January 2005.
Garganas Nicholas, "Adjusting to the single monetary policy of the ECB", No. 25, August 2005.
Mitrakos Theodoros, Simigiannis Georgios and Tzamourani Panagiota, "Indebtedness of Greek households: evidence from a survey", No. 25, August 2005.
Nicolitsas Daphne, "Per capita income, productivity and labour market participation: recent developments in Greece", No. 25, August 2005.
Nicolitsas Daphne, "Female labour force participation in Greece: developments and determining factors", No. 26, January 2006.
Mitrakos Theodoros and Zonzilos Nicholas, "The impact of exogenous shocks on the dynamics and persistence of inflation: a macroeconomic model-based approach for Greece", No. 26, January 2006.
Athanasoglou Panayiotis, Asimakopoulos Ioannis and Siriopoulos Konstantinos, "External financing, growth and capital structure of the firms listed on the Athens Exchange", No. 26, January 2006.
Mitrakos Theodoros and Nicolitsas Daphne, "Long-term unemployment in Greece: developments, incidence and composition", No. 27, July 2006.
Kalfaoglou Faidon, "Stress testing of the Greek banking system", No. 27, July 2006.
Pantelidis Evangelos and Kouvatseas Georgios, "Frontier survey on travel expenditure: methodology, presentation and output assessment (2003-2005)", No. 27, July 2006.
Brissimis Sophocles and Vlassopoulos Thomas, "Determinants of bank interest rates and comparisons between Greece and the euro area", No. 28, February 2007.
Simigiannis George and Tzamourani Panagiota, "Borrowing and socio-economic characteristics of households: results of sample surveys carried out by the Bank of Greece", No. 28, February 2007.
Papapetrou Evangelia, "Education, labour market and wage differentials in Greece", No. 28, February 2007.
Christodoulakis George, "The evolution of credit risk: phenomena, methods and management", No. 28, February 2007.
Karabalis Nikos and Kondelis Euripides, "Inflation measurement in Greece", No. 28, February 2007.
Kapopoulos Panayotis and Lazaretou Sophia, "Foreign bank presence: the experience of South-East European countries during the transition process", No. 29, October 2007.
Nicolitsas Daphne, "Youth participation in the Greek labour market: developments and obstacles", No. 29, October 2007.
Albani Maria, Zonzilos Nicholas and Bragoudakis Zacharias, "An operational framework for the short-term forecasting of inflation", No. 29, October 2007.

Asimakopoulos Ioannis, Brissimis Sophocles and Delis Manthos, "The efficiency of the Greek banking system and its determinants", No. 30, May 2008.
Balfoussia Hiona, "Stock market integration: the Athens Exchange in the European financial market", No. 30, May 2008.
Mitrakos Theodoros, "Child poverty: recent developments and determinants", No. 30, May 2008.
Asimakopoulos Ioannis, Lalountas Dionysis and Siriopoulos Constantinos, "The determinants of firm survival in the Athens Exchange", No. 31, November 2008.
Petroulas Pavlos, "Foreign direct investment in Greece: Productivity and Technology diffusion", No. 31, November 2008.
Anastasatos Tasos and Manou Constantina, "Speculative attacks on the drachma and the changeover to the euro", No. 31, November 2008.
Mitrakos Theodoros and Simigiannis George, "The determinants of Greek household indebtedness and financial stress", No. 32, May 2009.
Papazoglou Christos, "Is Greece's export performance really low?", No. 32, May 2009.
Zonzilos Nicholas, Bragoudakis Zacharias and Pavlou Georgia, "An analysis of the revisions of first (flash) quarterly national account data releases for Greece", No. 32, May 2009.
Rapanos Vassilis and Kaplanoglou Georgia, "Independent fiscal councils and their possible role in Greece", No. 33, May 2010.
Mitrakos Theodoros, Tsakloglou Panos and Cholezas Ioannis, "Determinants of youth unemployment in Greece with an emphasis on tertiary education graduates", No. 33, May 2010.
Gibson Heather and Balfoussia Hiona, "Inflation and nominal uncertainty: the case of Greece", No. 33, May 2010.
Migiakis Petros, "Determinants of the Greek stock-bond correlation", No. 33, May 2010.
Mitrakos Theodoros, Tsakloglou Panos and Cholezas Ioannis, "Determinants of the wage rates in Greece with an emphasis on the wages of tertiary education graduates", No. 34, September 2010.
Bragoudakis Zacharias and Panagiotou Stelios, "Determinants of the receipts from shipping services: the case of Greece", No. 34, September 2010.
Gibson Heather and Balfousia Hiona, "The impact of nominal and real uncertainty on macroeconomic aggregates in Greece", No. 34, September 2010.
Manesiotis Vasilios, "Numerical fiscal rules in practice", No. 35, June 2011.
Vasardani Melina, "Tax evasion in Greece: an overview", No. 35, June 2011.
Kalfaoglou Faidon, "The usefulness of stress testing exercises for assessing the soundness of the banking system", No. 35, June 2011.
Nicolitsas Daphne, "On-the-job training in Greece: a brief overview", No. 35, June 2011.
Papaspyrou Theodoros, "EMU sustainability and the prospects of peripheral economies", No. 36, April 2012.
Kanellopoulos Costas N., "Employment and worker flows during the financial crisis", No. 36, April 2012.
Kalfaoglou Faidon, "Bank capital adequacy framework", No. 36, April 2012.
Bragoudakis Zacharias and Sideris Dimitris, "Do retail gasoline prices adjust symmetrically to crude oil price changes? The case of the Greek oil market", No. 37, December 2012.
Kanellopoulos Costas N., "The size and structure of uninsured employment", No. 37, December 2012.
Migiakis Petros M., "Reviewing the proposals for common bond issuances by the euro area sovereign states under a long-term perspective", No. 37, December 2012.
Karabalis Nikos and Kondelis Euripides, "Indirect tax increases and their impact on inflation over 2010-2012", No. 38, November 2013.
Vourvachaki Evangelia, "Structural reform of the road haulage sector", No. 38, November 2013.

Kanellopoulos Nikolaos C., Mitrakos Theodoros, Tsakloglou Panos and Cholezas Ioannis, "The impact of the current crisis on private returns to education in Greece", No. 38, November 2013.
Papapetrou Evangelia and Bakas Dimitrios, "The Greek labour market during the crisis: Unemployment, employment and labour force participation", No. 38, November 2013.
Tzamourani Panagiota, "The Household Finance Survey: Description of the 2009 survey and main results on households' income, wealth and debt in Greece", No. 38, November 2013.
Dimitropoulou Dimitra, Koutsomanoli-Filippaki Anastasia, Charalambakis Evangelos and Aggelis Georgios, "The financing of Greek enterprises before and during the crisis", No. 39, July 2014.
Kanellopoulos Costas, "The Greek private sector labour market during the crisis", No. 39, July 2014.
Kalfaoglou Faidon, "European Banking Union: "Europeanising" banks' financial safety net", No. 39, July 2014.
Lazaretou Sofia, "The smart economy: cultural and creative industries in Greece. Can they be a way out of the crisis?", No. 39, July 2014.
Chaireti Aikaterini, "The housing situation in Greece during the crisis years 2008-2012", No. 39, July 2014.
Tagkalakis Athanasios, "Tax buoyancy in Greece", No. 40, December 2014.
Bragoudakis G. Zaharias, "An empirical investigation of the relationship between unit labour cost and price developments: The case of Greece", No. 40, December 2014.
Migiakis Petros M., "The international financial markets as a source of funding for Greek non-financial corporations", No. 40, December 2014.
Kalyvitis Sarantis, "Estimating the quality of Greek exports: A non-price based approach", No. 40, December 2014.
Kanellopoulos Costas, "The effects of minimum wages on wages and employment", No. 41, July 2015.
Georgiou Evangelia, "The use of cash and electronic payment instruments in the economy", No. 41, July 2015.
Kalfaoglou Faidon, "Alternative NPLs resolution regimes. A case studies approach", No. 41, July 2015.
Lazaretou Sophia, "How can the use of historical macroeconomic data series support economic analysis and policy making? The new macro history database 1833-1949 as part of the large database of Southeast European Countries", No. 41, July 2015.
Kasimati Evangelia and Sideris Dimitrios, "Towards a new growth model for tourism: structural reforms and the tourism product in Greece during the crisis (2008-2014)", No. 42, December 2015.
Tagkalakis Athanasios, "The determinants of unemployment dynamics in Greece", No. 42, December 2015.
Chaireti Aikaterini, "The Greek primary sector from 1995 to 2014", No. 42, December 2015.
Vettas Nikos, Giotopoulos Ioannis, Valavanioti Evangelia and Danchev Svetoslav, "The determinants of new firms' export performance", No. 43, July 2016.
Belli Styliani and Backinezos Constantina, "The transition to the new methodology for the compilation of balance of payments statistics – BPM6", No. 43, July 2016.
Lazaretou Sophia, "The Greek brain drain: the new pattern of Greek emigration during the recent crisis", No. 43, July 2016.
Kalfaoglou Faidon, "Bank recapitalisation: a necessary but not sufficient condition for resuming lending", No. 43, July 2016.
Manou Konstantina and Papapetrou Evangelia, "The economic behaviour of households in Greece: recent developments and prospects", No. 44, December 2016.

Papazoglou Christos, Sideris Dimitrios and Tsagklas Orestis, "Europe as an Optimum Currency Area: the experience of the Baltic countries", No. 44, December 2016.

Anyfantaki Sofia, "The evolution of Financial Technology (FinTech)", No. 44, December 2016.

Chatzivasiloglou Ioannis, "Introduction to Solvency II for (re)insurance undertakings", No. 44, December 2016.

Gibson Heather D. and Pavlou Georgia, "Exporting and performance: evidence from Greek firms", No. 45, July 2017.

Charalambakis Evangelos, "How did the Greek financial crisis impact on households? A comparison between the two waves of the HFCS", No. 45, July 2017.

Kosma Theodora, Papapetrou Evangelia, Pavlou Georgia, Tsochatzi Christina and Zioutou Pinelopi, "Labour market adjustment and labour market reforms in Greece during the crisis: findings from the third wave of the Wage Dynamics Survey", No. 45, July 2017.

Chatzivasiloglou Ioannis, "The valuation of assets and liabilities of (re)insurance undertakings", No. 45, July 2017.

ISSN: 1105 - 9729