ECONOMIC BULLETIN

No 34

SEPTEMBER
2010

BANK OF GREECE
EUROSYSTEM

ECONOMIC BULLETIN

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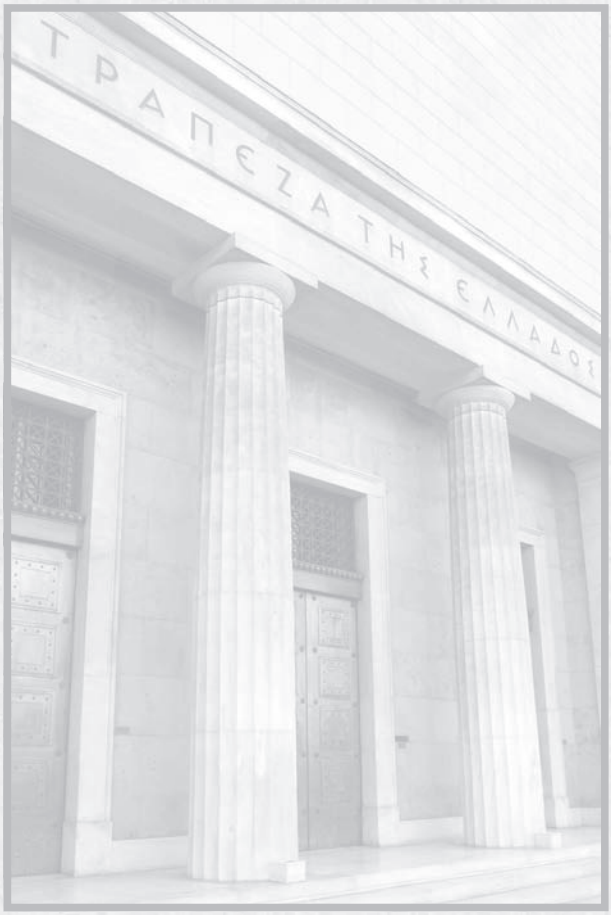

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Printed in Athens, Greece
at the Bank of Greece Printing Works

ISSN 1105 - 9729

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DETERMINANTS OF THE WAGE RATES IN GREECE WITH AN EMPHASIS ON THE WAGES OF TERTIARY EDUCATION GRADUATES*

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1 INTRODUCTION

In a previous study the authors established that, despite the increase in graduate unemployment over the last two decades and the high unemployment rates of tertiary education graduates during the first years after completion of their studies, graduation from a tertiary education institution provides a certain security against unemployment in the long run, at least in comparison to the lower levels of the education system (Mitrakos, Tsakloglou and Cholezas, 2010). However, lower unemployment rates alone cannot be taken as conclusive evidence of whether tertiary education is a good investment. To answer such a question, one also needs to know the rate of return to each level of education, or otherwise the wages that can be expected after graduation from a specific branch of the education system.

The literature on returns to education in our country (briefly reviewed below) is quite extensive. However, mainly on account of insufficient appropriate statistical information, so far no attempt has been made in the available empirical studies to estimate (private) returns to education for small homogeneous groups of graduates by field of study. The present study aims to fill this gap by using the wage data included in the Labour Force Surveys (LFSs) conducted in Greece in the period from the first quarter of 2004 to the third quarter of 2007 (2004 I – 2007 III).

The following section briefly reviews the findings of the available earlier empirical studies on returns to education in Greece. The third section describes the LFSs used in the empirical analysis, while the fourth section presents its major results. The last section summarises the study's conclusions, while detailed information is included in the Appendices.

2 LITERATURE REVIEW

The issue of wage differentials between various education levels in Greece has been examined mainly in the context of exploring returns to education (primarily "private" returns). In comparison to other countries, studies calculating returns to education in Greece are limited in number, as well as partly in depth, owing mainly to limitations of the available statistical information. The question of returns to education in Greece was first explored by Leibenstein (1967). Since then, relevant research work has been prolific.[1]

Published studies cover the time period from 1957 until today and draw on many different databases. Relying mostly on data collected by the Hellenic Statistical Authority (ELSTAT) – from Household Budget Surveys, European Community Household Panel, European

* The views expressed in this study do not necessarily reflect those of the Bank of Greece. The authors would like to thank H. Gibson, N. Kastis, I. Kalogirou, E. Kikilias, D. Nikolitsas, E. Papapetrou, T. Politis and G. Psacharopoulos for their useful comments. The present paper was supported by the cultural project "Protovoulia" (Educational and Development Initiative), as an earlier version formed part of a broader action of Protovoulia ("Education and Development: Connecting Education and Employment").

1 For a detailed review of the literature on private returns to education in Greece, see Cholezas and Tsakloglou (1999) and Cholezas (2005).

Union Statistics on Income and Living Conditions, etc.– they also use wage data collected by public and private enterprises, or even private researchers. Thus, it is not always easy to assess the quality and suitability of the information included in each database. All datasets used in the existing studies are cross-sectional.

As regards methodology, most earlier studies apply the Ordinary Least Squares (OLS) method to estimate Mincer's (1974) 'classical' semi-logarithmic human capital equation and calculate the effect of education on earnings. In general, the "education" variable is expressed either in years or in education levels with the use of dummy variables, while additional explanatory variables (such as potential experience and its square, or the age and education level of the father) are often used to improve the model's explanatory power. Heckman's two-step method for correcting the sample bias or selection error is used by Kanellopoulos (1997) to determine the returns for individuals working in the public sector, as well as by Kanellopoulos and Mavromaras (2002) who attempt to explain wage differentials between men and women. In addition, Papapetrou (2004) uses the quantiles regression method, which allows an estimation of the independent variables' effect on the dependent variable along the distribution of the latter. Finally, Leibenstein (1967), Psacharopoulos (1982), Magoula and Psacharopoulos (1999), and Kanellopoulos, Mavromaras and Mitrakos (2003) calculate social returns to education using cost-benefit techniques.

Almost all results of the available empirical studies are consistent with human capital theory, as they confirm a positive effect of education and potential experience on earnings. Returns to education levels increase with the years of schooling, and all additional variables have the expected signs. Of course such returns may in fact differ considerably among individuals, depending on, e.g., their mental abilities, or the particular institution they studied at (in terms of its quality and reputation in the labour market), but these hypotheses cannot be tested using the available statistical information. A further point of concern is that the widespread use of potential (rather than actual) work experience as an explanatory variable may lead to a possibly overestimated contribution of experience, since it takes no account of periods of unemployment, or non-participation in the labour force due to pregnancy or other reasons, or transition between jobs, etc. Moreover, given that many studies use additional independent variables, returns to education are no longer comparable when these variables affect the estimated contribution of education to earnings. On the other hand, these variables enhance the model's explanatory power and enable an exploration of the factors that affect earnings, often also revealing overestimated returns to education.[2] Finally, another important consideration relates to sample selection error. For instance, as regards women, only employed ones are included in the sample. However, if not chosen at random, i.e. if these are, e.g., primarily women with more years of schooling, or unmarried, then the sample is biased (not representative of all women) and, as a result of this selection error, estimates need to be corrected using appropriate econometric techniques.

A comparative analysis of the results of the available studies in light of the above considerations shows that, overall, returns to education in Greece follow a downward path until the late 1980s and increase in the course of the 1990s. Thus, the return to one additional year of schooling starts from 7.8% in 1964 (Kanellopoulos, 1985), falls to 5.8% in 1977 (Patrinos, 1992) and to 2.5% in 1985 (average for men and women, Patrinos and Lambropoulos, 1993), before rising again to 7.6% in 1994 (Magoula and Psacharopoulos, 1999) and then to even higher levels in 1999

2 Hence, the use of additional variables must be examined on a case-by-case basis, considering all positive and negative corollaries.

(Cholezas, 2005).[3] This 'recovery' of returns to education in the 1990s is attributed to the observed steady growth path of the Greek economy and the ensuing higher demand for skilled personnel, in parallel with the abandonment of the specific indexation policy pursued in the 1980s that led to the compression of earnings. In most studies, the return to each individual education level reveals an almost linear relationship to the years of schooling, with the possible exception of tertiary, particularly university, education. For example, in 1994, the respective returns per year are 6.7% for higher secondary (general) education, 6.3% for technical education of the same level, 6.9% for Technological Educational Institutes (TEI) and 8.7% for Universities (AEI) (Magoula and Psacharopoulos, 1999), whereas, in 1999, the corresponding figures for men (women) are 9.3% (12.5%), 9.6% (7.9%), 11.1% (21.2%) and 14.5% (16.3%) (Cholezas, 2005). In comparison with other EU Member States, according to evidence from European Community Household Panel (ECHP) data, in the second half of the 1990s returns appear higher in South European countries, and Greece ranks at one of the top positions (Cholezas, 2005). Opposite conclusions are drawn by other studies (Harmon, Walker and Westergaard-Nielsen, 2001; OECD, 2010) using, however, different databases for each country.

As regards the gender differential of return to education, although women often enjoyed lower rates of return in the past, more recent data imply a reversal of the situation, as returns to education for women today markedly surpass those for men. Thus, in 1964, the return to one additional year of schooling stood at 6.6% (6.5%) for male (female) employees (Kanellopoulos, 1982), while the corresponding rates for men (women) were 7.1% (11.4%) in 1974, 5.2% (6.4%) in 1988, 6.7% (7.8%) in 1994, and 7.2% (8.9%) in 1999 (Cholezas, 2005).

The exploration of returns to education by field of employment seems to yield more constant results, since returns are usually higher in the private sector (Hadjidema, 1998). This does not mean that the wages of women or private sector employees are higher than those of men or civil servants; on the contrary, their returns to education are higher mainly because the earnings of their reference group (i.e. women or private sector employees with low qualifications, accordingly) are exceptionally low (Cholezas, 2005). For example, the wages of women working in the private sector are 37% lower than those of women working in the public sector, while the wage differential between these two groups depends on the level of earnings and seems to decrease as earnings increase (Papapetrou, 2003).

The coefficient of potential experience (including tenure or not) is always positive and demonstrates the importance of past professional experience in the wage-setting process. The coefficient of tenure (included only in a few studies) is positive and higher than the coefficient of experience. This implies that employers are likely to value more the experience gained inside the enterprise at issue, deeming job-specific experience more important than general experience. In fact, including tenure among the independent variables lowers the return to one additional year of schooling by roughly one percentage point (Kanellopoulos, 1985). All the other variables used have the expected signs. Of particular interest is the higher return to one additional year of schooling observed for individuals whose fathers have attained a higher education level (Patrinos, 1992, 1995), as evidence of transmission of wage inequalities across generations.

The empirical literature also explores other individual questions somehow related to

3 Based on Household Budget Survey data for the period 1974-1999, Kanellopoulos, Mavromaras and Mitrakos (2003) describe a similar path of returns to education. In particular, as regards men, the authors find that returns to all education levels fell considerably between 1974 and 1988, increased significantly from 1988 to 1994, and then remained unchanged or decreased slightly between 1994 and 1999. In the case of women, the respective returns decreased considerably in the period from 1974 to 1982, before rising thereafter (during 1982-1999).

returns to education. Thus, although human capital theory posits that positive returns to education result from higher productivity, filter theory claims that they may be stemming from the fact that education signals to employers their employees' higher skills. In such cases education may actually represent a waste of resources, since it does not lead to increased worker productivity. The results of a number of studies on the Greek labour market (Lambropoulos, 1992; Magoula and Psacharopoulos, 1999; Cholezas, 2005) are not always consistent and tend to be influenced by the methodology adopted for the investigation of the problem.

Another point of interest related to returns to education is gender discrimination in the labour market. The existing studies show that wage differentials between men and women in Greece can largely be attributed to discrimination in the labour market, since 71.5% (53.8%) of their wage differentials in 1988 (1994) cannot be explained based on differences in terms of male and female human capital (Kanellopoulos and Mavromaras, 2002).[4] Between 1988 and 1999, the gender wage gap in the private sector slightly increases but, regardless of the methodology used, most of this differential cannot be explained by differences observed in the respective human capital stocks of men and women (Cholezas, 2005). In addition, although an important differentiation emerges between the earnings of men and women when the workers' position along the earnings distribution (Papapetrou, 2008) and their level of education (Papapetrou, 2007) are also taken into account, in most cases wage differentials cannot be explained by differences in the workers' productive characteristics.

As mentioned above, so far none of the available studies has estimated returns to education for individual groups of graduates within a specific level of education (e.g. engineers, physicians, economists, etc.) and, moreover, none has used LFS data. The present study, although not primarily concerned with the estimation of private returns to education but with an examination of wage differentials between groups of workers, nevertheless attempts to fill this gap.

3 LABOUR FORCE SURVEY: BRIEF DESCRIPTION AND FIRST DESCRIPTIVE RESULTS

For the purposes of this study we used the micro-data of the quarterly LFSs conducted by the Hellenic Statistical Authority (ELSTAT) between 2004 I and 2007 III. This period was chosen because (i) the LFS data collection methodology was radically revised in 2004 and (ii) ELSTAT microdata for this period are available in the form of a rotating panel, as each member of the sample participates in the LFS for six consecutive quarters ("waves").

Since 1998 ELSTAT has been conducting the LFS on a quarterly basis (previously only in the second quarter of each year). The main purpose of this survey is to collect detailed data on the employment and unemployment status of household members aged 15 or over. The LFS quarterly sample of the country's total population includes approximately 30,000 households (an average sampling fraction of 0.85%), with one sixth of it rotated (replaced) every quarter, which implies at least 120,000 interviews each year.

A final question in the LFS questionnaire – addressed only to household members working as employees – relates to their monthly earnings. Its exact wording is the following: "What are the total monthly earnings from your main job including extra payments paid monthly? (Data should refer to last-month payments)". Responses can be given on the basis of nine income brackets: less than €250, €251-500, €501-750, €751-1,000, €1,001-1,250, €1,251-1,500, €1,501-1,750, €1,751-2,000 and €2,000 or more. The present study makes use of these data, although grouped information is not so

4 According to Kanellopoulos, Mavromaras and Mitrakos (2003) this share of unexplained differential came to 87.9% in 1999 (1994: 70.7%, 1988: 46.3%).

suitable for an econometric analysis of wage differentials between members of the sample.

Initially, we attempted to use the panel data of the LFS by applying appropriate econometric techniques in order to isolate the influence of non-observable individual characteristics and calculate the "net" effect of specific education system components on the level of the employees' hourly wages. This proved unfeasible, however, since the variation of the dependent variable (and of many independent variables to an even greater extent) per unit of observation (individual) was extremely limited over time. In other words, in the vast majority of cases the income bracket showed only a slight change even after six consecutive quarters, and all other characteristics of the employees usually remained unchanged throughout their participation in the LFS. Therefore, for the purposes of the analysis, we used cross-sectional LFS data. More specifically, we used the first observation of each employee in the LFS over the period 2004 I – 2007 III. Table 1 presents the corresponding monthly wage distributions by employee education level. About 15% of the employees included in the sample did not answer the abovementioned question (replied: "Do not know/Do not answer") and thus were excluded from the analysis. This share does not seem to be closely related to the employees' education level, although it is slightly higher in the groups of very low and very high education levels.

For the purposes of the analysis, in the case of the "closed" income brackets we assumed that the employee's wage was the mean of the range, while for the corresponding values of the two "open" brackets (on the top and bottom ends of the distribution) we used the detailed data of the Household Budget Survey conducted by ELSTAT between February 2004 and January 2005, which collects information on the level of net wages without the use of income brackets. Given that the LFS sample utilised in the analysis of the wages covered the period 2004 I – 2007 III on a quarterly basis, the median value of each income bracket in each quarter of the LFS was adjusted for inflation, based on the Consumer Price Index data published by ELSTAT, in order for all wage data to be expressed in constant prices of the third quarter of 2007. Finally, to convert monthly wages into hourly earnings we used the employees' answers to the question of how many hours per week they

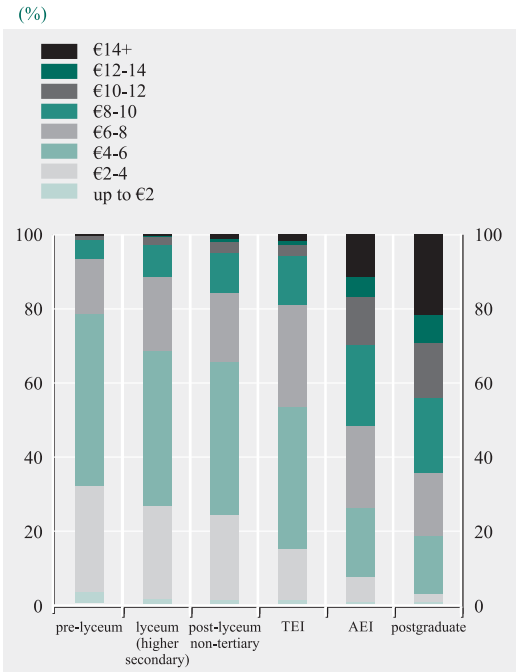
Table 1 Distribution of employees in income brackets per education level (percentages, all LFSs, not adjusted for inflation)

	Education level					
Net monthly earnings (€)	Pre-lyceum education	Lyceum	Post-lyceum non-tertiary education	TEI	AEI	Postgraduate studies
Up to 250	1.5	0.7	0.6	0.4	0.5	0.2
251-500	7.4	5.6	5.3	3.1	2.5	1.3
501-750	26.8	23.7	23.8	14.9	8.6	4.5
751-1,000	30.7	28.8	26.7	29.6	18.2	12.5
1,001-1,250	12.8	16.5	15.1	23.6	25.1	19.0
1,251-1,500	4.2	7.3	7.4	10.3	16.5	15.4
1,501-1,750	1.5	2.1	2.5	2.4	5.3	9.0
1,751-2,000	0.4	0.6	1.0	0.9	2.6	6.9
2,000+	0.2	0.4	1.5	1.1	3.3	11.9
No answer	14.6	14.3	16.3	13.6	17.3	19.3

usually work in their main job. This led to the exclusion of some additional responders who stated that "they cannot define the hours they usually work, because these differ significantly from one week to the other or from one month to the other". The resulting distributions appear in Chart 1 for six categories of employees grouped according to their level of education and reveal a clear positive relationship between hourly wages and education level. The next section analyses this relationship in detail.

As regards the definition of education groups, the LFS divides the population into a large number of education categories (often rather arbitrarily, in terms of the details provided). Given that this study focuses on tertiary education graduates, we chose to group AEI and TEI graduates with as much detail as possible. In many cases, however, this was unfeasible due to the limited number of employees in the groups at issue. In the end, the criterion for keeping or merging tertiary education groups was, apart from the homogeneity of the disciplines, the existence of a minimum number of observations (around 100 men or women) spread over a large number of years after graduation. For the lower education levels, fewer groups were formed. Moreover, it was decided to exclude from the sample a few groups with either a rather small number of observations or specific problems (graduates of special needs schools, of Open University and inter-disciplinary selection programmes, of military and law enforcement academies, of the School of Pedagogical and Technological Education (SELETE/ ASPETE) and of pedagogic academies with a two-year duration of studies). The precise equivalence between LFS education categories and those of the present study is presented in Mitrakos, Tsakloglou and Cholezas (2010) Annex II, with two exceptions due to the small number of male and female employees. The first exception involves the group of "Structural Engineering" TEI graduates, which has been merged here with the group of "Mechanical and Computer Engineering" technical school graduates (TEI). The

Chart 1 Distribution of employees into hourly wage brackets per education level (all LFSs, adjusted for inflation)



Source: Calculations based on LFS and ELSTAT data.

second exception refers to the group of IT graduates (AEI), which has been merged with the group of "Mechanical Engineering" graduates that also includes the relevant branch of "Computer Engineering".

4 ECONOMETRIC RESULTS

For the purposes of this study we estimate the hourly wages of the employees included in the sample according to human capital theory. This theory – originally developed by Mincer (1958, 1974), Schultz (1961), Becker (1964), Becker and Chiswick (1966) and Ben-Porath (1967) based on the ideas of Adam Smith – attributes labour wage differentials to the different human capital stock of the individual workers. Human capital stock determines their productivity, which, in a competitive market, determines in turn the level of their wages. Human capital consists of the knowledge, skills and abilities that individuals acquire through

formal or informal education and previous work experience (OECD, 1998), in addition to their inherent abilities. These assumptions formed the basis for the elaboration of the Mincerian wage equation (Mincer, 1974), extensively used in the literature on education economics. The empirical estimates of many such studies, as brought together by Psacharopoulos (Psacharopoulos, 1973, 1981, 1985, 1994; Psacharopoulos and Patrinos, 2004), confirm the existence of a strong positive correlation between education and earnings, but also of considerable differences in the level of – mainly private – returns to education across various countries and time periods.

Our analysis covers both broad education groups, such as those in Table 1, and narrow ones, strictly defined by the employees' field of study. In light of the literature reviewed in the second section, we opted to estimate econometric equations separately for men and women (considering that even if the variables affecting their respective wage levels are the same, the effect exerted is quantitatively different). The analysed sample consists of 29,317 men and 20,851 women, whose educational qualifications are presented in Table 2.

Two further points need to be made here. First, that self-employment is widespread in Greece: 41.0% (26.1%) of all employed men (women) in the sample are self-employed. Self-employment is particularly common among those with low educational qualifications (mostly in the agricultural sector) and within specific groups of individuals with high educational qualifications. Indicatively, only 25.2% of male law school graduates included in the sample are employees. Very low shares of salaried employment are also observed for male graduates of the structural engineering school (35.3%) and the medical school etc. (46.6%). The corresponding shares for the sample's female graduates are 44.0%, 54.7% and 45.1%. With respect to these groups, a slight risk may be involved in drawing conclusions for all graduates of the corresponding schools based on employees alone.[5] The second point to be made is that some groups are very small, or heterogeneous, or both. This holds for "Other TEI" and "Other AEI", and male graduates of "Languages" (as well as, to a lesser extent, for male graduates of "Social Sciences" and female graduates of "Horticulture and Forestry"). The results for these groups are not discussed.

The results reported in Table 2 could suggest that the sample of employees may not be random, thus calling for a two-step estimation method, i.e. an initial estimation of the probability of an individual's participation in the sample of employees, and then a subsequent estimation of the employees' wage rates, once the relevant correction term (Inverse Mills Ratio) has been included among the explanatory variables. However, as in all two-step estimation trials the relevant correction term was always statistically not significant, the results presented below were estimated using the least squares method.

Traditionally, econometric estimations of private returns to education use as dependent variable the logarithm of employees' hourly wages, and two main explanatory variables that proxy the human capital accumulated in the employee: education and work experience. In the main part of the analysis, the dummy variables we use for education represent the highest education level and specialty attained by the employee according to the detailed information of Table 2. For work experience, we use the years since graduation and their square. The quadratic term, expected to have a negative sign in the econometric estimations, indicates that the accumulation of experience increases an individual's earnings (albeit at a decreasing rate) and may have a negative marginal effect beyond a certain point (due to the depreciation of knowledge and skills). This variable used for work experience is not ideal,

5 It should be noted that these groups of graduates feature a small number of employees and not of observations in general. Thus, although they are used as independent groups, results need to be interpreted with caution, since a large share of these graduates are not employees.

Table 2 Percentages of employees in the total of employed persons aged 15-64 the first time they are included in the LFS sample (2004 I – 2007 III)

Education level	Men		Women	
	Percentage of employees	Number of employees	Percentage of employees	Number of employees
Pre-lyceum education	*49.6*	*10,090*	*53.6*	*4,218*
Primary	44.4	5,988	46.6	2,645
Lower secondary	58.6	4,102	68.7	1,573
Lyceum	*63.5*	*10,797*	*79.4*	*7,141*
General lyceum	62.3	7,503	78.9	6,249
Technical lyceum	69.8	1,629	88.0	642
Post-gymnasium technical school	63.0	1,665	72.2	250
Post-lyceum non-tertiary education	*69.5*	*2,501*	*83.6*	*2,903*
IEK	69.5	2,145	84.5	2,608
Other post-lyceum education	69.6	356	76.4	295
TEI	*69.7*	*1,506*	*89.7*	*1,803*
Structural, Mechanical & Computer Engineering	71.4	774	85.5	200
Agricultural & Food Technology	71.8	139	81.0	105
Economics & Management	68.6	416	88.4	578
Medical Sciences	65.8	146	93.0	809
Other TEI	55.2	31	89.6	111
AEI	*61.9*	*3,949*	*78.2*	*4,467*
Structural Engineering	35.3	260	54.7	149
Mechanical Engineering & IT	69.3	486	89.1	132
Physical Sciences	77.4	368	82.1	198
Mathematics & Statistics	75.3	281	88.9	160
Medical School etc.	46.6	417	45.1	287
Horticulture & Forestry	67.3	220	90.8	97
Law School	25.2	104	44.0	235
Economics & Management	68.9	880	88.8	795
Social Sciences	72.6	64	83.2	178
Humanities	82.3	386	90.2	1,071
Languages	57.4	27	81.2	327
Physical Education & Sports	80.4	267	91.4	167
Pedagogics	96.5	144	97.3	581
Other AEI	73.4	45	81.0	90
Postgraduate studies	*74.9*	*474*	*79.4*	*319*
Postgraduate degree	73.1	286	77.6	221
Doctorate	78.2	188	85.4	98
TOTAL	**59.0**	**29,317**	**73.9**	**20,851**

since it only approximates actual work experience (overlooking any periods of unemployment or withdrawal from the labour market, as well as of any work combined with stud-

ies).[6] This can lead to an overestimation of actual experience and, consequently, of its effect on wages. However, compared to the corresponding variable used in most of the works mentioned in the second part of this study (i.e., age minus the minimum years of study required for obtaining the degree minus 6), it is undoubtedly a much better proxy of the actual work experience. Given that theory suggests no reason to expect that the relationship between experience and earnings would be the same for all education levels and specialties, we included as independent explanatory variables in the estimated equation multiplicative terms introduced between the dummy variables of education levels and years since graduation and their square.

In addition to those that proxy the employee's human capital stock, the analysis also uses as explanatory variables some other variables associated with the employees' wage level. These are the region and degree of urbanisation of their place of residence, the sector (public/private) in which they work, their nationality and family status, the size of the local unit and the branch of economic activity of the firm for which they work, and the year and quarter of the LFS they took part in. Most results are illustrated in charts, where the dependent variable (hourly wage) is presented as a function of the years since graduation, separately for men and women. The reference group consists of single men or women (depending on the equation) who are general lyceum graduates, of Greek nationality, residents of Athens, employed in a business unit of 10 or less employees, in the private (retail or wholesale) sector, and have participated in the LFS in the third quarter of 2007. The detailed results and the description of the dependent and the independent variables used in the econometric analysis can be found in Appendix I. On account of heteroskedasticity, the coefficients' estimated standard errors were corrected using White's method (1980).

Before discussing the charts with the detailed results, it would be interesting to examine the corresponding results for six broad education groups, namely, individuals who have completed studies at pre-lyceum, lyceum (higher secondary), post-lyceum non-tertiary, TEI, AEI, and postgraduate levels. These results stem from estimations based on the variables

Chart 2 Estimated hourly wages per education level

(net hourly wages in euro, constant prices of 2007)

Source: Calculations based on LFS and ELSTAT data.

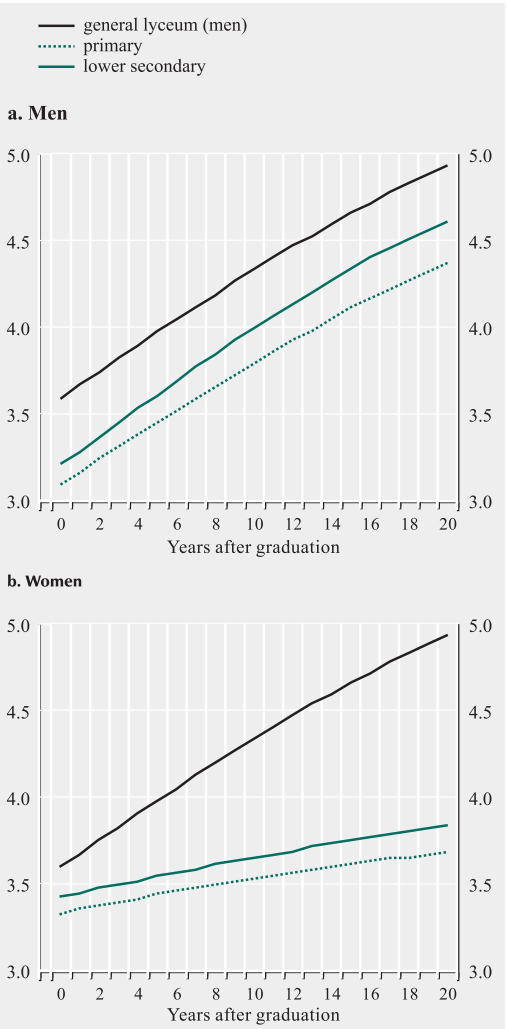
6 As already mentioned in the literature review, the use of potential experience as a proxy for actual work experience can lead to an overestimation of the latter's effect on hourly wages, given that tenure is not taken into account due to the lack of necessary information in the LFS sample.

mentioned above, but this time for broader groups of graduates. They are presented in Charts 2.a and 2.b for men and women respectively, which depict the estimated level of employees' hourly wages (vertical axis) as a function of the first 20 years since graduation from the highest education level completed (horizontal axis), once the effect of all other variables (family status, region, urbanisation, nationality, private or public sector, branch of economic activity, size of local business unit, quarter of the survey) has been checked. In all likelihood, twenty years after graduation is the maximum period that young people consider when deciding on the level and specialty of their studies. Similar charts are used in the rest of the study. These charts seem to fully confirm human capital theory (since the higher the education level, the higher the estimated level of earnings) and support our choice to introduce multiplicative terms between education level and years since graduation, as the slopes of the curves of the earnings/experience functions seem to differ considerably across education levels.

Charts 3.1.a to 3.7.b present similar results for homogeneous groups, usually within specific education levels, with an emphasis on the wages of tertiary education graduates. For comparison purposes, all charts also include the curve of the estimated wages of the men's reference group (male general lyceum graduates). Charts 3.1.a and 3.1.b show the estimated hourly wages of men and women with low educational qualifications (primary and lower secondary education graduates). Most members of these groups are of a relatively old age. The "primary education" category comprises as much persons who have not finished primary school, as primary school graduates or persons who have additionally attended a few years of gymnasium (high school). As expected, the earnings of both categories are lower than those of male lyceum graduates. What is surprising in Chart 3.1.b is the very small difference in the wages of these two groups of employees and the fact that these wages seem to register a minimal change over the years since graduation. In other words, the accumulation of work experience does not seem to substantially affect the wages of the employees belonging to these categories.

Chart 3.1 Estimated hourly wages of graduates of primary and lower secondary (compulsory) education

(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.
Note: For comparability reasons, all charts in this section also depict the estimated hourly wages of male general lyceum graduates.

Charts 3.2.a and 3.2.b refer to lyceum (higher secondary) and post-lyceum non-tertiary graduates. Graduates of higher secondary education are grouped into three subcategories: general lyceum, technical lyceum and post-

gymnasium technical schools. The first subcategory also comprises persons who have not completed tertiary education studies; the second consists of graduates of Technical Vocational Lyceums (TEL), Unified Multidisciplinary Lyceums (EPL) and Technical Vocational Institutes (TEE); and the third comprises graduates of Technical Vocational Schools (TES), post-gymnasium foreman schools and post-gymnasium mercantile marine schools. Post-lyceum non-tertiary education graduates are grouped into two subcategories: graduates of (public or private) Institutes of Vocational Training (IEK) and graduates of other post-lyceum education institutes. The third category comprises graduates of colleges, dance schools, tourism, (non-university) foreign languages, mercantile marine officers, etc. In the case of men, the estimated wages of general lyceum graduates are slightly higher than those of technical lyceum and post-gymnasium technical school graduates, although differences almost disappear after a decade. The estimated wages of graduates of other post-lyceum education institutes are clearly higher than those of IEK graduates. Indeed, the wages of the latter during the first five years after graduation do not differ from the corresponding wages of general lyceum graduates; however, the gap widens later on in favour of IEK graduates. In the case of women, the picture is slightly different. For a number of years after graduation, the wages of general lyceum and post-gymnasium technical school graduates are almost identical, whereas those of technical lyceum graduates are lower. In the case of women, the wages of graduates of other post-lyceum education institutes of non-tertiary education are higher than those of IEK graduates, but differences between the two groups are not as large as in the case of men.

Charts 3.3.a and 3.3.b show the estimated hourly earnings for graduates of TEI (or, previously, KATEE, i.e. Centres of Higher Technical and Vocational Training). These graduates have been grouped into five subcategories. The first has a technical orientation ("structural engineering, mechanical and computer engineering"), the second results from merging the graduates of agricultural technology and food technology schools ("agricultural and food technology"), the next two relate respectively to graduates of "economics and management" and "medical (or paramedical)" sciences, while the last one ("other TEI") comprises graduates of schools for librarians, social workers and applied arts. As mentioned earlier, due to the heterogeneity of

Chart 3.2 Estimated hourly wages of graduates of lyceum (higher secondary) and post-lyceum non-tertiary education

(net hourly wages in euro, constant prices of 2007)

Source: Calculations based on LFS and ELSTAT data.

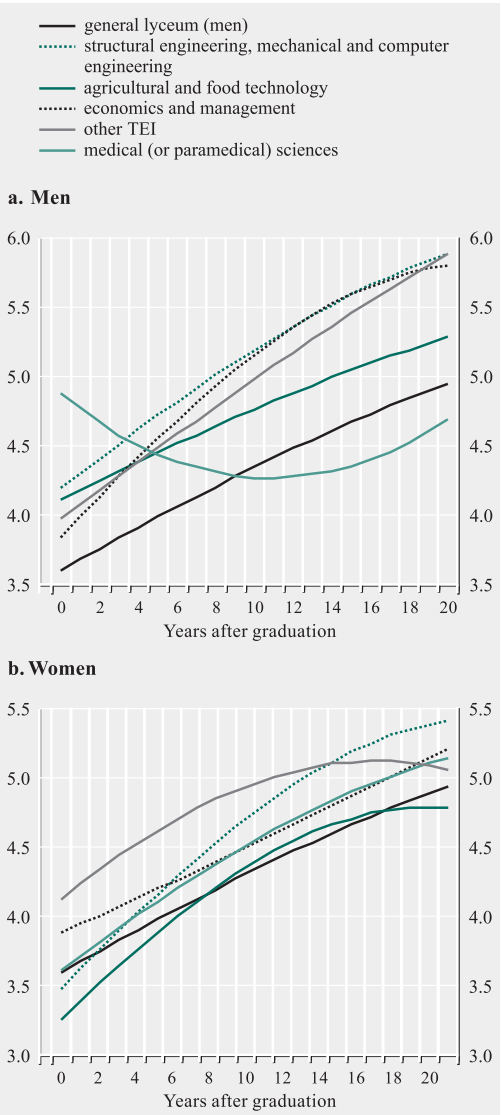
the latter and the small number of observations, results concerning the "other TEI" category should be interpreted with extreme caution and are not discussed in detail (see also the group's wage curve in Chart 3.3.a). For both men and women, the estimated wages of agricultural and food technology graduates are lower than those of other TEI graduates. As for the rest of the categories, structural engineering, mechanical and computer engineering graduates seem to hold a small advantage, but differences are not significant.

Because of the classification of AEI graduates (excluding postgraduates) into a large number of subcategories, the relevant results have been grouped and are presented in three sets of charts. Charts 3.4.a and 3.4.b show estimates of the hourly wages of science graduates. More specifically, estimates are presented for the groups of "structural engineering", "mechanical engineering and IT", "natural sciences" and "mathematics and statistics" graduates. Under "structural engineering" we have included graduates from schools such as civil engineering, architecture, topography, etc. "Mechanical engineering and IT" includes graduates from schools of naval engineering, electrical engineering, chemical engineering, mineralogy, etc. Under "natural sciences" we have included graduates from schools of physics, chemistry, biology (excluding medical biology) and geology. Due to the large number of self-employed "structural engineering" graduates, it might not be possible to generalise the results for all graduates of the schools that belong to this group.

Contrary to the charts concerning TEI graduates, these charts, as well as the next two sets of charts (concerning AEI graduates), reveal significant wage differentials over male general lyceum graduates. However, differences between men and women are also large. In the case of men, after the first five years "mechanical engineering and IT" graduates and "natural sciences" graduates seem to earn the highest wages among these four groups of AEI graduates, while the wages of "mathematics and statistics" graduates are somewhat lower. In the case of women, the estimated hourly wages of "natural sciences" graduates start at a relatively low level and in the first ten years after graduation lag behind the wages of technical university school graduates, but thereafter seem to be the highest among the four groups in the chart. For both men and women, "mathematics and statistics" graduates appear to earn the lowest wages among

Chart 3.3 Estimated hourly wages of TEI graduates

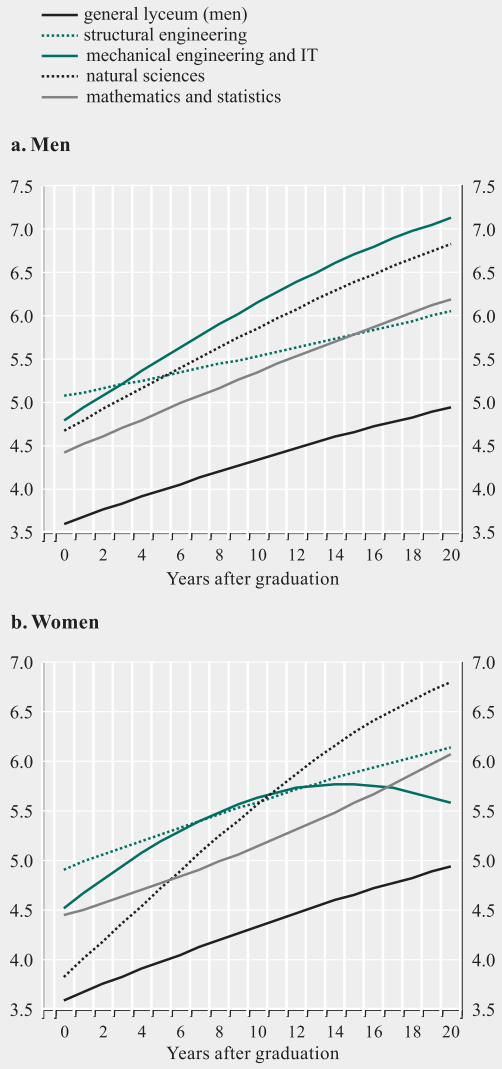
(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.

Chart 3.4 Estimated hourly wages of AEI graduates (I)

(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.

Chart 3.5 Estimated hourly wages of AEI graduates (II)

(net hourly wages in euro, constant prices of 2007)

Source: Calculations based on LFS and ELSTAT data.

the four groups in the first twenty years after graduation.

Charts 3.5.a and 3.5.b illustrate the estimated hourly wages for five groups of AEI graduates: "medical school, etc.", "horticulture and forestry", "law school", "economics and management" and "social sciences". Apart from medical doctors, the group "medical school, etc." includes graduates from dentistry, pharmaceutical and veterinary schools, while the "social sciences" group includes graduates from schools of sociology, psychology, anthropology, etc. Due to the high shares of self-employed among medical school and particularly law school graduates, it might not be possible to generalise these results for all graduates of these groups.

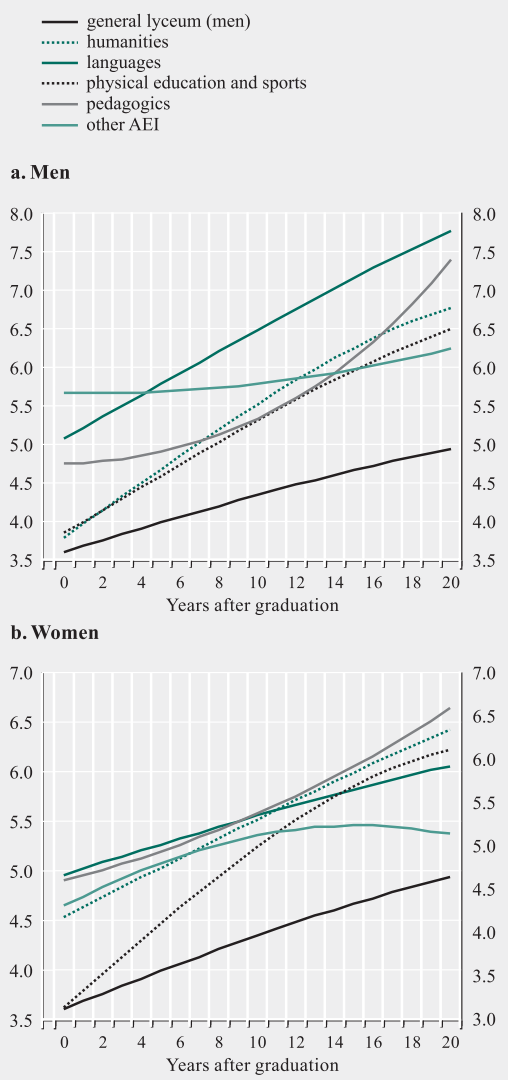
It is worth noting how the wages of "law school" graduates evolve as a function of years since graduation. Owing probably to the

mandatory traineeship that graduates of this group have to complete, their estimated hourly wages during the first years after graduation are exceptionally low, but then rapidly increase and, after a period of 12 years for women and 20 years for men, they are the highest among the groups examined. The wages of "medical school" graduates are also high, while those of female graduates of "horticulture and forestry" and of male graduates of "social sciences" range at relatively low levels. For men and women alike, the wages of the large group of "economics and management" graduates appear to start at satisfactory levels and evolve at a relatively fast pace (especially for men).

The third group of AEI graduates consists mainly of "instructor" school graduates and the relevant results are shown in Charts 3.6.a and 3.6.b, for five groups of schools: "humanities", "languages", "physical education and sports", "pedagogics" and "other AEI". As the "other AEI" group refers to graduates from schools of fine arts, medical biology, nursing, nutrition, journalism, librarianship, home economics, etc., due to its high heterogeneity and small size the corresponding estimates are not discussed. The same applies to the results for male graduates of "languages", because the relevant estimates are derived from very few observations (a problem also observed, to a lesser extent, among male social science graduates). Finally, the "humanities" group includes graduates from schools of Greek literature, philosophy, history, archaeology, theology, music, theatre, etc. It is worth noting that the estimated wages for (both male and female) graduates of "pedagogics" schools seem to rise at an increasing pace the further we move away from the year of graduation. However, given that this group includes very few graduates with extensive work experience (as studies in the corresponding schools and departments were only upgraded to AEI level roughly two decades ago), this result should be interpreted with caution. Equally noteworthy is that the estimated wages for (both male and female) graduates of "physical education" and male graduates of "humanities" start at relatively low levels but rapidly pick up as the years after graduation pass.[7]

Chart 3.6 Estimated hourly wages of AEI graduates (III)

(net hourly wages in euro, constant prices of 2007)



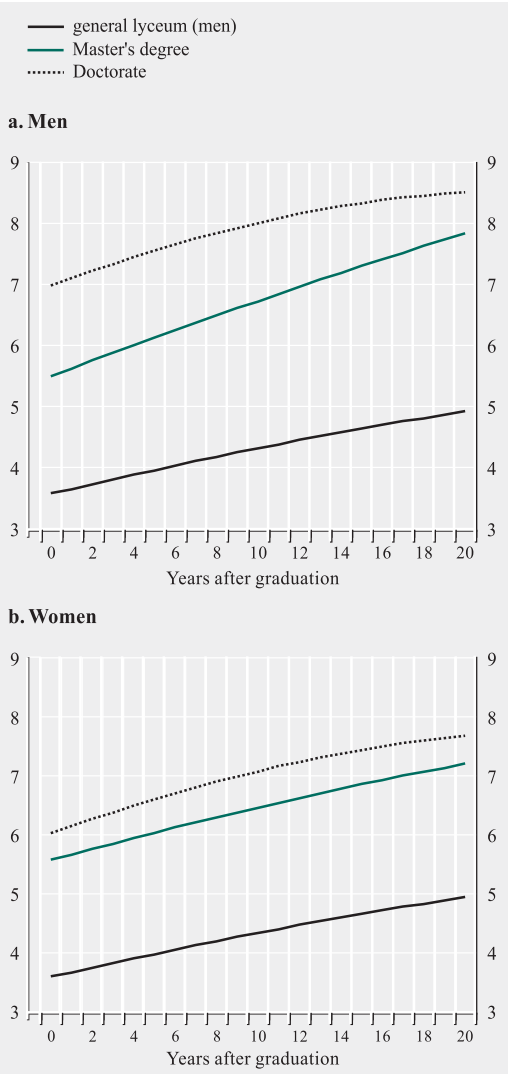
Source: Calculations based on LFS and ELSTAT data.

Finally, Charts 3.7.a and 3.7.b show the results for individuals with postgraduate studies, sep-

7 It should also be noted that, based on the experience drawn from many countries, a significant share of teachers (a group overrepresented in the above groups of graduates), when asked about their usual working hours often state just the teaching hours, overlooking any hours of preparation, etc., and so their estimated hourly wages are often overrated.

Chart 3.7 Estimated hourly wages of graduates of postgraduate studies

(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.

arately for Master's degree and doctorate holders.[8] In both cases, the estimated earnings start at relatively high levels and increase further with time. For both men and women, the wages of doctorate holders are clearly higher. However, in the case of women the gap between the two groups is relatively small and seems to remain unchanged throughout the horizontal axis (years after they completed their studies), while men's wages differ considerably early on, but gradually converge.

Charts 4.1.a to 4.2.b present some additional econometric results for male and female AEI graduates separately. In particular, Charts 4.1.a and 4.1.b illustrate the development of the two genders' wages over time as we move further away from graduation, for individuals working in the public and the private sector, once the impact of all other factors has been isolated. Moreover, our estimation includes among the explanatory variables multiplicative terms for the sector of employment and the years since graduation. The results are quite interesting. For both men and women, the estimated hourly wages are higher in the public sector. Indeed, for both genders, though more markedly for women, public and private sector wages diverge as we move further away from the year of graduation.

Charts 4.2.a and 4.2.b show the corresponding differences on the basis of the employees' nationality. Among both men and women, the estimated hourly wages of Greek nationals and of nationals from other EU countries are practically the same and considerably higher than those of the employees who are non-EU nationals. This could be the result of discrimination and, at the same time, a serious indication of the fact that the educational qualifications these persons have most probably acquired in their home countries are not particularly valued in the labour market.

The results of the econometric estimations broken down by degree of urbanisation and region of the place of residence of the employees are likely to also reflect differences in the cost of living in the various areas of the country (relevant charts available on request). Estimations for both men and women show that, *ceteris paribus*, wages in the urban centres, and particularly in the greater area of Thessaloniki, are higher than in the country's semi-urban and rural areas. As regards the development of the estimated hourly wages of male and female AEI graduates across the country's regions, the

8 Owing to these graduates' higher earnings, the vertical axis in these charts covers a wider range of wages than in all other charts.

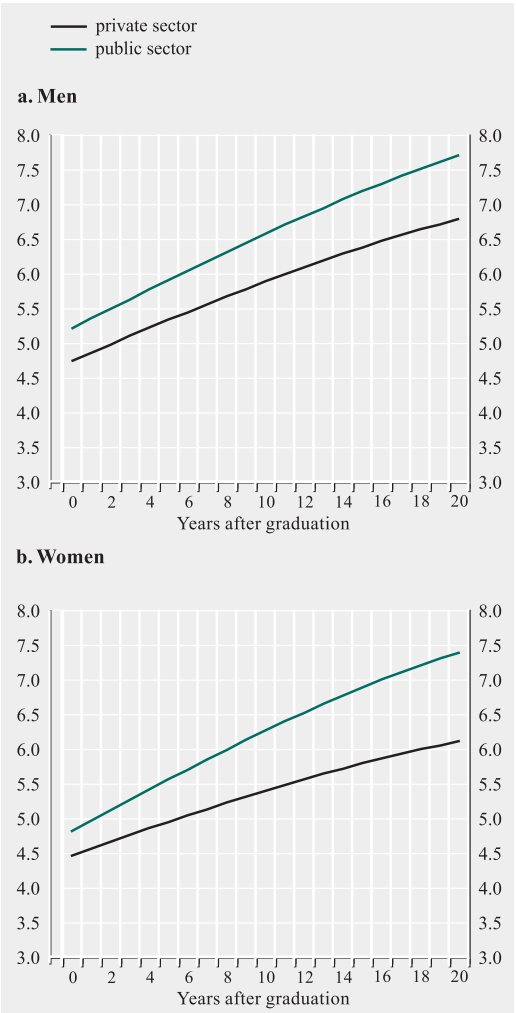
results of the estimations show certain differences between the samples of men and women. However, *ceteris paribus*, for both genders the estimated wages earned by employees are higher in the South Aegean region and lower in the regions of Central Macedonia, the Ionian Islands, and East Macedonia-Thrace.

Many empirical studies show that, *ceteris paribus*, larger enterprises pay higher wages than smaller ones. This phenomenon has been given many alternative interpretations. In Greece, the vast majority of enterprises are either small or very small. The LFS does not provide information on the size of the enterprise the employees work for, but only on the size of the local unit in which they are employed. This variable helps us classify under one category all the enterprises that are not too small (local unit with more than 10 employees), although of course the other category may thus include individuals working in small units of large enterprises. At any rate, the study's results regarding the effect of the size of the local enterprise unit on the estimated hourly wages are clear: employment in small units is associated with a rather large wage disadvantage.

The estimated econometric equation includes additional explanatory variables. Among the various branches of economic activity, wages differ greatly. Having isolated the impact of all other factors, "education", "extraterritorial organisations and bodies" and "mining and quarrying" are the branches that seem to offer higher wages, while employees in the branches of "agriculture and animal breeding", "domestic services" and, to a lesser extent, "retail and wholesale trade" seem to receive lower wages. Also, the wages of married persons are higher (more so of married men), something that can be attributed either to a greater effort made by them or, most likely, to the fact that family allowances are recorded together with wages. Finally, the wage levels show seasonality and, particularly, a trend over time – a fact expected since real wages increased significantly during the time period covered by the LFS waves used in the present analysis.

Chart 4.1 Estimated hourly wages of AEI graduates in the public and the private sector

(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.

The model explains 44.3% of the dependent variable's variation in the case of the equation for men, and 46.7% in the case of the one for women. These proportions are deemed to be quite satisfactory for the specific cross-sectional estimations of the present study.

Table 3 summarises the information included in Charts 3.1.a to 3.7.b in a more comprehensible way. It presents estimated hourly wages by education level and specialty, the first year after graduation, as well as 3, 5 and 10 years after graduation, separately for men and women of

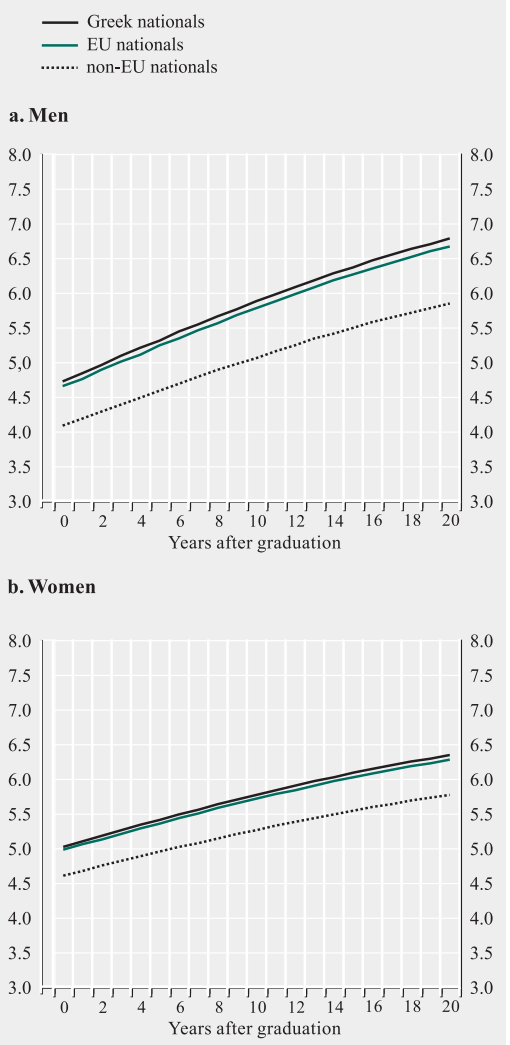
the reference group (single persons of Greek nationality that reside in Athens, work in a private sector enterprise with 10 or less employees, and have participated in the LFS in the third quarter of 2007). As regards tertiary education in particular, during the first decade after graduation, the graduates of "structural engineering, mechanical and computer engineering", followed by those of "economics and management", enjoy the highest estimated wages among TEI graduates. In some cases, the estimated wages of these groups are higher than the estimated wages of certain groups of AEI graduates. As regards AEI graduates, during the first decade after graduation, for both men and women, the highest estimated wages are observed among graduates of "medical school etc." and of the two types of engineering schools ("structural engineering" and "mechanical engineering and IT"), whereas, as already mentioned, the estimated wages of doctorate holders are higher than the estimated wages of Master's degree holders.

However, can the estimated hourly wages listed in Table 3 *a priori* reflect the wage that can be expected by an employed graduate of a specific education level and specialty? The answer is negative, since every stage in a person's career involves the possibility of unemployment. In fact, as Mitrakos, Tsakloglou and Cholezas (2010) demonstrate, the estimated rates of unemployment differ significantly across education levels and specialties, and change dramatically as we move further away from the year of graduation. Therefore, in order to calculate the expected wage, the estimations of Table 3 should be multiplied by the probability of employment of the corresponding education group at the specific time interval from the year of graduation, as this appears in Table 4 of that earlier study (Mitrakos, Tsakloglou and Cholezas, 2010).

The resulting estimations of the present study, shown in Table 4, are evidently lower than the corresponding ones in Table 3. In several education categories, especially during the first years after graduation when the estimated rates of unemployment are high, and more so for women than men, the estimations are much lower than those in Table 3. Nevertheless, particularly after the first few years since graduation, the higher the education level is, the higher the expected wage (adjusted for the probability of unemployment), with the differentials over the lowest education levels constantly increasing. Most of the results in Table 4 are not substantially different from those in Table 3 as to the ranking of the various specialties as far as tertiary education is con-

Chart 4.2 Estimated hourly wages of AEI graduates by nationality

(net hourly wages in euro, constant prices of 2007)



Source: Calculations based on LFS and ELSTAT data.

Table 3 Estimated hourly wages 0, 3, 5 and 10 years after graduation

(euro, 2007 constant prices)

	Men				Women			
	Years after graduation				Years after graduation			
Education level	<1	3	5	10	<1	3	5	10
Pre-lyceum education								
Primary	3.10	3.32	3.46	3.80	3.33	3.40	3.44	3.53
Lower secondary	3.21	3.46	3.62	4.00	3.42	3.50	3.54	3.65
Lyceum								
General lyceum	3.60	3.83	3.98	4.34	3.41	3.57	3.67	3.91
Technical lyceum	3.40	3.66	3.82	4.22	3.22	3.34	3.43	3.64
Post-gymnasium technical school	3.33	3.62	3.82	4.28	3.45	3.59	3.68	3.92
Post-lyceum non-tertiary education								
IEK	3.54	3.86	4.06	4.55	3.46	3.70	3.85	4.22
Other post-lyceum education	4.65	4.90	5.06	5.44	3.94	4.24	4.43	4.83
TEI								
Structural, Mechanical & Computer Engineering	4.18	4.50	4.71	5.18	3.48	3.90	4.16	4.75
Agricultural & Food Technology	4.10	4.31	4.44	4.76	3.26	3.65	3.89	4.39
Economics & Management	3.83	4.27	4.54	5.15	3.88	4.07	4.20	4.53
Medical Sciences	3.96	4.27	4.47	4.97	3.61	3.91	4.11	4.55
Other TEI	4.87	4.57	4.43	4.27	4.13	4.44	4.62	4.96
AEI								
Structural Engineering	5.07	5.21	5.30	5.54	4.91	5.13	5.26	5.59
Mechanical Engineering & IT	4.79	5.22	5.50	6.15	4.52	4.94	5.19	5.63
Physical Sciences	4.67	5.04	5.28	5.86	3.83	4.37	4.72	5.57
Mathematics & Statistics	4.42	4.71	4.89	5.35	4.45	4.64	4.77	5.14
Medical School etc.	5.10	5.52	5.79	6.42	5.10	5.25	5.35	5.58
Horticulture & Forestry	4.15	4.51	4.74	5.30	4.78	4.71	4.68	4.70
Law School	3.02	3.69	4.16	5.36	3.13	3.81	4.28	5.41
Economics & Management	4.22	4.63	4.90	5.56	4.04	4.39	4.61	5.12
Social Sciences	4.26	4.41	4.53	4.86	3.99	4.28	4.48	4.98
Humanities	3.79	4.32	4.67	5.53	4.52	4.82	5.02	5.51
Languages	5.08	5.50	5.79	6.49	4.95	5.14	5.26	5.55
Physical Education & Sports	3.84	4.29	4.59	5.31	3.62	4.13	4.46	5.24
Pedagogics	4.75	4.81	4.90	5.34	4.90	5.06	5.19	5.57
Other AEI	5.67	5.67	5.69	5.79	4.64	4.91	5.07	5.35
Postgraduate studies								
Postgraduate degree	5.52	5.89	6.14	6.74	5.57	5.84	6.02	6.45
Doctorate	6.99	7.34	7.56	8.02	6.03	6.37	6.59	7.06

Table 4 Estimated hourly wages 0, 3, 5 and 10 years after graduation adjusted for unemployment probability

(euro, 2007 constant prices)

	Men				Women			
	Years after graduation				Years after graduation			
Education level	<1	3	5	10	<1	3	5	10
Pre-lyceum education								
Primary	2.80	3.03	3.18	3.54	3.00	3.01	3.01	3.03
Lower secondary	3.05	3.29	3.45	3.83	3.13	3.18	3.20	3.29
Lyceum								
General lyceum	3.36	3.62	3.78	4.18	2.99	3.16	3.27	3.53
Technical lyceum	3.15	3.45	3.63	4.07	2.60	2.76	2.87	3.14
Post-gymnasium technical school	3.14	3.44	3.65	4.13	2.95	3.09	3.19	3.45
Post-lyceum non-tertiary education								
IEK	3.20	3.58	3.82	4.38	2.75	3.04	3.22	3.66
Other post-lyceum education	4.37	4.63	4.79	5.18	3.39	3.69	3.88	4.28
TEI								
Structural, Mechanical & Computer Engineering	3.75	4.21	4.49	5.06	2.53	3.26	3.67	4.48
Agricultural & Food Technology	3.59	3.95	4.15	4.58	2.38	2.84	3.13	3.73
Economics & Management	3.40	3.96	4.29	5.01	3.07	3.33	3.50	3.90
Medical Sciences	3.14	3.80	4.17	4.88	2.72	3.23	3.55	4.21
Other TEI	4.30	4.26	4.22	4.18	2.90	3.59	3.96	4.59
AEI								
Structural Engineering	4.75	4.99	5.13	5.45	3.95	4.51	4.81	5.36
Mechanical Engineering & IT	4.51	4.98	5.29	5.98	4.00	4.59	4.93	5.48
Physical Sciences	3.91	4.51	4.87	5.67	2.29	3.17	3.75	5.06
Mathematics & Statistics	3.34	4.18	4.57	5.26	2.49	3.44	3.95	4.84
Medical School etc.	4.66	5.11	5.43	6.23	4.15	4.61	4.86	5.33
Horticulture & Forestry	3.88	4.28	4.54	5.16	3.61	3.61	3.66	3.93
Law School	2.99	3.66	4.14	5.34	2.80	3.52	4.02	5.23
Economics & Management	3.76	4.32	4.66	5.43	3.30	3.79	4.09	4.76
Social Sciences	3.80	4.08	4.26	4.68	2.71	3.39	3.79	4.60
Humanities	3.30	3.93	4.34	5.33	3.29	3.84	4.19	5.00
Languages	4.13	4.82	5.33	6.41	4.30	4.61	4.79	5.19
Physical Education & Sports	3.34	3.83	4.15	4.96	3.29	3.64	3.88	4.62
Pedagogics	4.43	4.56	4.69	5.21	3.84	4.25	4.51	5.15
Other AEI	5.22	5.26	5.30	5.46	3.93	4.35	4.58	4.99
Postgraduate studies								
Postgraduate degree	5.03	5.53	5.85	6.55	4.60	5.16	5.48	6.13
Doctorate	6.49	7.02	7.33	7.95	4.93	5.62	6.00	6.73

cerned. Again, with respect to TEI, the graduates with the highest expected wages are those of "structural engineering, mechanical and computer engineering", followed by those of "economics and management" (and "medical sciences" in the case of women), while with respect to AEI, at least during the first ten years after graduation, the highest expected wages are observed among graduates of "medical school etc." and of the two types of engineering schools ("structural engineering" and "mechanical engineering and IT"). Things are less clear at the other end of the distribution, although graduates of "social sciences" schools feature almost invariably among the groups with the lowest expected wages.

However, the fact that graduates of one specialty of a specific education level may enjoy higher wages than those of another specialty of the same level does not necessarily imply that returns to education are higher for the former, as the years of study needed for the two specialties might differ. The data on which the estimations appearing in Tables 3 and 4 rely allow for a calculation of the internal rate of return to the completion of studies for each education level and specialty, adjusted (or not) for unemployment effects. This has never been attempted so far in the available Greek literature. Estimates of private returns to education for tertiary education graduates based on the information used in Tables 3 and 4 are presented in Table 5. Of course, as some of the groups of the sample at issue are relatively small, not adequately represented throughout the entire range of years since graduation, or showing high percentages of self-employment, the corresponding results should be treated with caution. The methodology applied is thoroughly described in Appendix II, including a detailed example (calculation of the annual marginal private returns to education in the years after graduation from lyceum for male and female AEI graduates of "economics and management" schools).

First of all, it should be noted that due to the use of multiplicative terms between education levels and specialties and years since graduation and their square, returns to education resulting from the analysis are not invariable, but change as we move further away from the year of graduation. The calculation of such returns relies on a number of assumptions.

As regards TEI graduates, we assume that they come mainly from technical lyceums, so their estimated wages are compared with those of technical lyceum graduates. Given that the latter are lower than the wages of general lyceum graduates, if TEI graduates actually come mainly from general lyceums, their returns are overestimated in the tables.[9] Until recently, studies in TEI (or formerly KATEE) lasted three years. However, since 2001 the required duration of studies for all TEI (for certain ones already since 1999) has been changed to four years. Thus, owing to the rather limited number of TEI graduates with four years of studies in our sample, the estimates presented below rely on the assumption that TEI studies have lasted three years for all TEI graduates. Obviously, the estimated internal rates of return would be lower had we assumed a four-year duration of studies. Similarly, we assumed that studies in technical university as well as "horticulture and forestry" schools last five years. Returns for "medical school etc." graduates were also calculated based on the assumption of five-year-long studies because, although medical school studies last six years, other schools of that group are completed in only five or even four years. Again here the estimated internal rates of return would have been lower had we assumed a shorter duration of studies. For all other AEI graduates, the assumption made was that their studies lasted four years. For postgraduate degree holders it was assumed that studies after lyceum lasted five years; therefore, if postgraduate studies last mainly two years and most

9 It should be recalled that the return to each education level is derived by comparing the estimated coefficient of the dummy variable of the given level with the corresponding estimated coefficient of the dummy variable of the immediately preceding education level (marginal return). Therefore, the assumption about the specific kind of education level the individuals come from (e.g. technical or general lyceum) before finishing their highest level of studies (e.g. TEI) is quite significant for the calculation, since it is one of the equation's terms.

Table 5 Estimated private returns to education

(percentages)

Education level	Not adjusted for unemployment probability		Adjusted for unemployment probability	
	Men	Women	Men	Women
TEI				
Structural, Mechanical & Computer Engineering	6.8	7.2	7.0	8.4
Agricultural & Food Technology	3.9	3.4	3.6	1.0
Economics & Management	5.4	7.5	5.5	6.9
Medical Sciences	6.1	6.4	5.8	7.8
Other TEI	3.6	8.8	3.7	9.2
AEI				
Structural Engineering	5.2	7.4	5.5	7.9
Mechanical Engineering & IT	7.0	5.7	7.1	6.9
Physical Sciences	7.8	8.2	7.4	7.3
Mathematics & Statistics	5.7	7.8	5.3	7.0
Medical School etc.	7.9	7.4	7.9	8.0
Horticulture & Forestry	4.0	4.7	4.2	3.9
Law School	5.5	7.0	6.2	8.1
Economics & Management	6.4	6.6	6.5	6.9
Social Sciences	4.1	6.7	3.8	6.2
Humanities	5.8	8.9	5.7	8.3
Languages	10.5	9.2	9.9	9.8
Physical Education & Sports	5.3	6.5	4.8	6.8
Pedagogics	8.7	10.0	8.9	9.9
Other AEI	8.6	6.9	7.9	7.1
Postgraduate studies				
Postgraduate degree	9.3	10.5	9.3	11.5
Doctorate	7.8	7.4	8.0	8.0

of the graduates come from schools with five or more years of bachelor studies, then the corresponding returns are overestimated in the tables. Finally, it was assumed that eight years of studies after lyceum are required in order to obtain a doctorate.

Needless to say, estimates in Table 5 focus on the pecuniary private returns to education, ignoring other (non-pecuniary) benefits students may enjoy thanks to their participation in higher levels of the education system. In order to calculate the returns listed in these tables, we assume that the individuals' working life is 35 years. This is most likely realistic for men, but could be somewhat exaggerated for women, at least currently (although recent developments in retirement age limits point to this direction). In the literature, working life is often estimated based on a person's (theoretical) graduation year and (theoretical) retirement age. In the case of Greece, however, this would translate into lyceum graduates with up to 46 years of work experience as employees. However, our sample includes very few workers (and almost no employees) with such characteristics.

In the literature, estimates such as those listed in Table 5 are usually called "private returns

to education". The results of Table 5 show the annual estimated returns to education, separately for men and women, by category of tertiary education graduates. Even though —as shown by the results in Table 3— women's wages are much lower than those of men, for both AEI and TEI graduates, in most cases returns to education are higher for women than for men. Of course this is mainly attributable to the fact that the gap between lyceum and tertiary education graduates is, respectively, even greater for women than for men. Also, returns to AEI studies seem to be higher than those on TEI studies, although vast differences appear between groups of schools within the two types of tertiary education. In general, the level of returns can be considered satisfactory. The highest returns are observed for graduates of "pedagogics" (a result that, as mentioned earlier, should be treated with caution), "foreign languages" (mostly women), "natural sciences" and, to a lesser extent, "medical school etc.", while at the opposite end we find those of "horticulture and forestry" and "social sciences" (only men). The returns of Master's degree and doctorate holders are particularly high.

If we consider that investment in human capital is really a form of investment, in estimating its return one should also take into account the cost of the potential risks involved. Most probably, the greatest risk is that of unemployment, which could wipe out (at an individual level) or considerably decrease (at a collective level) expected returns. Hence, we consider that real private returns to education are those resulting from the estimations shown in Table 4 and presented in Table 5. The calculation of the returns in question has taken into account the probability of unemployment for a specific number of years after graduation, as much for individuals in the reference group (general or technical lyceum graduates) as for graduates of every group of tertiary education.

Differences between the estimates of Table 5 are not very pronounced. The estimated annual returns to education may increase in some cases or decrease in others, but all such changes are usually small. Among the groups of TEI graduates, the highest returns seem to correspond to "structural engineering, mechanical and computer engineering" and the lowest to "agricultural and food technology", as regards both men and women. Among AEI graduates, returns increase in the case of the two categories of technical university graduates, "medical school etc.", "law school" and, to a lesser extent, "economics and management".

The ranking of schools according to the associated expected returns to education does not change significantly. Graduates of "pedagogics", "foreign languages" (women), "medical school etc.", "law school", "physical sciences" and the two categories of technical university graduates, i.e. "structural engineering" and "mechanical engineering and IT", show the highest returns, while the lowest returns are found in the groups of graduates of "horticulture and forestry" and "social sciences" (men). The returns for both Master's degree and doctorate holders appear to be even higher, while once again annual returns are remarkably higher for Master's degree holders than for doctorate holders (despite the highest earnings of the latter).

5 CONCLUSIONS

The present study contains several findings regarding particular groups of tertiary education graduates. Some of these findings are consistent with the results of previous studies, while others appear for the first time in the literature. The relationship between labour remuneration and education level is unquestionably positive. The wages of tertiary education graduates are considerably higher than those of graduates of lower levels of the education system at a comparable point of their career (years since graduation). However, some very important differences are detected within various groups of graduates. Despite the

limitations of the analysis stemming from the nature of the data used in this study (grouped wage data, samples with a small number of observations with unsatisfactory dispersion in terms of work experience for specific groups of graduates, high and differing rates of self-employment in various groups of specialties, etc.), certain conclusions can safely be reached. University graduates of medical and engineering faculties, as well as Master's degree and doctorate holders enjoy high hourly earnings, although this does not always entail higher internal rates of return compared with other specialties.

The fact that tertiary education graduates obtain higher wages does not necessarily imply that these individuals have become more productive because of their studies. It could simply mean that they are more capable of using their tertiary education qualifications as a 'signalling' mechanism vis-à-vis employers (an aspect not examined in the present study). Moreover, the returns to education examined in the present study are private returns. High private returns are not necessarily associated with high social returns, which would be indispensable in order to support the view that investment in tertiary education is profitable for society; even more so since no safe prediction can be made as to whether high private returns will carry on in the future as such, given that skilled and specialised labour supply in Greece is expected to increase significantly due to the observed rapid expansion of "mass" tertiary education attendance over the last ten years.

According to a recent study by Georganta, Kandilorou and Livada (2008), 58% of the second-year students in two specific AEI (Athens University of Economics and Business and University of Macedonia) reported that they had decided to pursue tertiary education studies in order to later find a better-paid job more easily. The findings of Mitrakos, Tsakloglou and Cholezas (2010) show that, indeed, graduation from a tertiary education institution shields against unemployment, at least in the long run. The findings of the present study also verify that tertiary education studies ensure a better-paid job and, consequently, satisfactory returns in the long run, especially in the schools and levels that seem to be most popular among applicants. In conclusion, according to the results of the analysis, Greek young people seem to be making totally rational choices as regards their education. However, a question that remains to be answered is whether it is equally rational for the Greek state to keep expanding tertiary education, by either establishing new AEI and TEI or creating new schools and departments in the existing institutions.

APPENDIX I
DETAILED ECONOMETRIC RESULTS

Estimation coefficients of the hourly wages logarithm

Dependent variable: logarithm of hourly wages at constant prices

Independent variables	Coefficient			
	Men		Women	
Primary	-0.1479	***	-0.0244	
Lower secondary	-0.1132	***	0.0031	
General lyceum	Reference group			
Technical lyceum	-0.0564	*	-0.0583	
Post-gymnasium technical school	-0.0785	**	0.0105	
IEK	-0.0151		0.0128	
Other post-lyceum education	0.2558	***	0.1447	
Structural, Mechanical & Computer Engineering (TEI)	0.1509	***	0.0206	
Agricultural & Food Technology (TEI)	0.1313	*	-0.0461	
Economics & Management (TEI)	0.0637		0.1292	***
Medical Sciences (TEI)	0.0970		0.0558	
Other TEI	0.3035	***	0.1896	
Structural Engineering	0.3433	***	0.3644	***
Mechanical Engineering & IT	0.2865	***	0.2798	***
Physical Sciences	0.2616	***	0.1163	
Mathematics & Statistics	0.2064		0.2650	
Medical School etc.	0.3479	***	0.4009	***
Horticulture & Forestry	0.1426	*	0.3369	***
Law School	-0.1755		-0.0852	
Economics & Management	0.1599	***	0.1690	***
Social Sciences	0.1680		0.1571	**
Humanities	0.0508		0.2819	***
Languages	0.3442		0.3719	***
Physical Education & Sports	0.0663		0.0578	
Pedagogics	0.2768		0.3613	***
Other AEI	0.4547	*	0.3065	***
Postgraduate degree	0.4283	***	0.4895	***
Doctorate	0.6638	***	0.5691	***

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

Estimation coefficients of the hourly wages logarithm *(continued)*

Dependent variable: logarithm of hourly wages at constant prices

Independent variables	Coefficient			
	Men		Women	
Years after graduation * Primary	0.0019		-0.0087	*
Years after graduation * Lower secondary	0.0042		-0.0083	*
Years after graduation * General lyceum	Reference group			
Years after graduation * Technical lyceum	0.0037		-0.0030	
Years after graduation * Post-gymnasium technical school	0.0081	**	-0.0024	
Years after graduation * IEK	0.0078	**	0.0079	**
Years after graduation * Other post-lyceum education	-0.0034		0.0106	
Years after graduation * Structural, Mechanical & Computer Engineering (TEI)	0.0044		0.0246	*
Years after graduation * Agricultural & Food Technology (TEI)	-0.0045		0.0250	
Years after graduation * Economics & Management (TEI)	0.0168		0.0004	
Years after graduation * Medical Sciences (TEI)	0.0040		0.0132	**
Years after graduation * Other TEI	-0.0462	**	0.0112	
Years after graduation * Structural Engineering	-0.0128		-0.0009	
Years after graduation * Mechanical Engineering & IT	0.0086		0.0182	
Years after graduation * Physical Sciences	0.0047		0.0305	***
Years after graduation * Mathematics & Statistics	-0.0003		-0.0020	
Years after graduation * Medical School etc.	0.0062		-0.0055	
Years after graduation * Horticulture & Forestry	0.0076		-0.0224	
Years after graduation * Law School	0.0489	**	0.0541	***
Years after graduation * Economics & Management	0.0107	**	0.0132	**
Years after graduation * Social Sciences	-0.0098		0.0084	
Years after graduation * Humanities	0.0249	***	0.0065	
Years after graduation * Languages	0.0062		-0.0027	
Years after graduation * Physical Education & Sports	0.0169	*	0.0314	**
Years after graduation * Pedagogics	-0.0203		-0.0051	
Years after graduation * Other AEI	-0.0224		0.0058	
Years after graduation * Postgraduate degree	0.0008		0.0012	
Years after graduation * Doctorate	-0.0039		0.0042	

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

Estimation coefficients of the hourly wages logarithm *(continued)*

Dependent variable: logarithm of hourly wages at constant prices

Independent variables	Coefficient			
	Men		Women	
Years after graduation sqrd./100 x Primary	-0.0022		0.0094	
Years after graduation sqrd./100 x Lower secondary	-0.0091		0.0102	
Years after graduation sqrd./100 x General lyceum	Reference group			
Years after graduation sqrd./100 x Technical lyceum	-0.0090		0.0164	
Years after graduation sqrd./100 x Post-gymnasium technical school	-0.0145	*	0.0141	
Years after graduation sqrd./100 x IEK	-0.0147		-0.0164	*
Years after graduation sqrd./100 x Other post-lyceum education	0.0049		-0.0407	
Years after graduation sqrd./100 x Structural, Mechanical & Computer Engineering (TEI)	-0.0164		-0.0719	*
Years after graduation sqrd./100 x Agricultural & Food Technology (TEI)	0.0062		-0.0885	
Years after graduation sqrd./100 x Economics & Management (TEI)	-0.0600	*	0.0121	
Years after graduation sqrd./100 x Medical Sciences (TEI)	-0.0009		-0.0368	**
Years after graduation sqrd./100 x Other TEI	0.1423	**	-0.0642	
Years after graduation sqrd./100 x Structural Engineering	0.0290		0.0011	
Years after graduation sqrd./100 x Mechanical Engineering & IT	-0.0224		-0.0974	**
Years after graduation sqrd./100 x Physical Sciences	-0.0075		-0.0686	***
Years after graduation sqrd./100 x Mathematics & Statistics	0.0067		0.0291	
Years after graduation sqrd./100 x Medical School etc.	-0.0174		0.0094	
Years after graduation sqrd./100 x Horticulture & Forestry	-0.0184		0.0705	*
Years after graduation sqrd./100 x Law School	-0.1010	**	-0.1318	***
Years after graduation sqrd./100 x Economics & Management	-0.0182		-0.0315	**
Years after graduation sqrd./100 x Social Sciences	0.0443		-0.0004	
Years after graduation sqrd./100 x Humanities	-0.0577	***	-0.0041	
Years after graduation sqrd./100 x Languages	-0.0031		0.0047	
Years after graduation sqrd./100 x Physical Education & Sports	-0.0323		-0.0803	**
Years after graduation sqrd./100 x Pedagogics	0.1337		0.0429	
Years after graduation sqrd./100 x Other AEI	0.0572		-0.0515	
Years after graduation sqrd./100 x Postgraduate degree	0.0044		-0.0013	
Years after graduation sqrd./100 x Doctorate	-0.0101		-0.0201	
Years after graduation	0.0216	***	0.0155	***
Years after graduation sqrd./100	-0.0287	***	-0.0184	***

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

Estimation coefficients of the hourly wages logarithm *(continued)*

Dependent variable: logarithm of hourly wages at constant prices

Independent variables	Coefficient			
	Men		Women	
Greek nationals	Reference group			
Other EU nationals	-0.0172		-0.0057	
Third country nationals	-0.1392	***	-0.1189	***
Eastern Macedonia – Thrace	-0.0963	***	-0.0626	***
Central Macedonia	-0.1024	***	-0.0995	***
Western Macedonia	-0.0514	***	-0.0169	
Epirus	-0.0151		-0.0092	
Thessaly	-0.0672	***	-0.0259	
Ionian Islands	-0.0687	***	-0.0355	
Western Greece	-0.0146		0.0005	
Central Greece and Euboea	-0.0095		-0.0195	
Attica	Reference group			
Peloponnese	-0.0560	***	-0.0369	**
North Aegean	0.0353	**	0.0105	
South Aegean	0.0346	***	0.0709	***
Crete	-0.0045		0.0055	
Capital region – Attica	Reference group			
City complex – Thessaloniki	0.0728	***	0.0950	***
Other urban areas	0.0022		-0.0031	
Semi-urban areas	-0.0259	***	-0.0197	
Rural areas	-0.0371	***	-0.0457	***
First year of survey (2004)	-0.0073		-0.0009	
Second year of survey (2005)	-0.0296	***	-0.0039	
Third year of survey (2006)	-0.0278	***	-0.0146	
Fourth year of survey (2007)	Reference group			
1st quarter	-0.0115	*	-0.0175	**
2nd quarter	-0.0261	***	-0.0259	***
3rd quarter	Reference group			
4th quarter	0.0105		0.0225	**

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

Estimation coefficients of the hourly wages logarithm *(continued)*

Dependent variable: logarithm of hourly wages at constant prices

Independent variables	Coefficient			
	Men		Women	
Agriculture, animal husbandry, hunting and forestry	-0.1414	***	-0.1221	***
Fishing	-0.0245		0.1955	***
Mining and quarrying	0.2171	***	0.1737	***
Manufacturing	0.0556	***	0.0642	***
Electricity, gas and water supply	0.1787	***	0.1399	***
Construction	0.0962	***	0.1376	***
Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods	Reference group			
Hotels and restaurants	0.0051		0.0193	
Transport, storage and communication	0.0864	***	0.0894	***
Financial intermediation	0.1359	***	0.1542	***
Real estate, renting and business activities	0.0234	*	0.0663	***
Public administration and defence, compulsory social security	0.1072	***	0.1236	***
Education	0.3150	***	0.2901	***
Health and social work	0.0612	***	0.1124	***
Other community, social and personal service activities	0.0637	***	0.0500	***
Private households with employed persons	-0.1571	***	-0.1698	***
Extra-territorial organisations and bodies	0.3139	***	0.3588	*
Local business unit with 10 persons or less	Reference group			
Local business unit with more than 10 persons	0.0807	***	0.0794	***
Single	Reference group			
Married	0.0313	***	0.0165	**
Private sector	Reference group			
Public sector	0.0757	***	0.0689	***
Public sector x Years after graduation	0.0025		0.0092	***
Public sector x Years after graduation sqrd./100	-0.0004		-0.0161	***
Constant term	1.2514	***	1.1754	***
Number of observations	*29,256*		*20,826*	
R-squared	*0.4432*		*0.4658*	

*** Statistically significant at the 1% level.
** Statistically significant at the 5% level.
* Statistically significant at the 10% level.

APPENDIX II

METHODOLOGY APPLIED TO THE CALCULATION OF PRIVATE MARGINAL RETURNS TO EDUCATION

The marginal private rates of return to education appearing in Table 5 were estimated using the discount rate of the equation describing internal return to investment. For example, to calculate the private marginal internal rate of return to graduation from the schools of economics and management (AEI) for men and women (6.4% and 6.6% respectively) we used the data of Tables A and B on the basis of the following formula:

$$\sum_{t=0}^{39} \frac{E(w_{St})}{(1+r)^t} = \sum_{t=0}^{39} \frac{E(w_{Tt})}{(1+r)^t}$$

where $E(w_{St})$ and $E(w_{Tt})$ are, respectively, the expected hourly wage rates of lyceum graduates and graduates of AEI schools of economics and management in year *t*, i.e.:

$[E(w_{St}) = \hat{w}_{St}(1-\hat{u}_{St})$ and

$E(w_{Tt}) = \hat{w}_{Tt}(1-\hat{u}_{Tt})]$

where $\hat{u}_{St}$ and $\hat{u}_{Tt}$ are the estimated unemployment rates of lyceum graduates and graduates of AEI schools of economics and management in year *t*;

$\hat{w}_{St}$ and $\hat{w}_{Tt}$ are the respective estimated unemployment rates for lyceum graduates and graduates of the AEI schools of economics and management in year *t*;

and *r* is the discount rate.

Techniques for calculating the discount rate that equates the net present value of the expected hourly wage rates of lyceum graduates with those of graduates of the AEI schools of economics and management are readily available even in relatively simple statistical packages, such as Excel.

Table A Estimated unemployment rates (-Us), estimated hourly wages (-Ws) and expected hourly wages (E(Ws)) of male lyceum graduates and graduates of AEI Economics & Management schools

	Lyceum graduate				Graduate of AEI Economics & Management schools			
t	Years after graduation	U_S	W_S	$E(W_S)$	Years after graduation	U_T	W_T	$E(W_T)$
0	0	6.65	3.60	3.36	-	-	-	-
1	1	6.26	3.68	3.45	-	-	-	-
2	2	5.89	3.75	3.53	-	-	-	-
3	3	5.54	3.83	3.62	-	-	-	-
4	4	5.21	3.90	3.70	0	10.87	4.22	3.76
5	5	4.91	3.98	3.78	1	9.20	4.36	3.96
6	6	4.62	4.05	3.87	2	7.79	4.49	4.14
7	7	4.35	4.13	3.95	3	6.60	4.63	4.32
8	8	4.10	4.20	4.03	4	5.60	4.77	4.50
9	9	3.86	4.27	4.10	5	4.77	4.90	4.67
10	10	3.64	4.34	4.18	6	4.07	5.04	4.83
11	11	3.43	4.41	4.25	7	3.49	5.17	4.99
12	12	3.24	4.47	4.33	8	3.00	5.30	5.14
13	13	3.05	4.54	4.40	9	2.59	5.43	5.29
14	14	2.88	4.60	4.47	10	2.26	5.56	5.43
15	15	2.72	4.66	4.53	11	1.98	5.69	5.57
16	16	2.57	4.72	4.60	12	1.74	5.81	5.71
17	17	2.43	4.78	4.66	13	1.55	5.93	5.84
18	18	2.30	4.83	4.72	14	1.39	6.05	5.96
19	19	2.17	4.89	4.78	15	1.26	6.16	6.08
20	20	2.06	4.94	4.84	16	1.15	6.27	6.20
21	21	1.95	4.99	4.89	17	1.05	6.38	6.31
22	22	1.85	5.03	4.94	18	0.98	6.48	6.41
23	23	1.75	5.07	4.99	19	0.92	6.57	6.51
24	24	1.66	5.12	5.03	20	0.87	6.67	6.61
25	25	1.58	5.15	5.07	21	0.84	6.75	6.70
26	26	1.50	5.19	5.11	22	0.81	6.84	6.78
27	27	1.43	5.22	5.15	23	0.79	6.91	6.86
28	28	1.36	5.25	5.18	24	0.79	6.98	6.93
29	29	1.29	5.28	5.21	25	0.79	7.05	6.99
30	30	1.23	5.31	5.24	26	0.79	7.11	7.05
31	31	1.18	5.33	5.26	27	0.81	7.16	7.10
32	32	1.13	5.35	5.29	28	0.84	7.21	7.14
33	33	1.08	5.36	5.30	29	0.88	7.24	7.18
34	34	1.03	5.37	5.32	30	0.93	7.28	7.21
35	35	0.99	5.38	5.33	31	0.99	7.30	7.23
36	-	-	-	-	32	1.06	7.32	7.25
37	-	-	-	-	33	1.16	7.34	7.25
38	-	-	-	-	34	1.27	7.34	7.25
39	-	-	-	-	35	1.40	7.34	7.24

Table B Estimated unemployment rates (-Us), estimated hourly wages (-Ws) and expected hourly wages (E(Ws)) of female lyceum graduates and graduates of AEI Economics & Management schools

	Lyceum graduate				Graduate of AEI Economics & Management schools			
t	Years after graduation	U_S	W_S	$E(W_S)$	Years after graduation	U_T	W_T	$E(W_T)$
0	0	12.19	3.41	3.00	-	-	-	-
1	1	11.98	3.47	3.05	-	-	-	-
2	2	11.75	3.52	3.10	-	-	-	-
3	3	11.52	3.57	3.16	-	-	-	-
4	4	11.28	3.62	3.21	0	18.26	4.04	3.30
5	5	11.03	3.67	3.27	1	16.57	4.16	3.47
6	6	10.78	3.72	3.32	2	15.04	4.27	3.63
7	7	10.52	3.77	3.37	3	13.65	4.39	3.79
8	8	10.26	3.82	3.43	4	12.38	4.50	3.94
9	9	9.99	3.87	3.48	5	11.24	4.61	4.09
10	10	9.72	3.91	3.53	6	10.21	4.72	4.23
11	11	9.45	3.96	3.58	7	9.29	4.82	4.37
12	12	9.18	4.00	3.64	8	8.46	4.93	4.51
13	13	8.90	4.05	3.69	9	7.71	5.03	4.64
14	14	8.62	4.09	3.74	10	7.04	5.12	4.76
15	15	8.34	4.13	3.79	11	6.44	5.22	4.88
16	16	8.06	4.17	3.84	12	5.91	5.31	5.00
17	17	7.78	4.21	3.89	13	5.43	5.40	5.10
18	18	7.50	4.25	3.93	14	5.01	5.48	5.20
19	19	7.22	4.29	3.98	15	4.63	5.56	5.30
20	20	6.94	4.32	4.02	16	4.29	5.63	5.39
21	21	6.66	4.36	4.07	17	3.99	5.70	5.47
22	22	6.38	4.39	4.11	18	3.72	5.77	5.55
23	23	6.11	4.42	4.15	19	3.48	5.82	5.62
24	24	5.84	4.45	4.19	20	3.27	5.88	5.69
25	25	5.58	4.48	4.23	21	3.08	5.93	5.75
26	26	5.32	4.51	4.27	22	2.92	5.97	5.80
27	27	5.06	4.54	4.31	23	2.77	6.01	5.84
28	28	4.81	4.56	4.34	24	2.65	6.04	5.88
29	29	4.56	4.58	4.37	25	2.54	6.07	5.91
30	30	4.32	4.61	4.41	26	2.44	6.09	5.94
31	31	4.08	4.62	4.44	27	2.36	6.10	5.96
32	32	3.86	4.64	4.46	28	2.29	6.11	5.97
33	33	3.63	4.66	4.49	29	2.24	6.11	5.97
34	34	3.42	4.67	4.51	30	2.19	6.10	5.97
35	35	3.21	4.69	4.54	31	2.16	6.09	5.96
36	-	-	-	-	32	2.13	6.08	5.95
37	-	-	-	-	33	2.12	6.05	5.93
38	-	-	-	-	34	2.12	6.03	5.90
39	-	-	-	-	35	2.13	5.99	5.86

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DETERMINANTS OF THE RECEIPTS FROM SHIPPING SERVICES: THE CASE OF GREECE*

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I INTRODUCTION

Since the 1950s, the areas of international economics that have attracted significant empirical research include the foreign trade flows and the testing of trade theories which focus on the following questions:

(i) What goods do countries trade?

(ii) With whom do countries trade?

(iii) How much do countries trade?

In order to investigate these issues, MacDougall (1951, 1952) used the comparative labour cost of the Ricardo model, while Leontief (1954) that of the Hecksher-Ohlin model. Deardorff (1984) discussed the empirical testing of the trade theories and Goldstein and Khan (1985) estimated the income and price elasticities of trade flows and the policy implications of their findings. Their work focused exclusively on merchandise trade and its determinants.

However, as trade in services between developed countries started to take off and a first initiative for the liberalisation of services trade was undertaken by the USA,[1] academic literature turned to the determinants of trade in services. Kravis (1983) discussed the contribution and implications of services as much for the domestic economy as for international transactions. He concluded that services represent a relative growth factor for the domestic economies and that trade in both commodities and services had rapidly expanded over his research period (1960-1979).

It is evident though that, as an increasing proportion of the world's GDP is generated by services, their importance for international trade has increased as well. According to Karsenty (2000) almost a third of world trade is generated by services. One of the first attempts at modelling US trade in services was undertaken by Helkie and Stekler (1987). Hung and Viana (1995) employed the two-step approach suggested by Granger and Engle (1987) —cointegration and Error Correction Model (ECM)— in modelling US services trade flows. Their research though focused on tourism, other private services, royalty and license fees, and excluded military and transportation services. More recent work was undertaken by the University of Michigan (November 2000) in relation to the quarterly forecast of the US Trade in Services, which extended the model to also include transportation services in the services trade flow (see Hyman, Deardorft and Stern, 2000).

For Greece, an important component of trade in services is shipping. Therefore, in the present study we focus on the determininants of shipping receipts in the Greek economy by the use of an ECM. Our results reveal that both freight rates and the stock of credit granted by the Greek banking system to the shipping sector are statistically significant determinants of the shipping receipts recorded in the balance of payments. We also evaluate the forecasting ability of the estimated ECM in the short term. We compare its forecasting ability with that of alternative models (autoregressive models of

* The authors would like to thank Helen Thanopoulou, George Zombanakis and Heather Gibson for their constructive comments. The views expressed in this article do not necessarily reflect those of the Bank of Greece. A draft version of the paper was presented in July 2007 at the Annual Conference of the International Association of Maritime Economists in Athens.

1 In the early 1980s the Reagan Administration undertook a diplomatic initiative for removing the obstacles of services trading.

first and third order, and random walk), and we conclude that the selected ECM specification outperforms the alternative forecasting models.

The remainder of the paper is organised as follows: the following section reviews empirical work on the determinants of shipping receipts in the national economy. Section 3 discusses the methodology and the data used, and Section 4 presents the empirical evidence. Finally, Section 5 concludes.

2 LITERATURE REVIEW

To the best of our knowledge, the first attempt to determine and forecast foreign exchange inflows from shipping in the Greek economy by using regression analysis was made by Constantopoulou (1976), for the requirements of the 5-year development programme of the time (1976-1980). Her methodology is based on calculating the income of the "factors of shipping services production" (labour and capital) and their impact on the foreign exchange inflows from shipping. In that period, the respective shipping inflows in the balance of payments statistics were recorded under the following items:[2]

1. Freight – mainly related to imports/exports of goods to/from the country.

2. Seamen's remittances.

3. Shipowners' remittances.

4. Ship store and repairs etc.

5. Contribution to the Seamen's Pension Fund (NAT).

6. Shipowners' taxation.

7. Passenger tickets.

Although disaggregated data based on the above seven categories were available, Constantopoulou decides to use aggregated data for the shipping foreign exchange inflows, due to her worries about the credibility of the disaggregated ones. Following a regression analysis (based on a variety of equations) performed on annual data (1960-1974) she concludes that foreign exchange inflows associated with shipping depend on seamen's income and on the Greek-flagged fleet revenues.

Tambakis (1984) performs a similar regression analysis focusing on disaggregated items of foreign exchange inflows from shipping (see above), as well as on aggregate inflows. He concludes that total inflows from shipping depend primarily on world seaborne trade (representing the demand for shipping services) and on the size of the Greek fleet, i.e. the number of ships carrying a Greek flag (representing the Greek supply of shipping services). As Goulielmos (1997) points out, the statistical significance of these two variables could also indicate the importance of freight rates, which are determined by world supply of and demand for shipping services.

Haralambides (1986) investigates the interrelation between foreign exchange inflows from shipping and domestic macroeconomic factors in comparison to internationally related ones. His study is based both on aggregate and disaggregate data, as that of Tambakis (1984). He performs a series of single equation regressions using, among other things, total foreign exchange inflows from shipping, shipowners' remittances, seafarers' remittances, as well as their first differences as the dependant variable. Freight rates, the Greek consumer price index and the US dollar/drachma (USD/GDR) exchange rate serve as independent variables. Haralambides performs two sets of regression analysis. In the first set, he tests the hypothesis of a correlation between foreign exchange inflows and

2 Up to the end of 1998, the Bank of Greece followed the foreign exchange currency approach in the compilation of the Balance of Payments.

factors from shipping domestic determinants – i.e. variables related to the Greek economy, such as the exchange rate inflation. In the second set of regressions he investigates the relationship between shipping inflows and the general freight index compiled by the General Council of British Shipping (GCBS). As he attests, he does not employ the most advanced econometric techniques available then, as the cost of time would not have been compensated by a significant increase in the robustness of the results (due to the small sample and the short time series available).

Based on the econometric results of his research, the main conclusions can be summarised as follows:

- The breakdown of revenues from shipping services, used then by the Bank of Greece, was erroneous and could lead to misleading conclusions.

- Inflows to Greece from seafarers were ineleastic with respect to freight rates, given that they covered the daily expenditure of their families as well as the fact that salaries do not follow freight rates, as they are agreed in advance.

- Foreign exchange inflows from shipping are predominantly related to domestic macroeconomic conditions rather than external ones, such as freight rates or export demand. He found that the basic macroeconomic parameters that influenced inflows were the inflation rate and the USD/GRD exchange rate, both factors under the control of the monetary policy authorities.[3]

Haralambides finds that drachma devaluations had a negative effect on USD-denominated inflows; Goulielmos (1997) counters this view, arguing that it is the relationship between drachma devaluation and nominal drachma wage increases of the seamen that matters. Goulielmos concludes that in much of the 1980s, the USD-dominated wages of crews either fell or exhibited minor increases. All three previous studies —Constantopoulou (1976), Haralambides (1986) and Tambakis (1986)— share the same shortcoming in relation to the issues of unit roots and cointegration, since the seminal work of R.F. Engle and C.W.J. Granger on cointegration was only published in 1987.

Goulielmos (1993) discusses the impact of the adoption of open registries (known also as "flags of convenience") by the Greek fleet on the foreign exchange inflows from shipping in the period 1981-1991. His research focuses on the relationship between crew cost and foreign exchange inflows. Specifically, in the abovementioned period, the decline in foreign exchange inflows can be principally attributed to the non-utilisation of vessels (laid-up tonnage), and subsequently to the unemployment of seamen, and secondly to the adoption of flags of convenience and its impact on employment.

The laid-up tonnage, the loss of employment for Greek seamen and the adoption of flags of convenience by national vessels have been identified by Goulielmos (1996) as the main factors that contributed to lower foreign exchange inflows from shipping in the period of the 1981-1987 crisis. In the 1970s, the main factors determining the remittance of shipping-related earnings to the Greek economy were: state-related obligations (i.e. tonnage tax, social insurance contributions) and operating expenses (i.e. running costs of the shore-based shipping operations, remittances to the seamen's families, repair costs). His work is based on micro-data from 715 Greek shipping companies. He concludes that "laid-up tonnage and reduced crew employment were mainly responsible —to an amount up to 83% (42% + 41%)— for the reduction in inflows between 1980 and 1982-1984".

Until 1998, the Bank of Greece followed the foreign exchange currency approach to the

3 Haralambides (1996) – by the use of Input/Output Analysis methodology – attempted to estimate the economic impact of shipping on the national economy. Such analysis is beyond the scope of this paper.

compilation of the balance of payments. Since 1999, it uses the 5th edition of the IMF Balance of Payments Manual (IMF 1993), which is based on the distinction between residents and non-residents.[4] The above research effort —aside from the methodological issue of unit root testing it may suffer from— is undertaken on annual data compiled according to the old methodology. The current compilation approach offers the advantage of selecting the element of shipping service inflows / receipts that is closely related to the international shipping freight rates, as will be discussed in Section 3. Another significant change is related to the introduction of the euro, which became the legal tender in Greece (since 2002 in physical form). Finally, as our interest focuses on the short-term path of receipts from shipping services, monthly data are used.

Thus, the present study attempts to investigate the determinants of receipts from deep sea shipping by utilising advanced econometric methods that were not available at the time of previous research. The data used has been compiled according to the new methodology. In addition, the ability of the model to forecast is tested using the out-of-sample forecast performance of the selected ECM, providing evidence of its superiority compared to other time series benchmark models.

3 DATA AND METHODOLOGY

3.1 DATA

According to the IMF Balance of Payments Manual (BPM), the Balance of Payments (BoP) is defined as:

> "...a statistical statement that systematically summarises, for a specific time period, the economic transactions of an economy with the rest of the world. Transactions, for the most part between residents and non-residents, consist of those involving goods, services, and income; those involving financial claims on, and liabilities to, the rest of the world; and those (such as gifts) classified as transfers, which involve offsetting entries to balance —in an accounting sense— one-sided transactions".

The distinction between residents and non-residents has an important role in the BoP. The BPM states that an enterprise has a resident status when it is engaged in a significant amount of production of goods and/or services in the domestic country. However, this definition may cause a split between the legal entity of a company and its resident status. Namely, parts of the company (i.e. branches) that are operating in a particular economy are given the resident status of this economy and therefore any transactions between the resident (branch) and the non-resident (parent company) would constitute a BoP transaction.

The operation of mobile equipment —as the operations of vessels are referred to in the Balance of Payments Textbook (1996)— introduces more difficulties for the complier of the BoP. The decision as to whether a service provided by mobile equipment (such as vessels) has resident status is made on the basis of the resident status of the enterprise operating such equipment (vessels). Moreover, in order to decide on the territory of the operating enterprise, the focus should be on issues such as the location of the company directing enterprise operations. It can be inferred then that the Greek-owned fleet flying a non-Greek flag can fall under the criterion of the territory of the directing enterprise. Thus, both the Greek-flag fleet and the non-Greek-flag fleet can be regarded as resident from a BoP point of view.

The Bank of Greece has gradually introduced, since 1999, the implementation of the 5th edition of the BPM (1993) and the respective Compilation Guide (1995) published by the IMF. According to the BPM, each month's

4 See also Box VIII.1 of the Bank of Greece *Annual Report* 1998, and Pantelidis (1997).

receipts should be recorded in the monthly BoP. The Bank of Greece collects data from financial institutions based in Greece. The services from shipping transportation comprise the following categories:

1. Cross-trade transportation services.

2. Transportation of passengers.

3. Transportation of goods.

4. Other/auxiliary services.

Based on the data presented in Table 1, it is evident that cross-trade represents the category with the highest contribution to the shipping transportation element of the BoP, representing (on average) 97% of the total amount of receipts from shipping transportation services over the period 2002-2009. By definition, cross-trade services include those services provided by Greek companies for the transportation of goods between third countries. This is not at odds with what would be expected. Although Greek-owned vessels (usually managed by companies based in Greece) represent roughly 15% of the world fleet capacity (in dwt terms), the Greek economy does not possess the depth of domestically-produced exportable commodities to employ a considerable share of the Greek fleet.

As receipts from the provision of shipping services for cross-trade account for the bulk of shipping receipts, the estimated model focuses on them. These receipts are expected to be closely related to the internationally agreed freight rates and reflect the operations of the traditional Greek shipping companies.

The euro is a more liquid and tradable currency in international foreign exchange markets compared to the Greek drachma. In 2002, euro coins and banknotes were put in circulation in Greece. This fact may have prompted Greek-based shipowners to carry out a higher portion of their transactions through their local (Greek) banking system, as the local currency was then the euro. Thus, we have decided that our sample period should begin in January 2002, and not earlier. Importantly, the sample period includes also the financial turmoil of 2008, which had an enormous impact on the shipping industry and freight rates. The non-seasonally adjusted data are monthly time series and the sample covers the period from January 2002 to March 2010.

Receipts from the provision of shipping transportation services in cross-trade are hypothesised to depend on the international freight rates, the size of the Greek-based maritime cluster (i.e. ship management companies, financial services and companies that provide auxiliary services to shipping), and the carrying capacity of the Greek-owned fleet.

In our analysis, the ClarkSea Index (expressed in USD per day) is used as the index of international freight rates. It is a weighted average freight index of all main commercial vessels. Specifically, as described by Clarkson Research Studies in 'Sources and Methods for the Shipping Intelligence Weekly' (2009):

> "The ClarkSea Index is the only published weekly indicator of earnings for all the main commercial vessel types. It is weighted according to the number of vessels in each fleet sector. Clarksons Research collects rates direct from the Clarksons brokers on a daily and weekly basis and these are used to calculate the earnings taken into account to make up the ClarkSea Index. The sectors in the ClarkSea Index are oil tankers (VLCC, Suezmax, Aframax and clean product carriers), dry bulk carriers (Capesize, Panamax, Handymax and Handysize), gas carriers (VLGC) and fully cellular containerships" (see www.clarksons.net).

As the size of the Greek-based shipping cluster increases, shipowners tend to strengthen their banking relations with Greek-based shipping finance institutions. In addition, when ship owners receive a loan from a bank to

Tables I Receipts from shipping services

(in million USD)

	2002	2003	2004	2005	2006	2007	2008	2009	Year average (2002-2009)
Receipts from shipping services	**7,561.8**	**10,136.5**	**15,429.7**	**16,114.7**	**16,674.6**	**21,487.2**	**25,920.0**	**17,102.5**	**16,303.4**
Passengers	95.3	75.5	94.6	119.6	92.3	135.7	168.3	114.7	112.0
Goods	49.1	49.5	64.0	42.6	48.2	89.8	92.5	60.3	62.0
Cross-trading	6,919.8	9,556.1	14,713.6	15,790.0	16,359.7	21,095.0	25,478.0	16,749.5	15,832.7
Auxiliary services	497.5	455.3	557.5	162.4	174.4	166.4	181.2	178.0	296.6
Receipts as percentages	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Passengers	1.3	0.7	0.6	0.7	0.6	0.6	0.6	0.7	0.7
Goods	0.6	0.5	0.4	0.3	0.3	0.4	0.4	0.4	0.4
Cross-trading	91.5	94.3	95.4	98.0	98.1	98.2	98.3	97.9	97.1
Auxiliary services	6.6	4.5	3.6	1.0	1.0	0.8	0.7	1.0	1,8

Source: Bank of Greece.

acquire a vessel, they are also required to open an operating account for the financed vessel at the same bank, and perform all the vessel's trading transactions (including freight receipts) though this account. Therefore, the amount of outstanding loans (in USD) can play a dual role, as it can reveal, on the one hand the expansion of the fleet, and on the other the increase in the Greek-owned fleet. As it is almost impossible to collect monthly data on the size of the Greek maritime cluster and the Greek-owned fleet, outstanding balances of credit to shipping companies granted by the domestic banking system through branches in Greece can act as a proxy for these variables. It should be noted though that, based on the annual data provided by the Greek Shipping Cooperation Committee, the Greek-owned fleet has increased by approximately 3.2% per annum (or the equivalent of 0.26%) over the estimated period (2002:M1-2010:M3).

Even today, the USD is the predominant currency in shipping transactions. In order to avoid any distortion on our results due to fluctuations of the exchange rate of the US dollar against the euro, we decided to express all time series in USD, using the average monthly rate of the US dollar against the euro as published by the European Central Bank (ECB).

3.2 ECONOMETRIC METHODOLOGY

The econometric methodology applied is described by the following stages.

First, the time series properties of all the variables are evaluated employing the Augmented Dickey-Fuller (1979) standard unit-root tests (ADF). Specifically, we examine the rank of integration I(d) for the logarithms of the ClarkSea Index (ind), outstanding credit balances to the shipping companies (ls), and receipts from the provision of shipping transportation services in cross-trade (sr).

At the second stage, we use an error correction framework in two steps as proposed by Engle and Granger (1987) to investigate the existence of a cointegration relationship between ind, ls and sr.

In a *first step*, if sr, ind and ls are I(1) and $d_t \sim$ I(1), the series would be cointegrated of order CI(1,1). This implies that if we wish to estimate the long-run relationship, it is only necessary to estimate the static model:

$$\log(sr)_t = \mu + \zeta \log(ind)_t + m \log(ls)_t + d_t \quad (1)$$

which implies that in the long run the endogenous variable of cross-trade shipping receipts (sr) is determined by the exogenous variables, the freight index (ind) and outstanding loans (ls).

The term μ is a constant; the parameters ζ and m denote the long-run elasticities of ind and ls; while dt are the long-run residuals. Estimating (1) using OLS achieves a consistent estimate of the long-run steady state relationship between the variables, while all dynamics and endogeneity issues can be ignored asymptotically. This arises because of what is termed the super-consistency property of the OLS estimator when the series are cointegrated (see Harris, 1995). To test the null hypothesis that shipping receipts and the exogenous variables ind and ls are not cointegrated we directly test whether $d_t \sim$ I(1) against the alternative that $d_t \sim$ I(0) by carrying out ADF tests and using the critical values provided by MacKinnon (1991).

In a *second step* we estimate an ECM, itself using the estimates of disequilibrium (d_{t-1}), to obtain information on the speed of adjustment to equilibrium. The ECM takes the following form:

$$\Delta log(sr)_t = \delta_0 + \sum_{i=1}^{m} \alpha_i \, \Delta log(sr)_{t-i} + \sum_{i=0}^{n} \beta_i \, \Delta log(ind)_{t-i} + \sum_{i=0}^{h} \varkappa_i \, \Delta log(ls)_{t-i} + \gamma d_{t-1} + \text{Sdummies} + \varepsilon_t \quad (2)$$

where Δ denotes first differences in logarithms;

$d_{t-1}=log(sr)_{t-1}-\zeta\, log(ind)_{t-1}-m\, log(ls)_{t-1}-\mu$ is the disequilibrium or the error correction term, tested to be stationary; and $\varepsilon_t \sim N(0, \sigma^2)$ are the residues from the estimation of model (2). If series *sr* and *ind* are both I(1), the stationarity of d_t is equivalent to *sr* and *ind* being cointegrated with a cointegration vector $x' = [1\text{-}\zeta\text{-}m\text{-}\mu]$ with ζ, m and μ being the parameters of the long-run relationship. Seasonal dummies (Sdummies) have been added in order to capture any seasonal pattern in shipping receipts. It should be noted that the Hendry (1995) type of 'general-to-specific' procedure is used to reduce the short-run ECM to its parsimonious form.

At the third stage, we present an evaluation of forecast performance between the selected parsimonious ECM and two benchmark time series models, random walk (RW) and autoregressive AR(k). A benchmark model is usually helpful in forming an idea about the relative forecasting performance of the different models. We use the Root Mean Square Error (RMSE) of recursive dynamic out-of-sample forecasts as the main criterion for the assessment, which is widely used in the literature (see e.g. Anderson, Hoffman and Rasche, 2002; Stock and Watson, 1999; Hoffman and Rasche, 1996; Clements and Hendry, 1993). Additionally, three measures of predictive accuracy —Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE) and Theil's inequality coefficient[5]— are employed to evaluate the predictive performance of the ECM compared to the benchmark time series models. We use a rolling period of 3 months ahead to assess the forecast performance, i.e. the first out-of-sample exercise starts in 2009:M1 on the basis of the total sample 2002:M1 to 2010:M3. The sample is then extended sequentially by one month up to 2010:M3. The out-of-sample exercise covers a period of 15 months. Each time, the models are re-estimated and a set of dynamic forecasts is computed for up to 3 months ahead.

4 EMPIRICAL RESULTS

The hypothesis of a unit root in the logarithmic levels of ind, sr and ls cannot be rejected. In contrast, the hypothesis of a unit root in the first differences is rejected in all cases, in favour of the alternative of stationarity. These results suggest that all series are I(1) (see Table 2). The residuals of the long-run relationship (1) are also stationary in levels $d_t \sim I(0)$, and so we can conclude that the two series are cointegrated of order CI(1,1).

5 The MAPE and the Theil's inequality coefficient are scale invariant. The RMSE and the MAE depend on the scale of the dependent variable and should be used as relative measures to compare forecasts for the shipping receipts across ECM, AR(k) and RW.

Table 2 Augmented Dickey-Fuller Test Results

ADF Statistics	log(rs)	Δlog(rs)	log(ind)	Δlog(ind)	log(ls)	Δlog(ls)	Long -run Residuals (d)
Intercept	-2.10 (-3)	- 4.61* (-2)	-2.50 (-1)	- 6.75* (0)	-1.31 (0)	-8.57* (0)	-7.06* (0)
Trend and Intercept	-2.14 (-3)	- 4.74* (-2)	-2.33 (-1)	- 6.82* (0)	-0.62 (0)	-8.71* (0)	-7.02* (0)
None	1.05 (-3)	- 4.45* (-2)	0.23 (-1)	- 6.77* (0)	6.32 (0)	-2.14* (-3)	-7.10* (0)

* Denotes rejection of the null hypothesis at the 5% significance level.
Note: The numbers in the parentheses are the selected lag length for no serial correlation of the ADF residuals based on Swartz information criterion.

The estimated long-run equation of shipping inflows is:

$$\log(sr) = \underset{(-12,0)}{-2.95} + \underset{(21,32)}{0,44}*\log(ind) + \underset{(31,21)}{0,64}*\log(ls)$$

$$R^2\text{-adj.} = 0,95 \qquad (3)$$

From the estimated long-term equation (3) it is obvious that both variables (freight index and outstanding loans) are statistically significant in explaining shipping receipts and (as was expected) they have a positive sign. The estimated cointegrating vector reveals a partial pass-through from the ClarkSea index to shipping receipts in the long-run, with the long-run parameter ζ estimated to be 0.44, which means that if the index increases by 10% in any month, shipping receipts will tend to rise by 4.4% only. This can be explained by the international nature of Greek shipping operations. Freight revenues can be deposited to bank accounts in major shipping centres such as London, New York and Piraeus. As a result, only part of the increased revenues passes into the Greek banking system and therefore to the data compiled by the Bank of Greece. Finally, when banks are granting loans to shipping companies, they also request the opening of a retention account which will be used for the loan repayment. Therefore, to the extent that Greek shipping companies are financed by non-Greek banks, freight revenues will be sourced in the international (non-Greek) banking system. In addition, the composition of the Greek fleet (focused predominantly on dry bulk and tanker vessels) is not necessarily the same as the composition of the world fleet. There could therefore be a mismatch between the weighting on the ClarkSea index and the composition of the Greek-controlled fleet.[6]

In the case of outstanding loans to shipping, the pass-through rate is estimated at 0.64, implying that a 10% increase in outstanding loans leads to 6.4% higher shipping inflows. The importance of outstanding loans —as was previously explained— is twofold. It represents the increase of the Greek-owned fleet, as well as the strengthening of the maritime cluster, since ship owners that receive a loan from a bank are also required to open an operational account for the financed vessel at the same bank, and to perform all the vessel's trading transactions (including freight receipts) though this account.

The parsimonious estimated ECM is the following:

$$\begin{aligned} d\log(sr) = {} & \underset{(4,10)}{0,05} - \underset{(-3,39)}{0,32}*d\log(sr)_{t-1} - \underset{(-1,74)}{0,13}*d\log(sr)_{t-2} \\ & + \underset{(2,31)}{0,17}*d\log(ind)_{t-1} + \underset{(1,73)}{0,59}*d\log(ls)_t \\ & - \underset{(-2,51)}{0,18}*DV038 - \underset{(-3,34)}{0,24}*DV0510 - \underset{(-5,06)}{0,55}*d_{t-1} \end{aligned}$$

$$R^2\text{-adj.} = 0,60 \qquad \text{F-statistic} = 12,07 \qquad (4)$$

Table 3 summarises the estimated parameters of equation (4).

Table 3 Results from the Error Correction Model

Shipping receipts (rs)	
[m,n,h]	[2,1,0]
δ_0	0.05* (4.10)
α_1	-0.32* (-3.39)
α_2	-0.13** (-1.74)
β_1	0.17* (2.31)
$\varkappa_o$	0.59** (1.73)
γ	-0.55* (-5.06)

* Denotes rejection of the null hypothesis at the 5% significance level.
** Denotes rejection of the null hypothesis at the 10% significance level.
Note: [m, n, h] are the maximum lags based on the Akaike (1973) and Schwarz (1978) information criteria.
The numbers in parentheses are t- statistics.

6 In Bragoudakis, Panagiotou and Thanopoulou (2010) an attempt is made to estimate a Greek Shipping freight index.

Table 4 Diagnostic Tests of ECM

R^2 - adj.	0.60
LM(1) [p-value]	0.82
LM(6) [p-value]	0.24
LM(12) [p-value]	0.68
ARCH(1) [p-value]	0.85
ARCH(2) [p-value]	0.78
Jarque-Bera [p-value]	0.35

In Table 4, the diagnostic tests of equation (4) are presented:

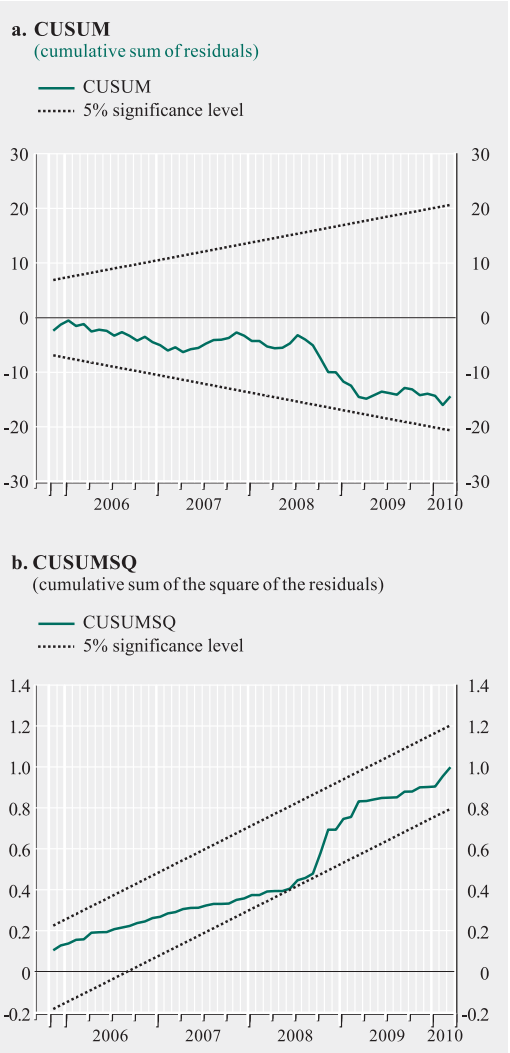
The estimated equation (4) shows good fitness and passes all diagnostic x^2 tests for the hypotheses that there is no serial correlation and autoregressive conditional heteroscedasticity and that the residuals follow the normal distribution. Furthermore, two impulse dummies that improve the fitness of the model —DV038 (August 2003) and DV0510 (October 2005)— were included.

One remaining problem concerns the stability of the estimated parameters of model (4) due to the relatively small sample. The CUSUM and CUSUM Square test was applied to the whole sample 2002:M2 to 2010:M3.

As Chart 1 shows, the null hypothesis of the parameter stability over the sample period cannot be rejected at the 5% significance level.

In the short run, the ClarkSea index with one-month time lag affects the inflow of receipts from shipping. The parameter β_1=0.17 —which represents the short-dynamic effect of the ClarkSea index on shipping receipts— measures the impact of the one-month lagged value of the freight index on the shipping inflows and generates an elasticity of 1.7%. Effectively, the modalities of freight collection imply that any payments will be recorded in the Greek BoP on average about a month later,[7] which is in accordance with the shipping practice.

Chart 1 CUSUM and CUSUMSQ test of the error correction model coefficients



Note: When the departures of the cumulative sum of residuals (CUSUM) and of the cumulative sum of the square of the residuals (CUSUMSQ) from their expected values lie within the upper and lower limits, this means that the null hypothesis that the coefficients remain constant at a 5% significance level can be accepted.

Parameter γ=-0.55 (adjustment coefficient) reveals the speed of adjustment to the equilibrium steady state and implies a relatively quick return to the long-run level. Finally, the negative coefficients α_1=-0.32 and α2=-0.13 of ship-

7 As confirmed by ship-broking sources (see Bragoudakis, Panagiotou and Thanopoulou, 2010).

Table 5 Recursive dynamic (3 months ahead) out-of-sample results

Models	ECM	AR(3)	AR(1)	RW
Forecast period	**RMSE**	**RMSE**	**RMSE**	**RMSE**
2009M1-2009M3	0.119	0.076	0.105	0.159
2009M2-2009M4	0.089	0.067	0.08	0.08
2009M3-2009M5	0.103	0.083	0.05	0.112
2009M4-2009M6	0.041	0.109	0.062	0.165
2009M5-2009M7	0.041	0.093	0.07	0.155
2009M6-2009M8	0.037	0.079	0.064	0.138
2009M7-2009M9	0.062	0.052	0.083	0.092
2009M8-2009M10	0.069	0.038	0.058	0.103
2009M9-2009M11	0.078	0.048	0.071	0.101
2009M10-2009M12	0.054	0.094	0.127	0.154
2009M11-2010M1	0.06	0.108	0.15	0.207
2009M12-2010M2	0.075	0.082	0.115	0.204
2010M1-2010M3	0.122	0.055	0.111	0.192
Average	**0.073**	**0.076**	**0.088**	**0.143**

ECM: Error Correction Model
AR(3): Autoregressive model of order 3
AR(1): Autoregressive model of order 1
RW: Random walk model
RMSE: Root mean square error

ping inflows with one- and two-month time lags respectively, indicate the corrective actions that companies may undertake in order to balance their overshooting behaviour. When inflows (revenues) for freight in one month are quite high, Greek-based shipping companies decide to reduce (in the following months) the freight revenues that charters remit to their accounts. Freight revenues are used, predominately, for bank loan servicing (interest and capital payments) and to cover ship management companies' operating expenses. This is an indication that each shipping company has a "target" account balance that it prefers to maintain, and any deviations are corrected.

The results of the recursive dynamic (3-months ahead) out-of-sample exercise based on equation (4) are presented in Table 5, and in more detail in the Appendix. The findings support the conclusion that the parsimonious estimated ECM outperforms the AR(3), AR(1) and random walk (RW) models. The average RMSE over the forecasting period 2009:M1-2010:M3 is lower for the ECM compared to the various benchmark time series models, thus the ECM produces more accurate estimations.

These findings are further supported by the results with respect to the MAE, MAPE and Theil's inequality coefficient statistics, as presented in the Appendix.[8] To conclude, the forecasting ability test of the proposed ECM provides evidence that this could be a useful tool for short-term projections of shipping receipts in the Greek economy. In addition, the discussed ECM —due to its structural specification— can be utilised for simulations analysis regarding the short-term response of shipping receipts to exogenous parameters related to

8 RMSE, MAE, MAPE and the Theil's inequality coefficient all favour the estimated ECM's forecasting ability. The only exception being the AR(1) model which —only according to the MAPE statistic— outperforms the ECM.

the freight rate index or the financing conditions in shipping.

5 SUMMARY AND CONCLUSIONS

Receipts from the provision of shipping services play a pivotal role in covering the Greek current account deficit. In the 1970s and 1980s, a number of researchers have explored the determinants of shipping receipts. However, since the change in the methodology used to compile the BoP and the changeover from the drachma to the euro, there has been no relevant research to the best of our knowledge.

This study explored the relationship between receipts from the provision of shipping services (cross-trade), freight rates, and outstanding loans to the shipping sector. Its empirical findings revealed the existence of a stable long-run relationship between the ClarkSea index, the outstanding loans and the inflows of shipping receipts.

It also detected evidence of a limited pass-through of 44% from freight rates and of 64% from outstanding loans to the shipping inflow. These results are closely related to the international nature of the Greek shipping business model and the increasing significance of Greek shipping and shipping cluster (including the shipping finance sector). Finally, the out-of-sample forecast performance exercise revealed that the selected ECM is more efficient (lower RMSE) than some "benchmark" selected time series models.

Recursive dynamic (3-months ahead) out-of-sample results

Models	ECM				AR(3)				AR(1)				RW			
Frecast period	RMSE	MAE	MAPE	Theil	RMSE	MAE	MAPE	Theil	RMSE	MAE	MAPE	Theil	RMSE	MAE	MAPE	Theil
2009M1-2009M3	0.119	0.099	177.891	0.526	0.076	0.071	124.184	0.345	0.105	0.083	69.021	0.783	0.159	0.116	55.636	0.657
2009M2-2009M4	0.089	0.076	210.715	0.573	0.067	0.057	211.278	0.454	0.080	0.053	78.666	0.892	0.080	0.068	447.368	0.456
2009M3-2009M5	0.103	0.087	254.617	0.605	0.083	0.082	257.948	0.743	0.050	0.040	96.382	0.645	0.112	0.106	498.866	0.642
2009M4-2009M6	0.041	0.039	86.584	0.285	0.109	0.101	198.741	0.983	0.062	0.050	74.849	0.690	0.165	0.159	531.004	0.861
2009M5-2009M7	0.041	0.040	58.353	0.226	0.093	0.075	95.344	0.719	0.070	0.070	98.007	0.670	0.155	0.144	277.698	0.959
2009M6-2009M8	0.037	0.034	35.658	0.182	0.079	0.062	62.223	0.452	0.064	0.063	63.008	0.434	0.138	0.119	221.329	0.553
2009M7-2009M9	0.062	0.047	76.416	0.334	0.052	0.050	60.218	0.370	0.083	0.083	106.669	0.649	0.092	0.088	195.991	0.354
2009M8-2009M10	0.069	0.061	586.451	0.445	0.038	0.036	539.899	0.261	0.058	0.055	417.768	0.437	0.103	0.100	104.573	0.396
2009M9-2009M11	0.078	0.076	614.473	0.798	0.048	0.042	501.327	0.499	0.071	0.065	385.080	0.884	0.101	0.096	115.287	0.589
2009M10-2009M12	0.054	0.048	233.683	0.232	0.094	0.085	484.860	0.510	0.127	0.104	191.897	0.815	0.154	0.134	120.586	0.660
2009M11-2010M1	0.060	0.057	54.303	0.24	0.108	0.103	80.560	0.574	0.150	0.146	117.806	0.863	0.207	0.185	75.040	0.668
2009M12-2010M2	0.075	0.060	93.444	0.279	0.082	0.066	45.311	0.400	0.115	0.099	75.758	0.635	0.204	0.168	56.387	0.650
2010M1-2010M3	0.122	0.108	115.082	0.587	0.055	0.047	42.025	0.240	0.111	0.094	73.592	0.638	0.192	0.158	57.735	0.627
Average	**0.073**	**0.064**	**199.821**	**0.409**	**0.076**	**0.067**	**207.994**	**0.504**	**0.088**	**0.077**	**142.193**	**0.695**	**0.143**	**0.126**	**212.115**	**0.621**

ECM: Error Correction Model
AR(3): Autoregressive model of order 3
AR(1): Autoregressive model of order 1
RW: Random walk model
RMSE: Root mean square error
MAE: Mean absolute error
MAPE: Mean absolute percentage error
Theil: Theil's inequality coefficient

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THE IMPACT OF NOMINAL AND REAL UNCERTAINTY ON MACROECONOMIC AGGREGATES IN GREECE*

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1 INTRODUCTION

The impact of nominal and real uncertainty on macroeconomic aggregates such as inflation and growth has generated a significant body of research. It is of particular relevance to policy makers in deciding whether there are welfare gains from stabilizing not only the levels of inflation and growth but also their variability.

In a previous paper (Balfoussia and Gibson, 2010) we examined the relationship between inflation and nominal uncertainty (as proxied by alternative estimates of the variability of inflation) for the Greek economy. The results suggested that inflation indeed affects nominal uncertainty, thus implying that it generates real costs for an economy. In this paper, we extend our analysis to examine real uncertainty (as measured by alternative estimates of the variability of real growth) and whether it impacts on inflation. Additionally, we examine whether nominal or real uncertainty impact on growth and, if so, in what direction. This can provide useful information to policymakers in deciding, first, whether they should be concerned about uncertainty (either nominal or real).

The results indicate that both nominal and real uncertainty impact on growth. Nominal uncertainty impacted negatively on growth in Greece, in particular during the period before EMU entry. The effect of real uncertainty on growth is more mixed. Overall, there is some evidence that real uncertainty positively influences growth though only at very short horizons. This effect too however seems to have disappeared following Greece's entry into the EMU. Finally, there appears to be no effect of real uncertainty on inflation.

The results provide support for the maintenance of a stable level of inflation which, by definition, reduces nominal uncertainty. It is indicative that, in the period following entry into the euro area, nominal uncertainty is not found to have affected real growth. This can arguably be attributed to the relatively low inflation environment that has prevailed, which has contributed to anchoring inflationary expectations.

The remainder of the paper is organized as follows. In Section 2 we consider the theoretical reasons why we might expect macroeconomic aggregates to be influenced by nominal or real uncertainty. We also discuss the empirical results that are available for a number of industrialized countries, Greece not among them. Sections 3 and 4 describe our data and econometric methodology, while Section 5 presents the results. Finally, Section 6 concludes.

2 THEORETICAL ARGUMENTS LINKING UNCERTAINTY TO INFLATION AND GROWTH

There are many theories which link uncertainty to inflation and growth and vice versa. In this paper, we are interested in three specific hypotheses and we concentrate our attention on theoretical arguments relevant to those hypotheses. First, does nominal uncertainty affect growth? Second, does real uncertainty affect growth? Finally, does real uncertainty affect inflation?

With respect to the first two questions, traditionally, growth has not been seen as being

* The views expressed do not necessarily reflect those of the Bank of Greece. The authors would like to thank G. Tavlas for his useful comments on a previous version of the study, and acknowledge any mistakes as entirely their own.

influenced by the variability of either inflation or growth itself. Instead, the business cycle has been considered to be independent of long-term growth, the latter being influenced by improved technology, labour and capital stock growth and the growth of total factor productivity. However, there are now a number of theories which link uncertainty to growth.

Taking the impact of nominal uncertainty (as reflected in the estimated conditional variance of inflation) on growth first, Friedman (1977) suggests that nominal uncertainty might influence growth negatively, at least in the short run. Greater uncertainty about inflation distorts price signals, leads to misperceptions by consumers and firms and results in a sub-optimal allocation of resources and lower efficiency. This has negative effects on growth.

More recently, however, authors such as Dotsey and Sarte (2000) have built models which imply a positive relationship between inflation uncertainty and growth. In a neoclassical growth model, augmented by a cash-in-advance constraint, increases in inflation volatility increase the uncertainty of returns on money balances and generate greater savings and, hence, growth. The mechanisms through which this result is generated include the existence of precautionary savings as well as increased risk balances.

The relationship between real uncertainty (as measured by the estimated conditional variance of growth) and growth likewise can go either way. Pindyck (1991), building on Keynes (1936), suggests that if output becomes more variable and uncertainty increases, investment and hence growth will fall. The rationale is based on the recognition that investment is usually irreversible. Thus, heightened uncertainty causes entrepreneurs to put off investments, lowering growth. Blackburn and Pelloni (2005) generate the same result from an endogenous growth model. Increases in real uncertainty cause workers to react by setting higher wages. This lowers employment and hence investment and growth.

By contrast, Sandmo (1970) and Black (1987) argue that increased real uncertainty will raise average growth. For Sandmo (1970), the effect works through precautionary balances. Increased uncertainty generates incentives to hold higher precautionary savings which, within a simple Solow growth model, will increase growth. Black (1987) starts from the positive relationship that exists between risk and return in a portfolio model. Increased uncertainty would encourage greater investment in riskier projects. These riskier projects have greater mean returns, but also generate greater variability in real output growth.

Finally, there is the potential impact of real uncertainty on inflation. Deveraux (1989) suggests a reason why we might expect a positive relationship. An increase in the variability of real shocks lowers the optimal amount of wage indexation in any economy. However, within a Barro-Gordon framework, lower wage indexation makes inflation surprises more effective. This will encourage the monetary authorities to generate more surprises and average inflation will be higher.

Alternatively, Dotsey and Sarte (2000) argue that an increase in the variability of inflation causes the return on money balances to become more uncertain. Agents reduce their demand for money balances and hence consumption falls and savings rise. A rise in savings in a simple Solow growth model would raise the rate of growth as it automatically results in an increase in investment.

Not surprisingly, given the variety of theoretical results, empirical evidence on these hypotheses is exceedingly mixed. The literature uses monthly data on industrial production for growth and, representing real uncertainty, estimates or survey measures of its variability; it uses analogous measures of the variability of either consumer prices or producer prices to measure nominal uncertainty.

The empirical results from a wide range of papers are summarised in Table 1. Overall, it

Table 1 Empirical results in the literature

Hypothesis	Reference	Sample	Results
Inflation uncertainty causes growth	Fountas and Karanasos (2007)	1957-2000, G7	US: CPI positive effect PPI negative effect GE, UK: negative effect CA, JP: positive effect
	Conrad and Karanasos (2005)	1962-2004, EU	BG, SE, UK: negative effect FI, FR, NL: positive effect
	Conrad and Karanasos (2008)	1960-2007, US	Strong positive effect
	Davis and Kanago (1996)	1951-1990, US	1 standard deviation increase in inflation, 1pp fall in growth
	Fountas et al. (2002)	1961-1999, JP	Negative and significant effect
	Fountas et al. (2006)	Late 1950s-2000, G7	Negative effect (except FR, IT)
	Lee and Ni (1995)	1954-1993, US	Negative and significant effect
	Kneller and Young (2001)	1961-1997, OECD countries	Negative and significant effect
	Grier and Perry (2000)	1948-1996, US	Negative and significant effect
Growth uncertainty causes growth	Fountas and Karanasos (2007)	1957-2000, G7	US: no effect G7 (excl. US, JP): positive effect
	Fountas and Karanasos (2008)	100 years, UK, DE, FR, IT, SE	Bidirectional causality; mixed signs
	Fountas et al. (2002)	1961-1999, JP	Causality reversed, positive effect
	Fountas et al. (2004)	1961-2000, JP	No effect
	Fountas et al. (2006)	Late 1950s-2000, G7	Positive effect
	Kneller and Young (2001)	1961-1997, OECD countries	Uncertainty measured over 5-year periods: negative and significant effect
	Ramey and Ramey (1995)	1960-1985, 92 countries	Negative and significant
	Martin and Rogers (2000)	24 OECD (1960-1988) 90 EU Regions (1979-1992) 72 developing countries (1960-1988)	Negative and significant for EU regions and OECD; not significant for developing countries
	Kormendi and Meguire (1986)	Post-war, 47 countries	Positive and significant
	Grier and Tullock (1989)	113 countries	Positive and significant
	Caporale and McKiernan (1996)	1948-1991, UK	Positive and significant
Growth uncertainty causes inflation	Fountas et al. (2006)	Late 1950s-2000, G7	Mixed evidence regarding both sign and significance
	Grier and Perry (2000)	1948-1996, US	No effect

appears that nominal uncertainty (i.e. increased volatility of inflation) tends to have a detrimental effect on growth. For the other two hypotheses no clear picture emerges.

3 ANALYSIS DATA

Our dataset is comprised of the monthly consumer price and industrial production indices for Greece (CPI and IP respectively), spanning the period 1981-2009, as provided by the Hellenic Statistical Authority. The latter index is used as a proxy for GDP, in line with the bulk of the related empirical literature, given that GDP itself is only available at a quarterly frequency. Following Balfoussia and Gibson (2010) we use these seasonally unadjusted dataseries to calculate seasonally-adjusted measures of month-on-month annualised CPI inflation and the growth rate of IP, by applying the Census X12 technique provided by the US Bureau of the Census[1] and used by the US Bureau of Labor Statistics for the estimation of seasonally-adjusted US CPI-U. The resulting constructed dataseries allow us to explore causality once seasonal variation has been accounted for.

4 ECONOMETRIC METHODOLOGY

The main empirical hurdle to be overcome in order to test the theories outlined in Section 2 is the need to decide upon an adequate measure of real and nominal uncertainty. Several alternative statistical approaches to proxying uncertainty can be found in the literature, the most commonly used ones being rolling statistical measures of a variable's variability and the dispersion of survey-based individual forecasts as proxies for uncertainty.[2] However, neither can be said to adequately capture uncertainty as understood in the present context. Statistical measures of variability, such as the moving average of a variable's standard deviation, incorporate both predictable and unpredictable variability; however, only the variance of the stochastic, or unpredictable, component of a variable reflects true economic uncertainty.[3,4]

Current research appears, on the whole, to reject purely statistical measures of uncertainty in favour of model-derived ones, primarily of measures based on GARCH-type estimations.[5] In contrast to the earlier proxies, GARCH specifications provide a tool to formally model and estimate the time-varying variance of the dependent variable's unpredictable innovations, i.e. a measure that corresponds well to the notion of uncertainty used in the theoretical literature underlying our work and reflects its time-variation. Hence, this is our methodology of choice.

Turning to the issue of testing for causality, virtually all of the aforementioned academic literature uses Granger causality tests to detect the presence of possible causal relationships between the variables in question. It should be noted that these tests, just as any other statistical approach, actually explore temporal precedence rather than causation, a point to be borne in mind when results are interpreted. This caveat notwithstanding, we perform Granger causality tests on our variables in line with the related empirical literature and try to reinforce our results by using several alternative proxies for uncertainty and testing for causality at many different horizons.

Three sequentially nested GARCH models are used to obtain the corresponding alternative estimated time-varying conditional variances for each of our two variables, that is, of inflation and the economy's real growth rate. These

1 http://www.bls.gov/cpi/cpisapage.htm
2 For a more detailed overview of alternative measures used in the literature see Balfoussia and Gibson (2010).
3 In the case of inflation, in particular, predictable inflation variability can be addressed by economic agents, e.g. through indexation; unpredictable inflation variability, which cannot, is more in line with the notion of inflation uncertainty.
4 Moreover we note that, in any case, survey measures are not available for Greece over a sufficiently long sample period.
5 A number of single country studies have employed the ARCH-class of models to proxy uncertainty, especially inflation uncertainty. Seminal among these are the articles by Engle (1983) and Bollerslev (1986). Fountas and Karanassos (2007) Hwang (2007) and Caporale and Kontonikas (2009) are but a few of the most recent ones.

are subsequently used as alternative measures of nominal and real uncertainty respectively. The three alternative model formulations are presented in equations (1) to (5).

A standard general GARCH (1,1) model is presented in equations (1) and (2).

$$x_{i,t} = \alpha_i + \sum_{\kappa=1}^{12} b_{i,k} x_{i,t-k} + e_{i,t} \quad (1)$$

$$\sigma^2_{i,t} = \alpha_i + \beta_i e^2_{t-1} + \gamma_i \sigma^2_{i,t-1} \quad (2)$$

We use $x_{i,t}$ where $i=\{1,2\}$ to denote each of the two macroeconomic variables at time t, i.e. $x_{1,t}$ denotes inflation at time t while $x_{2,t}$ denotes the real growth rate at time t. The variables' conditional means are specified in equation (1) as autoregressive processes of order 12, so as to reflect the monthly nature of our data where $e_{i,t}$ is the error term of variable $x_{i,t}$ which is assumed to follow a conditional normal distribution. The GARCH (1,1) representation of the conditional variances is presented in equation (2) where $\sigma^2_{i,t}$ denotes the conditional variance of variable $x_{i,t}$. The model assumes the conditional variance of $x_{i,t}$ follows an ARMA (1,1) process, i.e. that the conditional variance of each variable at time t depends on its own past innovations and variances. The implication is that, in predicting this period's variance, economic agents form a weighted average of the variable's long-term average variance α_i, its variance as observed in the previous period $\sigma^2_{i,t-1}$ and the size of last period's forecast error for this variable as captured by $e^2_{i,t-1}$. If last period's forecast error and/or variance were unexpectedly large, economic agents will increase their estimates of the variable's variance for the next period.

Equation (3) presents the alternative specification of the conditional variances implied by a Threshold-GARCH model (Zakooan, 1994 and Glosten, Jaganathan and Runkle, 1993).

$$\sigma^2_{i,t} = \alpha_i + \beta_i e^2_{i,t-1} + \beta^n_i r_{i,t-1} e^2_{i,t-1} + \gamma_i \sigma^2_{i,t-1} \quad (3)$$

where $r_{i,t}=1$ if $e_{i,t}<0$ and $r_{i,t}=0$ otherwise. In this specification, a variable's past innovations are allowed to have a different impact on its conditional variance depending on their sign, i.e. positive news may have a smaller impact on the variance of $x_{i,t}$ than negative news. In equation (3) positive news has an impact of β_i, while negative news has an impact of $\beta_i + \beta^n_i$.

Equations (4) and (5) present the conditional variance specification of a Component Threshold-GARCH (1,1) model. This formulation extends the previous ones by additionally allowing the conditional variance to mean-revert to a time-varying level.

$$\sigma^2_{i,t} - m_{i,t} = \beta_i (e^2_{i,t-1} - m_{i,t-1}) + \beta^n_i r_{i,t-1} (e^2_{i,t-1} - m_{i,t-1}) + \gamma_i (\sigma^2_{i,t-1} - m_{i,t}) \quad (4)$$

$$m_{i,t} = \omega_i + \varrho_i (m_{i,t-1} - \omega_i) + \varphi_i (e^2_{i,t-1} - \sigma^2_{i,t-1}) \quad (5)$$

where $m_{i,t}$ is the now time-varying long-run volatility. The first equation describes the transitory component $\sigma^2_{i,t} - m_{i,t}$ which converges to zero, while the second equation describes the long-run component $m_{i,t}$ which converges to ω_i, at rates defined by the coefficients of their respective equations. The variables in the transitory equation will have an impact on the short-run movements in volatility, while the variables in the permanent equation will affect the long-run levels of volatility.

Having estimated these three alternative univariate GARCH specifications for the error term of each variable, we examine their relative goodness of fit to each data series and proceed to use the estimated conditional volatilities as proxies for nominal and real uncertainty respectively. We perform pairwise bi-directional Granger causality tests between each of the three estimated conditional variance series obtained for each variable and the variables themselves for the three causal relationships implied in the theoretical literature and for different lag lengths (i.e. different causality horizons) up to 12 months, and examine the sign of the sum of the auxiliary (Granger causality) equations' relevant coefficients, in order to establish the direction of the effect where Granger causality is found.

Subsequently, we separate our sample at two different dates of possible structural breaks and repeat the process in order to explore whether there has been a break in the relationships we detected for the full sample.

5 EMPIRICAL FINDINGS

5.1 DIAGNOSTIC STATISTICS AND POSSIBLE STRUCTURAL BREAKS – AN INTUITIVE ACCOUNT OF THE DATA

The presence of strong ARCH effects in our data is confirmed by diagnostic Lagrange Multiplier (LM) tests. This implies, in other words, that volatility is time-varying and periods of high or low volatility tend to cluster together. Naturally, this effect is found to be much stronger for inflation, a highly volatile and persistent variable, than it is for the real rate of growth. All three GARCH specifications appear to provide a roughly equally good fit to the dataseries, as indicated by the adjusted-R^2 measures reported in Table 2. It is noted that the descriptive power of the models deteriorates somewhat for the seasonally adjusted datasets. This is to be expected as, by definition, part of the volatility in the original data has been removed. For unadjusted data, the T-GARCH model appears to provide a marginally superior fit on the basis of the reported information criteria, i.e. threshold effects appear to be significant in the variance of the inflation and industrial production growth processes. Conversely, for the seasonally adjusted data, it is the C-GARCH specification which appears to provide a marginally superior fit on the basis of most information criteria, i.e. threshold effects in combination with a time-varying mean variance appear to better describe the data, indicating perhaps that removing the seasonal fluctuations from the two variables renders the distinction between the transitory and permanent components of their conditional variances less elusive.

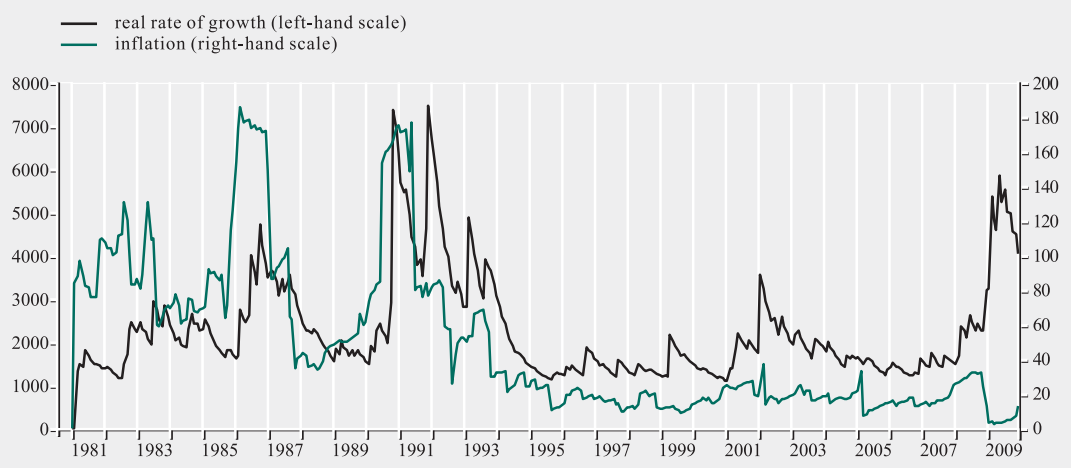
The conditional variances derived from the various GARCH specifications for both variables are plotted against time in Chart 1. Their evolution appears to be in line with developments in the Greek economy over the sample period. Turning first to inflation, volatility was high in the early part of the sample, with peaks after the 1983 and 1985 drachma devaluations, as would be expected. Volatility also rose in the early 1990s linked to oil price rises and large fiscal deficits which caused inflation to rise. Inflation was then propagated by the wage indexation mechanism. From around 1994 onwards, volatility fell gradually and has, largely, remained low thereafter. Fluctuations in the estimated con-

Table 2 Information criteria

Hypothesis	Akaike	Schwarz	Adj. R^2	Akaike	Schwarz	Adj. R^2
	Seasonally unadjusted CPI inflation			*Seasonally unadjusted IP growth*		
GARCH	6.65	6.83	0.78	10.59	10.77	0.73
T-GARCH	6.54	6.73	0.78	10.57	10.75	0.73
C-GARCH	6.61	6.82	0.78	10.56	10.78	0.73
	Seasonally adjusted CPI inflation			*Seasonally adjusted IP growth*		
GARCH	5.84	6.02	0.60	9.66	9.83	0.27
T-GARCH	5.84	6.03	0.60	9.66	9.85	0.28
C-GARCH	5.76	5.98	0.60	9.63	9.84	0.29

Note: Smaller values of the Akaike and Schwarz criteria are preferred.

Chart 1 Estimated conditional volatilities



ditional variance of the real growth rate during the pre-1994 period are analogous, most peaks and troughs coinciding with those just described. Real uncertainty also rapidly declines from around 1994 onwards, but records a brief surge during the period leading up to the 2004 Olympics and, again, in 2008 and 2009, marking the effect of the global and domestic crisis.

These fluctuations coincide with important policy choices made by Greek governments. The Maastricht treaty entered into force on 1 November 1993. It set out the path to monetary union in Europe and the Greek government publicly stated its aim to become a member, marking a major turning point for the Greek economy. 1994 was to be a crucial year towards that goal. Controls on capital movements were fully liberalized and monetary financing of the government's budget deficit was prohibited. The first convergence programme of the Greek government was adopted by ECOFIN and focused on fiscal consolidation to meet the Maastricht Treaty criteria. From 1995, the hard drachma policy was adopted to foster nominal convergence.[6] Henceforth, the economic climate improved markedly. The ongoing flow of EU structural funds channeled towards investments in infrastructure, the sharp decline in interest rates and the real improvement in key macroeconomic fundamentals provided a sustained boost for real economic activity, while the realisation of the substantial real implications of the country's acceptance to the eurozone fuelled expectations of long-lasting economic progress and stability. In brief, the rather striking reduction in the time-variation of our variables' estimated volatilities from the mid-1990s onwards reflects major developments in the Greek economy.

With the above developments in mind, we consider two alternative dates of structural breaks in our data. The first is at the end of 1993, when the Maastricht Treaty entered into force, and the second in January 2001, when Greece joined the euro area. Chow tests support the existence of structural breaks at both these dates.[7] We take these two alternative structural breaks into consideration by splitting our full sample accordingly and repeating all Granger causality tests for each of the resulting two pairs of subsample periods.

6 See Garganas and Tavlas (2001) for a discussion of this period.
7 Test results available upon request.

5.2 GRANGER CAUSALITY TESTS

The test results from all Granger causality estimations are presented in Tables 3 to 5. Estimated test statistics for the full sample of data are presented in Table 3 where results for seasonally unadjusted data are presented in the top panel and those for the seasonally-adjusted series in the bottom one. Test results corresponding to the subsample periods defined by the two alternative sample breaks are presented in Tables 4 and 5 respectively. For economy of space, only the estimates obtained for the seasonally-adjusted series have been included, the top panels now presenting Granger causality tests for each of the first subsample periods and the bottom panels for the corresponding second ones.[8,9]

In each panel three sets of estimations are presented, corresponding to each of the three theoretical causal relationships being tested. Moreover, for each possible causal relationship under consideration three sets of results are presented, each corresponding to one of the alternative GARCH specifications used to obtain measures of uncertainty. Our three null hypotheses are that in the Greek economy:

(i) real uncertainty does not Granger cause inflation;

(ii) nominal uncertainty does not Granger cause growth; and

(iii) real uncertainty does not Granger cause real growth.

Given the negative form of the tests, a rejection of any of these hypotheses at conventional levels of significance provides empirical support for the existence of the corresponding causal relationship. In these cases, the symbol in parentheses next to the appropriate Granger causality test statistic refers to the direction of the detected causal relationship, i.e. it is the sign of the sum of the relevant estimated coefficients in the corresponding auxiliary equation.

i. The causal effect of real uncertainty on inflation

An examination of the top section of each panel reveals that the hypothesis of Granger causality running from real uncertainty to inflation can be rejected for all sample periods and for all three alternative measures of the conditional variance of real growth employed in this paper. Hence our estimates provide no support for any of the corresponding theoretical arguments presented in Section 2. These findings are however in line with those reported by Grier and Perry (2000) who also detect no such causal relationship on 50 years of US data.

ii. The causal effect of nominal uncertainty on real growth

Turning to the empirical findings on the theoretical hypothesis of a causal relationship with direction from nominal uncertainty to real growth, the picture is quite different. For the full sample estimates, there appears to be a negative causal effect at the very short horizon and a positive one at longer horizons, up to a year, seemingly implying that both the Friedman (1977) and the Dotsey and Sartre (2000) effects come into play, each at a different horizon. Once the possibility of a structural break is considered, we are led to draw different conclusions. When accounting for a structural break at the end of 1993, the results for the first subsample are analogous to those obtained for the full sample. For the second

8 Results for the seasonally unadjusted data available upon request.
9 Using all three conditional variance estimates on seasonally unadjusted data for the full sample or any subsample period, it seems one cannot reject any of the three null hypotheses at any horizon. This finding reveals the weakness of the test on this dataset, confidence intervals for any null hypothesis being far too wide for any rejection or, equivalently, the test being too weak to allow us to distinguish between alternative null hypotheses. It would seem, in other words, that the seasonally unadjusted data is uninformative in this context, possibly due to noise resulting from the seasonal component. Given that the component of real and nominal variability which reflects seasonal behavioural patterns is of no interest to us here but may nonetheless strongly affect our measures of uncertainty, as it is likely to filter through to our estimates of the conditional variances, we undertake our exercise on data corrected for seasonality.

Table 3 Granger causality tests - full sample

Causality horizon (in months)

Null hypothesis	2	3	4	6	8	12
	Probability (p-values)					
Seasonally unadjusted data - full sample						
Real uncertainty (GARCH) does not Granger cause inflation	***0.121*** +	***0.172*** +	***0.485*** +	***0.350*** +	***0.198*** +	*0.030* –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.108*** +	***0.247*** +	***0.181*** +	***0.240*** +	***0.266*** +	**0.076** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.297*** +	***0.220*** +	***0.535*** +	***0.439*** –	***0.511*** +	***0.269*** –
Nominal uncertainty (GARCH) does not Granger cause real growth	***0.574*** –	***0.605*** –	***0.749*** +	***0.604*** –	***0.683*** +	***0.625*** +
Nominal uncertainty (T-GARCH) does not Granger cause real growth	**0.092** –	***0.139*** –	*0.030* +	**0.058** –	***0.227*** –	0.000 –
Nominal uncertainty (C-GARCH) does not Granger cause real growth	***0.249*** +	***0.532*** +	***0.610*** +	***0.532*** +	***0.796*** +	***0.568*** +
Real uncertainty (GARCH) does not Granger cause real growth	***0.473*** –	***0.256*** –	***0.221*** –	***0.182*** –	***0.351*** –	***0.743*** –
Real uncertainty (T-GARCH) does not Granger cause real growth	***0.336*** –	***0.546*** –	***0.673*** –	***0.747*** –	***0.697*** –	0.000 –
Real uncertainty (C-GARCH) does not Granger cause real growth	***0.105*** –	**0.066** –	***0.191*** –	***0.142*** –	***0.264*** –	*0.012* –
Seasonally adjusted data - full sample						
Real uncertainty (GARCH) does not Granger cause inflation	***0.864*** –	***0.921*** –	***0.919*** –	***0.826*** –	***0.613*** –	***0.631*** –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.893*** –	***0.908*** –	***0.959*** –	***0.124*** –	*0.031* –	***0.102*** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.811*** –	***0.851*** –	***0.922*** –	**0.060** –	*0.020* –	**0.076** –
Nominal uncertainty (GARCH) does not Granger cause real growth	*0.011* –	0.000 –	0.000 +	0.000 +	0.000 –	0.000 +
Nominal uncertainty (T-GARCH) does not Granger cause real growth	0.006 –	0.001 –	0.000 +	0.000 +	0.000 +	0.000 +
Nominal uncertainty (C-GARCH) does not Granger cause real growth	0.002 –	0.001 –	0.000 +	0.000 +	0.000 +	0.000 +
Real uncertainty (GARCH) does not Granger cause real growth	*0.016* +	0.004 +	**0.062** +	***0.101*** +	***0.267*** +	***0.269*** +
Real uncertainty (T-GARCH) does not Granger cause real growth	0.005 +	0.005 +	*0.047* +	**0.069** +	***0.191*** +	***0.224*** +
Real uncertainty (C-GARCH) does not Granger cause real growth	0.005 +	0.002 +	*0.028* +	*0.043* +	***0.149*** +	***0.194*** +

Note:
Figures in normal fonts denote that the null hypothesis can be rejected at the 1% significance level.
Figures in italics denote that the null hypothesis can be rejected at the 5% significance level.
Figures in bold italics denote that the null hypothesis can be rejected at the 10% significance level.
Figures in bold underlined italics denote that the null hypothesis cannot be rejected at the 10% significance level.
Plus and minus symbols indicate the sign of the sum of the relevant estimated coefficients in the corresponding auxiliary equation.

Table 4 Granger causality tests - structural break in 1994

Causality horizon (in months)

	2	3	4	6	8	12
Null hypothesis	**Probability (p-values)**					
Seasonally unadjusted data – sample: 1981M01-1993M12						
Real uncertainty (GARCH) does not Granger cause inflation	***0.606*** –	***0.782*** –	***0.704*** –	***0.839*** –	***0.803*** –	***0.851*** –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.661*** –	***0.828*** –	***0.917*** –	***0.594*** –	***0.300*** –	***0.620*** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.650*** –	***0.808*** –	***0.917*** –	***0.491*** +	***0.314*** –	***0.634*** –
Nominal uncertainty (GARCH) does not Granger cause real growth	**0.082** –	0.004 –	0.000 +	0.000 +	0.000 –	0.000 +
Nominal uncertainty (T-GARCH) does not Granger cause real growth	**0.058** –	0.007 –	0.000 +	0.000 +	0.000 –	0.000 +
Nominal uncertainty (C-GARCH) does not Granger cause real growth	*0.028* –	*0.015* –	0.000 +	0.000 +	0.000 +	0.001 +
Real uncertainty (GARCH) does not Granger cause real growth	*0.011* +	0.003 +	**0.066** +	***0.138*** +	***0.366*** +	***0.431*** +
Real uncertainty (T-GARCH) does not Granger cause real growth	0.007 +	0.007 +	**0.080** +	***0.147*** +	***0.321*** +	***0.414*** +
Real uncertainty (C-GARCH) does not Granger cause real growth	*0.014* +	0.006 +	**0.068** +	***0.141*** +	***0.316*** +	***0.472*** +
Seasonally adjusted data – sample: 1994M01-2009M12						
Real uncertainty (GARCH) does not Granger cause inflation	***0.238*** –	***0.225*** –	***0.365*** –	***0.424*** –	***0.380*** –	***0.639*** –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.150*** –	***0.257*** –	***0.371*** –	***0.476*** –	***0.514*** –	***0.751*** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.339*** –	***0.520*** –	***0.644*** –	***0.718*** –	***0.412*** –	***0.609*** –
Nominal uncertainty (GARCH) does not Granger cause real growth	0.004 –	*0.010* –	*0.029* –	*0.049* –	***0.109*** –	**0.100** –
Nominal uncertainty (T-GARCH) does not Granger cause real growth	0.004 –	0.010 –	*0.028* –	**0.053** –	***0.114*** –	***0.104*** –
Nominal uncertainty (C-GARCH) does not Granger cause real growth	*0.024* –	**0.053** –	***0.122*** –	***0.310*** –	***0.519*** –	***0.191*** –
Real uncertainty (GARCH) does not Granger cause real growth	***0.823*** –	***0.917*** –	***0.982*** –	***0.999*** –	***0.982*** –	***0.882*** –
Real uncertainty (T-GARCH) does not Granger cause real growth	***0.952*** +	***0.991*** +	***0.991*** +	***1.000*** +	***0.826*** –	***0.854*** –
Real uncertainty (C-GARCH) does not Granger cause real growth	***0.669*** +	***0.843*** +	***0.908*** +	***0.988*** +	***0.823*** –	***0.790*** –

Note:
Figures in normal fonts denote that the null hypothesis can be rejected at the 1% significance level.
Figures in italics denote that the null hypothesis can be rejected at the 5% significance level.
Figures in bold italics denote that the null hypothesis can be rejected at the 10% significance level.
Figures in bold underlined italics denote that the null hypothesis cannot be rejected at the 10% significance level.
Plus and minus symbols indicate the sign of the sum of the relevant estimated coefficients in the corresponding auxiliary equation.

Table 5 Granger causality tests - structural break in 2001

Causality horizon (in months)

Null hypothesis	2	3	4	6	8	12
	Probability (p-values)					
Seasonally unadjusted data – sample: 1981M01-2000M12						
Real uncertainty (GARCH) does not Granger cause inflation	***0.694*** –	***0.827*** –	***0.847*** –	***0.883*** –	***0.702*** –	***0.831*** –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.713*** –	***0.847*** –	***0.934*** –	***0.315*** –	**0.095** –	***0.313*** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.687*** –	***0.825*** –	***0.915*** –	***0.216*** +	**0.083** –	***0.279*** –
Nominal uncertainty (GARCH) does not Granger cause real growth	*0.023* –	0.001 –	0.000 –	0.000 –	0.000 –	0.000 –
Nominal uncertainty (T-GARCH) does not Granger cause real growth	*0.014* –	0.001 –	0.000 +	0.000 –	0.000 –	0.000 –
Nominal uncertainty (C-GARCH) does not Granger cause real growth	0.006 –	0.002 –	0.000 +	0.000 –	0.000 –	0.000 –
Real uncertainty (GARCH) does not Granger cause real growth	*0.041* +	0.006 +	***0.103*** +	***0.145*** +	***0.391*** +	***0.536*** +
Real uncertainty (T-GARCH) does not Granger cause real growth	*0.019* +	0.010 +	**0.094** +	***0.116*** +	***0.343*** +	***0.464*** +
Real uncertainty (C-GARCH) does not Granger cause real growth	*0.023* +	0.006 +	**0.065** +	**0.092** +	***0.293*** +	***0.437*** +
Seasonally adjusted data – sample: 2001M01-2009M12						
Real uncertainty (GARCH) does not Granger cause inflation	***0.204*** –	***0.356*** –	***0.513*** –	***0.239*** –	***0.431*** –	***0.527*** –
Real uncertainty (T-GARCH) does not Granger cause inflation	***0.121*** –	***0.232*** –	***0.372*** –	***0.195*** –	***0.369*** –	***0.452*** –
Real uncertainty (C-GARCH) does not Granger cause inflation	***0.270*** –	***0.452*** –	***0.617*** –	***0.262*** –	***0.400*** –	***0.605*** –
Nominal uncertainty (GARCH) does not Granger cause real growth	*0.028* –	**0.061** –	**0.097** –	**0.082** –	***0.177*** –	***0.179*** +
Nominal uncertainty (T-GARCH) does not Granger cause real growth	*0.025* –	**0.057** –	**0.099** –	**0.095** –	***0.192*** –	***0.169*** +
Nominal uncertainty (C-GARCH) does not Granger cause real growth	*0.023* –	**0.058** –	***0.117*** –	***0.176*** –	***0.298*** –	***0.141*** +
Real uncertainty (GARCH) does not Granger cause real growth	***0.458*** +	***0.663*** +	***0.879*** +	***0.788*** –	***0.472*** –	***0.551*** –
Real uncertainty (T-GARCH) does not Granger cause real growth	***0.342*** +	***0.510*** +	***0.831*** +	***0.707*** +	***0.389*** –	***0.829*** –
Real uncertainty (C-GARCH) does not Granger cause real growth	***0.210*** +	***0.346*** +	***0.622*** +	***0.507*** +	***0.448*** –	***0.863*** –

Note:
Figures in normal fonts denote that the null hypothesis can be rejected at the 1% significance level.
Figures in italics denote that the null hypothesis can be rejected at the 5% significance level.
Figures in bold italics denote that the null hypothesis can be rejected at the 10% significance level.
Figures in bold underlined italics denote that the null hypothesis cannot be rejected at the 10% significance level.
Plus and minus symbols indicate the sign of the sum of the relevant estimated coefficients in the corresponding auxiliary equation.

subsample, however, there now appears to be only a negative causal relationship, mostly significant at the shorter horizons. The previous finding of positive causality at the longer end of the horizon spectrum is no longer present for the second subsample.

Our results become even clearer and most intuitive when the full sample is split at the second possible structural break, i.e. at the end of 2000. There is now strong evidence of a negative causal relationship running from inflation uncertainty to real growth during the pre-EMU period. This finding is present at all horizons up to a year and for all measures of uncertainty and is clear evidence of the classic Friedman (1977) effect which was also detected for Greece for the same period in Balfoussia and Gibson (2010), as related to the relationship between nominal uncertainty and inflation. As seen in Table 1, evidence of such an effect is perhaps the only point of any consensus in the related empirical literature – see *inter alia*, for the US, Davis and Kanago (1996) on four decades of data and Grier and Perry (2000) on an even longer dataset, Fountas, Karanasos and Kim (2002) and Fountas, Karanasos and Kim (2006) on Japan and the G7 respectively, and Kneller and Young (2001) on the OECD countries. For the second subsample, the estimated test statistics now indicate, conversely, that there is virtually no causal effect during the post-EMU period at any horizon and for any measure of uncertainty, the weak negative causality which remained in the post-1994 subsample having now also vanished. This finding is also open to an especially intuitive interpretation, arguably reflecting the fact that Greece's entry in the EMU strongly anchored inflation expectations, thus diluting any pre-existing causal relationship between nominal uncertainty and growth. Similarly, in Balfoussia and Gibson (2010) strong evidence was reported that any causal relationship between inflation and inflation uncertainty that had previously existed in the case of Greece was disrupted during the post-EMU period.

iii. The causal effect of real uncertainty on real growth

Finally, turning to the theoretical possibility of a causal relationship existing with a direction from real uncertainty to real growth, here too there seems to be some evidence of a pre- and post-EMU effect, but only at the very short horizon. Turning first to Table 3, i.e. to estimates obtained for the full sample, a significant and positive causal relationship running from real uncertainty to real growth can be seen for up to a 6-month horizon. The same effect is present for up to the 3-month horizon in the first subsample period corresponding to each of our structural breaks, i.e. in the pre-EMU period (Tables 4 and 5 respectively). Conversely there appears to be no evidence of causality whatsoever in the post-EMU period.

A glance at Table 1 reveals that the overall picture emerging from the related empirical literature is mixed, though a number of empirical papers do seem to support the presence of a positive causal effect between the two variables. The apparent restriction of our empirical finding of positive causality to the very short horizons is however somewhat difficult to decipher, in view of the fact that all theoretical arguments proposed in the literature in support of such an effect are usually thought to imply medium- to long-term effects on growth rather than very short-term ones. This is true especially of the argument proposed by Black (1987), according to which higher income variability implies an incentive for investment in riskier technologies which in turn yield higher output growth. Nonetheless, given that this appears to be a pre- and post-EMU effect, albeit at the short horizon, one may tentatively take the view that it is evidence in favour of the Miraman (1971) argument for the pre-EMU period, according to which more income variability leads to a higher savings rate for precautionary reasons and hence to a higher equilibrium rate of economic growth. Should there have been such a mechanism in place in the pre-EMU period, it is likely to have been substantially diluted following Greece's entry into

the EMU, due to the associated prevailing expectations of sustained positive and stable economic growth. Hence it seems that, in the post-EMU era, it is the business-cycle theory's implication that real uncertainty has no causal effect on growth which is corroborated by our empirical estimates.

6 SUMMARY AND CONCLUSIONS

This paper examined whether nominal and real uncertainty has impacted on growth and whether real uncertainty has impacted on inflation in Greece and, if so, in what direction. Our empirical findings appear to be intuitive, when cast against the developments in the Greek economy over the sample period (1981-2009).

For the period prior to Greece's entry to the EMU, one of high and volatile inflation rates coupled with high real uncertainty, we find strong evidence of negative causality with a direction from inflation uncertainty to real growth, supportive of the classic Friedman (1977) effect commonly reported in the empirical literature for other countries. For the EMU era, one of lower and more stable inflation, sustained strong growth and buoyant economic expectations, our findings imply, in line with economic intuition, that the presence of the ECB as a monetary policy authority created a strong anchor for inflation expectations which appears to have diluted the negative causality from inflation uncertainty to real growth previously detected. Our findings corroborate those of Balfoussia and Gibson (2010) who also report evidence of the Friedman (1977) effect for Greece prior to EMU, as related to the relationship between inflation and nominal uncertainty, an effect which also appears to have been disrupted during the post-EMU period.

Real uncertainty appears to have had a positive causal effect on the real rate of growth during the first part of our sample, possibly pointing towards the Miraman (1971) hypothesis, but no causal effect was detected during the post-EMU period, in line with the implications of business-cycle theory. This shift arguably also reflects the economic climate of reduced real uncertainty and positive expectations which prevailed following Greece's entry to the EMU. Finally, real uncertainty appears to have had no causal effect on inflation during either period.

In summary, the inflation-targeting monetary policy adhered to in preparation for and during the EMU era coupled, with Greece's substantial efforts towards fiscal consolidation and macroeconomic convergence around the turn of the century appear to have contributed not only to sharply reducing the level of inflation and achieving sustained positive growth but, moreover, to reducing real and nominal uncertainty and anchoring expectations.

Our empirical findings are particularly relevant to policy makers, as they highlight the real welfare gains to be reaped from stabilizing not only the average levels of inflation and growth but their variability as well.

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Analyzing and comparing the impact of alternative concepts of resources in distributional studies: Greece, 2004/5

Working Paper No. 111
Theodore Mitrakos and Panos Tsakloglou

The usual practice in empirical distributional studies is to use either disposable income or consumption expenditure as a proxy for welfare. Essentially, both variables are used as approximations of the unobserved "permanent income" of the population members. This paper exploits the information in the Greek Household Budget Survey of 2004/5 and constructs an indicator of "permanent income" using a latent variable approach. The distributions of disposable income, consumption expenditure and permanent income are compared regarding their level and structure of inequality and poverty. Both inequality and poverty appear to be substantially lower using the distribution of permanent income instead of either the distribution of disposable income or the distribution of consumption expenditure, while differences are also evident when decomposition analysis of inequality and poverty is employed using appropriate indices.

Bretton-Woods systems, old and new, and the rotation of exchange-rate regimes

Working Paper No. 112
Stephen G. Hall, George Hondroyiannis, P.A.V.B. Swamy and George S. Tavlas

A recent contribution to the literature argues that the present international monetary system in many ways operates like the Bretton-Woods system. Asia is the new periphery of the system and pursues an export-led development strategy based on undervalued exchange rates and accumulated foreign reserves. The United States remains the centre country, pursuing a monetary policy strategy that overlooks the exchange rate. Under both regimes the United States does not take external factors into account in conducting monetary policy while the periphery does take external factors into account. We provide results of a test of this hypothesis. Then, we present a new method for the decomposition of a seasonally adjusted series, the business cycle and other components using a time-varying-coefficient technique that allows us to test the relationship between the cycle and macroeconomic policies under both regimes.

Boosting confidence: is there a role for fiscal policy?

Working Paper No. 113
Panagiotis Konstantinou and Athanasios Tagkalakis

In view of the rapidly evolving downturn in economic activity back in 2008-9, several international organisations, like the IMF, government officials, press commentators and labour union members expressed the view that fiscal policy action was urgently needed in order to fend off the risk of a protracted recession. Several governments around the globe decided to take decisive action by means of tax cuts and spending increases with two main goals. The first was to alleviate the effects of the economic crisis on low-income households, who are the most

affected ones. The second goal was to boost both consumer and business confidence, aiming at sustaining economic activity and stabilising the financial system.

It is a widely held view that the positive effect on consumer confidence is expected to reduce the risk of increasing precautionary saving, thereby leading to higher consumer spending, which in turn will sustain domestic demand and safeguard or even boost near-term economic growth. In the same vein, improvements in business confidence are likely to lead to higher or at least sustained investment spending and employment.

The paper investigates the widely held view that expansionary fiscal policy can boost consumer and business confidence. Using quarterly data for Australia, Canada, Finland, Ireland, Japan, the Netherlands, Sweden, UK, and the US from 1970 to 2007, we find evidence in favour of this argument, i.e. cuts in direct taxes generate a positive effect on consumer and business confidence, and the same applies in cases of higher non-wage government consumption. However, a higher government wage bill reduces confidence, possibly because it entails a permanent increase in the size of the public sector, which would have to be financed by higher future taxes. In line with the standard Keynesian view, we find that an increase in government investment lowers confidence, possibly due to the crowding out effect on private investment.

Export performance, competitiveness and commodity composition

Working Paper No. 114
Panayiotis P. Athanasoglou, Constantina N. Backinezos and Evangelia A. Georgiou

The study of export performance, especially for countries with serious external imbalances, like Greece, might be crucial for the choice of policies aimed at addressing these imbalances. This paper attempts to evaluate Greek export performance during the 1996-2006 period, using detailed panel data on bilateral trade by product that represent almost 95% of total Greek exports (279 exported product categories). First, the exposure of the Greek economy to international trade and the structure of exports are studied. Second, Greek export market shares by commodity and destination market are calculated and the method of Constant Market Share Analysis is used in order to estimate the contribution of different factors in Greek exports performance. Third, the role of commodity composition of exports, their competitive position in international markets and an analysis (both static and dynamic) of the specialization pattern of Greek exports are presented. Finally, the effect of price competitiveness on export market shares is examined. Given the degree of competition in international markets, that Greece and other developed economies face, and despite the decline in export market shares, Greek export performance was rather satisfactory. A considerable change in export structure, especially their destination, was observed during this period, which had a favorable effect on Greek market shares. The redirection of Greek exports towards the markets of South-Eastern Europe and the Mediterranean and Middle East was reinforced by the high growth of these economies, their geographical proximity to Greece and the significant presence of Greek companies and financial institutions. However, trade performance was negatively influenced by commodity composition (in terms of variety and quality) and competitiveness, during the period 1996-2006, due to the underlying structure of production. Although the technological intensity of Greek exports has improved substantially during the period under review, it has not improved sufficiently. Greek exports are still,

concentrated in low and medium technology sectors, and therefore unable to exploit the trends of foreign demand.

The growth of world trade and the geographic distribution of external markets had positive influence on Greek export performance, while the effects of commodity composition and competitiveness were negative. After entry into the EMS the impact of these last two factors improved substantially. Specifically, the effect of commodity composition continued to be negative but very close to zero and that of competitiveness became positive although it remained close to zero.

The intra-industry trade index for Greece is below the EU-15 average, which means that Greek exports are characterized by low degree of differentiation. In addition, the quality of Greek exports declined compared to the quality of its competitors, even though the quality of exports towards EU-15 improved substantially during the last two years. The degree of specialization of Greek exports remained relatively high. However, it declined during the period 1996-2006, as a result of the declining specialization of exports towards South-Eastern Europe. In addition, the specialization pattern of Greek exports reflects a concentration to the negative values of the revealed preferences index. The improvement in this index observed during the 2001-2006 period is due to exports directed to South-Eastern Europe and the Mediterranean and Middle East. The results also show the stability of the Greek export specialisation pattern between 1996 and 2006 in the positive (best) intervals of the index. This indicates a rather encouraging dynamic development for Greek exports.

The long-run elasticity of price competitiveness of Greek exports, according to the panel data analysis, was relatively low, which means that the improvement in export performance through changing export prices requires a rather strong effort. In addition, the adjustment time of the short-run market shares to the long-run ones is rather long. On the other side, it seems that Greek exporting firms have some competitive power in several commodity categories (such as mechanical equipment, manufactured metallurgy products, paper and glass) and could achieve better performance by focusing on non-price factors.

Therefore, policies that support innovation, variety and quality and create a suitable environment through investment in research and development are necessary, especially in sectors where Greece already has a comparative advantage and substantial competitive power.

European sovereign bond spreads: monetary unification, market conditions and financial integration

Working Paper No. 115
Dimitris A. Georgoutsos and Petros M. Migiakis

In this paper we examine the dynamics of European sovereign bond yield spreads focusing on issues related to financial integration and market conditions. The finding of near-unit-root effects highlights the need for careful econometric specification. Thus we formulate sovereign bond yield spreads, for eleven EMU countries against the Bund for the period 1992:1-2009:12, as AR(1) processes, while allowing for regime switching effects, along the lines of a Markovian probabilistic specification. Specifically, by taking into account regime switching effects we examine, rather than assume, whether monetary unification affected sovereign bond yield spreads, allowing for states of higher and lower interactions to be revealed. Next, we examine the effects of several exogenous explanatory variables. Our results indicate that European sovereign bonds achieved only partial integration even before the recent financial crisis, while financial integration and financial stability are

found to be interconnected. Specifically, we find evidence of different effects exercised by the same deterministic factors on sovereign bond yield spreads even before the recent crisis. Additionally, it appears that a negative relation exists between low-volatility conditions and the magnitude of effects exercised by idiosyncratic risk factors on bond yield spreads.

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