



GREEK SHIPPING EARNINGS AND INVESTMENT EXPENDITURE: EXPLORING THE PRE & POST "ORDERING-FRENZY" PERIOD

Zacharias G. Bragoudakis^a, Stelios Th. Panagiotou^b, Helen A. Thanopoulou^c

^aBank of Greece, Economic Analysis and Research Department,
21, El.Venizelou Avenue, 10250 Athens, Greece.
Email: zbragoudakis@bankofgreece.gr

^bBank of Greece and University of the Aegean
School of Business Administration, Department of Shipping Trade and Transport
2a Korai Street, 82100 Chios, Greece.
Email: spanagiotou@chios.aegean.gr

^cUniversity of the Aegean, School of Business Administration
Department of Shipping Trade and Transport
2a Korai Street, 82100 Chios, Greece.
Email: hethan@aegean.gr

Abstract

The influx of shipping receipts from the world's leading fleet has been critical for the development of the Greek economy. Following the disastrous September of 2008, the range and speed of the shift in direction of the freight rates, combined with the general economic and credit climate, have had a significant impact on Greek receipts from shipping. The paper investigates both the long and short term responses of shipping flows in the Greek balance of payments on the basis of monthly data. It also assesses the change in Greek ship-owners' investment expenditure from 2006 onwards. The paper presents estimations of the impact of freight market determinants on the shipping inflows through the construction of a unique Greek shipping freight rate index. The shipping outflows are influenced by the developments in the loans outstanding and the second-hand vessels' price index. The findings provide also evidence in favour of a change in the investment expenditure of the Greek shipping companies as well as of an increasing significance of the Greek ship financing cluster after 2006.

JEL codes: C3, C5, R4.

Keywords: Shipping Earnings; Shipping Investment; Balance of Payments; Shipping Services; Dynamic OLS; Error Correction Model.

1. Introduction

Developments in international freight markets, following the culmination of the credit crunch into an open financial crisis in late 2008, have put a strain on both private and national earnings from shipping. This has motivated an assessment of the impact of these developments on maritime countries like Greece. Foreign receipts from shipping have been instrumental in limiting chronic trade and current account deficits and for supporting thus the national economy (Harlaftis et al., 2009); they are even more so currently under the European Union and the International Monetary Fund economic adjustment programme, which has been running since the 2nd of May 2010, following problems of fiscal imbalances and a lack of external trade competitiveness.

In addition to their overall contribution to the economy, Greek shipping earnings have been most significant in filling the deficit gap of the current account balance created itself mainly by chronic trade balance deficits. Shipping has served for redressing a variety of imbalances in the Greek economy since the creation of the modern Greek state (Harlaftis et al, 2009) aided, in more recent decades, by tourism and, in previous periods, by significant remittances from Greek emigrants (Thanopoulou, 1994; Bank of Greece, 2008 & 2009). However, both tourism and international shipping are by their very nature widely exposed to the vagaries of the world economic climate. Turning points in the state of the world economy and/or shipping markets are thus of direct relevance to any researcher aiming at tracing trends in the respective net contribution of either activity.

On top of the state of the markets, which is largely reflected in the long run by the level of receipts from shipping services (Bragoudakis and Panagiotou, 2007 & 2010), shipping's net contribution to the current account depends also on the goods balance resulting from transactions in ships. The Sale & Purchase (S&P) market, however, can be assumed mainly to redistribute liquidity within a ship owning community, unless patterns of investment shift homogeneously towards net sales or net purchases. Thanopoulou (1996) indicates that although there was a clear anticyclical investment pattern among a group of Greek ship-owners, homogeneity of the direction of investment was not the case in the past. The combination of the markets' rapid decline and of a peak standing orderbook by Greek ship-owners could prove critical for the volatility of the net contribution of shipping, even if second-hand acquisitions and related loan obligations are not to be taken into account.

This paper aims at modelling the impact of the crisis on the Greek net shipping balance. Explanatory variables include inter alia monthly freight rates and monthly bank loan data, the latter serving as a proxy for cash-flow pressures on shipping companies and the availability of finance. A single Greek Shipping Freight index is constructed which reflects the specialisation of the Greek owned fleet.

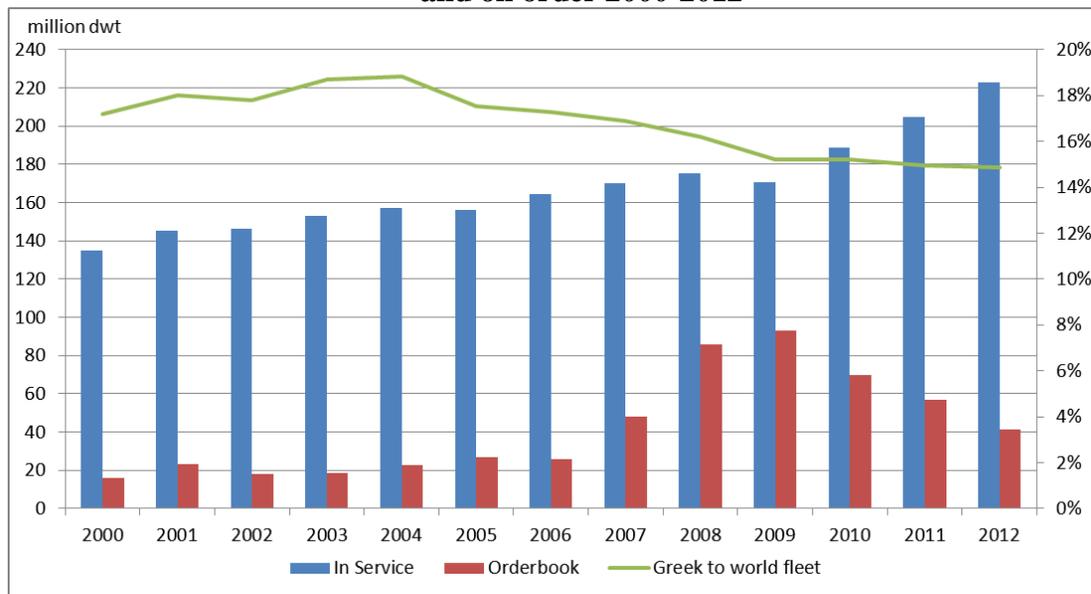
The overall approach is novel in the following aspects: a unique freight index which reflects the structure of the Greek-controlled fleet is constructed and used; it models separately inflows and, outflows of both shipping goods (i.e. sale and purchases transactions on vessels) and services (i.e. provision of shipping transportation services), which allows to distinguishing and estimating the power of the determinants of inflows and outflows separately; it technically moves a step forward by using additionally FMOLS (Fully modified OLS) and DOLS (Dynamic OLS) methods for the estimation of the long-run relationships, which are considered statistically more robust methods compare to simple OLS static method.

The paper is organized as follows: Section 2 presents the main features of freight markets and Greek shipping investment spending. Section 3 discusses some theoretical considerations about the impact on the net balance of shipping and presents the data. The data and the econometric analysis is pursued in Section 4 where methodology and techniques are discussed first and the results obtained about the impact of the main drivers on shipping inflows and outflows are also presented. In Section 5 some concluding remarks are summarized.

2. Freight markets and Greek shipping investment: cycles and reversals

Post-war Greek economic development remained sustainable mainly through the influx of foreign earnings from shipping and tourism, of direct EU transfers and through public borrowing from abroad. Reliance on shipping in this regard can be traced back to the creation of the Greek state (Harlaftis et al, 2009). At the same time, the overall contribution of shipping to the economy has been more than significant (University of Piraeus/Hellenic Chamber of Shipping, 2005). Neither the current ranking of the country in terms of international competitiveness, nor the recent decline of the former (IMD 2009) reflect in any way the leading position of Greece in post-war world shipping. Greece has continued to hold the leading place in terms of fleet ownership with practically no interruption for forty years since this was first achieved in 1969 (Hellenic Chamber of Shipping, 1996). It is too early to characterize the recent decline as a new trend (Figure 1).

Figure 1: 21st century evolution of the Greek-owned fleet in service and on order 2000-2012



Source: Greek Shipping Co-operation Committee (on the basis of LRS/Fairplay data). Ships over 1000gt in service and on order.

The influx of Greek shipping earnings allowed the continuation of a pattern of development which relied heavily on imports of goods for consumption as well as of intermediate goods. Its contribution was essential in the context of either volatile or worsening aspects of the Greek economy such as FDI internal flows or the deterioration of trade and current account balances (Christodoulakis, 2009).

Following the collapse of the financial markets in September 2008, one of the longer periods of shipping prosperity and successive records for freight rates, which had started around 2003 ended abruptly. The speed of decline in freight rates, culminating in some of the main shipping markets reaching record lows, was similar to the previous rises (Grammenos, 2012 and Strandenes, 2012). Moreover, the market reversal came at a time when the world fleet was projected to grow at record rates (Haralambides and Thanopoulou, 2014), having increased since the start of the new century by about 50% (UNCTAD 2009: 38). In shipping, the adaptation of supply, which entails either resorting to scrapping, dictated mostly by cash-flow pressures (Stopford, 2009), or to cancellations of existing orders, is slow; this makes adjustment both long and painful in times of crises. Despite a first spate of cancellations after the autumn of 2008, the orderbook at the start of 2009 was still over 40% for tankers and containerships and at over 70% for bulk carriers of the respective current fleet (Clarkson, 2009a) with no immediate prospect for returning to pre-boom levels.

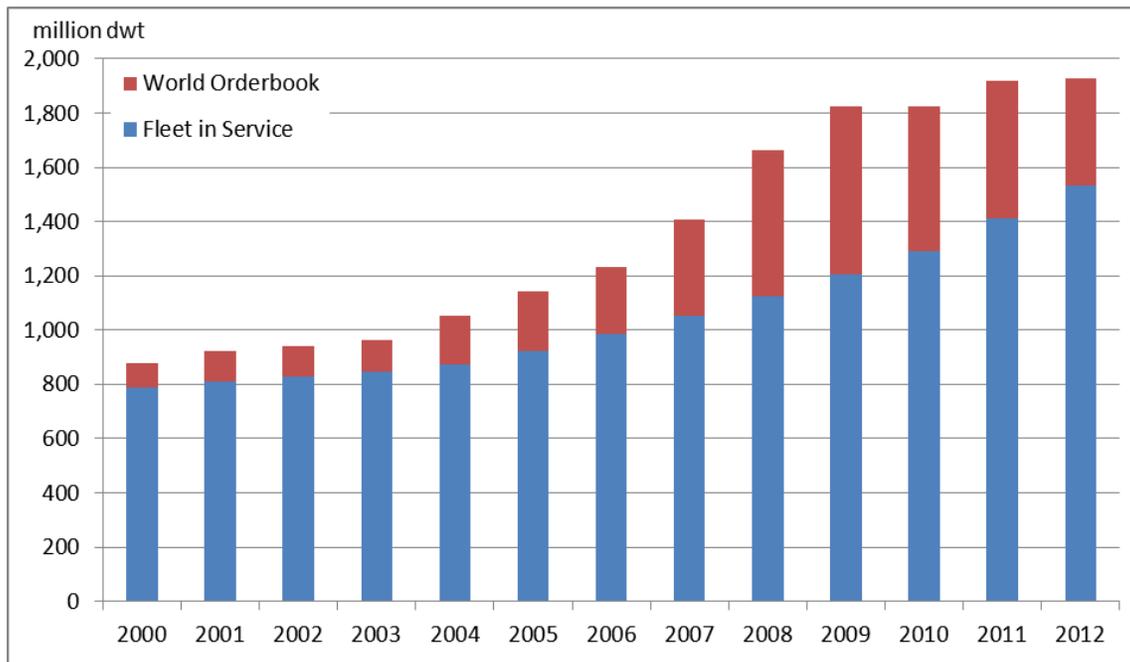
At the level of national economies, cash-flow pressures on market players were combined with weaker revenues due to falling freight rates and a significant lay-up rate. This impacted on shipping earnings, which in most instances had shown significant increases alongside freight market levels (Bank of Greece, 2008), especially when earnings are measured in dollars. This increase was also noted for Greece. For a number of shipping nations, reductions in shipping receipts could not have come at a worse time as pressures on public finances were multiplying as a consequence of the crisis.

Greek orders in the upward phase of the present cycle shared until 2006 a number of traits with the traditional anticyclical patterns of the past (Thanopoulou, 2007). Until the early 1990s, anticyclical moves in mainly the S&P market of second-hand ships led - along with a number of other factors related mainly to fleet specialization and the life of vessels - to an increase in the competitiveness of the Greek-owned fleet (Thanopoulou, 1998). The ratio of existing orders to tonnage in service in Greece rapidly converged to world levels in a number of shipping segments (Harlaftis et al, 2009). The combination of weakened revenues and the high orderbook was hardly beneficial for either the cash-flow position of companies or for net receipts from shipping related activities at the level of the Greek economy.

The short-term impact of the reversal of freight market trends became evident immediately at the level of foreign receipts from Greek shipping services. These had risen over the first seven months of 2008, by annual rates of more than 20% (Alpha Bank, 2009). By August of the same year, the first signs of strained market liquidity marked a turning point for freight rates and cancellations of new build order became noticeable (Portnews, 2008). As the financial crisis truly broke in September 2008, the rate of decline in the first seven months of 2009 was even more spectacular (Alpha Bank, 2009). At around the same time, the world's total orderbook was standing at historic highs. Indeed, even one year after the financial crisis broke, world orderbook-to-existing-fleet ratio was still near 50% (see: www.Clarksons.net data). Meanwhile, fleet to order ratios

have yet to be reduced to anywhere near their levels before the start of the market boom (Figure 2).

Figure 2: World orderbook and world fleet 2000-2012 (beginning of year)

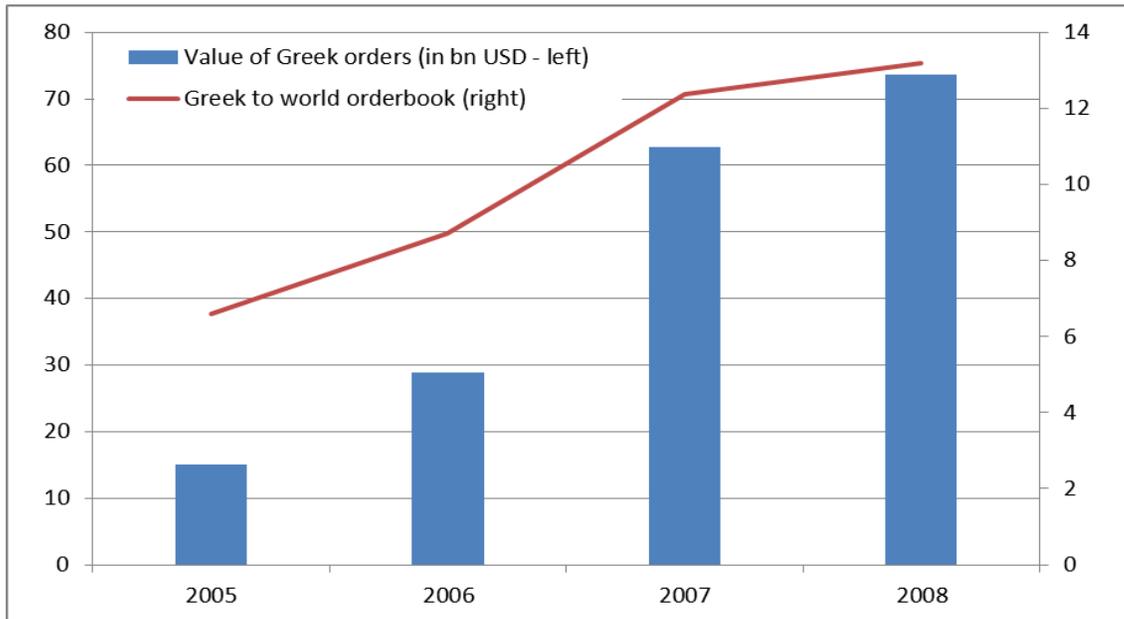


Source: Authors on the basis of www.Clarksons.net data.

In terms of the net contribution of Greek shipping to the balance of current account, outstanding orders and loan balances acquired a pivotal importance. In the very short term, as the state of the markets deteriorated rapidly, the negative impact of the decline in freight earnings was exacerbated by increased obligations resulting from direct payments to shipyards or for servicing early loan instalments. The burden of outstanding debt obligations on a per ship basis tracked the pattern of orders created in the years prior to the start of the financial crisis (Figure 3) it was highest or high for orders which had yet to be delivered or were delivered late and thus missed or shared little of the highs in the markets.

Orders placed - and loan obligations created - before that date would pose no loan-servicing problems on a ship by ship basis being either fully repaid or being left with a low ratio of outstanding debt to both projected income and asset values. Despite disparities of positions among companies due to different investment timing and exposure, the overall ratio of orders to fleet in service cannot but impair the degree of liquidity available at the level of the whole national industry, and is reflected in the development of the net contribution of shipping to the Greek current account.

Figure 3: Greek orderbook value and share in world totals



Source: Clarkson Research Services (2008). *World Shipyard Monitor*, December and calculations on the basis of data in *ibid*.

Greek shipping had for many years combined successfully a protracted period of exploitation of vessels (Thanopoulou, 1998) with a pattern of anticyclical investment in ships (Thanopoulou, 1996 and Thanopoulou, 2010) often second-hand, awaiting the turning points in markets and ship values. However, Figure 4 tells a different story for the last cycle. Developments in terms of number of vessels and of total tonnage coincided this time with a major move towards the building of new ships at a time of high ship prices. The rewards of previously placed orders have reduced the average age (based on the number of vessels) of both Greek-flagged and Greek-owned tonnage in the past few years; fleet age is now below the world average (Greek Shipping Co-operation Committee 2010). However, the result of the latest spate of orders was an increase in cash-flow pressures¹, at a time when shipping finance or re-finance has been restricted. This last point is also supported by market comments on the tight bank lending conditions worldwide for the sector (Naftika Chronika, 2010).

As the Greek shipbuilding industry is practically extinct in the area of building merchant vessels, these transactions are recorded either as payments from a bank abroad or from a bank (Greek or foreign) within Greece. Selecting variables and proxies is thus complicated. Indeed it is further complicated by the international character of the transactions and the status of Greek shipping companies which are, as a rule, legally established abroad and operate domestically as agents of an owned fleet. Loan repayments, for instance, do not have to be channelled through the Greek banking system. Despite these measurement problems, a careful analysis of shipping flows remains critical for any analysis of the Greek economy.

¹ When the financial position of companies is not adequate to face a quick downturn, the result of such cash flow pressures is distress sales (Thanopoulou, 2009), according to factors that are analogous to the ones in Grammenos, Nomicos & Papastolou (2008) on the occasion of the discussion of shipping bond defaults.

3. The impact on the net balance of shipping: Theoretical considerations and background

Greece's reliance on foreign sources of income has become increasingly stronger in the years before the sovereign debt crisis as Greece was caught between the fast growth of manufacturing in a group of cheaper competitors from outside the European Union and a time lag in the Greek economic development relative to the more developed members of the EU/OECD.

The impact of the collapse in financial markets, although quickly leading to the reversal of trends across the various shipping market segments, did not impact on each shipping market to the same extent. Since the autumn of 2008, the two largest sectors, dry bulk and tanker shipping; have been moving often in opposite directions, alternating for the prize the worst performer, while the container sector deteriorated rapidly staying, until late 2009, in deep recession. In terms of the immediate impact of the crisis, the decline was steeper and faster in the dry bulk sector; dry bulk indices lost about 90% of their peak values within about 6 months, the BDI falling from 11,793 in late May to 663 in early December 2008. Dry bulk shipping is one of the two main categories of tonnage in which Greek ship-owners have traditionally specialized along with tankers. Containerships, although not necessarily containership management, have become a non-negligible Greek owned tonnage category more recently (Thanopoulou, 2008). To increase the in-sample fitness of the model, pre-assigned weights are used in this paper to transform representative freight sub-indices covering different market segments into a weighted average, called the Greek Shipping Freight index. Weights for calculating the composite index reflect the proportion of the respective categories of ships in the Greek-owned fleet over time (for further details see Appendix II).

The relative short sample (from January 2002 to June 2012) over which the model estimated, combined with the also relative stability of the tonnage in service (see also Figure 1) over this period, and the (compensating for fleet growth) lay-up, allowed excluding the size of fleet from the explanatory variables. According to the IMF 5th Manual for the Balance of Payments (IMF, 1995), transactions in ships should be recorded in the goods' balance, while transactions in shipping services should be recorded in the services' balance. However, in this paper, we have constructed a 'hybrid' shipping balance. Specifically, we consider the following segmentation:

1. Total Shipping Inflows (TSI) = exports of ships (sales) + Receipts from Sea Transport Services
2. Total Shipping Outflows (TSO) = imports of ships (purchases) + Payments for Sea Transport Services

Due to the fact that TSI are dominated by the receipts of shipping revenues received for the provision of cross-trade shipping services, it is assumed that - in the long-run - TSI depends predominately on the freight rates that the Greek-owned fleet earns. It also depends on the inflows to service loans provided by domestic bank branches through the

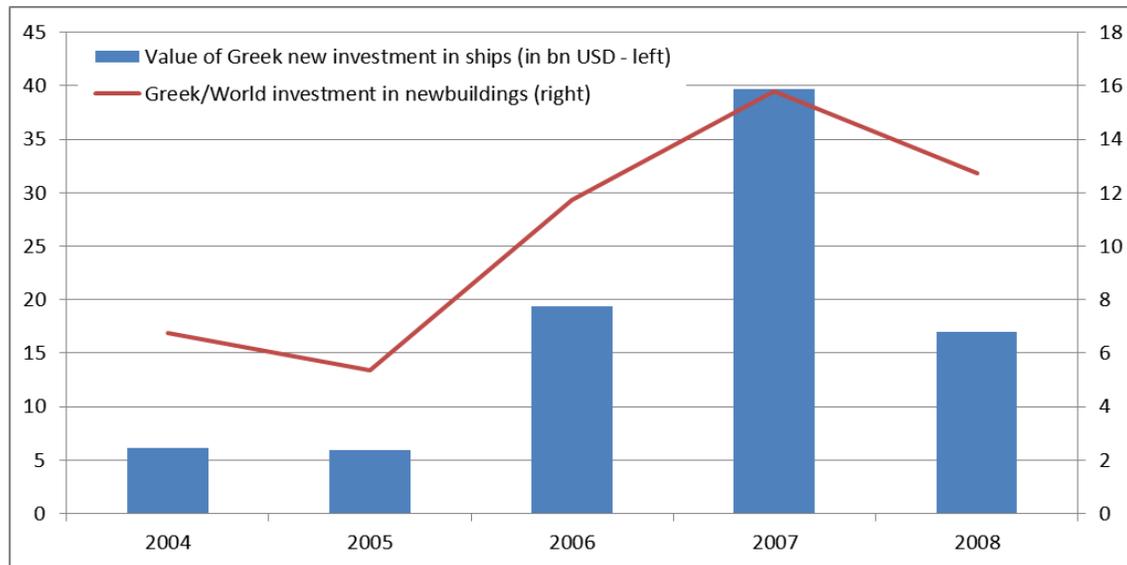
use of Greek-based operating accounts, depicted both by the outstanding loans to shipping companies and the second hand vessel price index².

By contrast, as the percentage of the Greek goods export trade is less than 0.1% of the global trade, the structure of the Greek TSO are dominated by the capital outflows for the purchase of second-hand vessels or the construction of new ones. Therefore, it is assumed that the prices of vessels (second-hand or new) as well as outstanding loans should play an important role in determining TSO.

From the above discussion it becomes apparent that the power of the driving forces behind TSI and TSO could be different and any attempt to estimate a one single equation for a hybrid net balance³ would not be appropriate from econometrical point of view.

The other element of interest is to pinpoint the turning point for Greek investment in vessels as recorded in the Balance of Payments. The way to account for the observed change of behaviour is through splitting the period under discussion – in the short-term analysis – into two distinctive sub-periods. The first sub-period runs from 2002 to 2005, while the second from 2006 until 2012. The year of 2006 as the cut-off year was selected taking into account the statistical analysis of the new building activity of Greek shipping companies as can be seen in Figure 4.

Figure 4: Ratio of Greek to world investment in new ships 2004-2007



Source: Data and calculations from data in Clarkson Research (2008). World Shipyard Monitor.

² One should also expect that the exchange rate would have a short-term effect through Euro denominated operating expenses of the Greek domiciled shipping companies.

³ Hybrid Net Shipping balance = Total Shipping Inflows– Total Shipping Outflows.

Effectively, in our econometric approach we estimate two static long-run relationships, one for the TSI and the correspondence one for the TSO. Then for each long-run equation, we estimate three dynamic short-run equations, one for the whole period (Jan.2002-June 2012) and the two sub-periods; the first one corresponding to the period (Jan.2002-Dec.2005), when there was limited second-hand and new-building investment activity, while the second sub-period (Jan.2006-June 2012) covers the ordering frenzy and the subsequent economic crisis.

4. Econometric methodology and empirical results

4.1 Data

The data are monthly and covers the period from January 2002 to June 2012. The monthly balance of payments data are from the Bank of Greece. The data includes the exports (sales) and imports (purchases) of ships as well as the receipts from and payments for sea transportation services⁴. The data were subsequently expressed in USD terms by the use of the monthly average exchange rate as published by the European Central Bank. The exchange rate between dollar and euro (EXR) is collected from the European Central Bank. The Greek Shipping Freight rate index (IND) is compiled from freight rate data collected from the Clarkson Research Services database and fleet structure data provided by the Greek Shipping Co-operation Committee.

A detailed account of the methodology on the compilation of the index is provided in the Appendix II. End of month outstanding loan data (LS) are published by the Bank of Greece; the data represent the loans that the Greek Banking system⁵ has provided to Greek shipping companies. These data were expressed in USD as in the case of the balance of payments data. Finally, the second-hand vessels' price index (SHV) was based on the Clarkson Research Services monthly data.

4.2 Econometric methodology

The specification of the long-run equation is an extension of the previous work by Tambakis (1984), Haralambides (1986) which investigated the determinants of the shipping foreign exchange inflows as well as Bragoudakis & Panagiotou (2010).

At first stage, the time series properties of all the variables are initially evaluated employing the Augmented Dickey-Fuller (1979) and DF-GLS (Elliot, 1996) unit-root tests. More specifically, we examined the rank of integration $I(d)$ for the series of the TSI, TSO, IND, LS, EXR and SHV.

At second stage, an error correction model (ECM) in 2-steps proposed by Engle-Granger (1987) was employed in order to investigate the structure of the shipping balance in terms of inflows and outflows in the context of a 'hybrid' shipping balance.

⁴ The data, which are compiled by the Bank of Greece Statistics Department, are the aggregation of the Greek shipping companies' individual transactions that are facilitated by the domestic banking system (both Greek and foreign banks).

⁵ The financial institutions that are based in Greece and record their shipping loans in the Greek branches.

In the first step of second stage, under the theoretical framework of the ‘hybrid’ shipping balance the existence of two long-run separate relationships was tested. Two cointegration relationships between IND, LS, SHV, EXR and TSI on the one hand and between LS, SHV, and TSO on the other hand are investigated. All series have been logarithmic transformed.

The specification of the long run relationship for shipping inflows (TSI) can be written as follows:

$$\ln(\text{TSI})_t = \mu + \alpha_1 * \ln(\text{IND})_t + \alpha_2 * \ln(\text{LS})_t + \alpha_3 * \ln(\text{SHV})_t + \alpha_4 * \ln(\text{EXR})_t + d1_t \quad (1)$$

which implies that in the long-run it is assumed that the endogenous variable of shipping inflows (TSI) is determined by the exogenous variables of the freight index (IND), the outstanding loans (LS), the second hand vessels’ prices (SHV) and the exchange rate (EXR). The corresponding specification of the long run relationship for shipping outflows (TSO) can be also written as follows:

$$\ln(\text{TSO})_t = \nu + \beta_1 * \ln(\text{LS})_t + \beta_2 * \ln(\text{SHV})_t + d2_t \quad (2)$$

which respectively implies that in the long-run the endogenous variable of shipping outflows (TSO) is determined only by the outstanding loans (LS) and the second hand vessels’ prices (SHV).

If IND, LS, SHV, EXR and TSI are $I(1)$ and $d1_t \sim I(0)$, the series would be cointegrated. Similarly, if LS, SHV and TSO are $I(1)$ and $d2_t \sim I(0)$, the series would be also cointegrated. The terms of μ and ν are the constant parameters, while the parameters of $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ and β_1, β_2 denote the long-run elasticities of (1) and (2). The terms of $d1_t$ and $d2_t$ are respectively the long-run residuals.

Estimating (1) and (2) using static OLS method achieves a consistent estimate of the long-run steady state relationships between the variables and 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.

This paper technically moves a step forward by using additionally FMOLS (Fully modified OLS) and DOLS (Dynamic OLS) methods for the estimation of the long-run relationships (1) and (2). FMOLS and DOLS are considered statistically more robust methods compare to simple OLS static method. According to Phillips and Hansen (1990), the resulting Fully Modified OLS (FMOLS) estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic χ^2 statistical inference. Furthermore, Saikkonen (1992) and Stock and Watson (1993) propose the Dynamic OLS (DOLS) method, which specifies the cointegrating regression with lags and leads resulting orthogonal cointegrating error term to the entire history of the stochastic regressor innovation. The criterion of residual sum of squares (RSS) was employed to assess the estimating results of the above three alternative methods. Finally, the method which provides the lower value of RSS is

selected as the best. Consequently, the residuals provided from the best method are employed to test for the existence of cointegration.

To test the null hypothesis of no cointegration the well-known Engle-Granger (1987) and Phillips-Ouliaris (1990) cointegration tests were employed. The estimated long-run relationships (1) and (2) by using the selected one cointegration method provide results of the following disequilibrium vectors:

$$d1_{t-1} = \ln(TSI)_{t-1} - \mu - \alpha_1 * \ln(IND)_{t-1} - \alpha_2 * \log(LS)_{t-1} - \alpha_3 * \ln(SHV)_{t-1} - \alpha_4 * \ln(EXR)_{t-1}$$

$$d2_{t-1} = \ln(TSO)_{t-1} - \nu - \beta_1 * \ln(LS)_{t-1} - \beta_2 * \ln(SHV)_{t-1}$$

In the second step of second stage, we estimate the two correspondence error correction models (ECM) by using the disequilibrium vectors $d1_t$ and $d2_t$. The ECM framework allows for capturing any short-run dynamics and also measuring the speed of adjustment to equilibrium of the endogenous variables TSI and TSO.

The specifications of the ECM for the TSI and TSO can be written in a general form as:

$$\begin{aligned} \Delta \ln(TSI)_t = & \delta_0 + \alpha_{1,i} * \sum_{i=1}^{k1} \Delta \ln(TSI)_{t-i} + \alpha_{2,i} * \sum_{i=0}^{k2} \Delta \ln(IND)_{t-i} + \\ & \alpha_{3,i} * \sum_{i=0}^{k3} \Delta \ln(LS)_{t-i} + \alpha_{4,i} * \sum_{i=0}^{k4} \Delta \ln(SHV)_{t-i} + \alpha_{5,i} * \sum_{i=0}^{k5} \Delta \ln(EXR)_{t-i} + \gamma_1 * d1_{t-1} + \varepsilon_{1t} \end{aligned} \quad (3)$$

and

$$\begin{aligned} \Delta \ln(TSO)_t = & \theta_0 + \beta_{1,i} * \sum_{i=1}^{k1} \Delta \ln(TSO)_{t-i} + \beta_{2,i} * \sum_{i=0}^{k2} \Delta \ln(IND)_{t-i} + \\ & \beta_{3,i} * \sum_{i=0}^{k3} \Delta \ln(LS)_{t-i} + \beta_{4,i} * \sum_{i=0}^{k4} \Delta \ln(SHV)_{t-i} + \beta_{5,i} * \sum_{i=0}^{k5} \Delta \ln(EXR)_{t-i} + \gamma_2 * d2_{t-1} + \varepsilon_{2t} \end{aligned} \quad (4)$$

where Δ denotes first differences in logarithms and $\varepsilon_{1t}, \varepsilon_{2t} \sim N(0, \sigma^2)$. The $k1, k2 \dots k5$, in the two equations denote the maximum lag lengths of each explanatory variable. Dummies have been also added in the models (3) and (4) to capture any impulse disturbance of the endogenous series. It should be noted that the Hendry –type ‘general - to –specific’ procedure is used to reduce the ECM to its parsimonious form.

The estimation period covers the period from January.2002 to June 2012 on monthly basis, but additionally we have split the sample in two sub-periods in order to have a more analytically investigation of the shipping companies’ investing expenditure before and after 2006. In other words, we try to estimate the impact of the change in Greek ship-owners’ investment spending from 2006 onwards. In addition, the split of the full sample before and after 2006 goal to give answer to what extent the Greek shipping finance cluster started to play a substantial role in financing shipping companies during the

second part of the sample. Finally, the well-known Chow break point test also suggests the split of the full sample before and after 2006 as mentioned in detail (in footnote 6) at sub-section 4.3.

4.3 Empirical results

The hypothesis of a unit root in the logarithmic levels of the series cannot be rejected. By contrast, the hypothesis of a unit root in the first differences is rejected in all cases in favour of the alternative of stationarity. This finding suggests that all employed series are I(1). In Table 1, we present the results of the unit root tests.

Table 1: ADF and DF-GLS unit-root tests

| ADF Statistics | log(TSI) | $\Delta\log(\text{TSI})$ | log(TSO) | $\Delta\log(\text{TSO})$ | log(IND) | $\Delta\log(\text{IND})$ | log(LS) | $\Delta\log(\text{LS})$ | log(EXR) | $\Delta\log(\text{EXR})$ | log(SHV) | $\Delta\log(\text{SHV})$ |
|---------------------|----------|--------------------------|----------|--------------------------|----------|--------------------------|---------|-------------------------|----------|--------------------------|----------|--------------------------|
| Intercept | -2.180 | -16.391* | -1.863 | -11.860* | -2.400 | -9.560* | -0.747 | -10.975* | -1.345 | -9.252* | -1.025 | -6.886* |
| Lags | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Trend and Intercept | -1.496 | -16.550* | -1.432 | -12.016* | -2.445 | -9.533* | -2.245 | -10.947* | -2.227 | -9.219* | -0.235 | -7.092* |
| Lags | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| None | 0.951 | -16.344* | 0.798 | -11.824* | -0.290 | -9.539* | 2.975 | -10.413* | -0.735 | -9.276* | -0.169 | -6.91* |
| Lags | 1 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| | | | | | | | | | | | | |
| DF-GLS Statistics | log(TSI) | $\Delta\log(\text{TSI})$ | log(TSO) | $\Delta\log(\text{TSO})$ | log(IND) | $\Delta\log(\text{IND})$ | log(LS) | $\Delta\log(\text{LS})$ | log(EXR) | $\Delta\log(\text{EXR})$ | log(SHV) | $\Delta\log(\text{SHV})$ |
| Intercept | -0.235 | -16.447 | -0.124 | -0.972 | -1.724 | -7.601 | 1.541 | -10.132 | -1.313 | -3.183 | -0.917 | -6.902 |
| Lags | 0 | 0 | 2 | 5 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 0 |
| Trend and Intercept | -1.126 | -16.445* | -1.294 | -3.317* | -1.995 | -9.108* | -1.920 | -10.239* | -1.678 | -7.683* | -0.628 | -6.974* |
| Lags | 1 | 0 | 1 | 3 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |

** Denotes rejection of the null hypothesis for the 5% significance. Critical values being provided by MacKinnon (1996) and Elliott-Rothenberg-Stock (1996). The selected lag length for no serial correlation of the ADF residuals based on Swartz Information Criterion.

The long-run estimation refers to the total sample from Jan.2002 to Jun.2012 and the results of the three competitive cointegration methods are presented in Table 2. The empirical finding which arises from the results of the Table 2 is that the long-run estimation method of DOLS performs better than those of OLS and FMOLS. The value of RSS in (1) and (2) is much lower using DOLS ($RSS_{\text{TSI}}=0.874$, $RSS_{\text{TSO}}=2.918$) compare to OLS ($RSS_{\text{TSI}}=1.002$, $RSS_{\text{TSO}}=2.987$ and FMOLS ($RSS_{\text{TSI}}=1.016$, $S_{\text{TSO}}=3.048$). Hence, the results presented in Table 2 provide evidence in favour of DOLS method. Consequently, the residuals provided from DOLS method are employed to test for the existence of cointegration. It is worth noting that the estimated parameters among three methods are very close implying the well-specification of the models.

Table 2: Long-run estimations

| Endogenous Variables | ln(TSI) _t | | | ln(TSO) _t | | |
|---|----------------------|---------------------|---------------------|------------------------|-----------------------|-----------------------|
| Sample Jan.2002-Jun.2012 | | | | | | |
| Long-run regression methods (HAC standard errors & covariance) | OLS | FMOLS | DOLS | OLS | FMOLS | DOLS |
| Explanatory Variables | | | | | | |
| Constant | 1.142** (1.943) | 1.402*** (2.978) | 1.291** (2.294) | -4.940*** (-17.943) | -5.075*** (-9.189) | -4.952*** (-8.904) |
| ln(IND) _t | 0.208*** (4.807) | 0.212*** (5.608) | 0.238*** (5.634) | | | |
| ln(LS) _t | 0.219*** (4.945) | 0.218*** (5.767) | 0.222*** (5.717) | 0.433*** (9.025) | 0.463*** (10.575) | 0.442*** (9.557) |
| ln(SHV) _t | 0.526*** (5.718) | 0.474*** (6.897) | 0.462*** (4.548) | 1.443*** (13.791) | 1.413*** (13.567) | 1.429*** (13.504) |
| ln(EXR) _t | 0.839*** (3.954) | 0.876*** (4.691) | 0.864*** (4.614) | | | |
| Adjusted R ² | 0.940 | 0.940 | 0.946 | 0.916 | 0.915 | 0.917 |
| RSS | 1.002 | 1.016 | 0.874 | 2.987 | 3.048 | 2.918 |
| S.E. of regression | 0.091 | 0.091 | 0.086 | 0.155 | 0.157 | 0.155 |

Notes: The number in parentheses are the t-statistics.

*** indicate significance at the 1% level. Critical values being provided by MacKinnon (1996).

** indicate significance at the 5% level. Critical values being provided by MacKinnon (1996).

* indicate significance at the 10% level. Critical values being provided by MacKinnon (1996).

In Table 3 (Appendix I), we present a suite of alternative ways to test for the existence of cointegration for the long run relationships (1) and (2). The standard ADF (1979) and DF-GLS (1996) unit-root tests provide evidence in favour of stationarity of the long-run residuals of TSI and TSO which means that $d1_t \sim I(0)$ and $d2_t \sim I(0)$, indicating that the corresponding series are cointegrated. These findings are also strongly supported by the results of the complementary residual based Engle-Granger (1987) and Phillips-Ouliaris (1990) cointegration tests.

As it has been noted earlier, the estimated parameters of (1) and (2) are much closed across the three alternative cointegration methods indicating the robustness of the models. Nevertheless, DOLS method was selected as the most robust method and the results of this method are presented in Table 2. The cointegration tests are summarised in Table 3 based on DOLS method of estimation.

Finally, the parsimonious ECM estimation for the short-run dynamics of shipping inflows (TSI) and outflows (TSO) which allows both of capturing any short-run fluctuations and obtaining information on the speed of adjustment to equilibrium are presented analytically in Table 4 and Table 5 (Appendix I).

4.3.1 Shipping inflows

The long-run elasticities of the shipping inflows (TSI) based on DOLS (see Table 2) are presented by the following equation:

$$\ln(\text{TSI})_t = 1.29 + 0.23 \cdot \ln(\text{IND})_t + 0.22 \cdot \ln(\text{LS})_t + 0.46 \cdot \ln(\text{SHV})_t + 0.86 \cdot \ln(\text{EXR})_t \quad (5)$$

(2.29) (5.63) (5.71) (4.54) (4.61)

$R^2_{\text{adjusted}} = 0.94$, $\text{RSS}_{\text{TSI}} = 0.87$, t-statistics numbers in parenthesis.

It is clear from (5) that all explanatory variables (freight index, outstanding loans and second-hand vessels' prices and exchange rate) are statistically significant and - as expected - they have positive signs. More specifically, the results indicate a partial pass-through rate of 0.23 for the freight index, which means that a 10% increase in index leads to 2.3% increase in the inflows. In the case of the outstanding loans, the pass-through rate is estimated at 0.22, meaning that a 10% rise in outstanding loans tends to increase the shipping inflows by 2.2%. The significance of outstanding loans can be explained by the fact that when ship-owners receive a loan from a bank they are also required to open an operating account for the financed vessel in the same bank, and perform all the vessel's trading transactions (including freight receipts) through this account. The amount of the outstanding loans can be deemed as a proxy for the increase of the Greek shipping cluster and its impact on the shipping inflows. Although the amount of outstanding loans relates to advancements and decisions taken place in previous period, it also indicates the amount of loans that have been provided by the domestic banking system through the Greek-based branches. Finally, the pass-through rate of the prices of second-hand vessels to the shipping inflows amounts to 0.46%, meaning that a 10% change in the vessels' price correspond to 4.6% respective change in the inflows.

Regarding the short-run shipping inflows TSI dynamics from the results of Table 4 (Appendix I) and looking the total sample (Jan.2002-June 2012), it becomes apparent that the shipping freight index with one month time lag affects the amount of the shipping inflows by 0.14% in terms of growth rate.

The short-run elasticity of $\alpha_2=0.14$ 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 growth rate. Effectively, the modalities of freight collection imply that any payments will be recorded in the Greek balance of payment (BoP) on average about a month later, which is in accordance with the shipping practice. The one month lag is in-line with the time duration required from the finalisation of the charter-party agreement until the payment of freight in the shipping company's account. Specifically, the modalities of paying and collecting freight imply that any payments will be reflected in the Greek balance of payments on average about a month later, although, as ship-broking sources confirmed, the practice varies by market according to tonnage category. In the case of outstanding loans to shipping, the short-run elasticity is estimated at $\alpha_3=0.16$, implying that a 10% increase in growth rate of

outstanding loans leads to 1.6% 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 the entire vessel's trading transactions (including freight receipts) through this account. Furthermore, the second-hand vessels' price index (SHV) was based on the Clarkson Research Services monthly data seems to play an important role to shipping inflows. The elasticity of $\alpha_4=0.70$ represents a substantial impact of the short-dynamic effect of the second-hand vessels' price index on shipping receipts. In addition, the exchange rate of the current month affects the short-term decision of the company for transferring funds to Greece. The positive sign of this coefficient $\alpha_5=1.45$ indicates that when the USD depreciates against the euro then the inflows in USD terms increase as well (see also Haralambides, 1986). Although, we should have expected the coefficient to be close to unity, it is quite higher, indicating the overshooting behaviour of the Greek Shipping companies. The overshooting behaviour underlines the fact that when the USD depreciates by 10%, the shipping companies increase by 14.5% the amount of USD they transfer in Greek banking accounts. Finally, the latter finding can explain the negative coefficients of the shipping inflows with three month time lag, which shall indicate the corrective actions that the companies may undertake in order to balance their overshooting behaviour. The error correction term coefficient is $\gamma_1=-0.61$ and reveals that the speed of adjustment to the equilibrium steady state is relatively quick, in the sense that the system needs less than two months to reach the equilibrium level.

In the first sub-period⁶ (Jan.2002-Dec.2005), the exchange rate and the ClarkSea index, the second-hand vessels' price index (at one month time lag) are statistically significant but the series of the outstanding loans does not seem to play any important role. However, in the second period (Jan.2006-June 2012), the series of outstanding loans is statistically significant and seems to have a substantial role on shipping receipts developments. Generally, the profile of the rest explanatory variables in terms of statistical significance is much better at the second period.

The above findings may indicate the gradual importance that the Greek shipping finance cluster started to play in financing shipping companies during the second part of the decade, from 2006 onwards, which resulted in the increasing importance of all variables in the short-term equation.

It should be noted that the estimated short-run shipping inflows dynamic equation (see Table 4) is characterized by relative good fitness and passes all diagnostics χ^2 tests for the hypotheses that there is no serial correlation and autoregressive conditional heteroscedasticity; that the residuals follow the normal distribution; and finally that the equation is well specified.

⁶ We carried out Chow test across two regimes before and after 2006. In particular, we specified two subsamples, one from Jan.2002 to Dec.2005 and one from Jan2006 to Jun2012. It is clear from equations (5) and (6) that the Chow breakpoint test rejects the null hypothesis of no breaks at 2006 suggesting that 2006 is indeed a break point year and indicating that the coefficients are not stable across regimes. The results of Chow test of the long-run shipping inflows [TSI equation (5), p-value $\chi^2(5) = 0.0008$] and outflows [TSO equation (6), p-value $\chi^2(3) = 0.0001$] indicate 2006 as break point.

One remaining problem concerns the stability of the estimated parameters of model (3) due to the relatively small estimation period when the sample divided in pre and post 2006. For this reason, the CUSUM and CUSUM Square tests were applied to the sub-periods Jan.2002-Dec.2005 and Jan.2006-June 2012.

As Figure 5 (Appendix I) shows, the null hypothesis of the parameter stability over the sub-periods cannot be rejected at the 5% significance level.

4.3.2. Shipping outflows

On the other side, the long-run run elasticities of the shipping outflows equation (TSO) based on DOLS (see Table 2) are the following:

$$\ln(\text{TSO})_t = -4.95 + 0.44 \cdot \ln(\text{LS})_t + 1.42 \cdot \ln(\text{SHV})_t \quad (6)$$

(-8.90) (9.55) (13.50)

$R^2_{\text{adjusted}} = 0.91$, $\text{RSS}_{\text{TSO}} = 2.91$, t-statistics numbers in parenthesis.

As Greek export trade is relatively small, the outflows for the purchase of second-hand vessels or new ones dominate the shipping outflows. Thus, the latter depends on the index of second-hand vessels price and the provision of loan funds. The pass through rate of the outstanding loans to the shipping outflows accounts for 0.44, meaning that a 10% increase in loan stock leads to 4.44% increase in the shipping outflows. Finally, the impact of the second-hand vessels' price index on the shipping inflows is much higher from 1, which means that a 10% increase in the second-hand vessels' price leads to a substantial increase (14.2%) in the outflows.

In the short-run, we estimate correspondingly an error correction model (ECM) using the estimates of disequilibrium with one lag ($d2_{t-1}$) to obtain information on the speed of adjustment to equilibrium of TSO. Regarding the short-run shipping inflows (TSO) dynamics at the whole period (Jan.2002-June 2012), the results from Table 5 (Appendix I) indicate the significance of the contemporaneous impact of the outstanding loans and the second-hand vessels' index as well as, the important role of the Greek Shipping Freight index.

Specifically, the outstanding loans have a contemporaneous effect on the outflows $\beta_3=0.35$, in accordance with the fact than any additional loan funds are destined for the purchase of new vessels. The short-run elasticity of $\beta_2=0.23$ which represents the short-dynamic impact of the ClarkSea index on shipping outflows, measures the effect of the one-month lagged value of the freight index on the shipping outflows growth rate. The short-run elasticity of the price index of the second hand vessels is estimated at $\beta_4=0.80$ but it is statistically significant only at 10% level. The exchange rate of the current month affects the short-term decision of the company for transferring funds out from Greece. The positive sign of this coefficient $\beta_5=1.09$ indicates that when the USD depreciates against the euro then the outflows in USD terms increase. The error correction term coefficient is $\gamma_2=-0.27$ and reveals that the speed of adjustment to the equilibrium steady

state is relatively slow which means that the system need almost four months to reach the equilibrium level.

The estimated short-run shipping outflows dynamic equation (see Table 5) is characterized by relative good fitness and passes all diagnostics χ^2 tests. When the same equation is estimated for the first sub-period Jan.2002-Dec.2005, the second-hand vessels' price index becomes insignificant, indicating at that time in the short-term Greek ship-owners did not follow trends in the second-hand market for that period. On the other hand, the coefficient of the outstanding loans $\beta_3=1.03$ seems to play an important role on this period. For the second sub-period (Jan.2006-Jun.2012), it is apparent that a pro-cyclical investment frenzy plagued the Greek shipping community. The coefficient on the prices of second-hand vessels becomes very significant and reaches to $\beta_4= 1.73$, implying that a 10% increase in the prices of vessels leads to an increase in outflows of 17.3% in the short-term and finally the explanatory power of the outstanding loans decreases compare to the whole period impact.

All estimated equations reveal relative good fitness and pass all diagnostic χ^2 tests for the hypotheses that there is no serial correlation and autoregressive conditional heteroscedasticity; that the residuals follow the normal distribution; and finally that the equations are well specified. The CUSUM and CUSUM Square test for the stability of the estimated parameters of model (4) was applied to the sub-periods Jan.2000-Dec.2005 and Jan.2006-Jun.2012.

As Figure 6 (Appendix I) shows, the null hypothesis of the parameter stability over the sub-periods cannot be rejected at the 5% significance level.

5. Conclusions

With the beginning of 2010, Greece was heading for the next chapter of an economic and sovereign debt crisis having broken the provisions of the European Growth and Stability Pact. This led to a series of emergency measures imposed on the economy and the initiation of strict monitoring procedures. Under the pressure of these aggravated circumstances, any progress towards a better understanding of the net contribution of shipping to the current account balance is consider very useful. At a time when the overall situation in the market for freight remains volatile, it is not easy to predict trend reversals in shipping's net contribution. The short-run empirical results derived here are thus a contribution in themselves.

The paper by employing FMOLS (Fully modified OLS) and DOLS (Dynamic OLS) methods for the estimation of the long-run relationships for inflows and outflows, which are more robust compared to simple OLS static, moves technically a step forward.

The econometric analysis suggests that the shipping inflows – in the long run - are determined mainly by developments in the freight market, the amount of outstanding loans and the value of second-hand vessels, while the shipping outflows only by the two latter variables.

A striking finding relates to the change in the investment spending of the Greek shipping companies after 2006. Normally, there should be some negative correlation between the price index for ships and the shipping outflows, if the Greek anti-cyclical pattern observed in earlier periods had prevailed.

Finally, the fact that the importance of the stock of loans turned out to be more significant in the period after 2006 could be an indication of the gradually increasing importance that the Greek shipping finance cluster started to play in financing shipping companies.

Acknowledgements

The authors would like to thank H. Gibson and G. Zombanakis for their useful comments and Capt. N. Pentheroudakis for valuable insights on freight collection.

References

- Alpha Bank (2009). Economic Bulletin (in Greek), October 2009, no 110.
- Bank of Greece (2008). Monetary Policy – Interim Report, (October 2008) – Box VI.1, 115.
- Bank of Greece (2009). Annual Report of the Bank of Greece for year 2008 – Box I.X 1, 148.
- Bank of Greece (2010). Monetary Policy – Annual Report, (March 2010) – Special Issue 2E, 147-151.
- Bragoudakis Z. and Panagiotou S. (2007). The relationship between freight rates and the Balance of Payments Receipts from shipping services: The case of Greece – Paper presented at IAME 2007.
- Bragoudakis, Z. and Panagiotou, S. (2010). Determinants of the receipts from shipping services: The case of Greece. Economic Bulletin, Bank of Greece, Economic Analysis and Research Department, September 2010, 34, 43-58.
- Christodoulakis, N. (2009). Ten Years of EMU: convergence, divergence and new policy priorities. GreekSE Paper No 22, Hellenic Observatory Papers on Greece and Southeast Europe London School of Economics.
- Clarkson Research Services (2008). World ShipOwner Orderbook Monitor, 15, (7).
- Clarkson Research Services (2009a). Sources & Methods for the Shipping Intelligence Weekly (updated May 2009).
- Clarkson Research Services (2009b). Shipping Intelligence Weekly, January 16.
- Clarkson Research Services (2010a), Shipping Intelligence Weekly, February 12.
- Clarkson Research Services (2010b). World ShipOwner Orderbook Monitor, 15(7).
- Clarkson Research Services – Shipping Intelligence Network at www.Clarksons.net.
- Dickey, D.A, and Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a unit root. *Econometrica*, 49, 1057-1072.
- Elliott, G., Rothenberg, T. and Stock, J. (1996) Efficient tests for an autoregressive unit root, *Econometrica*, 64, 813–36.
- Engle, R. and Granger, C. (1987) Cointegration and error-correction: representation, estimation and testing, *Econometrica*, 55, 251–76.
- Filippaios, F. and Tzioumis, K. (2008). FDI in Greece and Greek FDI. Presentation at Hellenic Observatory Seminar Series, London School of Economics, February 12, 2008.
- Grammenos, C.Th., Nomikos, N.K. and Papapostolou, N.C. (2008) Estimating the probability of default for shipping high yield bond issues. *Transportation Research Part E: Logistics and Transportation Review*. Vol.44, Issue 6, November 2008, 1123-1138
- Greek Shipping Co-operation Committee (2010). Greek Controlled shipping. An information paper based on data provided to the GSCC by Lloyd’s Register of Shipping – Fairplay.
- Haralambides, H (1986). Shipping and Economic development, Center for Planning & Economic Research, Report No 30.
- Haralambides, H. E., and Thanopoulou, H. (2014). The Economic Crisis of 2008 and World Shipping: Unheeded Warnings. *SPOUDAI-Journal of Economics and Business*, 64(2), 5-13.
- Harris, R., (1997). Using Cointegration Analysis in Econometric Modeling, Prentice Hall.

- Harlaftis, G., Thanopoulou, H. and Theotokas I. (2009). The present and the future of Greek Merchant Shipping, Study: Number 10, Athens: Academy of Athens.
- IMD (2009). World Competitiveness Yearbook.
- IMF (1995). Balance of payments compilation guide - Washington, DC, USA, International Monetary Fund.
- IMF (1996). Balance of payments textbook - Washington, DC, USA, International Monetary Fund.
- Naftika Chronika (2010). February 2010.
- OECD (1994). Reviews of foreign direct investment, Paris: OECD.
- OECD (2007). International investment perspectives, Paris: OECD.
- Panagiotou, St. and Bragoudakis, Z. (2010). Maritime Transportation & Ocean-going shipping, Bank of Greece Special Edition "The Greek Current Account: Causes for imbalances and policy suggestions", July 2010, Ch.2.5, pp. 221-234.
- Phillips, P. and S. Ouliaris (1990): Asymptotic Properties of Residual Based Tests for Cointegration. *Econometrica* 58, 165–193.
- Portnews, <http://en.portnews.ru/news/11823/>[accessed: 18 February 2010.]
- Schwarz, G. (1978), Estimating the Dimension of a Model, *Annals of Statistics*, 6, 461-464.
- Stopford, M. (2009), *Maritime Economics – 3rd edition*, Routledge.
- Strandenes, S. (2012), Chapter 6: Maritime Freight Markets, in Talley, Wayne K.(ed.) *The Blackwell Companion to Maritime Economics* , Blackwell Companion to Contemporary Economics, Wiley-Blackwell.
- Tambakis D. (1984). An econometric analysis of the factors affecting shipping in Greece. *Maritime Policy & Management*. 11(1), 21-33.
- Thanopoulou, E. (1994). *Greek and International Shipping*. Athens: Papazissis, (in Greek).
- Thanopoulou, H.A. (1996). Anticyclical investment strategies in shipping: The Greek case, in Hensher, D., King, J, and Oum, T (eds) (1996) *Proceedings of the 7th World Conference on Transport Research*. Oxford: Elsevier.
- Thanopoulou , H.A. (1998), What price the flag? The terms of competitiveness in shipping. *Marine Policy*, 22(4-5),.359-374.
- Thanopoulou, H. A. (2002). Investing in ships: An essay on risk and attitudes, in: Grammenos, C. (ed) (2002) *The Handbook of Maritime Economics and Business*. London: Lloyd’s of London Press.
- Thanopoulou, H.A. (2007). A fleet for the 21st century: Modern Greek Shipping, in Pallis, A. (2007). *Maritime Transport: the Greek Paradigm*. Oxford: Elsevier.
- Thanopoulou, H. (2008). “Sic transit...”? Dwelling on the competitiveness of Greek shipping, in: Angelides, M., Gravaris, D., and Sakas, D. (2008). *Social Theory and Political responsibility*. (In Greek). Athens: Typothito-Giorgos Dardanos.
- Thanopoulou, H. A. (2010). Investing in 21st century shipping: An essay on perennial constraints, risks and great expectations, in: Grammenos, C. (ed) (2010) *The Handbook of Maritime Economics and Business*. 2nd edition. London: Informa.
- Tsolakis S D, Cridland C & Haralambides H E (2003) *Econometric Modelling of Second-hand Ship Prices*, *Maritime Economics & Logistics*, 5, 347-377.
- University of Piraeus (2005). Report on impact of the Greek Shipping on the national economy (original in Greek). December 2005. In co-operation with the Hellenic Chamber of Shipping.

Appendix I: Tables 3-5 and Figures 5-6

Table 3: Cointegration tests.

| | TSI | TSO |
|---------------------------------|-----------------------------------|-----------------------------------|
| | Inflows | Outflows |
| Long-run regression method DOLS | Long -run Residuals (<i>d1</i>) | Long -run Residuals (<i>d2</i>) |
| ADF Statistics | | |
| Intercept | -8.010** | -6.417** |
| <i>Lags</i> | 0 | 0 |
| Trend and Intercept | -7.987** | -6.393** |
| <i>Lags</i> | 0 | 0 |
| None | -8.043** | -6.444** |
| <i>Lags</i> | 0 | 0 |
| DF-GLS Statistics | | |
| Intercept | -7.931** | -6.291** |
| <i>Lags</i> | 0 | 0 |
| Trend and Intercept | -7.963** | -6.379** |
| <i>Lags</i> | 0 | 0 |
| Engle-Granger t-statistic | -7.421** | -6.213** |
| Engle-Granger z-statistic | -77.656** | -59.374** |
| Phillips-Ouliaris t-statistic | -7.669** | -6.277** |
| Phillips-Ouliaris z-statistic | -86.617** | -61.139** |

Critical values being provided by MacKinnon (1996) and Elliott-Rothenberg-Stock (1996).

The selected lag length for no serial correlation of the ADF residuals based on Swartz Information Criterion.

** indicate significance at the 5% level.

Table 4: Estimation of the short-run shipping inflows (TSI)

| | Sub-sample Jan.2002-Dec.2005 | Sub-sample Jan.2006-Jun.2012 | Total Sample Jan.2002 -Jun.2012 |
|---|---------------------------------|---------------------------------|------------------------------------|
| Included observations (adjusted) | 47 | 78 | 125 |
| Endogenous Variable $\Delta \ln(\text{TSI})_t$ | TSI | TSI | TSI |
| Regression method (HAC standard errors & covariance) | OLS | OLS | OLS |
| Explanatory variables | | | |
| Constant | 0.005 (0.598) | -0.007 (-1.13) | -0.001 (-0.293) |
| $\Delta \ln(\text{TSI})_{t-3}$ | | | 0.113* (1.934) |
| $\Delta \ln(\text{IND})_{t-1}$ | 0.142* (1.748) | 0.155*** (2.907) | 0.143*** (3.262) |
| $\Delta \ln(\text{LS})_t$ | | 0.264*** (3.240) | 0.167*** (2.422) |
| $\Delta \ln(\text{SHV})_{t-1}$ | 0.752* (1.964) | 0.633** (2.138) | 0.707*** (3.928) |
| $\Delta \ln(\text{EXR})_t$ | 1.953** (2.530) | 1.241*** (3.736) | 1.450*** (4.685) |
| $\Delta \ln(\text{EXR})_{t-1}$ | -1.297*** (-3.856) | -0.777* (-1.686) | -0.976*** (-3.484) |
| $d1_{t-1}$ | -0.503*** (-4.951) | -0.773*** (-9.259) | -0.611*** (-8.021) |
| Adjusted R ² | 0.575 | 0.605 | 0.595 |
| DW | 2.214 | 2.144 | 2.229 |
| F-statistic | 9.915 | 15.750 | 19.281 |
| RSS | 0.193 | 0.314 | 0.535 |
| S.E. of regression | 0.070 | 0.067 | 0.068 |
| AIC | -2.313 | -2.445 | -2.439 |
| SIC | -1.998 | -2.173 | -2.191 |
| Diagnostic tests | | | |
| Ramsey-Reset (1) | 0.622 | 0.529 | 0.450 |
| LM(1) [P-value] | 0.321 | 0.202 | 0.059 |
| LM(3) [P-value] | 0.343 | 0.269 | 0.141 |
| LM(6) [P-value] | 0.691 | 0.282 | 0.385 |
| ARCH(1) [P-value] | 0.433 | 0.094 | 0.415 |
| ARCH(2) [P-value] | 0.768 | 0.107 | 0.596 |
| ARCH(3) [P-value] | 0.895 | 0.146 | 0.687 |
| Jarque-Bera [P-value] | 0.646 | 0.704 | 0.510 |

Notes : The number in parenthesis are the t-statistics.

*** indicate significance at the 1% level. Critical values being provided by MacKinnon (1996).

** indicate significance at the 5% level. Critical values being provided by MacKinnon (1996).

* indicate significance at the 10% level. Critical values being provided by MacKinnon (1996).

Figure 5: The CUSUM and CUSUM Square test for the estimated short-run shipping inflows dynamic equation.

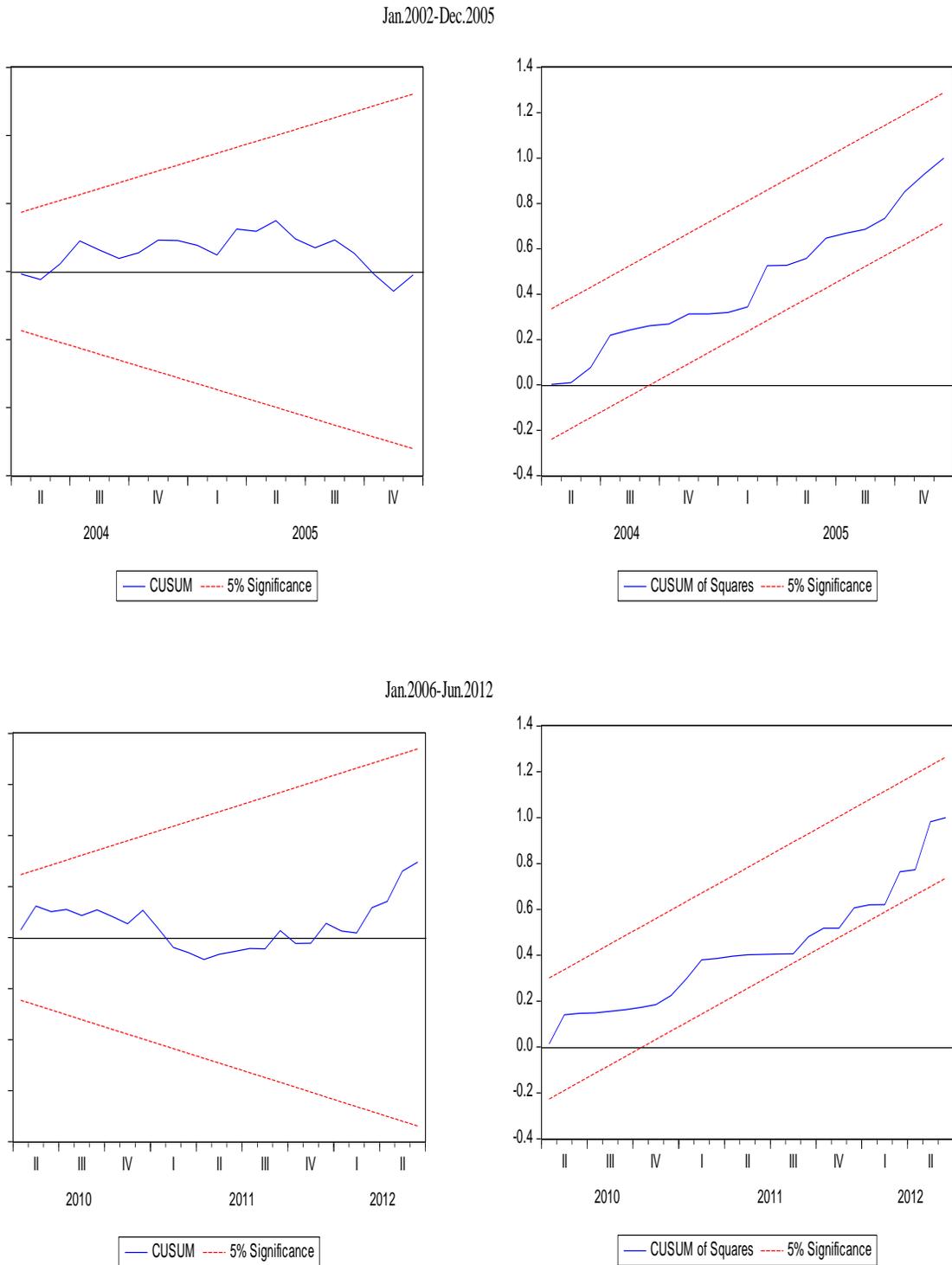


Table 5: Estimation of the short-run shipping outflows (TSO)

| | Sub-sample | Sub-sample | Total Sample |
|---|----------------------|----------------------|-----------------------|
| | Jan.2002-Dec.2005 | Jan.2006-Jun.2012 | Jan.2002 -Jun.2012 |
| Included observations (adjusted) | 47 | 78 | 125 |
| Endogenous Variable $\Delta \ln(\text{TSO})_t$ | TSO | TSO | TSO |
| Regression method (HAC standard errors & covariance) | OLS | OLS | OLS |
| Explanatory variables | | | |
| Constant | -0.019 (-1.095) | 0.009 (0.707) | -0.002 (-0.245) |
| $\Delta \ln(\text{TSO})_{t-1}$ | -0.220* (-1.787) | -0.182* (-1.643) | -0.243*** (-2.664) |
| $\Delta \ln(\text{TSO})_{t-2}$ | | -0.219** (-2.416) | -0.152* (-1.678) |
| $\Delta \ln(\text{IND})_{t-1}$ | | 0.203*** (2.282) | 0.235*** (3.320) |
| $\Delta \ln(\text{LS})_t$ | 1.031** (2.241) | 0.290* (1.863) | 0.352** (2.072) |
| $\Delta \ln(\text{SHV})_t$ | | 1.734*** (6.020) | 0.809* (1.780) |
| $\Delta \ln(\text{EXR})_t$ | 3.049** (2.950) | | 1.095** (2.003) |
| $d2_{t-1}$ | -0.324** (-2.355) | -0.281** (-2.316) | -0.272** (-2.380) |
| Adjusted R ² | 0.473 | 0.469 | 0.409 |
| DW | 2.100 | 1.977 | 2.046 |
| F-statistic | 7.892 | 8.573 | 8.825 |
| RSS | 0.507 | 0.861 | 1.595 |
| S.E. of regression | 0.112 | 0.112 | 0.118 |
| AIC | -1.392 | -1.411 | -1.331 |
| SIC | -1.116 | -1.109 | -1.059 |
| Diagnostic tests | | | |
| Ramsey-Reset (1) | 0.578 | 0.710 | 0.664 |
| LM(1) [P-value] | 0.328 | 0.960 | 0.548 |
| LM(3) [P-value] | 0.602 | 0.329 | 0.433 |
| LM(6) [P-value] | 0.257 | 0.626 | 0.648 |
| ARCH(1) [P-value] | 0.322 | 0.980 | 0.691 |
| ARCH(2) [P-value] | 0.299 | 0.975 | 0.888 |
| ARCH(3) [P-value] | 0.479 | 0.060 | 0.563 |
| Jarque-Bera [P-value] | 0.594 | 0.865 | 0.799 |

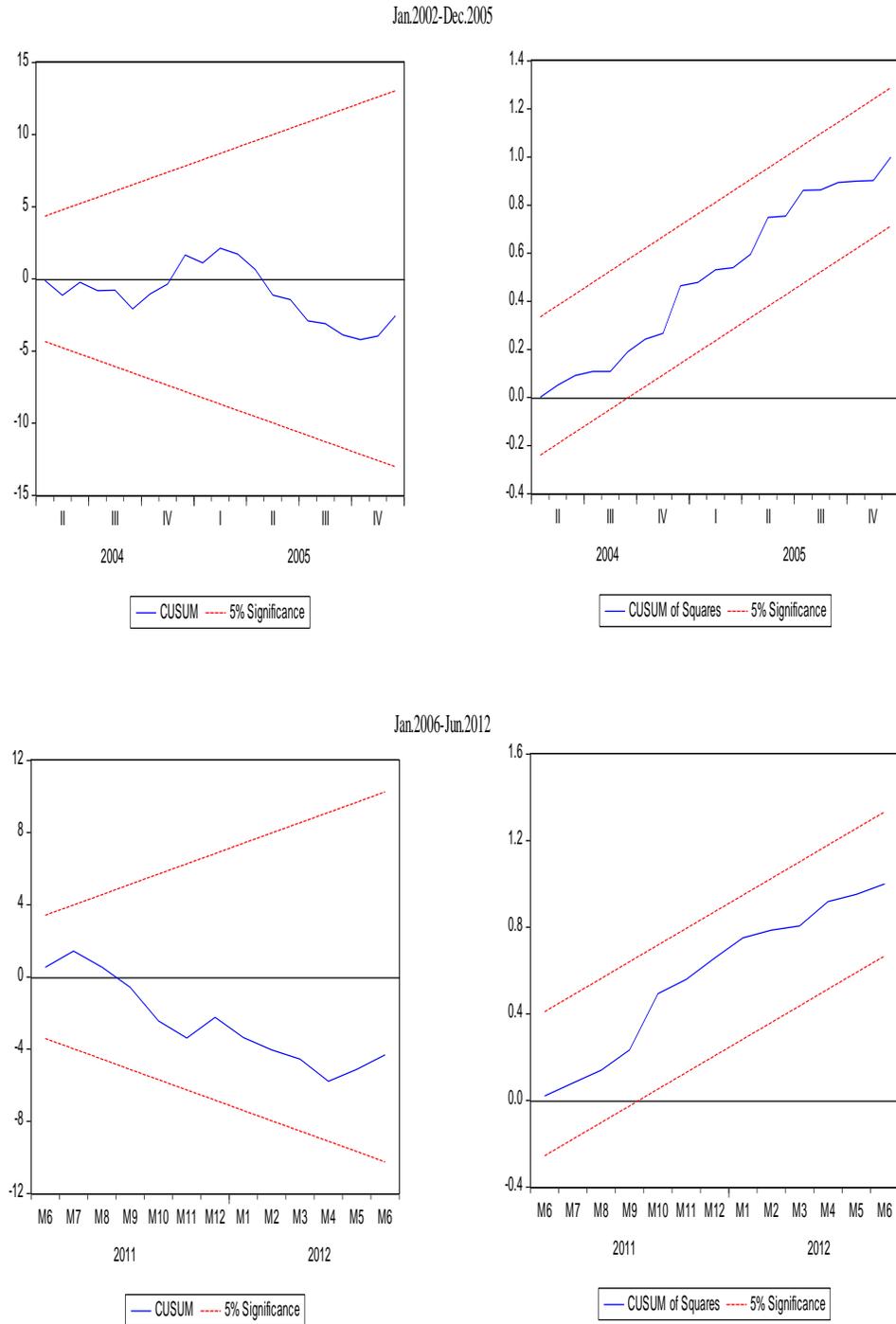
Notes : The number in parentes is are the t-statistics.

*** indicate significance at the 1% level. Critical values being provided by MacKinnon (1996).

** indicate significance at the 5% level. Critical values being provided by MacKinnon (1996).

* indicate significance at the 10% level. Critical values being provided by MacKinnon (1996).

Figure 6: The CUSUM and CUSUM Square test for the estimated short-run shipping outflows dynamic equation



Appendix II: Greek Freight Rate Index Methodology

In previous work (Bragoudakis & Panagiotou, 2007), the ClarkSea index was used as a proxy of the freight rate that the Greek shipping companies were receiving. However, it was apparent that a freight rate that captured the structure of the Greek fleet was needed in the context of the models proposed here. To this end, a new index was constructed based on fleet data and representative TCE earnings for the various fleet segments. The Greek fleet exhibits a high concentration in the dry-bulk and the tanker sector, while its presence in container-shipping is relatively limited (Greek Shipping Co-operation Committee 2010). For the construction of the Greek freight rate index, we firstly needed representative earnings for the three abovementioned sectors, which represent more than 92% of the total Greek-owned fleet capacity and secondly the respective weights these being their shares in the total fleet capacity. The data and the methodology for the construction of the index are presented below:

Data

The earnings data were retrieved from the Clarkson Research Services–Shipping Intelligence network database (<http://www.clarksons.net/>). According to the Sources and the Methods for the Shipping Intelligence Weekly (May 2009) ‘Earnings are estimated as daily time charter equivalents (TCEs) of voyage freight rates, and expressed in \$/day on the voyage.’ Clarkson Research Services publishes weighted average earnings for Dry bulk and Tanker vessels, which were used for the construction of the index⁷. In the case of containers – as a weighted average is not calculated by Clarkson – the earnings of the Sub-Panamax (2,750 TEU) were used as this represent the average size of the Greek-owned container vessels. The advantage of using TCE compared to any other freight indices (i.e. BDI or World scale) is the fact that we focus on the actual income of the Greek Shipping companies. This fact is even more important in the case of World scale, which is updated at an annual basis and may create distortions between the actual earnings and the World scale index (Tsolakis et.al, 2003)

Weights

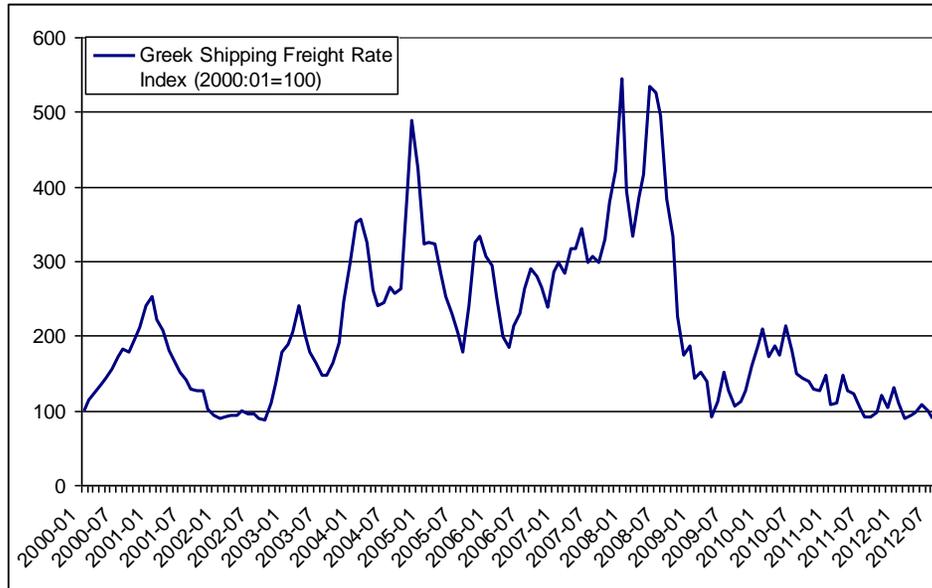
The weights to be assigned in each sector were calculated as the share of each of the three sectors (in dwt-terms) on their total capacity, averaged over the estimated period. We have decided to use fixed weights rather than annual updated weights, because the structure of the Greek-owned fleet has not experienced significant changes over the last decade.

⁷ For further details on the calculation of the earnings and the compilation of the weighted earnings, please see the Sources and the Methods for the Shipping Intelligence Weekly which is available at: http://www.clarksons.net/archive/research/archive/SNM/SIW_SNM.pdf

Index

Based on the above calculated fixed weights for each of the three sectors, we calculated the weighted Greek freight rate on a monthly basis and then January-2000 was set as the base of the Index (2000:01 = 100 points). The Index is presented in Figure 7⁸.

Figure 7: Greek shipping freight rate index



Source: Authors' calculations

⁸ The authors have also created a chain linked index (based on annual updates of the weights). However there was not any significant addition in the information content of the latter compared to the fixed weigh index. Thus, it was decided to utilise the simplest index and avoid the complication that are associated with the use of chain-linked indices.