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Financial Constraints and Exports: Evidence from Portuguese Manufacturing Firms

Armando Silva¹

Abstract

This paper analyses the links between financial constraints and firm export behaviour, at the firm level, by using data on Portuguese manufacturing enterprises. Previous empirical literature has not yet reached a consensus on these subjects and there is a great heterogeneity in measuring financial constraints. In line with a very recent trend, we approximate credit constraints by using a financial score built on eight variables. In order to assess the effects of exports on the financial status of firms we apply, for the first time to these types of studies, a propensity score matching with difference in differences. We find that new exporters show significant improvements in their financial situation.

Keywords: Exports, Propensity-Score-Matching, Financial constraints

JEL classification: F10; G32; L25

1. Introduction and brief literature revision

Managers of firms, especially in poor and developing countries, often cite financial constraints as the main impediment to their internationalization and growth. At another level, and in line with a recent trend in international finance literature, we argue that the very fact of starting to export could improve firms' access to external financial funds. In fact, the recent empirical literature has invoked four kinds of reasons to support the argument that exports reduce financial constraints:

(i) some authors (e.g., Campa and Shaver, 2002 or Bridges and Guariglia, 2008) argue that exporting firms should in principle benefit of more stable cash flows, as they are able to enjoy from international diversification of their sales. Thus, by assuming that international business cycles are only imperfectly correlated, exporting reduces vulnerability to demand-side shocks;

(ii) in another perspective, selling in international markets can be considered as a sign of efficiency and competitiveness by domestic investors and creditors; thus, in a context

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of information asymmetries and of financial markets imperfections, exporting would represent a clear signal sent by the firm to external investors, enabling them to obtain better financing. Some authors (e.g., Ganesh-Kumar et al., 2001) find that this kind of mechanism is mainly relevant in an emerging market characterized by low institutional quality;

(iii) meanwhile, some authors (e.g., Tornell and Westermann, 2003) argue that exporting is likely to open up access to international financial markets as well, at least those pertaining to the destination countries. In fact, foreign exchange revenues represent better collateral to access external funds in foreign financial markets;

iv) finally, exporters also tend to be larger, more efficient, have larger cash flows and therefore may have an easier time getting access to external finance, or get preferential terms on their outside funds (Bernard and Jensen, 1999; Clerides et al. 1998; Delgado et al. 2002). This would justify exporting firms' investments to be less sensitive to internal funds than their domestic counterparts.

Empirically, there are few studies assessing positively the influence of exports on firms' financial health. Campa and Shaver (2002) conclude that exporting can help firms to reduce their financial constraints but they do not take into account endogeneity or selection issues. Two other recent papers provide further evidence that exporting may exert a positive effect on firm financial health: Greenaway et al. (2007) and Bridges and Guariglia (2008) but none uses the methodology we employ. More recently, a few studies argue that exports have no positive effects on firms' financial health (e.g., Bellone et al., 2010 or Manole and Spatareanu, 2010).

In what follows, we present an evaluation of the ex-post effects of exports based on a large panel of Portuguese manufacturing firms. Portugal is an interesting case study of these issues because for nearly five years there is a strong government pressure for firms to become exporters and there is also a strong hope that it will generate improvements for these firms, in particular, and for the whole country, in general; thus, any proof that exports create positive effects would generate additional motivation for exports' support; moreover, no study, on the relationship between financial constraints and exports, existed for Portugal and it could be interesting to compare it with past or future similar studies. Our contribution is twofold. First, we propose a new way to measure the degree of financial constraints, in a development on the multivariate index proposed by Musso and Schiavo (2008), which we argue is preferable to existing methodologies of assessing financial constraints. Second, in an innovative proposal, and in order to adequately deal with selection and endogeneity issues recognized in several studies, we propose the use of Propensity Score Matching with Difference in Differences (PSM-DID) to evaluate the financial impacts of new exporting activities. We find significant improvement in the financial health of firms after entering into export markets.

We acknowledge that there is also another strand in the literature of financial constraints and exports that studies the opposite causality direction: the ex-ante financial constraints and export selection; in fact, there are some theoretical models that try to explain the causality nexus between firms' financial constraints and export beginning (e.g. Chaney, 2005) and there are some empirical studies arguing that only the domestic firms

which are financially unconstrained are able to become new exporters (e.g. Bellone et al., 2010); nevertheless, we do not approach, in this paper, such item.

The rest of the paper is organized as follows. Section 2 presents the data, discusses the shortcomings of usual strategies employed to measure financial constraints, and illustrates the methodology adopted here. In Section 3, we present propensity score matching and test the hypothesis that selling abroad improves firms' financial health. Section 4 concludes and draws some policy implications.

2. Data and measure of financial constraints

2.1 Data description

The empirical analysis combines two data sources from the Portuguese National Statistics Institute (INE): balance sheet information (IAE) and external trade information (ECE). Datasets are linked by firms' non-revealed fiscal number. IAE provides information of firms' balance sheets from 1996-2003, and uses a survey sample of all manufacturing Portuguese firms with less than 100 workers and all the universe of firms with more than 100 workers. We have used, as variables, number of employees, turnover, exports, investment, labour cost, stock of capital, assets (and their composition), liabilities (and their composition), amortizations, own funds and earnings. To limit the effect of outliers we trim observations lying in the top and bottom 0.5% of the distribution for each the variables. Firms are classified according to their main activity, as identified by INE standard codes (CAE), which are correlated with Eurostat Nace 1.1 taxonomy; almost 65% of all firms belong to food, beverage, wearing apparel, textiles, paper, furniture and wood sectors.

Capital is proxied by tangible fixed assets at book value (net of depreciation). In turn, ECE provides information for each firm, on trade volume (exports and imports) aggregated by year and by country (destination of exports and origin of imports), and it also displays information on the types of products/sectors traded for each transaction. An export starter is a firm that begins exporting in that year but doesn't export in the two previous years. All nominal variables are measured in 1996 Euros and are deflated using 2 digit industry-level price indices provided by INE; for capital stock we use the same deflator for all sectors; Tables A and B in Appendix present further details, namely the fact that new exporters (starters) show, in general, better financial performs than non-starters.

2.2 Measure of Financial Constraints

Given the lack of consensus and in order to account for potential problems in the use of other variables trying to measure financial constraints, we build a measure of financial health according to the methodology first proposed by Musso and Schiavo (2008) and further developed by Bellone et al. (2010). We exploit information coming from eight variables: size (total assets), profitability (return on total assets), liquidity (current asset over current liabilities), cash flow generating ability, solvency (own funds over total liabilities), trade

credit over total assets, repaying ability (financial debt over cash flow) and Total Factor Productivity (TFP)¹. The choice of these variables is due to their recognized importance in the financial constraints literature; moreover, as recognized by Musso and Schiavo (2008), by proposing a time-varying and continuous measure of financial constraints we acknowledge the multifaceted feature of this phenomenon and more important it allows us to capture different degrees of financial constraints.

For each variable, we scale each firm/year observation for the corresponding two-digit CAE sector average and then assign to it a number corresponding to the quintiles of the distribution in which it falls. The resulting information for each of the eight variables (a number ranging from 1 to 5) is then collapsed into a single index as a simple sum of the eight numbers (*Score A*). Finally, the index is then rescaled to lie on a common 1–10 range. General statistics of *Score A* are presented in Table C in Appendix; firms that present the lowest *Score A* also show the poorest levels of liquidity, solvency and profitability.

In what concerns TFP, since it is probable that profit-maximizing firms instantly adjust their input levels each time they notice productivity shocks, productivity and input choices are likely to be correlated and thus TFP estimation involves problems. As explained by De Loecker (2010), researchers often use proxy estimators of TFP suggested by Olley and Pakes (1996) and Levinsohn and Petrin (2003); they provide them empirical models to estimate production functions using firm-level data and, more important, such proxies deal with the endogeneity of inputs, the non random exit of firms, as well as allow for persistence in the unobserved productivity shocks. Due to data limitations we could only use the semi-parametric method of Levinsohn and Petrin. Thus, we compute TFP as the residual of a Cobb-Douglas production function where the firm value added is the independent variable and capital, labor and unobservable productivity level are the dependent ones. This methodology also assumes that intermediate inputs have a monotonic positive relationship with productivity and in this way could be used as proxies. In our case, given data availability, we use as intermediate inputs the deflated values of the account “global supplies and external services” at book value; we estimate production function for every 2-digit sector separately.

3. Export and finance: ex-post benefits

3.1 Methodology

Ideally, the effects (on financial or economic levels) of becoming an exporter should be measured by comparing a firm’s performance, some years after starting to export to what their hypothetical performance would have been at the same time had they never begun to export. Under the impossibility of such a measure, matching methods aim to evaluate the Average Treatment effect on the Treated (ATT), which means in practice, to evaluate

¹ The reason why TFP is included as an indirect indicator of financial constraints is due to our conviction that economic efficiency is highly correlated with financial health of firms.

the better as possible the effects of a treatment model, where treatment is the export entry. Thus, conceptually, we aim to measure the ATT, the average effects of a “treatment”, as the decision to start exporting on starters’ performances, by computing:

$$ATT = E\left[Y_{i,t}(1) - Y_{i,t}(0) \mid D_i = 1\right] = E\left[Y_{i,t}(1) \mid D_i = 1\right] - E\left[Y_{i,t}(0) \mid D_i = 1\right] \quad (1)$$

where $Y_{i,t}(1)$ is the outcome (financial or other) of a starter firm i at t given it began exporting at a certain time; $Y_{i,t}(0)$ is the outcome of i at t given it did not begin exporting at the stated time; D is the decision made by i if it was starting to export (1) or not (0). In practice, we can only compute $E\left[Y_{i,t}(0) \mid D_i = 0\right]$ thus, the solution is to replace the unobservable $E\left[Y_{i,t}(0) \mid D_i = 1\right]$ with the observable $E\left[Y_{i,t}(0) \mid D_i = 0\right]$; i.e., we use as the effect measure $E\left[Y_{i,t}(1) \mid D_i = 1\right] - E\left[Y_{i,t}(0) \mid D_i = 0\right]$ which originates a selection bias in the ATT computation.

Matching techniques pair each new exporting firm, in each year – on the basis of some observable variables, named as covariates – with a larger control group of most similar firms that stay non-exporters until that year. Given the variety of observable variables (covariates) that can be used to pair starters with non-starters (e.g., productivity, size, ownership, capital, sector, liquidity, general financial health), a problem of dimension of treatable variables arises. In line with Rosenbaum and Rubin (1983), this problem is solved by computing an average index: the “propensity score”. Using this index from a large group of non-treated firms, we can find those that are the most similar to starters in the pre-treatment period.

In the first phase and in the purpose of estimating the propensity score, we chose as covariates to identify the probability of a firm beginning to export: TFP, size measured by the logarithm of total assets, a dummy controlling for small firms (with fewer than 20 employees), capital stock, investment, dummies indicating whether the firm has R&D workers, if the firm has a foreign share of capital, if the firm imports, liquidity ratio, leverage ratio, financial health (*Score A*), loans and also sectoral dummies². We assume each one year lagged variables to affect export entry decision and the outcomes of starters and controls. In order to compute the propensity scoring the choice of the functional form seems to be robust since the binary treatment with logit or probit regressions yields similar results. In a second phase, we must match starters (treated firms) with controls (non-treated firms) by using the estimated propensity scores. To achieve it, there are several algorithms, which differ due to the different weighting regimes used to assess the importance of each control for each treated firm. We tested two of these weighting schemes: kernel matching

² Although not reported, we also tested the use of higher order polynomials, some interaction terms and other propensity score models. It was done in order to assess if *Score A* was affected; we conclude it was not.

and nearest neighbour matching³. Given that the different methods reach different points on the frontier of the trade-off between quality and quantity of the matches, and, in line with Caliendo and Kopeinig (2008), neither of them is a priori superior, we use both⁴; in fact, their joint consideration offers a way to assess the robustness of the estimates. Given the narrowness of our database, we perform the referred matching by pooling all cohorts of starters, given we have ensured it does not affect the matching quality. Complementarily, in order to assess matching quality, we compare the average level of the covariates before and after matching and look for differences between treated and control units; results of after-matching balancing tests (in Table D in Appendix) indicate that there are no significant differences between matched and control firms in terms of covariates; such evidence suggests the robustness of the matching implemented.

Nevertheless, in spite of all precautions when performing PSM, the self-selection bias may still exist, due to the bias coming from unobservables. In fact, if there are unobservable variables affecting both “assignment” into exporting and the outcome variable simultaneously, a hidden-bias may arise. A method for dealing with time-invariant unobservable bias is to add a differences-in-differences (DID) estimator to PSM. According to Blundell and Costa Dias (2000), this approach can improve the quality of non-experimental evaluation. Using DID, we compare differences in outcomes before and after the treatment (i.e., export entry) for the treated group – starters – to the same differences computed for the untreated group – controls. Naturally, without the treatment, the differences across both groups should not exist. Thus, to evaluate the impact of exporting on new exporters’ performances (ATT), we performed the PSM-DID estimator applying at every period after the entry into the export markets with respect to the year prior to entry ($t-1$); such implemented estimator could be written as

$$M^{PSM-DID} = \frac{1}{n_i} \sum_{D_i=1} \left[\left(Y_{i,Post} - Y_{i,pre} \right) - \sum_{D_j=0} w_{i,j} \left(Y_{j,Post} - Y_{j,pre} \right) \right] \quad (2)$$

In (2), Y is the required outcome (in logarithms, \ln , instead of absolute values to obtain differences in growth rates between starters and non-starters); Post and pre denote that the variable is in the post-entry and pre-entry period; $D_i=1$ ($D_j=0$) denotes the group of starters (non-starters) in the region of common support; n_i is the number of treated units on the common support; $w_{i,j}$ is the weight of the j^{th} observation of controls in constructing the counterfactual to the i^{th} treated firm. When using the nearest neighbour algorithm each treated firms is matched with a single control, but using Kernel means that all controls, in

³ Kernel matching is a nonparametric matching estimator that compares the outcome of each treated firm to a weighted average of the outcomes of all the untreated firms of the control group, with the highest weight being placed on those with scores closest to the treated firm. Nearest neighbor matching chooses a single firm from the comparison group as a match for a treated one in terms of the closest propensity score.

⁴ Nevertheless, we only report kernel algorithm results.

the common support region, are weighted for matching each treated firm. We considered a maximum of six years after the starting year and thus we calculated ATT effects from t to $t+6$. As mentioned, by using ln , values in Table 1 are percentage point differences in growth rates between starters and controls for *Score A*, observed cumulatively from $t-1$ to the end of that year.

Propensity score matching was performed either by the program `psmatch2` (developed by Leuven and Sianesi, 2003) and by the programs⁵ `pscore` and `attnd(w) / attk` (developed by Becker and Ichino, 2002). For both programs we used either nearest neighbour matching and Kernel matching. When using Kernel matching, standard errors are obtained by bootstrapping the entire estimation framework, including the propensity-score computation stage.

3.2 Results

Table 1 shows that the effect of exports on financial health (*Score A*) is positive and statistically significant from one year after export entry up to four years later; in fact, the growth of *Score A*, is higher for starters relative to control firms, for each year and always compared with pre-entry period. That growth advantage of starters, in financial health, is of 3 to 4 percentage points, compared with non-starters and reaches a maximum in the fourth year after exports begin.

These positive effects of new exporting activity seem to spread to efficiency (TFP growth of starters is also higher for four years) and to other financial variables such as solvency (for two years), cash flow, financial debt share on total liabilities and bond share in total liabilities. In fact, there is some evidence that starters are more able to reach higher growth in cash flow and are also more able to obtain higher increase in the importance of financial debt and of bond debt, suggesting that exports improve firms' ability to obtain financial credit. In addition, in the first two years after entry we notice starters to have a disadvantage in what concerns the growth in the return on assets (ROA); a similar fact is observed in cash flow growth for the same period. Such results could suggest that new exporters take some time to recover from sunk entry costs of exporting; moreover, the cash flow generating ability of starters begins to growth in a superior path only four years after export entry, thus "rewarding" new exporters for their "investment" in foreign markets. The fact that ROA never shows exporters' superiority may be due to the fact that the increase in returns is inferior to the increase in assets associated with foreign competition.

At another level, other sign of increased financial health of starters is presented by the decreasing share of trade credit relative to domestic firms; in fact, some years after entry the new exporters clearly decrease their trade credit share, relative to domestic firms; thus, suggesting new exporters get higher abilities to finance them from banks or directly from the markets (bonds) thus reducing their dependence from suppliers.

⁵ We only report results from `psmatch2`; other results are available upon request.

Table 1: PSM-DID estimations

	$t/t-1$	$t+1/t-1$	$t+2/t-1$	$t+3/t-1$	$t+4/t-1$	$t+5/t-1$	$t+6/t-1$
TFP	0.008 ⁺ (0.018)	0.026* (0.013)	0.045* (0.025)	0.039* (0.027)	0.059** (0.027)	-0.002 ⁺ (0.044)	-0.071 ⁺ (0.067)
Score A	0.014 ⁺ (0.011)	0.017** (0.010)	0.019* (0.010)	0.033 (0.012)	0.039** (0.018)	-0.008 ⁺ (0.024)	0.041 ⁺ (0.031)
Solvency	0.088 ⁺ (0.068)	0.003 ⁺ (0.007)	0.081 ⁺ (0.061)	0.118* (0.062)	0.154* (0.102)	-0.124 ⁺ (0.132)	0.144 ⁺ (0.172)
Liquidity	0.015 ⁺ (0.031)	0.022 ⁺ (0.032)	0.012 ⁺ (0.040)	-0.043 ⁺ (0.051)	-0.028 ⁺ (0.068)	0.012 ⁺ (0.061)	0.131 ⁺ (0.141)
ROA	-0.088 (0.047)	-0.093** (0.064)	-0.088 ⁺ (0.066)	-0.107 ⁺ (0.098)	-0.098 ⁺ (0.094)	-0.192 ⁺ (0.132)	-0.265 ⁺ (0.185)
Financial Debt share	0.019 ⁺ (0.210)	0.131 ⁺ (0.102)	0.211 ⁺ (0.182)	0.293** (0.213)	0.063 (0.023)	0.021 ⁺ (0.042)	0.017 ⁺ (0.025)
Bond share	0.017 ⁺ (0.200)	0.127 ⁺ (0.100)	0.201 ⁺ (0.172)	0.263 ⁺ (0.243)	0.061 (0.025)	0.025 ⁺ (0.044)	0.017 ⁺ (0.025)
Trade credit	0.142 ⁺ (0.060)	0.247 ⁺ (0.540)	-0.347 ⁺ (0.650)	-0.817 ⁺ (0.990)	-0.188 ⁺ (0.890)	-0.217* (0.145)	-0.277 ⁺ (0.310)
Cash Flow	-0.057** (0.031)	-0.061** (0.040)	-0.062 ⁺ (0.073)	0.115* (0.071)	0.171 (0.058)	0.147 ⁺ (0.137)	0.026 ⁺ (0.033)
Leverage	0.001 ⁺ (0.021)	0.004 ⁺ (0.011)	0.016 ⁺ (0.021)	0.003 ⁺ (0.0151)	-0.019 ⁺ (0.018)	0.021 ⁺ (0.018)	0.039 ⁺ (0.029)
Number Treated	732	723	489	381	281	181	111
Number Controls	2,782	2,747	1,822	1,298	869	509	233

Source: Own calculations.

Notes: By using a Kernel algorithm and program *psmatch2*, we report bootstrapped standard errors (200 replications), the number of treated on the common support and the number of matched controls. If nothing is mentioned, coefficients are significant at 1% and coefficients significant, at least at 10% are in bold.

** means significant at least at 5%.

* means coefficients are significant at least at 10%.

⁺ means coefficients are not significant.

Complementarily, we have also performed similar tests by splitting our database according to size and export intensity. In what respects size we divided data (both for treated and control groups) in “small” firms, with less than 20 employees, and “other” firms, with more than 20 employees; for each sub-group we performed the correspondent PSM-DID. Results of Table 2 show clearly that only small sized starters benefit of beginning to export; this could mean that “other” starters given their superior dimension have even prior to exporting a healthier financial situation, and which is not improved by selling abroad.

Table 2: PSM-DID for different size groups and for Score A

	<i>t</i> / <i>t-1</i>	<i>t+1</i> / <i>t-1</i>	<i>t+2</i> / <i>t-1</i>	<i>t+3</i> / <i>t-1</i>	<i>t+4</i> / <i>t-1</i>	<i>t+5</i> / <i>t-1</i>
Small firms	0.017* (0.010)	0.015* (0.010)	0.020 (0.011)	0.036 (0.014)	0.029** (0.019)	-0.020+ (0.030)
Big firms	0.001+ (0.014)	0.016+ (0.014)	0.018+ (0.019)	0.021+ (0.021)	0.009+ (0.034)	-0.016+ (0.033)

Source: Own calculations

Notes: See Table 1

At another level, we perform a second robustness check by splitting starters in accordance with their export intensity level (in the first two years)⁶; results of Table 3 show that to trigger the beneficial effects of exports there is no threshold of export intensity needed. These results have important policy implications given that they suggest that the simple fact of beginning to export is sufficient to improve the financial health of starters.

Table 3: PSM-DID for different export intensity groups and for Score A

	<i>t</i> / <i>t-1</i>	<i>t+1</i> / <i>t-1</i>	<i>t+2</i> / <i>t-1</i>	<i>t+3</i> / <i>t-1</i>	<i>t+4</i> / <i>t-1</i>	<i>t+5</i> / <i>t-1</i>
High intensity starters	- 0.01+ (0.011)	0.012+ (0.013)	0.010+ (0.014)	0.026+ (0.019)	0.032** (0.021)	-0.020+ (0.030)
Low intensity starters	0.015+ (0.014)	0.011** (0.08)	0.016* (0.012)	0.026 (0.015)	0.029+ (0.028)	0.005+ (0.024)

Source: Own calculations

Notes: See Table 1

⁶ We divide starters in two groups: one obtaining export intensity higher than 15% in the two first years of exporting; the other with lower export intensity.

In line with the arguments of Ganesh- Kumar et al. (2001), Campa and Shaver (2002), Greenaway et al. (2007) or Bellone et al. (2010) we argue that exports may exert a positive effect on firm financial health, namely by a revenue diversification effect (by reducing exposure to demand-side shocks) and by a signaling effect to financial markets (reducing informational asymmetries) given that the very fact of exporting could be a signal of efficiency given to creditors as only the best achieve to export.

4. Conclusions

This paper belongs to the recent stream of the literature that studies the links between exports and financial constraints. Given that the measure of financial constraints is still an ongoing issue, we propose a new way to assess the degree of financial constraints, in a development of the multivariate index proposed by Musso and Schiavo (2008).

Our main goal is to assess whether internationalization has any positive effect on financial health. Methodologically, we present, for the first time, a propensity score matching with difference in differences in order to evaluate the effects of new exports on the financial health of firms, overcoming the main handicaps of previous studies on these subjects.

We found that internationalization increases the path at which exporters improve their financial health compared to the correspondent path for non-exporters. Such positive effects are especially important for small firms and do not seem to require a threshold of export intensity.

In terms of policy evaluation these findings seem to justify the public support to new exporters given the positive properties that exports generate on financial health of firms. Nevertheless, several issues still need further discussion; we highlight two of them: the assessment on the quantitative influence of financial constraints on firm-level exports both at intensive and extensive margins, and the qualitative study of the channels through which firms improve their financial situation.

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Appendix

Table A: Number of firms studied

	1996	1997	1999	2000	2001	2002	2003
All	677	607	589	604	511	523	545
Starter	166	132	105	125	86	118	99

Source: Own calculations

Table B: Average values 1996-2003

	Control	Starter
Score A	4,75	5,45
Employees	35	93
Cap (10 ⁶ €)	3,35	6,59
Liquidity	0.39	0,52
TFP (10 ³ €)	79	156
Leverage	1,08	0,97

Source: Own calculations

Table C: General statistics of Score A

Score A	Share of all firms for each Score level	Liquidity Index (1 is maximum)	Solvency Ratio	ROA
2	0.1%	24%	8%	4%
3	1,5%	84%	2%	8%
4	11,6%	86%	13%	6%
5	27,4%	82%	22%	6%
6	31,8%	100%	30%	8%
7	20,5%	78%	28%	10%
8	6,4%	96%	27%	12%
9	0,7%	90%	24%	13%
Total	100%	85%	22%	8%

Source: Own calculations

**Table D: Assessing the matching quality –
Comparison between treated and control: values at t-1**

Unmatched sample

	TFP	Size	Capital	Invest.	Leverage	Score A	Liquid	Prop score
Treated	1023	15.67	106.97	5,40	0.86	6.09	0.60	0.26
Control	979	15.42	78.1	4,41	0.81	5.75	0.58	0.22
T test	1.19	1.56	4.67	2.17	0.97	3.65	1.70	7.59

Matched sample

	TFP	Size	Capital	Invest.	Leverage	Score A	Liquid	Prop. Score
Treated	1023	15.66	106.97	5,40	0.86	6.09	0.60	0.26
Control	1033	15.51	108.26	4,72	0.85	6.04	0.59	0.26
T test	-0.32	1.07	-0.19	0.76	0.23	0.62	0.98	0.33

Source: Own calculations

The political economy of regional integration in the Western Balkans

Pantelis Sklias¹

ABSTRACT

The paper aims to identify the roots and causes of the failure of existing regional economic integration efforts in the Western Balkans and the poor prospects for similar attempts in the future. Existing classical political and economic approaches are enriched by identifying a framework of analysis to capture regional economic integration. Seven political economic variables to measure regional economic integration endeavors are introduced, namely: coincidence in political interests and political barriers, common perceptions, values, principles, culture, complete and mature institutions, complementarily of productive basis, inter-state trade and financial flows and transactions, technology, infrastructure. The framework analysis is applied by measuring these variables within the Western Balkans region. It is concluded that potential economic integration efforts in the region may be achieved only through a top-down approach, namely a European Union/International Community forced process, rather than resulting from genuine efforts initiated by the respective countries of the region.

Keywords: Political economy, Regional Economic Integration, Western Balkans.

JEL classification: F59, G01

1. Introduction

During the last 20 years Western Balkans witnessed enormous social, political and economic changes. Thousands of pages have been written and excellent scientific work has been done in order to assess and evaluate the progress of the newly born states. A lot has been happening at national level, namely in terms of both socio-political and economic development. New states have emerged, newborn democracies have been established, and market economy structures are now in function. In other words, a new world now exists in the region, consisting of a series of traditional nation states with western oriented patters of development. It is also evident that FDI has been increasing, in the same period with Greece and Greek private firms have become the pioneer in the field. In the mean time Romania and Bulgaria have entered the European Union.

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In the paper it is argued that although the above mentioned critical and astonishing developments have taken place, regional integration and development are still under question and pending, far from being accomplished. Neoclassical economic theories set a series of prerequisites and variables to be fulfilled in order to presume a successful path and accomplishment of regional cooperation and development. Among those a series of political and economic criteria are set. It will be proved that although economic development and FDI have considerably contributed towards the well being of the people of the new born states, political development has not followed the same path, resulting in a series of inadequacies and gaps to what concerns the democracy model in the region. Even in terms of economic development, wealth is unequally distributed with large portions of the populations, especially national and religious minorities staying out of the scope. Regional economic projects have neither been visualized nor accomplished. An additional element to be evaluated in terms of what concerns the prospects of regional cooperation and development is the fact that Greece, a net contributor of FDI and a promoter of regional cooperation in the region, has been severely affected by the recent financial crisis, which limits its capabilities and potential as a political and economic figure.

The aim of the paper is to prove that regional cooperation still has a very limited scope in the region of the Western Balkans, while the conditions are not so promising. Although a series of economic steps have been realized, the political conditions for such an achievement have not been met, while the minimum impact of economic results are also now under threat due to the latest financial crisis and the limited capacity of Greece to play a key role in this direction. As a result, a stronger political will is now required, which seems to be out of hand of the political leaders of the region.

In this framework, the theoretical considerations to what concerns the prerequisites for achieving a certain level of regional integration will be assessed. More specifically, there will be an assessment regarding the level of accomplishment of a series of variables, which is personally believed to constitute the analytical framework for capturing the political economy of regional economic integration. Then, the proposed framework will be applied to the case of the Western Balkans economies and there will be a justification of the reasons the existing regional economic efforts are limited, and the prospects non-pragmatic. Finally, it is stated that a top-down approach from the point of view of the EU is more feasible to achieve results rather than genuine approaches originating from the states of the region themselves.

2. Theoretical Considerations

Regional Integration and Cooperation has been addressed by a considerable number of distinguished scholars. Nevertheless, the extended variety of approaches and perspectives, which the economists have attributed to regional integration, finally leads to the lack of a commonly agreed definition and meaning of the term, thus making the issue discussed ambiguous. It is characteristic that the discussion has also been overwhelmed by the distinction between the “positive” and the “negative” aspects of integration (Tinbergen,

1954, p.122). Namely, initiatives such as the abolishment of a series of obstacles including discriminatory treatment and functioning of reductionist institutions and policy measures are among those, which form the so-called “negative” integration. On the other hand, policy adaptation and establishment of new institutions and policies with compulsory authority are among those which form the so-called “positive” integration. Experience has demonstrated that “negative” integration is easier to achieve since “positive” integration and the measures encompassed very much influence, national sovereignty and the transfer of traditional state power to hyper state institutions and bodies.

Balassa (1973, p.1) considers economic integration both as a process and as a state of the art. Although the process entails a dynamic element within it, the notion of the state of the art is a rather static meaning of a given situation. Eventually, it still remains unclear to what extent a given process or situation may lead to a certain level of integration at local, regional, or global level. It is important to justify what the exact type and magnitude of a process required to reach a certain level of integration is.

Others (Molle, 1991, p. 5) make a clear cut interconnection among economic integration and the gradual abolition of national economic boundaries. In this framework, a certain period of time is required in order for the system to absorb the consequences of such a gradual abolition of economic borders. This period can be anything between five to ten years. Experience has shown that such a transitory period has not been necessary in cases such as the one of the EFTA countries, which had to satisfy the requirements of the *acquis communautaire* without such a period. The abolition of economic boundaries is also a prerequisite for Pelkmans (1984, p.3).

Pinder (1969, p. 143-145) considers the union to be the combination of different parts into a totality. Integration is a process towards the union. Economic integration entails the abolishment of discriminations among the economic subjects of the member states as well as the establishment of common policies.

Baldwin and Wyplosz (2006) propose six criteria for the examination of whether one country is able or unable to participate in a monetary union. These criteria can be based either on economic factors like labour mobility, production diversification, and openness or on political elements like the fiscal transfers, homogeneous preferences and the solidarity criterion. According to them the European countries do not satisfy either the labour mobility or the fiscal transfer criterion, they partly satisfy the homogeneity of preferences criterion and it is very unclear whether there exists a common sense of solidarity. Instead, the European countries satisfy the trade openness and the production diversification criteria.

Venables (2003) supports that “the outcomes of regional economic integration depend on the comparative advantage of members, relative to each other and relative to the rest of the world. Countries with a comparative advantage between that of their partners and the rest of the world do better than countries with an ‘extreme’ comparative advantage. Consequently, integration between low income countries tends to lead to divergence of member country incomes, while agreements between high income countries cause convergence. Results suggest that developing countries are likely to be better served by ‘north-south’ than by ‘south-south’ agreements”.

Soamiely (1999) states “The remaining outsiders would probably form a bloc of their own, which would lead members of the original bloc to increase its size in anticipation of the creation of the second bloc. The threat of regionalism by outsiders would foster larger regional integration arrangements. Even if blocs were formed and merged simultaneously, yielding progressively larger symmetrical blocs, they would fail to converge in a single bloc unless the external tariff was low enough. In other words, global free trade could be achieved through bloc expansion if trading blocs lowered their external tariffs when abolishing their internal tariffs”.

Numerous researchers and scholars have attributed to economic integration merely economic characteristics with emphasis on the abolition of discriminatory measures among the various parts, participating in the process as well as in the establishment of joint economic policies and institutions. Nevertheless, it is personally believed that such an approach is rather restrictive and does not adequately address the phenomenon from a spherical point of view. Namely, it does not take into consideration the level of political development required within the various states to be integrated for the accomplishment of such a complex task, such as the one of economic integration.

In this case, economic boundaries are the notional line across which movement of goods, services and other production elements are of a low intensity. The main argument when contemplating such an approach is the fact that the simple abolition of economic barriers is not adequate to guarantee the movement of goods, services and other sources. It is rather a simplified approach, which does not take into consideration a series of non-economic obstacles, including the language, principles, culture, perceptions, etc. The same is the case concerning the political institutions as well as the level of political development among the nations concerned.

3. The framework of analysis: the political economy of regional integration

What is being argued in this part of the paper is the need for an enriched approach when attempting to assess and evaluate the prospects of a regional integration endeavour. Neoclassical economic thinking has contributed to the understanding of this process from the economic point of view. Nevertheless, social, political and cultural aspects have been omitted which, in the end, make the whole epistemological attempt obscure, thus leading to fragmented outcomes and often misleading observations and understanding of the reality.

Political development analysts and scholars have also clearly put forward both the quality and the quantity aspects of political development (Koutsoukis, 1999, p. 84). Quality meaningfully addresses “change” and “modernisation”, while quantity entails “growth” and “numerical increase”. Political development is considered as the transition from a given situation to another which becomes better, bigger, more comprehensive. In all understandings, political development entails the political system, meaning the government, institutions and processes, which, in the end, contribute to the better functioning of the political system in terms of production and distribution of the political goods.

The impact of political preferences on trade preferential arrangements has also

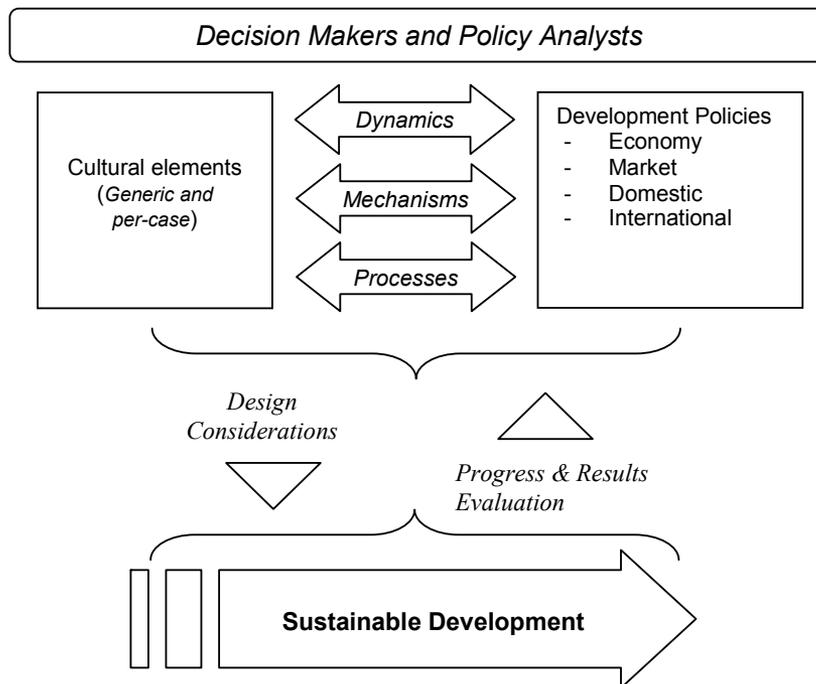
been addressed (Krishna, 1998). In this framework, preferential trading arrangements are analysed from the viewpoint of the “new political economy” that considers trade policy as being determined by lobbying of concentrated interest groups. Two conclusions are reached: first, the trade-diverting preferential arrangements are more likely to be supported politically; and second, such preferential arrangements could critically change domestic incentives so multilateral liberalisation that is initially politically feasible could be rendered infeasible by a preferential arrangement. The larger the trade diversion resulting from the preferential arrangement, the more likely this will be the case.

Dascher, Kristof and Haupt, Alexander (2008) argue that:

“At borders where rich and poor countries meet, services prices differ hugely. In principle, price differentials could be exploited to mutual benefit, offering improved job opportunities to the poor as well as better shopping opportunities to the rich. However, cross-border shopping is often limited by the substantial transaction costs of crossing the border. Moreover, local governments frequently fail to cut these transaction costs even where they have the opportunity to do so. In this paper, we show (i) why a majority of the local electorate often backs this outcome, (ii) how intra-country mobility affects local policy, and (iii) how (inter-)national regulations shape local decisions”.

The impact of culture on processes, practices and dynamics has also been extroverted by scholars (Koutsoukis, Sklias, Roukanas, 2011).

Figure 1: The analysis framework: Culturally-aware economic development supports sustainable development in Koutsoukis N., Sklias P. and Roukanas S. (2011).



Koutsoukis *et. al.* (2011) have demonstrated that:

“Culture is one of the factors to be considered for the transformation of the social capital to economic development achievements. Culture and economy create a circuit of two-way inflows and outflows. On one side, the economy supplies culture (the political-social architecture, the institutional environment, the legal civilisation, the behaviours related to values) with inflows, such as investment capital, capital equipment, technology and specialised workforces. On the other side, culture, through the institutionalised system of redistribution of public revenues for social provisions and programmes (state budget) and the effective operation of the rule of law state, transforms the above inflows of resources to social capital. Furthermore, by means of increasing the social dividend it boosts the process of independent development, thus leading to the utilisation of all social forces and modernising the productive framework through the inflow of scientific and properly trained human resources. The institutional architecture and the axiological origins of the society affect the policies followed, since they relate culture to development in a harmonious manner”.

Hazakis (2011, p.180) also enriches the study and the research on competitiveness by encompassing a series of qualitative factors in his analyses. More precisely, he states that:

“It is further suggested that the notion of competitiveness is as much about qualitative factors (i.e., networks, interactions of institutions), as it is about quantifiable attributes (i.e., patenting rates or export market shares). Consequently, more attention should be given to the issue of the link between structures, agents and norms, to understand not only competitiveness outcomes, but also factors that determine the content of competitiveness. To put it simply, competitiveness depends both on intra-organisational resources and on extra-organisational assets. One needs to understand the dynamic interplay of these factors in a particular institutional setting, to explain the failure or success of firms”.

He (Hazakis 2010, p.1) also stresses the role of ethics when assessing transition economies. He suggests that:

“Transition economies need not to provide dichotomy between the end and the means of economic policies but rather need to reflect ethically how market and institutions interact efficiently, targeting in general economic and social welfare”.

From the above it can be argued that the political economy of regional integration can only be comprehended as part of a holistic approach in capturing the different levels of political and economic development. In such an approach, a series of indicators can be considered, namely:

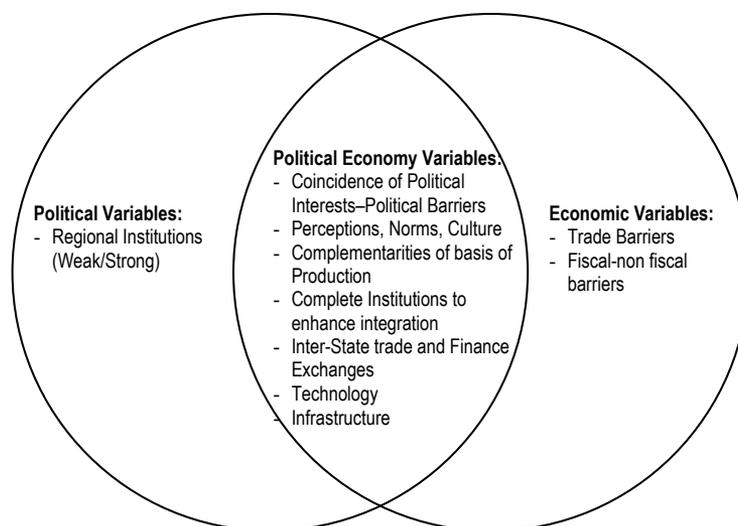
- *Economic indicators including:*
 - GDP growth
 - Trade in goods and services
 - Foreign Direct Investments
 - Equal distribution of income and wealth
 - Production structure

- *Political indicators including:*
 - Free elections
 - Free expression
 - Political willingness
 - Definition of national interests
 - Functioning of the party system
 - Participation in elections
 - National pride and sovereignty
 - National security
 - Level of political maturity
 - Functioning of institutions
- *Social indicators including:*
 - Social participation
 - Respect for human rights
 - Female participation

By stating the above indicators it can be claimed that the evaluation of a regional integration process overpasses the pure economic criteria, to a large extent. Social and political elements play their own role and in a lot of cases overweigh the neoclassical economic prerequisites. Abolition of trade, fiscal and other barriers of pure economic nature is only one part of the whole picture. However, the perceptions on national interest, identities and norms, national security notions as well as the dependency path, play their own role when assessing the success or failure of a process. Thus, political willingness still remains the question.

Such a methodological approach may be figured as below.

Figure 2: Capturing Regional Economic Integration



The above Figure makes clear that from a personal point of view the variables to be assessed when attempting to evaluate perspectives for regional economic integration can be considered as follows:

A. Traditional Economic Variables:

1. Trade barriers

The level of removal of trade barriers and trade distortion measures and policies is a clear indication of the level of regional economic integration to be achieved. The more trade barriers exist, the less integration level can be achieved.

2. Fiscal and non-fiscal barriers

The level of removal of fiscal and non-fiscal barriers and distortion measures and policies is a clear indication of the level of regional economic integration to be achieved. The more fiscal and non-fiscal barriers exist, the less integration level can be achieved.

B. Traditional Political variables

1. Regional Political institutions

The existence of strong regional institutions to mobilize regional economic and political initiatives in favour of regional economic cooperation and integration is a serious tool and mechanism towards achieving the direction and accomplishment of the process. Whether such initiatives are to have a sound basis or they are to “swallow” attempts may be an indication of the depth of any effort undertaken.

C. Political Economy variables

1. Coincidence of national interests and political barriers

The coincidence of national interests at a given moment is, in my opinion, a serious impetus to mobilize, initiate and deepen regional economic integration schemes. The existence or non-existence of political barriers is a parameter to be considered when assessing the attempts for regional integration. More precisely, historical events, political rivalries and the existence of minorities may be elements that can or cannot enhance regional economic integration prospects.

2. Perceptions, Norms, Values, Culture

A common perception in both government and people’s level of the nations to go ahead with a regional integration scheme is a prerequisite for its success or failure. The larger the level of common understanding is, the better the chances for the said scheme are.

3. Complementarity of Productive basis

It is proven that countries with complementary productive basis have more possibilities to benefit from a regional economic integration scheme. In other words a south to south integration scheme has less chance to be successful compared to a north-south scheme. The comparative advantage theory can be more successful and applicable in economies whose

productive basis is complementary rather than competitive and potentially antagonistic. This is more obvious in the cases of economies whose productive basis is heavily dependent on agriculture or in non-competitive sectors.

4. Complete and Mature Institutions

Incomplete and / or immature political and economic institutions are a serious impediment for regional economic integration. Within this specific variable I also encompass administrative capacity, effectiveness, as well as the level of corruption and the level of satisfaction for its citizens.

5. Inter-state trade and financial transactions

Inter-state and financial transactions among the nations to participate in a regional economic integration scheme are a positive indication for the success or failure of that scheme. The evolution of the level of transactions may also be an indication of the prospects.

6. Technology

Regional economic cooperation prospects among countries with low level of technology are limited. Limited use and low level of technology among the countries to potentially participate in a regional economic integration scheme means fewer possibilities for communication and material and non-material exchanges and limited communication channels among the people, thus reduced level of understanding, more normative obstacles and lack of common principles.

7. Infrastructure

The existence and use of high levels of infrastructure, that is an extensive transportation network, telecommunications, etc. is a positive contributing factor for achieving regional economic integration. The lack of such an infrastructure basis is a negative factor when assessing regional economic integration prospects.

Having developed an analytical and methodological framework of analysis I will now proceed with the application of the said variables in order to assess the political economy of regional economic integration in the Western Balkans.

4. The Political Economy of Regional Integration in the Western Balkans

In order to evaluate the prospects for regional economic cooperation in the Western Balkans the explanatory framework developed above will be used. More precisely, the variables to be assessed are the following: coincidence of national interest, common perceptions on norms, principles, culture, complementarity of productive basis, political barriers, complete and mature institutions, inter state trade and finance transactions, technology, infrastructure. With the term Western Balkans it is meant the countries of

Albania, Former Yugoslav Republic of Macedonia (FYROM), Kosovo (under the UN Resolution 1244), Serbia, Montenegro and Bosnia & Herzegovina.

1. Coincidence of national interests and political barriers

It is more than evident that national interests as they have been expressed by the political elites of the countries concerned are not coinciding. There are a series of indicators that clearly prove the above argument. More precisely, Table 1 exposes the most indicative ones:

Table 1: Level of coincidence in national interests among the Western Balkans states – political barriers

Negative Indicator	Yes (countries involved)
Cross – boundary disagreements – political barriers	Yes (FYROM-Kosovo; Kosovo-Serbia, Serbia – B&H)
Conflicting declarations and public statements	Yes (Kosovo-Serbia, Serbia-FYROM, Serbia-Croatia, Albania-FYROM)
Ethnic minorities rights issues raised	All the countries in the region
Separatist aspirations within states	Yes (Kosovo, FYROM, B&H, Serbia)
Perceptions on potential armed conflict	Yes (all countries)

It is also characteristic that although most Balkan citizens did not anticipate another armed conflict in the region, the proportions of those respondents holding this view varied between 62% in Serbia and 88% in Croatia (Balkan Monitor, 2010). A notable change was registered in Bosnia and Herzegovina: since 2009, the share of interviewees thinking that the risk of war was not imminent has increased sharply by 22 percentage points to 49%. Respondents in FYROM and Serbia were the most likely to say that it was *probable* or *certain* that war would break out in the region (28% and 24%, respectively).

2. Common Perceptions on Norms, Principles, Culture

Researches have indicated that the level of common perception in terms of norms, principles and cultures among the people in the Western Balkans is still very limited (Andrianos 2007). A series of indicators demonstrate that we are still a long way from reaching a common understanding in terms of a common future under common rules and guidelines. Indicative indicators include:

The role of religion. Religion is gaining importance for most ethnic groups in the Western Balkans. The only groups that placed less importance on religion were nationals in FYROM and Bosnians in Bosnia and Herzegovina (Balkan Monitor, 2010).

The expectation for the future. As in earlier survey waves, respondents across the Western Balkans were more prone to see *better opportunities abroad* than at home (Balkan Monitor, 2010). Notable developments were registered in Albania and Kosovo, where the numbers being provided better opportunities outside their country have fallen dramatically since 2008: by 25 percentage points in Kosovo (to 48%) and by 12 points in Albania (to 52%). The opposite was seen in Croatia and Montenegro, where the shares of interviewees being provided better chances abroad have increased (since 2008) by 17 points (to 48%) and by 14 points (to 52%), respectively.

Social and Economic Integration of Minorities. Statistics demonstrate that national minorities are not socially and economically integrated. It is characteristic that unemployment rates among national minorities still remain considerably higher than majority populations in the respective countries. Additionally, free movement of persons is not yet guaranteed, for example, in Kosovo, which mainly affects minority groups and enclaves in the region (European Commission, 2009b). The situation in Serbia is also elusive. More precisely, it is stated that (European Commission):

“As regards *Vojvodina* no agreement has been reached at national level on the adoption of a new Statute. An agreement on the restructuring of the Government Coordination Body for *southern Serbia* was reached. However the situation in southern Serbia deteriorated in July 2009 following a number of attacks on the Serbian gendarmerie. The situation in *Sandžak* is volatile; divisions within the Muslim community have continued and there have been several outbreaks of violence. The number of *refugees* and *internally displaced persons (IDPs)* in Serbia remains high. The situation for IDPs continues to be very difficult and they are faced with many obstacles in exercising their social rights”.

The situation in Montenegro is also similar (European Commission, 2009c). It is stated that:

“The social and economic situation of displaced persons and the RAE population remains a matter of serious concern. They continue to face very difficult living conditions and discrimination. Implementation of legislation and strategies must be pursued with more determination”.

3. Complementarity of Basis of Production

The level of complementarity on the basis of production is limited. This means that we are facing the potential for competition among the economies rather than the potential for cooperation.

Among the key structural challenges in the economies of the Western Balkans the following are included (OECD 2010):

- Small private sector;
- Low level of innovation by domestic firms with emphasis on processes rather than R&D;

- Weak linkages between business and tertiary education and skills gap;
- Export profile dominated by low skilled services and natural resource intensive products.

Grupe and Kusic (2005) argue that although there are still some non-tariff trade barriers in South Eastern Europe, the main reason that actual and potential trade is still rather low is related to similar trade structures and little complementarities. The comparative advantages are overlapping to a large extent.

The need for differentiation through value-added services and innovation is apparent (OECD, 2008, p.19):

“To support growth, sector specific policy barriers need to be removed. In the apparel manufacturing sector, investing in technology to upgrade offering capabilities is key to responding to investor requirements: for example, investing in electronic data interchange (EDI) to reduce lead times, or in equipment to move from cut-make-trim (CMT) manufacturing and become original equipment manufacturers (OEMs) able to provide finished goods. However, access to and the cost of finance are a significant constraint on investment. On average, companies in the sector need collateral of 177%, with an interest rate of 11%. There is a need to improve awareness of the type of financing available and the requirements for obtaining it. In the automotive components sector, there is a need to enhance collaboration efforts with international companies to upgrade capabilities. More than 50% of companies are experiencing a skills gap in regard to design, supply chain and logistics capabilities. There is a need to improve both sector linkages between original equipment manufacturers (OEMs) and suppliers, but also to improve awareness of local capabilities that could be exploited much further through, for example, regional supplier databases”.

4. Institutions

Institution and Capacity – Building in the region still has to be developed further. Based on EC’s appraisal (European Commission, 2009a):

“Kosovo is not yet ready to negotiate and implement a trade agreement. For example, the administrative capacity to ensure the effective implementation of antitrust policy and state aid regulation needs to be prepared. As regards intellectual property rights, key elements of industrial property rights legislation are in place, but Kosovo still needs to build the basic administrative capacity to ensure compliance. Kosovo also needs to make significant progress in legislative alignment in the area of copyright legislation and enforcement. It also needs to make significant progress in the legislative and institutional structures affecting trade in goods, including sanitary and phyto-sanitary matters. The institutional framework to ensure adequate accreditation, certification, standardization and market surveillance needs to be applied effectively”.

Level of satisfaction from government’s performance is still limited (Balkan Monitor, 2010). Relative majorities of respondents in Albania, Kosovo and Montenegro were

satisfied with their countries' government. In Serbia, Croatia and Bosnia and Herzegovina, respondents were at least three times as likely to disapprove of their countries' government as to be satisfied. Albania was an exception: its citizens' approval of the government has increased strongly by 17 percentage points (to 48%) since 2006.

Perceptions on Corruption level is considerably high in the countries of the region (Euractiv, 2010). The survey, carried out in September 2009, revealed that more than two-thirds of Balkan respondents see corruption as "pervasive" and "widespread" in both government and business. The perception of corruption in business is highest in Croatia (92%), Serbia (91%) and Bosnia and Herzegovina (90%), with the figure having risen for all countries except Albania and Macedonia since 2006. The perception of corruption in government is highest in Kosovo (84%) and Bosnia and Herzegovina (81%), with Montenegro the notable exception at a much lower level of 49%. Alarmingly, more than a quarter of respondents in Bosnia and Herzegovina and Kosovo said they are personally affected by organised crime in their day-to-day life. More than half of Albanians said they had to offer a bribe or gift to solve a problem last year, compared to just 8% of Croatians.

5. Inter-state trade and financial transactions

Inter-state trade and financial transactions is limited within the region, although the level of economic integration of each one individual state with the EU increases. This means that we are facing a paradox: an increasing tendency for economic integration with the EU for every individual state, with limited development to what concerns inter-state trade and financial transactions among the states of the region themselves.

It is characteristic that the European Commission states for Kosovo (European Commission, 2009):

“The openness of the economy, measured by the value of imports plus exports in goods and services as a percentage of GDP, increased to 71.1% in 2008, up from 64.5% in 2007. EU Member States and CEFTA continued to be the two main trading partners for Kosovo, accounting for 40% of total trade each, the latter despite Serbia's blocking the exports and Bosnia and Herzegovina's refusing preferential treatment. The share of exports bound for the EU increased from 42% in 2007 to 47.8% in 2008. The EU's share of total imports remained at around 36%. *Overall*, economic integration with the EU has increased”.

6. Technology

The level of technology in the countries of the region is considerably low. For Kosovo, for example, it is stated that (European Commission, 2009):

“*Overall*, the technology base and the state of physical infrastructure remain weak and the pool of qualified human capital small. As a result, Kosovo companies are too rarely competitive even in sectors where competitive potential exists”.

The outcome for the rest of the countries of the region is very much the same. It is also characteristic that high technology exports as % of manufactured exports in 2008

accounted for 4% in the case of Albania and Bosnia & Herzegovina (World Bank, 2011). OECD (2008, p.20) also states:

“Due to the mismatch between skills demanded and skills supply, the Western Balkans faces a serious challenge in supporting growth in most sectors. For example, 44% of automotive component companies identify availability of skills as a top challenge they face in expanding operations. Lack of skills has a negative impact on competitiveness – increasing operating costs, lowering output quality and contributing to a loss of business. Mechanisms for institutionalization and dialogue between ministries of economy/industry and education are limited. This reduces the possibilities to match supply with demand at the structural level. Moreover, many nationally sponsored reform initiatives fail to include all relevant stakeholders in the reform process, limiting the political support needed to see reforms through”.

7. Infrastructure

Overall, the infrastructure in Western Balkans is considered to be poor and under developed. This entails road transport, railways as well as aviation (European Commission, 2009). Petrakos (2000) states that given the weak existing regional trade network, the existence of infrastructure gaps, and the diversity of countries now existing in the Balkans, the prospects for trade expansion in the region are modest. Overall, the infrastructure is considered to be among the weaker elements when considering the prospects for regional economic integration in the region of the Western Balkans.

The empirical analysis can be summarized in the table below.

Table 2: Political Economy Variables for Regional Integration in the Western Balkans Level of Accomplishment / Intensity

Variable	Level of Accomplishment - Intensity	
	Low	High
Coincidence of national interest and political barriers	√ (for coincidence of national interest)	√ (for political barriers)
Common Perceptions on Norms, Principles, Culture	√	
Complementarity of Productive Basis	√	
Complete and Mature Institutions	√	
Inter State Trade and Finance Transactions	√	
Technology	√	
Infrastructure	√	

The above table clearly demonstrates that the variables denoting regional economic integration prospects among the Western Balkans economies show a remarkably negative tendency. In my opinion, this justifies why existing attempts have had limited success while prospects for the future also seem to be dim.

5. Conclusions and Assumptions for the future

In the paper it was argued that normative neoclassical approaches in regional economic integration present an inadequate framework for assessing existing efforts and preview the faith of the future ones. Political economy variables may offer a satisfactory and in depth evaluation of both the current situation and the future perspectives and endeavours. In this framework, seven political economy variables to measure regional economic integration endeavors were introduced, namely: coincidence in political interests and political barriers, common perceptions, values, principles, culture, complete and mature institutions, complementarity of productive basis, inter-state trade and financial flows and transactions, technology, infrastructure.

The proposed framework in the case of the Western Balkan economies was applied providing an explanatory basis for assessing current regional economic attempts and evaluating future perspectives. I have justified why regional economic efforts are limited and the prospects non-pragmatic. The main reason is the fact that empirical analysis of the above political economy variables mentioned seem to be of a low intensity and low level of accomplishment. I conclude that potential economic integration efforts in the region may be achieved only through a top-down approach, namely a European Union/International Community forced process, rather than resulting from genuine efforts initiated by the respective countries of the region.

The above proposed framework analysis could also be useful when assessing regional economic integration schemes among low economically developed, war torn, multiethnic societies such as the cases of the regions of Central and Sub Saharan Africa or Central Asia. The level of intensity and accomplishment (high/low) of the proposed political economy variables can be an indicator of potential regional economic integration.

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Infrastructure, Economic Growth and Population Density in Turkey

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Abstract

Transportation infrastructure is an exciting topic for public policy, private sector and the connection between them. This study deals with the impact of railways as hard type of transportation infrastructure on economic growth and population density. The purpose of this study is to search for historical relationships between railway infrastructure and economic growth; and between railway infrastructure and population density in Turkey. By using annual data for 1950-2004, both tangible and intangible effects of railway infrastructure are aimed to be estimated. The results from cointegration and causality tests imply that there is a positive long run relationship between railway length and population density and between railway length and real GDP per capita. Railway length causes real GDP per capita to increase only in the long run but it causes population density to increase both in the long and the short run. These results confirm the theoretical framework that improvements in transportation infrastructure lead to higher income and higher population in the investigated area.

Keywords: Hard types of infrastructure, Public Policy, Transportation systems, Railways, Causality

JEL classification: H54, O40, L92

1. Introduction

Public and private sector complementarities have many important linkages for stabilized continuity in terms of infrastructure in wide range (such as transportation, communication). Firm clusters, national and international companies establish their production facilities near transportation sources to benefit from the services they provide. Firms are in need of more opportunities and maintenance from public authorities for various transportation systems. In addition, when new plants are built, public service expenditures such as water, sewer, electricity, telephone lines and internet lines are provided by public sector. Public authorities' support is crucial for private sector settlements for different

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kinds of reasons; for example, more plants offer new job opportunities, thus, they reduce unemployment around those areas.

This perspective argues that public policies create important incentives for private sector as they affect private sector output, labour market, manufacturing industry and many other economic measures. Therefore, public policy should contain feasible and beneficial elements of infrastructure investment to sustain development. Thus, transportation infrastructure is an exciting topic for public policy, private sector and the connection between them. Transportation systems improve rapidly and these improvements go parallel to economical issues such as manufacturing industry production and exports. This is a strong basis for public sector to make innovations, purchase new equipments and provide better maintenance for transport infrastructure.

There are two types of infrastructures; hard type of infrastructure and soft type of infrastructure. Transportation systems or in other words transportation infrastructure is considered to be a part of both types. Hard type of infrastructure deals with roads, highways, railways, harbours, airports, water and sewer and other. Soft type of infrastructure concerns telephone lines, internet, other communication infrastructures and institutional infrastructure types which act as complements to hard types of infrastructure. In this study, hard types of transportation infrastructure, and especially railways, are taken into consideration due to their positive role in the historical economic development of Turkey.

The purpose of this study is to search for historical causality relationships between railway infrastructure and economic growth and between railway infrastructure and population density. By these, it is aimed to measure not only the tangible but also the intangible effects of railways.

The next section of the study provides the literature review about the proposed hypothesis. The third part includes the data as well as the methodology. The results, which are obtained by relevant econometric tests, are presented in the empirical analysis part. The conclusion and the policy implications are given in the fifth section.

2. Literature Review¹

2.1 Transportation Infrastructure and Economic Measures

The effects of infrastructure on economic measures have been investigated for more than three decades. These effects became more visible with the increase of trade in the world which resulted in the requirement of faster and multi dimensional trade routes. Firms began to form clusters near airports and harbours. More firms meant more plants which increased the demand for infrastructure. Therefore, infrastructure investment became one of the most susceptible connections between the private sector and public authorities.

The pioneer study which considers the relationship between economic and infrastructure measures from public and private sector complementarity perspective,

¹ This section provides only a brief discussion of the literature. The authors have conducted a comprehensive literature survey which is dismissed due to space limitations.

is Aschauer (1989) where he investigates the impact of public capital on private sector productivity. His results indicate that the elasticity of private sector productivity with respect to public capital is positive, meaning that infrastructure has positive impact on private sector productivity.

In a later study, Aschauer (1990) defines an exact transportation infrastructure rather than a basket of infrastructure measures and selects highways to analyse the impact on per capita income. His findings denote there is a positive relationship.

Government expenditures on transportation are analysed by Jones (1990) and Mofidi and Stone (1990) with the help of a production function; where Jones (1990) takes employment, income and investment as economic measures and finds that transportation expenditures have positive effects on these economic measures. Mofidi and Stone (1990) also find positive interaction between highway spending and manufacturing investments and employment. Munnell and Cook (1990) follow previous studies and they show that highways increase Gross State Product (GSP). Similarly, Duffy-Deno and Eberts (1991), Eisner (1991), Garcia-Mila and McGuire (1992) and Moonmaw, et al. (1995) find a positive relationship between transport infrastructure and per capita income. Singletary, et al. (1995), Crihfield and Panggabean (1995), Garcia-Mila, et al. (1996) and Fernald (1999) attain similar results, such that highway constructions have positive impact on manufacturing industry employment growth, manufacturing output, private sector output and productivity.

The researchers that use cost function approach also come up with positive impact of transportation infrastructure. Berndt and Hansson (1992), Lynde and Richmond (1993), Seitz (1993), Nadiri and Mamuneas (1994), Conrad and Seitz (1994) and Boarnet (1996; 1998) analyse Sweden, United Kingdom, West Germany and USA, respectively, and their common outcome is that transportation infrastructure is a cost reducing element in different geographies and industries.

The marginal contribution of public infrastructure relies on the structure of economy and previous conditions of the country (Crihfield and Panggabean, 1995). There is not a consensus on its effect on growth rate of output when transportation is viewed as public capital. The payoff of the investment is related to the size and configuration of the network, being usually smaller in the case of larger networks. If public capital is viewed as a public good, increases in the public capital shift the production function upward, raising the steady state level of output and the growth rate of the economy in the transition to the steady state. On the contrary, many services provided by the public capital stock may be subject to congestion, and therefore the marginal increments of the public capital stock may not have an impact on output. Sanchez-Robles (1998) show that infrastructure expenditures as a share of GDP yield inconclusive results but the indexes of infrastructure physical units are significantly and positively related to per capita growth.

2.1 Transportation Infrastructure and Demographic Measures

In addition to the effects of transportation infrastructure on tangible measures such as output, there are also intangible effects on demographic variables such as living standards,

population and migration. People may desire to live in a city, where their children can receive better education and they can find jobs with higher wages. This kind of behaviour tends to be seen more in developing countries rather than developed countries. That is why investing in transportation infrastructure has often been appraised as an effective strategy for policy-makers in underdeveloped areas rather than developed ones.

Although scholars define the role of transportation infrastructure differently on the basis of regional economic theories, all recognise the fact that it plays an important role in regional economic growth and development (Mikelbank, 1996). Demographers view transportation infrastructure as a necessary but not sufficient requirement for local economic growth and development (Halstead and Deller, 1997), as if transportation infrastructure is one of many factors affecting population change (Boarnet and Haughwout, 2000; Bohm and Patterson, 1971, 1972; Briggs, 1981; Hobbs and Campbell, 1967; Taylor, Broder, and McNamara, 1987; William, 1958).

Chi, Voss and Deller (2006) provide an extensive summary of the existing literature for transportation and population change. They argue that there are two ways to understand the relationship between transportation and population: the possible paths by which investments in transportation influence population change in addition to the stages (preconstruction, construction, and post construction) and spatial areas (urban, suburban, and rural) that population change is related to transportation. At the county and municipal levels, they address transportation as indirect causes of population change via economic growth, employment change, socio-demographic structures, and environmental change.

Growth theories (neoclassical growth theory, growth pole theory, and location theories) are the principal regional economic theories that relate transportation infrastructure investment to economic growth and population change. Neoclassical growth theory is insightful in explaining and predicting metropolitan development after the transportation network has been built. Neoclassical growth theory considers transportation infrastructure as an input into the production process (Boarnet, 1997; Eberts, 1990), an enhancer to increase the productivity of other inputs such as labour (Eberts, 1994) or a household amenity factor to attract workers (Eberts, 1994).

Growth pole theory is useful for forecasting population change from the standpoint of decision makers because it specifically outlines how resources should be invested in a region given limited resources to devote to economic growth and development (Thiel, 1962). Growth pole theory interprets transportation investment as a catalyst of change to influence population growth in its surrounding areas where population decline is also a possible outcome. Location theory is strong in interpreting geographic distributions of human settlements. This theory perceives transportation infrastructure as a facilitator for the flows of raw materials, capital, finished goods, consumers, and ideas among central places and their neighbourhoods and a limitation on these flows, as a means of importing inputs into and exporting outputs out of a location (Vickerman, 1991); or as necessary but not sufficient for local economic growth and development (Halstead and Deller, 1997).

Allen and MaClennan (1970) use growth pole theory to identify centers of economic activity that are believed to attract investment because of their agglomerative powers. They

observe regional problems which are caused directly and/or indirectly by public policies in Italy and France. The study identifies growth poles as urban areas having population interval between 30,000 and 200,000 residents. The research concludes that rural areas close to these cities may benefit from spread effects and public policies are effective among those benefit relations. Hansen (1971) uses regional development theory to determine the best use of infrastructure investment at a minimum population threshold of 250,000 for areas deemed worthy of infrastructure investment. He argues that investment in public infrastructure should be concentrated in urban areas that have some level of prior dynamism or development.

Gaegler, March and Weiner (1979) and Lichter and Fuguitt (1980) investigate the relationship between interstate highways and demographic measures such as employment population characteristics for various service industries in non-metropolitan counties during the period 1950-75. They find that counties with interstate highways consistently maintained an advantage over other counties in net migration and employment growth. Population growth was also found to be the greatest in interstate highway counties, with positive effects of highways on net migration, and the strongest in less remote areas.

Hilewick, Deak and Heinze (1980) is another empirical study which looks at rural growth effects of investing in transportation networks compared with the effects of investing in communications systems, thus, providing a comparison among soft type and hard type of infrastructure systems. They conclude that investing in communication results in stronger short-term and long-term effects rather than transportation investments on demographic and economic measures such as population, jobs, income, gross regional product and overall economic structure.

Carlino and Mills (1987) and McHugh and Wilkinson (1988) investigate the factors affecting US county population and employment growth during the 1970s. Total employment, manufacturing employment and population density are positively affected by the presence of limited-access highways.

Just as population change can have many causal factors, transportation can influence population change by several paths: economic growth or decline, employment and socio-demographic structure. Forkenbrock and Foster (1996) examine the degree to which highways as transportation measures are likely to influence business location decisions. They argue that access to highways generally has become a less important factor in location decisions than it was earlier. State-level highway investment policies that emphasise proper maintenance and relatively minor improvements are likely to be more cost-effective strategies for economic development than expensive highway construction projects.

3. Data and Methodology

3.1 Data

The variables used in this study are railway length for railway infrastructure, population density and real GDP per capita for economic growth. These variables are

represented by RW, PD and GDP respectively throughout the analysis. Data for railway length is acquired from Turkish State Railways (TCDD) (<http://www.tcdd.gov.tr>) in kilometers. Population and real GDP per capita data are acquired from Penn World Tables (<http://pwt.econ.upenn.edu>) and the areas in square kilometers are obtained from Turkish Statistical Institute (TUIK) (<http://www.turkstat.gov.tr>).

Population density data is not directly acquired from any database and therefore, population density² is calculated by dividing the population of the observed place by the area of the same place in square kilometers³. All data are obtained annually for the period from 1950 to 2004.

3.2 Methodology

The aim of this study is to investigate the historical relationships between railway infrastructure and economic growth as well as between railway infrastructure and population density for Turkey by using time series analysis (cointegration and causality analysis). The literature reveals that production-function and cost-function approaches in addition to causality analysis are widely used to test the relationship between transportation infrastructure and economic growth. Causality analysis is also used to investigate the effect of transportation infrastructure on demographic measures.

Time-series analysis requires that the variables should be tested in order to find their stationarity by applying unit-root tests. The stationarity of the variables are determined by the use of three different tests to check the robustness of the results: ADF (Augmented Dickey-Fuller), PP (Phillips-Perron) and KPSS (Kwiatkowski-Phillips-Schmidt-Shin) unit-root tests.

After unit-root tests, cointegration tests are performed as the second step. A cointegration analysis is used to determine whether a group of non-stationary variables are cointegrated or not. The Engle-Granger cointegration test, which is also called Engle-Granger two-step cointegration test, is conducted first and is composed of two steps. The first step gives the long-run relationship with respect to the coefficients and t-statistics of variables, integrated in the same order. The error term, which is taken from first step, is saved and ADF unit-root test is applied to error term (u_t) to find that if it is stationary or not. Error Correction Mechanism (ECM) is the aim of the second step and is the first lagged value of the error term (u_{t-1}) obtained from the first step. If that value is between 0 and -1, ECM is said to work.

Johansen cointegration test is also performed to compare the results of Engle-Granger cointegration test as the second test. Johansen cointegration test implements Vector auto-regression (VAR) based cointegration analysis developed by Johansen in the early 1990s.

Causality relationship analysis is the third step after unit root testing and cointegration analysis. Causality tests can be performed in both bivariate and multivariate models. A

² Population Density = Population / Area (number of inhabitants per square kilometer)

³ Lakes are excluded in the calculation of the population density of the observed area.

stationary variable X_{1t} is said to Granger-cause another stationary variable X_{2t} if the past values of X_{1t} are significant in the explanation of X_{2t} . If the variables are found to be cointegrated, the error correction terms of the cointegrating vectors are included in causality testing. Granger-Causality test is modeled as follows:

$$(1) \quad X_1(t) = \sum_{j=1}^p A_{11j} X_1(t-j) + \sum_{j=1}^p A_{12j} X_2(t-j) + E_1(t)$$

$$X_2(t) = \sum_{j=1}^p A_{21j} X_2(t-j) + \sum_{j=1}^p A_{22j} X_1(t-j) + E_2(t)$$

This model tests the causality relationship between two variables in both directions such as from railways to population and from population to railways. The direction of the effect is important as well as the magnitude of the relation. The test uses F-test on lagged values of both variables during the estimation process of the regression model. The general model (1) above is transformed to model (2) in order to test the relationship between real GDP per capita and RW and in order to test the relationship between PD and RW it is transformed to model (3). If the variables are found to contain unit roots, they should be differenced until they are stationary.

$$(2) \quad GDP(t) = \sum_{j=1}^p A_{11j} GDP(t-j) + \sum_{j=1}^p A_{12j} RW(t-j) + E_1(t)$$

$$RW(t) = \sum_{j=1}^p A_{21j} RW(t-j) + \sum_{j=1}^p A_{22j} GDP(t-j) + E_2(t)$$

$$(3) \quad PD(t) = \sum_{j=1}^p A_{11j} PD(t-j) + \sum_{j=1}^p A_{12j} RW(t-j) + E_1(t)$$

$$RW(t) = \sum_{j=1}^p A_{21j} RW(t-j) + \sum_{j=1}^p A_{22j} PD(t-j) + E_2(t)$$

4. Empirical Analysis

Before starting to employ the econometric tests, it is deemed valuable to graph the variables in question and provide descriptive statistics about them. Figure 1 through 3 plots the variables against the time period. Each variable is shown in individual graphs as their scales are different. Table 1 presents the descriptive statistics of the three series.

Figure 1: Population Density (number of inhabitants per square kilometer)

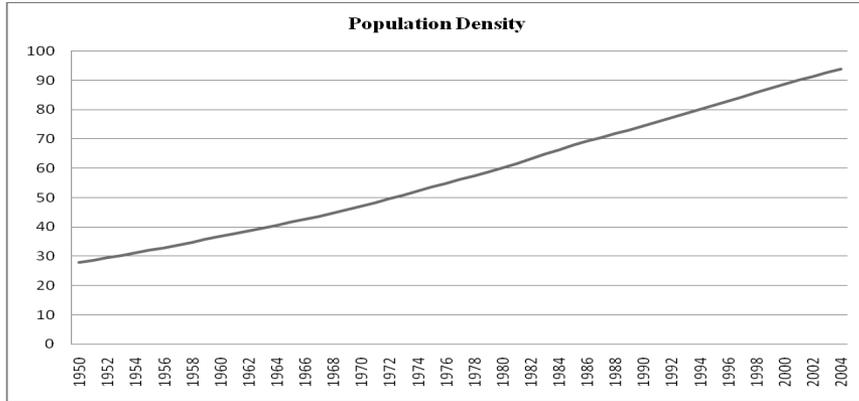


Figure 2: Real GDP per capita

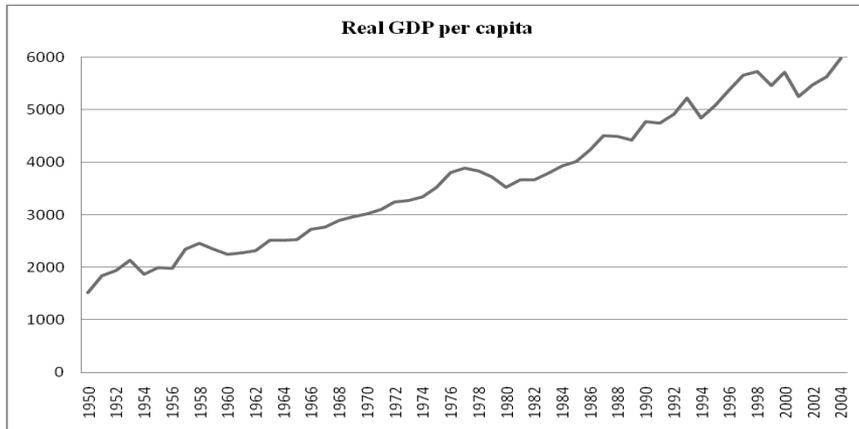


Figure 3: Railway Length (in km)

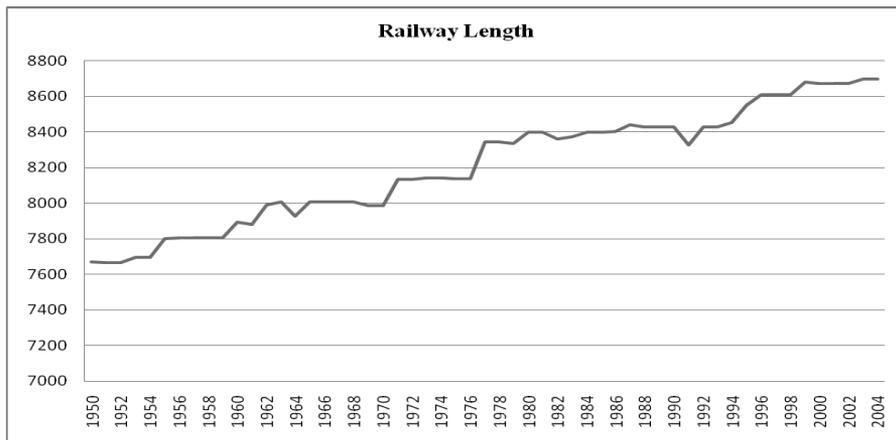


Table 1: Descriptive Statistics of Series

	PD	GDP	RW
Mean	3,9962	8,1407	9,0123
Standart Deviation	0,3678	0,3661	0,0389
Skewness	-0,2095	-0,2655	-0,1999
Kurtosis	-1,2139	-1,0046	-1,1651

Cointegration analysis is feasible only if the variables under consideration are integrated of the same order, i.e. if they have the same number of unit roots. Table 2 shows the results of the Augmented Dickey Fuller (ADF), Phillips-Perron and KPSS unit root tests for RW, PD and GDP. The results indicate that all variables have one unit root or in other words, they are integrated of order (1). This implies that cointegration analysis can be pursued.

Table 2: Unit-Root Tests

			GDP	RW	PD
ADF	No Trend	Level	-1,849** (1)	0,972** (1)	-1,367** (1)
		1st Dif.	-9,113 (0)	-9,135 (0)	-3,012 (2)
	Trend	Level	-1,804** (3)	-3,36** (1)	-3,047** (3)
		1st Dif.	-5,72 (0)	-9,082 (0)	-4,172 (2)
PP	No Trend	Level	-2,762** (0)	-0,866** (2)	-4,672 (1)
		1st Dif.	-14,857 (3)	-9,463 (3)	-2,560* (2)
	Trend	Level	-4,913 (0)	-3,37** (3)	-3,90* (5)
		1st Dif.	-28,285 (3)	-9,440 (2)	-0,935 (1)
KPSS	No Trend	Level	1,912* (2)	0,883** (6)	1,079** (5)
		1st Dif.	0.394 (2)	0,058 (2)	0,340 (6)
	Trend	Level	0.219** (3)	0,189** (2)	0,183* (4)
		1st Dif.	0.056 (3)	0,036 (2)	0,189 (9)

Note: *, ** and *** denotes the unit root existence at 1%, 5% and 10% significance levels respectively. The numbers in parenthesis are optimum number of lags determined according to AIC for ADF test; critical values are based on MacKinnon (1991). For PP and KPSS tests, numbers in parenthesis are the truncation lag determined according to Bartlett Kernel.

In the next step Engle-Granger two-step cointegration test is performed and Table 3 and Table 4 show the results of this test on the two hypotheses of the paper. In both cases, there is evidence of positive long run cointegration relationship. Railway length affects gross domestic product and population density positively with very close coefficients (11.29 and 11.84 respectively). ECM is obtained from the second step of Engle-Granger test as -0,17 and -0,02 for both hypotheses, which can be monitored in tables 3 and 4 respectively. ECM is working in both hypotheses because the values of the ECM terms are between 0 and -1 and are statistically significantly less than 0. It should be mentioned that the ECM term in the second regression in Table 4 is only just significant at the 10 % level and the coefficient of the term is much smaller than the one in Table 3, implying a much weaker error feedback effect.

Table 3: Engle-Granger Cointegration Test for railway length and real GDP per capita

$lgdp_t = \beta_0 + \beta_1 lrw_t + u_t$				
	Regressor	Coefficient	Standard Dev.	T-stat (Prob.)
1 st STEP	C	-96.2828	3.5321	-27.2594 [.000]
	RW	11.2855	0.3816	29.5701 [.000]
ADF on residuals: -3.5245** (1)				
$\Delta lgdp_t = \alpha_0 + \alpha_1 \Delta lrw_t + \alpha_2 u_t(-1) + e_t$				
	Regressor	Coefficient	Standard Dev.	T-stat (Prob.)
2 nd STEP	u_{t-1} (ECM)	-0.1709	0.0847	-2.017 [.049]

Note: * denote the rejection of the null hypothesis and ** denote the non-rejection of the null hypothesis at 5% level respectively. Critical value are based on MacKinnon (1991) and at 5% significance level are -2.9179; models include constant and no trend; k is the lag length used in the test for each series and number of lags are determined according to the AIC and given in parenthesis.

Table 4: Engle-Granger Cointegration Test for railway length and population density

$lpd_t = \beta_0 + \beta_1 lrw_t + u_t$				
1 st STEP	Regressor	Coefficient	Standard Dev.	T-stat (Prob.)
	C	-45.8564	1.1087	-41.3595 [.000]
	RW	11.8422	0.2758	42.9251 [.000]
ADF on residuals : -3.6124** (1)				
$\Delta lpd_t = \alpha_0 + \alpha_1 \Delta lrw_t + \alpha_2 u_t(-1) + e_t$				
2 nd STEP	Regressor	Coefficient	Standard Dev.	T-stat (Prob.)
	u_{t-1} (ECM)	-0,0176	0,0105	-1.6777 [.100]

Note: * denote the rejection of the null hypothesis and ** denote the non-rejection of the null hypothesis at 5% level respectively. Critical value are based on MacKinnon (1991) and at 5% significance level are -2.9179; models include constant and no trend; k is the lag length used in the test for each series and number of lags are determined according to the AIC and given in parenthesis.

Although Engle-Granger test is suitable for an analysis with two variables, Johansen cointegration test is also applied in order to test the robustness of the results. The results of this test provided in Tables 5 and 6, confirm the results of the Engle-Granger test of a cointegration relationship for both of the relationships. The coefficients are 13.09 and 10.64 respectively and statistically significant.

Table 5: Johansen Cointegration Tests for railway length and real GDP per capita

TRACE TEST					
Null	Alternative	Statistics	1 %	5 %	10 %
$r = 0$	$r \geq 1$	35.6366	25.0781*	20.2618*	17.9803*
$r \leq 1$	$r \geq 2$	8.6456	12.7607	9.1645	7.5567*
MAXIMUM EIGENVALUE TEST					
Null	Alternative	Statistics	1%	5%	10%
$r = 0$	$r \geq 1$	26.9910	25.0781*	15.8921*	13.9059*
$r \leq 1$	$r \geq 2$	8.6456	12.7607	9.1645	7.5567*
$lgdp_t = -49.17^* + 13.095^* lrw_t$					

*,*** denote statistical significance at 1 and 10 % respectively.

Table 6: Johansen Cointegration Tests for railway length and population density

TRACE TEST					
Null	Alternative	Statistics	1 %	5 %	10 %
r = 0	r >= 1	66.9313*	31.1538	25.8721	23.3423
r <= 1	r >= 2	7.4890	16.5538	12.5179	10.6663
MAXIMUM EIGENVALUE TEST					
Null	Alternative	Statistics	1%	5%	10%
r = 0	r >= 1	59.4423	23.9753	19.3870	17.2341
r <= 1	r >= 2	7.4890***	16.5538	12.5179	10.6663
$lpd_t = -40.97^* + 10.641^*lrw_t$					

*,*** denote statistical significance at 1 and 10 % respectively.

Granger causality test takes into account the cointegration relationships between the variables and tests the causality of this long run in addition to the short run causality by determined lag lengths. The causality test is carried through a vector auto regression where the short run causality is tested with F-test and the long run cointegration relationship is tested with t-test. All variables are in their first differences as they are found to contain one unit root. In addition, the ECM terms are included and tested as long term causality.

According to the results posted in Table 7, the long run relationship for railway length and real GDP per capita is significant for both directions; meaning that they cause each other in the long run. However, in the short run, real GDP per capita causes railway length to decrease (-0.036, -0.008).

Railway length causes population density to increase both in the short and the long run. The size of the F-statistics is interestingly very large (12943.36). Population density affects railway length only in the long run as the coefficient of the cointegration relationship is found to be significant.

Table 7: Granger Causality Test

null hypotheses	dependent variable	# of lags	f-test for short run	coefficients	t-test for long run
<i>Railway length doesn't cause GDP</i>	Δ (GDP)	(2)	2.226	-0.388 -3.067	-2.100**
<i>GDP doesn't cause railway length</i>	Δ (railway length)	(2)	3.744***	-0.036 -0.008	3.183*
<i>Railway length doesn't cause population density</i>	Δ (population density)	(3)	12943.36*	0.011 0.006 0.001	2.822*
<i>Population density doesn't cause railway length</i>	Δ (railway length)	(3)	2.004	-3.454 5.577 -2.535	2.739*

*, ** and *** indicate the rejection of the null hypothesis at 1, 5 and 10% significance levels respectively. Δ denotes change.

5. Conclusion

From the perspective of public sector and private sector complementarities, transportation infrastructure constitutes an important and interesting topic. National and international companies establish their production facilities near transportation sources to benefit from the services they provide. Firms are in need of more opportunities and maintenance from public authorities for various transportation systems. In addition, when new plants are built, public service expenditures such as water, sewer, electricity, telephone lines and internet lines are provided by public sector.

This study investigates the historical causality relationships between railway transport infrastructure and economic growth as well as that between railway infrastructure and population density in Turkey for 1950-2004. The long run estimation results indicate that both of the relationships are positive in the long run. Railway length causes real GDP per capita to increase only in the long run but it causes population density to increase both in the long and the short run. These results confirm the theoretical framework that transportation infrastructure leads to higher income and higher population in the investigated area.

There is also evidence that although increase in real GDP per capita leads to an increase in railway length in the long run, in the short run it leads to a decrease. This implies that when income of the country increases, resources are devoted out of railway infrastructure to other areas, but in the long run investment in railways continues. In addition, as railways

cause population density to increase in the long run, population density makes the same effect on railway length.

Finally, it should be emphasised that this study has focused only on bilateral relationships between railways and population and also between railways and income per capita. Future research on the topic will therefore be directed towards enhancing the analysis by utilising multi-variable econometric tools such as Vector Auto Regression Analysis (VAR) in which other relevant variables (e.g. agricultural production) can be included.

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The perceptions of managers of Greek firms regarding the Costs and Benefits ensuing from the adoption of International Financial Reporting Standards in Greece

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Abstract

The study seeks to investigate the costs and benefits resulting from the application of IFRS in Greece. A questionnaire survey was conducted in order to identify the perceptions of the financial managers of Greek listed firms regarding the benefits and the costs associated with the transition to IFRS. In addition, it was asked to indicate whether the IFRS benefits are sufficient to cover the related costs. Four types of costs appear to be prevalent: personnel training costs, consultants' fees, preparation of two sets of accounts and costs to adjust existing information systems. The findings of the analysis of the responses suggest that, although the majority of respondents believe that the introduction of IFRS improved the quality of the financial statements published by Greek firms, they have serious concerns regarding the costs related to the introduction of IFRS.

Keywords: IFRS adoption, Greece, costs, benefits

JEL classification: M41

1. Introduction

This paper investigates perceptions of managers of Greek firms regarding the costs and benefits ensuing from the adoption of International Financial Reporting Standards (IFRS) by companies operating in Greece. The benefits ensuing from the adoption of IFRS mainly relate to the quality of information provided to the users of the firms' financial statements and the comparability of financial statements. The financial statements prepared according to IFRS are supposed to provide a faithful representation of the firm's financial position and financial performance by assigning importance to the economic substance of events. The more complete and analytical the disclosures made in the financial statements

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are, the easier it is for the investors and other users of the firm's financial reports to evaluate its financial position and financial performance (Sunder, 2007). The costs of implementing IFRS usually relate to personnel training costs, consultants' costs and costs to adjust existing information systems (Ionascu et al. 2007). A questionnaire survey was conducted in order to gather information regarding the perceptions of managers of a sample of Greek firms about the benefits and the costs resulting from the introduction of IFRS. The findings of the survey indicate that the Greek managers believe that the adoption of IFRS improved the quality of the financial statements of Greek companies. On the other hand, it appears that the introduction of IFRS is a high-cost process.

Previous research has investigated the costs and the benefits ensuing from the application of IFRS by Greek firms (Karamanis and Papadakis, 2008). The present study, in addition to investigating the costs and benefits related to the implementation of IFRS in Greece, it investigates whether the financial managers of Greek firms believe that the costs ensuing from the application of IFRS are justified from a cost benefits point of view. The findings of this study can be useful to accounting regulators in identifying and evaluating the benefits and costs entailed by the implementation of IFRS. The potential significance of the findings of this study is enhanced by the fact that it is conducted within the business environment of Greece that posses certain structural characteristics. In Greece, as in other European countries (e.g. France, Italy) many listed firms are characterised by a high degree of ownership concentration (Nobes and Parker, 2000), while a substantial proportion of listed firms can be identified as family controlled (Ballas and Tzovas, 2010). Bank loans constitute a major source of financing for most Greek firms (Bellas and Tzovas, 2008). The dominant role of the bank credit in the financing of business enterprises is a distinct characteristic not only of the Greek business environment, but also of many other European countries (e.g. France, Germany). The financial statements under IFRS are only prepared for financial reporting purposes. Yet, the fact that for decades the financial statements of Greek firms were used for tax purposes as well means that tax considerations might still influence the preparation of financial statements. The similarity of the characteristics of the Greek business environment with that of other European countries means that the findings of this study can contribute in identifying the costs and benefits resulting from the application of IFRS in other European countries.

The rest of the paper proceeds as follows. Section 2 discusses the literature on the benefits and costs related to the adoption of IFRS while in section 3 the sample and the research design followed in this article are described. Section 4 reports the results of the empirical investigation undertaken for the purposes of this study. Section 5 summarizes and concludes the paper with suggestions for further research.

2. Previous research

The introduction of IFRS is supposed to substantially improve the quality and quantity of the financial information revealed in the published financial statements (Sunder, 2008). The adoption of IFRS increases the comparability and the transparency of financial

statements (Jermakowicz, 2004). As a consequence, the introduction of IFRS should assist investors in their decision making and enhance stock market efficiency (Botosan and Plumlee, 2002; Healy and Palepou, 2001; Leuz, 2003, Iatridis and Rouvolis, 2010). The implementation of IFRS is accompanied by less earnings management (Renders and Gaeremynck, 2007; Iatridis and Rouvolis, 2010). Leuz et al. (2003) show that Greek firms appear to engage in some of the most extreme practices in the world. Bhattacharya et al. (2003) provide similar evidence, since in their study Greek firms are the most engaged in earnings management among companies from 34 countries. Further evidence is provided by Koumanakos (2007). A further cause of creative accounting is poor enforcement and poor creditor and investor protection, common in French-style civil law countries, which include Greece (Ballas and Tzovas, 2010; Chalevas and Tzovas 2010). It should be noted that poor legal protection of investors also appears to correlate with high ownership concentration (La Porta et al., 1998). Greek culture may also influence the disclosure behaviour of Greek firms. Greece is considered to be a low trust society with a strong element of individualism and a strong preference for state regulation (Ballas et al. 1998), which in the case of accounting manifests in the form of detailed rules over principles and economic substance (Ballas et al. 1998). In addition, large power distances and uncertainty avoidance characterises Greek society (Ballas et al. 1998). The impact of these cultural factors means that Greek firms will prefer confidentiality to transparency (Ballas and Tzovas, 2010). Confidentiality will have a direct impact on the level of information disclosure by firms (Alexander et al. 2003).

Within this context, the introduction of IFRS can improve the quality of the financial statements prepared by Greek companies. The financial statements prepared according to IFRS are supposed to provide a faithful representation of the firm's financial position and financial performance by assigning importance to the economic substance of events. The more complete, detailed and analytical disclosure requirements provided by the IFRS, the easier it is for the investors and other users of the firm's financial statements to evaluate its financial position and financial performance. According to Lang and Lundholm (1996), the precision of the analysts' predictions is positively associated with the increase of the level of the companies' disclosure.

On the other hand, the complicated nature of some of IFRS, the lack of guidance during the first application of the new standards, the system of deferred taxation and the underdevelopment of the capital markets of some countries have been identified as possible obstacles to the transition of the companies to this new status (Larson and Street, 2004). Furthermore, the emphasis assigned to fair value by IFRS is likely to introduce volatility in book values and reported earnings (Andrews, 2005; Barth et al. 2005; Goodwin and Ahmed, 2006; Hung and Subramanyan, 2007), and thus motivate firms to adjust their strategies and decision making processes in order to mitigate the adverse impact of the adoption on their financial reporting figures (Jermakowicz and Gornik-Tomaszewski, 2006; Iatridis and Rouvolis, 2010). Larson and Street (2004) suggest that a considerable number of European countries (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria, Romania, Iceland, Turkey) will continue to use national accounting standards, in parallel with IFRS, for individual accounts, implying the appearance of a

“double standards” system. Jermakowicz and Gornik-Tomaszewski (2006) argue that the complexity of IFRS, coupled with the lack of guidance and of a uniform interpretation, can hinder the transition to IFRS. In addition, Jermakowicz and Gornik-Tomaszewski (2006) provide evidence which indicates that many companies would have not adopted IFRS if it were not mandatory. In relation to the application of the European Accounting Directives by EU candidate countries, Day and Taylor (2005) underlined the importance of an adequate administrative and regulatory authority by agencies that are responsible for the implementation of the accounting standards in these countries. There can be detected a tendency by companies to postpone the implementation of IFRS, so that they can be better prepared for the upcoming changes and to limit the ensuing negative effects (Ionascu et al. 2007).

Previous research has indicated that there are some concerns regarding the costs related to the introduction of IFRS (see, Ionascu et al. 2007). The main costs related to the application of IFRS refer to the cost of staff training, the provision of consulting services and the adjustment of information systems (Ionascu et al., 2007). Furthermore, there is some skepticism concerning the extent to which the benefits related to the implementation of IFRS justify the implementation costs. In particular, a survey of listed firms in 12 European countries indicated that in many countries there are considerable concerns regarding the costs of moving in IFRS (e.g. Poland, Belgium, Luxemburg), while only 30 % of the Polish firms believe that the benefits would outweigh costs (Mazars, 2005). In Belgium and Luxemburg the 55 % of the respondents judge that the benefits will outweigh costs. On the other hand, only 20 % of Czech firms believe that the costs of moving to IFRS are considerable. Ionascu et al. (2007) found that 60 % of the finance directors of the Romanian firms believe that benefits from implementing IFRS are insufficient to cover related costs.

According to Karamanis and Papadakis (2008) Greek accountants and auditors believe that the introduction of IFRS will improve the quality of the financial statements prepared by Greek firms. In particular, they believe that the implementation of IFRS improves the understandability, relevance, reliability and comparability of financial statements. On the other hand, the respondents in the survey expressed some concerns regarding the difficulties they face when they implement IFRS. In particular:

- Lack of an integrated institutional-legislative framework
- Lack of adequate guidance regarding the technical aspects of the implementation of IFRS
- The fact that the IFRS encourage the exercise of professional judgment to a considerable extent means that firms have a considerable latitude to influence the level of accounting figures
- The fact that the non-listed firms apply the local GAAP may hinder the efficient functioning of the market while it may raise issues of unfair competition.

Interestingly, 66% of the auditors believe that benefits of the IFRS implementation justify the transition costs while 56% of the accountants judge that the implementation benefits justify the transition costs.

This study aims to investigate:

1. the extent to which Greek managers believe that the introduction of IFRS is necessary.
3. the perceived costs and the benefits resulting from the implementation of IFRS by Greek companies.

In order to investigate whether the managers of Greek firms believe that the introduction of IFRS was necessary, it was examined whether Greek firms implemented IFRS on a voluntary basis in the period before their application was mandatory. A voluntary application provides an indication that the firms that applied them voluntarily believe that important benefits ensue from the preparation of financial statements according to IFRS.

It is investigated whether the perceived application costs exceed the perceived costs benefits ensuing from the application of IFRS.

3. Methodology

A questionnaire survey was conducted in autumn 2008. The anonymous questionnaire was sent to the 100 largest listed companies, classified on the basis of their turnover (see Table 1). Of the 100 questionnaires that were mailed out, 42 were returned completed and usable. The response rate, therefore, is 42%. In certain questions the financial managers have the option of multiple answers. The questionnaire is presented in Appendix I.

Table 1: Sector classification of respondent companies

SECTOR	NUMBER OF COMPANIES
Personal and Household goods	6
Construction and Materials	5
Industrial goods and Services	4
Food and Beverage	4
Retail	4
Banks	3
Telecommunications	3
Basic resources	2
Travel and Leisure	2
Chemicals	2
Technology	2
Oil and Gas	2
Media	1
Financial services	1
Health care	1
Total	42

If the response rate is not sufficiently high, the extent to which the sample is representative of the whole population should be assessed and taken into consideration in the analysis of the responses to the survey. Moser and Kalton (1993) maintain that if the response rate is above the range of 20-30 %, the danger that a serious bias has been introduced in the sample is limited. As mentioned above, the response rate was 42 %. Thus, it can be argued that the probability that the data is seriously biased, may not be high. Yet, the issue of the non-response bias was examined. According to Moser and Kalton (1993), a convenient way to assess the extent to which the sample is representative of the population of interest is to include certain questions in the questionnaire, the responses to which can be subsequently checked against the population data. For this survey the analysis of the non-response bias was based upon the sector distribution of the responding firms. We used a t-test statistic in order to investigate whether the sector distribution of the respondent firms was significantly different from the sector distribution for the population of the 100 largest listed Greek firms. The results of the t-test statistic suggest that the sector distribution of the respondent firms was not significantly different from the sector distribution for the population of the 100 largest listed Greek firms.

4. Results and Findings

In order to examine whether the sample firms adopted IFRS on a voluntary basis the date of adoption of IFRS was examined. As it is reported in Table 2 only a small proportion of the sample companies (14,3%) adopted IFRS before their mandatory application. According to Ionascu (2007) a possible explanation for the firms' tendency to adopt IFRS before their mandatory application is their need to raise funds either domestically or from foreign capital markets. Karamanis and Papadakis (2008) found that respondents believe that the application of IFRS by Greek firms will improve their prospects of raising funds from the domestic and foreign capital markets.

Table 2: Date of implementation of IAS / IFRS

Date of implementation	Frequencies	Percentages
After the mandatory application	36	85.7%
Before the mandatory application	6	14.3%
Total	42	100%

It appears that a large proportion of sample firms (90,5%) applied IFRS due to legal obligation (see Table 3). A smaller proportion of the sample firms adopted IFRS for reasons related to the need to raise funds from foreign financial institutions (16,7 %). Only

three respondent firms (7,1 %) indicated that they adopted IFRS in order to improve their prospects in raising funds from domestic financial institutions. In seven cases (16,7 %) it was the management of the firm that took the initiative for implementing IFRS. Only one sample firm responded that it adopted IFRS after shareholders' request. These findings are not surprising given the structural characteristics of the Greek business environment. As mentioned earlier, Greek firms are characterised by a high level of ownership concentration. In most cases, the owners are actively involved in their companies' administration by occupying important posts within the organisational structure of their firms (Makridakis et al. 1997; Sykianakis & Ballas, 2006). Managers in such firms can communicate information regarding the firm's performance directly to their superior owner-managers without having to rely upon financial statements. Under these circumstances, there are no strong incentives for firms to provide high quality financial information to the firm's owners through published financial statements. Besides, the main providers of funds of Greek companies are banks. Banks developed a close relationship with many companies, while in certain cases they own part of the firm's share capital (Ballas and Tzovas 2010). Thus, banks in many instances may directly obtain any relevant financial information, without having to rely upon publicly disclosed data. It has been argued that the fact that financial accounting in many European countries has been dominated by tax regulations and has never developed to a genuinely independent branch of accounting can be partially attributed to the fact that when "... even listed companies in continental countries are dominated by banks, governments or families, the need for published information is less clear." (Nobes and Parker, 2000, p. 21).

Table 3: Reasons for the implementation of IAS / IFRS

Reasons for the implementation of IAS / IFRS	Frequencies	Percentages
Management's initiative	7	16,7%
Request of the shareholders	1	2,4%
Need to raise debt capital from domestic financial institutions	3	7,1%
Need to raise debt capital from foreign financial institutions	7	16,7%
Legal obligation	38	90,5%

The fact that only a small proportion of sample firms applied IFRS on a voluntary basis provides an indication that the perceived benefits related to IFRS were not apparent for most Greek firms. Alternatively, these findings may suggest that the costs associated with the application of IFRS were perceived to be significant.

The respondents in the questionnaire survey identified four major categories of costs

related to the transition to IFRS (see Table 4). In particular, they indicated that: the training cost of personnel, the preparation of two sets of accounts, the costs of consulting services and the adjustment of information systems are the main costs that are related with the adoption of IFRS.

Table 4: Occurrence of IAS / IFRS adoption costs

Type of cost	Frequencies	Percentages
Training of personnel	23	54.8%
Two sets of accounts	9	21.4%
Consultant's fees	27	64.3%
Adjustment of information systems	26	62%

Additional costs elements identified by the respondents include: cost of external auditing (four respondents), independent evaluators' fees (three companies), updating, researching and documentation costs (one company). These findings are in line with the findings of Ionascu et al. (2008). According to Ionascu et al. (2008) 94,7 % of the respondents indicated the training of personnel as major cost of IFRS transition, 71, 1 % indicated the adjustment of information systems, 65, 8 % the consultant's fees, and 23,7 % the double reporting.

An interesting finding from the analysis of the responses is that a considerable proportion of the responding firms (21,4 %) identify the preparation of two sets of accounts (one set according to IFRS and one according to the local GAAP) as a significant cost element. In fact, it appears that 20 (47, 6 %) of the responding firms prepare two sets of accounts (see Table 5). In particular, they prepare their financial statements according to the local GAAP and they subsequently restate these statements according to IFRS. This finding is in line with the findings of Larson and Street (2004).

Table 5: Type of reporting

Type of reporting	Frequencies	Percentages
Full IAS / IFRS	22	52.4%
Restatement	20	47.6%
Total	42	100%

With respect to the benefits ensuing from the introduction of IFRS a large proportion of the respondents (71%) believe that the introduction of IFRS was necessary for the listed firms since the financial statements prepared according to IFRS offer more useful

information to investors (see Table 6). Half of the respondents believe that the companies that apply IFRS will have easier access to the foreign financial markets. According to 48% of the respondents, the financial statements that are prepared according to IFRS provide valuable information not only to external users of accounts but also to the firms' managers as well. These findings are consistent with the findings of previous research (see, Colwyn Jones and Luther, 2005; Ionoscu et al. 2007; Karamanis and Papadakis, 2008; Ballas and Tzovas, 2010; Ballas et al. 2010). Iatridis and Rouvolis (2010) found that the implementation of IFRS improved the quality of the financial statements prepared by Greek firms since the financial statements provide more value relevant accounting measures.

Table 6: Benefits from the implementation of IFRS

Advantages of the implementation of the IAS / IFRS	Frequencies	Percentages
Relevant information to investors	30	71%
Access to foreign financing market	22	52%
Solutions for transactions not yet regulated	7	17%
Good information resource for decision making	20	48%
Straightforward accounting system	18	43%

The respondents were asked to relate the costs and the benefits which are associated with the implementation of IFRS. Some 42, 8 % of the respondents believe that in the initial period of applying IFRS the costs are more significant compared to the benefits ensuing from their application, while 16,8 % of the respondents believe that even in the long run the benefits will not exceed the costs which are associated with the costs related with the application of IFRS (see Table 7). On the other hand, 40,6% of the respondents believes that the benefits from the adoption of IFRS exceed the respective costs.

Table 7: Assessment of costs and benefits

Costs and benefits	Frequencies	Percentages
Costs exceeds Benefits	7	16.6%
Presently, lower benefits than costs	18	42.8%
Benefits exceed costs	17	40.6%
Total	42	100%

This finding is in line with the findings of Ionoscu et al. (2007) that found 60 % of the finance managers of Romanian companies believe that the IFRS benefits are insufficient to cover related costs. The benefits ensuing from the application of IFRS mainly relate to the improvement of the financial disclosure, which in turn improves the firms' prospects to raise capital in favourable terms. Yet, within the context of the Greek business environment this benefit may not be apparent. As mentioned above, the ownership structure of many Greek firms, coupled with the strong links that have been developed between firms and financial institutions, do not create strong incentives for the provision of high quality financial information. Consequently, the importance of public accounting information may further diminish. Within this context, the demand for high quality disclosure is not expected to be high. As a consequence, the importance of the benefits ensuing from the application of IFRS is undermined, especially when the costs of IFRS implementation are not trivial. The fact that only a small proportion of the respondent firms adopted IFRS on a voluntary basis, before the date of mandatory application (see, Table 2), might suggest that few of the respondents believe that benefits of the implementation exceed the corresponding transition costs. It should be pointed, however, that these findings are not consistent with the findings of Karamanis and Papadakis (2008). As mentioned earlier, the majority of respondents in the Karamanis and Papadakis (2008) survey believe that the costs of transition to IFRS would be recovered through the ensuing implementation benefits.

The changes that take place in the Greek banking system, as a response to the international and domestic financial crisis may influence Greek firms' attitudes regarding the benefits ensuing from the application of IFRS. Banks' loan decisions are likely to be based on strict financial criteria, while particular importance would be assigned to the quality of the financial information. Within this context, the financial statements prepared according to IFRS – assuming that they provide high quality financial information - can be an important informational input in the Greek banks' decision making process.

5. Conclusions

This study aimed to investigate the costs and the benefits related with the implementation of IFRS by Greek companies. A questionnaire survey was conducted in order to identify the perceptions of the financial managers of Greek listed firms regarding the benefits and the costs associated with the transition to IFRS. In addition, it was asked to indicate whether the IFRS benefits are sufficient to cover the related costs. The findings of the analysis of the responses suggest that, although the majority of the respondents believe that the introduction of IFRS improved the quality of the financial statements published by Greek firms, they have serious concerns regarding the cost/benefit relationship from the introduction of IFRS. A further investigation is required in order to ascertain whether specific companies' characteristics, such as the firm's size or the firm's ownership structure, can explain the managers' perceptions regarding the costs and benefits related to the introduction of IFRS.

6. Limitations

The present study investigated through a questionnaire survey the opinions of financial managers of a sample of Greek firms regarding the costs and the benefits related to the introduction of IFRS. In some questions managers were asked to provide multiple answers, but asking them to rank their responses would have offered further understanding of their perceptions. The use of semi-structured questionnaires and / or the conducting of interviews may provide alternative insights in the issues under investigation. Besides, the fact that financial managers had to bear the effort of implementing IFRS may bias their opinion. In order to acquire a more balanced perspective on the relationship between the costs and benefits of adopting IFRS it might be interesting to investigate the opinions of investors and financial analysts.

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Appendix: The Questionnaire

- 1) Your enterprise prepares its financial statements according to:
 - i. Applies only IAS/IFRS
 - ii. By restating the financial statements prepared in accordance with Greek accounting standards to the requirements of IAS/IFRS

- 2) Since when does your enterprise apply the IAS/IFRS
.....

- 3) The application of IAS/IFRS in your enterprise is due to:
 - i. Management's initiative
 - ii. the request of the shareholders
 - iii. the need for domestic financing
 - iv. the need for foreign financing
 - v. the mandatory accounting regulations
 - vi. other reasons:
.....
.....

- 4) Please state which is the most important component of the costs related to the implementation of IAS/IFRS for your enterprise? :
 - i. training of personnel;
 - ii. double reporting
 - iii. consulting services;
 - iv. adjustment of computer information systems;
 - v. Other costs:
.....

- 5) Have the costs of implementing IAS/IFRS been budgeted?
 - i. Yes
 - ii. No

- 6) The costs of implementing IAS/IFRS have not been budgeted because:
- i. the change of relevant legislation was made rapidly;
 - ii. the enterprise does not run a budget system;
 - iii. other reasons, please specify:
.....
- 7) In your opinion, the implementation of IAS/IFRS reporting offers the following advantages: (several answers may be chosen)
- i. it is an appropriate accounting system for listed companies as it offers relevant information to investors;
 - ii. permits the access to the foreign financing market;
 - iii. offers solutions for transactions not yet regulated;
 - iv. offers managers a good information resource for decision making;
 - v. it is a straightforward accounting system;
 - vi. other advantages, please specify:
.....
.....
- 8) How do you evaluate the relationship between the costs and benefits related to the implementation of the new reporting system in your enterprise?
- i. the benefits of implementing IAS/IFRS do not cover related costs;
 - ii. the benefits of implementing IAS/IFRS do not cover related costs at present, but these will be recovered in the future;
 - iii. the benefits of implementing IAS/IFRS exceed the related costs.
- 9) The finance and accounting personnel has been trained to apply IAS/IFRS:
- i. Yes
 - ii. No
- 10) Your enterprise has received/receives consulting services
- i. Yes
 - ii. No

- 11) What is your enterprise's relationship with the foreign financial market?
 - i. it frequently resorts to this type of financing;
 - ii. it occasionally resorts to this type of financing;
 - iii. does not resort to foreign financing market at present, but envisages this type of financing;
 - iv. it is not interested in this type of financing.

- 12) In the official classification, your enterprise is classified as:
 - i. a small enterprise;
 - ii. a medium-size enterprise;
 - iii. a large enterprise.

- 13) The share capital of your enterprise is:
 - i. wholly or majority owned by Greek shareholders;
 - ii. wholly or majority owned by foreign shareholders

- 14) What is the sector classification of your enterprise?
.....

Testing for Linear and Nonlinear Causality between Crude Oil Price Changes and Stock Market Returns

Emmanuel Anoruo¹

Abstract

This paper examines both the linear and nonlinear causal relationships between crude oil price changes and stock market returns for the United States. In particular, the study applied a battery of unit root tests to ascertain the time series properties of crude oil price changes and stock market returns. The linear and nonlinear causality tests were conducted through the standard VAR and the M-G frameworks, respectively. The results from both the linear and nonlinear unit root tests indicate that crude oil price changes and stock market returns are level stationary. The results from the standard VAR model provide evidence of bidirectional causality between crude oil price changes and stock market returns. The results from the M-G causality test support the finding of nonlinear bidirectional causality between crude oil price changes and stock market returns.

Keywords: Crude oil prices, nonlinear causality, stock market returns, BDS, structural breaks

JEL classifications: G10, G12, Q43

1. Introduction

An understanding of the relationship between high crude oil prices and stock markets is important to investors, financial analysts and policymakers. The conventional wisdom holds that high crude oil prices promote economic growth for oil exporting countries while on the other hand, stunts growth for oil importing countries. High oil prices decrease the amount of disposable income that consumers have available to spend on other goods and services. Furthermore, high oil prices lead to increases in the cost of production for non-oil producing firms. Increases in cost of production negatively affect the major determinants of stock market returns including corporate profits and dividends. The equity pricing model suggests that the price of equity at any given point in time is equal to the expected present value of the discounted future cash flows (Hung et al., 1996). Increases in crude oil prices are often associated with inflationary pressures. Thus, the central bank in an effort to avert

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the impending inflation increases interest rates. Increases in interest rates have direct effect on discount rates used in equity value calculation and hence lead to decreases in stock prices.

Given its importance in financial economics, a number of studies have examined the effect of high crude oil prices on stock markets. However, earlier studies on this issue lacked consensus relative to the impact of high crude oil prices on stock markets. For instance, Honarvar (2009), Lardica and Mignon (2008), Anoruo and Mustafa (2007), and Huang et al., (1996) found significant relationship between high crude oil prices and stock markets. However,

Al-Fayoumi (2009), Sari and Soytas (2006) and Maghyreh (2004) found that high crude oil prices have no significant effect on stock markets. Honarvar (2009) using the Crouching Error Correction Model examined the relationship between retail gasoline and crude oil prices for the U.S. He found evidence of cointegration between positive components of crude oil and negative components of gasoline prices. Based on this finding he concluded that in the long run that gasoline prices are more influenced by technological changes on the demand side than crude oil price movements on the supply side. Lardic and Mignon (2008) examined the long run relationship between crude oil prices and economic activity using asymmetric cointegration procedures for the U.S. economy, the G7, Europe and the Euro area economies. They found evidence of asymmetric cointegration between oil prices and GDP. However, they failed to reject the null hypothesis of no linear cointegration between oil prices and GDP. Anoruo and Mustafa (2007) examined the relationship between oil and stock market returns for the United States using cointegration techniques and the vector error correction model (VECM). They found that oil and stock market returns are cointegrated. Using the VECM they also found that causality runs from stock market returns to oil market returns but not vice versa. Based on these results, they concluded that the two markets are integrated rather than segmented. They interpreted the finding of cointegration between oil and stock market returns as evidence that investors cannot benefit from diversification by holding assets in oil and stock markets simultaneously.

Ciner (2001) examined the relationship between crude oil prices and stock market for the United States using the Hiemstra-Jones (1994) nonlinear Granger causality test. He found evidence that crude oil prices and the stock market returns are nonlinearly related. Ciner blamed the inability of the earlier studies to find significant relationship between crude oil prices and stock market returns on their use of linear models. Similarly, Sadorsky (1999) found that oil price shocks have significant implications for stock market returns. Jones and Kaul (1996) examined the relationship between oil prices and equity markets. They found that oil price shocks have significant effect on stock market returns for the United States. Huang, et al. (1996) using the VAR model examined the relationship between daily oil futures return and stock market returns for the United States. They found evidence of Granger causality running from daily oil futures return to stock of individual oil companies. However, they failed to find evidence of causality running from daily oil futures return to stock market returns (proxied by the S&P 500). Kaul and Seyhun (1990) investigated the

relationship between real stock market returns and the volatility of oil prices. They found that there is a significantly negative relationship between real stock returns and oil price volatility.

On a related study, Peri and Baldi (2010) using the threshold cointegration technique examined the long-run relationship between vegetable oil prices and conventional diesel prices in the European Union for the period spanning 2005 through 2007. In particular, they explored the issue of asymmetric dynamics between the prices of rapeseed oil, sunflower oil, and soybean oil, and the price of diesel. They found evidence in support of a two-regime threshold cointegration between the rapeseed oil price and the diesel price, but not for the other pairs. They therefore concluded that the rapeseed oil price responds asymmetrically to deviations from its long-run equilibrium with fossil diesel prices. Al-Fayoumi (2009) examined the relationship between changes in oil prices and stock market returns for three oil importing countries including Turkey, Tunisia and Jordan using the VECM. He failed to find evidence supportive of the notion that oil prices have predictive power on stock market returns for the sample countries. He therefore recommended that the authorities and portfolio managers should concentrate on other macroeconomic factors like interest rate and industrial production rather than oil prices in forecasting movements in stock market returns.

Bekiros and Diks (2008) examined the linear and nonlinear causal relationships between daily spot and futures prices for maturities of one, two, three and four months of West Texas Intermediate crude oil. They found that the linear causal relationships between daily spot and futures prices for maturities of one, two, three and four months crude oil prices tend to disappear after VECM cointegration filtering. In addition, they found that the nonlinear causal relationships in some cases persisted even after GARCH filtering in both periods which they considered. Based on these findings, they concluded that spot and futures returns might exhibit asymmetric GARCH effects. They also find that neither the spot market nor the futures market leads or lags the other consistently over time. In other words, the pattern of leads and lags was found to change with time. Sadorsky (2008) examined the relationship between oil price changes, firm size, and stock prices. Specifically, he investigated whether movements in oil prices have larger or smaller effects on the stock prices of small- or medium-sized firms. He found evidence that the relationship between oil price fluctuations and stock prices varied with the size of the firm. He further found that the relationship between oil price movements and medium-sized firms is the strongest.

Hammoudeh and Choi (2006) examined the relationships between stock markets and three global factors (i.e. the WTI oil prices, the U.S. 30-months Treasury bill rate and the S&P Index) for five members of the Gulf Cooperation Council. They failed to find evidence of direct impact of oil prices on the S&P 500 index. Agren (2006) investigated the volatility transmission between oil prices and stock markets using the GARCH model for Japan, Norway, Sweden, the U.K. and the U.S. He found evidence supportive of volatility transmission between oil prices and the stock markets for the sample countries. Sari and Soytas (2006) examined the relation of oil price shocks to real returns in Turkish stocks that

traded on the Istanbul Stock Exchange market. They found evidence that oil price shocks do not have significant impact on real stock returns for Turkey. Maghyereh (2004) using the VAR model investigated the relationship between crude oil price shocks and stock market returns for 22 emerging economies. Based on the results from the VAR model, he concluded that crude oil price shocks have no implications for stock market returns for the sample emerging economies.

Unlike most of the earlier studies that relied on linear models in examining the relationship between crude oil prices and stock market returns, the present study applies a more recent nonlinear causality test that is capable of conditioning on the samples of the causing variable being either positive or negative. In addition, the study uses longer time series spanning from February 1974 through December 2009. Given the length of the study period, the paper also applies the Bai and Perron (1998, 2001, 2003) procedures to search for possible structural breaks in the data.

The remainder of the paper is organized as follows. After the present introduction, section 2 provides the methodology. Section 3 describes the data and provides descriptive statistics. Section 4 reports empirical results of the study. Finally, section 5 offers the summary and policy implications.

2. Methodology

This study applies the modified Dickey and Fuller (DF-GLS) unit root test developed by Elliot et al. (1996). The DF-GLS procedure has been shown to have better power than the conventional Dickey-Fuller (Elliot et al. 1996). The DF-GLS unit root test is based on the following regression equation:

$$\Delta X_t^k = \alpha_0 X_{t-1}^k + \sum_{j=1}^m \alpha_j \Delta X_{t-j}^k + \mu_t \quad (1)$$

where m is the maximum lag, X_t^k represents locally detrended series of X_t [i.e. $X_t^k = X_t - z_t \tilde{\alpha}$, where $z_t = (1, t)$ and $\tilde{\alpha}$ is the regression of \hat{X} on \hat{z}]. The Modified Akaike Information Criterion proposed by Ng and Perron (2002) is used to determine the maximum lag lengths for the various time series in the system. The DF-GLS unit root test involves testing the null hypothesis that $\alpha_0 = 0$ against the alternative that $\alpha_0 < 0$, in equation (1).

2.1 Linear Granger Causality Test

To test for linear causality between crude oil price changes and stock market returns, the study implements the standard VAR model. Causality tests are based on the seminal work of Granger (1969). The following VAR models are estimated to ascertain the causal relationships between crude oil price changes and stock market returns:

$$SMR_t = \alpha + \sum_{i=1}^a \beta_i SMR_{t-i} + \sum_{j=1}^b \varphi_j COP_{t-i} + \mu_t \quad (2)$$

$$COP_t = \alpha + \sum_{i=1}^a \beta_i SMR_{t-1} + \sum_{j=1}^b \phi_j COP_{t-1} + \mu_t \quad (3)$$

where *SMR* represents stock market returns, *COP* stands for crude oil price changes, *a* and *b* are the maximum lag orders determined by the Akaike Information Criterion. The error term is represented by μ in equations (2) and (3). In equation (2), crude oil price changes have causal influence on stock market returns, if the regression coefficients on *COP* are jointly statistically different from zero. In either case, the null hypothesis that crude oil price changes do not Granger-cause stock market returns is rejected. The joint significance of the regression coefficients on *COP* implies that crude oil price changes are important in predicting movements in stock market returns. Similarly, the null hypothesis that stock market returns do not have causal implications for crude oil price changes is rejected if the regression coefficients on *SMR* in equation (3) are jointly significant at the conventional levels. The *F*-test is used to determine the joint significance of the variables in the VAR models.

2.2 BDS Nonlinearity Test

Prior to applying the M-G causality tests, the study implements the BDS nonlinearity test proposed by Brock et al. (1987, 1996) to determine the existence of nonlinear dependence in the data. The BDS test is applied to the residual of the series of interest. Nonlinearity is indicated if the test statistic is greater than the critical value for the standard normal distribution at the conventional levels. The BDS nonlinearity test is based on the correlation integral of the time series as follows:

$$W_m(\varepsilon, T) = \frac{\sqrt{T}[C_m(\varepsilon, T) - C_1(\varepsilon, T)^m]}{\sigma_m(\varepsilon, T)} \quad (4)$$

where $W_m(\varepsilon, T)$ represents the BDS test statistic, $\sigma_m(\varepsilon, T)$ stands for the standard deviation of $C_m(\varepsilon, T)$, *m* is the embedding dimension, while ε represents the maximum difference between pairs of observations considered in calculating the correlation integral. The BDS test statistic is asymptotically normally distributed with zero mean and unit variance [i.e. $N(0,1)$]. The null hypothesis of the BDS procedure is that the data are independently, identically distributed (i.i.d). The null hypothesis of linearity is rejected if the computed test statistic exceeds the critical value at the convention level. The rejection of the null hypothesis reveals the presence of nonlinear dependence in the data.

2.3 Bai and Perron Test for Multiple Structural Breaks

To address the issue of possible structural breaks in the data, the paper applies the Bai and Perron (1998, 2001, 2003) procedures. Structural break testing is important in this paper for two reasons. First, the paper employed longer time series starting from January 1974 and ending in December 2009. Second, structural breaks have been cited in the literature as one of the sources of nonlinearity in economic and financial time series

(Kyrtsov 2011, pp. 3). The Bai and Perron multiple structural break procedures involve three tests including the SupF type, the double maximum statistics – Udmax and WDmax, and the SupF($l+1|l$). The procedures involve regressing the variable of interest (Y) on a constant and then test for structural breaks. The tests are based on the following model with m breaks ($m+1$ regimes):

$$Y_t = \beta_t + \mu_t, \text{ for } t = T_{j-1} + 1, \dots, T_j, j = 1, \dots, m + 1 \quad (5)$$

where Y_t is a stationary variable in period t . β_t represents the mean variable in the j th regime. T_1, \dots, T_m are indices that represent the break points, which by assumption are unknown. In equation (5), y is estimated through ordinary least squares technique. Bai and Perron (1998) consider an F -statistic of the type given below:

$$SupF_T(b) = F_T(\lambda_1, \dots, \lambda_b), \quad (6)$$

where $\lambda_1, \dots, \lambda_b$ minimize the global sum of squared residuals $ST(T\lambda_i)$ with $i = 1, \dots, b$ (b is the number of breaks detected by the testing procedure). The paper assumes five structural breaks (i.e. $M=5$) in the data with a trimming factor of 0.15. To test the null hypothesis of no breaks in the time series against the alternative of an unknown number of breaks given an upper bound M , Bai and Perron (1998) proposed two test statistics known as the double maximum statistics (i.e. Udmax and WDmax). The Udmax procedure is given by the expression:

$$UDmax = \max_{1 \leq m \leq M} SupF_T(m) \quad (7)$$

In addition, Bai and Perron consider a different set of weights in such a way that the marginal p -values are equal for all values of m . This particular type of test is denoted as the WDmax. To determine the number of structural breaks in the data, Bai and Perron suggest that the researcher should first examine the results from the Udmax and WDmax to see if at least one structural break exists. The break points are then selected by examining the test statistics from the SupF($l+1|l$) procedures which involve sequential testing of the null hypotheses against various alternatives. For instance, the null hypothesis of l breakpoint is tested against the alternative hypothesis of $l+1$ breakpoints. Depending on the results from the SupF($l+1|l$) techniques, the Schwarz Information Criterion (BIC), the modified Schwarz Information Criterion (LWZ) (Liu, Wu, and Zidek (1994) and the sequential procedures can be used to select the exact number of structural breaks in the data.

2.4 Nonlinear Granger Causality Test

Hiemstra and Jones (1993) point out that one of the shortcomings of the linear causality tests involves their inability to detect the nonlinear relationships between macroeconomic variables. In addition to linear linkages, many financial time series including crude oil prices and stock market returns may be related in a nonlinear fashion. Kyrtsov and Labys (2006)

suggest that a small change in one variable can produce multiplicative and disproportionate impact on the variables in the presence of nonlinearity.

This paper applies the bivariate noisy Mackey-Glass (M-G) model proposed by Kyrtsou and Terraza (2003, Kyrtsou and Labys (2006) to determine the nonlinear causal relationship between crude oil price changes and stock market returns. The M-G nonlinear causality tests are based on the following:

$$X_t = a_{11} \frac{X_{t-\tau_1}}{1 + X_{t-\tau_1}^{c_1}} - \delta_{11} X_{t-1} + a_{12} \frac{Y_{t-\tau_2}}{1 + Y_{t-\tau_2}^{c_2}} - \delta_{12} X_{t-1} + \mu_t ; \mu \sim N(0,1) \quad (8)$$

$$Y_t = a_{21} \frac{X_{t-\tau_1}}{1 + X_{t-\tau_1}^{c_1}} - \delta_{21} X_{t-1} + a_{22} \frac{Y_{t-\tau_2}}{1 + Y_{t-\tau_2}^{c_2}} - \delta_{22} X_{t-1} + \mu_t ; \mu \sim N(0,1) \quad (9)$$

In equations (8) and (9) α and δ are parameters to be estimated. τ represents the delay parameter and c is a constant. Under the M-G framework, the parameters τ_1 , τ_2 , c_1 , and c_2 are selected a priori. The Schwarz criterion is used to determine the optimal delay parameters including τ_1 and τ_2 . The M-G nonlinear causality test involves testing whether the past values of a variable such as Y have predictive non-linear impact on the current value of another variable such as X and vice versa. The M-G nonlinear causality technique has a number of advantages over the conventional VAR model. First, the M-G technique has the ability to filter more difficult dependent dynamics in time series. Second, the M-G nonlinear causality model allows the researcher to isolate the effects of either negative or positive values of the independent variable on the dependent variable. For example, using the M-G asymmetric model the impact of positive/negative crude oil price shocks on stock market returns can be examined. The null hypothesis that y does not M-G cause x is $\alpha_{12} = 0$. The null hypothesis is rejected if the F -statistic is greater than the critical value at the conventional levels. Details of the M-G framework can be found in Kyrtsou and Terraza (2003) and Kyrtsou and Labys (2006).

3. Data and Descriptive Statistics

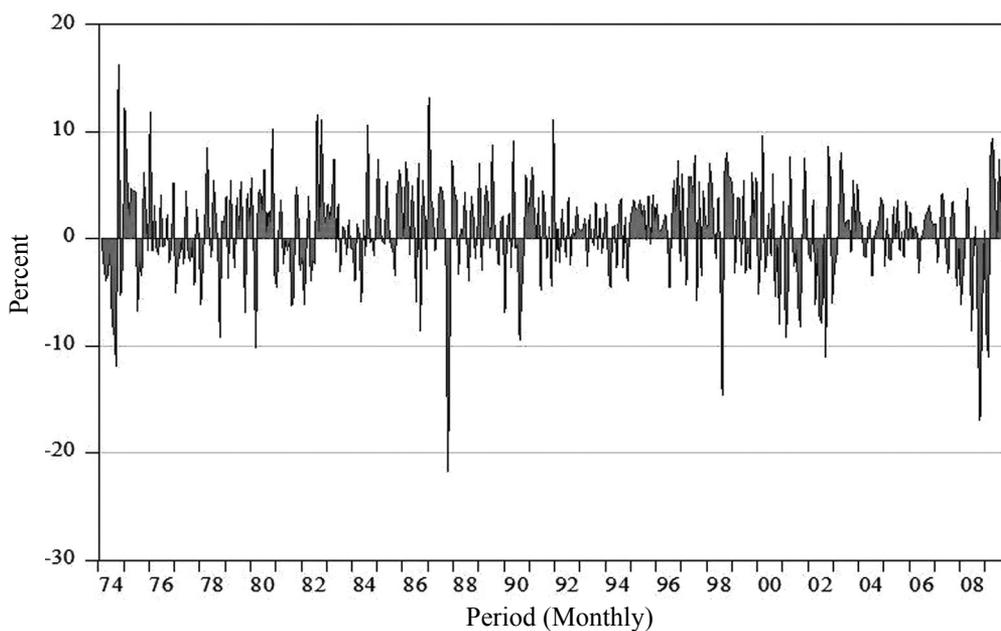
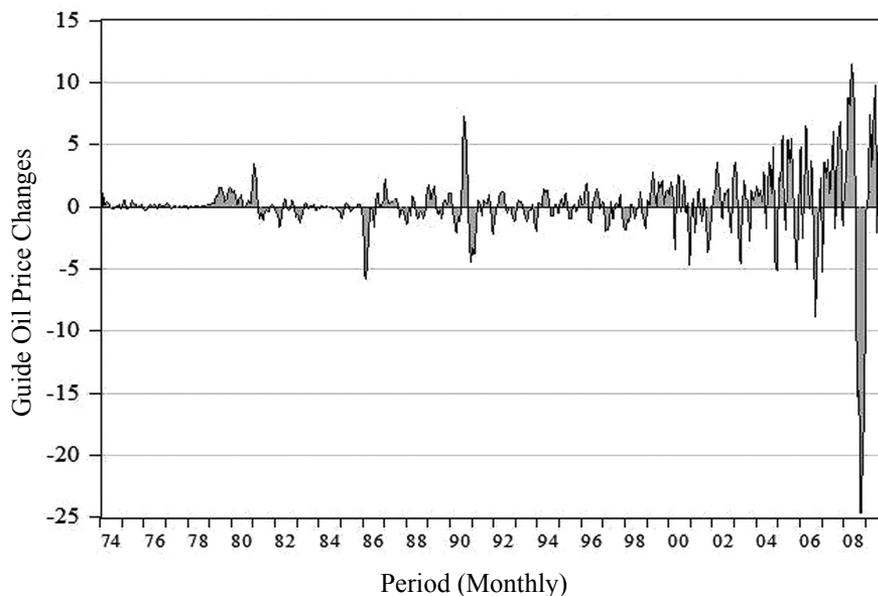
The data used in this study consist of monthly observations on nominal crude oil prices and the S&P 500 index (proxy for stock market). The stock market return series are calculated as percentage changes in the S&P 500 index. Crude oil price changes are obtained by $(y_t - y_{t-1})$. The sample period covers February 1974 through December 2009. Crude oil price data were collected from the *US Energy Information Administration* (EIA) website at (http://tonto.eia.doe.gov/dnav/pet/pet_cons_top.asp). The stock market data were retrieved from Finance Yahoo at (<http://finance.yahoo.com>).

Table 1: Descriptive Statistics

Statistics	<i>COP</i>	<i>SMR</i>
Mean	0.152	0.672
Maximum	11.550	16.305
Minimum	-24.690	-21.763
Standard Deviation	2.922	4.543
Skewness	-2.787	-0.465
Kurtosis	26.459	4.993
Jarque-Bera	10440.600***	86.870***
Probability	0.000	0.000
Observations	431	431

*** rejection of normality assumption at the 1% level of significance. *COP* = crude oil price changes, *SMR* = stock market returns (S&P500).

Table 1 presents the descriptive statistics for crude oil price changes and stock market returns. The mean return values are 0.152 and 0.672, respectively for crude oil price changes and stock market returns. The minimum and maximum values indicate that the return series varied during the period under consideration. For instance, crude oil price changes varied from a minimum of -24.690 to a maximum of 11.550. The stock market return series exhibited the greatest variability (4.543%) from the mean as indicated by the standard deviation. Both crude oil price changes and stock market returns are negatively skewed. The skewed statistics ranged from -2.787 for crude oil price changes to -0.456 for stock market returns. The crude oil price changes and stock market returns exhibited excess kurtosis. However, the excess kurtosis for crude oil price changes (26.459) is more pronounced than that of stock market returns (4.993). Based on the Jarque-Bera statistics, the null hypothesis that crude oil price changes and stock market returns are normally distributed is rejected at the 1 percent significance level in all of the cases. Figures 1 and 2 plot the crude oil price changes and stock market return series. These graphs reveal that stock market returns exhibit more volatility than crude oil price changes. This observation is consistent with the standard deviations displayed in Table 1.



4. Empirical Results

The empirical analysis of the study begins with unit root testing. In particular, the study ascertains the time series properties of crude oil price changes and stock market returns by applying a battery of unit root testing procedures including the conventional

ADF (Dickey-Fuller, 1981), the modified ADF (DF-GLS), the KPSS (Kwiatkowski, et. al., 1992) and the NLADF (Kapetanios, et al., 2003). The unit root tests were first conducted with a constant and then with a constant and time trend. Table 2 displays the results from the various unit root testing procedures. The results indicate that crude oil price changes and stock market returns are level stationary at the 1 percent significance level. In each case, the test statistics from the ADF, DF-GLS, KPSS and KSS unit root procedures exceed the critical values at least at the 10 percent level of significance. For the KPSS unit root procedures, the test statistics are less than the critical values, indicating that the null hypothesis of stationarity should not be rejected at the 1 percent level of significance.

Table 2: Linear and Non-Linear Unit Root Test Results

Series	<i>ADF</i>	<i>DF_GLS</i>	<i>KPSS</i>	<i>NLADF</i>
Panel A: Tests with Constant				
COP	-9.867(1)***	-9.159(1)***	0.079(1)***	-3.351(1)*
SMR	-14.687(1)***	-13.909(1)***	0.153(1)***	-5.720(1)***
Panel B: Tests with Constant and Trend				
COP	-9.684(1)***	-9.472(1)***	0.038(1)***	-3.351(1)*
SMR	-14.692(1)***	-14.387(1)***	0.114(1)***	-5.720(1)***

The 1%, critical values for the ADF and DF-GLS with a constant are -3.9835. For KPSS the 1% critical value is 0.739. For with a constant and a time trend, the 1%, critical values for the ADF and DF-GLS with a constant are -3.448 while that for the KPSS is 0.1260. The critical values for the NLADF unit root tests at the 1, 5 and 10% levels are -3.90, -3.4 0 and -3.13, respectively. *COP* = crude oil price changes, *SMR* = stock market returns (S&P500).

Having determined that the series are level stationary, the study next applies the linear Granger causality tests. The Granger causality test results based on the standard VAR models are presented in Table 3. The results suggest that the null hypothesis that stock market returns do not Granger-cause crude oil price changes should be rejected, since the test statistic (*F-Statistic* = 4.516) exceeds the critical value (CV=3.863) at the 5 percent significance level. Similarly, the results indicate that the null hypothesis that crude oil price changes do not Granger-cause stock market returns should be rejected. Again, the test statistic (*F-Statistic* = 6.815) exceeds the critical value (CV=3.863) at the 5 percent significance level. Taken together, the results from the linear Granger causality tests reveal that there is a feedback relationship between crude oil price changes and stock market returns. In other words, the two time series reinforce one another.

Table 3: Linear Granger Causality Tests

Null Hypothesis:	<i>Obs</i>	<i>F-Statistic</i>	<i>5%CV</i>
<i>SMR</i> → <i>COP</i>	428	4.516**	3.863
<i>COP</i> → <i>SMR</i>	428	6.815**	3.863

** indicates rejection of the null hypothesis of noncausality at the 5% significance level. *COP* = crude oil price changes, *SMR* = stock market returns (S&P500). Optimal lag of 3 was determined by the AIC.

In addition to linear causal relationship between crude oil price changes and stock market returns, the study explores the possibility that the two time series might also have nonlinear influence on each other. One of the frequently cited weaknesses of the standard Granger causality test is its inability to detect nonlinear relationships between variables. In other words, the conventional Granger causality test is essentially designed to capture linear relationships among macroeconomic variables. However, a number of studies have shown that the relationship between crude oil prices and stock market returns tend to be nonlinear. For example, Ciner (2001) using the Hiemstra-Jones (1994) framework found that oil prices and the stock market are nonlinearly related for the United States. Similarly, Hamilton (1996, 2000) found for the United States that oil shocks and output are nonlinearly related. If indeed crude oil price changes and stock market returns are nonlinearly related, results from the linear Granger causality test would be biased. In either case, wrong inferences pertaining to the relationship between the two variables would have been drawn. To avoid spurious inferences, this study applies the M-G nonlinear causality tests.

Prior to testing for M-G nonlinear causality between crude oil price changes and stock market returns, the study applies the BDS nonlinearity test developed by Brock et al. (1987). Table 4 displays the p-values for the BDS nonlinearity tests. The results reveal that the null hypothesis of linearity should be rejected at the 1 percent level of significance for both crude oil price changes and stock market returns. The optimal lag lengths (*m*) were automatically determined within the model.

Table 4: Linearity Test Results (*P*-Values)

Series	<i>BDS</i>	<i>MCLEOD</i>	<i>WHITE</i>	<i>M</i>
<i>COP</i>	0.000***	0.000***	0.000***	5
<i>SMR</i>	0.007***	0.001***	0.081*	1

***, **, * indicate rejection of nonlinearity hypothesis at the 1%, 5% and 10% levels, respectively. *COP* = crude oil price changes, *SMR* = stock market returns (S&P500).

To check the robustness of the BDS test results, the study also implemented the McLeod and the White (1989) nonlinearity tests. The results from the McLeod and the White nonlinearity tests presented in Columns 3 and 4 of Table 4 suggest that the null hypothesis of linearity in crude oil price changes and stock market returns should be rejected at least, at the 10 percent significance level. These results are consistent with those provided by the BDS procedure. Taken together, the results from the three nonlinearity tests indicate that crude oil price changes and stock market returns are nonlinear.

Table 5: Bai and Perron Test for Structural Breaks

Statistics	<i>COP</i>	<i>SMR</i>
SupF _T (1) ^a	0.1950	3.7920
SupF _T (2)	1.9488	4.2818
SupF _T (3)	2.0045	4.0257
SupF _T (4)	1.6043	3.9090
SupF _T (5)	1.6487	2.6369
UDmax ^b	2.0045	4.2818
WDmax ^c	3.6179	6.7212
SupF _T (2/1) ^d	3.7795	4.2811
SupF _T (3/2)	1.6139	2.4478
SupF _T (4/3)	0.1689	2.4747
SupF _T (5/4)	—	—
<i>No of Break(s) Selected</i>		
BIC	0	0
LWZ	0	0
Sequential	0	0
Break Dates	None	None

COP = crude oil price changes, *SMR* = stock market returns (S&P500).

- The critical values for the supF tests at the 5%(10%) level for 5 breaks are 8.5800(7.0400), 7.2200(6.2800), 5.9600(5.2100), 4.9900(4.4100), and 3.9100(3.4700).
- The critical values for the UDmax tests at the 5%(10%) level are 8.8800(7.4600).
- The critical values for the WDmax tests at the 5%(10%) level are 9.9100(8.2000).
- The critical values for the supF(l+1/l) (for l=1 to 5 breaks) tests at the 5%(10%) level are 8.5800(7.0400), 10.1300(8.5100), 11.1400(9.4100), 11.8300(10.040), and 12.2500(10.5800).

The study next implements the Bai and Perron multiple structural break tests to determine whether the crude oil price changes and stock market return series are structurally stable. The results from the Bai and Perron tests are presented in Table 5. The results from the SupF procedure reveal the absence of structural breaks in both stock market returns and crude oil price changes. In each case, the test statistic is statistically insignificant. Similarly, the test statistics for the double maximum (i.e. UDmax and WDmax) procedures which test the null hypothesis of no structural break against the alternative of an unknown number of breaks are statistically insignificant at the conventional levels. For crude oil price changes, the test statistics 1.6487 and 2.0045, respectively for the UDmax and WDmax procedures are less than the critical values (7.4600 and 8.2000) at the 10 percent level of significance. For stock market returns, the test statistics for the UDmax and WDmax are 4.2818 and 6.7212, respectively. Again, the test statistics are all less than the critical values at the 10 percent level, confirming the absence of structural changes in the data. The test statistics for the SupF(l+1/l) procedures are all insignificant for both crude oil price changes and stock market returns. The test statistic in each case is less than the critical value at the 10 percent level of significance. Given the insignificance of the test statistics from the SupF(l+1/l) procedures, the BIC, LWZ, and the sequential procedures selected zero structural breaks for both crude oil price changes and stock market returns. Taken together, the results from the SupF, UDmax, WDmax and SupF(l+1/l) suggest that crude oil price changes and stock market returns are structurally stable for the study period.

Table 6: Nonlinear Causality Test Results (Symmetric Case)

Null Hypothesis:	<i>F-Statistic</i>	<i>P-value</i>
<i>SMR</i> → <i>COP</i>	0.072	0.789
<i>COP</i> → <i>SMR</i>	5.607**	0.018

** indicates rejection of the null hypothesis of noncausality at the 5% significance level. *COP* = changes in oil prices, *SMR* = stock market returns (S&P500). The parameters for the M-G model are as follows: $\tau_1=10$, $\tau_2=1$, $c_1=4$, and $c_2=1$.

Given that crude oil price changes and stock market returns are nonlinear and structurally stable, the study next implements the M-G causality tests to determine the causal relationship between the two time series. Table 6 presents the results from the symmetric version of the M-G nonlinear causality test whereby the entire sample of the causing variable is used. In other words, the causing variable (in our case, crude oil price changes) is not conditioned on being positive or negative. The results suggest that the null hypothesis that stock market returns do not M-G cause crude oil price changes should be accepted based on the test statistic ($F = 0.072$, $pv = 0.789$) which is not statistically significant at the conventional levels. However, the results indicate that the null hypothesis that crude oil price changes do not M-G cause stock market returns should be rejected. The F -static (12.738, $pv = 0.000$) is statistically significant at the 1 level.

Table 7 displays the results from the asymmetric M-G causality tests, in which case the causing variable (i.e. crude oil price changes) is conditioned on being negative. The results indicate that the null hypothesis that stock market returns do not have nonlinear causal influence on crude oil price changes should not be rejected as the test statistic ($F = 0.275$, $pv = 0.600$) is statistically insignificant. However, the null hypothesis that positive values of crude oil price changes do not M-G cause stock market returns should be rejected given that the test statistic ($F = 12.738$, $pv = 0.000$) is statistically significant at the 1 percent level.

Table 7: Nonlinear Causality Test Results (Asymmetric Case for Negative Crude Oil Price Changes)

Null Hypothesis:	<i>F-Statistic</i>	<i>P-value</i>
$SMR \rightarrow COP$	0.275	0.600
$COP \rightarrow SMR$	12.738***	0.000

*** indicates rejection of the null hypothesis of noncausality at the 1% significance level. *COP* = changes in oil prices, *SMR* = stock market returns (S&P500). The parameters for the M-G model are as follows: $\tau_1 = 1$, $\tau_2 = 1$, $c_1 = c_2 = 2$.

Table 8 presents the results obtained from the asymmetric M-G causality test conditioned on the values of crude oil price changes being positive. The results suggest that the null hypothesis that stock market returns do not M-G cause crude oil price changes should be rejected. The test statistic ($F = 2.929$, $pv = 0.088$) is statistically significant at the 10 percent level. Similarly, the null hypothesis that positive values of crude oil price changes do not M-G cause stock market returns should be rejected. The test statistic ($F = 10.600$, $pv = 0.001$) is statistically significant at the 1 percent level. Taken together, the results presented in Tables 8 indicate that there is a bidirectional relationship between positive values of crude oil price changes and stock market returns for the United States for the period under study.

Table 8: Nonlinear Causality Test Results (Asymmetric Case for Positive Crude Oil Price Changes)

Null Hypothesis:	<i>F-Statistic</i>	<i>P-value</i>
$SMR \rightarrow COP$	2.929*	0.088
$COP \rightarrow SMR$	10.600***	0.001

*** and * indicate rejection of the null hypothesis of noncausality at the 1% and 10% significance levels, respectively. *COP* = changes in oil prices, *SMR* = stock market returns (S&P500). The parameters for the M-G model are as follows: $\tau_1 = 1$, $\tau_2 = 1$, $c_1 = c_2 = 2$.

The finding that crude oil price changes have nonlinear causal influence on stock market returns is consistent with Ciner (2001) who used the Hiemstra and Jones (1994) nonlinear Granger causality test. However, it must be pointed out that unlike Ciner (2001), the present study applied a more powerful test which allows the causing variable to be conditioned on being positive or negative. In addition, Ciner (2001) considered only the symmetric relationship between crude oil price changes and stock market returns. The present study, however, examined both the symmetric and asymmetric relationships between the two time series. An interesting finding that emerges from Tables 7 and 8 is that stock market returns respond asymmetrically to both positive and negative shocks to changes in crude oil prices. However, crude oil price changes respond nonlinearly to only positive shocks to stock market returns.

5. Summary and Implications

This paper has examined the linear and nonlinear causal relationships between crude oil price changes and stock market returns for the United States. In particular, the study used linear (i.e. ADF, DF-GLS and the KPSS) and the nonlinear (i.e. NLADF) unit root tests to determine the time series properties of both crude oil price changes and stock market returns. For linear Granger causality test, the study applied the standard VAR models. However, in order to test for nonlinear causal relationship between crude oil price changes and stock market returns, the study implemented both the symmetric and asymmetric versions of the M-G framework. Prior to testing for nonlinear causality between the two variables, the BDS, McLeod and White nonlinearity tests were implemented to test for linear dependencies in the variables. The study further applied the Bai and Perron multiple structural break tests to examine the stability of crude oil price changes and stock market returns for the study period.

The results from the various unit root tests indicate that crude oil price changes and stock market returns are level stationary. The results from the standard Granger causality tests provide evidence of bidirectional causality between crude oil price changes and stock market returns. The results obtained from the BDS, McLeod and White tests indicate that crude oil price changes and stock market returns are nonlinear. The results from the Bai and Perron procedures reveal that crude oil price changes and stock market returns are structurally stable for the period under investigation. The results from the symmetric M-G causality test indicate that nonlinear causality runs from crude oil price changes to stock market returns, but not vice versa. When the M-G test is conditioned on the negative values of crude oil price changes, there was found evidence of causality running from crude oil price changes to stock market returns but not vice versa. However, when the M-G causality test is conditioned on the positive values of crude oil price changes, the results provided evidence of a bidirectional causal relationship between crude oil price changes and stock market returns. The major finding of this study is that oil and stock markets are integrated rather than segmented as suggested by the feedback relationship between crude oil price changes and stock market returns. From investment perspective, the results indicate that

the oil and stock markets are not efficient as the past values of one can be used to predict movements in the other.

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Amortisation Versus Impairment of Goodwill and Accounting Quality

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Abstract

In this paper there has been made a comparison between the amortisation and the impairment methods for accounting for goodwill, with regards to their associated effects on accounting quality. Based on two qualitative characteristics of accounting information, as formulated by the International Accounting Standards Board (IASB), the effects of the new impairment method are examined using a value relevance and a timeliness model. The sample consists of European companies that adopted this new method of goodwill accounting, following the required adoption of the International Financial Reporting Standards (IFRS) in 2005. The results indicate that impairment of goodwill is actually less value relevant than amortisation, but that it does lead to more timely accounting information. It is concluded that the objective of the IASB in issuing a new accounting standard is not completely met and it only partially contributes to higher accounting quality.

Keywords: Amortisation, impairment, goodwill, value relevance, timeliness

JEL classification: M21, M41, M48

1. Introduction

The International Accounting Standards Board (IASB) issues new accounting standards with the objective to improve the quality of financial reporting. One example is IFRS 3 (IASB, 2005; 2008), which came in effect in 2005. This accounting standard radically changed the way companies account for goodwill. Following IFRS 3, amortisation of goodwill is no longer allowed. The useful life of goodwill and the pattern it diminishes

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are often not possible to predict (IASB, 2005). For this reason companies now have to annually test the value of goodwill carried in their balance sheets for possible impairment.

“After initial recognition, the acquirer shall measure goodwill acquired in a business combination at cost less any accumulated impairment losses” (IASB, 2005, par. 54).

The IASB amended IFRS 3 in 2008. The revision was part of a project performed together with the Financial Accounting Standards Board (FASB), which issued SFAS 141 *Business Combinations* around the same time. Although many differences still exist, the standards became more harmonized. The revised IFRS 3 came in effect as of July 1, 2009 and it does not explicitly refer to goodwill anymore, but states that all assets and liabilities acquired in a business combination are subsequently accounted for in accordance with other standards on the item (IASB, 2008, par. 54).

In the case of goodwill, IAS 36 *Impairment of Assets* and IAS 38 *Intangible Assets* outline the regulation about recognition and subsequent measurement. Related topics refer to: intangible assets with a finite and/or indefinite useful lifetime (IASB, 2004b, par. 89); annual impairment testing and measuring of the recoverable goodwill amounts (IASB, 2004a); fair value less costs to sell and the ‘value in use’; the recoverable amount of the cash-generating unit (CGU) to which the asset belongs to (IASB, 2004a, par. 66) if fair value cannot be determined; and disclosure requirements regarding the impairment test.

The motivation of the IASB to prohibit the method of amortisation of goodwill is that it leads to arbitrary accounting (IASB, 2005). However, the method of impairment of goodwill also gives management a lot of discretion on assumptions and estimates. It is therefore interesting to investigate whether this change in accounting method has led to better quality of accounting information.

In this context, the objective in this paper is to empirically examine whether the change in accounting for goodwill has led to higher accounting quality indeed. This is performed in accordance to the quality characteristics of accounting information (i.e. value-relevance and timeliness) as these were formulated by the IASB in its framework for financial reporting. Consequently, a value-relevance and timeliness model as well as a sample selection of firms included in Worldscope Datastream, which report under IFRS 3 since 2005, are used. A comparison is made between the periods 2001-2004 in which goodwill was amortised, and 2005-2010 in which goodwill was potentially impaired. The years from 2007 to 2010 will be mentioned separately and examined whether the credit crunch had any effect on the model. For the timeliness model a sample from 2001-2004 and 2005-2009 is used respectively. There will also be an examination of all the years separately to see if there is an incremental change in value relevance and timeliness when both companies and investors have become more familiar with the goodwill impairment method. The selection for the testing period is grounded on the most recent data available at the time this work was undertaken. Ideally, it would be preferable the two samples to be of equal length but there proved to be very few values for the amount of goodwill amortisation before 2001 and for quarterly data for 2011.

The results show that the amortization expense on goodwill is more value relevant than the impairment expense. This indicates that investors perceive the amortization

expense as more relevant information for investment decisions and stock price valuation. However, the impairment method of goodwill accounting does lead to timelier accounting information. As a result, the findings only partially support the goals of the IASB in introducing new accounting standards.

The remainder of this paper is organized as follows. The next section discusses the academic literature on the quality characteristics of accounting for goodwill, amortisation and impairment testing. The research methods used to test our hypotheses are introduced afterwards. Section 4 presents the results of the modelling and, section 5 provides a summary and the conclusions.

2. Literature review

2.1 Accounting Information Quality

In 1989, the International Accounting Standards Board (IASB) issued the 'Framework for the Preparation and Presentation of Financial Statements', which was adopted in 2001 (IASB, 1989). This framework was intended to serve as a guide for the preparation of accounting standards as the objective of financial statements is "*to provide financial information that is useful for decision making*" (ibid.: par 12 – 14). Whether the information provided is indeed useful to investors depends on its quality characteristics that are also presented by IASB (1989).

In an Exposure Draft of the harmonisation work IASB and FASB have been undertaking, two fundamental characteristics of financial information are highlighted; namely, relevance and faithful representation (IASB/FASB, 2008). The quality of accounting information can be measured in many other ways of course. For example, Pomeroy and Thornton (2008) list more than twenty measures of financial reporting quality in their study on audit committee effectiveness with each measure relating to other quality characteristics of accounting information (e.g. reliability, comparability, etc.). However, the main focus in this paper is on the attributes of value relevance and timeliness.

Relevance of accounting information is defined as "*the capability of making a difference in the decisions made by users*" (IASB/FASB, 2008, p. 17). This is often measured by taking into consideration the relation between market information (share price) and accounting information (financial statements). Value relevance specifically measures the extent to which accounting information is incorporated in stock prices.

Timeliness is defined as "*having information available to decision makers before it loses its capacity to influence decisions*" (ibid.: 21). In academic research (see for example Palepu et al., 2007; Lev and Zarowin, 1999), this is described as the timely reflection of relevant economic events in the financial statements. Under the efficient market hypothesis, all relevant information is already incorporated in the share price of the company. After linking market information (share price) with accounting information (financial statements) conclusions can be made about timeliness. The sooner an economic event is recognized in the financial statements, the timelier the accounting information is.

In this context of value relevance the paper examines the two methods of accounting for goodwill (e.g. amortisation and impairment) in an attempt to conclude on which method provides more useful accounting information. Goodwill is deemed of particular interest, because of the relatively recent changes in accounting regulation.

2.2 Accounting for Goodwill

Goodwill is defined as “*an asset representing the future economic benefits arising from other assets acquired in a business combination that are not individually identified and separately recognised.*” (IASB, 2005, app. A). It is measured as the excess of the cost of the business combination over the fair value of the net identifiable assets acquired. There have been long discussions (Johnson and Petrone, 1998; Schuetze, 1993; Bugeja and Gallery, 2006) about the recognition of goodwill and its subsequent accounting treatment where it is debated whether goodwill can even be seen as an asset.

Some researchers argue that goodwill should be expensed immediately at acquisition (see for example Brunovs and Kirsch, 1991; Nobes, 1992; Hughes, 1982). This suggested treatment is motivated by the argument that goodwill is hard to measure because of possible omitted identifiable assets. Proponents of this treatment argue that the future economic benefits, if there are any, cannot be reliably measured. It would therefore not meet the definition of an asset and it should be expensed instead.

Following the definition on goodwill, the IASB argues that it satisfies the general definition of an asset. Academic literature supports this view. Johnson and Petrone (1998) for example argue that goodwill in general meets the definition of an asset, although it also explicitly has to be measurable, reliable and relevant before it can be recognised. Further to this, there is academic evidence showing positive relations between recognized goodwill and equity values (Chen et al., 2004; Churyk and Chewing, 2003; Jennings et al., 1996) indicating that investors perceive goodwill as an economic resource that creates future economic benefits.

However, there is no consensus on the measurement of goodwill. Some researchers even argue that the amount of goodwill that was initially recognized should not be impaired at all. They motivate this by the possibility that the future economic benefits of the goodwill may hold over time, because of excellent financial performance for example. In this context Bugeja and Gallery (2006) perform a study on the relevance of goodwill over time. Their results show that investors only perceive goodwill relevant if it is acquired in the last two years. Keeping goodwill on the balance sheet for a longer period is therefore not giving investors relevant information. This result highlights the importance of a proper accounting treatment for goodwill that deals with this declining relevance.

Recognized goodwill should be expensed over time because it loses its value (Bugeja and Gallery, 2006). For a long period, the amortisation method was commonly used and allowed by most accounting standard-setting boards. Amortisation comprises a fixed expense charge every reporting period over the estimated useful lifetime of the goodwill, with a maximum set at forty years by most accounting standard boards. This method

has some serious disadvantages because it does not account for the 'real' decrease in the underlying economic value of the goodwill, but instead it is based on the assumption that it decreases in a straight line over time. Also, as Bugeja and Gallery (2006) show, goodwill might not meet the definition of an asset after two years implying that the amortisation period of forty years is too long. For this reason the accounting standard boards introduced the new impairment method.

2.3 Goodwill Amortisation

The academic literature is mostly dominated by research on the standard issued by the FASB, SFAS 142. Research on IFRS 3 is much less present. The value-relevance of amortisation has been examined in several ways. Overall, there is mixed evidence on the value relevance of amortisation of goodwill. Nevertheless, the IASB and FASB decided to change their accounting standards.

Jennings et al. (1996) investigate the relation between accounting goodwill numbers and equity values. Regarding the amortisation of goodwill, they find that there is a negative relation with equity value. This means that investors perceive amortisation as a relevant accounting number that indicates a decrease in the value of goodwill, the value of the company and therefore also its share price. The authors acknowledge, however, that evidence on these results is somewhat weak, indicating that goodwill may not decline in value for all companies or not as fast as the expected economic lifetime assumes. Although this is a limitation, the paper does show that amortisation of goodwill is relevant information to investors.

Jennings et al. (2001) examine whether goodwill amortisation had an effect on the usefulness of earnings. In their valuation of share prices, investors might find an earnings number excluding goodwill amortisation more relevant. Two valuation models are compared to investigate whether this is the case. The results show that the model excluding goodwill amortisation has more explanation power than the model including it. The authors also test a model in which the goodwill amortisation number is added back, separately from the earnings number, to see whether goodwill amortisation is even relevant at all. In contrast to Jennings et al. (1996) their results show that this is not the case. The authors therefore conclude that goodwill amortisation is not useful to investors and only adds noise to their valuation of share prices.

Moehrle et al. (2001) perform a similar study on the information content of goodwill accounting numbers. Their paper is based on the plans of the FASB to change its earlier Exposure Draft *Business Combinations and Intangible Assets*. The Exposure Draft proposed to let companies report several earnings numbers, one of them excluding goodwill amortisation. This paper also uses a model comparing the explanation power of the different earnings numbers. Inconsistent with the findings of Jennings et al. (2001), the authors find that the explanation power of earnings numbers excluding or including amortisation of goodwill do not differ significantly, even for a sample of firms with large goodwill amortisation numbers. Amortisation is therefore not a source of noise, because

the explanatory power is not significantly lower for this model. However, the conclusion that goodwill amortisation is not relevant to investors is maintained in consistency with Jennings et al. (2001), as including goodwill amortisation does not increase the explanatory power of the model.

Li and Meeks (2006) investigate the value relevance of goodwill in the UK. They argue that this market is important regarding goodwill, as it is the second largest takeover market. Especially between 1997 and 2002, the years used in the sample, takeovers were very common and goodwill was recognized in many of them. Consistent with the findings of Bugeja and Gallery (2006) they find that goodwill is value relevant but that it diminishes over time. They also find that amortisation is not relevant to investors.

Churyk and Chewning (2003) performed a similar study regarding the relevance of goodwill amortisation. Like the previous studies, they use database Compustat for a sample selection with firms listed on equity indices in the US. Their results show that goodwill amortisation is negatively related to equity values. This means that the market perceives goodwill as an asset that declines in value over time, consistent with the findings of Bugeja and Gallery (2006). Churyk and Chewning (2003) argue that FASB's Standard Nr. 142, that prohibits amortisation, is not based on valid assumptions. The authors state that goodwill should be treated like any other economic asset and that it should be amortised over its useful economic life. However, the IASB states in IAS 36 *Impairment of Assets*, that goodwill should be reviewed for impairment annually. This means that companies have to impair goodwill, even when they did not expect to be required to, because no impairment event had taken place. This implies that the argumentation of Churyk and Chewning (2003) is not applicable to IFRS 3, as declines in the value of goodwill are always recognised in the form of an impairment expense.

2.4 Goodwill Impairment

There is less academic literature on the impairment method of goodwill. This is no surprise since this method is in effect for a few years only.

Chambers (2006) examines the effects of SFAS 142 on financial reporting by using a value relevance model. Not only does he test the relevance of impairments, but he also investigates the effects of the elimination of goodwill amortisation. The results, consistent with the goals of the FASB, show that financial reporting quality has improved by using impairments. However, the author also finds that the elimination of the amortisation method resulted in lower quality of reporting. In addition, he creates a fictional accounting system that includes both methods. This system results in the most relevant accounting numbers. Overall, Chambers (2006) concludes that the introduction of SFAS 142 led to higher accounting quality, consistent with the goals of the FASB. A similar work was undertaken by Chen et al. (2004). The authors here make a distinction between a one-time impairment at adoption and the following yearly impairments. The initial impairment is caused by the difference between the carrying amount after all amortizations over the past years and the recoverable amount of the goodwill. The change in accounting standard could possibly

have led to a one-time extra impairment. Chen et al. (2004) also investigate the timeliness effects of the impairment. Their results show that prior share prices already incorporated some parts of the initial impairment and the impairment in the first year. Interesting is that the first year impairment has a significant relation with share prices in the previous year, indicating that returns lead earnings and that the accounting information is fairly timely since there is only a gap of one year between the economic decline in value of the goodwill (measured by the share price return) and the recognition of the impairment in the financial statements. Consistent with Chambers (2006), the authors find that value relevance increases after the adoption of SFAS 142

Lapointe et al. (2009) also examine an initial impairment, but one that is based on the retroactive method. In contrast with the cumulative method in which the initial impairment is reflected in the income statement, the retroactive method requires firms to adjust retained earnings in the opening balances for the impairment amount. This method is also required following IFRS 3. Using a Canadian setting, the authors investigate the timeliness and value relevance of these impairments. Their results are similar to those of Chen et al. (2004). The authors conclude that the retroactive method, soon to be required for firms reporting under US GAAP, is consistent with the objectives of the FASB regarding the quality of accounting information.

More evidence on the effects of SFAS 142 is provided by Churyk (2005). She examines whether the elimination of the amortisation of goodwill is appropriate. This is done by comparing market valuations of goodwill, based on the Exposure Draft that the FASB issued on SFAS 142. The author finds that goodwill at acquisition is almost never overvalued and argues that this implies that systematic amortisation is not required. However, she does find indications of a value decline of goodwill in subsequent periods. Stock price decreases or the situation when the book value of equity is greater than the market value of the company are events that justify an impairment of goodwill (Churyk, 2005). The conclusion is that the impairment method is justified and also that the elimination of the method of amortisation is appropriate.

There is also evidence available from other settings than the US GAAP. Between 1998 and 2002, accounting regulation in the UK allowed companies to use the impairment method of accounting besides the amortisation method. Li and Meeks (2006) use this period to investigate the relevance of impairments. Not surprisingly, impairments were most common in 2002, the final year in the sample. Besides the economic downturn in that year, organisations were more familiar with impairment testing than in preceding years. In contrast with amortizations, impairments are perceived relevant by investors. The coefficient on impairments is large, interpreted by the authors as a possible overreaction of the market to bad news or as a signal to investors of lower future earnings. Although the results are very convincing, this study is limited because only one year in the sample is useful for investigating impairments.

Iatridis et al. (2006) investigate the timeliness of impairments in the UK, using a sample of firm-years that is subject to the same accounting regulations as the sample of Li and Meeks (2006). They examine the question whether the goodwill impairments are

associated with a decline in equity market values in the year preceding or in the year of the impairment. Their results show that this happens for both cases. Impairments are timely because of the significant relation between the impairment and the negative stock return in the same or preceding year. However, the authors also note an important limitation of their study. All firms in the sample reported an impairment but it is not certain that all firms that should have reported one did so. This means that firms that may have not reported impairments in a timely manner are left out of the sample, caused by the small range of sample years (2000 and 2001). This sample selection bias might have affected the results of their study.

In 2005, the European Union decided to require companies to report their financial statements in accordance with IFRS. This created an opportunity for academic studies to investigate the effects of IFRS 3, as many companies used this standard for the first time in that year. The work undertaken by Barksjö and Paananen (2006) and Hamberg et al. (2006) are examples of such studies. However, because of the recent adoption of IFRS, the amount of such studies is limited. They could also suffer from problems with data availability and their conclusions may therefore not be supported by strong evidence.

Barksjö and Paananen (2006) test the value relevance and the timeliness of the financial statement information before and after the implementation of IFRS. Not only do they compare the impairment expense with the amortisation expense, but they also make a distinction between companies with relative high and low amounts of intangible assets. They argue that previous research on goodwill (for example Jennings et al., 2001) has shown that the method of amortisation does not result in financial statements reflecting the underlying economic value of goodwill and that therefore companies with high amounts of intangible assets will benefit of the change to the impairment method of accounting, by experiencing increased value relevance. The results of their work show that this hypothesis is supported. However, all other hypotheses regarding the increased value relevance and timeliness of accounting information are not. This means that the introduction of IFRS has not led to higher accounting quality. A limitation is however that only the years 2004 and 2005 are selected in the sample to make a comparison between both methods of accounting. It is possible that because firms were less familiar with the impairment method of accounting, investors perceive the information disclosed as less reliable because of (possible) measurement errors. An extension of the sample selection with extra years could therefore provide more reliable evidence on the comparison between the two methods of accounting for goodwill.

Hamberg et al. (2006) used the same setting as Barksjö and Paananen (2006) to examine the effects of the adoption of IFRS, namely the Swedish stock market. The authors find evidence of goodwill being more persistent under the impairment method than under the amortisation method. This is consistent with expectations, as an impairment expense may not arise every year. Goodwill persists therefore longer as an asset on the balance sheet. However, this sample selection is also limited. It could be therefore possible that, impairments were not very common in the sample year(s) and that this affected the conclusions. Secondly, Hamberg et al. (2006) test the relevance of the reported goodwill by

using a trading strategy in which they buy stocks with relative high amortisation costs and sell stocks with relative low amortisation costs. The authors expect to earn abnormal returns because of the longer persistence of goodwill under the impairment method of accounting, but only if investors did not incorporate the changes already in prices. Their results show that this is indeed the case. Investors therefore perceived the higher persistence of goodwill as new information, although the results are not significant, Hamberg et al. (2006) conclude that overall the introduction of IFRS led to more relevant accounting information.

Oliveira et al. (2010) studied the value relevance of earnings and intangible assets like goodwill and R&D of listed non-finance companies in Portugal. First, the authors analysed if these accounts were value relevant and then they proceeded with analysing if the introduction of IFRS changed their value relevance. The reasoning of the authors was that any increase in value relevance, due to the adoption of IFRS, would be more pronounced in circumstances where the adoption of IFRS was mandatory and took place in a code law (rather than a common law) country. Thus, with Portugal being a code law country, the authors expected their results to be pronounced. However, the increase in the value relevance of goodwill that they observed can only be considered slight. Where goodwill turned out to be slightly more value relevant, earnings actually turned out to be less value relevant after the adoption of IFRS.

3. Research Method

3.1 Hypotheses

It was mentioned earlier that the introduction of the impairment method of goodwill accounting by the IASB was motivated by the belief that the method of amortisation led to arbitrary accounting (IASB 2005). The information that is reported on the basis of such a method is therefore expected not to be relevant for investors in decision-making, because the information does not reflect the underlying (change in the) financial position of the firm. As it is the goal of the IASB to make accounting information more relevant, new accounting standards are therefore expected to add relevance for decision makers.

More specifically, the introduction of IFRS 3 and the amendments to IAS 36 and IAS 38 are expected to increase the relevance of goodwill accounting numbers. This means that the impairment expense on goodwill should be more relevant than the amortisation expense. Evidence for this statement regarding SFAS 142 is among others provided by Lapointe et al. (2009), Chambers (2006), and Chen et al. (2004). Barksjö and Paananen (2006) find no evidence for this statement however, in examining the effects of IFRS in Sweden. In this light our first hypothesis examined here is:

H1: The value relevance of goodwill impairment expense is higher than the value relevance of goodwill amortisation expense.

One specific element of relevance mentioned in the framework is timeliness. This measure considers the gap between the economic decline in goodwill and the recognition of this

decline in the financial statements. Under the amortisation method, the reported value of goodwill steadily declined following the amortisation expense that was subtracted from the balance sheet amount every report period. Any decline in the underlying economic value of the goodwill was not recognized. Therefore, it could be possible that the reported amount was higher or lower than the economic value. Under the impairment method, firms are required to do an annual impairment test. This should lead to a more timely recognition of the decline in economic value of the goodwill, as it is now reported when it actually occurs. Chen et al. (2004) find support for this statement regarding SFAS 142 and Iatridis et al. (2006) for regulation in the UK. However, Barksjö and Paananen (2006) find however no evidence for this statement regarding IFRS in Sweden. The second hypothesis therefore is:

H2: The goodwill impairment expense is timelier than the goodwill amortisation expense.

3.2 Research Models

Our hypotheses are tested using two models that are commonly used in the academic literature: a market valuation model (based on the work of Ohlson, 1995); and an earnings-return model respectively.

3.2.1 Market Valuation Model

Value relevance was earlier described as the relation between market information and accounting information. If accounting information is value relevant, then investors use this information in their valuation of the company and therefore for decision making. Ohlson (1995) developed a market valuation model that relates accounting information with the market value of the company. The model formulates the market value of the company as a function of the book value of equity and the earnings number. It is useful to break down the Ohlson model into two parts: Residual Income Valuation and Ohlson's information dynamics. Residual Income Valuation is based on the notion that investors base security prices on the amount of future dividends. However, it does not offer any guidance on how to proxy for the boundless series of expected abnormal earnings.

The Ohlson model builds on the foundations supplied by the Residual Income Valuation model by adding information dynamics as well as on the more solid foundation of Modigliani and Miller (1958) assuming perfect capital markets, the Ohlson model is thus not meant to be descriptive of the real world. The addition the Ohlson Model provides to empirics is a testable pricing equation that identifies the roles of accounting as well as non-accounting information. Dechow et al. (1998) find support for these information dynamics. However, Dechow et al. (1998) also find that the Ohlson Model is only slightly better than traditional valuation models like the Gordon model.

The Ohlson Model was written as a model for one single firm. Selecting firms from different countries and putting them in one sample could mean that the results could turn out biased because of the accounting systems differing across borders. This will however

only marginally affect our study because our samples include only companies that use their respective local GAAP and after 2005 IFRS. We mitigated the potential bias towards only large companies by choosing a database that contains smaller as well as larger companies.

Our basic model is:

$$MVE_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 NI_{it} + \varepsilon_{it}$$

Where MVE_{it} is the market value of the company, BVE_{it} is the book value of equity and NI_{it} is the net income number. Value relevance is measured as the explanatory power of the model. If the accounting information is useful for decision makers, then it will have a strong relation with the market value of the company and the explanatory power of the model is high. If, on the other hand, accounting information is not useful, then the explanatory power of the model will be low.

One major advantage of the model developed by Ohlson (1995) is that extra variables can be easily added to the equation. As a consequence, two models and two explanatory powers can be compared with each other. A conclusion on which accounting information is more value relevant can be drawn from this comparison.

To test our first hypothesis, we use the basic Ohlson-model (1995) with some necessary adjustments. To compare the value relevance of goodwill impairments and goodwill amortisation, two models are needed, each containing one of the two different variables. The first equation is as follows:

$$MVE_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 NI_{it} + \beta_3 AMORT_{it} + \varepsilon_{it} \quad (1)$$

Where $AMORT_{it}$ is the amount of goodwill amortisation for the year and all other variables are as previously defined. The value of the company is measured three months after the fiscal year-end to make sure that the financial statements have been made public and that the information is available to investors. All variables were deflated by the number of shares outstanding to control for size differences. The extended model should have a higher explanatory power if investors view the amortisation variable as useful, valuable and relevant. As discussed earlier, Moehrle et al. (2001) find that there is no significant difference, while Jennings et al. (2001) even find that the explanatory power decreases, indicating that the variable adds noise to the valuation. However, this comparison is not the focus here and it is not further examined in detail.

Equation (1) will be compared with a model that contains an impairment variable:

$$MVE_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 NI_{it} + \beta_3 IMP_{it} + \varepsilon_{it} \quad (2)$$

Where IMP_{it} is the amount of goodwill impairment for the year and all other variables are as defined previously. Again, all variables will be deflated by the number of outstanding shares and market value is measured three months after fiscal year-end. Equation (2) should also have a higher explanatory power than the basic Ohlson-model (1995) if investors view impairment of goodwill as useful, valuable and relevant. For example Lapointe et al. (2009) find that this is the case, while Barskjö and Paananen (2006) find no evidence for this, although they use a slightly different method.

Hypothesis 1 states that the value relevance of goodwill impairments is higher than the value relevance of goodwill amortisation. This is measured using the explanatory power of equations (1) and (2). Following this hypothesis it is expected that the value relevance of equation (2) is higher than that of equation (1). Information on the variables $AMORT_{it}$ and IMP_{it} could give more evidence on the comparison of the value relevance, depending on the significance of these variables in the model.

3.2.2 Earnings-Return Model

Timeliness was previously described as “*having information available to decision makers before it loses its capacity to influence decisions*” (IASB/FASB, 2008, p. 21). This definition also relates market information with accounting information. However, timeliness is not concerned with the extent to which accounting information is used in market valuation, but with the timely recognition of a change in the economic value of the company in the financial statements. The following equation applies to this situation:

$$E_{it} = \chi_0 + \chi_1 R_t + \chi_2 R_{t-1} + \chi_3 R_{t-2} + \varepsilon_t \quad (3)$$

E_{it} = earnings deflated by the price per share at $t-1$

R_t = the return on the firm from 9 months before the fiscal year-end to 3 months after

R_{t-1} = the return on the firm from 9 months before the fiscal year-end to 3 months after for the preceding year

R_{t-2} = the return on the firm from 9 months before the fiscal year-end to 3 months after for the second preceding year

As with the share price measure in the value relevance model, the return period before the fiscal year-end, is used to enable the financial statement information to be incorporated in the valuation by investors. The earnings measure is deflated by the price per share at $t-1$ because the return figure is also relative and based on the share price at t , $t-1$ and $t-2$.

The earnings-return model tries to measure the extent to which the returns are reflected in earnings. If earnings are completely timely, then all changes in economic value (captured by the return measure) should also be present in the earnings number, because this is the change in the book value of equity of the company. Other equity transactions, for example dividends, are controlled for in the returns measure.

Yet, earnings are almost never completely timely. This is caused by the fact that the valuation of the share price by investors depends on expectations of future economic benefits. If a company, for example, makes an investment that will generate a lot of profits in the future, this is taken into account by investors in their valuation. The share price will probably rise and the return on the firm goes up. However, the deal itself is not recognized in the financial statements yet, resulting in returns that lead earnings. The same argument can be made regarding the goodwill accounting method. When companies are allowed to amortise goodwill over a certain fixed period, investors are able to estimate the amortisation expense very well, only depending on the fact whether new goodwill is acquired or

not. Earnings are therefore not timely, because the expense is incorporated in the share price valuation far before the actual expense will be recognized. On the other hand, the impairment test method leads to an impairment expense that is less easy to predict, but should be more related to the change in underlying economic value of the goodwill. Taken together, impairments should be timelier and therefore result in higher associations with earnings than amortisation expenses. This expectation is also formulated in hypothesis 2. We use returns for multiple years, to see whether returns lead earnings and also to make a comparison between amortisations and impairments.

Following Barksjö and Paananen (2006) and Chen et al. (2004), we regress equation (3) using E_{it} as the earnings number with and without the amortisation or impairment expense. This distinction can give more information about the timeliness of the goodwill expense charge itself. For example, both Barksjö and Paananen (2006) and Chen et al. (2004) find that earnings numbers that include the goodwill amortisation or impairment are timelier than earnings numbers excluding these figures, indicating that the financial statements contain new information that investors use in their valuation and therefore are reflected in the return of the company.

3.3 Data selection

The data used in the paper were extracted from the financial database Datastream. The variables included in the dataset are the book value of equity -excluding the amortisation or impairment variable respectively-, earnings for the year, share price at three months after fiscal year end and either the amortisation or impairment amount, depending on the year of the sample.

To make a comparison between the two methods, data from 2001-2004 for the amortisation method and 2005-2010 for the impairment method are used. Although these periods are not equal of length, this does not by definition implicate that they are not comparable, due to (possible) different economic conditions, the number of companies recording an amortisation or impairment expense on goodwill etc. However, potential differences in the datasets could affect the conclusions drawn.

The data were selected by using the 'Worldscope' database from Datastream. Companies from Germany, France, Spain and the Netherlands were selected. In all of these four countries, the benchmark treatment under their respective local GAAP was that goodwill should be capitalised and subsequently systematically amortised over its useful life, with a rebuttable presumption that the useful life of goodwill would not exceed twenty years from initial recognition. The 'Worldscope' database contains small as well as large companies. Thus, the sample is not biased in terms of company size. For the years before 2005 we only selected companies that used their own local GAAP and for the years starting 2005 only companies that use IFRS to comprise their annual accounts. Outliers were deleted by using scatter plots.

4. Results

4.1 Market Valuation model

Hypothesis 1 is examined by comparing equations (1) and (2). The results on equation (1) are presented in Table 1.

Table 1: Market valuation model – Amortisation Expense and Descriptive Statistics

	N	Intercept	BVE	NI	AMORT	
2001	302	9,2	1,0	0,6	13,3	
p-value		<0,01	<0,09	<0,01	<0,01	
t-statistic		6,6	15,2	1,7	3,6	
2002	343	4,8	0,7	1,9	4,5	
p-value		<0,01	<0,01	<0,01	<0,01	
t-statistic		5,9	12,6	8,0	10,1	
2003	317	13,4	0,3	2,7	6,6	
p-value		<0,01	<0,01	<0,01	<0,01	
t-statistic		10,2	12,6	9,0	6,5	
2004	327	9,6	0,6	4,3	7,8	
p-value		<0,01	<0,01	<0,01	<0,01	
t-statistic		10,0	13,5	11,9	12,6	
Pooled	1289	11,4	0,5	2,6	6,1	
p-value		<0,01	<0,01	<0,01	<0,01	<u>Adjusted R²</u>
t-statistic		19,2	24,5	15,9	13,6	0,55

2001-2004	<i>Share price</i>	<i>Equity</i>	<i>Net income</i>	<i>AMO</i>
Mean	20,42	11,42	0,48	0,38
Standard Error	0,81	0,82	0,10	0,03
Median	11,11	5,40	0,42	0,08
Standard Deviation	28,91	29,56	3,48	1,25
Sample Variance	835,68	873,85	12,08	1,55
Kurtosis	16,20	351,63	24,12	60,91
Skewness	3,51	15,14	-1,42	6,38
Range	247,82	833,54	64,23	24,90
Minimum	0,18	-61,16	-33,32	-8,50
Maximum	248,00	772,38	30,92	16,40
Sum	26315,19	14714,09	613,99	488,22
Count	1289,00	1289,00	1289,00	1289,00
Confidence Level (95,0%)	1,58	1,62	0,19	0,07

For the years 2001-2004, there were 1289 firm-years that contained a goodwill amortisation expense. The results on the variables BVE_{it} , NI_{it} and $AMORT_{it}$ are very consistent and conclusive, because they are all significant at the 1% level over all firm-years and in the pooled sample, except for Net income in year 2001. This means that investors use these accounting information numbers in their valuation of the company. Of course this result is not very surprising; because the book value of equity and changes therein, the net income, represent the value of the company that belongs to the equity holders. More interesting are the results on the amortisation variable. Besides being significant, $AMORT_{it}$ shows an even higher t-statistic than Net income in 2001 and 2004.

It is also remarkable that the coefficients on the amortisation variable are all positive. This would mean that an increase in goodwill expense leads to an increase in share price and the value of the company. Clearly this is contradictive to the concept that higher amortisation expenses decrease the market value of a company. The explanatory power of the model is the reported Adjusted R^2 of 55.1%. This means that just over fifty five percent of share prices can be explained by the combination of the three variables in the model. The same regression is also run without the Amortization variable (result not shown here), which show a lower Adjusted R^2 of 51.3%.

The results on equation (2) are presented in Table 2. The first obvious difference between the two equations is that there are far more firm-years that contain an amortisation expense than an impairment expense. This is caused by the fact that amortisation is an expense that reoccurs every year over the economic useful lifetime of the goodwill. Under the impairment method, it is possible that the value of goodwill on the balance sheet is not affected because the recoverable amount exceeds the carrying amount. An impairment expense is then not recognised. During the early years of the sample (2005-2007), economic conditions were relatively good and it is probable that for many companies, the recoverable amount of the goodwill exceeded the carrying amount. However, in 2008 and 2009 the number of firms, reporting an impairment expense, clearly increases again. In 2005 the number of firms reporting an impairment expense also seems to be higher than in the two years to come. This might be due to the fact that under IFRS firms are allowed to readjust the value of the goodwill they have on their balance sheet downwards as well as upwards, although never higher than its amortised value. Firms that wrote off their goodwill quicker might have taken advantage of the opportunity by revaluing their goodwill upwards in the first year of IFRS adoption. Although the total number of firm-years is lower than for the sample used for equation (1), there are still enough observations present to come to a reasonable strong conclusion about the goodwill impairment expense.

Table 2: Market valuation model – Impairment Expense and Descriptive Statistics

	N	Intercept	BVE	NI	AMORT
2005	146	9,4	1,4	3,3	-5,8
p-value		<0,01	<0,01	<0,01	0,5
t-statistic		6,5	11,9	5,4	-0,7
2006	132	8,8	1,4	2,5	-5,0
p-value		<0,01	<0,01	<0,01	0,4
t-statistic		4,0	9,9	3,8	-0,8
2007	109	9,8	0,5	2,1	2,3
p-value		<0,01	<0,01	<0,01	0,2
t-statistic		6,1	5,2	4,3	1,3
2008	141	5,2	0,6	1,0	-1,6
p-value		<0,01	<0,01	<0,01	0,2
t-statistic		4,3	12,7	3,5	-1,2

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2009	157	8,8	0,7	1,3	-1,5	
p-value		<0,01	<0,01	<0,01	0,5	
t-statistic		6,5	13,8	3,4	-0,8	
2010	118	10,37	0,37	4,89	4,6	
p-value		<0,01	<0,01	<0,01	0,3	
t-statistic		4,98	4,31	6,57	1,0	
Pooled	802	9,94	0,73	3,10	-0,4	
p-value		<0,01	<0,01	<0,01	0,7	Adjusted R²
t-statistic		12,78	20,10	14,53	-0,3	0,66

2005-2010	<i>Share price</i>	<i>Equity</i>	<i>Net income</i>	<i>IMP</i>
Mean	24,87	16,03	1,09	0,29
Standard Error	1,03	0,76	0,13	0,02
Median	14,59	8,14	0,55	0,08
Standard Deviation	29,14	21,45	3,63	0,57
Sample Variance	849,11	460,32	13,16	0,33
Kurtosis	7,67	7,59	10,83	16,85
Skewness	2,26	2,46	1,16	3,67
Range	223,97	172,43	48,44	5,04
Minimum	0,04	-18,78	-20,40	-0,36
Maximum	224,00	153,66	28,03	4,68
Sum	19943,25	12858,96	871,22	233,85
Count	802,00	802,00	802,00	802,00
Confidence Level(95,0%)	2,02	1,49	0,25	0,04

Consistent with equation (1), BVE_{it} and NI_{it} are significant for all the years in the sample, for at least at a 1% level. As explained earlier, this result is of no surprise. But the coefficients on the impairment expense do not have the same characteristics as those on the amortisation expense. First, they are all negative, except for the years 2007 and 2010, indicating that an increase in impairment expense results in a lower market valuation. This is consistent with the concept that higher impairment expenses lead to lower equity values and share prices. Second, the pooled sample shows that overall, the IMP_{it} coefficient is insignificant. When the separate years are examined, IMP_{it} also shows insignificant results for all years.

On the other hand, the explanatory power of Equation (2) has an R^2 of 66.1%. Compared with the explanatory power of 55.1% of Equation (1), it can be concluded that the change from amortisation of goodwill to impairment of goodwill leads to higher value relevance. There is, however, a very present possibility that the increased explanatory power is the result of increased relevance of one of the other variables, BVE_{it} and NI_{it} . To add credibility to the conclusions, additional analyses (not reported here) were also conducted by performing a regression on the models without the amortisation or impairment variable. The analyses show that for the second regression the increased relevance is caused by the BVE_{it} and NI_{it} variables and not by any changes in the relevance of the Impairment variable. For Equation (1), it is clearly the Amortisation expense that contributes to the explanatory value of the model.

Hypothesis 1 states that the value relevance of goodwill impairment is higher than the value relevance of goodwill amortisation. Although the explanatory power for equation (2) is higher than for equation (1), it is concluded that this hypothesis cannot be confirmed. Therefore, in the present study goodwill impairments are not more value relevant than goodwill amortisation.

When looking at the years from 2007 to 2010 separately, a drop in explanatory power of the model is clearly seen. For the year 2007 the adjusted R^2 is still 71.7%, but in 2008 it drops to 58.8%. It does, however, recover and in 2010 it is back up to 68.9%. The drop in 2008 might be due to the hit of the financial crisis. An insecure time period for investors and companies alike might make it more difficult for the investors to value a balance sheet item like goodwill, and the future cash flows that are supposed to flow from it, now that the true accounting, fair value, number is reported.

4.2 Return Valuation model

Hypothesis 2 is examined by running a regression on equation (3) over the periods 2001-2004 and 2005-2009. It states that the impairment expense is timelier than the amortisation expense. This expected increased timeliness is interpreted in several ways: increased explanatory power of the model for the impairment regression, a shift in the value of the coefficients on certain variables for the period 2005-2009 and larger differences between the two earnings measures used.

The earnings measure in both periods is split up into the actual earnings number (including the amortisation or impairment expense) and an adjusted earnings number that excludes the amortisation or impairment component. This separation can give some additional insights in the information content of the amortisation or impairment expense in the earnings number. In contrast with the market valuation model, pooling the results from 2001-2004 into one sample is not useful, because of the high correlation between these years. For example, the return over 2001 is used in the equation for 2002 (as R_{t-1}) and 2003 (as R_{t-2}).

The results of the regression of equation (3) for the whole period 2001-2004 are presented in table 3. One of the first conclusions that can be drawn is that only the returns for the years that are closest to fiscal year end have a significant relation with the earnings numbers (including and excluding the amortisation expense). When earnings are timely, one would expect a strong relationship between the earnings number and the return measure for the same year (R_t) and a less strong relationship with the return measure for the other years (R_{t-1} and R_{t-2}). This is the case for all of the years in the sample. It can therefore be concluded that earnings are timely for the sample years 2001-2004.

Table 3: Timeliness of the amortization expense, 2001 – 2004

	<u>N</u>	<u>Interc</u>	<u>Rt</u>	<u>Rt-1</u>	<u>Rt-2</u>		<u>N</u>	<u>Interc</u>	<u>Rt</u>	<u>Rt-1</u>	<u>Rt-2</u>
	<i>Earnings including amortisation component</i>						<i>Earnings excluding amortisation component</i>				
2001	320	0,0	51,7	0,1	-0,2	320	0,0	46,2	0,2	-0,2	
p-value		0,0	0,0	0,2	0,0		0,0	0,0	0,1	0,0	
t-statistic		4,2	8,9	1,4	-2,3		5,0	8,0	1,7	-2,3	
Adj, R ²					0,36						0,33
2002	385	0,0	85,5	0,1	-0,4	385	0,0	64,2	0,1	-0,3	
p-value		0,2	0,0	0,1	0,0		0,0	0,0	0,0	0,0	
t-statistic		1,3	14,4	1,6	-3,7		4,4	11,5	2,0	-3,0	
Adj, R ²					0,51						0,43
2003	359	0,0	187,3	0,0	-0,3	359	0,0	185,5	-0,1	-0,3	
p-value		0,0	0,0	0,8	0,0		0,3	0,0	0,7	0,0	
t-statistic		-3,6	13,6	0,2	-2,8		-1,1	13,9	-0,4	-2,8	
Adj, R ²					0,51						0,50
2004	358	0,0	171,9	-0,1	-0,2	358	0,0	147,0	-0,2	-0,2	
p-value		0,0	0,0	0,3	0,0		0,2	0,0	0,1	0,0	
t-statistic		-2,5	16,3	-1,1	-3,2		1,3	14,7	-1,6	-2,7	
Adj, R ²					0,53						0,46

Another result visible from Table 3 is that the model with the adjusted earnings figure (excluding the amortization expense) has less explanatory power than the model with the regular earnings number. This is consistent with the results from the market valuation model, because it shows that including the amortisation expense in the earnings number gives the market new information and that investors use this piece of new information in their valuation. Conclusions on the increased timeliness of the impairment expense compared to the amortisation expense can only be made after a comparison with the results from the sample years 2005-2009. These are presented in Table 4.

Table 4: Timeliness of the impairment expense, 2005 – 2009

	<u>N</u>	<u>Interc</u>	<u>Rt</u>	<u>Rt-1</u>	<u>Rt-2</u>		<u>N</u>	<u>Interc</u>	<u>Rt</u>	<u>Rt-1</u>	<u>Rt-2</u>
	<i>Earnings including impairment component</i>						<i>Earnings excluding impairment component</i>				
2005	166	0,0	196,8	-0,4	-0,2	166	0,0	171,6	-0,4	-0,1	
p-value		0,0	0,0	0,0	0,3		0,4	0,0	0,0	0,6	
t-statistic		-3,0	15,4	-2,0	-1,0		-0,9	14,1	-2,6	-0,6	
Adj, R ²					0,72					0,68	
2006	164	0,0	58,8	-0,3	0,1	164	0,1	35,3	0,0	0,1	
p-value		0,0	0,0	0,2	0,0		0,0	0,0	0,8	0,3	
t-statistic		4,5	6,4	-1,3	2,1		6,9	4,0	0,2	1,1	
Adj, R ²					0,49					0,38	
2007	137	0,0	106,6	-0,2	0,1	137	0,0	66,6	0,0	-0,1	
p-value		0,0	0,0	0,0	0,6		0,0	0,0	0,7	0,5	
t-statistic		2,0	16,4	-2,0	0,5		5,1	10,9	-0,4	-0,6	
Adj, R ²					0,67					0,48	
2008	180	0,0	75,2	0,1	-0,2	180	0,0	52,5	-0,1	0,0	
p-value		0,1	0,0	0,5	0,0		0,6	0,0	0,5	0,5	
t-statistic		-1,8	9,7	0,7	-2,7		0,5	8,7	-0,7	0,7	
Adj, R ²					0,57					0,46	
2009	194	-0,1	180,7	-0,6	0,9	194	0,0	121,8	-0,4	1,0	
p-value		0,0	0,0	0,1	0,0		0,0	0,0	0,2	0,0	
t-statistic		-3,5	9,6	-1,6	2,3		-2,0	7,0	-1,2	2,9	
Adj, R ²					0,45					0,32	

When looking at the relationship between the return measures and the earnings number for the years in the sample, it can be seen that there is again a strong relationship

between the earnings number and the return measure for the same year (R_t). It can therefore be concluded that earnings are also timely for the sample years 2005-2009.

An interpretation of increased timeliness for the impairment expense is that the coefficients on returns close to the reporting date (R_t) are higher and, therefore, show a more significant relation, while the coefficients on returns further away from the reporting date (R_{t-1} and R_{t-2}) are lower, compared to those from the amortisation expense (Table 3). This expectation is supported by the results in table 4.

Another interpretation of increased timeliness of the impairment method is an increase in explanatory power of the model for the impairment regression compared with the results of the amortisation regression. Increased explanatory power shows a stronger relationship between earnings and returns and this indicates that the actual change in economic value of the company lies closer to the recognition of this change in the financial statements. The results from table 4 show that this is indeed the case and that R^2 are generally higher for the impairment regression. In contradiction to our earlier conclusion this justifies that the impairment expense is timelier than the amortisation expense.

It has to be pointed out that the previous two interpretations of increased timeliness are highly affected by other variables than only the amortisation or impairment expense. This is caused by the fact that the earnings and returns measures both contain information on all variables that affect the (change in) value of the company. However, it is not possible to find a proxy for the actual change in the economic value of goodwill, as the market only receives information on this change from the reported financial statements. The comparison between the regular earnings number and the adjusted earnings number without the amortisation or impairment expense creates the possibility to examine the effect of including this amount in the earnings definition.

Including the impairment expense in the earnings definition (the regular earnings number) increases the coefficients on the returns and increases the explanatory power of the model. When these increases are higher for adding the impairment expense than for adding the amortisation expense, it could be argued that the impairment expense is timelier. When comparing Tables 3 and 4, it can be concluded that this is in fact the case.

Hypothesis 2 states that the impairment expense is timelier than the amortisation expense. Based on several interpretations of increased timeliness, it can be concluded that the results on the regressions run, namely they support this statement. Consequently, hypothesis 2 is not rejected and it is concluded that the impairment expense appears to be timelier than the amortisation expense.

5. Summary and Conclusion

Regulation on goodwill accounting was changed by the IASB (IFRS 3) in 2001 and by the FASB (SFAS 142) in 2005. From that moment amortisation of goodwill was no longer allowed. Companies now have to perform an impairment test on goodwill annually, to test whether the recoverable amount of the goodwill is higher than the carrying amount. If not, then goodwill has to be impaired and a related expense has to be recognised.

The objective of this change in accounting standards is to increase the quality of accounting information. The IASB argues that when information is of higher quality, investors will prefer this because it is more useful for investment decisions. In the framework that the IASB and FASB produced together, all quality characteristics of accounting information are outlined. Relevance is pointed out as one of the fundamental characteristics, while timeliness is regarded as an enhancing characteristic.

Academic research has investigated both methods of goodwill accounting. However, no consensus is reached on their effect on accounting quality. The IASB motivated its change in accounting standard by stating that the amortisation method leads to arbitrary accounting (IASB, 2005), implying that the impairment method does not. Nevertheless, this statement is not supported by clear academic evidence.

In this paper it is examined whether the introduction of IFRS 3 and the accompanying change in method of accounting for goodwill has led to higher quality of accounting information. This is investigated by using the two important qualitative characteristics of accounting information identified by the FASB and IASB; namely value-relevance and timeliness.

It is believed that the present work contributes to academic literature in several ways. Firstly, both goodwill accounting methods are compared using the introduction of IFRS 3 by the IASB in 2005, whereas most academic research has focused on the effects of SFAS 142 regulation by the FASB. Also, since the standard was only issued in 2005, previous research suffered with data availability problems. In addition, some research on IFRS 3 used specifically the Swedish stock market as a dataset. In this paper, an extended sample of five and six years (2005-2009 and 2005-2010 respectively) is used to provide stronger evidence on the research questions at hand.

Based on this particular sample and the two accounting quality characteristics examined here (relevance and timeliness) the results show mixed evidence of increased accounting quality. The impairment expense on goodwill is not more relevant than the amortisation expense, indicating that investors do not find it more useful in their valuation of share prices and therefore also not for decision-making. This could very well be due to the fair value nature of the impairment expense. Fair value does represent the underlying economic and commercial events better but it also makes it more difficult for investors to interpret the accounting number. The results of the timeliness test, however, do show increased timeliness regarding the impairment expense in comparison with the amortisation expense. This indicates that there is a decrease in the gap between the actual decline in economic value of the goodwill and its recognition in the financial statements. Accounting quality has therefore increased regarding the timeliness characteristic. As a result, it is concluded that the objective of the IASB is not completely met. IASB should perhaps reconsider the content of the impairment method of goodwill accounting. The impairment test could, for example, be simplified making it easier for investors to understand the information content, or the IASB could publish extra guidelines to help companies perform an impairment test. These are options that could increase the relevance and timeliness of accounting information.

6. Future research and limitations of the Ohlson model

At this stage it is important to consider some limitations of the work given and suggest areas for future research. Although the sample size was increased in comparison to other studies that examined the effects of IFRS 3, it still has its shortcomings. One limitation is that the impairment method is investigated during the years 2005-2010. This means that impairments due to bad economic conditions were quite common during the last credit crunch. It could be very well possible that an extended sample size gives better information on accounting quality, regarding the relevance and timeliness of accounting information.

Future research could focus on studying the same research question, but by using other samples. Including more firm-years or a change in the market indices investigated could give more general insights into whether accounting quality increased as a consequence of the change in accounting method. Over time, companies become more familiar with the impairment method of accounting for goodwill, like measurements and disclosure requirements. It is therefore probable that the relevance and the timeliness of the impairment expense increases over time.

Another option would be to examine the research question regarding other qualitative characteristics of accounting information. Due to the lengthy limitations, there was a focus on the fundamental features of value relevance and the enhancing characteristic of timeliness. These are however not the only distinctiveness of accounting quality. The IASB and FASB also suggest *faithful representation* as the other fundamental characteristic, while *comparability*, *verifiability* and *understandability* are additional enhancing features. Future research could investigate whether accounting quality has improved regarding these other elements.

Hand and Landsman (1998) made a study that tested the Ohlson model. Their explanation for anomalies is the fact that dividends play a significant part in signaling profitability. The Ohlson model rules this part out. The Ohlson (1995; 1998) as well as the Feltham and Ohlson (1995; 1997) models presume a lack of information asymmetry and these models assume there is no role to play for dividends as signaling devices. Finance research has tested two alternative hypotheses. The first is Jensen's (1986) free cash flow theory; the second is the hypothesis in which managers use dividends as a way to signal information. (Bhattacharya, 1979; Kalay, 1980; Miller and Rock, 1985). Both hypotheses predict positive relationships between share prices and dividends.

Future research could also make use of even different types of models than the ones based on Ohlson's value relevance model which is a linear model. The dynamic nature of the market leads to very complex relationships between stock returns and earnings. Some researchers feel that these could be better explained by non-linear models. Freeman and Tse (1992) developed such a model. Relative to the linear model (earnings response coefficient), a non-linear approach provides a richer explanation as well as a higher explanatory power. The Freeman and Tse model rests on the assumption that earnings persistence is negatively

correlated with the absolute value of unexpected earnings. Future research could build further on their model which is an important contribution to empirics in predicting share prices in our complex current environment.

Another model that could give new insight might be the Gordon model (1959). The Gordon growth model is a variant of the discounted cash flow model, a method for valuing a stock or business. The model requires one perpetual growth rate, greater than negative 1 and less than the cost of capital. However, for many growth stocks the current growth rate can vary with the cost of capital significantly year by year. Also if the stock does not currently pay a dividend, like many growth stocks, more general version of the discounted dividend model should be used. One common technique is to assume that the Miller-Modigliani (1958) hypothesis of dividend irrelevance is true, and therefore replace the stocks' dividend D with E earnings per share. Using the above mentioned models in future research on the value relevance, timeliness as well as other characteristics of accounting quality of goodwill amortisation versus goodwill impairments would certainly contribute to the existing literature on this subject.

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Volatility Shifts and Persistence in Variance: Evidence from the Sector Indices of Istanbul Stock Exchange

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Abstract

This study examines the impact of volatility shifts on volatility persistence for three major sector indices of Istanbul Stock Exchange (ISE) and ISE National 100 index over the period beginning from 1997 and ending in 2009. The exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model is extended by taking account of the volatility shifts which are determined by using iterated cumulative sums of squares (ICSS) and modified ICSS algorithms such as Kappa-1 ($\kappa-1$) and Kappa-2 ($\kappa-2$). The results indicate that the inclusion of volatility shifts in the model substantially reduces volatility persistence and suggest that the sudden shifts in volatility should not be ignored in modelling volatility for Turkish sector indices.

Keywords: Stock return volatility, volatility shifts, persistence, Turkish stock market

JEL classification: C22, C52, C58

1. Introduction

It is important for investors, fund managers and policy makers to determine the volatility of stock markets for pricing the financial assets, managing risks and predicting future volatility. In estimating volatility, autoregressive conditional heteroskedasticity (ARCH) family models have gained attention and are used by many finance researchers as they are simple to implement and able to cover the stock return volatility features such as clustering and mean-reverting. However, the shortcoming of these models might be the overestimation of the persistence of volatility, which might cause misinterpretation on volatility persistence and spurious volatility modelling (see for example Lastrapes, 1989; Lamoureux and Lastrapes, 1990; Malik, 2003; Ewing and Malik, 2005). The standard ARCH models assume that there is no shift in volatility, yet especially in emerging markets there

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may potentially be sudden changes in volatility since these countries run into economic, political and social events more often than the developed markets. It is therefore important to take account of these shifts in estimating volatility persistence particularly for emerging markets.

In this context, the volatility of the Turkish stock market which is one of the most important and highly volatile emerging markets in the world that has experienced many financial crises, causing shifts in volatility, is examined. Since most of the investors prefer to hold mutual funds or sector index funds to achieve efficient portfolios rather than holding individual securities, in this paper besides the ISE-100 index, the major sector indices are examined including ISE-Financial (ISE-FIN), ISE-Industrial (ISE-IND), and ISE-Service (ISE-SRV). The sample period begins from 1997 and ends in 2009, covering major economic and financial events in Turkey such as the domestic and global financial crisis, government elections, changes in the monetary and fiscal policies and improvements in the EU adaptation process which might cause sudden changes in volatility. These events might have a systematic effect on the whole market or might only affect a particular sector. Therefore, the investors and managers of index funds need to determine whether these major events cause shifts in volatility in the whole market or a particular sector in order to create much better diversified portfolios, to predict the future volatility of these index funds properly and to value them accurately.

Hence, the major aim of this paper is to explore an effective model for volatility of the Turkish stock market and sector indices by considering the sudden shifts. In order to achieve this objective, similar to the previous studies, initially, the time points of the shifts in volatility are determined endogenously by utilising the iterated cumulative sums of squares (ICSS) algorithm which was introduced by Inclan and Tiao (1994). It was widely evidenced that financial data have time-varying variance and excess kurtosis; however, the ICSS algorithm assumes constant variance and mesokurtosis within a regime. Thus, different from the previous studies, modifications of this model including Kappa-1 ($\kappa-1$) and Kappa-2 ($\kappa-2$) which were developed by Sanso et al. (2004) are applied. $\kappa-1$ only corrects the non-mesokurtosis, whereas $\kappa-2$ corrects both the non-mesokurtosis and persistence in conditional variance. In addition, there is an attempt to interpret the major events around the time points of increased volatility. Then, the exponential generalised ARCH (EGARCH) model (Nelson, 1991) is employed incorporating these volatility shifts to measure the effect of a shock on volatility persistence in an asymmetric fashion. To the best of our knowledge, this is the first study to examine this issue for Turkish stock market by using such an econometric methodology that is explained below in detail.

The rest of the paper is structured as follows: Section 2 briefly reviews the previous studies. Section 3 presents the methodology. Section 4 describes the data and sample statistics. Section 5 presents the empirical results and Section 6 concludes the paper.

2. Literature Review

Lamoureux and Lastrapes (1990) and Hamilton and Susmel (1994) found that there

was a considerable reduction in the estimated persistence of volatility of stock returns when regime shifts were incorporated in the standard ARCH model. While the former determined the regime shifts in returns exogenously, the latter determined them endogenously by employing Markov-Switching ARCH (SWARCH) models. Most of the recent empirical studies focus on the structural changes in volatility rather than returns and use the ICSS algorithm to identify sudden changes in volatility endogenously. Among these studies firstly Aggarwal et al. (1999) used the ICSS algorithm to investigate the large shifts in the volatility of eleven emerging stock markets in Asia and Latin America, in addition to the U.S., Germany, the U.K., Hong Kong and Singapore stock markets. They used weekly data from 1985 until 1995 and found the local and country-specific factors to be the dominant causes behind the sudden changes. The October 1987 stock market crash in the U.S. was the unique global factor that affected numerous emerging markets in their sample. Later studies followed the study of Aggarwal et al. (1999) and detected the sudden changes in variance endogenously by using ICSS and incorporate these shifts in the ARCH family models to find the effect of a shock on persistence of volatility. Among these studies Malik, Ewing and Payne (2005) examined the Canadian Stock Market by using weekly data from June 1992 and October 1999. They investigate the impact of regime changes on volatility persistence and conduct ICSS algorithm to detect sudden changes in the volatility and incorporate those shifts into variance equation of GARCH model to avoid overestimating the volatility persistence. They conclude that the persistent volatility is reduced after considering sudden volatility changes in stock returns. In this manner, their findings are consistent with the Lamoureux and Lastrapes (1990), Aggarwal, Inclan, and Leal (1999). Ewing and Malik (2005) investigate the existence of asymmetry in the predictability of the volatilities of small and large companies in the USA. They use ICSS algorithm to detect large changes in the unconditional variance of stock returns and incorporate this information in Bivariate GARCH model. According to their results, spillover effects between small and large cap stock returns disappears when endogenously determined volatility shifts are taken into consideration. Moreover, they observe significant decline in the transmission of volatility between those stock returns. Hence, they suggest not ignoring regime changes to estimate degree of volatility transmission more accurately. Fernandez (2005) conducts ICSS algorithm and Wavelet Analysis (WA) to investigate the existence of structural breaks in the four stock indices and four interest rates series. Dataset consists of Emerging Asia, Europe, Latin America and North America indices of Morgan Stanley Capital International (MSCI). Fernandez (2005) focuses on the effects of the Asian crisis and the terrorist attacks of September 11, 2001 on the volatility of those stock indices and the interest rate series of the Central Bank of Chile. Empirical findings suggest that ICSS algorithm and WA detects several breakpoints in the data. Fernandez (2005) concludes that those sudden changes in the unconditional variance of series should be considered. Wang (2006) conducts a study to examine the impact of financial liberalisation on the volatility of several stock indices during the period from 1986 to 1998. They use daily returns data at a daily frequency. Wang (2006) applies ICSS algorithm to detect structural breaks due to the announcement of liberalisation. According to the empirical findings, there exists several breakpoints in the

unconditional variance of the daily returns of South Korea, Malaysia, Philippines, Thailand, Taiwan, Turkey, Argentina, Brazil, Chile, and Mexico for over ten years. According to analytical results, the volatility of stock returns increased significantly for the markets of Thailand, Brazil, Chile, and Mexico whereas unconditional volatility remains unchanged for the rest. Hammoudeh and Li (2006) examined the volatility of Gulf Arab stock markets using weekly data from 1994 to 2001. In contrast to the study of Aggarwal et al. (1999) they found that most of the Gulf Arab stock markets were more sensitive to major global events such as the 1997 Asian crisis and the September 11th attack than to local and regional factors. Fernandez (2007) investigates the impact of political events in the Middle East on stock markets worldwide. She applied ICSS algorithm and WA to detect the structural breaks in the unconditional variance of several stock markets. The data in the analysis includes Israel, Turkey, Morocco, Egypt, Jordan, Pakistan, and Indonesia, the UK, Germany, Japan, the US, and Spain, and four international indices for the period spanning from April 2000 to March 2005. Fernandez (2007) concludes that the war in Iraq has a significant impact on the volatility of several Middle East and Emerging Asian countries. Moreover, volatility of stock markets is affected from Middle East conflicts. Thus, she suggests estimating financial risks by considering breakpoints in the volatility. Fernandez and Lucey (2008) conduct a study to investigate the determinants of volatility shifts on ten emerging markets, namely Argentina, Brazil, Chile, India, Indonesia, Mexico, Philippines, Singapore, South Africa, and Turkey. They use three statistical approaches, ICSS algorithm, WA, and Bai-Perron's (2003) test to determine the breakpoints in the both mean level and variance of the time series at a weekly frequency, over the period from January 1996 to April 2006, giving in total 536 observations. ICSS algorithm and WA tend to estimate more breakpoints than Bai-Perron's structural breaks test. Fernandez and Lucey (2008) observe that volatility shifts are mostly associated with local political or economic events rather than global events. Marcelo et al. (2008) uses Spanish stock market data at weekly frequency covering the period between January 3, 1990 and January 5, 2005. They conduct their analysis in two steps: First, they apply ICSS algorithm to detect volatility shifts and then they incorporate this piece of information to EGARCH model. Their motivation behind using EGARCH model is to conduct their analysis to better capture the asymmetric behaviour. They observe that volatility persistence is significantly reduced when endogenously determined volatility shifts are taken into account. Moreover, their findings reveal that spillover effects are declined after sudden changes are considered. Wang and Moore (2009) examined the stock markets of transition economics of EU using weekly data over the period 1994-2006 and found that the sudden changes in volatility aroused from the evolution of emerging stock markets, exchange rate policy changes and financial crises. Kasman (2009) investigates the volatility shifts in the stock markets of the BRIC countries, Brazil, Russia, India and China. He works with daily data covering the period between 1990 and 2007 to investigate the effects of sudden volatility shifts on persistence of volatility. Kasman (2009) applies ICSS algorithm to detect the time of breakpoints and incorporate this in GARCH model. Empirical findings suggest that persistence of volatility is dramatically declined when sudden changes in volatility are taken into account. Thus, he states that previous literature may overestimate

the persistence of volatility because they do not consider structural breaks in the data due to the economic or political events during the time period. Lastly, Karaoglou (2010) conducts a study on the stock market indices of 27 OECD countries for the period spanning from 1994 to 2006. He hypothesises that abnormal behaviour may arise because of the joint existence of structural breaks and ARCH effects in the time series data. Karaoglou (2010) employs several econometric tests to determine the sudden changes in variance. These tests include ICSS algorithm of Inclan and Tiao (1994), Kappa tests of Sanso et al. (2004) and Kokoszka and Leipus (2000) type of tests refined by Andreou and Ghysels (2002). Daily closing values of the stock market indices are used in the analysis. The paper concludes that when structural breaks are taken into account high persistence of volatility reduced and asymmetric effects and risk aversion arises only temporarily. All of these papers suggested that when sudden changes were taken into account in the GARCH models, the persistence of volatility was reduced significantly and argued that the findings of the previous studies could have overestimated the degree of the persistence of volatility existing in the stock market data.

While the aforementioned studies examined the stock markets on country basis, Malik and Hassan (2004) examined five major sector indices of the U.S. stock market from January 1992 to August 2003 by applying the same methodology and argued that most of the volatility breaks are associated with global events rather than sector-specific news. Their study has important implications for index investing. Although, investing into index funds is a passive strategy, portfolio managers have to revise the composition of their index funds especially after the major events which might cause shifts in volatility.

In this paper, similar to the study of Malik and Hassan (2004), the three major sector indices of ISE and ISE 100 index are examined, yet, unlike the previous studies in addition to the ICSS algorithm, modified ICSS algorithms such as κ -1 and κ -2 are applied to determine the sudden changes on volatility. These algorithms will be discussed in detail in the following section.

3. Methodology

3.1 Detecting Time Points of Shifts in Variance

First, ICSS algorithm is implemented to detect sudden changes in the variance of a stock return series. The algorithm assumes that the financial series displays a stationary variance over an initial time period, and then there is a sudden shock that alters the variance which becomes stationary again until another shock hits the market (Hammoudeh and Li, 2008).

ICSS algorithm is based on D_k statistics and tests the null hypothesis of constant unconditional variance. D_k statistics is computed as follows:

$$D_k = \frac{C_k}{C_T} - \frac{k}{T} \quad D_0 = D_T = 0 \quad \text{with} \quad k = 1, \dots, T \quad (1)$$

where $C_k = \sum_{t=1}^k \varepsilon_t^2$, $k=1, \dots, T$ ¹. C_k is the cumulative sum of squares of ε_t . Then, the test proposed by Inçan and Tiao (1994) can be written as follows:

$$IT = \sup_k \left| \sqrt{T/2} D_k \right| \quad (2)$$

where $\sqrt{T/2}$ is used to standardise the distribution. One can conclude that k^* , which is the point of k at which $\sup_k |D_k|$ is obtained, is a change of variance when $IT = \sup_k \left| \sqrt{T/2} D_k \right|$ exceeds the predetermined boundary estimated by the Inçan and Tiao (1994). The asymptotic distribution of the test under the assumption that $\varepsilon_t \sim i.i.d.N(0, \sigma^2)$ ² is based on the following notation:

$$IT \Rightarrow \sup_r |W^*(r)| \quad (3)$$

where $W^*(r) \equiv W(r) - rW(1)$ is a Brownian Bridge, $W(r)$ is a standard Brownian motion and \Rightarrow denotes weak convergence of the associated probability measures (Sanso et al., 2004).

Since financial data have generally excess kurtosis (greater than three), and inconstant variance over time, there might be some drawbacks using aforementioned IT test. Because IT algorithm assumes $\varepsilon_t \sim i.i.d.N(0, \sigma^2)$ IT statistic can be oversised when error terms follow a GARCH process (Rapach and Strauss, 2008; de Pooter and van Dijk, 2004; Sanso et al., 2004). Rapach and Strauss (2005) also note that IT test is plagued by size distortions if ε_t follows a dependent process. To overcome these shortcomings, Sanso et al. (2004) proposed two tests; κ -1 and κ -2 which consider the fourth moment properties of the disturbances and the conditional heteroskedasticity. In this paper, in addition to the ICSS algorithm, these tests are employed to detect sudden changes³.

κ -1 test corrects for non-mesokurtosis and it is a generalised form of IT. The asymptotic distribution of the κ -1 test under the conditions of $\varepsilon_t \sim i.i.d.(0, \sigma^2)$ and $E(\varepsilon_t^4) \equiv \eta_4 < \infty$ can be written as follows:

$$IT \Rightarrow \sqrt{\frac{\eta_4 - \sigma^4}{2\sigma^4}} \sup_r |W^*(r)| \quad (4)$$

¹ Note that D_k statistics have value around zero. However, when change in unconditional variance occurs, D_k statistics take values different from zero in either sign, negative or positive.

² ε_t are a zero mean, normally, identically and independently distributed random variables.

³ Potter and Dijk (2004) imposed a restriction to conventional ICSS algorithm in order to prevent breaks from being identified unrealistically close together. They imposed minimum distance restriction between breakpoints for daily data as 63 or 126 business days. We do not report the mathematical details about this procedure, and the results of the procedure since Potter and Dijk's (2004) procedure fit for purpose with Sanso et al. (2004) procedure; and both tests also suggest the same time points of volatility shifts. We thank two anonymous referees for their suggestions.

Thus, the distribution that has nuisance parameters and numerous distortions can occur when critical values of maximisation of a Brownian Bridge are used. It is possible to experience that null hypothesis of constant variance might be rejected too many times when distribution is heavily tailed, in other words, leptokurtic⁴ ($\eta_4 > 3\sigma^4$). However, when distribution is platykurtic (negative excess kurtosis), the test becomes so prudent that there would not be too many conclusions of inconstant variance. Hence, Sanso et al. (2004) suggest following correction for the IT test to be free of nuisance parameters for identical and independent zero-mean random variables:

$$\kappa_1 = \sup_k \left| \frac{1}{\sqrt{T}} B_k \right| \quad (5)$$

where $B_k = \frac{C_k - \frac{k}{T} C_T}{\sqrt{\hat{\eta}_4 - \hat{\sigma}_4^2}}$ and $\hat{\eta}_4 = \frac{1}{T} \sum_{t=1}^T \varepsilon_t^4$ and $\hat{\sigma}^2 = \frac{1}{T} C_T$. Asymptotic distribution under the same conditions of equation 5 can be adjusted as follows: $\kappa_1 \Rightarrow \sup_r |W^*(r)|$.

In case of a conditionally heteroskedastic process, IT and κ -1 lose power because they have an assumption of independence of the random variables which is not appropriate for the financial data (Bollerslev et al., 1992; 1994). To correct for non-mesokurtosis and persistence in conditional variance some additional assumptions on ε_t are required similarly following Herrndorf (1984) and Phillips and Perron (1988). Sanso et al. (2004) assume that sequence of random variables, $\{\varepsilon_t\}_{t=1}^\infty$ is consistent with the following conditions:

1. $E(\varepsilon_t) = 0$ and $E(\varepsilon_t^2) = \sigma^2 < \infty$ for all $t \geq 1$;
2. $\sup_t E(|\varepsilon_t|^{\psi+\varepsilon}) < \infty$ for some $\psi \geq 4$ and $\varepsilon > 0$;
3. $\omega_4 = \lim_{T \rightarrow \infty} E\left(\frac{1}{T} \left(\sum_{t=1}^T (\varepsilon_t^2 - \sigma^2)\right)^2\right) < \infty$ exists, and
4. $\{\varepsilon_t\}$ is α -mixing with coefficients α_j which satisfy $\sum_{j=1}^\infty \alpha_j^{(1-2/\psi)} < \infty$

If the second and the third conditions hold, it is not the case that ε_t in data sequence are distributed as student-t distribution with three degrees of freedom. ω_4 is the long-run variance of the zero mean variable $\xi_t = \varepsilon_t^2 - \sigma^2$. Fourth condition controls for the degree of independence of the data sample and shows a trade-off between serial dependence and the existence of high order moments (Sanso et al., 2004: pp. 5).

In the light of the facts that κ -2 test is based on following equation:

$$\kappa_2 = \sup_k \left| \frac{1}{\sqrt{T}} G_k \right| \quad (6)$$

⁴ Under normal distribution $\eta_4 = 3\sigma^4$ and $IT \Rightarrow \sup_r |W^*(r)|$

where $G_k = \frac{1}{\sqrt{\hat{\omega}^4}} \left(C_k - \frac{k}{T} C_T \right)$ and $\hat{\omega}^4$ is a consistent estimator⁵ of ω_4 . Consequently, under four conditions above IT, κ -1 and κ -2 can be written as follows:

$$IT \Rightarrow \sqrt{\frac{\omega_4}{2\sigma^4}} \sup_r |W^*(r)| \tag{7}$$

$$\kappa_1 \Rightarrow \sqrt{\frac{\omega_4}{\eta_4 - \sigma^4}} \sup_r |W^*(r)| \tag{8}$$

$$\kappa_2 \Rightarrow \sup_r |W^*(r)| \tag{9}$$

3.2. EGARCH Model without and with Shifts in Variance

After the time points of the shifts in variance are identified, the volatility persistence in the presence of these shifts are calculated. We begin with the estimation of EGARCH model without shifts in variance.

Nelson (1991) developed the EGARCH model that accounts for the asymmetry effect of news and posits no constraints on the coefficient of variance equation since it models logarithm of conditional variance. EGARCH specification is as follows:

$$\ln(h_t) = \alpha_0 + \sum_{i=1}^p \beta_i \ln(h_{t-i}) + \sum_{j=1}^q \alpha_j \left(\frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right) + \sum_{k=1}^r \xi_k \left(\frac{\varepsilon_{t-k}}{\sqrt{h_{t-k}}} \right) \tag{10}$$

where ξ is the asymmetry coefficient. If ξ is negative and statistically significant, one might conclude that the relationship between volatility and returns is negative, or to put it another way, the effect of shock on the conditional variance would be $(\alpha_j - \xi_k)$. It is important to note that EGARCH specification is built to use *standardised* square root of ε_{t-j}^2 to provide a more accurate interpretation about shocks to the natural logarithm of conditional variance (Enders, 2010, pp.156-157). β is the measure of persistence and if it is less than one, EGARCH specification is assumed to be covariance stationary. The EGARCH model with sudden changes in variance can be expressed as follows⁶:

$$\ln(h_t) = \alpha_0 + \sum_{i=1}^p \beta_i \ln(h_{t-i}) + \sum_{j=1}^q \alpha_j \left(\frac{\varepsilon_{t-j}}{\sqrt{h_{t-j}}} \right) + \sum_{k=1}^r \xi_k \left(\frac{\varepsilon_{t-k}}{\sqrt{h_{t-k}}} \right) + \sum_{l=1}^{\eta_b} d_{b,l} DUM_{b,l,t} \tag{11}$$

⁵ Sanso et al. (2004) also suggest using non-parametric estimator of ω_4 :

$\hat{\omega}_4 = \frac{1}{T} \sum_{i=1}^T (\hat{\varepsilon}_i^2 - \hat{\sigma}^2)^2 + \frac{2}{T} \sum_{l=1}^m w(l, m) \sum_{i=l+1}^T (\hat{\varepsilon}_i^2 - \hat{\sigma}^2)(\hat{\varepsilon}_{i-l}^2 - \hat{\sigma}^2)$ where $w(l, m)$ is a lag window. It should be added when $\hat{\xi}_i = \hat{\varepsilon}_i^2 - \sigma^2$ and then $\hat{\omega}_4 \rightarrow E(\hat{\xi}_i^2) = \eta_4 - \sigma^4$.

⁶ Bollerslev, Chou and Kroner (1992), Hansen and Lunde (2001) suggest using $p=q=1$ specification which outperforms in many applications.

n_b is the number of structural breaks of return in market b , $DUM_{b,t}$ represent the dummy variables taking a value of 1 from each point of sudden change in variance onwards, 0 otherwise. In financial literature, statistical fat-tailed distributions, namely Student-t or GED that capture leptokurtosis should be used rather than normal distribution. In this paper, as Nelson (1991) suggested, errors are assumed to be distributed according to GED which has a probability density function as follows:

$$f(\varepsilon_t) = \frac{v \exp \left[-\left(\frac{1}{2} \right) \left| \frac{\varepsilon_t}{\lambda \sqrt{h_t}} \right|^v \right]}{2^{\left(\frac{1+v}{v} \right)} \lambda \sqrt{h_t} \Gamma \left(\frac{1}{v} \right)} \quad (12)$$

where v is the shape parameter indicating the thickness of the tail compared to the Gaussian distribution. v denotes that the distribution has thicker or thinner tails, if v is less than two, and greater than two, respectively. Γ is the usual gamma function and λ is identical to $\left[\left(2^{(-2/v)} \Gamma(1/v) \right) / \left(\Gamma(3/v) \right) \right]^{0.5}$. Moreover, conditional log-likelihood function can be written as:

$$L(\varepsilon_t)_{GED} = \sum_{t=1}^T \left[\ln \left(\frac{v}{\lambda} \right) - 0.5 \left| \frac{\varepsilon_t}{\lambda \sqrt{h_t}} \right|^v - \left(\frac{v+1}{v} \right) \ln(2) - \ln \left[\Gamma \left(\frac{1}{v} \right) \right] - \frac{1}{2} \ln(h_t) \right] \quad (13)$$

4. Data and Descriptive Statistics

Daily returns of ISE indices are employed including ISE-100, and sector indices including ISE-FIN, ISE-IND, and ISE-SRV. Continuously compounded daily returns series are calculated by taking the difference of the natural logarithm of price indices⁷. Log-returns of price series are calculated as follows: $r_t = \ln(P_t / P_{t-1})$ where r_t denotes *continuously compounded return* at time t , P_t and P_{t-1} denote value of index at time t and time $t-1$ respectively, and \ln is the natural logarithm.

Table 1 presents the descriptive statistics for our sample. ISE-FIN is the most volatile index with the highest standard deviation. Skewness and kurtosis statistics depict that the series are skewed and leptokurtic respectively. In addition, Jarque-Bera test statistics suggest that there is strong evidence of rejecting the null hypothesis of normal distribution for all. Ljung-Box statistics for returns and squared returns up to 10, 20, and 40 lags indicate the existence of serial correlation. According to the Engle's (1982) ARCH-LM⁸ test (TR²), evidence of ARCH effect is detected revealing time-varying conditional distribution.

⁷ Return series is mostly used in financial literature instead of price series because of several appropriate statistical properties, namely stationarity, ergodicity. In addition, return of an asset is a complete and scale-free of the investment, put another way, returns are unit-free (Campbell, Lo, & Mackinlay, 1997), (Tsay, 2002), (Brooks, 2008).

⁸ Engle (1982) proposed this test to check the necessity of modelling volatility with ARCH model.

5. Empirical Results

5.1 Integration

Before investigating the impact of volatility shifts on the persistence of variance, unit root tests are used, namely Augmented Dickey-Fuller (ADF), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) to find out whether return series are stationary or not. Table 2 (in Appendix) indicates the results of conventional unit root tests namely, Augmented Dickey Fuller (1979) (ADF), and Kwiatkowski et al. (1992). All series are found as integrated of order zero (0), in other words, they are all stationary regardless the trend variable is included.

Since daily returns are stationary, $I(0)$, and symptom of ARCH effect is detected in the residuals, it is appropriate to conduct ARCH family models to model volatility. Thus, we applied EGARCH model under the assumption of a GED structure for the errors.

5.2 Volatility Shifts in Variance

Before the EGARCH model is estimated, the possible volatility shifts in unconditional variance are determined endogenously by using ICSS algorithm, $\kappa-1$ and $\kappa-2$. Table 3 (in Appendix) reports time points of volatility shifts for the aforementioned indices. After $\kappa-2$ procedure is applied, three important shifts in the volatility of the ISE-100 and ISE-FIN indices and one for the ISE-IND and ISE-SRV indices are observed. $\kappa-2$ procedure detected a significant increase in volatility in March 2003 in all sector indices and ISE 100 index. This could be due to the Iraq War which began on March 20, 2003 with the invasion of Iraq. Turkish stock market decreased by 11.29% during the week from March 17-21, 2003. In addition, the second round of the Assembly session including governmental decree to send Turkish troops to Iraq was another source of this volatility increase. The first volatility shift of ISE-100 index on March 25, 2003 is due to the concerns that Iraq war could last longer than expected. At this date, ISE-100 index decreased to the lowest level of the last five months and trading volume decreased substantially.

There was a significant increase in volatility of ISE-FIN on June 8, 2004. The closing price of the index reached its maximum level on that date. In addition to the positive developments in international markets, decreases on the Turkish Treasury bill rates, the value of U.S. dollar against Turkish Lira (TL) and the inflation rate of May were the major determinants of this increasing trend in Turkish stock market. Moreover, shift in volatility was observed for ISE-100 index on June 14, 2004. In contrast to the previous week, the price index declined. This could be due to the expectations on the ground that FED would increase the interest rates and the results of the EU parliamentary elections were not promising for Turkey. The shift in volatility in both ISE-100 and ISE-FIN indices on July 18, 2007 might be the result of the general elections in Turkey. During the third week of July, Turkish stock market increased substantially due to the effect of the optimistic

expectations of investors on the grounds that eventually a single party government would again be formed after the elections in Turkey.

The results of the κ -2 procedure indicate that the stock market indices were mostly influenced by domestic factors. Although some sudden changes after the 1997 Asian currency crisis, 1999 Russian crisis, 2000-2001 Turkish banking crisis and the most recent U.S. financial crisis were observed, when both ICSS algorithm and κ -1 were applied these shifts were not observed when κ -2 was employed. It can be on the grounds that κ -2 detects only deep (essential, radical) regime shifts. If the changes of the indices on the figures in Appendix are analysed, these radical shifts can clearly be seen. ISE indices exhibit a dramatic increase after 2003 and the index level goes further away from the level of 1998-2003 period rapidly. In addition, it can be clearly observed that the speed of increase in the index levels during the 2004-2007 period is somewhat higher than that of the 2003-2004 period. On the other hand, the shift during the 2003-2004 period is higher than the shifts for the following one-year periods. The shift in 2007 can be explained on the grounds that the index was testing its peak level after the 2004-2007 period and then it had begun to fall sharply depending on the effects of the global financial crisis. According to the results of the κ -2 procedure, it is observed that sector specific risks have a significant impact on the volatilities of each index since the timing and number of shifts in the unconditional variance of ISE-SRV are slightly different from the other indices. Moreover, one can conclude that the sector specific risks of the ISE-FIN index and those of the ISE-100 indices are very similar. This is evident from the close similarity between them in terms of the calculated number and timing of their volatility shifts. It is noteworthy that volatility shifts in the year 2004 for the ISE-100 and ISE-FIN are sequential indicating a possible lead-lag relationship between the two. This might be the evidence that ISE-100 is mostly led by the companies listed on the ISE-FIN index.

5.3 EGARCH estimation without and with Sudden Changes in Variance

After the sudden changes in variance are detected, the GED-EGARCH (1,1) model is employed to estimate volatility with or without taking those volatility shifts into account. The main reason behind implementing EGARCH model is to account leverage effect⁹ on equity index volatility. Moreover, asymmetric GARCH models are generally the better fit to high frequency data (e.g. daily data) for equity indices (Alexander, 2008: 147). The results are reported in Table 4 and 5 (in Appendix) where the former is for models without dummy variables, and the latter for models with dummy variables that represent determined volatility shifts¹⁰.

⁹ Leverage effect refers to that negative shocks often increase volatility to a greater extent than positive shocks because negative returns imply a larger proportion of debt through a reduced market value of the firm, which leads to a higher volatility.

¹⁰ We have estimated GED-EGARCH (1,1) model four times: once without dummy variables and the remaining three estimation with volatility shifts identified by ICSS, κ -1, and κ -2 respectively.

Table 4 and 5 indicate that β coefficients in all models are statistically significant at 1% level. Asymmetry coefficients (ξ) are found less than zero and significant at least 10% level indicating that negative shocks lead to higher subsequent volatility than positive shocks both in ISE-100 and the ISE sector indices. In other words, good news has a smaller effect on the conditional volatility than bad news. β coefficients, measure of persistence shocks are close to unity in the models which do not consider the volatility shifts. High degree of persistence in variance suggests that shocks on volatility die out slowly over time. Following Lamoureux and Lastrapes (1990), half-life shock¹¹ which measures the number of days a shock to conditional variance reduces to half its original size was also reported. Average half-life shock for the models without dummy variables is calculated as 26.05 days¹². The results with volatility shifts determined by conventional ICSS algorithm are summarised in the Panel-A of Table 5 (in Appendix). For all models, degree of persistence declines by at least 28% and estimated half-life shocks decreases dramatically to the 1.32 days on average. The findings from models of Panel-A are consistent with the results of papers discussed in the literature review section. That is, degree of persistence of shocks on variance might be overestimated, if volatility shifts (i.e. determined by ICSS algorithm) are not considered. However, another problem arising here is that the number of breakpoints in the data period could be overestimated. Panel-B and Panel-C of Table 5 (in Appendix) show the results of models with volatility shifts determined according to κ -1 and κ -2 tests respectively¹³.

The degrees of persistence decline in models in Panel-B and Panel-C are, on average, 11.84%, and 7.27% respectively. In addition, half-life shocks in those models are, on average, estimated as 4.43 and 6.65 days respectively. Overall, controlling for the fourth moment properties and conditional heteroskedastic process diminishes the number of breakpoints determined by ICSS algorithm dramatically. From now on, since the breakpoints are spurious in ICSS, only the results of Panel-C will be discussed in detail, as suggested by Sanso et al. (2004). All indices except ISE-SRV show decline in volatility persistence by around 6.5%; however, the largest decline in the degree of persistence belongs to ISE-SRV index with a 9.4%. Coefficients including all breakpoints in models are highly significant. For ISE-100 and ISE-FIN indices, there are no ARCH effects and no serial dependency in the level of residuals. Although, there is evidence of ARCH effect up to 1 lag, and autocorrelation up to 12 lags for the ISE-IND index, those problems of modelling disappear in the high levels of lags. Nevertheless, modeling volatility of the ISE-SRV index is not successful by amended EGARCH (1,1) since there are significant ARCH effects up to 1 and 4 lags respectively.

¹¹ For EGARCH specification, half-life is calculated as follow: $-\ln(2)/\ln(\beta)$.

¹² Average half-life shock is computed by conducting half-life formula to the mean of persistence.

¹³ Volatility shifts in variance equation for the models in Panel-B and C are all statistically significant at conventional levels. However, dummy variables in models of Panel-A are not all significant. Since degrees of persistence in models with all volatility shifts, and with only significant shifts are very similar, we only present the former ones.

6. Conclusion

The major aim of this paper is to determine an effective model for volatility of the ISE-100 index and three major sector indices of ISE including ISE-FIN, ISE-IND and ISE-SRV by taking into account the sudden changes in variance. To achieve this goal initially, time points of volatility shifts are determined endogenously by implementing ICSS algorithm which was introduced by Inclan and Tiao (1994) and was widely used by the finance researchers. However, the ICSS algorithm that assumes constant variance and mesokurtosis within a regime detects more breaks and finds less evidence of dependent processes, such as GARCH dynamics. Thus, differently from the previous studies, modifications of this model including κ -1 and κ -2 tests which were developed by Sanso et al. (2004) are applied. κ -1 only corrects the non-mesokurtosis whereas κ -2 corrects both the non-mesokurtosis and persistence in conditional variance.

In addition, the major events corresponding to these volatility shifts are analysed and it is found that the global and domestic political and economic factors lead these sudden changes in variance. There were not observed any sector specific factors that cause significant shifts in variance. Then, these sudden changes are incorporated in the EGARCH model introduced by Nelson (1991) to measure the effect of a shock on volatility persistence in asymmetric fashion and significant reductions in the volatility persistence are found after these sudden changes are accounted for. This also indicates that parameter estimates of (E)GARCH process are changing significantly in the subsamples defined by sudden shifts in the conditional volatility. The results suggest that investors and fund managers have to pay attention to both domestic and global shocks in their portfolios since these shocks might influence the risk-return trade-off and the composition of the optimal asset allocation. The results are also consistent with the findings of previous studies on the persistence in volatility and evidence by means that ignoring sudden changes might result in overestimation on the degree of volatility persistence and inaccuracy of volatility estimations of ISE indices for fund managers and investors.

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Appendix

Figure 1: Daily ISE-100 index prices and returns

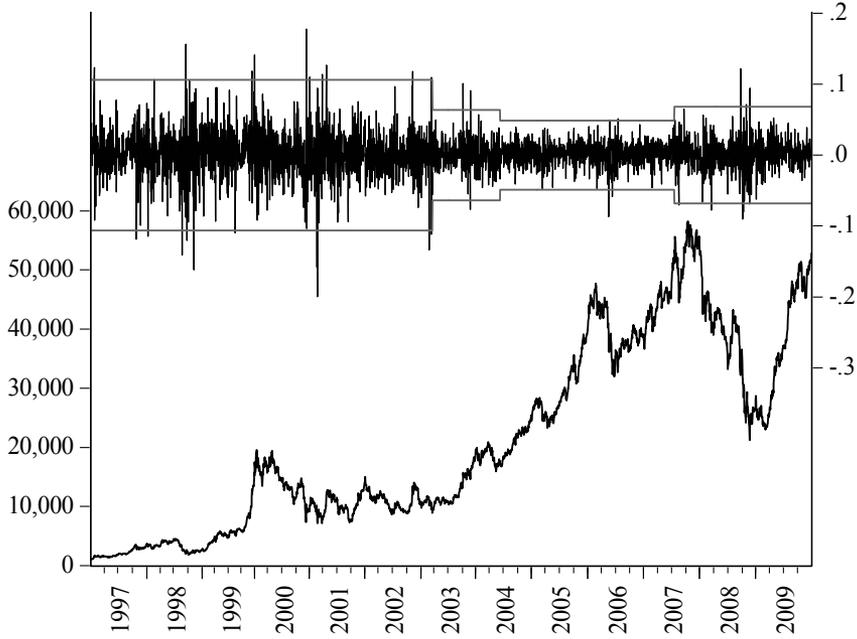


Figure 2: Daily ISE-IND index prices and returns

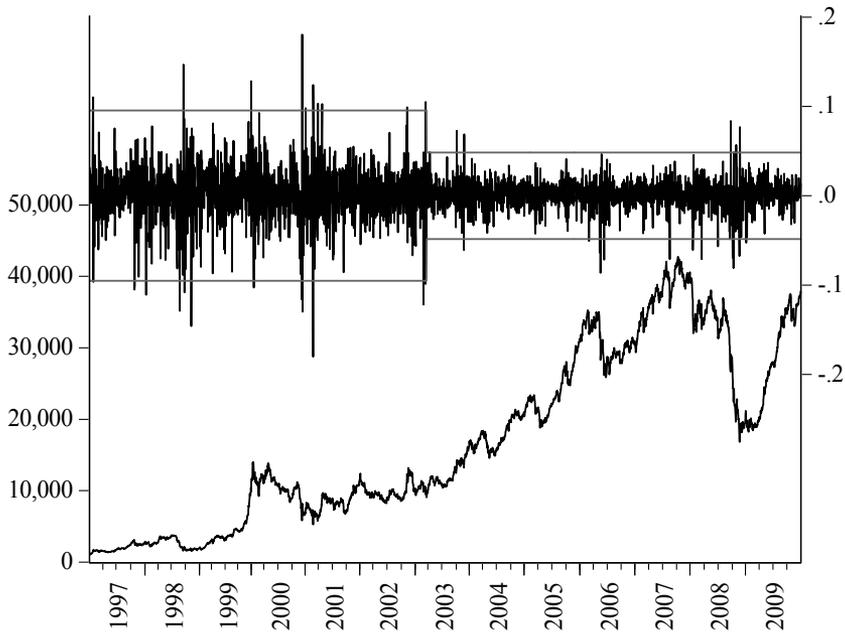


Figure 3: Daily ISE-FIN index prices and returns

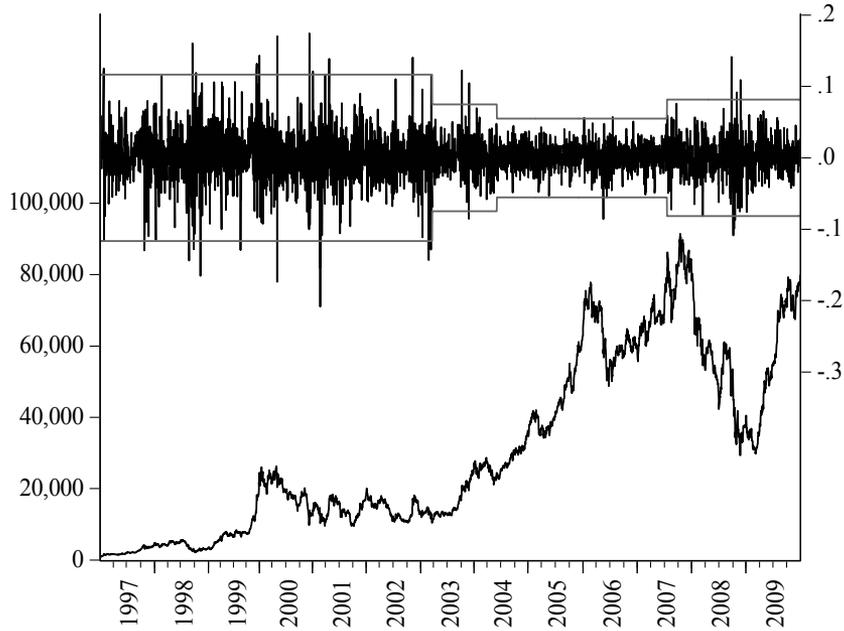


Figure 4: Daily ISE-SRV index prices and returns

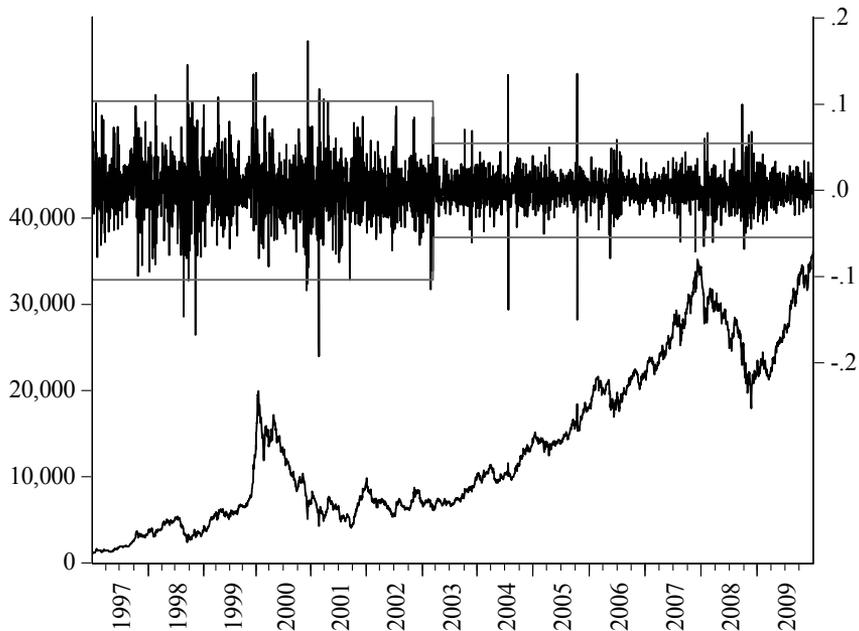


Table 1: Descriptive statistics

	ISE-100	ISE-IND	ISE-FIN	ISE-SRV
Mean	0.12%	0.11%	0.14%	0.11%
Std. Dev.	0.0283	0.0248	0.0316	0.0272
Skewness	-0.0293	-0.2123	0.0015	0.0147
Kurtosis	7.6752	9.1239	7.1324	8.9231
Maximum	0.1777	0.1804	0.1746	0.1733
Minimum	-0.1998	-0.1801	-0.2084	-0.1926
J-B	2944.87*	5076.06*	2300.39*	4726.14*
TR²(1)	246.02*	472.47*	208.99*	242.51*
TR²(5)	388.08*	616.49*	299.97*	431.12*
TR²(10)	409.85*	625.67*	326.13*	438.49*
Q(10)	36.27*	37.90*	33.69*	22.16**
Q(20)	59.62*	62.63*	57.28*	39.27*
Q(40)	93.54*	92.30*	91.44*	68.12*
Q_s(10)	783.86*	1223.10*	577.63*	866.88*
Q_s(20)	1006.10*	1450.30*	750.44*	1041.02*
Q_s(40)	1324.90*	1779.60*	977.30*	1256.25*

Note: J-B denotes Jarque-Bera (1980) normality test statistics. *, and ** denote statistical significance at level of 1% and 5%, respectively. TR²(.) is the ARCH-LM test statistics up to 1, 5, and 10 lags respectively. Q(.) and Q_s(.) are the Ljung-Box statistics for returns and squared returns up to 10, 20, and 40 lags, respectively. Our data covers the period from January 2nd 1997 to December 31st 2009 including 3233 observations all obtained from Electronic Data Delivery System of the Central Bank of the Republic of Turkey (www.tcmb.gov.tr).

Table 2: Unit root tests

Index		ADF		KPSS	
		Level	First Diff.	Level	First Diff.
ISE-100	η_{μ}	-2.1594	-14.4708*	6.2637*	0.2412
	η_{τ}	-2.7766	-14.5122*	0.6097*	0.0609
ISE-IND	η_{μ}	-1.9200	-14.0028*	6.4166*	0.2257
	η_{τ}	-2.4781	-14.0392*	0.7863*	0.0416
ISE-FIN	η_{μ}	-2.3163	-14.4066*	6.1767*	0.2861
	η_{τ}	-2.8683	-14.4572*	0.5875*	0.0729
ISE-SRV	η_{μ}	-2.1419	-15.0342*	5.9647*	0.1822
	η_{τ}	-3.0161	-15.0610*	0.3310*	0.0926

Note: η_{τ} and η_{μ} refer to the test statistics with and without trend, respectively. * denotes rejection of null hypothesis at 1% significance level.

Table 3: Volatility Shifts in Unconditional Variance

	ISE-100		ISE-IND		ISE-FIN		ISE-SRV	
	IT	K-1	IT	K-1	IT	K-1	IT	K-1
1	17-03-97	07-08-98	07-03-97	17-11-00	08-01-97	26-09-03	31-03-97	17-11-00
2	27-06-97	25-11-98	18-06-97	27-04-01	22-01-97	01-12-03	26-05-97	30-03-01
3	24-10-97	25-11-99	30-06-97	06-12-01	04-02-97	08-06-04	27-06-97	19-03-03
4	23-02-98	01-03-00	24-10-97	01-11-02	30-06-97	06-07-07	10-10-97	
5	07-08-98	17-11-00	27-02-98	25-03-03	10-10-97	05-09-08	02-03-98	
6	25-11-98	27-04-01	07-08-98	10-09-08	23-02-98	01-12-08	07-08-98	
7	08-12-99	14-04-03	25-11-98	24-11-08	07-08-98	08-06-09	24-11-98	
8	01-03-00	10-09-08	09-12-99	20-02-09	24-11-98		08-09-99	
9	07-12-00	01-12-08	01-03-00		08-12-99		25-11-99	
10	25-07-01	20-05-09	27-11-00		31-01-00		07-03-00	
11	01-11-02		07-12-00		05-05-00		17-11-00	
12	14-04-03		16-02-01		09-05-00		08-12-00	
13	26-09-03		12-03-01		17-11-00		16-02-01	
14	01-12-03		27-04-01		12-03-01		26-02-01	
15	18-01-08		06-12-01		19-07-01		06-12-01	
16	10-04-08		01-11-02		11-09-01		13-06-02	
17	25-06-08		16-04-03		06-12-01		19-03-03	
18	10-09-08		26-09-03		01-11-02		20-07-04	
19	01-12-08		02-12-03		25-03-03		26-07-04	
20	20-05-09		14-06-04		26-09-03		11-03-05	
21			06-03-06		01-12-03		28-04-05	
22			14-03-06		14-06-04		12-10-05	
23			11-05-06		06-07-07		14-10-05	
24			26-05-06		05-09-08		11-05-06	
25			20-07-06		01-12-08		28-07-06	
26			26-02-07		08-06-09		26-06-07	
27			15-03-07				18-01-08	
28			15-01-08				12-02-08	
29			18-03-08				10-09-08	
30			10-09-08				24-11-08	
31			24-11-08				05-03-09	
32			20-02-09					

Note: IT, K-1, and K-2 stand for ICSS algorithm of Inclan Tiao (1994), Kappa-1, and Kappa-2 procedures, respectively. For instance, time point of volatility shift detected by Kappa-2 procedure for the ISE-IND index is on March 25, 2003.

Table 4: EGARCH(1,1) Model without dummy variables

Index	β	ξ	LLH	ARCH(1) ARCH(4)	Q(12) Q(20)	Half-live Shock
ISE-100	0.9782* (0.0052)	-0.0277* (0.0097)	7431.75	7.4799* 14.9090*	25.956** 31.731**	31.45
ISE- IND	0.9719* (0.0057)	-0.0379* (0.0114)	8014.24	11.4633* 15.0847*	32.218* 35.661**	24.32
ISE-FIN	0.9756* (0.0058)	-0.0244** (0.0101)	7017.77	7.3601* 12.961**	22.869** 27.752	28.06
ISE-SRV	0.9693* (0.0061)	-0.0379* (0.0118)	7664.82	28.4131* 31.5988*	36.459* 39.787*	22.23

Note: β is coefficient of the GARCH term and it is a measure of volatility persistence in EGARCH model. ξ is asymmetry term. LLH stands for log likelihood. ARCH(.) refers to ARCH-LM tests. The Q(12) and Q(20) are the Ljung–Box test statistics with 12 and 20 degrees of freedom based on the residuals respectively; SE are reported in the parentheses below corresponding parameter estimates.

Table 5: EGARCH(1,1) Model with dummy variables

Index	β	Ξ	Pers. Decline	LLH	ARCH(1) ARCH(4)	Q(12) Q(20)	Half-live Shock
PANEL-A: ICSS algorithm							
ISE-100	0.6909* (0.0584)	-0.0769* (0.0213)	0.2873	7505.08	0.3623 5.0395	17.724 28.380	1.87
ISE-IND	0.4971* (0.0780)	-0.1115* (0.0227)	0.4748	8156.18	0.7486 4.1395	15.172 22.371	0.99
ISE-FIN	0.5976* (0.0863)	-0.0683* (0.0235)	0.3780	7121.56	0.4908 6.9369	15.553 21.698	1.35
ISE-SRV	0.5830* (0.0699)	-0.0395*** (0.0226)	0.3863	7831.01	0.5605 3.1371	8.332 17.807	1.28
PANEL-B: κ -1							
ISE-100	0.8256* (0.0363)	-0.0663* (0.0173)	0.1526	7481.17	1.7896 7.1139	20.562*** 33.383**	3.62
ISE-IND	0.8475* (0.0238)	-0.0803* (0.0174)	0.1244	8062.74	2.0799 3.0624	12.652 21.654	4.19
ISE-FIN	0.8904* (0.0229)	-0.0445* (0.0150)	0.0852	7045.22	1.7495 6.6539	16.935 22.483	5.97
ISE-SRV	0.8580* (0.0251)	-0.0547* (0.0171)	0.1113	7697.48	16.8688* 20.1527*	24.066** 27.002	4.53
PANEL-C: κ -2							
ISE-100	0.9132* (0.0175)	-0.0555* (0.0142)	0.0650	7457.78	2.1099 7.2280	17.243 24.241	7.63
ISE-IND	0.9065* (0.0151)	-0.0733* (0.0152)	0.0654	8044.24	4.3456** 6.2717	22.412** 27.663	7.06
ISE-FIN	0.9097* (0.0192)	-0.0451* (0.0143)	0.0659	7040.86	1.9942 5.1528	13.596 18.055	7.32
ISE-SRV	0.8749* (0.0217)	-0.0582* (0.0164)	0.0944	7694.58	18.0196* 21.2754*	25.574** 28.248	5.19

Note: β is coefficient of the GARCH term and it is a measure of volatility persistence in EGARCH model. ξ is asymmetry term. LLH stands for log-likelihood. ARCH(.) refers to ARCH-LM tests. The Q(12) and Q(20) are the Ljung–Box test statistics with 12 and 20 degrees of freedom based on the residuals respectively. SE are reported in the parentheses below corresponding parameter estimates. Dummies are determined according to three tests, Inclan Tiao, Kappa-1 and Kappa-2 respectively.

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