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Determinants of Intra-industry Trade between Western Balkans and EU-15: Evidence from Bilateral Data

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Abstract

This paper provides analysis of intra-industry trade determinants between Western Balkan countries and old European Union Member States. Overall intra-industry trade has been analysed, as well as its horizontal and vertical component, within bilateral trade framework. All components of intra-industry trade exhibit much lower degree than EU New Member States achieved during their accession period. Most of the intra-industry trade is related to vertical component, while horizontal component is negligible. Intra-industry trade determinants analysis has revealed that relative income level, distance, relative factor endowments and relative trading costs are significant factors for the analysed countries' trade relations. The determinants of vertical component are the same, although for some variables smaller significance levels were found. Horizontal component determinants in general have the same sign, although relative income levels, employment shares and export costs were not found significant.

Keywords: intra-industry trade, vertical intra-industry trade, horizontal intra-industry trade, Western Balkans, EU accession

JEL Classification: F14, F15

1. Introduction

Western Balkan countries belong to the group of European transition economies, but their relative performance falls behind more advanced transition economies. Even though these countries are facing numerous problems, one of persistent issues is relative lack of competitiveness and inability to improve their position on international market. This fact might be very important in the near future since Western Balkan countries are[2], with exception of Iceland, next in line for EU integration. Thus, their relative position in trade with European Union gives some indications on the abilities of these countries to

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[2] The factors behind relative slow progress in regional integration of Western Balkan countries has been analyzed in Sklias (2011).

participate actively in the common market. So far, the available data indicates that Western Balkan countries' trade with EU is fairly stagnant, contrary to predictions of a successful integration processes.

Not only that trade increases are important, but the types of goods traded between the countries also play significant role in countries' development prospects (Hidalgo et al., 2007). The analysis of trade patterns enables gaining important insight into underlying dynamics of a group of countries within a trade network. Western Balkan countries are frequently considered to be similar to other transition economies that became EU New Member States in 2004 and 2007. The analysis below points to certain differences between these two groups of transition economies, and thus calls for additional alertness when designing policy measures related to Western Balkan countries' trade promotion.

In order to analyse trade patterns, the paper focuses on intra-industry trade (IIT) dynamics. Intra-industry trade refers to simultaneous imports and exports, recorded at a detailed level of product aggregation. If there are no simultaneous imports and exports recorded, than the trade between two countries is considered to be inter-industry. Since the seminal work of Balassa (1966) and Grubel and Lloyd (1975), a considerable amount of literature analysing intra-industry trade has been produced. The attention to this issue has most recently been drawn within the analysis of EU accession process, related to the smooth adjustment hypothesis. The hypothesis states that if intra-industry trade has higher share in the overall trade between the countries, the integration associated adjustment costs will be less severe than in cases when the share of inter-industry trade is higher. Azhar and Elliot (2008) offer following explanation for this argument. The increases in trade will result in changes in imports and export on a sector/product level. If the trade patterns are for the most part inter-industry in nature, than these sector changes will be reflected in transferring production resources between industries, from contracting to expanding industries. If there are large differences in relative production factor endowments of the two trading countries, the costs of adjustments from one industry to another will be higher. From the Western Balkan countries' perspective, this hypothesis implies that changes in trade patterns could have significant structural impact on their economies within the EU integration process.

Integration process should theoretically increase trade (and consequently growth) prospects, which is in particularly interesting for transition economies in their catching-up aspirations. Due to the capability to address this phenomenon empirically, literature exploring trade patterns during EU accession is rather extensive. The literature on trade patterns within the context of EU integration is relatively abundant for Central and Eastern European Economies (Aturupane, Djankov and Hoekman, 1999; Caetano and Galego, 2007; Firdmuc, Grozea-Helmenstein and Wörgötter, 1999; Gabrisch, 2006; Kandogan, 2003; Hoekman and Djankov, 1996; Fidrmuc, 2005; Janda and Münich, 2004). Similar analysis for Western Balkan countries is relatively scarcer, with some exceptions (Damijan, de Sousa and Lamotte, 2006; Kaminski and de la Rocha, 2002; Mardas and Nikas, 2008; Buturac and Teodorović, 2012).

The main contribution of the present paper is that the analysis of trade patterns determinants between European Union and Western Balkan countries relies on a more

detailed level of trade data aggregation than previous studies. Since methodology applied to more aggregated data can give misleading results, previous findings for Western Balkan countries in general indicate more integrative factors with European Union, which could have serious policy implications. Additional contribution comes from the fact that Western Balkans' bilateral trade patterns determinants with European Union members are analysed, while previous literature predominately treats European Union as a single entity.

Western Balkan countries analysed in the paper are: Albania, Bosnia and Herzegovina (B&H), Croatia, Former Yugoslavian Republic of Macedonia (FYRM), Kosovo under UNSCR 1244/99 (Kosovo), and Montenegro and Serbia, all considered as separate entities. European Union is represented by 15 old Member States.

The structure of the paper is following. Next section presents data, methodology and the results of estimating IIT, vertical IIT (VIIT) and horizontal IIT (HIIT). Section 3 presents estimation strategy, results and discussion on IIT, VIIT and HIIT determinants. Last section brings conclusions.

2. Estimating IIT, VIIT and HIIT: methodology and results

European Union represents major trading partner for Western Balkan economies, although contrary to expectations the trade relationships have not intensified with the integration process so far[3]. To investigate possible reasons for this stagnation, a deeper analysis of trade patterns between the two groups of countries is required. The focus of the analysis in this paper is on degree of intra-industry trade between Western Balkan countries and European Union. Early literature on intra-industry trade (Grubel and Lloyd, 1975) observed that it has a large share in trade of industrialized economies, contrary to the predictions of standard Ricardo and Heckscher-Ohlin theories, which emphasized dominance of inter-industry trade flows based on relative factor endowments.

Theoretical fundamentals for the intra-industry trade have been founded in the models proposed by Balassa (1966) and Krugman (1979). Also, Lancaster (1980) and Helpman (1981) are prominent early contributions aimed at explaining the existence of intra-industry trade, with seminal Helpman and Krugman (1985) book providing synthesis theory.

In addition to theoretical models, much of energy in the literature related to intra-

[3] Eurostat data show that in 2010, which is the last year of the analyzed period in this paper, EU-15 had 66.1 percent share of exports in Albania, 40 percent in Bosnia and Herzegovina, 44.6 percent in Croatia, 46.8 percent in FYR Macedonia, 37.9 percent in Montenegro and 35.8 percent in Serbia. Comparable figures for imports are 56.4 in Albania, 30.9 percent in Bosnia and Herzegovina, 45.1 percent in Croatia, 38.6 percent in FYR Macedonia, 29.7 percent in Montenegro and 34.2 percent in Serbia. The data on other trading partners for Kosovo were not available, so there are no estimates on the EU share in total. The dynamics of both exports and imports in the analyzed period is presented in Botrić (2012), where interested reader can also find following: IIT estimates for EU-15 and EU-NMS with Western Balkan countries on overall EU-level, separation of VIIT into up-market products and down-market products, as well as discussion on marginal intra-industry trade.

industry trade is devoted to the issue of measurement and appropriate classification of the overall trade into its intra (trade of products produced within the same industry) and inter-industry (trade of products from different industries) component. Thus, many proposed methodologies exist, starting by most frequently used Grubel and Lloyd (1975) index. Another well known examples include Balassa (1966), Greenaway and Milner (1983), Aquino (1978), Hamilton and Kniest (1991), Greenaway et al. (1994), or Brülhart (1994).

Within the intra-industry trade, of special interest is the type of products traded. The whole intra-industry trade is thus further disaggregated into horizontal intra-industry trade (which is the trade of relatively close substitute products within the same industry) and vertical intra-industry trade (which is the trade of differentiated products within the same industry). The beginning of theoretical foundations for horizontal intra-industry trade (HIIT) can be found in Helpman and Krugman (1985), while the modelling of vertical intra-industry trade (VIIT) has been initiated by Caves (1981). Vertical intra-industry trade models can be associated either with consumer demand for different product qualities (Falvey and Kierzkowski, 1987) or segmentation of production process across regions as a result of multinational activities (Markusen and Venables, 2000). Theoretical models inspired VIIT and HIIT empirical estimation. One of relatively frequently used method for that purpose relies on the unit values (value per ton of good) of exports and imports relationship on a detailed level of product aggregation. The idea traces its origin to the Stiglitz (1987) assumption that relative prices of goods reflect their relative qualities.

In order to examine trade patterns between Western Balkan countries and European Union old member states, an overall trade has been disaggregated using Grubel-Lloyd index, which can be assessed according to following expression:

$$GL_i = \frac{\left(X_i - M_i\right) - \left|X_i - M_i\right|}{\left(X_i + M_i\right)} \tag{1}$$

Where X refers to exports, M to imports. The whole expression can be multiplied by 100 to obtain index, which ranges from 0 to 100. If at the particular level of aggregation the expression is above 0.5 (or the index is above 50), the trade is considered to be intra-industry. Grubel-Lloyd index has been challenged in the literature (Hamilton and Kniest, 1991; Brülhart and Elliot, 1998) for its ability to disentangle trade patterns especially in the cases of transition countries, which usually have large trade disbalances as well as structural changes. Nevertheless, empirical investigation of the IIT determinants in our case relied on this relatively widespread indicator for two reasons. The first one is related to its frequency of use in the literature. We argue that relying on more widespread indicator provides more points of comparisons to the previous studies on other transition economies. The second argument relates to the relatively short period under analysis. Considering, for example, marginal intra industry trade indicators would imply reducing one year of observation, which would reduce the panel dataset significantly in our empirical exercise. Thus, these extensions are left for future research.

In order to distinguish between HIIT and VIIT, a standard unit value approach has been applied in the paper (Fontagné and Freudenberg, 1997). A ratio between unit value of exports and unit value of imports has been evaluated against a threshold according to the following expression:

$$\frac{1}{1+\alpha} \leq \frac{Unit\,value\,of\,exports}{Unit\,value\,of\,imports} \leq 1+\alpha \tag{2}$$

Horizontally differentiated products are those for which the evaluated ratio of unit values falls between the specified borders, implying that the differences between unit values of exports and unit values of imports for that product are small. Vertically differentiated products are those for which the unit value ratio falls outside the borders, implying that either the goods from the home market are at the lower end of the EU market (unit value ratio is below the lower boundary) or they are up-market goods (for those whose unit value ratio exceeds 1+α).

Unit values have been calculated as the ratio of the value of trade in EUR and a corresponding quantity in tons. Threshold value α has been set to 15 percent, which is a frequently utilized value, although not unchallenged (Kandogan, 2003) in the literature. According to Crespo and Fontoura (2004), the unit value approach has a number of shortcomings. First, consumers may buy expensive products for reasons other than quality, an argument which might be in particular relevant for the transition economies entering new markets. Second argument Crespo and Fontoura (2004) mention is that values of two bundles may differ if the mix of products differs, so that one bundle contains a higher proportion of high unit value items than the other. Finally, this approach can theoretically be consistent if analyzed at a very detailed level of product aggregation, to be able to claim that the products traded are similar. This argument governed the decision to conduct the analysis presented below at the most detailed level of aggregation the data would allow.

The described indicators were calculated based on the Eurostat's trade database, COMEXT. The major reason for relying on this data source is the lack of disaggregated data from the national statistics offices that would enable comparative analysis. The original data are thus represented from the EU countries' perspective. The indicators presented below are, however, from the perspective of Western Balkan countries. However, the overall trade volume used for the analysis between the EU and Western Balkan countries is the same, regardless of the country of origin, since the same data source has been used throughout the paper.

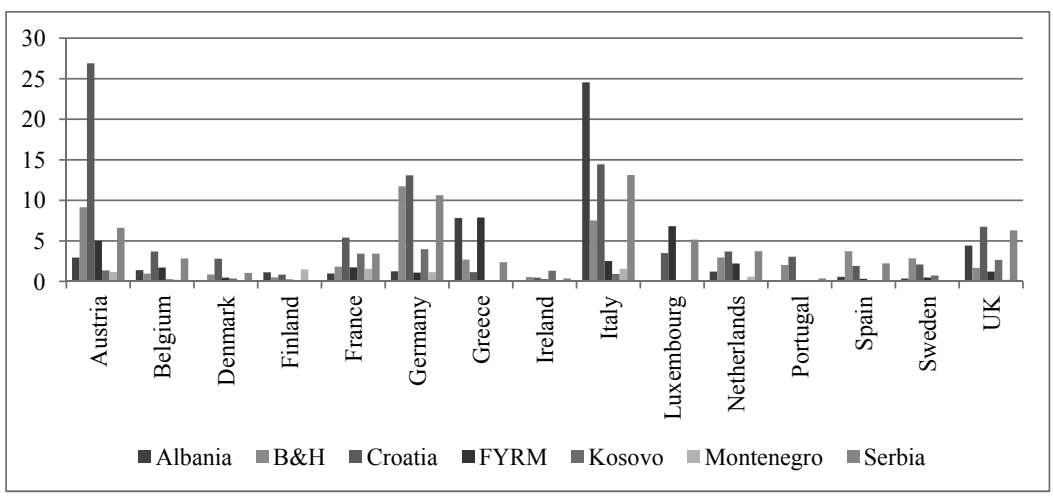
The analysis is performed on the 8-digit level of Combined Nomenclature[4]. This approach has been taken due to the fact that results can be highly sensitive to the level

[4] Estimated IIT on the 8-digit level is systematically lower than IIT on, for example, 6-digit level or 4-digit level for the analyzed countries in the analyzed period. In order to save space, we present only the 8-digit level data. IIT data on other levels of aggregation is available from the author upon request.

of disaggregation (Gullstrand, 2002), in particular in transition economies where the trade patterns are rapidly evolving. Thus, we follow the Sawyer, Sprinkle and Tochkov (2010) advice, who claim that the best solution is to calculate the IIT at as high level of disaggregation as the data permits.

Methodology described has been applied to the available dataset with the aim to provide the longest available series for IIT determinants' analysis. This approach has resulted in indicators available since 1988 for Albania, 1992 for Bosnia and Herzegovina and Croatia, 1993 for Fyrm and 2005 for the remaining three countries. Due to the intention to treat all the countries as separate entities, comparison among Western Balkan countries is available only for the 2005-2010 period. The reason is that Montenegro and Serbia became separate entities in 2006, and Kosovo proclaimed its independence in 2008. Having in mind all this restrictions, we present average bilateral IIT for the whole analysed period in Figure 1.

Figure 1: Share of IIT in trade between Western Balkan countries and European Union old member states, Grubel-Lloyd methodology, 2005-2010 average, in percent



Source: author's calculations based on COMEXT database.

The share of intra-industry trade in overall trade between Western Balkan countries and European Union is relatively low, even when compared to other transition economies (Fainštein and Netšunajev, 2011). The highest share is between Croatia and Austria, followed by Italy and Albania. Italy and Germany, and somewhat less Austria, have relatively more IIT with several countries. These are also the most important trading partners of Western Balkan countries. For most of the cases, IIT share in overall trade is negligible.

The trade between the two groups of countries thus resembles more traditional North-South trade pattern, than the trade between the developed industrialized countries. This is additionally substantiated when overall IIT is disentangled into its vertical and

horizontal component. Specifically, within the intra-industry trade, vertical trade share is more dominant, reflecting that the trade in differentiated products is more widespread than the trade in similar products within the same industry. Such trade patterns point to the possible increased difficulties of Western Balkan economies within the integration process. In the next section we explore the determinants of such relatively low IIT shares.

3. IIT, VIIT and HIIT determinants: estimation strategy, results and discussion

In order to analyze the determinants of trade patterns between European Union old member states and Western Balkan countries, we estimate separate equations for three different measures of intra-industry trade: overall IIT, vertical component and horizontal component. Theoretical models as well as previous empirical findings suggest that determinants of VIIT and HIIT differ. Due to the data availability constraints, we consider and include in the analysis only a subset of possible determinants previously discussed in the literature. The reason for their inclusion in specification is explained below in more details, while the data sources of the explanatory variables can be found in the Appendix.

Even though the dependent variable by construction falls between zero and 1, which violates the assumption that the error term should follow a normal distribution, transforming the variable by the usual approach in the literature (i.e. logistic transformation) would in the case of our pairs of countries produce a large number of missing values. Since the main goal of the present paper is to estimate the determinants of IIT using all available information, we rely on the arguments proposed by Greenaway and Milner (1986) and proceed with the original values of dependent variable.

Three dependent variables - IIT, HIIT and VIIT between a Western Balkan country and an EU-15 country - were tested for the unit root presence. Im-Pesaran-Shin test was applied, due to the fact that we can consider both N and T fixed in our sample, which does not have to be balanced and we want to allow panel specific unit root processes. In all three cases, t-bar statistics was below the 1 percent critical value, indicating a strong rejection of the null hypothesis that all series contain a unit root. Thus, we proceed with specifying dependent variable in levels.

Models explaining intra-industry trade determinants usually consider differences in stages of economic development between the countries, differences in relative factor endowments, relative distances between the countries (Bergstrand, 1990). Since intra-industry trade was first observed as a phenomenon between developed countries, we would expect that relative similarity of countries in terms of economic development would be positively associated with share of intra-industry trade. Same is expected for the horizontal segment of intra-industry trade, since it is more likely that similar countries will trade products of similar quality. Trade in vertically differentiated products is more likely to develop between unequal trading partners.

In addition to relative income levels, important factor in traditional models, but also models related to vertical IIT, are trading partners' factor endowments. Measuring relative factor endowments for Western Balkan countries can be considered quite a challenge, due

to data availability constraints. Thus, simple approach has been taken, that admittedly might mask a variety of underlying factors. Instead of trying to measure capital-labour ratio (Blanes, 2005; Faustino and Leitão, 2007) or skill of the labour force (Sawyer, Sprinkle and Tochkov, 2010; Zhang, van Witteloostuijn and Zhou, 2005), we have included two separate general indicators of available capital and available labour force.

We follow a fairly standard estimating procedure and include distance between the capital cities of the countries as a measure of trading costs (Blanes, 2005). Another frequently used proxy for a trading cost is border between the countries. In addition, Bergstrand and Egger (2006) propose and test a model that specifically includes trade costs and find that increases in trade costs reduce the overall share of intra-industry trade. Relying on their findings, we include two explicit measures of trade costs in the specification. We cannot, however, test all the propositions as specified in their model. Instead, we follow approach similar to Djankov, Freund and Pham (2010), and include relative time to import and relative time to export, also relative cost to import and relative cost to export as measures of implicit and explicit trading costs.

It is widely recognized in the literature that overall intra-industry trade determinants could differ from vertical and/or horizontal component. For example, Jensen and Lüthje (2009) argue that the effect of differences in factor endowments on VIIT depend on the size of economies, as well as industry structures and demand patterns. Having in mind previous discussion, Table 1 briefly summarizes predictions regarding the determinants analyzed in present paper.

Table 1: Expected IIT, VIIT, HIIT determinants

Variable	Expected effect of the variable on		
	IIT	VIIT	HIIT
Border (bor)	+	+ (?)	+
Distance (dist)	–	– (?)	–
Exportcost (EXcost)	–	– (?)	–
Exporttime (EXtime)	–	– (?)	–
GDPpc (gdp)	–	–	– (?)
Gross fixed capital (gfc)	+	+ (?)	+
Employment (empl)	+	+ (?)	+

Source: author's systematization. (?) implies that effect depends on other factors.

The share of intra-industry trade between two countries in our estimation strategy is expected to be a factor of relative income, relative factor endowments and relative trading costs. Following Zhang, van Witteloostuijn and Zhou (2005), most of the independent variables (border and distance excluding, for obvious reasons) were transformed using the following expression:

$$X = \left| \left(X_{WB} - X_{EU} \right) / X_{WB} \right| \tag{3}$$

In other words, the absolute difference between the indicator values in Western Balkan country and its trading EU member partner was divided by the value of the same indicator in Western Balkan country, to obtain relative indicator. Thus, relative distance between the trading partners was measured according to the different indicators. Following equation has been estimated for IIT, HIIT and VIIT:

$$\begin{aligned} IIT_{i,t} = \beta_0 + \beta_1 bor_{i,t} + \beta_2 dist_{i,t} + \beta_3 EXcost_{i,t} + \beta_4 EXtime_{i,t} + \beta_5 gdp_{i,t} + \\ + \beta_6 gfcf_{i,t} + \beta_7 \beta empl_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{4}$$

Where i=1, ...n denotes country and t=1, ...T denotes year.

The final equation does not include all considered variables. Specifically, relative time to import and relative costs to import were excluded to avoid multicolinearity. To estimate the equations panel GLS method[5] was chosen to allow for heteroskedasticity across countries, but also to correct for possible correlation between the independent variables and constant term (Jensen and Lüthje, 2009). The number of observations included in the analysis reflects the data availability constraints. Results of the estimation are summarized in Table 2.

The results presented in Table 2 corroborate the story that the trade between European Union old Member States and Western Balkan countries resembles more traditional trade patterns, than trade patterns between equally developed countries. This result can be also found in the case of other transition economies. Fainštein and Netšunajev (2011) explore a wider set of models (and more extensive set of explanatory variables) in their search for determinants of IIT between Baltic countries and European Union. For the trade between transition economies and old EU Member States, it seems that traditional trade models explain existing trade patterns relatively well.

According to theoretical models, HIIT is more likely to be observed between developed economies with similar factor endowments, while VIIT is more likely to be associated with different income levels (Falvey and Kierzkowski, 1987; Flam and Helpman, 1987). These theories suggest that vertical intra-industry trade is more likely to develop between countries with different relative income levels and differences in relative factor endowments. The analysis presented in previous table supports this view, since relative

[5] Literature suggests that border and distance might be important determinants of intra-industry trade. This might be of additional importance for the relatively distant countries, such as, for example Albania and Sweden, both in our sample. Although fixed-effects method is frequently used in panel data analysis of countries, this method is not sustained with dummy variables, such as border and distance. Due to the fact that empirical studies of intra-industry determinants in Western Balkan countries are relatively rare in the literature, we opted for examining as many as possible explanatory variables. However, interested reader could get the results of fixed effects estimation from the author upon request.

Table 2: IIT, VIIT, HIIT determinants in trade between Western Balkan and EU-15 countries

Independent variable	Estimated coefficient (standard error)		
	IIT	**VIIT**	**HIIT**
Constant	0.094*** (0.004)	0.083*** (0.003)	0.010*** (0.001)
Border (bor)	0.064*** (0.007)	0.037*** (0.007)	0.021*** (0.004)
Distance (dist)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Exportcost (EXcost)	-0.009*** (0.003)	-0.007** (0.003)	-0.000 (0.001)
Exporttime (EXtime)	-0.020*** (0.004)	-0.016*** (0.004)	-0.004*** (0.001)
GDPpc (gdp)	-0.002*** (0.001)	-0.002*** (0.001)	-0.000 (0.000)
Gross fixed capital (gfc)	0.018*** (0.006)	0.012** (0.005)	0.002** (0.001)
Employment (empl)	0.006** (0.003)	0.004* (0.002)	0.000 (0.001)
Diagnostics			
Wald	846.28***	756.06***	153.23***
N	445	445	445

Source: author's estimates.
Note: *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent. Robust standard errors in parentheses.

GDP per capita and relative employment rates are both significant for vertical intra-industry trade, but not significant for horizontal. Since the share of vertical IIT is also larger than the share of horizontal, the VIIT determinants dominate in the overall IIT estimates. Similar VIIT determinants have also been previously documented as being significant for European economies (Jensen and Lüthje, 2009).

We have to emphasize that every Western Balkan country has lower income level than any EU-15 country. Thus, indicator approaches zero when the economic distance between the two groups of countries is smaller. Negative sign of the estimated coefficient for the relative GDP variable is logical, meaning that the closer the countries are in terms of income level, more IIT and VIIT there will be between them. Income effect of horizontal IIT, although of the same size, was not found significant. This is the results on deficiencies

on both side of estimating equation: low share of horizontal IIT and low average GDP in Western Balkan countries.

Highly expected result is that distance has a negative, while having common border has positive effect on IIT and its components (Balassa, 1986). This is frequently interpreted in the transport costs context of the traded goods. Furthermore, production and demand patterns of neighbouring countries tend to be more similar than distance countries, reflecting among other things, cultural and historic influences as well. These factors could induce at least some horizontal intra-industry trade, which explains the significance of the estimated coefficient.

Two explicit measures of trading costs, i.e. relative time to export and relative cost to export, measure money costs which are important for trading partners, but in the case of transition economies the relaxation of relevant procedures might be even more important. One of the trade and growth impediments in transition economies, and in particular Western Balkan economies, is excessive and inefficient bureaucracy. This issue has been recognized and addressed on policy level by all the countries in the region, with the result of reducing unnecessary procedures, including those related to international trade. This is clearly visible in the dataset used for the analysis in this paper, with the effect that the relative reduction in export-related procedures has significant impact on IIT, VIIT and HIIT. This is not repeated in the case of relative costs, which are significant only in the case of IIT and to a lesser extent VIIT, and not significant for HIIT.

Relative factor endowments have the same sign in the cases of IIT, VIIT and HIIT, even though not always significant. The higher the relative share of investments in GDP in Western Balkan country in comparison to EU-15 member, the higher the share of intra-industry trade, but also vertical and horizontal intra-industry trade. Since capital is relatively scarcer factor of production in Western Balkan countries, and intra-industry trade is more likely to develop between the countries that have similar levels of development, this result is highly expected. It also emphasizes that in order to catch-up with the more advanced economies, Western Balkan countries should be more oriented towards investment promotion.

Additional factors might also exert significant role on intra-industry trade between the Western Balkans and European Union. One of these factors might be foreign direct investments and the role of multinationals (Egger, Egger and Greenaway, 2007). In order to substantiate this empirically, we would require the data on bilateral FDI flows for these countries, which are not very reliable or comparable across different data sources. Although FDI effects might play significant role in the integration of Western Balkan countries into common EU market, previous studies have established that foreign investors are less oriented towards the manufacturing sector in the region. This implies that relative size of FDI is not so important, as the individual sector in which it is invested. If foreign investors chose manufacturing sector, transfer the knowledge through FDI and increase average productivity in that sector sufficiently enough to ensure the competitiveness on the international markets, this will probably also result in more intra-industry trade. Whether more horizontal or vertical IIT, depends on the FDI type and investors' motives,

in accordance with the product life cycle theory (Vernon, 1966). Since more insight on this can be achieved from the analysis on individual industry level, rather than country level, reaching firm conclusions on the topic is left for future research.

However, comparative analysis of FDI in transition economies points to another issue addressed in this paper, and this is the labour market factor. FDI literature generally finds that relatively expensive labour force discourages investors (Bellak, Leibrecht and Riedl, 2008; Rasciute and Pentecost, 2010). Although relative wages in Western Balkan countries are not high, the question of average workers' skills and productivity remains. The findings in this paper imply that the higher the relative employment shares in Western Balkan countries, the higher the share of intra-industry trade. This relationship is significant for intra-industry trade, somewhat for VIIT and not significant for HIIT. Although Western Balkan countries are perceived as the ones in which labour intensive industries have comparative advantage, the potential for intensifying production in those industries is not fulfilled, which is mirrored in comparatively lower employment rates. Furthermore, transition has actually brought a deindustrialization process, which was combined with increased unemployment and decreased competitiveness of industrial production, not only on international but also on domestic market. This might be related to the trade liberalization effect, which has through the smooth adjustment hypothesis already resulted in labour market difficulties (Brülhart and Elliot, 1998; Brülhart, Elliott and Lindley, 2006; Fidrmuc, 2005). Thus, further integration of Western Balkan countries could either intensify the problems or the adjustment costs have already materialized during the earlier phases of transition.

4. Conclusion

Trade relations between European Union and Western Balkan economies are marked by prolonged period of stagnation. This is related to the competitiveness problems Western Balkan economies are facing, that mirror the underlying unresolved structural problems of these slow advancing transition economies. However, trade is an important integrating factor and analyzing its patterns and dynamic might be very important for future integration processes of these countries into the common EU market.

This paper has focused on the intra-industry trade and the analysis of its determinants. The intra-industry trade degree should indicate current stage of integration between the two economies, while the determinants analysis would point to the main issues reflecting relatively low degree of integrative trade patterns between the two groups of countries. The analysis has revealed that the trade patterns mostly follow standard North-South dynamics, with relative factor endowments still playing important role for these economies. The share of IIT is lower than during the EU New Member States accession, and within the IIT the vertical component is dominant, while the horizontal is negligible.

Empirical analysis of the IIT determinants has resulted with theoretically founded coefficients, which have also been important in empirical studies in other European transition economies. Specifically, IIT determinants analysis has revealed that relative

income level, distance, relative factor endowments and relative trading costs are significant factors for the analyzed countries' trade relations. The determinants of vertical IIT are the same, although for some variables with smaller significance level. Horizontal IIT determinants in general have the same sign, but are more frequently found insignificant. These findings substantiate the conclusion that the trade relations are predominately based on traditional trading models, and also point to the possibility of relative high adjustment costs related to the integration process.

Even though the analysis in this paper does not establish causal relationships between the specific IIT determinants and the established trade patterns, we could speculate that traditional policy recommendations given to the group of countries could eventually lead to the improvements in their competitive position, and also to more intra-industry trade. The question remains whether such structural changes could be made in the short run, prior to EU accession, to enable easier integration into the common EU market.

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Appendix

Table A1: Data sources

Variable	**Source**
Cost to export (US$ per container); Cost to import (US$ per container); Time to export (days); Time to import (days); GDP per capita, PPP (constant 2005 international $); Gross fixed capital formation (% of GDP); Labor participation rate, total (% of total population ages 15+); Employment to population ratio, 15+, total (%)	World Development Indicators database
IIT, VIIT, HIIT (author's calculations based on…)	COMEXT database
Distance between capital cities in km	http://www.geobytes.com/citydistance.htm

A Country's Process of Development as Described by a Butterfly Catastrophe Model: The Case of European South

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Abstract

For a long period of time a country's development has been synonymous with its economic growth. Over the last years, however, economies and societies have been undergoing dramatic changes. These changes have led to the concept of sustainable development, which refers to the ability of our societies to meet the needs of the present without sacrificing the ability of future generations to meet their own needs. Measuring sustainable development means going beyond a purely economic description of human activities; requires integration of economic, social and environmental concerns. New techniques are required in order to benchmark performance, highlight leaders and laggards on various aspects of development and facilitate efforts to identify best practices. New tools have to be designed so as to make sustainability decision-making more objective, systematic and rigorous. The majority of those methodologies make use of a single indicator in order to measure separately the evolution of each component i.e. the economic, the social and the environmental. Our objective in the present paper is to:

- *Outline the process of a country's development taking into account all its three dimensions, economic, social and environmental.*
- *Present a model for quantifying its process of development encompassing all those dimensions.*
- *Apply the model to European South countries.*
- *Discuss the results.*

Keywords: Country's Image, Country's Process of Development, Economic Social & Environmental Factors, Butterfly Catastrophe Model

JEL Classification: C65, Q01, R58

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1. Introduction

A country's development is a multi dimensional concept, including socio-economic ecological, technical and ethical perspectives. In the early stages of a country's development the dominant factors are economic. However as the development process progresses, the role of the social factors is gradually strengthened and in some cases becomes decisive. Environmental factors are usually the last to be considered when people realize that the rapid growth of the socioeconomic subsystem has begun to overload some of the capabilities of the ecosystem locally as well as globally.

The scope of the present paper is to:

- Outline the process of a country's development taking into account all its three dimensions, economic, social and environmental.
- Present a model for quantifying its attractiveness (process of development) encompassing all those dimensions.
- Apply the model to the countries of the European South.
- Discuss the results.

2. Sustainable Development

The concept of development is used to express the achievements or the positive changes in the basic elements of human socio-economic behaviour. Those who seek for a scientific definition for development disregard the fact that development is not only a technical subject. It has an important ideological content and reflects a strong set of values. Thereby the term development is identified in the 20th century with the terms economic growth and industrialisation. Economic policies have typically measured development with the growth of per capita income or consumption.

Sustainable development is not a new concept. J.A. Du Pisani (2006) points out that, as early as the ancient Egyptian, Mesopotamian, Greek and Roman civilizations, environmental problems such as deforestation, salination and loss of soil fertility occurred, which we would today refer to as sustainability problems. Plato in the 5th century BC, Strabo and Columella in the 1st century BC and Pliny the Elder in the 1st century AD discussed different types of environmental degradation resulting from human activities such as farming, logging and mining. These authors were not only aware of environmental degradation, but also recommended what we call sustainable practices to maintain the "everlasting youth" of the earth. J.S. Mill (1883), one of the great economists of the 19th century showed his concern by focusing on issues such as the ultimate point to which society is tending by its industrial progress and the conditions mankind will have to face when this progress seizes. Many years later, R. Solow (1991), another leading and Nobel prize winner economist, focusing on the same subject stated that sustainability must be understood as an obligation to conduct ourselves so that we leave to the future the option or the capacity to be as well off as we are. Furthermore, he urged the decision makers to

take all the measures needed to ensure a distributional equity between the present and the future.

Taking sustainability seriously into account creates a need for the inclusion of the physical appraisal of the environmental impact on the socio-economic system too. Systemic approaches to sustainability issues consider the relationships between three systems: the economic system, the social system and the environmental system. The economic system includes the economic activities of people. The social system comprises all social activities. Finally, the environmental system includes both the economic and social system (O´Neill, 1993; Martinez-Alier et al., 1998; 2001).

Today, the territorial organisation of economies and societies is undergoing dramatic change. Sustainable development is a strategy by which communities seek economic development approaches that also benefit the local environment and quality of life. It provides a framework under which communities can use resources efficiently, create sufficient infrastructures, protect and enhance quality of life, and create new businesses to strengthen their economies. It can help us create healthy communities that can sustain our generation, as well as those that follow us.

3. The changing role of the Economic, Social and Environmental Dimensions of a Country's Development

Environmental degradation is one of the basic problems most countries around the world are facing today. Furthermore, it has been found that one of the main causes of this problem is their fast economic growth. Obviously this finding raises a very important point, as fast economic growth has, for many years, been considered as the centrepiece of a country's progress. Hence, the concept of development has to be reconsidered. A new environmental aspect of development may be added to the economic and social ones and the blending of all three dimensions in defining sustainable development over time should be examined. The changing role of these three dimensions is briefly outlined below.

In the 1950's and 1960's the focus of economic progress was on growth and increase in output, based mainly on the concept of economic efficiency. Environment was not yet taken into account since it didn't seem to affect the economic performance.

By the early 1970's the large and growing numbers of poor in the developing world led to greater efforts of directly improving income distribution. The development paradigm shifted towards equitable growth where social objectives were recognized as distinct from and as important as economic efficiency. The end of this decade also marks the appearance of environment as a new factor affecting economic activity but with limited importance. Environmental threats are conceived of as local in time and space and hence easy to overcome. Furthermore, at that time, economic growth and environmental quality were largely perceived as opposing each other.

Protection of the environment is the emerging strong new concern in the next decade. At that time the importance of reconciling economic growth with the environment had come to be generally recognised providing an intellectual underpinning to efforts to elevate the

importance of environmental issues in policy making. By the early 1980's protection of the environment has become the third objective of development showing that environmental degradation was a major barrier to progress. The concept of sustainable development has therefore evolved to encompass three major points of view: economic, social and environmental (Angelis et al., 1999). Furthermore by the end of the decade environmental concern is for the first time integrated into the business decision making process.

In the 1990's and at the beginning of 21st century, the crucial role of the environmental dimension and its increasing contribution to sustainable development has been further established. Environmental matters are considered to be a major component of the wider economic activity. Furthermore, environmental threats are now perceived as emerging on a very large scale, often related to socio-economic turbulent factors and requiring immediate corrective action. The gradual awareness of actual and potential conflicts between economic growth, social progress and preservation of the environment led to the concept of sustainable development. Hence, all governments have declared, and still claim, their willingness to pursue economic growth under the flag of sustainable development although often development and sustainability are contradictory terms. The concept of sustainable development has wide appeal, because it carries the ideal of a harmonization or simultaneous realization of economic growth, social progress and environmental concerns (Munda, 2005). Sustainable development aims to achieve simultaneously environmental system goals (genetic diversity, resilience, biological productivity), economic system goals (satisfaction of basic needs, enhancement of equity, increasing useful goods and services), and social system goals (cultural diversity, institutional sustainability, social justice, participation). This definition correctly points out that sustainable development is a multidimensional concept, but as our everyday life teaches us, it is generally impossible to maximize different objectives at the same time and compromised solutions must be found (Barbier, 1987).

4. Measuring Sustainable Development

Measuring sustainable development means going beyond a purely economic description of human activities and integrates economic, social and environmental concerns. In other words, sustainable development means ensuring economic efficiency while respecting social equity and safeguarding ecological integrity. When dealing with sustainability issues no reductionism, economic, social or environmental is possible. A reductionist approach for building a model can be defined as the use of just one measurable indicator (e.g. GDP per capita), one dimension (e.g. economic), one objective (e.g. the maximization of economic efficiency) and one time horizon. If one wants to avoid reductionism, there is a clear need to take into account incommensurable dimensions using the proper techniques so as to reach a solution (Munda, 2005).

Many tools and methodologies have been used over the past years to measure the progress towards sustainability (Munda, 2006; Karol and Brunner, 2009; Yigitcanlar and Dur, 2010). The majority of those methodologies make use of a single indicator in order

to measure separately the evolution of each component i.e. the economic, the social, the environmental. The criteria, according to which indicators are selected for measuring sustainable development, are exhaustive in literature (Barrios and Komoto, 2006; Singh et al., 2009). As a tool for conflict management, multi-criteria evaluation has demonstrated its usefulness in many sustainability policy and management problems (see e.g. Romero and Rehman, 1989; Nijkamp et al., 1990; Beinat and Nijkamp, 1998; Janssen, 1992; Munda, 1995; Munda et al., 1998; Ringius et al., 1998; Janssen and Munda, 1999; Hayashi, 2000; Bell et al., 2001; Munda, 2005; 2008).

In conclusion, it can be said that measuring sustainable development requires at a minimum integration of economic, social and environmental concerns. This is not an easy task and requires the design of a specific tool. In this paper we introduce the concept of a country's image, a measure of its overall progress towards sustainable development, which encompasses all the three dimensions and suggest ways of measuring it.

5. The Concept of a Country's Image

The term image is currently used in a variety of contexts. Image is a sum of beliefs, ideas and impressions. It is the total impression an entity makes on the minds of people and exerts a powerful influence on the way people perceive things and react to them (Dowling, 1998; Dichter, 1985). Relevant literature suggests that the image is important in this process and identifies different types, including projected and received entity images (Kotler et al., 1993). Projected place images can be conceived as the ideas and impressions of a place that are available for people's consideration. These types of images reach people by transmission or diffusion process through various channels of communication, which they can alter, the character of the message. The received place images are formed from the interaction between these projected messages and people' own needs, motivations, prior knowledge, experience, preferences, and other personal characteristics. In this way people create their own unique representations or mental constructs, resulting in their own personal images of a place (Ashworth and Voogd, 1990; Gartner, 1993; Bramwell and Rawding, 1996).

In this paper, image is defined in a slightly different way, as a function of objectively measured factors, which influence people. It is clear that a country's image, based on objectively measured factors and expressing its current state of development, may be improved through marketing and promotion activities. Nevertheless, it is believed that the impact of those activities on the country's Image is temporary and limited and the only lasting effect is the objective improvement of the various attributes of this image.

Different people hold quite different images of the same place. Because a country consists of a number of groups of people that have a different type of interaction with it, each of these groups is likely to have a different image of the particular country. Hence, a country does not have an image, but multiple images (Dowling, 1998).

Based on the above it can be said that at each stage of the process of a country's development we can observe its image. In other words, it can be argued that, at each point

in time, the country «sends out» its image and, depending on its impact on the people, the country may be considered attractive or non attractive. One may also argue that since people «receiving» the image of the country belong to various distinct groups and are sensitive to different factors; the impact of the country's image on the members of each particular group will be different (Kotler et al., 1999; Bryson & Daniels, 2007).

Whilst this argument is plausible, the available evidence suggests that all groups of people react similarly to a basic set of factors; more precisely, a set of minimum standards, largely common to all groups, must be satisfied if the country is to be considered as an attractive one.

To reconcile these two views we refine the concept of a country's image by introducing the following two concepts: the Basic Image and the Specific Image.

- The Basic Image of a given country measures the degree to which the country satisfies a set of basic criteria, common for all people.
- The Specific Image of a given country, as perceived by a particular group of people, measures the degree to which people belonging to that particular group consider the country as their first preference.

The remainder of this paper will focus on a country's Basic Image, a summary measure of its current state of development and future prospects as perceived by all groups of people. A physically realizable measure for the Basic Image is difficult to find. What may be measured more easily, are the net changes in the values of a number of economic welfare indicators. However, those measurable changes may be generally considered as the delayed and smoothed consequence of prior changes in the Basic Image. Hence, the study of the mechanisms governing the shaping and the changes of a country's Basic Image is a task of imperative importance.

On the basis of all the above the Basic Image of a country may be defined as a function of a number of variables which may be divided into three sets according to whether they express the economic, the social or the environmental function of the country.

The factors of the first set (e.g. *GDP per Capita, Energy Expenditure per Capita, Employment Rate, Research & Development percentage of GDP*) provide a measure of the country's economic development prospects. This measure is referred to as **Economic Indicator** $\left(IND_i^1\right)$. Similarly, the factors of the second set (e.g. *Public Expenditure on Education, Persons with Upper Secondary or Tertiary Education, Healthy Life Years, Hospital Beds, Expenditure on Social Protection, People at Risk of Poverty or Social Exclusion*) provide a measure of a country's social profile. This measure is referred to as **Social Indicator** $\left(IND_i^2\right)$. Finally, the factors of the third set (e.g. *Share of Renewable Energy Sources (RES) in Electricity Generation, Share of Renewable Energy Sources in gross Final Energy Consumption (FEC), Energy Intensity of the Economy, Greenhouse Gas Emissions)* provide a measure of the quality of the environment in the country. This measure is referred to as **Environmental Indicator** $\left(IND_i^3\right)$. Hence,

$$\text{Basic Image} = \varphi\left(IND_i^1, IND_i^2, IND_i^3\right)$$

At this point it should be mentioned that the growth of a country may be expressed both in absolute or relative terms. In the latter and most interesting case the development pattern of a given country is compared to that of a hypothetical country, which is referred to as the "typical" country and expresses, as far as possible, an average of the main countries of a similar type to that under study. In this paper we shall be looking at the relative development patterns of a country. Hence, all the factors affecting its Basic Image should be expressed in relative terms as compared to the corresponding values of the "typical" country.

6. Modeling a Country's Basic Image

We have so far defined a country's Basic Image as a function of three indicators. In order to get a first feeling of the shape of its graph we start by stating the following simple observations describing the way in which the three indicators operate.

i. The higher the Economic Indicator of a country the more Attractive its Basic Image.
ii. The higher the Social Indicator of a country the more Attractive its Basic Image.
iii. The higher the Environmental Indicator of a country the more Attractive its Basic Image.
iv. If the Economic Indicator of a country is continuously increasing but, at the same time, its Social Indicator is continuously decreasing, the Basic Image of the country may be either attractive or non attractive and sudden changes in its state may be expected.

Observation (iv) is the most interesting because it implies that the graph we want to draw may be discontinuous with multiple equilibria. Furthermore, the recent work on resilience seems to indicate the existence of multiple equilibria in systems such as persons, firms, products or even nations (Pendall et al., 2010). According to Berkes and Folke (1998) and Gunderson et al. (2002), the important measure of resilience is the magnitude or scale of disturbance that can be absorbed before the system changes in structure by the change of variables and processes. Systems are seen to be complex, non linear, multi-equilibrium and self-organising; they are permeated by uncertainty and discontinuities. Resilience in this context is a measure of robustness and buffering capacity of the system to changing conditions. Finally, the available evidence presented so far indicates that sustainability issues are characterized by a high degree of conflict.

The study of discontinuous functions requires special mathematical tools. Such a tool is Catastrophe Theory (Thom, 1975; Zeeman, 1973) the general mathematical theory of discontinuous and divergent behavior from continuous underlying forces. The theory is derived from Topology and is based upon some new theorems in the geometry of many dimensions, which classify the ways in which discontinuities may occur, in terns of a few archetypal forms called elementary catastrophes (Gilmore, 1993; Poston and Stewart, 1996). Although the underlying mathematics are difficult and the proofs of the theorems involved complicated, the elementary catastrophes themselves are relatively easy to

understand and can be used effectively, even by non-experts in the subject. Catastrophe theory was developed and popularized in the early 1970's. After a period of criticism, it is now well established and widely applied (Rosser, 2007). Today, the theory is very much alive and numerous nonlinear phenomena that exhibit discontinuous jumps in behavior have been modeled by using the theory, for instance in chemistry (e.g Wales, 2001), in physics (e.g. Aerts et al., 2003), in psychology (e.g. Van der Mass et al., 2003) in clinical studies (e.g. Smerz and Guastello, 2008) and in the social sciences (e.g. Smith et al., 2005; Dou and Ghose, 2006; Huang, 2008).

Table 1: Some Elementary Catastrophes

Number of Behavior Variables	Number of Control Variables	Type of Catastrophe
1	1	Fold
1	2	Cusp
1	3	Swallowtail
1	4	Butterfly

Table 1 summarizes the elementary catastrophes in the case where a process is expressed through one behaviour variable depending on one up to four control variables. In the case of a process, for example, whose behaviour depends on two control variables it is sufficient to know that a theorem exists giving the qualitative shape of a 3-dimensional surface, which shows all possible ways in which a discontinuity in the behaviour may occur. The two control variables are usually referred to as normal and splitting factor respectively.

Returning to the present case it must be reminded that the Basic Image of a country has been defined as a function of three potentially conflicting indicators. Therefore, according to Catastrophe Theory, the appropriate elementary catastrophe is the swallowtail and consequently the value $BI = x_i$, of a country's Basic Image is given as a solution of the equation:

$$x_i^4 - Dx_i^2 - Bx_i - A = 0$$

At this point, however, it should be mentioned that the swallowtail catastrophe is not particularly useful as a model because under a wide range of conditions no stable state can exist. This problem together with the fact that environment may, in some cases, act as a buffer delaying/accelerating the decline of a declining country or accelerating/delaying the growth of a growing country, with high or low environmental quality respectively, leads us to consider the next elementary catastrophe namely the butterfly catastrophe. The butterfly catastrophe involves four control factors and in order to use it as the basis for modeling the shaping of a country's Basic Image we need, on top of the three indicators already defined Economic, Social and Environmental, to introduce a fourth one. This indicator may be the Political Indicator (POI), which expresses the general socio-economic and political climate

in which the country is found in the period under study. Consequently, the value $BI = x_i$, of a country's Basic Image, at each point in time, is given as a solution of the equation:

$$x_i^5 - Cx_i^3 - Dx_i^2 - Bx_i - A = 0$$

For the purposes of this work, we set $D = 0$ and comments for its use in the general case are given in the final section of the paper. Hence, the value x_i, of the i^{th} country's Basic Image, at each point in time, is given as a solution of the equation:

$$x_i^5 - Cx_i^3 - Bx_i - A = 0 \tag{1}$$

with:

$$\begin{pmatrix} A \\ B \\ C \end{pmatrix} = \begin{pmatrix} mk & k & -\sqrt{m^2+1} \\ \sqrt{k^2+1} & -m\sqrt{k^2+1} & 0 \\ m & 1 & k\sqrt{m^2+1} \end{pmatrix} \begin{pmatrix} IND_i^1 - IND_0^1 \\ IND_i^2 - IND_0^2 \\ IND_i^3 - IND_0^3 \end{pmatrix} \text{ when } \begin{matrix} m \le 1 \\ k \le 1 \end{matrix}$$

$$\begin{pmatrix} A \\ B \\ C \end{pmatrix} = \begin{pmatrix} k & \frac{k}{m} & -\frac{\sqrt{m^2+1}}{m} \\ \frac{\sqrt{k^2+1}}{m} & -\sqrt{k^2+1} & 0 \\ 1 & \frac{1}{m} & \frac{k}{m}\sqrt{m^2+1} \end{pmatrix} \begin{pmatrix} IND_i^1 - IND_0^1 \\ IND_i^2 - IND_0^2 \\ IND_i^3 - IND_0^3 \end{pmatrix} \text{ when } \begin{matrix} m > 1 \\ k \le 1 \end{matrix}$$

$$\begin{pmatrix} A \\ B \\ C \end{pmatrix} = \begin{pmatrix} m & 1 & -\frac{\sqrt{m^2+1}}{k} \\ \frac{\sqrt{k^2+1}}{k} & -\frac{m}{k}\sqrt{k^2+1} & 0 \\ \frac{m}{k} & \frac{1}{k} & \sqrt{m^2+1} \end{pmatrix} \begin{pmatrix} IND_i^1 - IND_0^1 \\ IND_i^2 - IND_0^2 \\ IND_i^3 - IND_0^3 \end{pmatrix} \text{ when } \begin{matrix} m \le 1 \\ k > 1 \end{matrix}$$

$$\begin{pmatrix} A \\ B \\ C \end{pmatrix} = \begin{pmatrix} 1 & \frac{1}{m} & -\frac{\sqrt{m^2+1}}{mk} \\ \frac{\sqrt{k^2+1}}{km} & -\frac{\sqrt{k^2+1}}{k} & 0 \\ \frac{1}{k} & \frac{1}{km} & \frac{\sqrt{m^2+1}}{m} \end{pmatrix} \begin{pmatrix} IND_i^1 - IND_0^1 \\ IND_i^2 - IND_0^2 \\ IND_i^3 - IND_0^3 \end{pmatrix} \text{ when } \begin{matrix} m > 1 \\ k > 1 \end{matrix}$$

Equation (1) is referred to as the **Basic Image Equation** and IND_i^1, IND_i^2 and IND_i^3 express the values of the three Indicators for the i^{th} country, while IND_0^1, IND_0^2 and IND_0^3, express the values of those three Indicators for the "typical" country. The variable m expresses the relative weight attached between the Economic and Social Indicators in defining the country**'s Basic Image** while k expresses the relative weight between the plane defined by the Social and the Economic Indicators on one hand and the Environmental Indicator on the other (Kondakis et al., 2010).

Composite indicators for ranking countries are very common in a variety of economic and policy domains, such as industrial competitiveness, sustainable development, globalization and innovation. As a result, there is an extensive literature on the construction of such indicators (Saisana and Tarantola, 2002; Munda and Nardo, 2005, 2009; Shen et al., 2011; Dallara and Rizzi, 2013).

Table 2: The Economic, Social and Environmental Indicators of country *i*

$IND_i^1 = \sqrt[3]{\prod_{j=1}^{3} SbI_{ij}^1},\ i = 1, 2, \ldots, n$		$IND_i^2 = \sqrt[3]{\prod_{j=1}^{3} SbI_{ij}^2},\ i = 1, 2, \ldots, n$	
where		where	
$\boldsymbol{IND_i^1}$:	**The Economic Indicator of country *i***	$\boldsymbol{IND_i^2}$:	**The Social Indicator of country *i***
SbI_{i1}^1:	The Financial Conditions Sub indicator of country i	SbI_{i1}^2:	The Education Sub indicator of country i
SbI_{i2}^1:	The Employment Sub indicator of country i	SbI_{i2}^2:	The Health Sub indicator of country i
SbI_{i3}^1:	The R & D Sub indicator of country i	SbI_{i3}^2:	The Social Conditions Sub indicator of country i

$IND_i^3 = \sqrt[3]{\prod_{j=1}^{3} SbI_{ij}^3},\ i = 1, 2, \ldots, n$	
where	
$\boldsymbol{IND_i^3}$:	**The Environmental Indicator of country *i***
SbI_{i1}^1:	The RES Sub indicator of country i
SbI_{i2}^1:	The Energy Efficiency Sub indicator of country i
SbI_{i3}^1:	The Climate Change Sub indicator of country i

For the purposes of this work, each of those Indicators is expressed as the geometric mean of several Sub indicators, as shown in Table 2. A clear overview of the variables

affecting a country's Basic Image and their conversion through Sub Indices, Relative Sub indices, Relative Indices and Sub-indicators into Indicators and, finally, into the country's Basic Image is given in Table 3. Furthermore, the values of all Indicators lie in the interval [0,1], whereas the value of the Basic Image lies in the interval [-1,1]. The value of the "typical" country's Basic Image is 0. Hence, positive Basic Image indicates an attractive country.

Table 3: Conversion of the variables affecting the Basic Image of country *i*

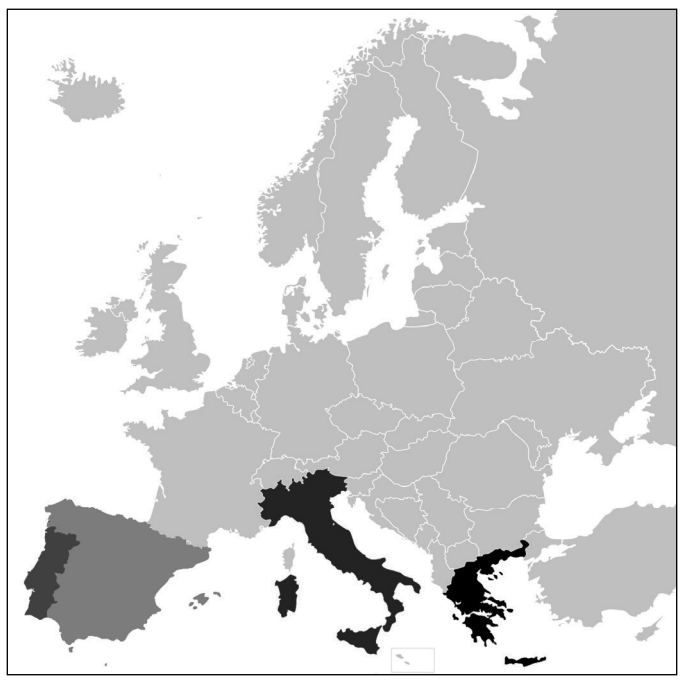
INDICATORS, INDICES AND VARIABLES CONCERNING COUNTRY *i*					
Indicators	**Sub indicators**	**Relative Indices**	**Relative Sub indices**	**Sub indices**	**Variables**
Economic Indicator $\left(IND_i^1\right)$	The Financial Conditions Sub indicator $\left(SbI_{i1}^1\right)$	Relative Financial Conditions Index $\left(RI_{i1}^1\right)$	Relative Sub index for Gross Domestic Product per inhabitant $\left(RSI_{i1_1}^1\right)$	Sub index for Gross Domestic Product per inhabitant $\left(SI_{i1_1}^1\right)$	Gross Domestic Product
					Population
			Relative Sub index for Energy expenditure per inhabitant $\left(RSI_{i1_2}^1\right)$	Sub index for Energy expenditure per inhabitant $\left(SI_{i1_2}^1\right)$	Energy expenditure
					Population
	The Employment Sub indicator $\left(SbI_{i2}^1\right)$	Relative Employment Index $\left(RI_{i2}^1\right)$			Persons aged 20 to 64 in employment
					Population of the same age group
	The R & D Sub indicator $\left(SbI_{i3}^1\right)$	Relative R & D Index $\left(RI_{i3}^1\right)$			Gross domestic expenditure on R&D
					Gross Domestic Product
Social Indicator $\left(IND_i^2\right)$	The Education Sub indicator $\left(SbI_{i1}^2\right)$	Relative Education Index $\left(RI_{i1}^2\right)$	Relative Sub index for Persons with upper secondary or tertiary education $\left(RSI_{i1_1}^2\right)$	Sub index for Persons with upper secondary or tertiary education $\left(SI_{i1_1}^2\right)$	Persons with upper secondary or tertiary education (15 to 64 years)
					Population of the same age group
			Relative Sub index for Public expenditure on education $\left(RSI_{i1_2}^2\right)$	Public expenditure on education $\left(SI_{i1_2}^2\right)$	Public expenditure on education
					Gross Domestic Product
	The Health Sub indicator $\left(SbI_{i2}^2\right)$	Relative Health Index $\left(RI_{i2}^2\right)$	Relative Sub index for Healthy Life years $\left(RSI_{i2_1}^2\right)$	Sub index for Healthy Life years $\left(SI_{i2_1}^2\right)$	Healthy Life years for males
					Healthy Life years for females
					Males/females in the population
			Relative Hospital beds Sub index $\left(RSI_{i2_2}^2\right)$	Sub index for Hospital beds $\left(SI_{i2_2}^2\right)$	Hospital beds (per 100,000 inhabitants)
	The Social Conditions Sub indicator $\left(SbI_{i3}^2\right)$	Relative Social Conditions Index $\left(RI_{i3}^2\right)$	Relative Sub index for Social Protection Expenditure $\left(RSI_{i3_1}^2\right)$	Sub index for Social Protection Expenditure $\left(SI_{i3_1}^2\right)$	Social Protection Expenditure
					Population
			Relative Sub index for People at risk of poverty $\left(RSI_{i3_2}^2\right)$	Sub index for People at risk of poverty $\left(SI_{i3_2}^2\right)$	People at Risk of Poverty
					Population

Environ-mental Indicator $\left(IND_i^3\right)$	The Renewable Energy Sources (RES) Sub indicator $\left(SbI_{i1}^3\right)$	Relative Renewable Energy Sources (RES) Index $\left(RI_{i1}^3\right)$	Relative Sub index for Share of RES in Electricity Generation $\left(RSI_{i1_1}^3\right)$	Sub index for Share of RES in Electricity Generation $\left(SI_{i1_1}^3\right)$	Share of RES in Electricity Generation
			Relative Sub index for Share of RES in gross FEC $\left(RSI_{i1_2}^3\right)$	Sub index for Share of RES in gross FEC $\left(SI_{i1_2}^3\right)$	Total RES Consumption
					Total FEC
	The Energy Efficiency Sub indicator $\left(SbI_{i2}^3\right)$	Relative Energy Efficiency Index $\left(RI_{i2}^3\right)$			Gross inland consumption of energy
					Gross Domestic Product
	The Climate Change Sub indicator $\left(SbI_{i3}^3\right)$	Relative Climate Change Index $\left(RI_{i3}^3\right)$			Total Greenhouse Gas Emissions
					Population

7. Application of the proposed model

The methodology presented in the previous section has been used for the estimation of the Basic Image of four countries in the South of Europe, Greece, Italy, Spain and Portugal (Figure 1), over the period 2000-2010. The required data have been drawn from the official site of Eurostat.

Figure 1: The Map of the European South



The results are summarized in Tables 4-5 and in Figures 2-5. Table 4 contains the values of the Economic, Social and Environmental Indicators for Greece, Italy, Spain and Portugal for the period under study. The values of the Economic, Social and Environmental Indicators of the "typical" country have been also calculated.

Figure 2 presents the values of the Economic Indicator for all four countries and the "typical" country throughout the period under study. As we san see Greece has the lowest Economic Indicator value among the four countries, which has been actually steadily decreasing over the period under study. Portugal started with an Economic Indicator value lower than those of Italy and Spain, but by the end of the period, it has surpassed them. Finally, Italy and Spain show an almost constant Economic Indicator throughout the period under study with the lead changing between them until 2008, when Portugal climbed into the first place. It must be noted that throughout the period Greece maintains an Economic Indicator value lower than that of the "typical" country, whereas Italy, Spain and Portugal exhibit values higher than that of the "typical" country, with only a few exceptions.

Figure 2: The Economic Indicator of the European South, 2000-2010

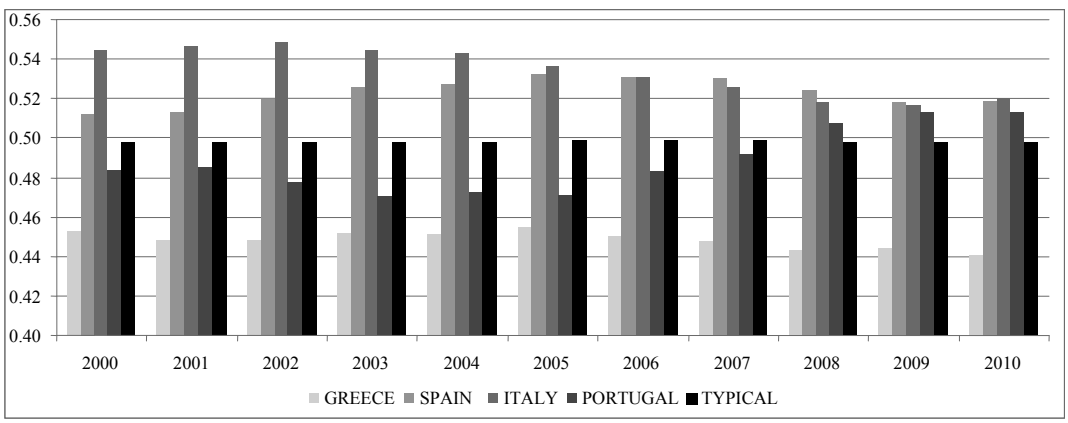


Figure 3 presents the values of the Social Indicator for all four countries and for the "typical" country throughout the period under study. As we can see Italy started with the highest Social Indicator value followed by Greece which however is catching up Italy towards the end of the period. Spain shows an almost constant Social Indicator value throughout the period and the same holds for Portugal but at a lower level. It must be noted that throughout the period Portugal and Spain maintain Social Indicator values lower than that of the "typical" country, whereas Greece and Italy higher values.

Table 4: The values of Economic, Social and Environmental Indicators of the European South, 2000-2010

Countries	Indicators		
	Economic	Social	Environmental
2000			
Greece	0.4524	0.503	0.431
Spain	0.5125	0.490	0.478
Italy	0.5444	0.542	0.500
Portugal	0.4839	0.464	0.572
Typical Country	**0.4983**	**0.4996**	**0.4952**
2001			
Greece	0.4484	0.503	0.418
Spain	0.5129	0.488	0.491
Italy	0.5467	0.541	0.496
Portugal	0.4855	0.467	0.574
Typical Country	**0.4983**	**0.4996**	**0.4947**
2002			
Greece	0.4480	0.506	0.434
Spain	0.5193	0.489	0.484
Italy	0.5484	0.537	0.510
Portugal	0.4773	0.467	0.557
Typical Country	**0.4982**	**0.4996**	**0.4963**
2003			
Greece	0.4522	0.506	0.433
Spain	0.5262	0.489	0.488
Italy	0.5442	0.534	0.480
Portugal	0.4705	0.469	0.577
Typical Country	**0.4983**	**0.4996**	**0.4944**
2004			
Greece	0.4510	0.511	0.443
Spain	0.5274	0.488	0.486
Italy	0.5427	0.532	0.500
Portugal	0.4728	0.467	0.558
Typical Country	**0.4985**	**0.4996**	**0.4968**
2005			
Greece	0.4547	0.515	0.454
Spain	0.5323	0.490	0.485
Italy	0.5368	0.525	0.508
Portugal	0.4708	0.469	0.544
Typical Country	**0.4986**	**0.4996**	**0.4979**
2006			
Greece	0.4507	0.515	0.446
Spain	0.5312	0.491	0.478
Italy	0.5305	0.525	0.490
Portugal	0.4829	0.467	0.569
Typical Country	**0.4988**	**0.4997**	**0.4957**
2007			
Greece	0.4479	0.519	0.430
Spain	0.5299	0.493	0.485
Italy	0.5257	0.519	0.489
Portugal	0.4917	0.468	0.574
Typical Country	**0.4988**	**0.4996**	**0.4947**
2008			
Greece	0.4433	0.520	0.431
Spain	0.5242	0.494	0.494
Italy	0.5180	0.517	0.498
Portugal	0.5076	0.467	0.563
Typical Country	**0.4983**	**0.4997**	**0.4966**
2009			
Greece	0.4438	0.521	0.432
Spain	0.5182	0.493	0.502
Italy	0.5166	0.516	0.501
Portugal	0.5133	0.469	0.553
Typical Country	**0.4980**	**0.4996**	**0.4971**
2010			
Greece	0.4404	0.519	0.434
Spain	0.5189	0.495	0.503
Italy	0.5200	0.520	0.496
Portugal	0.5134	0.465	0.556
Typical Country	**0.4982**	**0.4997**	**0.4972**

Figure 3: The Social Indicator of the European South, 2000-2010

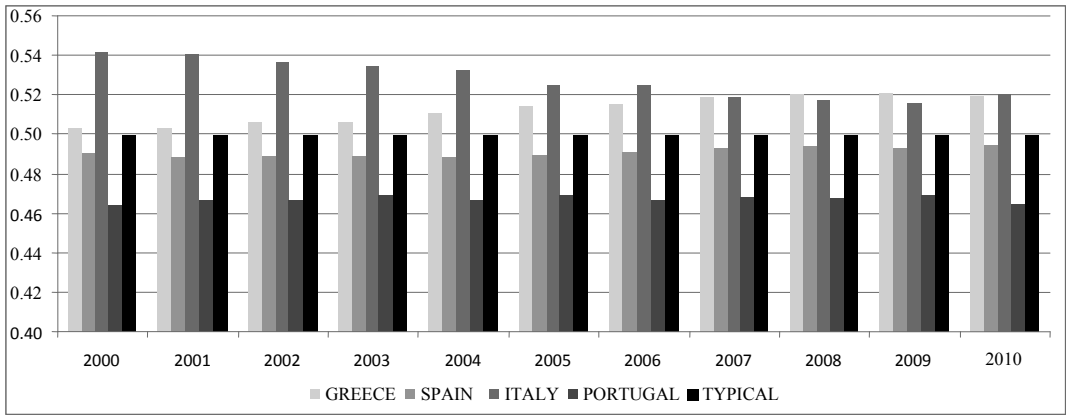


Figure 4: The Environmental Indicator of the European South, 2000-2010

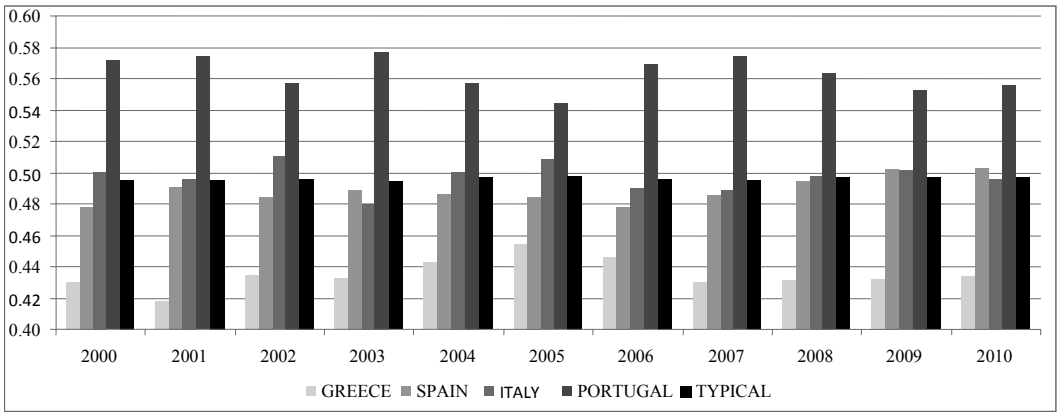
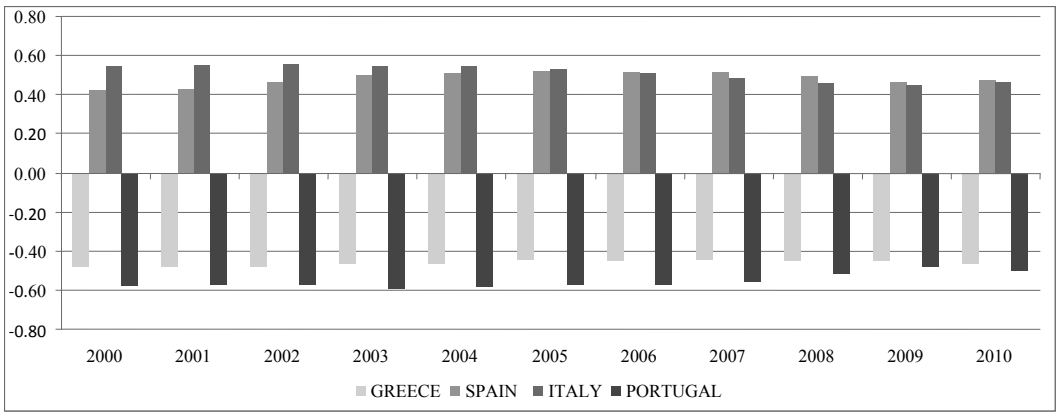


Figure 4 presents the values of the Environmental Indicator for all four countries and for the "typical" country throughout the period under study. Portugal maintains the highest Environmental Indicator value over the whole period, whereas Greece the lowest. Spain and Italy exhibit an almost constant Environmental Indicator value at a similar level throughout the period. It must be noted that throughout the period under study Greece and Spain (with a few exceptions) maintain Environmental Indicator values lower than that of the "typical" country, whereas Portugal and Italy (with a few exceptions) higher.

Table 5: The values of the Basic Image of the European South, 2000-2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
GREECE	-0.4770	-0.4800	-0.4820	-0.4690	-0.4650	-0.4480	-0.4540	-0.4450	-0.4540	-0.4500	-0.4640
SPAIN	0.4260	0.4320	0.4690	0.5010	0.5050	0.5220	0.5160	0.5130	0.4930	0.4670	0.4710
ITALY	0.5460	0.5510	0.5600	0.5420	0.5440	0.5320	0.5060	0.4900	0.4590	0.4520	0.4670
PORTUGAL	-0.5800	-0.5730	-0.5760	-0.5930	-0.5840	-0.5760	-0.5740	-0.5570	-0.5140	-0.4790	-0.5000

Figure 5: The Basic Image of the European South, 2000-2010



Finally, Table 5 contains the values of the Basic Image for all four countries throughout the period under study and Figure 5 presents them graphically. Italy and Spain maintain an almost constant positive Image value with Italy leading in the former years and Spain in the latter. Greece and Portugal maintain a negative Basic Image value with Portugal having constantly the worse value. At a first glance this last finding seems somehow unexpected since Portugal has two out of its three Indicators (Economic and Environmental) higher than those of Greece but still its Basic Image is marginally worse than that of Greece. A closer look however reveals the following:

- The non-linear Butterfly Catastrophe model used in this paper for the estimation of a country's Basic Image value is based on three Indicators: Economic, Social and Environmental. However the key determinants of the Basic Image are the first two indicators whereas the Environmental Indicator accelerates or decelerates the changes generated by them.
- If we follow the changes in the values of all Indicators and the Basic Image values for Greece and Portugal throughout the period under study, the following observations may be made:
  - In the case of Portugal the Economic Indicator is, after a period of stagnation, continuously increasing whereas the other two Indicators remain almost constant.

Hence, its Basic Image follows the trend of the Economic Indicator and improves considerably in the second half of the period under study. Furthermore, the Social Indicator of Portugal is well **below** the Social Indicator of the "typical" country and its Economic Indicator is **below** that of the "typical" country for almost the whole period.

- In the case of Greece the Social Indicator, after a period of stagnation, increases slightly whereas the other two Indicators remain almost constant throughout the period under study. Hence, its Basic Image improves slightly in the second half of the period under study. Furthermore, the Social Indicator of Greece is **above** the Social Indicator of the "typical" country and its Economic Indicator is **below** that of the "typical" country for almost the whole period.

On the basis of all the above it is clear that in the last three years under study the key determinants of the Basic Image value, in both Greece and Portugal, are comparable and hence any relative ranking of the two countries and perhaps a sudden change may be expected. However, it is obvious that the trend of their Basic Image values has changed in favour of Portugal (which closes the gap) and if the key determinants keep moving in the same way, Portugal will soon take the lead.

8. Conclusions and suggestions for further research

A country's path of growth depends on its ability to tackle the conflicts characterizing sustainability issues. This ability is reflected on what we call the Image of a country, a measure expressing, at each point in time the country's current state of development and its future prospects.

The paper introduced the concept of a country's Basic Image, developed a mathematical model for its estimation, applied the model to the case of the four countries of the European South and presented the results. The Basic Image gives a "true" picture of a country's development and an early warning of any future problems. Furthermore, its structure allows a researcher to identify not only the changes in the Basic Image values, but also the causes of those changes and, hence, take the necessary measures. Consequently, the Basic Image may prove to be a very useful managerial tool, which can help the authorities to improve the country's attractiveness and future prospects of development.

The application results seem logical and expected. They show that the proposed model expresses a country's process of development in a realistic way, in the sense that it quantifies the country's appeal to the full range of people.

The Basic Image, as defined so far, has left out a number of important variables, endogenous or exogenous. Hence, another area of further research would be to redefine a country**'s Basic Image, so as to include some of those variables. Such a set of variables may be those related to the** general socio-economic and political climate in which the country is found in the period under study and could define a fourth indicator, which may be referred to as the Political Indicator. This indicator has been included in the model

presented in section 6 but for simplification reasons it was set equal to zero. However, in the general case the variables affecting this indicator will be identified, measured and scaled and the indicator will be calculated along the lines used for the other three indicators. Hence, our task will be to examine how the complete Butterfly catastrophe (with $D \neq 0$) may be used to model the enriched Basic Image.

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What Drives Stock Exchange Integration?

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Abstract

This paper contains an empirical analysis of determinants of international integration projects over the time period 1995-2010. After a broad discussion of the existent literature, the investigation combines a large number of potentially relevant determinants for the explanation of whether stock exchanges are participating in formal integration projects. Using the weekly data of stock market returns, correlation and cluster analysis investigate a measure of integration among stock markets. Johansen cointegration test estimates the presence of multilateral long run equilibrium relationship among integrated stock exchanges. Finally, multivariable logit regression with three-year lagged dependent variable is applied and interpreted. A number of significant variables are identified as determining the existence of de jure stock market integration projects.

Keywords: stock market integration, Johansen cointegration test, logit

JEL Classification: G15, G17

1. Introduction

The integration of stock markets can be considered as one of the most significant changes in the global financial market and an evidence of the globalization that the world economy is leaving. The old fashioned pictures of stock exchanges as open outcry markets is not representing stock markets anymore. The demutualization of stock exchanges removed the cultural, economic and regulatory barriers to the development of new companies, called to manage more than one stock markets at once. The new opportunities provided by the ICT supported the development of stock exchanges in doing their business and made international stock exchanges feasible.

This new market framework has been widely analysed by the literature. Many authors confirm that alliances, mergers and other forms and attempts of cooperation between stock and derivatives exchanges represent a new strategy in order to increase the value of stock exchange markets (Cybo-Ottone et al., 2000; Domowitz, 1995; Domowitz and Steil, 1999;

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Hasan and Schmiedel, 2004; Lee, 1998). Moreover, there are some evidences that latent factors may also determine the integration processes between stock exchange markets worldwide. Recent attempts of merge between stock exchanges provided also new case studies in order to verify what factors make successful integration projects, have opened the new research possibilities to investigate the determinants of stock exchange integration. Such mergers like NYSE - Euronext (2007), NASDAQ - OMX (2008), and even the failed attempts of integration represented by TMX Group and London Stock Exchange (2011), Singapore Stock Exchange and Australian Stock Exchange (2011) and NYSE Euronext and Deutsche Borse (2012), opened the new research possibilities to investigate the determinants of stock exchange integration. However, the high number of stakeholders involved in this integration process made the development of the market structure unclear and the drivers of its evolution unknown. Thus, the aim of this paper is to shed light on the determinants of M&A projects in stock exchange industry and to contribute both to the understanding in the academic literature, as well as to the professional practitioners' knowledge, of the possible drivers of integration processes between stock exchange markets worldwide.

This paper extends the literature on the determinants of stock exchange cooperation, providing new evidence on the key elements of a successful integration project. Data from 1995 to 2010 have been collected in order to test empirically the relevance of different possible explanatory variables. Data from failed and succeed integration projects were both included in the analysis to highlight the differences between the two groups. Furthermore, different methodologies have been applied, including correlation and cluster analysis, Johansen cointegration test and multivariable logitmodelling.

Overall, this research confirms the complexity of the integration process, and how it depends on different macroeconomic, structural, cultural-geographical and operative forces. The explanatory power of different variables, that have been supposed to be relevant on a theoretical base by previous studies, is confirmed by empirical evidence. Moreover, the final results demonstrate that financial harmonization, cross-membership agreements, for-profit corporate structure and integration openness are important drivers of stock exchange fusion. By contrast, a large size of stock exchange market has a negative impact on the likelihood of successful merger.

The paper is organised as follows. A literature review will summarise the state of the art of research on stock market integration. Data will be presented by the analysis of the sampling criteria and some descriptive statistics. The next section describes the methodology applied to measure stock exchange integration and to analyse the determinants of integration, while the results will be presented prior to some conclusions and remarks.

2. Literature review

The studies related to stock market integration can be summarised in three main areas. Studies related to the definition of financial integration from a theoretical point of view, providing the initial framework to the following researches. A second research field collects studies that analyse the determinants of stock markets integration, while the third

area concerns the consequences of having these new global players for the functioning of the financial system. Previous studies confirms a clearmarket trend toward an internationalisation of stock exchange business since the ’90s (Hasan et al., 2010). Furthermore, academic literature demonstratesa huge interest in this topic, trying to analyzeit in different ways. However, the complexity of this phenomenon and different points of view adopted by scholars suggest the need for a clear definition of stock exchange integration. The literature provides diverse definitions and approaches of financial integration both from a micro and macro perspectives. According to the law of one price, Pieper and Vogel (1997) define integrated markets as“markets where investors can, in one country, buy and sell without restriction equities that are issued in another country and as a result identical securities are issued and traded at the same price across markets after adjustment for foreign exchange rates”. In terms of risk sharing, Korajczyk (1999) suggests that if equity markets are financially integrated, the price of risk should be the same across markets. Moreover, Bekaert and Harvey (2003), argue that in integrated equity markets, domestic investors are able to invest in foreign assets and foreign investors in domestic assets; hence, assets of identical risk command the same expected return, regardless of trading location. Finally, Bhalla and Shetty (2006) formulate macroeconomic definition stock exchange integration, showing that those events in one country will have its impact felt in the financial markets of other countries.

The following broad definition of financial stock exchange integration will be adopted in this paper, in accordance with Baele et al. (2004) and Schmiedel and Schonenberger (2005). The market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics (1) face the same set of rules when they decide to deal with those financial instruments and/or services, (2) have equal access to the above-mentionedset of financial instruments and/or services, and (3) are treated equally when they are active in the market. In terms of the development of stock exchange integration phenomenon, Hasan and Schmiedel (2004) indicate that deregulation, globalization, and technological developments have altered the business strategies of stock exchanges around the world. Many scholars confirm the increasing convergence in international stock markets in recent years (Karolyi and Stulz, 2001; Eun and Lee, 2006; Mishkin, 2007; Christos and Nektarios, 2009).The traditional role played by stock exchanges as self-regulatory, controlled and governed by members or governments is being questioned due to the recent spectacular advances in information technology, globalization, growing competition, which in turn has put more pressureon stock markets to change their governance structure in order be more cost efficient, transparent and widely accountable. As a result, stock exchanges started changing their structures and then integrated, consolidated, merged or allied with other stock exchanges either domestically or cross-borders. Moreover, there are different forms of integration that can be presented as steps towards the full integrated stock exchange: cross border deals, restructuring (domestic mergers), cross remote membership, cross listing, cross membership and cross listing, and other forms of alliances (Shy and Tarkka, 2001; Hasan and Schmiedel, 2004; Armanious, 2005; Nicolini, 2010). Di Noia (1998) showed that the increase in competition among the

securities markets in Europe, has produced mergers, technological agreements takeovers, and the creation of new exchanges, even within the same country. Thereby, the continued globalisation of financial and securities markets, resulted in a rapid expansion of cross-border trading, custody, clearing and settlement activity. Finally, Polato and Floreani (2009) show that in recent years stock exchange markets have undergone a process of consolidation aimed at improving their scale and diversifying their activities, where nowadays two stages of the process could be enucleated. In a first stage, consolidation engaged mainly European markets. The main references are the Euronext exchange and the Nordic exchange, but in recent years the phenomenon is expanding, involving even American exchanges.

Thus, if the previous researches provide the main features of the new regulatory and technological framework that make the integration between stock exchanges feasible mainly from a macroeconomic perspective, this study investigates the stock exchange behaviours in the integration processes, trying to figure out the main drivers that lead them to be part of a new (international) market institution. In this way, the consequences of integration processes among financial markets become, especially, important. The relevance of consequences related to the integration between stock exchanges for different stakeholders is confirmed by many scholars. For the financial institutions and investors,market integration allows economies of scale and scope (McAndrews and Stefanadis, 2002; Neumann et al., 2002; Carretta and Nicolini, 2006). An integrated market will support the intermediaries and the issuers that will benefit from higher efficiency and transparency, and they will avoid the duplication of costsrelated to the market infrastructure (Pagano and Padila, 2005; Varadi and Boppana, 2009). Furthermore, the investors will benefit from more diversified portfolios and higher market liquidity (Polato and Floreani, 2010; Grose, 2011). However, if the integration of the stock markets seems to be desirable for all its participants, the interests represented by the various stakeholders are mutually different and sometimes conflicting.

New evidences on the consequences that integration can have on financial markets have been provided by the recent financial crises, that showed the role stock of exchange integration in terms of financial contagion and difficulties in providing adequate risk diversification opportunities. According to Schmukler and Zoido-Lobatón (2011) the imperfections in financial markets can generate bubbles, irrational behaviour, herding behaviour, speculative attacks, and crashes among other things. Moreover, even though domestic factors tend to be key determinants of crises, there are different channels through which stock exchange integration can be related to crises. Stock markets, as a proxy variable for economic activity, positively affects the real economy (Sariannidis et al., 2009; Sariannidis, 2010). In particular, financial linkages can also trigger contagion through potential spillover effects and regional shocks. Finally, as many authors confirm, countries with internationally traded financial assets and liquid markets tend to be subjected to contagion (Alen and Gale, 2000; Lagunoff and Schreft, 2001; Claessens and Forbes, 2004).

Overall, the analysis of related literature and important consequences of market integration highlight the relevance of present study to further investigate the causes of

stock exchange fusion for better early warning modelling. Recent studies provide some theoretical and empirical underpinning of possible drivers; however, there is still a gap in the literature, trying to analyse the stock exchange integration in a comprehensive manner. Thus, this paper represents a multilateral work on the field of stock exchange integration to shed light on the determinants of M&A projects in stock exchange industry and to identify the main drivers of stock exchange integration. To the knowledge of the author, this study is one of the first to attempt to analyze the stock market integration in an international perspective, trying to figure out the similarities between different integration projects.

3. Data

The lack of available database on stock market integration requested to collect the data in order to construct a cross-country panel data of European and International stock markets' characteristics. Each country is represented by its national stock exchange market. Due to the limited availability of high frequency macroeconomic data, the analysis used annual macroeconomic control variables. This practice is consistent with previous studies (e.g. Kim et al., 2006). Data are referred to 16 years long period from 1995 to 2010. All the following geographic areas are represented: North America, Latin America, Africa and Middle East, Asia and Oceania. The list of analyzed international stock markets is reported in Table 1.

Table 1: Sample of Analysed International Stock Exchange Markets

GEOGRAPHICAL REGION	NAME OF STOCK EXCHANGE
NORTH AMERICA AND CANADA	Nasdaq (USA), Nyse (USA), Toronto Stock Exchange (CANADA);
LATIN AMERICA	Sao Paulo Stock Exchange (BRAZIL), Buenos Aires Stock Exchange (ARGENTINA), Colombia Stock Exchange (COLOMBIA), Mexican Stock Exchange (MEXICO), Santiago Stock Exchange (CHILE), Lima Stock Exchange (PERU);
OCEANIA AND ASIA	New Zealand Stock Exchange (NEW ZEALAND), Australian Securities Exchange (AUSTRALIA); Shenzhen Stock Exchange (SHENZHEN), Hong Kong Stock Exchange (HONG KONG), National Stock Exchange of India (INDIA), Jakarta Stock Exchange (INDONESIA), Tel Aviv Stock Exchange (TEL-AVIV), Tokio Stock Exchange (TOKIO), SingaporeStock Exchange (SINGAPORE), Korea Stock Exchange (SOUTH KOREA);

AFRICA AND MIDDLE EAST	Egypt Stock Exchange (EGYPT), Saudi Stock Exchange (SAUDI ARABIA), Johannesburg Stock Exchange (SOUTH AFRICA);
WESTERN EUROPE	EURONEXT, Brussels Stock Exchange (BELGIUM), Paris Stock Exchange (FRANCE), Amsterdam Stock Exchange (NETHERLANDS), Lisbon Stock Exchange (PORTUGAL), Frankfurt Stock Exchange (GERMANY), Vienna Stock Exchange (AUSTRIA), Swiss Stock Exchange (SWITZERLAND), Italian Stock Exchange (MILAN), London Stock Exchange (UK), Irish Stock Exchange (IRELAND), Luxembourg Stock Exchange (LUXEMBOURG), Athens Stock Exchange(GREECE), Madrid Stock Exchange (SPAIN), BarcelonaStock Exchange (SPAIN), Valencia Stock Exchange (SPAIN), BilbaoStock Exchange (SPAIN);
NORTHERN EUROPE	OMX Nordic Stock Exchange, Stockholm Stock Exchange(SWEDEN), Helsinki Stock Exchange (FINLAND), Copenhagen Stock Exchange(DENMARK), Oslo Stock Exchange (NORWAY);
EASTERN EUROPE	PragueStock Exchange (CZECH REPUBLIC), Warsaw Stock Exchange (POLAND), Bucharest Stock Exchange (ROMANIA), RussianStock Exchange (RUSSIA), Budapest Stock Exchange (HUNGARY).

There are 27 European countries that are represented by their stock exchanges: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland and the United Kingdom. Moreover, 22 international stock exchanges are analysed from the following countries: Argentina, Australia, Canada, China, Colombia, Egypt, India, Indonesia, Israel, Japan, Mexico, New Zealand, Peru, Saudi Arabia, Singapore, South Africa, South Korea and USA.

To identify which of the selected stock markets have been integrated during 1996-2010, the analysis considered the following successful stock exchange integration projects: EURONEXT (2000), BME (2002), OMX (2003-2006), LSE-BORSA ITALIANA (2007), CEE GROUP (2009), NYSE-EURONEXT (2007), NASDAQ OMX GROUP (2008), MERCADO INTEGRADO LATINOAMERICANO (2009). The full sample of analysed integration projects is reported in Table 2.

Table 2: Sample of Analysed Integration Projects

INTEGRATION PROJECT	MARKET INDEX	YEAR OF INTEGRATION
European Markets		
EURONEXT	Amsterdam Stock Exchange	September 2000
	Brussels Stock Exchange	September 2000
	Paris Stock Exchange	September 2000
	Lisbon Stock Exchange	September 2002
BME	Madrid Stock Exchange	February 2002
	Barcelona Stock Exchange	February 2002
	Bilbao Stock Exchange	February 2002
	Valencia Stock Exchange	February 2002
OMX	Stockholm Stock Exchange	September 2003
	Helsinki Stock Exchange	September 2003
	Copenhagen Stock Exchange	January 2005
	Oslo Stock Exchange (10% stake)	October 2006
LSE-BORSA ITALIANA	London Stock Exchange	March 2007
	Italian Stock Exchange	March 2007
CEE GROUP	Vienna Stock Exchange	September 2009
	Prague Stock Exchange	September 2009
	Budapest Stock Exchange	September 2009
	Ljubljana Stock Exchange	September 2009
International Markets		
NYSE-EURONEXT	Euronext Stock Exchange	September 2007
	New York Stock Exchange	September 2007
NASDAQ OMX GROUP	Nasdaq	March 2008
	OMX	March 2008
MILA	Bolsa de Valores de Colombia	December 2009
	Lima Stock Exchange	December 2009
	Santiago Stock Exchange	December 2009

The total sample of European integrated stock markets counts 18 stock exchange markets, meanwhile the total sample of international integrated stock markets consists of 5 stock exchange markets. To test the level of integration within international stock markets from 1995 to 2010 via correlation and cluster analysis, we use a single national stock market indexes for each stock exchange. All indexes are gathered on a weekly base, and

they are reported in US dollars. The data source is Datastream (by Thomson Financial). The final sample includes general price indexes of 49 national stock markets between 1995 and 2010. From the time series of price indexes, continuously compounded returns for all 49 stock indexes have been calculated as:

$$R_t = \ln P_t - \ln P_{t-1} \tag{1}$$

In order to investigate the main drivers of an integration process between stock exchanges, data for potential variables have been collected. The list of possible drivers of integration is based on the analysis of previous studies. The awareness that integration can be the result of different decision paths suggested to test the explanatory power of different set of variables: macroeconomic variables, development variables, regulation variables, structural variables, stock exchange regulation variables and trading variables. The full list of control variables is reported in Table 3.

3.1 Predictor variables

The analysis of literature suggests that various classes of variables can be relevant indicators of stock exchange integration. In this study we use different types of predictor variables: macroeconomic variables, development variables, regulation variables, structural variables, stock exchange regulation variables, operative variables and control variables. The full list of regression variables in presented in Table 3.

To identify the determinants of stock exchange integration, the analysis is started with a set of macroeconomic variables that are normally associated with country characteristics. *Union* and *Currency* variables as used as dummy variables of country's participation in trade and monetary unions. In particular, the importance of different trade unions, political unions and monetary unions in the financial integration is highlighted by many authors. For example, Heaney et al. (2000) justified that one of the main reason in regional equity integration is macro-economic integration, which is largely due to trading block formation, where the European financial markets are the results of removals of exchange rate controls and the establishment of common criteria towards the formation of a common currency system together with policy coordination and market liberalization. Moreover, the role of sharing a unique currency in the European financial integration was proved by Kim et al. (2005; 2006), showing the effectiveness of the economic convergence criteria associated with the EMU in driving integration process across the member states. Hooy and Goh (2009) in their study also found that affiliations to trading bloc explain the different level of market integration. We test the role of *Trade Openness* as one of the factor of integration (Pretourius, 2002). According to Arribas et al. (2006) and Walti (2005), the increased trade openness is also one of major factors influencing globalization, which starts with the openness of economies. Finally, following Edison et al. (2002), Prasad et al. (2003), Vo (2005), Mishkin (2007), we control for *GDP* as the evidence of financial international integration among developed and rich countries.

Table 3: List of control variables

Name	Unit	Definition	Source
Macroeconomic variables			
Union	Dummy	Country participation in trade and political unions	Authors' calculation based on the data provided by www.bilaterals.org
Currency	Dummy	Country participation in monetary union (sharing the same currency)	Authors' calculation based on the data provided by www.singleglobalcurrency.org
Trade Openness	Ratio	Degree of trade openness=(Exports+Imports)/ GDP as in Rodriguez (2000)	Authors' calculation based on OECD, IMF
GDP	Index	GDP of country (US $, current prices, current PPPs)	Authors' calculation based on World Bank
Development variables			
Market Development	Ratio	Stock Market Capitalization / GDP	Authors' calculation based on World Bank
Market Value	Ratio	Stock Market Total Value Traded /GDP	Authors' calculation based on World Bank
Market Size	Ratio	Number of listed companies per 10k population	Authors' calculation based on World Bank
Turnover	Ratio	Total value of shares traded during the period divided by the average market capitalization for the period.	Authors' calculation based on World Bank
Regulation variables			
Regulatory Quality	Index	Yearly index (-2.5 - 2.5) reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development	Authors' calculation based on the Worldwide Governance Indicators (2012)
Financial Regulation	Dummy	Legislative acts, directives and other harmonization acts, issued by Regulation Authorities that can influence on the decision of stock exchange integration.	Authors' calculation based on official publications of the EC Commission and national Regulators
Stock exchange variables			
Market Capitalization	Discrete	Market capitalization of stock exchange markets.	Authors' calculation based on WFE, FESE, World Bank
Cross-Membership	Dummy	Presence of cross-membership agreement	Authors' calculation based on individual Stock Exchange Annual Reports
Demutualization	Dummy	Change of governance structure of Stock Exchange Market	Authors' calculation based on individual Stock Exchange Annual Reports
Self-Listing	Dummy	Self-listing of Stock Exchange Market	Authors' calculation based on individual Stock Exchange Annual Reports
Shareholder	Dummy	Presence of another stock exchange among shareholders	Authors' calculation based on individual Stock Exchange Annual Reports
Acquisition Attempt	Dummy	Presence of hostile takeover attempt by another the stock exchange market.	Authors' calculation based on individual Stock Exchange Annual Reports

Trading Variables			
Average Traded	Discrete	Average amount traded per day (Mln, US $)	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Equities	Discrete	Total number of traded equities	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Bonds	Discrete	Total number of traded bonds	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Listed Companies	Discrete	Total number of listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Domestic	Discrete	Total number of domestic listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Foreign	Discrete	Total number of foreign listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Foreign Ratio	Ratio	Ratio of foreign listed equities to total number of listed companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Delisting	Discrete	Number of delisting companies with shares	Authors' calculation based on WFE, FESE, Stock Exchange Annual Reports
Operative Variables			
Trading Platform	Dummy	Sharing the same trading software with another stock exchange market	Authors' calculation based on Stock Exchange Annual Reports
Post-Trading Operator	Dummy	Sharing the same post-trading operator (clearing and settlement of transactions) with another stock exchange market	Authors' calculation based on Stock Exchange Annual Reports
Control Variables			
Integration Openness	Index	Overall correlation index calculated for each stock market index, measuring the degree of association with other indexes from the sample	Authors' calculation on Datastream data and correlation analysis
Region	Dummy	Presence in the same cluster of three or more stock exchange markets from the same geographical region. Geographical classification is done according to UN macro geographical regions: Eastern Europe, Western, Northern Europe, Southern Europe, Latin America and the Caribbean, Northern America, Africa and Middle East, Asia and Oceania.	Authors' calculation on Datastream data and cluster analysis

A second group of variables includes macroeconomic characteristics of stock market development. We test *Market Development* as the stock market capitalization to GDP, measuring the importance of the stock market. Stock markets could be sizable because of the large number of listings, but may be illiquid or shallow because of the lack of active trading. Hence, we control for stock market illiquidity, using the variables *Market Value* as the stock market value traded to GDP and *Turnover ratio* as the total value of shares traded during the period divided by the average market capitalization for the period. Following Beck et al. (2010), Allen et al. (2011), we also use *Market Size* as the number of listed companies per 10k population.

A third group of variables controls for financial reforms and institutional frameworks in the sample countries. According to Vo (2006),regulation of financial markets and official control on cross-border capital movements can explain variation in international financial integration, where a high degree of international financial integration must be associated with the free capital mobility without any impediment. Using the database of Worldwide Governance Indicators we constructed the index of *Regulatory Quality*, reflecting the perceptions of government ability to formulate and implement sound policies and regulations that permit and promote financial sector development. Moreover, Kokkoris and Olivares-Caminal (2007), Aggarwal et al. (2010) in their studies show that equity market integration is driven by market variables and legislative changes but constrained by regulatory barriers. Thus, we employ the *Financial Regulation* variable to check the role of financial harmonization acts in terms of stock exchange integration.

The literature on the determinants of stock exchange integration suggests that the nature of stock exchange market can be a relevant factor of the integration phenomenon. Thus, a fourth group of variables control for individual stock exchange characteristics. In particular, Buttner and Hayo (2011) in their empirical study found that the size of relative and absolute market capitalisation is also one of the determinants of equity market integration. This idea was also confirmed by Tan et al. (2010), in explaining the nature of the underlying financial integration dynamics and information transmission. Accordingly, we use *Market Capitalization*as annual capitalization of each stock exchange market. Next, many studies also confirm that stock exchange stakeholders can create important non-official integration links, which can be the first steps towards consolidation. Following El Serafie and Abdel Shahid (2002) and Armanious (2005), we test *Cross-Membership* variable. The change of organizational structure of exchanges was found to be a very relevant factor in integration decision (Aggarwal 2002; Aggarwal and Dahiya, 2006). We use a *Demutualization* variable to check the role of the organizational transformation of the stock exchanges into for-profit corporations. We add *Self-listing* variable according to the idea that exchanges perform better than their non-listed counterparts as self-listed exchanges are seeking the profit and may create integration projects. Moreover, *Shareholder* controls for the presence of another stock exchanges among main shareholders. In fact as Nicolini (2010) reports, if two or more exchanges are controlled by different management companies, but governed by the same shareholders, their competitive behaviour and the chances of integration between markets

could be different. Finally, to account for differences in stock exchange's behaviour after the hostile takeover attempt, we use *Acquisition Attempt* variable.

Theoretical analysis of integrated stock exchange markets both in Europe and abroad suggests that the integration is a complex process, where some new variables can be tested. In particular, we control the individual performance of each stock exchange market. *Average Traded* is defined as the average amount traded per day by each stock market. Furthermore, we test the role of the total number of traded equities (*Equities*) and bonds (*Bonds*) in order to control the specialization of stock exchanges. We test the hypothesis that trading particular instruments can increase the probability of a new integration project with the aim to create a more important trading venue. Furthermore, the control for the total numbers of domestic and foreign listed companies with shares (*Listed Companies, Domestic, Foreign*), can show the level of stock exchange development. Moreover, *Foreign Ratio*, defined as the ratio between foreign and total listed companies, indicate the openness of stock exchange market for integration project. Finally, we add *Delisting* to test the number of delisting companies as important characteristics of stock exchange market.

Operative variables can be also considered as one of the most important factors of integration decisions. Following Aggarwal (1999), who pointed out that technology is making globalization more feasible, we test *Trading Platform* and *Post-Trading* variables defined as sharing a common software and the same post-trading operator between stock exchange markets. In fact, the role of non-official electronic integration between international markets was confirmed by many authors (Van Cayseele and Wuyts, 2007; Nicolini, 2010). According to Schmiedel and Schonenberger (2005), the developments in information and communication technology have increased pressure for further consolidation of securities trading, clearing, custody and settlement on a global scale.

Finally, there are evidences in the literature about several other latent factors that may also determine the integration processes between stock exchange markets worldwide. Many scholars, studying the variables of financial integration, indicate the role of geographical and cultural variables among principal drivers of global economic integration (Guerin, 2006; Fridlund, 2005; García-Herrero and Wooldridge, 2007; Sinha and Pradhan, 2008).

Stock exchanges of the same geographic area can improve their external efficiency and pursue a growth strategy through regional financial integration partnerships. To confirm the role of regional integration, we use *Region* variable as the presence in the same cluster of three or more stock exchange markets from the same geographical region in order to control the cooperation between neighbouring regions. Geographical classification is done according to Table 1. We also introduce *Integration Openness* variable as index estimated yearly for each stock exchange market with other stock indexes from the sample, to measure the common degree of financial integration with other stock markets worldwide.

To conclude descriptive statistics for the above mentioned control variables are reported in Table 4. Data are reported separately for integrated and non-integrated stock exchanges.

In particular, integrated stock exchange markets demonstrate, especially, high difference in macroeconomic variables, financial regulation, development of stock exchange

Table 4: Descriptive statistics of variables

	Integrated Stock Exchange Markets						Non-Integrated Stock Exchange Markets					
	N	Mean	Median	St. Dev	1 Pctile	99 Pctile	N	Mean	Median	St. Dev	1 Pctile	99 Pctile
Union	114	0.921	0.271	1	1	1	568	0.695	0.461	1	0	1
Currency	114	0.456	0.500	0	0	1	568	0.120	0.325	0	0	0
TradeOpeness	114	0.746	0.341	0.654	0.543	0.949	568	0.734	0.567	0.585	0.448	0.770
GDP	114	2164851	4190465	388049	244645	1477840	568	1119647	1996884	350645	148010	1061033
Market Development	102	385.8	302.2	246.3	126.2	661.2	547	175.175	183.617	113.490	38.338	221.939
Market Value	102	103.431	93.912	91.935	23.85	143.16	547	45.620	56.842	24.770	7.970	58.468
Market Size	102	0.237	0.198	0.173	0.103	0.353	561	0.292	0.401	0.138	0.043	0.340
Turnover	102	123.7	85.8	117.8	63.4	159.6	547	63.753	55.724	49.776	25.079	86.857
RegulatoryQuality	86	1.305	0.421	1.4	1.15	1.61	394	0.791	0.797	0.880	0.055	1.555
Financial Regulation	114	0.877	0.330	1	1	1	568	0.364	0.482	0	0	1
Market Capitalization	104	3089399	14100000	447825	139676	1826025	556	621338	1438363	116103	34061	550930
Cross Agreement	114	0.219	0.416	0	0	0	568	0.109	0.312	0	0	0
Demutualization	114	0.860	0.349	1	1	1	568	0.435	0.496	0	0	1
Self-Listing	114	0.667	0.473	1	0	1	568	0.255	0.436	0	0	1
Shareholder	114	0.237	0.427	0	0	0	568	0.025	0.155	0	0	0
AcquisitionAttempt	114	0.228	0.421	0	0	0	568	0.030	0.171	0	0	0
AverageTraded	105	13656.5	28611.6	1828.1	418.8	8279.4	456	3167.709	7584.390	375.72	76.15	2523.395
Stocks	114	1173.561	1508.464	365	236	1861	566	828.000	2044.865	317	158	773
Bonds	91	2533.022	3378.570	1025	300	3657	488	2467.920	5782.323	277.5	59.5	1299.5
Listed Companies	114	1117.956	1484.760	331.5	191	1691	526	847.818	2095.858	317.5	175	759
Domestic Companies	112	344.563	731.930	34.5	8	199	510	542.265	889.452	198	16	579
Foreign Companies	114	899.711	1434.730	326.5	172	924	530	409.434	1952.951	76	15	295
Foreign Ratio	114	0.111	0.118	0.065	0.018	0.174	527	0.131	0.226	0.034	0.003953	0.175
Delisting	90	68.244	109.061	18	9	59	332	44.142	87.004	17	7.5	31
Trading Platfrom	114	0.570	0.497	1	0	1	568	0.174	0.380	0	0	0
Post Trading	114	0.535	0.501	1	0	1	568	0.248	0.432	0	0	0
Correlation	114	0.215	0.194	0.1675	0.084	0.291	551	0.198	0.194	0.159	0.067	0.299
Cluster	114	0.526	0.502	1	0	1	568	0.363	0.481	0	0	1

and trading activities. These observations highlight the findings of Hasan and Schmiedel (2004), indicating that deregulation, globalization, and technological developments have altered the business strategies of stock exchanges around the world.

4. Methodology

4.1 Correlation and Cluster Analysis

The analysis of possible drivers of integration between stock exchanges has been conducted using different methodologies. The application of various methods should ensure the robustness of results. Following Longin and Solnik (1995), Hassan and Naka (1996), Karolyi and Stulz (2001), Walti (2006), Schindler and Voronkova (2010), correlation analysis has been adopted to investigate the presence of similarities in the performances of different stock markets (Table 3). The correlation coefficient is widely used as a measure of co-movements between different stock returns in a given time period, and is widely exploited by the literature too. According to the Pearson product-moment correlation coefficient, the correlation index has been calculated by dividing the covariance of two index returns by the product of their standard deviations:

$$\rho_{X,Y} = corr(X,Y) = \frac{\mathrm{cov}(X,Y)}{\sigma_X * \sigma_Y} = \frac{E\left[(X-\mu_X)(Y-\mu_Y)\right]}{\sigma_X * \sigma_Y} \tag{2}$$

where E is the expected value operator, *cov* means covariance and *corr* is a widely used alternative notation for Pearson's correlation. From the time series of weekly index returns of stock exchange markets from 1995 to 2010, the annual values of the average correlation will be used as a measure of integration within stock markets worldwide.

If correlation can be seen as a pre-condition of integration, a more robust methodology has been applied by a cluster analysis. This type of analysis is also widely exploited by the literature, investigating the interdependence of global equity markets (Hooper et al., 1999, Sorensen and Gutiérrez, 2006, Hooy and Goh, 2009; Bastos and Caiado, 2009). Cluster analysis can show the presence of integration trend between analysed stock market returns by the reduction of the total number of clusters and by the increase of the total number of cluster groups. In particular, *k*-medoid was employed as a classical partitioning technique of clustering that clusters the data set of n objects into k clusters known a priori. Thus, the number of clusters k is based on certain specific distance measurements (silhouette width), running diagnostic checks for determining the optimal number of clusters in the data set.

Given a set of observations $(x_1, x_2, \ldots, x_n)$, where each observation is a d-dimensional real vector, k-means clustering aims to partition the n observations into k sets ($k \leq n$) $S = \{S_1, S_2, \ldots, S_k\}$ so as to minimize the within-cluster sum of squares:

$$\mathrm{argmin}_s \sum_{i=1}^{k} \sum_{xj \in Si} \| x_j - \mu_i \|^2 \tag{3}$$

where μ_i is the mean of points in S_i.

The choice of correlation and cluster methodology is based on the fact that these techniques can indicate the presence of common integration trend between all analyzed stock exchange markets. We assume that high correlation coefficients between the international indexes show the degree of increasing integration within stock exchange markets; however, the low number of successful integration projects in recent years can indicate the presence of other relevant determinants in order to conclude the fusion.

4.2 Johansen Cointegration Test

Following Bessler and Yang (2003) and Kasibhatla et al., (2006), the Johansen cointegration methodology is employed to test the cointegration processes between integrated stock markets from Table 4. The Johansen cointegration test is applied to capture the cointegrating relationships among the selected stock exchange markets and to identify a number of cointegrating vectors via its test statistics. The Johansen test methodology is used to estimate the multilateral long-run equilibrium relationship among the stock exchange market indices of integrated stock exchange markets. In particular, the Johansen cointegration test can indicate whether all integration projects had cointegrated markets before the fusion or it is possible to identify other possible determinants of stock exchange mergers. The main research hypothesis assumes that if there are no cointegrating vectors among integrated stock markets or there is no long-run equilibrium relationship, it suggests the presence of other latent determinants, which will be investigated via multivariable logit regression.

The Johansen process is a maximum likelihood method that determines the number of cointegrating vectors in a non-stationary time series Vector Autoregression (VAR) with restrictions imposed, known as a vector error correction model (VEC). Having a set of g variables ($g \geq 2$) which are integrated of first order I(1) and thought to be cointegrated, a VAR model with k lags containing these variables could be set up:

$$y_t=\beta_1 y_{t-1}+ \beta_2 y_{t-2}+\ldots.+ \beta_k y_{t-k}+u_t \quad (4)$$

For Johansen test to be used, the above VAR needs to be transformed into a vector error correction model (VECM) of the following form:

$$\Delta y_{t=}\Pi y_{t-k}+ \Pi\beta_1 \Delta y_{t-1}+ \Gamma\beta_2 \Delta y_{t-2}+\ldots.+\Gamma_{k-1}\Delta y_{t-(k-1)}+u_t \quad (5)$$

This VAR model contains ‘g’ variables and ‘k–1’ lags of the dependent variables (differences), with a Γ coefficient matrix. As the Johansen test can be affected by the lag length, the lag length (11) was selected. Moreover, there are two test statistics for cointegration under Johansen methodology: trace statistic (λtrace) and the Max-Eigenvalue statistic (λmax). λtrace is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to ‘r’ against the alternative hypothesis that there are more than r. Max-Eigen test statistics is used to check for existence of a co-integrating rank of 0 or 1 is compared against the corresponding critical values at 5 percent. Max-Eigen test statistics is formulated in the following way:

$$\lambda max(r,r+1) = -T\ln(1- \lambda r+1) \quad (6)$$

where r is the number of cointegrating vectors under the null hypothesis (r=0, 1, k-1), k represents number of variables in the system, T is number of observations, and λ is the estimated value for the i^{th} ordered eigenvalue (characteristic root) obtained from the estimated Π matrix. λmax conducts separate tests on every eigenvalue and the null hypothesis is that the number of cointegrating vectors is less is 'r' against the alternative hypothesis that there are 'r + 1'. If the test statistic is greater than the critical value from Johansen's tables, the null hypothesis that there are 'r' cointegrating vectors is rejected against the alternative hypothesis that there are more than r (for λtrace) or that there are r + 1 (for λmax).

4.3 Multivariable Logit Model

Regression analysis is the last methodology applied to investigate the drivers of stock market integration. The dichotomous nature of the dependent variable suggested using a multivariable logit regression analysis. The logit model is a widely accepted tool in early warning modelling to evaluate explanatory contribution of each independent variable. Following Panchenko and Vu (2009), Christiansen and Ranaldo (2009), Lin and Cheng (2008), multivariable logit regression is used to test the statistical significance of set of variables presented in Table 3. Following the research aim, interested in the determinants that drive stock market integration, the dependent binary variable Y is lagged (t-3), and it associated with 1, if stock market was integrated and zero otherwise. The lag length for the lagged dependent variables is 3 years before the integration.

The following logistic regression is used to verify the drivers of stock exchange integration:

$$P_{jt}(Y=1|X_1, X_2, \ldots X_k)=1/(1+\exp(-(\beta_0 + \beta_1 X_1, jt + \beta_2 X_2, jt + \ldots + \beta_k X_k, jt))) \quad (7)$$

where Pr(Y=1) is the probability of integration for stock market j at the end of year t, exp is the exponential function, β_1, $\beta_2 \ldots \beta_k$ are the slope coefficients, X_1, $X_2 \ldots X_k$ are the explanatory variables.

5. Empirical results

5.1 Correlation and Cluster Analysis

Results from correlation and cluster analysis are reported in Table 5. Time series of weekly index returns have been estimated annually from 1995 to 2010. The values of correlation index report the average of correlation indexes between the performances of all analysed markets. Correlation is used as a first measure of integration under the hypothesis that high level of integration between stock markets can be detected by an increasing

correlation trend between stock exchanges indexes. Meanwhile cluster analysis is assumed under the hypothesis that with higher level of integration, the number of optimal clusters will decrease by the time.

Table 5: Results of correlation and cluster analysis

	Correlation	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Market 0.156	0.159	0.288	0.335	0.161	0.302	0.319	0.324	0.301	0.473	0.371	0.509	0.517	0.656	0.599	0.630	
North America and Canada	Nasdaq	1	**1**	**1**	**1**	**1**	1	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Nyse	2	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
	Toronto Stock Exchange	3	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**1**	**1**
Latin America	Sao Paulo Stock Exchange	4	3	2	2	2	**3**	3	3	3	2	2	**3**	3	3	**1**	2
	Buenos Aires Stock Exchange	5	4	3	**3**	3	**3**	4	4	4	3	3	**3**	**2**	**4**	**1**	3
	Colombia Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	**5**	5	5	**1**	4	**4**	4	5	2	4
	Mexican Stock Exchange	6	5	4	**3**	4	4	6	6	6	**1**	5	**4**	**1**	6	3	**1**
	Santiago Stock Exchange	n/a	**6**	**5**	4	5	5	7	**7**	7	4	6	**4**	5	7	4	5
	Lima Stock Exchange	**7**	7	6	5	**6**	**7**	**5**	**7**	**2**	5	7	**4**	6	**4**	5	**1**
Oceania and Asia	New Zealand Stock Exchange	8	8	**7**	**6**	**6**	**7**	**8**	**2**	**2**	6	8	5	**7**	8	6	6
	Australian Securities Exchange	9	**2**	**7**	**6**	**6**	**7**	**8**	**2**	**2**	**7**	**1**	**1**	8	**2**	7	**1**
	Shenzhen Stock Exchange	10	9	8	7	7	8	9	8	8	8	9	6	9	9	8	7
	Hong Kong Stock Exchange	11	10	9	8	8	9	10	**2**	**9**	9	**10**	**1**	**7**	10	**9**	**8**
	National Stock Exchange of India	12	11	10	9	9	10	11	9	10	10	11	7	10	11	10	9
	Jakarta Stock Exchange	13	12	11	10	10	11	12	10	11	11	12	8	11	12	11	**8**
	Tokio Stock Exchange	14	13	12	11	11	12	13	11	12	12	**1**	**1**	**1**	**1**	**9**	**8**
	Singapore Stock Exchange	n/a	n/a	n/a	n/a	**12**	**7**	**8**	**2**	**9**	**13**	**13**	**1**	**7**	**10**	**9**	**8**
	Korea Stock Exchange	**7**	14	13	12	13	13	14	12	13	**14**	**14**	9	12	**10**	12	**8**
Africa and Middle East	Egypt Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**15**	**15**	10	13	13	13	9
	Saudi Stock Exchange	n/a	n/a	n/a	n/a	n/a	**7**	**5**	7	14	**16**	16	11	14	**2**	**1**	**1**
	Johannesburg Stock Exchange	n/a	15	14	13	14	14	15	13	15	17	17	12	15	14	14	10
	Tel Aviv Stock Exchange	n/a	16	15	**1**	**12**	15	**2**	14	16	18	18	13	16	**1**	**1**	**1**

Western Europe	Euronext	n/a	n/a	n/a	n/a	n/a	**16**	**16**	**15**	**17**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	Brussels Stock Exchange	**15**	**17**	**16**	**14**	**15**	**16**	**16**	**15**	**17**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	Paris Stock Exchange	n/a	**18**	17	**15**	**15**	**16**	**16**	**15**	**17**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	Amsterdam Stock Exchange	**15**	**6**	18	**15**	**15**	**16**	**16**	**15**	**17**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	Lisbon Stock Exchange	16	**6**	19	**14**	16	**3**	**17**	16	**2**	**13**	**10**	**1**	**2**	4	**7**	**11**
	Frankfurt Stock Exchange	**15**	**6**	**5**	**1**	**12**	**16**	**8**	**2**	**2**	**13**	**13**	**3**	**2**	**2**	**7**	**12**
	Vienna Stock Exchange	17	**6**	**16**	**14**	**15**	**7**	**8**	7	**2**	**7**	**14**	**15**	**2**	**2**	**7**	**11**
	Swiss Stock Exchange	18	**6**	**5**	**14**	**15**	**16**	**17**	**15**	**2**	**13**	**13**	**3**	**2**	**2**	**7**	**12**
	Italian Stock Exchange	19	n/a	n/a	**14**	**15**	**16**	**16**	**15**	**17**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	London Stock Exchange	20	**2**	**16**	16	17	**16**	**16**	**15**	**17**	**13**	**13**	**1**	**2**	**2**	**7**	**1**
	Irish Stock Exchange	n/a	n/a	n/a	**1**	**15**	**7**	**2**	17	**1**	**14**	**13**	**14**	**2**	**2**	**7**	**11**
	Luxembourg Stock Exchange	n/a	n/a	n/a	n/a	**12**	**16**	**8**	18	**2**	**13**	**13**	**14**	**2**	**2**	**7**	**11**
	Athens Stock Exchange	21	**1**	20	17	18	**17**	18	19	18	**15**	**13**	**14**	**2**	10	**7**	13
	Madrid Stock Exchange	22	**18**	**21**	**15**	**15**	**3**	**17**	**20**	**19**	**7**	**10**	**3**	**17**	**4**	**15**	**14**
	Barcelona Stock Exchange	n/a	n/a	n/a	**1**	**12**	**3**	**17**	**20**	**19**	**7**	**10**	**3**	**17**	**4**	**15**	**14**
	Valencia Stock Exchange	22	**18**	**21**	**15**	**15**	**3**	**17**	**20**	**19**	**7**	**10**	**3**	**17**	**4**	**15**	**14**
	Bilbao Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	**17**	**20**	**19**	**7**	**10**	**3**	**17**	**4**	**15**	**14**
Northern Europe	OmxNordic Stock Exchange	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**21**	**20**	**13**	**15**	**14**	**2**	**2**	**15**	**12**
	Stockholm Stock Exchange	23	**17**	**22**	**14**	**15**	**16**	**16**	**21**	**20**	**13**	**15**	**14**	**2**	**2**	**7**	**12**
	Helsinki Stock Exchange	24	**17**	**22**	**14**	19	**17**	19	**21**	**20**	**13**	**15**	**14**	**2**	**2**	**7**	**12**
	Copenhagen Stock Exchange	**15**	**6**	**16**	**1**	**12**	**16**	**2**	**15**	**2**	**13**	**15**	**3**	**2**	**2**	**7**	**12**
	Oslo Stock Exchange	**15**	**6**	23	18	20	18	**8**	22	21	**7**	**14**	**15**	**2**	**2**	**7**	**12**
Eastern Europe	Prague Stock Exchange	25	19	24	19	21	19	20	23	22	19	16	**15**	**2**	**6**	16	**11**
	Warsaw Stock Exchange	26	20	25	20	22	20	21	24	23	20	17	16	18	**6**	17	15
	Russian Stock Exchange	27	21	26	21	23	21	22	25	24	21	18	17	17	15	18	**12**
	Budapest Stock Exchange	n/a	n/a	n/a	22	24	22	23	26	25	22	19	18	**7**	**6**	19	16
	Total Clusters	**27**	**21**	**26**	**22**	**24**	**22**	**23**	**26**	**25**	**22**	**19**	**18**	**18**	**15**	**19**	**16**

First, the results of correlation analysis from Table 5 demonstrate the presence of increasing integration trend among the returns of stock exchange markets worldwide during the last sixteen years. In particular, the degree of association from (0.156) in 1995 has increased significantly to (0.63) in 2010. These findings confirm the trend of common globalization among international financial markets after 2000.

Second, results of cluster analysis highlight the presence of integration trend between analyzed stock market returns and within single geographical regions like Europe and North America even since 1995. Moreover, the globalization within stock exchange markets is growing faster, especially, in last five years. It means that stock exchange indexes worldwide tend to cluster together, especially, in recent years. In fact, the number of total clusters from our sample is reduced from 27 in 1995 to 16 in 2010. Moreover, the findings highlight a strong integration trend within European stock exchange markets even before the creation of Economic and Monetary Union (EMU), which had enormous influence on economic linkages between European financial markets. Furthermore, there is a strong relationship within North American stock markets, meanwhile, stock exchange markets from Asia, Africa and Middle East seem to be less affected by common financial integration.

Finally, the results of correlation and cluster analysis confirm a stable market trend toward an integration. If these two methodologies confirm that integration in the stock market exists, results from other research methods will analyze the determinants of this process.

5.2 Johansen Cointegration Test

Johansen multilateral analysis was applied to all the integrated stock exchanges of the sample in order to check the presence of multilateral long run equilibrium relationship among the stock market indices. Max-Eigen test statistics for the existence of a co-integrating rank of 0 or 1 were compared against the corresponding critical values at 5 percent. If the calculated test statistics exceed the critical values at 5 percent, the null hypothesis of no co-integrating vectors ($r = 0$) is rejected and the variables are determined to be co-integrated. Table 6 summarizes the results of the Johansen cointegration test.

Results for the Euronext project show that there was not cointegration relationship between the involved markets. In fact, Johansen cointegration test statistic (16.56)is lower than 5 percent criticalvalue (27.58), so the null hypothesis of $r = 0$ cannot be rejected. These findings suggest that the merger was driven by harmonization factors of European financial markets without the long-runrelationships between the analyzed markets.

In case of the Spanish Stock Exchange markets, Johansen cointegration test statistic (35.72) is higher than the 5 percent critical value (27.58). Thus, the null hypothesis of $r = 0$ can be rejected. However, there is no long run relationship between Spanish Stock Exchange markets prior to February 2002 as we cannot reject $r=1$. Thereby, we can conclude that integration initiative was a response of Spanish markets to the new international

Table 6: Johansen cointegration test results

Stock Exchange Markets	Integration Project	Hypothesised Number of Cointegrated Equations	Max-Eigen Value	0.05 Critical Value	Prob.**	Number of Cointegrating Equations
Amsterdam Stock Exchange, Brussels Stock Exchange, Paris Stock Exchange, Lisbon Stock Exchange	EURONEXT	None	16.56373	27.58434	0.6175	0
		At most 1	9.879367	21.13162	0.7559	
Madrid Stock Exchange, Barcelona Stock Exchange, Bilbao Stock Exchange Valencia Stock Exchange	BME	None	35.72712	27.58434	0.0036	1
		At most 1	20.34675	21.13162	0.0641	
Stockholm Stock Exchange, Helsinki Stock Exchange, Copenhagen Stock Exchange Oslo Stock Exchange	OMX	None	27.46436	27.58434	0.0518	0
		At most 1	5.301384	21.13162	0.9931	
London Stock Exchange Italian Stock Exchange	LSE-BORSA ITALIANA	None	14.92656	14.26460	0.0392	1
		At most 1	2.372779	3.841466	0.1235	
NYSE Euronext	NYSE EURONEXT	None	175.3156	14.26460	175.3156	1
		At most 1	0.419516	3.841466	0.419516	
Nasdaq OMX	NASDAQ OMX GROUP	None	76.11980	14.26460	0.0000	1
		At most 1	0.003225	3.841466	0.9530	
Vienna Stock Exchange Prague Stock Exchange Budapest Stock Exchange Ljubljana Stock Exchange	CEE GROUP	None	250.1157	21.13162	0.0001	1**
		At most 1	217.9086	14.26460	0.0001	
Bolsa de Valores de Colombia, Lima Stock Exchange, Santiago Stock Exchange	MILVA	None	219.0081	21.13162	0.0001	1**
		At most 1	113.1609	14.26460	0.0001	

financial settings after the creation of Euronext project more than a decision based on the cointegration of the Spanish stock exchanges (Madrid, Barcelona, Valencia and Bilbao).

Results from the OMX project suggest the absence of any long-runrelationships between the involve markets as we cannot rejectthe null hypothesis of r = 0. This results show that OMX merger was driven by other factors than stock exchange integration. The strategic role that technology had in the project and the attempts of hostile takeover could have done the main drivers of integrations.

Furthermore, London Stock Exchange and BorsaItalianashow one cointegration equation between their market indexes at 5 of level of significance. However, we cannot confirm the long run relationship between these markets. The timing of this project, born after the Euronext and OMX project, support the hypothesis that the merger between BorsaItaliana and the London Stock Exchange was part of a defensive strategy in a new scenario featured by an increased competition between stock exchanges and different attempts of hostile takeover.

Analyzing NYSE and Euronext stock market indexes, Max-Eigen statistics confirm one cointegration equation between the indices with values (175.31) higher than the 5 percent criticalvalue (15.49). However, there is no existence of long run relationship between these markets. Consequently, the findings confirm that themerger was the first and the most ambitious attempt to form intercontinental cross-border exchange consolidation without long-lasting cointegration between two markets.

Similar results were obtained for NASDAQ and OMX stock exchange markets. Table 6 showsthe existence of one cointegration equation between the markets (the r=0 hypothesis must be rejected). However, the findings do not show the long run relationship before the merger. The fact that the NASDAQ bids for the OMX Group only after the failed attempt to acquire the London Stock Exchange, suggests that the integration process was driven different reasons than the correlation between their market performances.

Testing the null hypothesis of at most one cointegrating vectors for CEE GROUP stock market, the test statistic is higher for both r=0 and r=1 hypotheses with the 5 percent critical values. It means that a strong multilateral long run equilibrium between integrated markets exists. A close cooperation between neighboring countries had resulted in the closer integration of their financial markets.

The same results were obtained for Latin American stock markets, which are part of MILVA project (Chile, Peru and Colombia). The Max-Eigen statistics indicate the presence of more than one cointegrating vector among their indexes.

Summary results for the Johansen multilateral cointegration analysis indicates that not all integration projects held the long-runrelationships between their stock exchange markets before the merger. If the presence of a full cointegration in terms of long run equilibrium for most of the projects was not conclusive in order to explain the behavior of stock exchanges in their integration process, results from the regression analysis are needed.

5.3 Multivariable Logit Model

This section provides the results from the logit regression model reported in Section 3.3. The dependent variable is a three years lagged dummy variable, equal to one if a stock exchange is engaged in an integration project at time "t", and zero otherwise. The explanatory variables are measured annually from 1995 to 2010.

To check the collinearity among selected variablesthe correlation analysis between all potential variables was applied before logit regression modeling. Moreover, to assess the robustness of the findings and with the purpose to maximize the sample size, six different specifications have been estimated starting from Column 1 with a macroeconomic model which includes only basic country characteristics available for the full set of selected stock exchange markets. Next, in Column 2, we re-estimate the model with a measure of regulatory variables. We then, progressively, add variables referring to structural stock exchange characteristics in Column 3 and in Column 4. In Column 5 we control for trading variables associated with stock exchanges' performance. The final specification reported in Column 6 control for most important variables. The final results are presented in Table 7.

Table 7: Determinants of International Stock Exchange Integration - Logit Model

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Regression Analysis						
Union	1.507***	0.566	0.845	0.753	0.234	1.123
	(0.526)	(0.579)	(0.651)	(0.781)	(0.733)	(1.019)
Currency	0.398	-0.578	-1.002*	-0.188	-0.565	-0.355
	(0.371)	(0.468)	(0.570)	(0.674)	(0.650)	(0.771)
TradeOpeness	0.378	-0.110	-0.446	-0.502	-0.913	0.741
	(0.335)	(0.511)	(0.611)	(0.960)	(0.864)	(1.230)
GDP	-0.001	-0.001	-0.001	-0.001***	0.001	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market Development	0.002***	0.001	0.001	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Market Value	0.011***	0.003	0.001	-0.007	-0.001	-0.009
	(0.003)	(0.005)	(0.005)	(0.007)	(0.008)	(0.009)
Market Size	-2.913***	-4.868***	-5.607***	-9.378***	-6.241**	-10.051***
	(0.879)	(1.373)	(1.773)	(3.553)	(2.951)	(3.432)
Turnover	-0.003	-0.002	-0.004	0.003	-0.001	0.013
	(0.004)	(0.005)	(0.005)	(0.007)	(0.007)	(0.011)
RegulationQuality		1.399***	1.495***	1.610**	1.937***	2.351***
		(0.429)	(0.480)	(0.700)	(0.677)	(0.809)
Financial Regulation		0.017	0.180	-0.320	-0.739	-0.751
		(0.512)	(0.544)	(0.650)	(0.675)	(0.857)
Market Capitalization			0.001	0.001***	0.001	0.001**
			(0.001)	(0.001)	(0.001)	(0.001)
Cross-Membership			1.079*	1.633**	0.574	1.923**
			(0.563)	(0.690)	(0.637)	(0.775)

Demutualization			1.896***	2.132***	1.397**	1.406*
			(0.564)	(0.745)	(0.626)	(0.838)
Self-Listing		1.400***				
		(0.369)				
Shareholder			(0.564)	(0.745)	(0.626)	(0.838)
			0.054	-0.620	0.561	-1.166
Acquisitionattempt			(0.690)	(0.942)	(0.833)	(1.044)
			0.063	0.879	0.026	0.104
AverageTraded				0.001**		0.001
				(0.001)		(0.001)
Equity				-0.001		-0.002
				(0.003)		(0.036)
Bond				-0.001		-0.001*
				(0.001)		(0.001)
Listed Companies				0.001	0.003	0.002
				(0.003)	(0.003)	(0.018)
Foreign					-0.003	0.001
					(0.002)	(0.018)
Domestic					-0.005*	-0.007
					(0.003)	(0.019)
Foreign Ratio					-2.424	-3.185
					(2.351)	(2.944)
Delisting					0.007	
					(0.006)	
Trading Platform						0.525
						(0.732)
Post Trading						-1.431
						(0.908)
Integration Openness						7.525***
						(2.715)
Region						-0.019
						(0.545)
Constant	-4.210***	-3.924***	-4.616***	-3.957***	-2.928***	-6.010***
	(0.576)	(0.652)	(0.831)	(1.048)	(0.869)	(1.696)
Observations	649	468	459	348	305	331
Pseudo R2	0.164	0.197	0.241	0.303	0.253	0.416

Panel B: Model Performance and Integration Probability

Correctlyclassified	89.98%89.32%90.41%90.52%87.21%90.63%
Pr average (integration)	20.8%21.7%24.6%30.1%29.5%41.4%
Pr average (non-integration)	8.5%8.7%7.9%7.8% 10%6.9%

*** p<0.01,** p<0.05, * p<0.1

Overall, this analysis suggests that several characteristics are strong predictors of the likelihood to conclude an integration projects during the period of 1995-2010. Specifically, in all models this probability increases with Regulation Quality, Cross-membership agreement, Demutualization and the degree of Integration Openness while it decreases for big stock exchange markets in terms of Market Size and systematic risk.

In terms of macroeconomic characteristics, Column 1 shows that Union, Market Development and Market Size variables appear strong predictors of the likelihood to participate in stock exchange projects. In particular, the probability increases with participation in trade or political union and high stock market capitalization in terms of GDP. However, these variables are significant only in first model. In fact, Model 7 suggests that significant GDP level and systemic size of stock market decrease the probability of integration. Furthermore, this finding confirms the failed merger between NYSE Euronext and Deutsche Börse due to their market sizes, where the European Commission has blocked the deal to prevent a near-monopoly in European financial markets.[1]

Second, in terms of regulation variables we observe that Regulation Quality in terms of legislative changes and government ability to formulate and implement sound policies to promote financial development, increase the probability of stock exchange integration (Wellons, 1998; Di Giorgio and Di Noia, 2003). Moreover, implementation of common financial regulation implies the presence of trade or political union and high economic characteristics of analysed countries. In fact, regulation variables are highly correlated with macroeconomic variables that lose their significance starting from Model 2.

Next, among structural stock exchange characteristics, the results confirm the presence of Cross-Membership agreement as an initial step towards the consolidation and the role of Demutualization process of the stock exchanges into for-profit corporations. Meanwhile Market Capitalization demonstrated very low contribution to stock exchange integration. Finally, Self-Listing provides an important contribution to the likelihood,however, this variable is highly associated with Demutualization. In fact, stock exchange markets after the organizational transformation perform better than their non-listed counterparts, and self-listed exchanges are seeking the profit and may be interested in integration projects (Otchere, 2006; 2007; Otchere and Abou-Zied, 2008).

Furthermore, among the variables of stock exchange business performance, the Average Amount Traded per day seems to be a significant determinant of integration, however, however, it shows very low contribution. Meanwhile, the high number of domestic listed companies is negatively related to the integration likelihood. In fact, high concentration of domestic shares confirms the lack of stock market openness towards the international cross-listing.

In terms of operative forces, the results of regression analysis do not confirm the role of Trading Platform and Post-Trading Operator as significant variables in terms of probability.

[1] http://europa.eu/rapid/press-release_SPEECH-12-52_en.htm

Finally, integration openness measured in terms of correlation analysis is an important driver of stock exchange projects. In fact, according to Tam and Tam (2012) market integration manifests in the convergence of stock ratios in the long run, driven by common global factors across markets.

To investigate the probability of stock exchange integration for each key variable, Table 8 reports the values estimated for explanatory variables (Market Size, Regulation Quality, Cross-Membership, Demutualization and Integration Openness), when the remaining variables are fixed at their average. The calculation is based on the final model presented in Column 6.

Table 8: Probability of Stock Exchange Integration

	(1)	(2)
	Probability of Integration: 10^{th} percentile (%)	Probability of Integration: 90^{th} percentile (%)
Market Size	3.96	0.001
RegulationQuality	0.013	1.627
Cross-Membership	0.2	1.378
Demutualization	0.117	0.476
Integration Openness	0.044	2.073

The results show that in terms of contribution to the probability of stock exchange merger, quality of financial regulation appears the key variable: when the sample size increases from the 10^{th} to the 90^{th}. Furthermore, integration openness providesan important impact on the likelihood due to the fact that the consolidation process has stepped over national frontiers and continents. Next, Cross-Membership agreements and for-profit corporate structure in terms of Demutualization contribute significantly to the likelihood of successful merger. Finally, there is a higher probability of integration for medium and small stock markets than for big ones, where Regulator cannot block the fusion in terms of competition.

To conclude interaction between Market Size and Regulation Quality on the probability was estimated for different levels of Market Size and Regulation Quality, which were identified by values equal to the 10^{th} percentile, the mean and the 90^{th} percentile of the sample distribution, and plotted on probability. Notably this effect was estimated only for demutualized stock markets. The main results are in Figures 1.

Figure 1: The impact of Regulation Quality on probability of stock market integration for different levels of Market Size

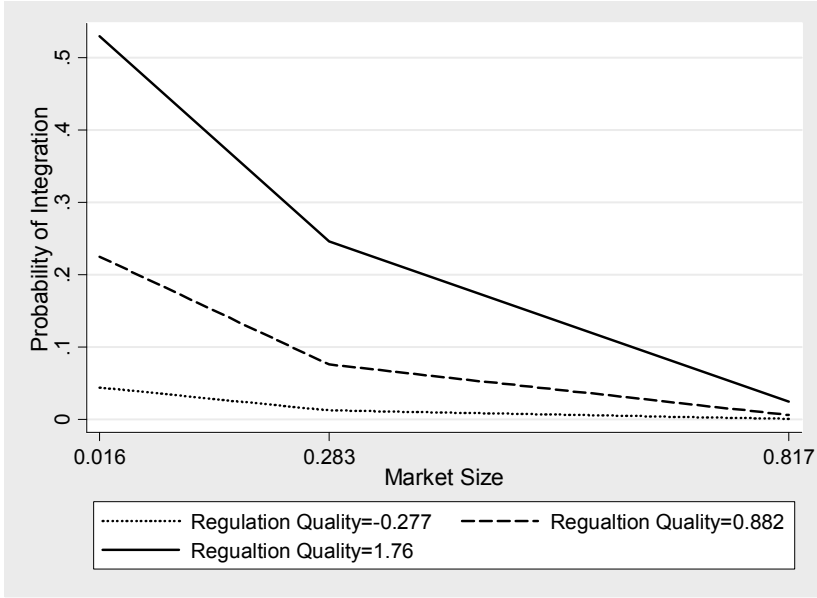

Figure 1 confirms that being a large stock exchange market substantially decreases the chances of stock exchange integration. The extremely large markets maintain a much higher systemic risk and attract the attention of Regulators in terms of competition. Thus, the probability of integration is higher for smaller markets. Furthermore, high Regulation Quality to implement sound policies and to promote financial development, increases, significantly, the likelihood of successful merger.

In spite of the size and regulation, the probability of integration was checked in Figure 2 with the presence of Cross-Membership Agreement and Integration Openness. Values of Integration Openness and Cross-Membership Agreement equal to the 10^{th} percentile, the mean and the 90^{th} percentile of the sample distribution were plotted on probability for demutualized stock markets.

Figure 2: The impact of Cross-Membership on probability of stock market integration for different levels of Integration Openness

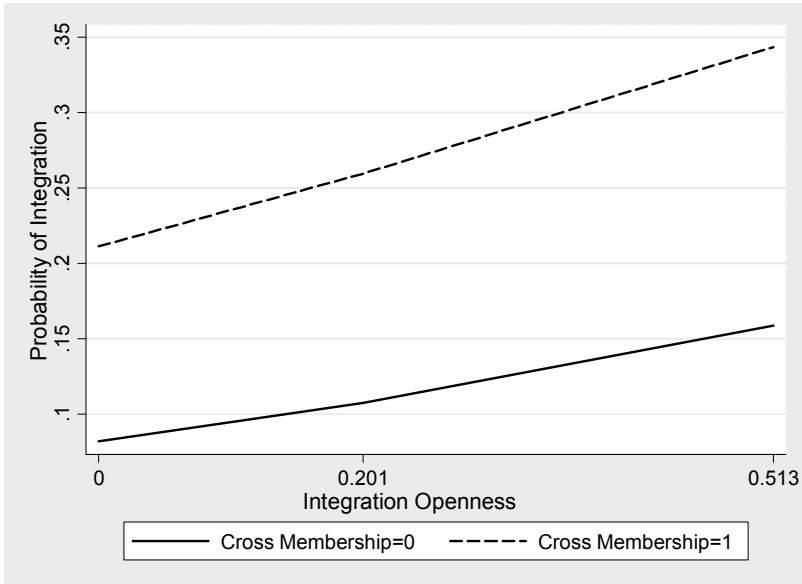

Figure 2 demonstrates that the probability to be integrated is increasing for stock markets that have cross-trading agreements and are highly integrated in global trading activity.

The results discussed in this section offer a clear support to the growing regulatory attention on stock exchange business and on the need to impose more stringent requirements to decrease the risk of financial contagion, that are generally in line with previous findings reported in the literature.

Conclusions

This paper analysed the determinants of stock exchange integration in an international perspective, adopting a multistage statistical data analysis, based on annual panel data of 43 stock exchanges from 1995 to 2010. Results confirm the complexity of the integration processes, and how it depends by different macroeconomic, structural, cultural-geographical and operative forces.

Furthermore, the integration phenomenon within the stock exchange markets worldwide has been analysed from different perspective. The results of correlation and cluster analysis confirm a trend of common globalization within international financial markets, measured by a growing values of correlation indexes and by a reducing numbers of clusters. Many stock markets show along-runrelationships between their returns; however,

the low numbers of successful integration projects with the long-run relationships suggest the presence of relevant drivers in order to conclude the merger between stock exchanges.

Results confirm the complexity of the integration processes, and how it depends by different macroeconomic, structural, cultural-geographical and operative forces. In particular, the results of correlation and cluster analysis confirm a trend of common globalization within international financial markets, measured by a growing values of correlation indexes and by a reducing numbers of clusters. Many stock markets show a long-run relationship between their returns; however, the low numbers of successful integration projects with the long-run relationships suggest the presence of relevant drivers in order to conclude the merger between stock exchanges. Results from a multivariable logit regression analysis are consistent with previous studies. The explanatory power of different variables that have been supposed to be relevant on a theoretical basis by previous studies is confirmed by empirical evidence. Meantime, the findings demonstrate that financial harmonization, cross-membership agreements, for-profit corporate structure and integration openness are important drivers of stock exchange fusion. By contrast, a large size of stock exchange market has a negative impact on the likelihood of successful merger.

Results from this study can be useful for policy makers, regulatory authorities and stock exchanges in their responsibilities on market supervision and the evaluation M&As of strategies. In particular, the existence of de jure stock market integration projects suggests designing a special regulatory framework in order to benefit from important consequences of an integration and to decrease the risk of financial contagion.

Finally, in the current regulatory environment, the growing strategy through mergers and acquisitions becomes very difficult for big stock exchanges markets, meanwhile possible co-operation and partnership agreements are still available solutions for large and small operators, where the large exchange operators can bring their reputation and trading technology, meanwhile the smaller markets can provide access to fast-growing and emerging markets.

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Public financial support to investments in rural areas: The case of the region of Thessaly in Greece

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Abstract

Greek governments have supported investments to rural areas financially either by covering part of the investment and/or offering advantages with respect to interest rate loans or tax advantages. This support had been tendered either by nationally financed programs, called Development Laws, or by other programs, mainly financed by the European Union. The financial support depended on the area where the investment took place, as well as the sector and the nature of the investment. Additionally, another program, the LEADER initiative, was developed. It was financed mainly by the European Union, in order to support investments in rural areas and promote the development and the structural adaptation of the less developed European regions.

This paper examines public financial support for investments in rural areas in the case of the region of Thessaly, one of the 13 regions in Greece. Its aim is to point out the importance of investments in the sectors of tourism, industry and agriculture. The region of Thessaly presents obvious interest because of the development of these sectors at different levels, depending on local production characteristics. The time period is the 2000s, when important investments were undertaken in the region, supported financially by Development Laws and the LEADER initiative.

Keywords: Financial support, investments, rural areas, Thessaly, Greece

JEL Classification: G32, H54, R51

1. Introduction

During the 1990s, Greek governments encouraged investments by partially financing them and/or offering other financial incentives with regard to the interest rate of loans or tax incentives. These initiatives were in the form of nationally financed programs and other programs, mainly financed by the European Union (EU).

National initiatives were defined by the so-called Development Laws (DL). In the 1990s, the first DL to be applied was 1892/1990; it was replaced by DL 2601/1998. Later,

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in the 2000s, two more DLs were applied, DL 3299/2004 and DL 3522/2006. This financial support for investments was applied to several sectors in almost all geographical regions of Greece. They primarily financed investments by supporting part of the total invested capital. The financial support depended on the geographic area, the sector and the type of investment. These initiatives did not focus exclusively on rural development.

Parallel to these financial support initiatives, a program financed mainly by the European Union was implemented to support investments in rural areas. This program, known by the acronym LEADER (Liaisons Entre Actions de Développement de l' Economie Rurale i.e. Links Between Actions for the Development of the Rural Economy), was an EU initiative to promote the development and the structural adaptation of the less developed European regions. The LEADER initiative was launched in 1991 as the LEADER I initiative for the period 1991-1994. In June 1994, the European Commission approved the LEADER II initiative for the time period 1994 to 2001. It was followed by the LEADER + initiative, which spanned 2002 to 2008. The LEADER initiatives were based on the active participation of the local population, particularly local companies, associations, cooperatives and local authorities (European Commission, 2000). Greek governments used the LEADER initiatives in their regional policy since they represented a substantial funding source for investments in the less developed rural areas of Greece.

The development of rural areas was the objective of all investment initiatives launched by the Greek state and supported by public finance. This support varied depending on the philosophy and the targets of the initiative. This paper examines public financial support for investments in rural areas, studying the case of Thessaly, one of the 13 regions in Greece. It examines the investments financed by public support respecting the different sectors, agriculture, industry and tourism, but also the various geographic areas of the region and the philosophy of public investment initiatives.

The time period is the 2000s, when important investments were undertaken in the region, supported financially by both national and EU programs, through Development Laws 2601/1998, 3299/2004, 3522/2006 and the LEADER + initiative. These investments influenced the region's production. A comparative analysis, between investments and production by sector and geographic area, is then offered. Production is examined by sector and prefecture in the region of Thessaly between 2000 and 2007 (last available data).

Following the introduction, previous studies are discussed in section 2. Section 3 presents the region of Thessaly through some macroeconomic aspects while section 4 presents the public investment initiatives. Section 5 discusses the results of the investments, including the impact on the region's production, by means of a sector and prefecture analysis. Finally, conclusions are presented in section 6.

2. Previous studies

With very few exceptions, development initiatives through public financing of investments, at least in Greece, have not been the object of scientific studies (contrary to studies focusing on private financing, see for example Arvanitis et al. (2012), the auto-

financing through activities' profits, see Silva (2011), or the mobilization of the local savings, see Bairamli et al. (2010). Karafolas (2007), examined the development initiatives for the case of the region of West Macedonia during the 1990s. He found that the LEADER II initiative has been the most appropriate program for the development of the rural area in this region. Emanuel and Papadopoulou (2004) described the general framework for the application of European programs in Greece. Georgiou (1999) examined the role of Community Support for Greece regarding the regional convergence during the early 1990s. The author concluded that allocation of funds was necessary in order to develop the regions of Greece which lie outside its two core regions, Athens and Thessaloniki. In this way, the intense regional inequalities between these two regions and the rest of Greece could be reduced. The author placed the region of Thessaly with the rest of Greece, in accordance with its development level and structural problems. Regarding the region of Thessaly in particular, only a few reports and business plans exist that offer interesting conclusions as far as the region's problems and opportunities, especially in the rural areas, are concerned. One of these points out some problems for the region's rural areas; among these are: migration to urban areas, ageing populations, the lack of job opportunities in rural areas (Region of Thessaly 2003). The same study points out the change in agricultural policy from a sectoral to a spatial approach; the latter could include the multi-activity in rural areas related to tourism. Thus agro-tourism activities could be exercised in addition to agricultural ones. These studies do not refer, however, to the main issue of this paper, the interest in public finance for the region's investments. When the question concerns specific funding programs, there appears to be an absence of references to national funding programs, such as the Development Laws, with the exception of Karafolas (2007). Notwithstanding, the LEADER initiatives have been examined in Greece and other countries as a financial instrument for rural development. In the case of Greece, a study on LEADER + showed that rural tourism was the sector most benefited, since it attracted the majority of investments (Karafolas, 2009). In the case of rural tourism, LEADER initiatives had a very positive impact on development by financing investments in the Wine Roads network in Greece (Karafolas, 2007a). A study based on a sample of 11 local action groups in Greece (Efstratoglou and Mavridou, 2003), concluded that LEADER II had had a positive impact on rural development. Another study, on rural coastal areas of the North and South Aegean (Loizou et al., 2010), found that the positive impact of the LEADER initiatives was limited because of its insufficient financial sources. The LEADER initiatives relating to agricultural policies were examined on an historic basis by Chatzitheodoridis et al. (2006).

3. The region of Thessaly

Thessaly is one of the 13 Greek regions. It lies in the heart of Greece and borders the regions of Central Macedonia, West Macedonia in the north, Epirus in the west, Central Greece in the south and the Aegean Sea in the east. Thessaly occupies almost 11% of the total Greek area. The region consists of four prefectures: Karditsa, Larisa, Magnesia and Trikala. In compliance with the new administrative reform, implemented in 2011, the

region is divided into 5 peripheral units, the four above plus a new unit consisting of the Sporades islands (Wikipedia, 2011). Be that as it may, the examined programs have been applied under the old administrative formation of four prefectures. The region's population represented 6,8% of the total Greek population in 2011 (Table 1). The population break-down is 44% urban, 40% agrarian and 16% semi-urban, with the agrarian population declining while the semi-urban increases (Wikipedia, 2011).

Table 1: Macroeconomic data of prefectures of the region of Thessaly

	Population*		**GDP****		**Deposits*****	
		(%)	Meuros	(%)	Meuros	(%)
Larisa	284.420	2,6	4.049	1,9	3.782	1,6
Magnisia	203.540	1,9	3.447	1,6	2.744	1,2
Trikala	129.700	1,2	1.511	0,7	1.801	0,8
Karditsa	113.070	1,0	1.190	0,6	1.248	0,5
Thessaly	730.730	6,8	10.197	4,8	9.574	4,0
Greece	10.787.690	100,0	213.205	100,0	237.531	100,0

Source: Hellenic Statistic Authority (2011), Bank of Greece (2011), Epilogi (2010),

*Temporary data of census of 2011, ** Gross Domestic Product on 2006, *** Deposits end of 2009

The region produced on average 5,0% of the country's gross domestic product (GDP) during the period 2001-2007. This production ranked the region fourth among the 13 regions of Greece (Epilogi, 2010). The region accumulated 4% of deposits in Greece (Table 1). The income per capita in the region of Thessaly is somewhat lower than the national one, being 71,7% of the national average in 2007. Unemployment is higher than the national average, with 8,4% in 2008, against 7,7%, which was the national average (Epilogi, 2010). Within the region, one needs to distinguish the prefectures of Larissa and Magnesia, which are more densely populated (67% of the total population) and have the greater part of the region's GDP (73,5% of total GDP) from the prefectures of Karditsa and Trikala, which are less densely populated (33% of the total population) and have only 26,5% of the region's GDP (calculations from Table 1).

On a sectoral basis, at the beginning of the investigated period, 2000, Public Administration and Construction produced the greater part of Gross Value Added (GVA). Nevertheless, the GVA of agriculture was much higher in the region of Thessaly in comparison to the national average; agriculture offers 17% of the GVA in the region against only 7% for the country as a whole. The Agriculture GVA was higher in the prefectures of Karditsa and Larissa in comparison to the region's average; it was significant, but lower than the region's average, in the prefecture of Trikala. The prefecture of Magnesia is characterized more as an industrial and tourist area (calculations from Table 8). Rural areas in Thessaly faced problems such as migration to urban centers, mainly Larissa and Athens, the aging rural population, unemployment, the absence of job opportunities

and tight funding (Region of Thessaly, 2003). Additionally, rural areas in Thessaly, and generally in Greece, are influenced by multi-activity. Many farming families, in order to increase their agricultural income, resorted to other activities and occupations. Up until the 1980s, agricultural policies did not consider this eventuality. Multi-activity for the rural population began in the mid-1990s and any policy concerning rural areas should consider this likelihood. Subsequently, it was advocated, especially by Law 1257/1999 and the application of the LEADER initiatives (Region of Thessaly, 2003). As a result of these developments, populations that had migrated to urban areas could return to rural areas in search of occupation either in agricultural activities or in agro-tourism. Programs funding rural areas and regional development should focus on or at least take into consideration this contingency. Any policy should have an appropriate structure if it is to be applied successfully. Bontron (2003), working in France and Belgium, and Shucksmith (2000) and Mc Dowell (2003), working in the UK, concluded that the role of infrastructures in the application of development initiatives was of high importance; on infrastructures positive effect see also Adonat et al. (2011). Further, the governance of companies can play a very significant role (see Gstraunthaler et al. (2008) and Milos et al. (2008)).

In Greece, local authorities and collective schemes like agricultural cooperatives didn't accomplish their role; more often than not, they were manipulated by governments and political parties. This was the case not only in Thessaly but also throughout Greece (Patronis, 1999). European Union policies on agriculture and local development, in relation to the inefficiency of the Greek state to apply those policies, favoured the creation of intermediary entities to accomplish this task; these are mainly Local Development Agencies whose responsibility it was to apply and execute funding programs mainly in rural areas.

4. Public Programs financing development investments in Greece

4.1 Investment Laws 2601/1998, 3299/2004 and 3522/2006

Investment initiatives by the Greek state were applied through measures that determined the form of public financial support, as well as the region and sector where these initiatives would be applied. During the 1990s, these measures were defined by Development Law 1892/1990 for the period 1990-1998, and Development Law 2601/1998, which replaced the previous law, for the period 1999-2004 (Journal of Government, 1998). Law 2601/1998 was replaced by Law 3299/2004 (Journal of Government, 2004). Law 3299/2004 presented some differences from the previous law; the new law introduced the motif of grant for the creation of employment posts; it made no distinction between new and old investors as did the previous, thus offering more possibilities for grants; it expanded the grants to include new entrepreneurial activities; it focused on tourism and special investments; it offered more favorable arrangements for the allocation of grants (e.g., investing in leased land). On the other hand, it demanded a minimum amount for the investment and minimum self participation of 25%. Part of Law 3299/2004 has been modified by Law 3522/2006 in order to facilitate investments (Journal of Government

2006). Law 3522/2006 introduced a new regional aid map that divided the territory into 3 areas; the aid ceiling was 40%, applied to area C, the most benefited. The new law gave the opportunity for small and very small enterprises to receive additional grants, up to 10 and 20 units respectively. It also allowed the new grant scheme to be exploited by new small business and those that were in the first stage of development. Furthermore, it facilitated eligibility and the investment's checking process.

The three last laws were applied during the decade of 2000s. Financial support could either be a grant covering part of the investment, a subsidy on interest paid for loans related to the investment, or income tax allowances up to a certain percentage of the investment. Development laws divided Greece into geographic areas, for which different levels of grants were applied. Criteria were related to the current level of economic development in each area. According to Law 1892/1990, the level of grants for investments could vary from 15% to 45% of the investment's budget. Laws 3299/2004 and 3299/2006 aimed to attract investments higher than 100.000 euros in all sectors of the economy, especially in emerging ones, and applied across the entire country, focusing on small and medium enterprises (SMEs). For the application of the provisions of the law, Greece was divided into three zones, the first including the richest prefectures of Greece (such as Athens, the capital of Greece, and Thessaloniki), while the third zone incorporated the poorest ones. The whole region of Thessaly was placed in the second zone, which included the majority of prefectures; this zone was between the smallest and the biggest beneficiary regarding grants and tax allowances. Incentives for investment plans offered by zone and category of activity were divided into subsidies, grants and tax allowances. Grants for investment ranged from 15% to 40% of the investments, in relation to category and zone. Tax allowance ranged between 50% and 100%, depending on the category of activity and the geographic zone. The management and supervision of development laws was divided between the national level, exercised by the Ministry of National Economy, and the regional level, exercised by the regional and prefectural authorities.

All development laws applied during the 1980s, 1990s and 2000s have been objects of criticism on economic development, especially at regional levels. While economic growth in Greece was indisputable during this period, disparities were obvious between regions, especially between major urban areas (Athens and its peripheral areas, Thessaloniki) and other semi-urban areas (Ministry of Regional Development and Competitiveness, 2012).

4.2 The LEADER + initiative

Contrary to development laws that were applied with a top-down philosophy, the LEADER initiatives were characterized by a bottom-up philosophy. LEADER initiatives were drawn up from what regions, especially administrative districts, decided to develop; that could permit a more efficient application of the program since local needs are better knowing (to similar results on banking credit, arrived a study by Djedidi Kooili in the French case, 2012). The application of the LEADER + initiative in Greece adopted general EU rules targeting the development and the structural adaptation of the less developed

regions. Within these principal targets, the initiative had to contribute to economic and social cohesion, sustainable development, the growth of employment and environmental conservation. In Greece, the LEADER + initiative was applied to mountain regions (classified by the 75/268/CEE directive) and island regions, which are the least developed agricultural areas in Greece. The initiative could also be applied to other less developed neighboring regions if they had structural problems but showed development prospects; the initiative was applied to environmentally sensitive areas, such as NATURA 2000 (Ministry of Rural Development and Foods of Greece and European Union, 2006).

The national LEADER + initiative had 3 principal priority Axes. These were: Axe 1 "Pilot strategies for rural development", Axe 2 "Support for cooperation among rural areas" and Axe 3 "Clusters". Every axe was divided into measures that had been specified by several actions. A fourth axe concerned the program's management. The main measure (measure 1.2) aimed at interventions for rural tourism and small businesses in the rural sector. Investments through this measure rose to 236,4 million euros, corresponding to 64% of LEADER + investments. Another important target of this program was the conservation and promotion of the natural environment (measure 1.4.) Investments through this measure rose to 50,4 million euros, corresponding to 13,7% of LEADER + investments (Karafolas, 2009).

The LEADER + initiative was, first and foremost, public financing. This financing varied, covering from 55,5%, in the case of strong private participation, up to 100%, in the case of infrastructure projects. This public financing may be considered higher in comparison to that of LEADER II (Karafolas, 2007). The European Union, the principal finance source of LEADER +, contributed half of the total budget and benefactors covered 30,6%, while the Greek state contributed only 18,9% (Table 2).

Table 2: Financial source of LEADER + investments, by axe and measure (*)

	Amount (in Keuros)	**Part of EU (%)**	**Part of Greek state (%)**	**Part of Private share (%)**
Total	368.243	50,5	18,9	30,6
Axe 1	349.227	49,5	18,7	31,8
Measure 1.1.	53.491	74,3	24,8	1,0
Measure 1.2.	236.377	39,3	16,3	44,5
Measure 1.3.	8.956	61,0	20,3	18,6
Measure 1.4.	50.403	69,2	23,2	7,6
Axe 2	9.678	61,2	20,4	18,4
Axe 3	1.973	75,0	25,0	0,0
Axe 4	7.365	75,0	25,0	0,0

Source: Karafolas (2009)

* M.1.1. Technical support to L.A.G., M. 1.2. Investment subsidies-Support for Entrepreneurship, M. 1.3. Support measures, M. 1.4. Protection, Promotion and Exploitation of natural and Cultural Heritage.

Financial contribution was not homogenous. Measures related to private investments received a strong private contribution that rose to 44,5%, as in the case of Measure 1.2. Projects related mostly to infrastructure were funded mainly by the European Union and the Greek state (Table 2 and Karafolas, 2009).

The management and supervision of the LEADER + initiative at a national level was performed by the Ministry of Rural Development and Food. At a regional level, the management was assigned to Local Action Groups (LAG) consisting of local collective parties such as local government, unions, municipal enterprises, agricultural cooperatives and other social and professional bodies. Their legal status is normally that of a Limited Company, and is aimed at local rural development.

In the region of Thessaly, four Local Action Groups were formed in accordance with the priorities of the region and the prefectures. In the prefecture of Magnesia, a major marine tourism destination, the LEADER + initiative focused on the development of Mount Pelion and the initiative was managed by the Pelion Development Agency. The target was to attract investments in the locality of Mount Pelion and the North Sporades Islands, which, compared to the rest of the prefecture, are less developed rural areas. Similarly, in the biggest prefecture of the region, Larisa, the LAG was created in order to develop the rural area of Elassona (a small rural area), and Mount Kissavos (the Elassona – Kissavos Development Agency). Priority was given to keeping the local population in this area by increasing local development and exploiting local resources and potential. The two other LAGs also focused on rural mountain areas, the Karditsa Development Agency focusing on the mountain regions of Karditsa, Fthiotida and Southern Larissa, and the Kalampaka-Pyli Development Centre focusing on the mountain areas of Kalambaka and Pyli.

The LEADER + initiative was established on a regional basis with targets to be financed in relation to local needs and priorities. The application of the initiative was undertaken by the LAG's (as the four LAGs in the region of Thessaly). The LAGs then proceeded to call for expressions of interest, offering any possible help and information. They received, examined, evaluated and approved the submitted proposals (Larissa Prefecture Development Company 2012). The whole process meant that the decision makers were based locally and proceeded on the basis of local needs, which had already been defined before the application of the initiative.

Procedures regarding priorities, evaluation and application of programs are quite different in the case of national development laws. Decisions on the program's priorities, public funding, the evaluation process and the final approval of projects are decided centrally, usually by the Ministry of Finance and Economy and the Ministry for Development. Local authorities can only make proposals, mainly with reference to grants; the final decision remains the privilege of the national authorities. Therefore, development laws are based on policies and priorities at a national level and not on specific local priorities and particularities. If an investment responds to local specificities, this is because of the investor's decision and not the consequence of a centrally oriented policy on such specific investment.

5. Comparative results of the financial support programs

Our analysis refers to the number of projects and the total budget of investments that have been approved. Data were provided mainly by the local and national authorities managing those programs (General Secretariat for Investments and Development, Region of Thessaly, LAG's in Thessaly)

The analysis is based on the support program or initiative, the sector of investment and the geographic area indicated by prefectures. It discusses whether a concentration of investments exists in some sectors and if a concentration of investments appears within prefectures of Thessaly. It examines the characteristics of these investments with respect to activities and budget allocations. Investments are examined in comparison to the region's production on a sectoral and geographic basis.

5.1 An examination by support program

Development Law 2601/1998 received the majority of projects during the examined decade 2000-2010, and it was followed by those of Law 3299/2004 (Table 3); it was estimated that some parts of the projects were not completed (General Secretariat for Investments and Development, 2011). On the contrary, however, projects concerning the LEADER + initiative were completed in their totality. The reasons for the non-completion of projects may be related to insufficient business opportunities for the companies concerned and the high risks undertaken because of the substantial budget of the investment. Conclusions were similar in the case of West Macedonia (Karafolas, 2007).

As is evident from Table 3, the average budget of approved projects within Development Law 3299/2004 and Development Law 3522/2006 approached one million euros, which was much higher compared to other programs, especially the LEADER + initiative. The LEADER + initiative appeared very attractive for small companies owing to the additional incentive of strong financial support, surpassing 60% of the total budget (Table 3). The other programs received considerably lower financial support (Table 3). In the region of Thessaly, Development Law 3299/2004 attracted the biggest budget of investments within all public financing programs (Table 3). The positive prospects of the Greek economy during the first half of the 2000s and the expectations created by awarding the 2013 Mediterranean Games to the town of Volos in the prefecture of Magnesia are factors that favored these investments.

Table 3: Public financed investments in the region of Thessaly, by financial program (number of projects and investments)

	Number of projects	Total budget (Meuros)	Average budget (Meuros)	Total grants (Meuros)	Grants/ Budget
Development Law 2601/98	324	170,8	0,53	47,6	28%
Development Law3299/04	309	254,4	0,82	104,4	41%
Development Law 3522/06	217	182,3	0,84	71,0	39%
Leader + Initiative	137	15,9	0,12	9,7	61%

Source: General Secretariat for Investments and Development (2011) and Region of Thessaly (2012)

The number of projects realized through the LEADER + initiative (approaching the totality of approved projects), shows the program's popularity in the region of Thessaly. This can be explained by the higher financial support and the program's orientation towards small investments, which are more appropriate to the region's enterprises (mainly small enterprises). Additionally, the LEADER + initiative seemed to respond better to the needs of the regional economy by creating the appropriate infrastructure to boost the rural economy through rural and alternative tourism related to culture, mountain and lake activities and local gastronomy. This area began to develop in Greece during the 2000s, receiving financial support on a regional or sectoral basis, such as the case of Wine Roads (Karafolas, 2007a; Vlachvei & Notta, 2009). The absence of facilities relating to these local activities and the need for their creation encouraged appropriate investments with a relatively small budget. Investments through the other development laws were not directed at these specific targets in rural areas and they did not favor small budget investments (Table 3).

5.2 A sectoral examination

Industry has been the main beneficiary of investments through the examined development laws, which favored relatively big projects (Table 4). Such projects could be realized by industry. Projects related to tourism had lower budgets while agriculture received the smallest part of the total budget and mainly concerned investments in livestock.

Contrary to the above development laws, investments through the LEADER + initiative were very much oriented towards tourism, particularly agro-tourism. Table 4 illustrates the fact that tourism received 67% of total investments against 31% for small industries for the production of local products. Investments in cultural events and in residential and natural environments also had a positive influence on rural tourism. This initiative appeared more attractive to small companies since investments in this initiative demanded smaller budgets in comparison to those of the other development laws. These

Table 4: Public financed investments in the region of Thessaly, by financial program and sector: A/ in Meuro, B/ Part of each sector in total budget (%)

A/	Development Law 2601/98	Development Law3299/04	Development Law 3522/06	Leader + Initiative	Total
Tourism	31,0	77,4	42,8	10,7	161,9
Industry	125,2	172,9	98,9	4,9	401,9
Agriculture	14,5	4,1	40,6		59,2
New technologies				0,3	0,3
Total	170,8	254,4	182,3	15,9	623,4
B/					
Tourism	18,2%	30,4%	23,5%	67,4% *	26,0%
Industry	73,3%	68,0%	54,2%	30,7%	64,5%
Agriculture	8,5%	1,6%	22,3%		9,5%
New technologies				1,9%	0,0%
Total	100,0%	100,0%	100,0%	100,0%	100,0%

Source: Development Agency of Elassona-Kissavos (2011), Development Agency of Karditsa (2011), Development Centre of Kalampaka – Pyli (2011), Pelio Development Agency (2011), General Secretariat for Investments and Development, Directorate General for Private Investments (2011)
*Agro tourism

observations are close to the conclusions drawn regarding West Macedonia in the 1990s, which were presented in a comparative study on two Development Laws and the LEADER II initiative (Karafolas, 2007).

5.3 An analysis by prefecture

If we examine investments in the region of Thessaly for the total support programs over the whole period, no concentration appears in any one prefecture, regarding total projects and budgets approved (Table 5). The Prefecture of Magnesia seems to be a relatively larger beneficiary in terms of number of projects and budget while the prefecture of Larisa seems to receive a relatively more substantial budget per project (about 0,9 million euros per project against 0,6 million, the region's average) (Table 5). If we specify by financial program and period, it appears that the period of investments and the support program influenced both projects and budgets for every prefecture. Moreover, at least in the beginning, the existing infrastructure in some sectors, such as agriculture and industry, seems to have influenced investments for the profit of the biggest prefecture, Larisa (Table 1), and the second prefecture, Magnesia, which had the most substantial industrial GVA in the 2000s (Table 8). Thus, these two prefectures attracted more than 73% of projects and budget, which were approved through DL 2601/1998 (Table 5).

An opposing image was presented with the projects approved through the next DL, 3299/2004, since the prefectures of Trikala and Karditsa received the majority of investments. A more balanced image was presented for the investments approved through DL 3522/2006. Contrary to the above Development Laws, in the case of the LEADER + initiative, the prefectures of Trikala and Karditsa were the main beneficiaries since they accumulated 72.3% of projects and 60.1% of the total budget (Table 5).

Table 5: Public financed investments in the region of Thessaly, by prefecture and financial program

	Karditsa	Larisa	Magnisia	Trikala	**Thessaly**
Development Law 2601/98					
Number of projects	19	105	133	67	324
Budget (Meuros)	12,9	68,1	56,6	33,2	170,8
Average budget (Meuros)	0,68	0,65	0,43	0,50	0,53
Development Law 3299/2004					
Number of projects	92	32	74	111	309
Budget (Meuros)	26,4	68,3	78	81,8	254,4
Average budget (Meuros)	0,29	2,13	1,05	0,74	0,82
Development Law 3522/2006					
Number of projects	34	64	67	52	217
Budget (Meuros)	29,6	53,8	52,1	46,7	182,3
Average budget (Meuros)	0,87	0,84	0,78	0,90	0,84
Leader + Initiative					
Number of project	83	24	37	76	220
Budget (Meuros)	9,2	6,9	5,9	10,1	32,1
Average budget (Meuros)	0,11	0,29	0,16	0,13	0,15
Total					
Number of projects	228	225	311	306	1.070
Budget (Meuros)	78,1	197,1	192,6	171,8	639,6
Average budget (Meuros)	0,34	0,88	0,62	0,56	0,60
***Part** in Thessaly's projects*	21,3%	21,0%	29,1%	28,6%	100,0%
***Part** in Thessaly's budget*	12,2%	30,8%	30,1%	26,9%	100,0%

Source: Development Agency of Elassona-Kissavos (2011), Development Agency of Karditsa (2011), Development Centre of Kalampaka – Pyli (2011), Pelio Development Agency (2011), General Secretariat for Investments and Development, Directorate General for Private Investments (2011)

The need and the potential for the development of rural areas in these prefectures (especially in agro-tourism, which was a main objective of the LEADER + initiative) may explain the concentration of investments through this initiative. As we can see on Tables 8 and 9, in these two prefectures, the GVA of agriculture was superior to that of industry. Investments through these initiatives could cover major issues, such as job opportunities in rural areas, by developing multi-activities in these areas using agro tourism, as well as the manufacture and promotion of local products (Region of Thessaly, 2003). Furthermore, these investments could develop innovative production processes and productivity growth through the technological upgrading, since the region of Thessaly is characterized by a considerable number of small family or individual businesses with low productivity (Region of Thessaly, 2000).

5.4 The structure of investments by sector, area and funding program

An examination of investments funded by the various development laws on a sector basis shows that investments in agriculture were concentrated in the prefectures of Trikala and Larisa, which accumulated more than 80% of the approved budget within all examined development laws (Table 6). In the case of industry, a more even allocation of funding appears, shared mainly between the prefectures of Larisa, Magnesia and Trikala. In the case of tourism, not including agro-tourism, a concentration of investments was observed in the prefecture of Magnesia since more than 57% of approved investments in tourism were in this prefecture.

Table 6: Structure of investments through development laws, per sector and prefecture

	D.L.2601/1998	D.L.3299/2004	D.L.3522/06
Agriculture			
• Karditsa	1,3%	13,7%	9,7%
• Larisa	64,2%	14,0%	31,1%
• Magnesia	11,6%	0,0%	9,8%
• Trikala	22,9%	72,3%	49,4%
Total	100,0%	100,0%	100,0%
Industry			
• Karditsa	9,2%	13,8%	18,0%
• Larisa	46,8%	27,2%	31,6%
• Magnesia	30,5%	18,8%	27,6%
• Trikala	13,5%	40,2%	22,8%
Total	100,0%	100,0%	100,0%

Tourism			
• Karditsa	1,7%	6,9%	22,6%
• Larisa	3,6%	16,3%	19,7%
• Magnesia	74,9%	51,6%	45,4%
• Trikala	19,8%	25,2%	12,2%
Total	100,0%	100,0%	100,0%

Source: Idem. Tables 3, author's calculations

With regard LEADER + initiative agro-tourism received the main part of investments for all the examined prefectures (Table 7).

Table 7: Structure of investments through LEADER + initiative, per sector and prefecture

	Karditsa	Larisa	Magnesia	Trikala
Agro tourism	54,2%	51,4%	49,0%	52,8%
Small enterprises, handicraft	23,3%	37,7%	13,7%	40,4%
Residential environment	18,4%	3,1%	31,0%	3,5%
New technologies	0,7%	2,2%	3,6%	1,1%
Natural environment	1,4%	4,2%	1,9%	1,3%
Cultural events	1,9%	1,4%	0,7%	0,8%
Total	100,0%	100,0%	100,0%	100,0%

Sources: Development Agency of Elassona-Kissavos (2011), Development Agency of Karditsa (2011), Development Centre of Kalampaka – Pyli (2011), Pelio Development Agency (2011).

Substantial amounts were invested in small enterprises and handicraft workshops for the manufacture of local products. The whole program and investments focused on rural economy either through agro-tourism and manufacture of local products or, indirectly, by creating the necessary infrastructure for promoting the local cultural heritage, for example, by investing in the renovation of old buildings, such as churches, vineyards, museums and also in the organization of cultural events.

We can see an example through the tourism and services investments financed by the LEADER + initiative and DL 3299/2004 in the prefecture of Larisa. In the case of the DL 3299/2004, 3 projects were approved for the creation or renovation of hotels, with an average budget of 780.000 euros; in addition, 3 centers for health rehabilitation were approved with an average budget of 1.700.000 euros (Region of Thessaly 2012). In the same area and sector, through the LEADER + initiative, five projects for the creation of small hotels and rooms to let, with an average budget of 350.000 euros, and 11 projects for the creation of traditional taverns and cafes, with an average budget of 111.000 euros

were approved (Development Agency of Elassona-Kissavos, 2011). Therefore, not only the budget but also the philosophy is different since the LEADER + initiative focused on small investments of family or individual character, much more integrated into the local scene. On the other hand, DL focused on big investments, such as big hotels and rehabilitation centers, that could be realized by, for example, a stockholder company.

5.5 Evolution of regional production

Investments have an impact on a region's production. Production can be expressed by Gross Value Added (GVA) measured by the national statistical service. Two years have been considered, 2000 and 2007 (last available data). Data refer to a large number of sectors, thus permitting a sectoral examination as well. This analysis focuses on: a) the evolution of the GVA, as a sum total and by sector, and b) the structure of the GVA by sector in 2000 and 2007. This enables one to compare whether one sector benefited more than others during this period, not only within the region of Thessaly but also nationwide. It should be noted that there may be a time gap between the accomplishment of the investment and the production that will result, and, therefore, the GVA that ensues.

Between 2000 and 2007, the GVA produced in the region increased by 53%; this was lower than the Greek average, 66% (Table 10). The evolution of GVA was not homogenous within the region. It was higher for the prefectures of Magnesia and Trikala and lower for the two other prefectures (Table 10). In particular, in the case of Karditsa, this evolution was influenced by the fall GVA in the agricultural sector.

In a sectoral analysis, it becomes evident that the manufacturing industry had the highest growth of GVA; between 2000 and 2007 its GVA doubled in the region, while the average growth nationwide was 62%. Thessaly's GVA growth was the result of investments in industry in the region; industry concentrated 65% of its investments in the region through the examined programs of this period (Table 4); these findings are in accordance of part of results of a study on Greek manufacturing for the period 1995-2004 (Papadogonas et al., 2010). On the other hand, a serious fall in the GVA of agriculture is apparent; it is much higher than the country's average: 16% against 3% nationwide; it is even higher for some prefectures, especially Karditsa and Magnesia (Table 10). This is the result of limited investments in agriculture, only 9,5% in the examined period; it may also be related to circumstantial reasons because of bad weather conditions during the period 2006-2007 (PASEGES 2011). We have to single out, however, investments in agro-tourism. If we consider GVA for hotels we observe a substantial growth of 39% for the region, which is quite close to the national average of 45%. This growth is even more substantial, 54%, for the prefecture of Karditsa, which profited from sizeable investments in agro-tourism through the LEADER initiative (Table 7). Investments may also have benefited trade indirectly, since this sector presented a high growth of 82%, analogous to the national one, 93% (Table 10).

This evolution had consequences on the productive structure of the region of Thessaly between 2000 and 2007. For some sectors, these changes were much higher in comparison

to the national average. The participation of agriculture in the region's GVA, which was double the national average in 2000, no longer had the same significance in 2007. Its proportion in the region's GVS was only 9% in 2007 against 17% in 2000 (Tables 8 and 9). This evolution was influenced by a drop in production in the prefectures of Karditsa (from 26% in 2000 to 12% in 2007) and Larisa (from 22% in 2000 to 13% in 2007). Nevertheless, it remains, quite substantial in comparison to the national average and, beyond that, to the European average (in 2009, the Greek GVA from agriculture was 5,6%, against only 2,7% for the EU average, see PASEGES (2011)). The fall in the significance of agriculture is compensated by the strong growth of the GVA from industry. Contrary to the stagnation at national level, in the region of Thessaly, the GVA from industry grew. It rose from 14% of the region's GVA in 2000 to 19% in 2007. This structure is evident in all prefectures of the region and in particular to those of Magnesia, Karditsa and Trikala (Tables 8 and 9). Within other sectors, we should take note of the growth in commerce, in particular in the prefecture of Karditsa (Tables 8 and 9).

These results show that, during the examined period, investments influenced the evolution of the GVA and caused a number of changes in the productive structure not only of the region but also of the prefectures. The most significant was the decrease in agricultural productivity for the benefit of industry, which received the great majority of investments.

Table 8: Gross Value Added (GVA) at 2000: Sector's part on total, per NUT II, III(%)

	Agriculture Fishing	Manufacture Mining Electricity	Construction Real estate	Trade	Hotels	Finance	Administration Education Health	Transport Storage Communication	Total GVA
Greece	7%	14%	22%	15%	8%	6%	22%	8%	100%
Thessalia	17%	14%	22%	10%	6%	5%	23%	2%	100%
Karditsa	26%	8%	22%	9%	4%	5%	25%	1%	100%
Larisa	22%	12%	22%	10%	4%	5%	23%	2%	100%
Magnisia	9%	22%	22%	9%	9%	5%	20%	2%	100%
Trikala	15%	9%	20%	14%	6%	5%	28%	3%	100%

Table 9: Gross Value Added (GVA) at 2007: Sector's part on total, per NUT II, III(%)

	Agriculture Fishing	Manufacture Mining Electricity	Construction Real estate	Trade	Hotels	Finance	Administration Education Health	Transport Storage Communication	Total GVA
Greece	4%	14%	20%	17%	7%	5%	24%	10%	100%
Thessalia	9%	19%	19%	12%	6%	4%	28%	3%	100%
Karditsa	12%	12%	20%	13%	4%	4%	33%	2%	100%
Larisa	13%	14%	20%	13%	4%	3%	30%	3%	100%
Magnisia	4%	30%	19%	11%	8%	3%	23%	3%	100%
Trikala	9%	13%	19%	15%	5%	5%	32%	2%	100%

Table 10: Evolution of Gross Value Added (GVA) per sector and NUTS II, III, 2007-2000 (%)

	Agriculture Fishing	Manufacture Mining Electricity	Construction Real estate	Trade	Hotels	Finance	Administration Education Health	Transport Storage Communication	Total GVA
Greece	-3%	62%	52%	93%	45%	38%	85%	107%	66%
Thessalia	-16%	100%	36%	82%	39%	12%	88%	89%	53%
Karditsa	-37%	108%	32%	100%	54%	13%	85%	117%	40%
Larisa	-7%	64%	36%	79%	42%	10%	96%	107%	49%
Magnisia	-29%	119%	35%	87%	36%	3%	82%	82%	61%
Trikala	-8%	137%	48%	75%	38%	35%	79%	52%	59%

Source: Hellenic Statistical Authority, 2008 and 2010

6 Conclusion

Greek governments have encouraged investments by partially financing budgets, offering tax advantages and waiving interest rates of loans. This support was tendered though several investment initiatives financed by the Greek state and the European Union. During the 2000s these initiatives were tendered by Development Laws that were applied with the philosophy of supporting sizeable investments in all sectors, agriculture, industry and tourism. Another initiative, the LEADER initiative, mainly financed by the European Union, focused on rural areas, in order to help less developed regions; the most supported area in this program was agro-tourism. While Development Laws supported programs elaborated and applied on a national central basis, LEADER + initiative was determined and applied on a regional basis.

Judging by the case of the region of Thessaly, it is evident that the LEADER + initiative focused on smaller budgets in specific areas related to rural area activities, such as agro-tourism and manufacture of local products. Investments through the other initiatives were mostly industry oriented while tourism investments focused mainly on areas by the sea.

Geographic distribution of investments showed a clear concentration on the rural areas of Karditsa and Trikala by the LEADER + initiative. On the contrary, the most densely populated prefectures of Larisa and Magnesia received investments mostly through the other investment support programs.

The examined investments influenced local production, especially industry. Agro-tourism and commerce were influenced positively, especially in the areas that benefited more from the LEADER + initiative. On the other hand, the agricultural production, which received minor investments, fell significantly. This evolution reflected the structure of the region's production in favor of industry and against agriculture. Results show that, during the 2000s, industry was the most favored sector of the region's development planning. A second meaningful conclusion is the successful impact of the LEADER + initiative on agro-tourism, since the hotel business's GVA increased in the non-tourist areas, such as Karditsa, Larisa and Trikala.

These observations may give some idea of the results of such investment policies. They make development trends in different rural areas comprehensible. They could be an instrument to understanding how efficient support programs can be and thus to understanding the limitations of regional and national policies for local development. Further development of such a study could examine whether these investments created leverage effects and how sustainable these investments, especially in the middle of an economic crisis, have been.

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Entrepreneurial Orientation (EO) and Knowledge Creation (KC)

Franc Vidic[1]

Abstract

There is wide acceptance of the precept that entrepreneurial orientation is associated with superior firm performance, and knowledge has been recognized as a key resource for preserving the competitive advantage. Enterprises must know what to do, how to do it, as well as when and where to do it. They must be able to identify and exploit opportunities.

This study explains the relationship between entrepreneurial orientation (EO) and knowledge creation (KC). It uses a sample of 195 items from SMEs to explore the relationship between entrepreneurial and knowledge creation orientation. Entreprenurship orientation includes five dimensions: innovativeness, risk–taking, proactiveness, competitive aggressiveness and autonomy process, while the knowledge creation includes the following four processes: socialization, externalization, combination and internalization. The findings show the existence of a close relationship between entrepreneurial orientation and knowledge creation.

Keywords: SMEs, entrepreneurial orientation (EO), knowledge creation (KC)

JEL Classification: M13, M130

1. Introduction

The concept of entrepreneurial orientation aims to explain the mindset of firms, whereby knowledge generation is now widely accepted as a key determinant of economic performance. The production, acquisition, absorption, reproduction, and dissemination of knowledge are seen as the fundamental characteristic of contemporary competitive dynamics. Economic performance is not determined just by the creation of new knowledge, but also by the ability and the willingness of entrepreneurs to recognize and exploit new opportunities based on new knowledge (Audrech, Bonte, Keilbach, 2008).

An increasing number of studies considered the relationship between knowledge, and entrepreneurship (Moller, 2007; Miller, Fern & Cardinal, 2007). We believe that better understanding of the interaction between entrepreneurial orientation and knowledge creation processes impact the company performance. With better knowledge individuals, companies and the business sector can develop better skills that will contribute to higher

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competitiveness. Based on a study of relationship between entrepreneurial orientation and creation of new knowledge, we determined the interconnections among individual factors.

This article has the following structure. The first part of this paper following the introduction comprises a theoretical background and discussion about EO and KC. The second part includes is brief presentation of the research method and the empirical findings. The empirical test is based on a sample with 195 items collected through a questionnaire submitted to entrepreneurs and executives from Slovenian SMEs. Finally, the conclusion summarizes the results along with their implications.

2. Research background and hypothesis

"Knowledge has to be the key economic resource and the dominant – and perhaps even the only – source of competitive advantage" (Drucker, 2009). Knowledge-based economy is based on the creation, evaluation and trading of knowledge. Labour costs become decreasingly important and traditional economic concepts, such as scarcity of resources and economies of scale, cease to apply. Knowledge is an important production factor and the most strategically significant resource of a firm. It creates the longest lasting competitive advantage and serves as a source of sustainable differentiation due to immobility. Teece, Pisano and Shuen (1997) and others (Morgan, Vorhies & Mason, 2009) upgraded Knowledge based theory with Theory of dynamic firms capability. The theory assumes that heterogeneous sources are not sufficient in the dynamic market environment (Morgan et al., 2009; Teece et al., 1997). Trends, outlook and market information uses must be dynamic (Busenitz & Barney, 1997 in Holcomb, Ireland, Holmes & Hitt, 2009), whereby thinking along established routes is not sufficient (Nonaka, 1991).

The environment is changing constantly and rapidly along with the market and customers' needs (Prajogo & Ahmed, 2006). Constant and rapid changes in the present, networked knowledge society give rise to new challenges to human competencies (Paavaola & Hakkarainen, 2005). Audretsch (2010) describes an entrepreneurial society built upon the knowledge-based society. The entrepreneurial society assumes the role of physical capital and entrepreneurial capital upgraded with the knowledge capital, economic growth, job creation and competitiveness in a complex environment (Audretsch, 2010). The recognition of opportunities and the decision to commercialize them is the focal concern. Enterprises must know what to do, how to do it, as well as when and where to do it in order to successfully compete. Without knowledge, this is impossible (Korposh, Lee, Wei & Wei, 2011). Productive participation in knowledge intensive work requires that individual professionals, their communities, and organizations continuously surpass themselves, develop new competencies, upgrade their knowledge and understanding as well as produce innovations and create new knowledge (Paavola & Hakkarainen, 2005). Human work is increasingy focused on deliberate advancement of knowledge rather than mere production of material things (Bereiter, 2002 in Paavaola & Hakkarainen, 2005). Knowledge and innovation are widely considered as a key prerequisite for achieving organizational competitiveness and sustained long-term wealth in an increasingly volatile

business environment (Esterhuizen, Schutte & Toit, 2011). Organization learning improves the innovation process and its effectiveness (Huang & Wang, 2011), and competitive advantage (Barsh, 2007).

Entrepreneurial orientation (EO)

EO refers to strategic orientation and entrepreneurial activities, which involve specific entrepreneurial decision-making, such as taking calculated risks, as well as being innovative and proactive (Covin & Slevin, 1989; Lumpkin & Dess, 1996). EO reflects how a firm performs rather than what it does (Lumpkin & Dess, 1996). The resource-advantage theory views EO as a resource to outperform other rivals and yield marketplace positions of competitive advantage (Hunt & Morgan, 1995). EO reflects leadership skills, the integration of proactive and aggressive initiatives and turning of competitive environment to their advantage (Atuathene-Gima, 2001). EO companies have competencies to respond quickly and take advantage in niche markets (Zahra & Covin, 1995). They innovate and take risks with the strategy for positioning of new products (Miller & Friesen, 1982).

EO is a multidimensional phenomenon composed of processes, structures and habits (Lumpkin & Dess, 1996). The conceptualization of EO has been the focus of systematic inquiry in literature (Miller, 1983; Covin & Slevin, 1991; Lumpkin & Dess, 1996; Lumpkin, Cogliser & Schneider, 2009; Wiklund, 1999). The concept of entrepreneurial orientation can apply to individuals as well as organizations (Bolton & Lane, 2012; Rauch, Wiklund, Lumpkin & Frese, 2009). In our research we accept that: competitive aggressiveness, autonomy, innovation, proactiveness and willingness to take risks are five of the characteristics commonly associated with entrepreneurial orientation (Bolton & Lane, 2012; Fillis, 2010; Lumpkin & Dess, 1996; Rauch et al., 2009; Ward, 2004). Each dimension is important, but they may not be important to the same degree (Kreiser, Marino & Weaver, 2002; Lamadrid, Heene & Gellynck, 2008; Lumpkin & Dess, 2001; Rauch et al., 2009). Each dimension can be reflected complementary to the others or in conjunction with them (Lyon, Lumpkin & Dess, 2000). The dimensions of EO are expected to vary independently on a range of possible environmental and organizational factors (Kreiser et al., 2002).

Innovation represents a firm's tendency to pursue creative and novel solutions to challenges faced by the firm: the successful generation, development and implementation of new and novel ideas which introduce new products, processes and/or strategies to enhance current products, processes and/or strategies leading to commercial success and possible marketing leadership, as well as the creating of value for shareholders, driving economic growth and improving standard of living (Katz, 2007). Firms use innovation to pursue new opportunities, which can keep them ahead of competitors and help them gain competitive advantages, consequently leading to improved financial performance (Wiklund, 1999).

Risk-taking (Cantillon, 1730 in Jun & Deshoolmeester, 2006) is associated with entering in an unknown field, with the involvement of one's own and others' resources to operate in an uncertain environment. It is important to reduce and manage risks (Lumpkin & Dess, 1996).

Proactiveness refers to a posture of anticipating and acting on the basis of future demands and needs in the marketplace, thereby creating first-mover advantage vis-à-vis competitors (Lumpkin & Dess, 2001). It is the response to and exploration of opportunities for products and services to achieve an advantage over its competitors while offering adjustments to future demand. Proactivity encompasses not only alertness to unnoticed opportunities, but also effort to capture these opportunities through monitoring and influencing trends, forward-looking activities, and assertively acting on future needs or changes (McMullen & Shepherd, 2006).

Competitive aggressiveness represents a firm's propensity to directly and intensely challenge its competitors to achieve an entry or improve position to outperform industry rivals (Lumpkin & Dess, 1996). Hence, competitive aggressiveness is a response to threats in hostile business environments where competition is intense and resources are constrained, whereas proactiveness is a response to opportunities (Lumpkin & Dess, 2001). Competitively aggressive firms direct their efforts toward outperforming of rivals (Covin & Covin, 1990).

Autonomy is the independent action of an individual or team in bringing forth an idea or vision and carrying it through to completion, as well as the ability and will to be self-directed in the pursuit of alternatives (Lumpkin & Dess, 1996). Autonomous entrepreneurs are inherently creative entrepreneurs; creative with a desire to be independent. Autonomus independence is thus important for entrepreneurs and entrepreneurial teams in the establishment and management of new business (Burgelman, 1984; Hart, 1992). Autonomy requires individuals' or groups' freedom to act independently in the decision making process to pursue entrepreneurial activities and achieve strategic advantages (Lumpkin et al., 2009; Rauch et al., 2009).

H1: Entrepreneurial orientation consists of five dimensions.

Knowledge creation

Knowledge is the fundamental source of competitiveness and success of the company. Knowledge is formed and exists in the minds of people; in the light of creation of new ideas it is an important form of interaction between individuals (Davenport & Prusak, 2000; Nonaka, 1994). Nonaka, Toyama and Konno (2000) note that knowledge creation is necessarily context-depend in terms of those who participate, as well as how they participate. From the perspective of resource-advantage theory, knowledge is not easy to transfer and can easily disperse due to its characteristics of tacitness and immobility (Grant, 1996; Hunt & Morgan, 1996). Knowledge creation (KC) process allows firms to amplify knowledge embedded internally and transfer knowledge into operational activities in order to improve efficiency and generate business value (Nonaka & Konno, 1998; Nonaka & Takeuchi, 1995; Nonaka, Toyama & Nagata, 2000). Knowledge creation, include elements of EO and market orientation, which are further converted into knowledge capital, which can be transmitted among other employees (Li, Huang & Tsai, 2009).

Organizational knowledge creation integrates context, knowledge assets, and knowledge creation processes throughout the organization (Von Krough & Nonaka, 2011). Different factors affect the process of knowledge creation in organization. These factors include the organization's structure, culture, level of application of knowledge management, available technology, application of practice communities, and knowledge management methods (Korposch, Lee, Wei & Wei, 2011). Corporate culture and leadership encourage people to communicate, collaborate and engage in social interaction (Li, Huang & Tsai, 2009). Social cohesion provides an effective combination of knowledge from different areas of expertise (De Luca & Atuahene-Gima, 2007). Interacting with a combination of knowledge comes to the extent which results in good interpersonal relationships (Floyd & Lane, 2000, in De Clecq, Dimov & Thongpapanl, 2009), provided that organizational atmosphere is based on honesty, trust and support (Kuratko, Ireland, Covin & Hornsby, 2005). New insights affect entrepreneurial behaviour and allow for the ability to successfully exploit opportunities (De Clecq et al., 2009). The quantity and quality of information to be exchanged are important (Birckshaw, 2000 in Williams & Lee, 2009). If a proper knowledge creation process is implemented the knowledge, which a team can create, is more than just a sum of the knowledge created by all individuals (Lin, Lin & Huang, 2008). Entrepreneurs need to replace the existing knowledge with new knowledge, in order to recognize which positioning is no longer optimal for the organization, and develop the organization's ability to operate in tomorrow's market (Hamel & Prahalad, 1994). It is necessary to balance between research and development (Renko, Carsrud & Brännback, 2009).

Based on the Theory of knowledge creation, knowledge creation is a process involving a spiral of socialization, externalization, combination and internalization. According to Nonaka's knowledge creation (SECI) model an organization creates knowledge through a dynamic process including interactions amongst individuals and organizations, as well as the interaction between tacit and explicit knowledge (Nonaka, 1991; 1994; Nonaka & Takeuchi, 1995; Nonaka, Toyama & Konno, 2000; Lin, Lin & Huang, 2008). The interaction between the two types of knowledge is called `knowledge conversion'. Through the conversion process, tacit and explicit knowledge expands in both quality and quantity. Within organizations, knowledge 'becomes' or 'expands' according to a four-stage conversion process (SECI) (Nonaka, von Krogh & Voepl, 2006): (1) socialization (from tacit knowledge to tacit knowledge); (2) externalization (from tacit knowledge to explicit knowledge); (3) combination (from explicit knowledge to explicit knowledge); and (4) internalization (from explicit knowledge to tacit knowledge). The knowledge spiral consists of two inter-related processes: knowledge conversion at the individual level and knowledge crystallization and transfer between the organization and its members (Nonaka & Kogut, 2009). The processes of knowledge conversion between its tacit and explicit forms and knowledge transfer between the organization and its members are not repeated at the same level but consist of an upward knowledge spiral through which the organization and its members create new knowledge beyond their existing knowledge.

Socialization is the process of converting tacit knowledge possesed by individuals through shared experiences (Nonaka, Toyama & Konno, 2000). Since tacit knowledge is

difficult to formalise and often time- and space-specific, it can be acquired only through shared experience, such as spending time together or living in the same environment. Socialization typically occurs in a traditional apprenticeship, where apprentices learn the tacit knowledge needed in their craft through hands-on experience, rather than from written manuals or textbooks. Socialization may also occur in informal social meetings outside of the workplace, where tacit knowledge, such as world views, mental models and mutual trust, can be created and shared. Socialization also occurs beyond organizational boundaries. Firms often acquire and take advantage of the tacit knowledge embedded in customers or suppliers by interacting with them (Nonaka, Toyama & Konno, 2000).

Externalization is the process of articulating tacit knowledge into explicit knowledge. When tacit knowledge is transformed into explicit, knowledge is crystallised; thus allowing to be shared by others, and becoming the basis of new knowledge. Concept creation in new product development is an example of this conversion process. The successful conversion of tacit knowledge into explicit knowledge depends on the sequential use of metaphors, analogy and models (Nonaka, Toyama & Konno, 2000).

Combination refers to the new explicit knowledge. It is the process of converting explicit knowledge into more complex and systematic sets of explicit knowledge by merging, categorizing, reclassifying, and synthesizing of existing explicit knowledge. Explicit knowledge is collected from within or outside of the organization and then combined, edited or processed to form new knowledge. The new explicit knowledge is then disseminated among the members of the organisation. (Nonaka, 1994; Nonaka, Toyama & Konno, 2000; Nonaka, Toyama & Nagata, 2000).

Internalization refers to the creation of new tacit knowledge from explicit knowledge (Nonaka, 1994). Through internalization, the created explicit knowledge is shared throughout an organisation and converted into tacit knowledge by individuals. Internalization is closely related to learning by doing. Explicit knowledge, such as the product concepts or the manufacturing procedures, has to be actualised by action and practice. By reading documents or manuals about their jobs and the organisation, and by rejecting upon them, trainees can internalise the explicit knowledge written in such documents to enrich their tacit knowledge base. Explicit knowledge can be also embodied in simulations or experiments that trigger learning by doing. When knowledge is internalized to become a part of individuals' tacit knowledge bases in the form of shared mental models or technical know-how, it becomes a valuable asset. Through internalization, knowledge is transformed into organizational memory and actualized in practical operations such as new product development or manufacturing procedure This tacit knowledge accumulated at the individual level can then set off a new spiral of knowledge creation when it is shared with others through socialization (Nonaka, Toyama & Konno, 2000). The firm utilizes its human capital to transfer tacit knowledge, which becomes the base for further innovation and new routine (Nonaka, Toyama & Nagata, 2000).

H2: Knowledge creation is a four-dimensional process

Entrepreneurial orientation and knowledge creation process

Entrepreneurial attitude and conduct are critical for new ventures to facilitate the utilization of new and existing knowledge resulting in the discovery of market opportunities (Wiklund & Shepherd, 2003). KC processes such as socialization, externalization, combination, and internalization (SECI) describe a spiral of interactions between explicit and tacit knowledge (Nonaka, 1994; Nonaka & Konno, 1998). Firms exchange and transform knowledge continuously through dynamic self-transcendental processes (Nonaka & Konno, 1998; Nonaka, Toyama & Konno, 2000). When developing EO, ventures can exploit the dynamic SECI spiral to create and share knowledge dispersed among individual members. Innovative firms may have a tendency to support new ideas and novelty, and further increase the engagement in development of new products, services, or processes (Lumpkin & Dess, 1996). They must be proactive, anticipate and act on future demands and needs in the marketplace, thereby creating first-mover advantage vis-à-vis its competitors (Lumpkin & Dess, 2001). The development of new products and services involves extensive and intensive knowledge activities. Knowledge conversion provides value to their customers and helps achieving a competitive position in the market (Griffith, Noble & Chen, 2006). The organization creates a new combination of resources and products, intended for upcoming changes, opportunities and entry into market, while taking advantage and exploiting opportunities (Lumpkin & Dess, 2001). New types of knowledge and new ways of organising the production thereof may emerge as knowledge generators' response to the challenges posed by a changing society (Fogerberg, Fosaas, Soprassart, 2012).

Knowledge exchange between the social system and the individuals' cognitive system is the basis for development of the new knowledge (Kimmerle, Cress & Held, 2010). The SECI spiral can facilitate knowledge conversion and transformation into new types of knowledge (Nonaka, Takeuchi, 1995). Knowledge conversion, new product development or marketing activities all start with socialization (Nonaka & Toyama, 2005). Socialization processes such as direct interaction, brainstorming, and informal meetings help employees to share and exchange valuable knowledge (Zhang, Lim & Cao, 2004).

Entrepreneurs should capitalize knowledge resources, as well as identify and exploit business opportunities (Griffith et al., 2006), promote innovation and motivate employees to take risks in order to deal with the challenging and creative activities (Lumpkin & Dess, 1996). Employees need socialization process to upgrade interaction for exchanging tacit knowledge, solving problems, and avoiding mistakes (Nonaka et al., 1996; Quinn, 1992).

Externalization activities articulate tacit knowledge into explicit forms. Through externalization employees can understand new product development and increase their involvement in the activities of articulating tacit knowledge into substantial concepts and notions (Nonaka & Konno, 1998; Nonaka & Takeuchi, 1995; Nonaka & Toyama, 2005). The newly created knowledge and existing knowledge are then combined, edited or processed to form more complex and explicit knowledge through the combination process.

Innovative ideas become more usable, thereby crystallizing knowledge into new products or services (Nonaka & Konno, 1998). Internalization process promotes the actualization of new product innovation or improvements within the organization.

Autonomy reflects the ability to be self-directed in the pursuit of market opportunities (Lumpkin & Dess, 1996). Employees need autonomy, as well as independent assortment and selection activities to achieve their goals (Li, Huang & Tsai, 2009). Socialization process makes employees set up interaction for the free exchange of advanced personal or professional knowledge. To translate tacit knowledge into understandable forms, the firm engages in externalization activities such as action, experimentation, and observation (Nonaka, Takeuchi & Umemoto, 1996).

The acquisition of knowledge is associated with learning at work, learning from work or learning by doing. In enterprises sharing knowledge within the company led to the creation of new knowledge and its diffusion across an enterprise (Cohen & Levinthal, 1990). This is reflected in the use of knowledge (Li, Huang, Tsai, 2009). Wiklund and Shepherd (2003) note a positive relationship between resources, knowledge-based orientation and performance of the organization.

However, there is considerable literature which attempts to define knowledge-based innovation and suggests that the process of innovation itself relies heavily on innovation knowledge that is usually created and transferred or disseminated within a company, between companies, or between companies and innovators (Nonaka and Von Krogh, 2009). Grant (1996), Teece (2000), Watson and Hewett (2006 in Li, Liu, Wang, Li & Guo, 2009) observed correlation with innovation and creation of knowledge through its collection and use within the enterprise. A high degree of entrepreneurial orientation involves long-term development vision, mission, and work with customers, as well as setting up of new capacities. Realizing the vision of entrepreneurs can be related to double loop learning (Cui & Zheng, 2007; Chaston & Scott, 2012). The knowledge creation process appears to be the key mechanism through which EO is developed and implemented (Griffith, Noble & Chen, 2006). Knowledge creation is of strategic value to the firm in order to maintain the achieved competitive advantage (Nonaka & Takeuchi, 1995; Tsai & Li, 2007). Kim, Song, Sambamurthy, and Lee (2011) find strong support for the relationship between entrepreneurial intensity and knowledge integration mechanisms.

According to the above, SMEs characterised by entrepreneurial orientation are more inclined to focus attention and effort towards the knowledge creation process. The SECI spiral can utilize the full potential of knowledge and further facilitate its creation and utilization within the firm, thus facilitating the transformation and activation of entrepreneurial orientation. We can reasonably expect a positive relationship between entrepreneurial orientation and knowledge creation process.

H3: Entrepreneurial orientation is correlated with the knowledge creation process.

3. Research design and methods

Sample selection and data collection

The sample for this study is drawn from different places in Slovenia. A sample of 2500 questionnaires were sent to SMEs; firms with more than 6 and less than 250 employees from the Slovenian information system (IPIS). Classic mail was sent to the target respondents inviting them to participate in the survey by completing questionnaire. 203 responses were received, four of them were without any data on it and another four were incomplete. The remaining 195 valid and completed questionnaires were used for quantitative analysis. It represented a useable response rate of 7.8%. The comparison between sent and returned questionnaires is presented in Table 1.

Table 1: Comparison between sent and returned questionnaires according to the number of full and part-time employees

	Sent questionnaires		Returned questionnaires	
No. of employees	**Frequency**	**Percentage (%)**	**Frequency**	**Percentage (%)**
6–9	968	38,72	57	28,64
10–19	853	34,12	62	31,16
20–49	480	19,20	46	23,12
50–99	129	5,16	24	12,06
100–250	70	2,80	10	5,02
No answer			4	
Cumulative	2500		203	

We collected data of the measures of knowledge creation process and entrepreneurial orientation within each company.

Measurement model

For data collection we employed a questionnaire survey approach to collect data, and all items required five-point Likert-style responses ranged from 1 = "strongly disagree," through 3 = "neutral," to 5 = "strongly agree". We requested respondents to evaluate their level of agreement with each question.

Entrepreneurial orientation (EO)

Drawing upon previous studies (e.g. Li, Huang, Tsai, 2009; Covin & Slevin, 1989; Lumpkin & Dess, 1996, 2001; Miller, 1983), entrepreneurial orientation was measured with five dimensions: innovation, risk-taking, proactiveness, competitive aggressiveness, and autonomy. Three items measure innovation, which refers to a willingness to support

creativity and experimentation in introducing new products/services, and novelty, technological leadership and R&D in the development of new processes. Risk-taking means the tendency to take bold actions, such as venturing into unknown new markets; committing a large portion of resources to ventures with uncertain outcomes; and/ or borrowing heavily. It is measured with two items. Three items measure proactiveness, which refers how firms relate to market opportunities by seizing initiative in the marketplace. Competitive aggressiveness refers to how firms react to competitive trends and demands that already exist in the marketplace. Autonomy is defined as independent action by an individual or team aimed at bringing forth a business concept or vision and carrying it through to completion. Competitive aggressiveness is measured with two items, whereby autonomy is measured with three.

Competitive aggressiveness is measured with competitive processes used by the founder-managers to pursue rivals or take up new competitors, since its point of reference is competition (Lumpkin & Dess, 1996). Autonomy is measured by independent action undertaken by founder-managers or teams directed at bringing about a new venture and seeing it to fruition (Lumpkin, Cogliser & Schneider, 2009).

Knowledge creation process (KC)

This study used a five-point scale to measure the knowledge creation process dimensions. The instrument was designed by Sabherwal and Becerra-Fernandez (2003), and adapted by Li, Huang and Tsai (2009). The four dimensions of the knowledge creation process are socialization, externalization, combination, and internalization (Nonaka, 1994; Nonaka, Takeuchi & Konno, 2000; Sabherwal & Becerra-Fernandez, 2003). Five items measured socialization: cooperative projects across directorates, the use of apprentices and mentors for knowledge transfer, brainstorming retreats or camps, and employee rotation across areas. Eight items measured externalization: a problem-solving system based on a technology-like case-based reasoning, groupware and other collaboration learning tools, pointers to expertise, modelling based on analogies and metaphors, and the capture and transfer of expert knowledge. Five items measured combination: web-based access to data, web pages, databases, and repositories of information, best practices, and lessons learned. Three items measured internalization: on-the-job training, learning by doing and learning by observation.

4. Analysis and results

We performed descriptive analysis of all items to establish their suitability for statistical analysis to use factor analysis. Afterwards we performed an explorative followed by a confirmative factor analysis, and in the end we used the structured modelling method to estimate the model and relationship between EO and knowledge creation.

Descriptive analysis

We analysed all variables of the construct of entrepreneurial orientation and knowledge creation. We checked their characteristics and whether they are suitable for factor analysis (normality, skewness, kurtosis). Assessment of normality showed that the ratio of the standard error of skewness and kurtosis of each variable has acceptable value. All skewness and kurtosis values are lower than 2 or greater than -2 (Table 2, Table 3).

Table 2: Entrepreneurial orientation - descriptive analysis

Innovation	N	Mean	Standard deviation	Skewness	Standard error	Kurtosis	Standard error
The top managers favour strong emphasis on R&D, technological leadership, and innovation	202	3.64	1.080	-0.496	0.171	-0.523	0.341
My firm owns many new lines of products/services which aremarketed in the past 5 years	200	3.56	1.172	-0.505	0.172	-0.659	0.342
Changes in product or service lines are usually quite dramatic	197	3.02	1.120	0.048	0.173	-0.786	0.345
Risk taking							
My firm usually has a strong proclivity for high risk projects with chances of very high returns	201	2.67	1.115	0.230	0.172	-0.783	0.341
Due to the nature of the environment, bold, wide-ranging acts are required to achieve the firm's objectives	198	3.66	1.024	-0.559	0.173	-0.173	0.344
When decision is faced with uncertainty, preference is given to maximizing the possibilities of utilization of opportunities	198	3.48	0.949	-0.280	0.173	-0.303	0.344
Proactiveness							
In dealing with competitors, my firm usually initiates actions which competitors then respond to	200	3.47	1.084	-0.400	0.172	-0.513	0.342
In dealing with competitors, my firm is very often the first business to introduce new products/services, administrative techniques, operating technologies, etc	202	3.49	1.177	-0.426	0.171	-0.743	0.341

In general, the top managers of my firm have a strong tendency to be ahead of others in introducing novel ideas or products	197	3.83	1.130	-0.749	0.173	-0.390	0.345
Competitive aggressiveness							
My firm usually adopts a very competitive "undo-the-competitors" position	203	3.16	1.155	-0.050	0.171	-0.704	0.340
My firm is very aggressive and intensely competitive	198	2.96	1.096	-0.070	0.173	-0.551	0.344
Autonomy							
My firm promotes the independent action of an individual or a team in bringing forth an idea or a vision and carrying it through to completion	200	3.77	1.037	-0.772	0.172	0.046	0.342
My firm has the ability and will to be self-directed in the pursuit of opportunities	201	3.93	0.922	-0.857	0.172	0.594	0.341
My firm takes action free of stifling organizational constraints	198	3.86	1.006	-0.660	0.173	-0.218	0.344

All items were measured with five-point Likert scale.

Table 3: Knowledge creation - descriptive analysis

Socialization	**N**	**Mean**	**Standard deviation**	**Skewness**	**Standard error**	**Kurtosis**	**Standard error**
My firm usually supports cooperative projects and R&D across directorates	201	3,40	1,184	-0,430	0,172	-0,742	0,341
My firm usually supports brainstorming retreats or camps	199	3,03	1,376	-0,081	0,172	-1,260	0,343
My firm usually supports employee rotation across areas	200	2,91	1,261	0,004	0,172	-1,072	0,342
My firm usually uses apprentices and mentors to transfer knowledge	199	2,96	1,259	-0,046	0,172	-1,013	0,343
My company organize employee meetings to share and exchange their knowledge and experience	199	3,51	1,150	-0,562	0,172	-0,414	0,343

Externalization							
My firm usually adopts a problem-solving system approach based on a technology like case-based reasoning.	200	3,34	1,157	-0,368	0,172	-0,778	0,342
My firm usually promotes groupware and other learn collaboration tools	199	2,94	1,236	-0,040	0,172	-0,970	0,343
My firm usually promotes pointers to expertise	198	2,82	1,264	0,048	0,173	-1,081	0,344
My firm usually promotes modelling based on analogies and metaphors	193	2,58	1,125	0,210	0,175	-0,807	0,348
My firm usually captures and transfers experts' knowledge	63	2,89	1,220	-0,057	0,302	-0,843	0,595
My firm usually forms discussion working group with a variety of techniques over the Internet	197	2,68	1,247	0,037	0,173	-1,121	0,345
My firm usually collects knowledge from experts and customers which is designed in an acceptable form	198	2,84	1,137	-0,159	0,173	-0,912	0,344
My firm usually shares information, experience, best practices and studies to solve problems	199	3,55	1,076	-0,641	0,172	-0,215	0,343
Combination							
My firm has open access to data via the Internet	198	3,60	1,293	-0,659	0,173	-0,634	0,344
My firm usually supports web-based access to data	197	3,56	1,117	-0,472	0,173	-0,528	0,345
My firm usually uses web pages	198	3,43	1,141	-0,395	0,173	-0,704	0,344
My firm usually uses databases	198	3,65	1,001	-0,625	0,173	-0,006	0,344
My firm usually promotes repositories of information, best practices, and lessons learned	198	3,24	1,227	-0,340	0,173	-0,860	0,344
Internalization							
On the job training	199	4,04	0,873	-1,036	0,172	1,380	0,343
Learning by doing	199	4,11	0,827	-0,912	0,172	1,138	0,343
Learning by observation	197	3,75	1,076	-0,856	0,173	0,286	0,345

All items were measured with five-point Likert scale.

Descriptive and factor analysis were performed with the SPSS 18 and EQS 16 software bundles. Factor analysis was utilised to examine the underlying patterns or relationships for a large number of variables and to determine whether the information can be condensed or summarized in a smaller set of factors or components (Hair, Black, Babin, Anderson, 2010). Data matrix has a sufficient number of correlations. We checked each theoretical construct. Where it was necessary, we reduced the number of variables. Four factors selection were taken into account: theoretical frameworks, preliminary scree test criterion, the eigenvalue greater than 0.8, and the explained total variance.

For the analysis of the constructs of EO, we keep five factors which represent five dimensions. Two of them are explained by two variables, while the rest are explained by three variables. To analyse of the constructs of knowledge creation we keep the four factors, which represent the expected four dimensions. One is explained by tree variables and all others with five dimensions. This is what we expected in accordance with theoretical standards. In both cases the Bartlet test of sphericity statistically verified the correlation between variables and showed that the correlation matrix has significant correlations (degree of freedom = 0.000). Furthermore, the Kaiser-Meyer-Olkin measure of sampling adequacy has a value higher than 0.80.

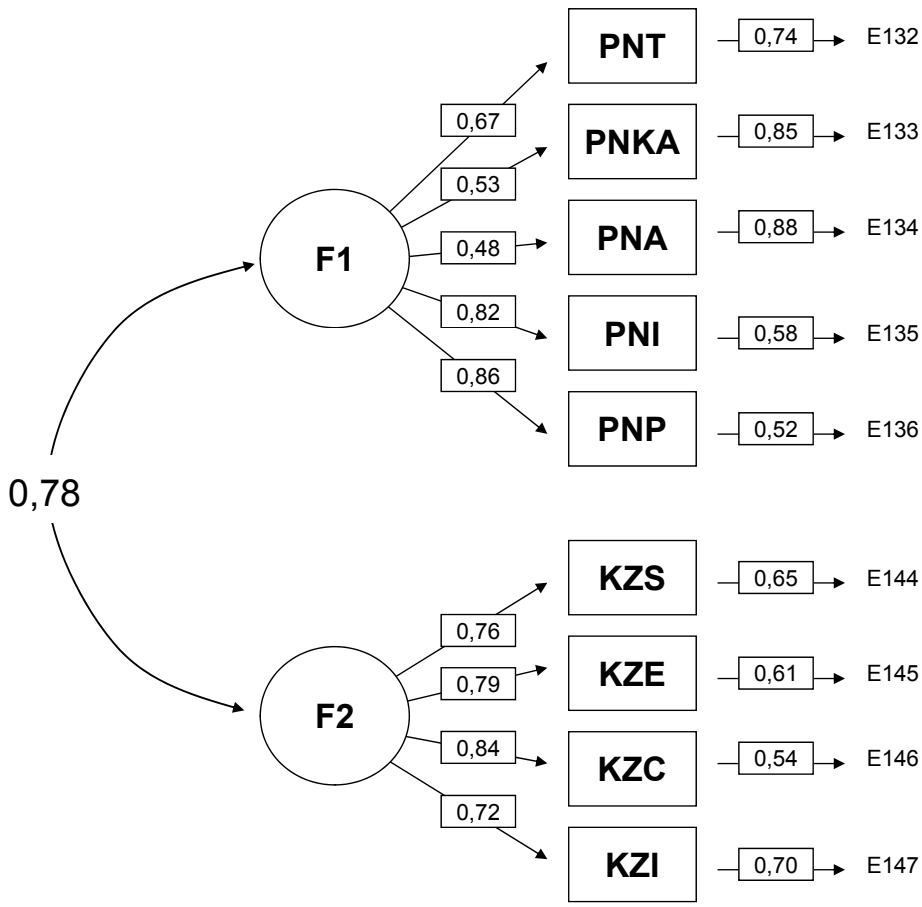
All the set constructs were verified by confirmatory factor analysis with the EQS 6.12 software bundle. We applied confirmatory factor analysis to test how the measured variables represent the construct with the aim to verify and acquire better understanding results of the explorative factor analysis. We confirmed the validity of the results of the exploratory analysis.

Reliability of the multi-item scale for each dimension was determined using Cronbach alphas and composite reliability measures. All measures of reliability are higher than 0.80 and thus higher than the recommended minimum standard of 0.60 (Hair et al., 2010).

EQS6.12 provides a chi-square value and five additional indices that assess the fit of path models, (RMSE), the Bentler – Bonett normed fit index (NFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). The fit indexes of confirmatory factor analysis for the measurement models ranged from adequate to excellent (construct EO: Chi Sq. = 91.65, 55 degrees of freedom, P = 0.00, CFI = 0.98, RMSEA = 0.06, NFI = 0.95, Crombach $\alpha = 0.88$, RHO = 0.93; construct KC: Chi Sq. = 242.523, 129 degrees of freedom, P = 0.00, CFI = 0.97, RMSEA = 0.07, NFI = 0.94, Crombach $\alpha = 0.92$, RHO = 0.94).

Hypothesis H1: "*Entrepreneurial orientation consists from five dimensions", and hypothesis H2:* "*Knowledge creation is four-dimension process*", *is support.*

Figure 1: EQS 6.1, correlation between entrepreneurial orientation and knowledge creation



Notes: F1 - EO with dimensions: PNT - risk-taking, PNKA - competitive aggressiveness, PNA - autonomy, PNI - innovativeness, PNP – proactiveness; F2 – KC with dimensions: KZS - socialization, KZE - outsourcing, KZC - combination KZI – internalisation

In the next step we express the dependence relationship among constructs of independent variables. For structured equation modelling, we use EQS software package 6.1. We measure the relationship model between EO and KC, and its convergent and discriminatory validity. Thus we have proved multidimensionality model and its comparability, as most indicates the suitability of the construct of integrated model of excellent value (Chi sq. = 48.94 degrees of freedom, P = 0.00, CFI = 0.96, RMSE = 0.11, NFI = 0.91, Crombach α = 0.88, RHO = 0.90). The correlation relationships between constructs show high correlation between the construct of EO and knowledge creation with the value of 0.78 (Fig. 1, Table 4).

Table 4: Iteratively reweighted least squares solution (elliptical distribution theory). Its decomposition of effect with standardized values parameter effects

STANDARDIZED SOLUTION:				R-SQUARED
PNPT	=V132=	0.673*F1	+ 0.739 E132	0.454
PNKA	=V133=	0.528*F1	+ 0.849 E133	0.279
PNA	=V134=	0.477*F1	+ 0.879 E134	0.228
PNI	=V135=	0.817*F1	+ 0.577 E135	0.668
PNP	=V136=	0.855*F1	+ 0.518 E136	0.731
KZS	=V144=	0.758 F2	+ 0.652 E144	0.574
KZE	=V145=	0.793*F2	+ 0.609 E145	0.629
KZK	=V146=	0.840*F2	+ 0.542 E146	0.706
KZI	=V147=	0.715*F2	+ 0.699 E147	0.512

Notes: F1 - EO with sub-dimensions: PNT - risk-taking, PNKA - competitive aggressiveness, PNA - autonomy, PNI - innovation, PNP – proactivity; F2 – KC with sub-dimensions: KZS - socialization, KZE - outsourcing, KZC - combination KZI – internalisation

Theoretical bases and empirical analysis confirm our position that hypothesis H*3* "*Entrepreneurial orientation correlates with the knowledge creation process,*" *is supported.*

5. Discussion and limitations

In accordance with different theories of entrepreneurship, entrepreneurial spirit arises from eight differences among individuals, their entrepreneurial orientation and knowledge. EO increase collection and use of information, their activities, creativity, proactive orientation and readiness to take risks (Slater, Narver, 1998; Keh et al., 2007). Hurley and Hult (1998) found a correlation between high levels of innovation and a culture of learning. This is reflected in the use of knowledge (Li, Huang, Tsai, 2009). Grant (1996), Spender (1996), Teece (2000), Watson and Hewett (2006 in Li, Liu, Wang, Li & Guo, 2009) observed correlation between innovation and creating knowledge through the collection and its use within the organization. Organizations with innovative tendencies are more inclined to exchange and use information (Altman, 1986; Von Hipp, 1988 in Williams & Lee, 2009). In entrepreneurial firms sharing knowledge within the company led to the creation of new knowledge and its diffusion across an enterprise (Cohen & Levinthal, 1990). EO organization often directly supports generative learning by focusing on the identification and exploitation of new opportunities, while motivating employees to move from the pressure armour routine work (Cui & Zheng, 2007, Chaston & Scott, 2012). A high degree of EO involves long-term development guidelines, vision, mission, and work with customers, as well as setting up new capacities. Realizing the vision of entrepreneurs is related to the double loop learning (creating of knowledge) (Cui & Zheng, 2007).

The results of the study show close relationship and correlation between EO and KC. Empirical analysis supported all of three hypothesis: *H1: Entrepreneurial orientation consist of five dimensions; H2: Knowledge creation is a four-dimensional process; and H3: Entrepreneurial orientation correlates with the knowledge creation process*. The results allow for a better understanding of the development dynamics, proactive actions, knowledge creation and firm performance in a dynamic and competitive environment. Results help to improve the knowledge and close the gap, support the resource-advantage theory and add a piece of knowledge to the mosaic of researches in different countries, with a survey among Slovenian companies. Finally, this study contributes to the integration of the domains of entrepreneurial orientation and knowledge management research.

From a practical point of view, our study suggests that enterprises should be aware of the importance of the knowledge creation process and its connection with EO. Enterprises must facilitate a creative environment to supply for the dynamic knowledge creation process. In a low knowledge context, with a lack of new ideas, enterprises will not generate or recognize entrepreneurial opportunities.

From an academic perspective, this study has some inherent limitations. First, our cross-sectional design prevents us from studying causal relationships among variables. A longitudinal investigation would provide further insights into the dynamic nature of knowledge creation and different organizational levels. Future researches might use longitudinal design to draw causal inferences of our model. This study opens up several paths for future research. There is a need to expand the survey to other countries and investigate the relationship between different variables connected to business performance and entrepreneurship. A research gap exists in the link between the EO and KC and empirical research about the commercialization of knowledge.

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International Trade and Income in Malawi: A Co-integration and Causality Approach

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Abstract

This paper investigates causal relationships between exports, imports, and economic growth in Malawi over the period 1961-2010. These relationships are examined using the Johansen frameworks for co-integration whereas the Vector Error Correction (VECM) framework is further used to provide estimates for both short-run and long-run dynamics in the series under study. The empirical results, including the impulse responses support the export-led economic growth and export driven imports hypotheses in the long run, but they provide no evidence of any economic growth-driven exports. These results strongly support the role of international trade in Malawi's economic development and hence policies that seek to facilitate Malawi's trade within and outside the SADC regional would be worthwhile to pursue.

Keywords: exports, incomes, Malawi, causality, co-integration

JEL Classification: F12; F14; F43

1. Introduction

At present, the Malawi government is pursuing an exchange rate regime that can best be described as a free float where central bank intervention is very limited following the IMF's recommendation to the new government of President Joyce Banda who rose to power following the demise of President Bingu wa Mutharika in April 2012. This is in contrast to the stance that her predecessor took since coming to power in 2004.

From 2004, the government started pursuing a fixed exchange rate policy and also embarked on an ambitious Farm Input Subsidy Program (FISP) at the same time with an intention of increasing people's incomes by addressing the pervasive liquidity constraints that almost every rural farmer faces even today (see Chirwa and Chinsinga, 2011).

A combination of the two policies appeared to have exerted enormous pressure on foreign exchange mainly because Malawi imports all farm inputs and the over-valued

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exchange rate regime suppressed export earnings. Moreover, while the subsidy programme should normally have led to burgeoning export values, this was not *per se* the case because Malawi's FISP targeted maize which is not one of Malawi's major export crops. Maize in Malawi has a high political value and its sale is controlled such that despite the record increases in maize production in the post 2008, external trade in maize was still undermined by restrictions and bans e.g. in 2010 (see Chirwa and Chinsinga, 2011).

The change in exchange policy from an inflexible regime to a free float regime following the end of Bingu wa Mutharika's presidency, in the absence of any marked downscaling of the FISP appeared to have done little to reduce foreign exchange rate problems and negative trade balance.

2. Malawi's Exports and Imports

As at the end of 2012, Malawi's total imports increased by 74% in 2011 to an overwhelming US$ 2.7 billion, whereas exports only increased by 31% in 2011 to US$1.3 billion in 2012 thereby registering an overwhelming trade balance of US$1.4 billion (Ministry of Trade and Industry, 2012). The trade balance appears to have deteriorated not only because inputs (which are imports) are expensive, but also because under a flexible exchange rate, the country such imports become even more expensive.

Indeed the growth in Malawi's trade deficit post 2001 and 2012 came about because of more rapid growth in imports than in exports in the absence of any ability to the economy to turn imports into a productive base of the economy (Ministry of Trade and Industry, 2012). As such the gap was largely financed by aid flows, such that the cutting of aid in 2011 resulted in the dwindling of foreign reserves and a major foreign exchange crisis that renders 2011 data unreliable for long-term planning purposes (Ministry of Trade and Industry, 2012). The foreign exchange rate demands, could not be met by Malawi's only major export crop-tobacco which generated about $585 million in 2010, accounting for about 50% of exports in that year (Ministry of Trade and Industry, 2012).

Today, there appears to be a realisation that input subsidy program's targeting maize alone may only be expected to have limited influence on poverty and food security. The new export strategy (NES) as well as the MGDSII seek to find ways of expanding international trade through export diversification. Instead of relying solely on tobacco exports, which currently accounts for more than 55% of exports (see Lea and Hanmer 2009) and generates more than 60 per cent of export earnings, the NES identifies oilseeds, and other crops as potential substitutes to tobacco which is facing anti-smoking lobbies, which in 2010 led to drastic negative changes on tobacco prices leading to poverty. The new export strategy also identifies processing as important as raw materials face deteriorating terms of trade over time (Ministry of Trade and Industry, 2012).

Considering international trade as a whole, Malawi imports mostly from RSA (22%), and in 2012, fuel was the major import covering 13% of all imports. Over the same period, Malawi exported mostly to Canada (10%) and tobacco was the major export covering 53% (Ministry of Trade and Industry, 2012b). Within the SADC, Malawi imported goods worth

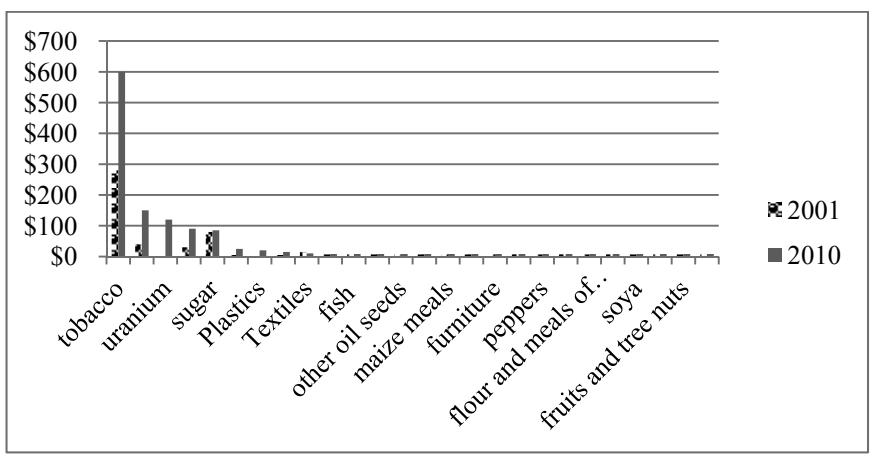
US$1.2 billion from SADC (42% of the World) and Fuel was the major import covering 30% of all SADC imports. Malawi exported goods worth US$0.2 billion to SADC (19% of the world) and cereals were the major exports covering 16% of all SADC Exports (Ministry of Trade and Industry, 2012b).

At the level of COMESA, Malawi imported goods worth US$0.6 billion from COMESA (22% of the World) and fuel was the major import covering 31% of all COMESA imports. Over the same period, Malawi exported goods worth US$0.2 billion to COMESA (14% of the world). Tobacco was the major export covering 14% of all COMESA Exports. Malawi also trades with the EU and she imported goods worth US$0.4 billion from EU (13% of the World). Pharmaceuticals were the major imports covering 29% of all EU imports and Malawi exported goods worth US$0.3 billion to EU (26% of the world). Tobacco was the major export covering 64% of all EU Exports (Ministry of Trade and Industry, 2012b).

With Asia, Malawi imported goods worth US$0.9 billion from ASIA (33% of the World) and fertilizer was the major import covering 23% of all ASIA imports whereas, she exported goods worth US$0.2 billion to ASIA (17% of the world) and tobacco was the major export covering 51% of all ASIA Exports (Ministry of Trade and Industry, 2012b).

Below is a snapshot of the trade situation in Malawi.

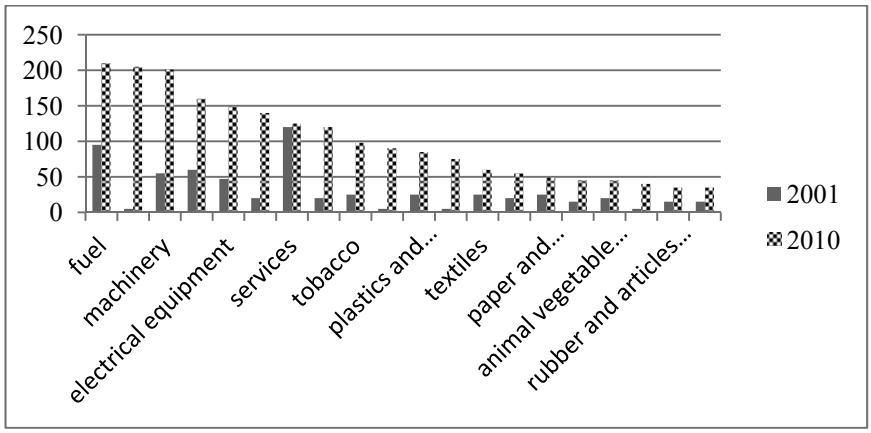
Figure 1: Malawi's main exports by value, $ million



Source: www.trademap.org. Total exports stood at $493 million in 2001 and $1,208 million in 2010.

Figure 1 shows that while tobacco is an important export crop, tea, sugar, services and mining sectors are coming up as important for exports. On the import side, shown by Figure 2, it appears that fuels, fertilizers, machinery, vehicles, electrical equipment, pharmaceuticals and services were among the major streams of imports into Malawi. An important reason behind the burgeoning trade deficit in Malawi is its lack of industries to manufacture any of the frequently imported goods and services.

Figure 2: Malawi's main imports by value, $ million



Source: www.trademap.org. Total imports rose from $733 million in 2001 to $2,299 million in 2010.

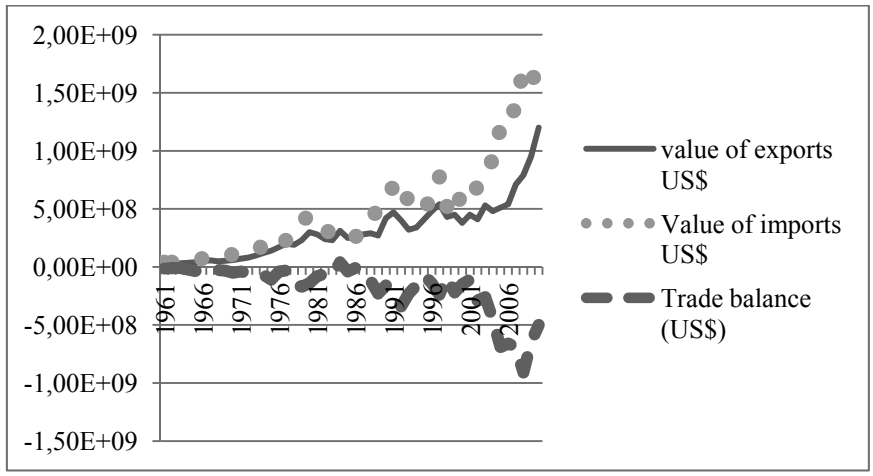
That the fertilizer import bill was large in 2010 is not surprising. The FISP has claimed a lot of resources and has constituted at least 30% of the agricultural budget and in 2012 the proportion of the agricultural budget that went to the FISP rose to 57% (Ministry of Trade and Industry, 2012). It ought to be noted however that the percentage of Overseas Development Assistance (ODA) to agriculture, has averaged only about 8 percent over the entire FISP implementation period, which underscores the importance of national monetary policy on imports.

The Malawi Growth and Development Strategy (MGDSII) highlights the importance of export promotion and diversification in a bid to reduce the balance of payment problems that Malawi is facing currently. It is also noted that 'increased industrial activities are critical for generating employment opportunities, expanded manufacturing base, enhancing value addition and diversifying exports' (Ministry of Trade and Industry, 2012).

Against this background, this paper's objectives were to find out if there is an empirical link between international trade and incomes and if so, what needs to be done in malawi to ensure that trade is enhanced and incomes are enhanced.

Malawi's imports have soared since the 1960's and at present the trade balance has worsened further as exports have stagnated relative to imports. The Figure 3 shows inter-temporal trends in balance of trade, exports and imports and the gap between imports and exports over time is conspicuous.

Figure 3: Trends in Exports, Imports and Trade Balance for Malawi



Source: Author's computation based on World Bank data (2012)

The worsening trade balance may be attributed to inefficiencies on the supply side of the economy, high population growth that stimulates demand and at least after the 1990's, imports increased sharply owing to the depreciation of the South African rand relative to Malawi Kwacha (see SADC, 2007). This is an important issue because South Africa is Malawi's single most important trading partner in the region. To put it in perspective, Malawi gets almost 40% of its imports from South Africa, which in turn buys 12% of Malawi's exports (SADC 2007). The supply side of the economy has not seen any radical changes in technology and continues to grow at a lower rate over time. Such slow growth has trailed the growth in imports.

The trend in Figure 3 is worrisome for two reasons: (1). If the trend continues such that exports forever trail imports, Malawi will continue to face foreign exchange problems, (2). If indeed it is the case that exports and economic growth have a longrun relationship, there is cause for concern because poor export performance will impact economic growth negatively. It should also be noted that as tobacco revenues, accounts for about 60 percent of total export revenues, the 2010 tobacco price shock caused severe balance of payments problems (see Pauw et al., 2013), which partly explain the further deterioration of the trade balance that year. In 2011, the external debt due to the balance-of-payments was 16.8% of the GDP. This paper seeks to investgate whether exports and economic growth are tied in a long run relationship in the case of Malawi.

Export growth is often considered to be among the main determinants of production and employment growth of an economy (Ramos, 2001; Raju and Kurien, 2005). The said causal relationship is often called the export-led growth (ELG) hypothesis (Ramos, 2001). The proponents of ELG thesis argue that export promotion, for example through policies such as export subsidies or exchange rate depreciation could be good for the growth of incomes (Mishra, 2011).

The ELG hypothesis appears to be substantiated on the grounds that through the foreign trade multiplier, export growth leads to an expansion of production and employment, whereas the foreign exchange made available by growth in export earnings permits the importation of capital goods which, in turn, increases the production potential of an economy (see Ramos, 2001). It is argued that competition in international markets could promote economies of scale and increases efficiency by concentrating resources in sectors in which the country has a comparative advantage (see Mishra, 2011).

The volume of, and the competition in export markets yield economies of scale and an acceleration of technical progress in production (Ramos, 2001). Lastly, given the theoretical underpinnings so flagged, the observed strong correlation of export and production growth is interpreted as empirical evidence in favour of the ELG hypothesis (see Ramos, 2001; Raju and Kurien, 2005).

The relationships between economic growth and exports is well treated in literature (Ramos, 2001), but the lack of consensus on the long-run and short run relationships between incomes, exports and imports implies that the relationships may be context specific (Ramos, 2001). On the Malawian scene, studies that purport to achieve this are hard to find and undoubtedly this study could have policy implications and could add to the general debate on export orientation strategies in development policy with the unique case study of Malawi.

As a case under study, Malawi stands out as a unique case where perhaps the potential policy gain from these studies is the highest especially now because of the many foreign exchange problems that the country faces. At present the Malawi economy is facing difficulties to grow and foreign exchange is often unavailable due to lack of enough exports in the midst of enormous increases in demand for imported goods. Studying the export-economic growth issue for Malawi alone, stimulates the curiosity in the topic among scholars and policy makers and has the potential to add value to economic development policy processes in Malawi.

In order to unravel the importance of exports and imports to incomes, we follow Ramos (2001) and argue that a test for long-run and short-run relationship among these variables is important. As in Ramos (2001) this study applies the theory of co-integration developed by Engle and Granger (1987) Johansen (1988), Stock and Watson (1988) and Johansen and Jesulius (1990) to examine whether Malawi's exports, imports and incomes all in real terms (2000 was the base year), for the period 1961 to 2010 were co-integrated. Unlike in Ramos (2001) and other previous authors, the paper goes further to employ impulse response functions as well as error variance decomposition techniques to confirm the dependence between the variables in subject thereby achieving the main purpose of this paper.

The rest of this paper is organized as follows. The next section discusses the in brief the relationships between the variables under study, while the subsequent sections 3 and 4 present the methodologies, results and conclusions in that order.

3. Literature Review

3.1 The relationship between exports, imports and income

The relationship between the overseas sector and GDP can be thought of as threefold namely; export-led growth, growth-driven exports, and the two-way causal relationship that may be termed feedback (see Ramos, 2001) and are discussed below:

3.2 Export-led growth

The work by Balassa (1978), Michaely (1977), Feder (1982), Marin (1992) , Thornton (1996) as well as Nasreen (2011) provide evidence of export-led growth in that they found that countries exporting a large share of their output seemed to grow faster than others. This is also evident in Chow (1987) who concluded in his study that his findings supported the export-led growth strategy in that expansion in exports not only promoted the growth of national income but also led to structural transformation of the developing countries.

The growth of exports has a stimulating influence across the economy as a whole in the form of technological spill-overs and other externalities (Ramos, 2001). But Mishra (2011) investigating the relationship in India using data for the 1970 to the 2009 period, rejected the ELG hiypothesis.

Grossman and Helpman (1991), Rivera-Batiz and Romer (1991), Romer (1990) appear to suggest that an increase in intra as well as extra-regional trade increases the number of specialized inputs, increasing growth rates as economies become open to international trade (see Ramos, 2001). This is also evident in Chow (1987) and Balassa (1978) and Esfahani (1991) who concluded in their study that export promotion was particularly important for countries with insufficient access to foreign aid and /or capital. Although controversies still rage in this area of research, with Jung and Marshall (1983) and the others such as Love and Chandra (2005) and Dodaro (1993) finding no evidence, it appears that a majority of studies succeed in confirming the export-led growth hypothesis although studies of this kind are rare in Southern Africa.

Shabbaz (2012) investigated the effect of trade openness on economic growth in the long run using the familiar ARDL approach to co-integration. The analysis showed that in the long run, trade openness promoted economic growth and this hypothesis was also upheld by VECM Granger causality test as well as by innovation accounting. On the other hand Shabbaz et al. (2011a) examined the exports-led growth hypothesis using quarterly data over the period 1990-2008 in case of Pakistan. In their study, Ng-Perron unit root test, ARDL bounds testing approach to cointegration and error correction method (ECM) for short run dynamics were employed to test the hypothesis of export-led growth and the results showed that exports were positively correlated with economic growth confirming the validity of exports-led growth hypothesis. Exchange rate depreciation slowed down economic growth. In some way, these results supported Shabbaz et al. (2011), Shabbaz and Rahman (2012), as well as Shabbaz and Rahman (2010) who found that Foreign Direct

Investments (FDI), a proxy of a country's openness, was a promoter of economic growth, at least in Pakstan.

3.3 Growth-driven exports

The counterargument of the ELG thesis relies on the notion that gains in productivity give rise to comparative advantages in certain sectors that lead naturally to export growth (see Raju and Kurien, 2005). Also, countries with high growth rates and relatively low absorption rates should export the excess output (see Raju and Kurien, 2005). Indeed as noted by Bhagwati (1988) an increase in GDP often leads to an expansion of trade, unless the pattern of growth-induced supply and corresponding demand creates an anti-trade bias (see Ramos, 2001).

The neoclassical theory of trade stresses the causality that runs from home-factor endowments and productivity to the supply of exports (see Findlay, 1984; Ramos, 2001; Raju and Kurien, 2005). Using the Johansen co-integration procedure, Love and Chandra (2004) found evidence to support export-led growth hypothesis both in the short-run and the long-run with annual data from Pakistan although applying similar procedures to Pakstan data for different years gave no evidence of co-integration using Granger tests (Love and Chandra, 2005). The evidence also appeared elusive in Dodaro (1993) and in Leitão (2012) who showed that economic growth was highly correlated with all measures/indicies of globalization (trade).

3.4 Feedback

Bhagwati (1988) and Ramos (2001) further notes that there may be a bidirectional causal relationship between economic growth and exports because increased trade produces an increase in GDP, whereas more income leads to trade expansion. These arguments appear to have also been noted widely by Grossman and Helpman (1991) in models of north-south trade. Other studies by Bahmani-Oskooee and Alse (1993) further reveal evidence of bidirectional causality between output growth and export growth.

Again, Nasreen (2011) examined the export-growth linkages for Asian countries for the period 1975-2008 using panel unit root tests among other strategies and generally found bidirectional causality between exports and economic growth. Their heterogeneous causality hypothesis showed that the causality run from economic growth to exports in case of Pakistan, Sri Lanka and Indonesia and from exports to economic growth in Malaysia and Thailand. But bidirectional causality also was established in cases of India, Sri Lanka and Indonesia whereas a neutral relationship was found in case of Bangladesh (Nasreen, 2011).

4. Methodology

In the presence of the highlighted theoretical possibilities regarding the relationships between GDP and exports, it appears that this is an empirical question. The present

investigation proceeds by examining the time-series properties of the data, undertaking a systems co-integrating analysis, and examining Granger causality tests.

4.1 The data

The data constitutes annual observations on real GDP, real exports, and real imports for Malawi, sourced from the World Bank's African Development Indicators section and supplemented with the Malawi National Statistical Office data where needed. Annual data on all variables are available from 1961 to 2010.

Plots of the logarithms of the three time series are shown in Figure 4. Figure 4 demonstrates that the natural logarithms of real GDP, (LogY), the real exports (logX), and the real imports log (M), exhibit strong upward trends which provide qualitative evidence that the three series tend to move together. Summary statistics of GDP (Y), Exports (X), and Imports (M) indicate that these variables have means equal to US$8380 million, US$312 million, US$489 million with associated standard deviations of US$3,740 million, US$246 million, US$436 million, respectively. See Table 1 below

Table 1: Descriptive Statistics

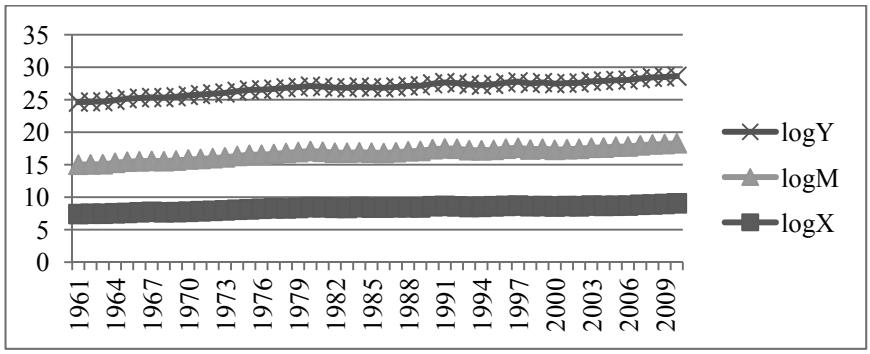
Variable	Obs	Mean (US$) in Millions	Std. Dev. (US$) in Millions
Imports (M)	50	489	436
Exports (X)	50	312	246
GDP (Y)	50	8380	3740

4.2 Testing for integration

It is important in multivariate time series analysis to run regressions with similar orders of integration to avoid getting spurious results (Gujarati, 2005). Univariate analysis of each of the three time series real GDP, real exports, and real imports was carried out by testing for the presence of a unit root in order to check for stationarity of the variables. This was achieved using the Dickey-Fuller DF Unit root-tests (Dickey and Fuller, 1979), Phillips and Perron tests (1988) -tests as well as the Augumented Dickey Fuller AGDF tests for the individual time series and their first differences. The major results are shown in Table 2. The lag length for the ADF tests was selected to ensure that the residuals were free from autocorrelation.

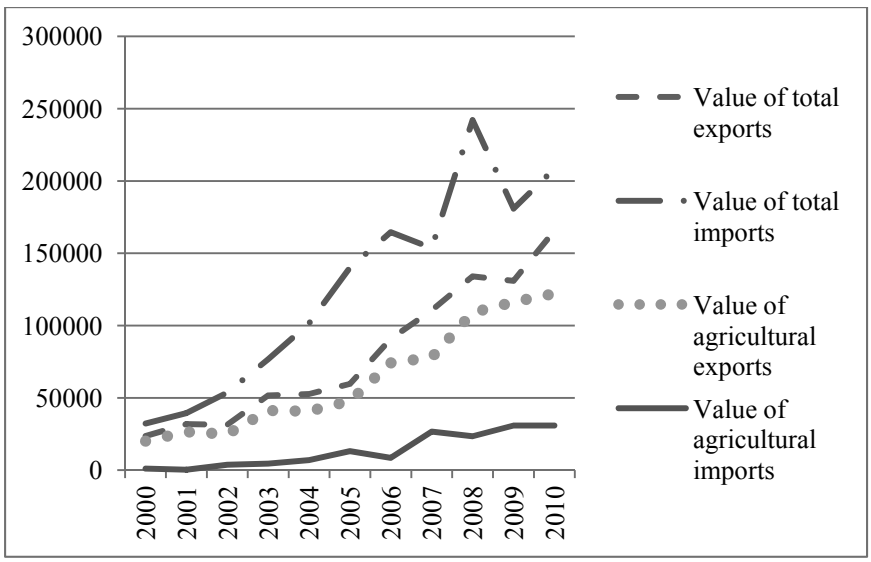
The results from the DF, ADF, DF-GLS tests and the Phillips and Perron PP tests show that none of the variables in their level form represents a stationary process. However the DF, ADF and PP tests applied on the first differences of the three variables confirm that there were stationary and hence presenting some evidence that the series were integrated of order 1i.e. $I(1)$.

Figure 4: Co-movement of the logY, logM and logX series



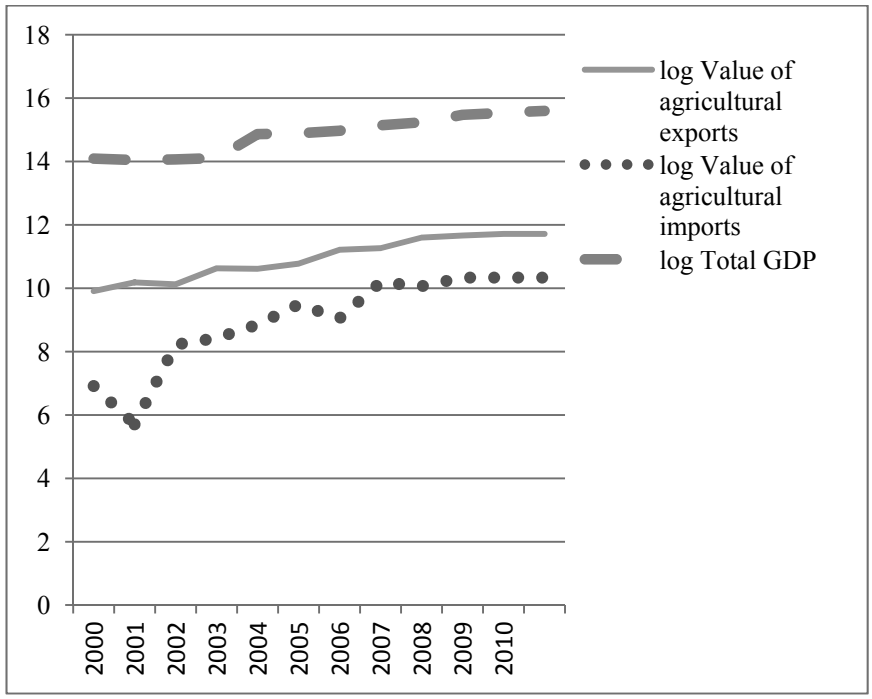
Source: Authors computations from World Bank Data

Figure 5: Co-movement between agricultural trade and total trade variables (million kwacha)



Data Sources (ReSAKSS-SA)

Figure 6: Co-movements between GDP and agricultural trade variables



Data Sources (ReSAKSS-SA)

The Figures 4 up to Figure 6 show that exports, gdp and imports follow each other quite closely. Moreover it is evident from the data from the Regional strategy Analysis and knowledge support system (ReSAKSS-SA) that agricultural exports and imports also follow the GDP curve quite closely too, which is not surprising considering that agricultural exports constitute a large share of Malawi's exports.

Table 2: tests for orders of integration

	Single unit root (i.e. on levels)				Second unit root (i.e. on changes)		
Series	DF	ADF	PP	DFGLS	DF	ADF	PP
Y	-1.42	-2.54	-1.61	-1.57	-8.28***	-5.71***	-50.53***
X	-1.71	-1.94	-1.66	-1.28	-6.89***	-5.12***	-42.98***
M	-1.03	-2.74	-1.27	-1.82	-6.27***	-4.82***	-41.82***

***; **; * Imply significance at 1%, 5% and 10% levels respectively. The null hypothesis is unit root and so, significance implies stationarity; N=50.

In Table 2, considering that first differencing produced stationarity it may be concluded that each of the series Y, X, and M was integrated of order 1, *I*(1).

4.3 Testing for co-integration

The idea behind co-integration is that two or more variables have a long run relationship with each other (co-integrated) even if they may be individually nonstationary, their difference must be stationary (see Ramos, 2001). In the event that nonstationary variables have a nonstationary difference, it is said that they are not co-integrated and any bid to find a long run relationship between them will simply yield spurious results (see Gujarati, 2005; Greene, 2003). As per Ramos (2001) using the idea of a stochastic trend, one may wish to examine whether given variable series are driven by common trends (Stock and Watson, 1988) or whether they are co-integrated (Engle and Granger, 1987; Ramos, 2001). Testing for co-integration implies testing the following relationship (Ramos, 2001):

$$\sum_{j=1}^{3} \beta_{ji} z_{jt} = \varepsilon_{it} \ , \ i = 1,....,r \tag{1}$$

In equation (1) the ε_{it} are *I(*0) series, although the *Zjt* are *I*(1) variables. Given the *I(*0) nature of ε_{it}, the long-run behaviour of *Zjt* (j=1,...3) is determined by 3-*r* common trends (Ramos, 2001). The question of how many co-integrating relationships and certain linear restrictions in a system of equations is normally tested using the approach proposed by Johansen (1988) and Johansen and Juselius (1990). The other way of testing for the long run relationship is to use what is known-as the residual based approach to co-integration (Gujarati, 2005) where the residuals of an Ordinary Least Squares (OLS) model are subjected to the univariate unit root tests as described previously. A rejection of unit root implies that the residuals are stationary and hence the variables associated with them are co-integrated/they have a long run relationship so that a permanent rise in another will yield a permanent rise in the other.

Tables 3 and 4 present the results obtained by the application of the residual based approach to co-integration and the Johansen's procedure respectively. Considering that the results from these tests are often sensitive to the lag order selected, the lengths of the Vector Autoregressive model (on which the tests were based) were chosen by minimizing the Akaike Information Criterion (AIC). Concerning the number of co-integrating vectors, *r*, the results from the Johansen's procedure support the existence of two co-integrating relations.

Table 3: Residual based test for co-integration

Series	DF	PP
Residuals for logY	-3.54***	-19.76***
Residuals for logX	-2.90*	-14.27***
Residuals for logM	-3.84***	-24.39***

Significance: *** ; **, and * stand for signifcance at 1%, 5% and 10% levels respectively. This implies that residuals from the models of logged values of Y, X and M were stationary.

To establish if the variables are co-integrated, the ADF unit roots test was applied on the residuals from the three equations for Y, X and M show co-integration.

Table 4: Johansen's co-integration tests

Hypothesized co-integrating H0	Number of relationships H1	Test statistic		Critical values (95%)	
		Max. eigenvalue	Trace	Max. eigenvalue	Trace
r=0	r>0	26.6**	22.51**	20.30	29.68
r<=1	r>1	14.3**	18.26**	13.23	15.41
r<=2	r=3	3.00	1.17	3.5	3.76

Significance: *** ; **, and * stand for signifcance at 1%, 5% and 10% levels respectively
Source: Authors' tests using Stata 2012; N=50

The results suggest two co-integrating relationships implying a confirmation of previous residual based co-integration approach that the series under study have a long run relationship.

4.4 Granger Causality

The null hypothesis being that all coefficients of the lagged x in the first equation above is zero against an alternative that it's not zero. In this paper, implementation of Granger tests have been conducted in both Vector Auto regressive models (VAR) and Vector Error Correction Model (VECM) settings following Sims (1980) and Johansen and Jesulius (1990) respectively. The ECM-VARs for the three variables in subject are hence characterised as:

$$\Delta y = \alpha_{11}\varepsilon_{1,t-1} + \alpha_{12}\varepsilon_{2,t-1} + \sum_{l=1}^{m}\varphi_{11,l}\Delta y_{t-1} + \sum_{l=1}^{m}\varphi_{12,l}\Delta x_{t-1} + \sum_{l=1}^{m}\varphi_{13,l}\Delta m_{t-1} + u_1 \quad (2)$$

$$\Delta x = \alpha_{21}\varepsilon_{1,t-1} + \alpha_{22}\varepsilon_{2,t-1} + \sum_{l=1}^{m}\varphi_{21,l}\Delta y_{t-1} + \sum_{l=1}^{m}\varphi_{22,l}\Delta x_{t-1} + \sum_{l=1}^{m}\varphi_{23,l}\Delta m_{t-1} + u_2 \quad (3)$$

$$\Delta m = \alpha_{31}\varepsilon_{1,t-1} + \alpha_{32}\varepsilon_{2,t-1} + \sum_{l=1}^{m}\varphi_{31,l}\Delta y_{t-1} + \sum_{l=1}^{m}\varphi_{32,l}\Delta x_{t-1} + \sum_{l=1}^{m}\varphi_{33,l}\Delta m_{t-1} + u_3 \quad (4)$$

The symbols Δy , Δx , Δm , φ_{ij} , α_{ij} , ε_{ij} m and u_i stand for the change in log of real income, change in log of real exports, change in log of real imports, adjustment parameters, speeds of adjustment, error correction terms and disturbance terms respectively. The Granger Causality results are based on the following model

$$\Delta y_t = \sum_{l=1}^{m} \varphi_{11,l} \Delta y_{t-1} + \sum_{l=1}^{m} \varphi_{12,l} \Delta x_{t-1} + \sum_{l=1}^{m} \varphi_{13,l} \Delta m_{t-1} + u_{1t} \quad (5)$$

$$\Delta x_t = \alpha_2 + \sum_{l=1}^{m} \varphi_{11,l} \Delta y_{t-1} + \sum_{l=1}^{m} \varphi_{12,l} \Delta x_{t-1} + \sum_{l=1}^{m} \varphi_{13,l} \Delta m_{t-1} + u_{2t} \quad (6)$$

$$\Delta m_t = \alpha_3 + \sum_{l=1}^{m} \varphi_{11,l} \Delta y_{t-1} + \sum_{l=1}^{m} \varphi_{12,l} \Delta x_{t-1} + \sum_{l=1}^{m} \varphi_{13,l} \Delta m_{t-1} + u_{3t} \quad (7)$$

It has to be said however that since the variables herein are cointegrated, the Granger Causality results may be somewhat misleading because a standard assumption that must be met for Granger causality to be valid is that the variables ought not be con-integrated (see Engle and Granger, 1987; Georgantopoulos and Tsamis, 2012). In view of this, this results should be interepreted with caution. Fortunately though, in this paper these Granger causality results are supported highly by the results of the error correction models as well as the qualitative evidence ensuing from the inpulse response functions, as will be appreciated uponexamining the sections below.

4.4.1 Causality results from the standard Vector Auto-Regressive (VAR) model

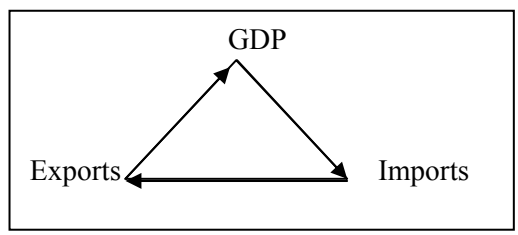
Table 5: Granger causality Wald tests

Equation	Excluded	Chi2	df	prob > chi2
DlogY	DlogX	6.2**	2	0.05
DlogY	DlogM	2.3	2	0.30
DlogY	ALL	11.4**	4	0.02
DlogX	DlogY	0.89	2	0.63
DlogX	DlogM	7.1**	2	0.03
DlogX	ALL	12.5***	4	0.01
DlogM	DlogY	5.5*	2	0.06
DlogM	DlogX	1.5	2	0.46
DlogM	ALL	8.3*	4	0.08
Autocorrelation Test	Lagrange Multiplier	Ch2=6.87 Prob>chi2 =0.65		
Residual normality test	Kurtosis	Chi2=3.52 Prob >Chi2 =0.32		
VAR-stability	All Eigen-values lie in unit circle			

DlogXi stand for change in the log of variable i. N=50; estimator;oLS
Significance: *** ; **, and * stand for signifcance at 1%, 5% and 10% levels respectively

Table 5 above shows results from the Granger Causality framework. Because the results of the granger causality tests partly depend on stationarity or lack thereof for the variables being tested Adamopoulos (2010) and Georgantopoulos and Tsamis (2012), the results reported above are based on changes in the variables for income, exports, and imports. The results suggest unidirectional causality between changes in exports and changes in income confirming the export-led growth hypothesis. The results also show that changes in imports granger cause changes in exports possibly because being predominantly agrarian, Malawi has to import its factors of production (seeds, fertilizers, pesticides, as well as machinery for manufacturing industries and agriculture). Not surprisingly, an increase in GDP growth granger causes imports. This is again a true reflection of the Malawian economy where imports get stifled with economic downturns. The findings above can be summarized in the following diagram, where the arrows point to the variable being granger caused by the variable on the other end of the arrow.

Figure 7: The relationships between GDP, Exports and Imports in Malawi



From the diagnostic tests performed after the Granger methodology, it is clear that there are no problems associated with the model. The model residuals show normality and more importantly they are free from serial autocorrelation which is important for the results to be consistent and unbiased (Greene, 2003). Furthermore, all the eigenvalues associated with the estimation lie inside the unit circle so the VARs satisfy stability conditions (Greene, 2003) which is also important.

These results imply that exports are good for economic growth which makes intuitive sense as exports bring in foreign exchange which in turn is used for imports necessary for production and hence income growth. Growth itself is also important because it makes some sectors of the economy more competitive and hence economic growth appears to stimulate future exports (see Ramos, 2001). The import of high quality capital goods could expand the country's production possibilities. For example this may imply that imports allow the export sector to use more advanced technologies which subsequently lead to higher export activities (Ramos, 2001; Lee, 2010).

Exports may also have a direct effect on the expansion of income of a country Ramos, (2001). For instance, exports may lead to an improvement in efficiency by increasing competition and by allowing export sector to adopt more advanced technologies while on the other hand, addition of international markets to the domestic market allows firms

in the export sector to have higher capacity utilization and to enjoy greater economies of scale (Ramos, 2001). Higher income may encourage domestic firms to invest in the areas which can be used to increase the export capacity of domestic producers and to explore foreign markets (Ramos, 2001). In general, exports, imports and income of a country tend to reinforce each other directly or indirectly (Ramos, 2001; Lee, 2010), and appears so in the case of Malawi.

In the section that follows, we present some discussion and results of co-integration in the renowned Johansen framework (Johansen, 1990).

4.4.2 Granger-causality in the ECM-VAR

As in Ramos (2001), the number of co-integrating relationships presented in Table 4 will result in a corresponding number of residual series, and hence error correction terms ECTs, to be used in the subsequent VECM (see Ramos, 2001). The systems under study are anlogous to the following, where the error correction model must be seen as correcting towards an equilibrium which in the present case case has two dimensions (See Ramos, 2001). Table 6 presents results showing the short run elasticities for the relationship between GDP, exports and imports.

4.4.3 Results of the short and long elasticities from error correction models

Table 6: VECM results showing short-run elasticities and adjustment parameters for the three equations

	Δy (income)		Δx (exports)		Δm (imports)	
		Std. Err.		Std. Err.		Std. Err.
_ce1						
L1.	-0.11**	0.04	-0.14*	0.07	-0.11	0.08
_ce2						
L1.	0.01	0.08	0.35**	0.13	-031*	0.16
logY						
LD.	-0.34**	0.13	0.02	0.25	0.27	0.29
logM						
LD.	0.03	0.08	-0.11	0.15	0.14	0.18
logX						
LD.	0.25**	0.09	0.04	0.16	0.16	0.18
_cons	-0.01	0.01	0	0.02	0	0.02

*Imply significant at 10%, ** imply significant at 5% and ***, imply significance at 1%; ce1 an ce2 are error correction terms for the models; N=49; Estimator -OLS

The speeds of adjustment (error correction terms) for the GDP equation are -0.11, significant at 1%; and 0.01 which is not significant. This implies that, real GDP adjusts slowly following a shock in the system i.e. in imports, exports, or GDP. The short run adjustment parameters (elasticities) in the real GDP model are -0.34 for real GDP and is significant; -0.03 for imports and is insignificant and finally, 0.25 for exports and is highly significant at 1% level. This implies that shocks to exports have observable impacts to the GDP in the short run but this is not necessarily the case with respect to changes in imports (also see Bindu et al., 2011 for a similar interpretation). This supports the results from standard Granger causality results.

The results also show that in the short run, shocks to exports, imports and GDP do not per se cause observable changes in exports and imports, however once the shocks are experienced, the error correction terms associated with the adjustment process in imports are -0.11 (not significant) and -0.31 which is significant at 5% level. Exports adjust more quickly with error correction terms in the order of -0.14 and 0.36 both of which are significant.

From the results above, it seems that exports responds more / faster than real GDP and imports following a shock in the system in the short run.

The fast adjustment associated with exports is consistent with what is observed. Exports appear to increase more quickly when imports of inputs increase. The speeds of adjustment also show that exports adjust faster followed by imports and then incomes which appears intuitive.

In order to see which of the pairs of the three variables enter into a long run relationship (form co-integrating vectors), and study the long run coefficients, we present results from the Johansen's co-integrating equations in Table 7.

Table 7: Johansen's Co-integrating equations

Beta	Coef.	Std. Err.
_ce1		
logY	1	.
logM	(omitted)	
logX	0.55*	0.31
trend	-0.03**	.01
_cons	-6.13	
_ce2		
logY	(omitted)	
logM	1	.
logX	-0.75**	0.11
trend	-0.01**	0.003
_cons	0.69	

Significance: *** ; **, and * stand for signifcance at 1%, 5% and 10% levels respectively N=50

From the Johansen's procedure, there are two co-integrating relationships confirmed namely: The first one is that of (logY +0.55logX-0.03 trend- 14.22) implying that GDP and exports are co-integrated in the long run and that the relationship runs from exports to the GDP in other words exports are good for economic growth (export-led economic growth). This is consistent with the previous findings from other studies and from the Granger causality test results presented earlier.

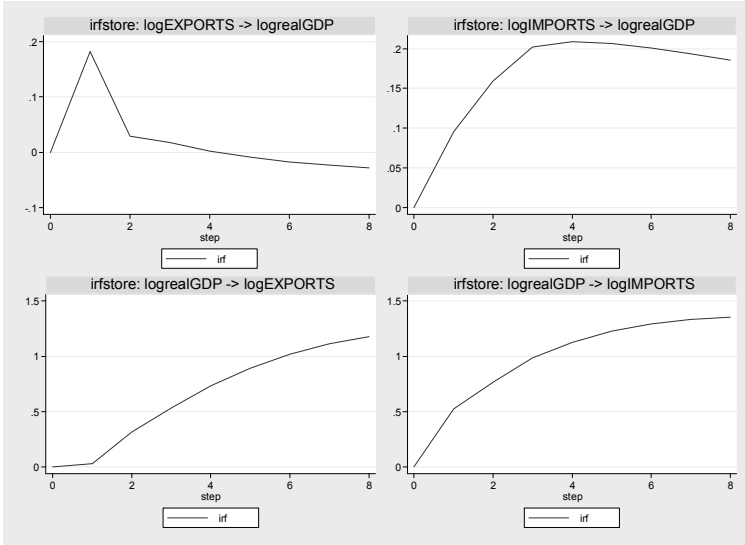
The second long run relationship is that of imports and exports i.e. (LogM- 0.75logX -0.01trend -2.02) implying that there is a long run relationship between imports and exports that runs from exports to imports. Although this results does not per se affirm the granger causality results, it is clear that exports and imports enter a long run relationship in the long run.

The Johansen procedure shows that in the long run a permanent one per cent increase in exports leads to about a half (0.55) per cent increase in real GDP in Malawi, while GDP influences imports. These results in general support the granger causality results that highlighted a Granger causal relationship between imports, exports and GDP and are also in concord with the residual based co-integration results. Again, the results augur very well with the actual Malawi economy whose foreign exchange generation is mainly dependent on export earnings as the reserves are thin and the economy often faces short term foreign exchange problems. There is also no evidence of import-led growth in the long run and in the short run imports appeared to have insignificant impacts albeit adverse ones, which is not a strange finding in the literature associated with these studies. In general the three variables under study are all interdependent as they potentially impact on each other in some degree.

A test of the VECM stability following the Eigen value criterion shows that the model was stable as all Eigen values lied within the unit cycle.

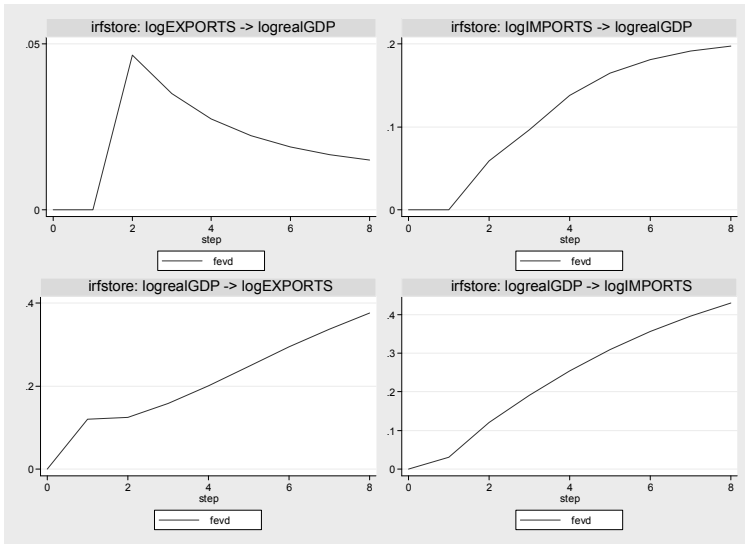
The results from co-integration affirm the long run relationships between some pairs of the three variables. The figures below present some graphs that show some qualitative evidence of the links between pairs of the variables under study. The error variance decomposition procedures are a powerful way of understanding the causality between endogenous variables (see Nkoro and Uko, 2012)

Figure 8: Impulse Response functions for the three variables



**the arrows in the headings originate from the impulse variable and point to the variable that responds. E.g. the first part of the figure presents a response of real GDP following a shock to exports. The other tables can be understood the same way.irfstore: stand for impulse response function; step stands for period of prediction; irf is impulse response function*

Figure 9: Cholesky Forecast Error Variance Decomposition



**the arrows in the headings originate from the impulse variable and point to the variable that responds. E.g. the first part of the figure presents a response of real GDP following a shock to exports. The other tables can be understood the same way. irf is impulse response function; fevd stands for forecast error variance decomposition*

The general qualitative story coming from the two graphs above is that incomes, exports and imports have some level of interdependence in the long run. Combining these qualitative conclusions with the findings from co-integration tests performed using Granger methodology and the Johansen's procedure, it is clear that international trade is good for income growth and should be encouraged. Policies that seek to remove inefficiencies from the extra and intra-regional agricultural markets, including high tariffs, import duties, and other forms of trade barriers (Non-Tariff Barriers) may not *per se* be the solution as Malawi is already committed to the SADC Trade Protocol and other bilateral trade agreements in the region, such that agricultural trade barriers are generally very low (see SADC, 2007). However, the SADC region needs to ease some trade barriers against Malawi in the area of Malawi's manufactured goods.

5. Conclusions

The causality frameworks employed herein have led to the finding that export-led growth and growth-led imports are not rejected. An increase in exports in previous periods, lead to growth in income and imports whereas the in increase in imports in the previous period also leads to gains in exports and incomes. This makes sense for the Malawian economy as exports determine foreign exchange which is crucial for imports of goods used as inputs in agriculture, the main sector whose growth determines income growth. These findings provide evidence in support of export orientation and hence international trade is crucial for the growth of the Malawian economy. Policies that seek to facilitate trade between Malawi and other countries have to be encouraged. On the other hand, since it is clear that exports are good for economic growth, Malawi needs to increase the value of exports, and hence should invest in value addition and general agricultural production (modern seeds, inputs and water use technology) and post-harvesting technology among other things. The notion that this is the right time for radical structural changes on the supply side of the Malawi economy cannot be overemphasized.

Fortunately, the NES detailed in (NES, 2012), appears to be a step towards that direction. Malawi needs to diversify its export base as over reliance on tobacco appears precarious and unsustainable. There is need to think seriously about the FISP strategy in terms of its strategy (what should be subsidized cash crops or food crops, production and/or processing) sustainability as it is intricately linked to international trade and incomes. There is also need to think carefully about the exchange regime of the economy as it determines terms of trade and other important indicators such as trade balance.

Evidence on better exchange rate regimes for developing countries appear to show that less flexible exchange rates enhance better macroeconomic environment characterised by low inflation rates, higher economic growth and low interest rates., Very flexible exchange rates, on the other hand may stimulate exports, but the final economy-wide results are an empirical question because the resulting high inflation rates, economic contraction and higher interest rates (as is the case at present following the free float regime) erode

incomes, create uncertainty and deters economic progress at least in the short to medium term (see Harrigan, 2006).

Radical tructural change in the agricultural sector ought to take the form of introduction of modern/transgenic technology, mechnization, rural re-organziation and development of agroprocessing (value addition) at a larger scale to ensure agriculture can be commerce oriented other than subsistence as it currently is.

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Drivers of change in management accounting practices in an ERP environment

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Abstract

This study contributes to contemporary research on changes in management accounting (MA) practices by examining the effect of changes in data quality, information quality and management accountants' tasks on accounting efficiency and effectiveness, and indirectly on management accounting change after the implementation of an Enterprise Resource Planning (ERP) system. Data was collected through an online survey questionnaire distributed to Finnish companies. Overall, the results of the PLS tests (n=70) provide significant support for the proposed model. Consistent with previous studies, time since ERP adoption appears to be a significant determinant of MA change, but the findings of this study also suggest that late adopters, that is, firms adopting an ERP system more recently, perceive greater changes in MA than early adopters. Further, the results indicate that global ERP implementations and use of business intelligence (BI) tools significantly relate to changes in MA practices. The implications of these results for practice and future research are discussed.

Keywords: Management accounting, ERP, BI, change, survey

JEL Classification: M10, M15, M40

1. Introduction

Enterprise resource planning (ERP) systems have become popular in medium-sized and large firms all around the world over the last twenty years. ERPs are organization-wide and integrated information systems that enable organizations to manage and coordinate all their information, resources and functions from shared databases. As ERPs are used to integrate all corporate information into one central database, they allow information to be retrieved from many different organizational functions and assist in providing visible objects for organizations (Dechow and Mouritsen, 2005; Kallunki et al., 2011).

Despite the wide use of ERPs in current business operations, knowledge of their effect on management accounting (MA) is rather scarce (Sutton, 2006; Vakalfotis et al., 2011). Nevertheless, it is important to examine examples of well-functioning relationships

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between ERP use and MA, as ERP systems are supposed to provide an easy and rapid access to operational data, and the role of MA is to convey such data into a managerially relevant and usable form (e.g. Cooper and Kaplan, 1998). Arnold and Sutton (1998) also argue that it is common practice for accounting logic to be reviewed and possibly changed when organizations carry out major scale changes on information systems. Furthermore, scholars (Hunton, 2002; Sutton, 2006) maintain that ERP systems would have an influence on all areas of accounting. Findings from the existing early studies on the impact of ERP on MA indicate, however, that ERP systems have had only a limited impact on MA practices (Fahy and Lynch, 1999; Granlund and Malmi, 2002; Scapens and Jazayeri, 2003). Booth et al. (2000) argue that one main reason for the low impact is that ERP systems are effective in transaction processing, but less effective in reporting and decision support. However, organizations continue to commit substantial business investment to ERP systems, so it is increasingly important to understand the extent to which ERP systems affect MA practices (Sutton, 2000, 2006; Rom and Rohde, 2006; Granlund, 2011).

This study aims to examine the impact of ERP systems on MA change by investigating the effect of changes in data quality, information quality and management accountants' roles and tasks on accounting efficiency and effectiveness, and through that on the change in MA practices, measured as changes in MA techniques. Data from an online survey questionnaire among Finnish large and medium-sized enterprises is used to test hypotheses. The results indicate significant support for the proposed model explaining approximately 52 per cent of variance in changes in MA practices.

Consistent with previous studies, time since ERP adoption appears to be a significant determinant of MA change, but the findings of this study also suggest that late adopters, that is, firms adopting an ERP system more recently, perceive greater changes in MA than early adopters. Further, the results indicate that global ERP implementations and use of business intelligence (BI) tools significantly relate to changes in MA practices. The implications of these results for practice and future research are discussed.

The remainder of this article is organized as follows. The next section provides a literature review of relevant previous studies, the research model and the hypotheses. Section three describes the research method and data collection. Section four presents some details about the MA techniques and the findings of the PLS analysis. The final section provides the conclusions and suggestions for future research.

2. Theory and Hypothesis Development

It has been suggested that an organization's effectiveness largely depends on the effectiveness of its sub-systems, including the accounting function (Kondalkar, 2009). To date, a rather limited number of empirical studies have investigated the relationship between information technology and management accounting using quantitative or qualitative research approaches. Vakalfotis et al. (2011) provide an overview of previous studies on ERP systems, and argue that the majority of previous empirical studies tend to focus on describing changes in MA practices and the role of management accountants resulting from

ERP implementation rather than on analysing and understanding those changes. Granlund and Malmi (2002) developed a theoretical model for the impact of ERP systems on MA and accountants. They propose both direct and indirect effects of ERP systems on management accountants and MA. Direct effects will occur when the implementation of an ERP system directly changes reporting practices, for example. Indirect effects are changes in MA resulting from changes in management practice and/or business processes, initiated by the ERP implementation. Rom (2008) presented a theoretical model to illustrate the relationship between integrated information systems and MA. The Rom (2008) model divides MA into four parts i) tasks, ii) techniques, iii) organization of MA, and iv) behaviour, use and user perceptions.

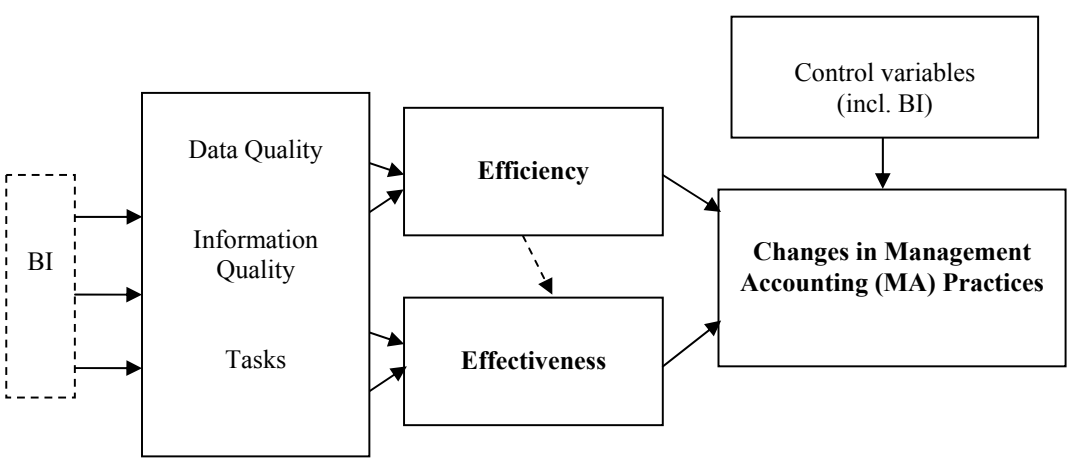
Prior research on the organizational level maintains that information systems, such as ERP systems, are implemented within an organization to improve effectiveness and efficiency (e.g. Davenport, 1998; Adam and O'Doherty, 2003; Hevner et al., 2004). Effectiveness implies the degree to which predetermined goals are met, whereas efficiency refers to the economical manner in which goal-oriented operations are conducted, usually measured as an input/output ratio (e.g. Kondalkar, 2009). Efficiency and effectiveness have also been seen in prior studies as measures of system success (e.g., Smithson and Hirschheim, 1998). To what extent those goals are achieved will, however, depend on several factors such as the capabilities of the information system (IS) and characteristics of the organization; its work systems, its people and its development and implementation methodologies (Silver et al., 1995). For example, the IS success model, developed by DeLone and McLean (1992), and considered one of the prominent instances of successful theory development alongside the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Evermann and Tate, 2009), illustrates that the effects of information technology on the overall organization may depend on the effects on the individual user, the system use, the underlying quality of the system and the quality of the information in the system. Thus, DeLone and McLean (1992) regard IS success as a multifaceted construct including quality measures (system and information quality), attitudinal outcomes (use and satisfaction), and performance-related outcomes (individual and organizational effects).

The DeLone and McLean model (1992; 2003) has gained widespread acceptance as an IS success model (e.g. Tsai et al., 2011), but it has also been criticized for its weak theory in applying *IS use* as one of the key variables of the model (Seddon, 1997; Rai et al., 2002; Bradley et al., 2006). Bradley et al. (2006) argued that is not the use of the information system itself but the impact of the IS use on organizations that is important and represents a success measure. Therefore, this study uses MA impact (measured as efficiency and effectiveness) as an ERP success measure to represent outcomes from ERP use on MA. Further, the DeLone and McLean model has been criticized for focusing too much on the quality of the information technology and system, indicating that only the technology characteristics determine the overall impact. Scapens and Jazayeri (2003), in identifying the *drivers* of MA change through a longitudinal case study, emphasized four characteristics of the SAP software in question –integration, standardization, routinization and centralization – but also noted that the system apparently changed the work of the management accountants.

Therefore, given that the implementation of an ERP system often is accompanied by major changes in ways of working (Grabski and Leech, 2007; Kallunki et al; 2011) to improve efficiency in organizational work (Seddon, 1997; Bernroider, 2008), it is suggested that task-related aspects (that are considered to relate to individual users) should be included in the research model as an independent rather than as an outcome (dependent) variable. Drawing on the above theoretical reasoning, the DeLone and McLean (1992; 2003) model is used as a reference model and underlying theory in this study, however, it is modified to fit the current setting with the construct *Tasks* as an independent variable. In summary, this study considers efficiency and effectiveness as intermediate variables between the independent variables (data quality, information quality, tasks) and the dependent variable (changes in MA practices).

Previous research has considered time elapsed since ERP implementation crucial when studying the effect of the ERP implementation on accounting. It has been argued that a longer period of use will help organizations develop their expertise with the system more effectively and generate business benefits. Granlund and Malmi (2002) argued that some features, such as analytic tools (BI tools), were not included in the early ERP implementations, which could have slowed down the adoption of new MA techniques. Nicolaou and Bhattacharya (2006) maintain that due to the problems and performance drop after the implementation, positive financial performance should not be expected until after a period of at least two years has passed since adoption. Rom (2008) used the period since adoption as a control variable in his study of relationships between integrated information systems and MA, something that will also be tested here.

Figure 1: Theoretical model depicting the influence of changes in data and information quality as well as the accountants' tasks through administrative efficiency and effectiveness on changes in management accounting practices
Model 1 (main model): BI tools as a control variable to changes in MA practices
Model 2: BI tools as an antecedent to data quality, information quality and tasks



Furthermore, although Scapens and Jazayeri (2003) found in their study that the implementation of the SAP software in a European division of a large US multinational company did not lead to the adoption of more advanced MA techniques, this was considered the ultimate goal because previous research maintain that technological changes require fundamental changes to performance measures and methods (e.g., Drury and Tayles, 1995). Scholars (Scapens and Jazayeri, 2003; Rom and Rohde, 2006) argue, however, that despite the lack of adoption of new MA techniques, the ERP system would increase the users' knowledge about these new techniques, which is seen as a starting point for further development. Likewise, in this study the ultimate goal of the implementation of an ERP system is proposed to be fundamental improvements or changes in MA techniques, achieved through a successful ERP implementation as indicated by improved efficiency and effectiveness of MA practices. It is also proposed that achieving efficient and effective MA practices will, however, be contingent upon technology characteristics and MA tasks. Positive relationships are hypothesized to exist between all variables in the model. The variables are modified to the current context based on previous studies in this area. The research model, as illustrated in Figure 1, is controlled for firm- and technology-related characteristics

The research model proposes using unidirectional, rather than bi-directional, paths between the constructs (see Figure 1). DeLone and McLean (2003) suggest in their model that the association between IS use and the net benefits (effects) of the system may be complicated, as the benefits may arise from system use, but positive or negative feedback loops may influence and reinforce subsequent use. While acknowledging that a bi-directional relationship is in this study highly likely between *efficiency/effectiveness* and *change in MA practices* and also between *technology characteristics*, *MA tasks* and *efficiency/effectiveness*, prior studies seem to consider and support a one-way direction. Scholars (Davenport, 1998; Granlund and Malmi, 2002) argue that it is more likely that the ERP system will have an effect on MA practices than vice versa, as the configuration of the ERP system is difficult to change after implementation. Therefore, linear one-way links are adopted in this study, but noted as a limitation of the study. The research model and the proposed relationships will next be discussed in more detail.

It has been argued that IT resources create economic value by increasing operational efficiencies and creating competitive advantage (Melville et al., 2004; Rai et al., 2006). Although the organizational impact of IT/IS has been measured in a number of ways in previous studies (Gorla et al., 2010), research within MA regards efficiency and effectiveness as two main key indicators in assessing and measuring the performance of organizations related to accounting practices and information technology. As stated, one of the key areas and aims of ERP implementation is to achieve increased efficiency and effectiveness of the organization and accounting function. In this study, efficiency and effectiveness are used as mediators to investigate changes in MA techniques. Laitinen (2002) presented two dimensions, cost and quality, in the measurement of the performance of activities. Those dimensions have been modified and used as the dimensions to measure the efficiency of

MA after the adoption of ERP. Thus, the items used relate to the cost of the MA department and the quality of MA work.

Nicolaou (2000) defined the effectiveness of accounting information systems based on the perceptions of decision-makers of whether the output information available to them through transaction processing, management reporting, and budgeting systems meets their requirements for organizational control. He also emphasized the importance of ongoing monitoring as an indicator of effective accounting and internal control systems. Nicolaou's study suggests that effectiveness can be evaluated using indicators like: i) Reports (e.g. daily or weekly reports) are provided frequently, systematically and regularly; ii) Accounting information systems provide information useful for the ongoing monitoring of decisions and actions. These indicators were modified and used as instruments to measure effectiveness in this study.

Regarding the research model of this study it is proposed that increased efficiency and effectiveness in accounting practices will facilitate (in the sense of providing time and resources for) the improvement and development of MA practices and thus trigger a change from existing practice. Thus, it is proposed that an increase in accounting efficiency and effectiveness will positively influence changes in MA practices, here measured as changes in MA techniques. This is stated in the following two hypotheses:

***H1**: There is a positive relationship between efficiency and changes in MA practices*

***H2**: There is a positive relationship between effectiveness and changes in MA practices*

Data quality was defined by Park and Kusiak (2005) as the measure of the agreement between the data views presented by ERP and that same data in the real world. Data quality has been considered essential to information quality, as poor data quality results in poor information quality. Poor data quality, and hence poor information quality, has adverse effects on organizations at the operational, tactical and strategic levels (Redman, 1998). Among others, Sangster et al. (2009) reported that successfully implemented ERP systems have automated data collection and improved information quality, which is in line with prior research indicating that ERP systems are effective in terms of information processing.

Ballou and Pazer (1985) identified four dimensions of data quality: data accuracy, data timeliness, completeness and consistency. Data accuracy means that the recorded data conforms to the actual value, data completeness implies that all data for a certain variable is recorded and data consistency that the representation of the data value is the same in all cases. These dimensions (with the exception of data timeliness) were included as measurement items in this study. It is proposed that positive changes in data quality will positively affect the efficiency and effectiveness of the accounting function and practices.

***H3a:** There is a positive relationship between changes in data quality and efficiency*

***H3b**: There is a positive relationship between changes in data quality and effectiveness*

Further, information provided by an IS system that does not meet its end users' needs is likely to incur heavy maintenance costs and disrupt the operations of the organization, also resulting in high costs to the organization (Swanson, 1997). Therefore, it is argued that high *information quality* (i.e. accurate, complete, and relevant information) leads to better cost control and increased organizational efficiency (i.e. increased profit margin, increased decision making efficiency) (Gorla et al., 2010). In addition, inaccurate or incomplete information may cause job dissatisfaction and the quality of decision making can be negatively affected by irrelevant information. Spathis (2006) reported that information management in ERP systems rated among the most highly rated accounting benefits derived from the implementation of ERP systems. The following benefits were stated by respondents: increased flexibility in information generation, increased integration of applications, improved quality of reports, quicker issuing of reports, improved decisions based on timely and reliable accounting information, and speedier end of year accounting procedures. Their study further found, in contrast to some other prior studies, a significant relationship between ERP systems, reporting and decision making. In addition, Granlund and Malmi (2002) argued for greater accuracy of reports and improved information as a result of ERP implementation in their explorative study. Scapens and Jazayeri (2003) emphasized that the availability of information from an SAP system improved and that information was more up-to-date. Drawing on the above prior studies it is proposed here that the ERP system will affect the quality of information, which in turn will have an effect on the efficiency and the effectiveness of the accounting function. This is stated in the following hypotheses:

***H4a**: There is a positive relationship between changes in information quality and efficiency*

***H4b**: There is a positive relationship between changes in information quality and effectiveness*

Scapens and Jazayeri (2003) recorded the following four changes in the work of management accountants: the elimination of routine jobs leading to a reduction in size of the accounting function; increased accounting knowledge requirements for line managers; more forward-looking information provided by the ERP, enabling them to produce better forecasts; and a broader knowledge of the business required of management accountants, as they were far more involved in the management team. Similarly, Sangster et al. (2009) found that ERP implementation results in changes in the *tasks* of the management accountants. It was also concluded that when the ERP implementation was successful, management accountants had more time for other activities and their role became more enriching. Drawing on these studies, the proposal made here is that a change in the tasks and roles of management accountants will positively affect the efficiency and effectiveness of management accounting in the company, which will provide slack time for development and to implement changes to MA practices. This is stated as follows:

***H5a**: There is a positive relationship between tasks and efficiency*

***H5b:** There is a positive relationship between tasks and effectiveness*

Control variables

Previous studies have also found that demographic characteristics of the firm, such as industry, age and audit firm may explain variations in research findings. Therefore, some firm and ERP demographics were selected as control variables in this study. There might of course be numerous characteristics, acting alone or in combination with other characteristics and events, that affect MA change. One control variable in this study is ERP success, which has been found in previous studies to affect ERP implementation significantly (Sangster et al., 2009). Also ERP scope, that is, the extent of the implemented system, has been found to have an effect on the impact of the system and benefits gained (e.g., Nicolaou, 2003), and is therefore controlled for. Previous research also suggests that major development work might take place after the ERP system has been in use for some time (e.g., Granlund and Malmi, 2002), indicating that additional and more advanced features of the ERP might be adopted at a later stage of the implementation (e.g. Markus et al., 2000; Spathis and Ananiadis, 2005). Consequently, time elapsed since adoption is considered a vital control variable.

Furthermore, scholars have argued that many organizations fail to retrieve all the information they want from their ERP systems and need BI tools (Rom and Rohde, 2006). BI tools are BI software products deployed in an organization (Wieder et al., 2012) to add value to the large data infrastructure investments (e.g., ERP systems) made by firms and believed to have the potential to help a firm access the substantial value locked up in its data resources (Burns, 2005). BI techniques include the activities of decision support systems, querying and reporting, online analytical processing (OLAP), statistical analysis, text mining, data mining and visualization. BI tools provide a business with the ability to analyse business information in order to support and improve management decision making across a broad range of business activities. Chou et al. (2005) claim that the BI tools, compared to the ERP systems, provide better access to data, greater functionality in analyzing data and that the tools are implemented to enhance the performance of the ERP systems. Further, BI tools are considered critical in helping an organization to adapt to change and improve its performance (Watson and Wixom, 2007).

While scholars generally agree on the importance of BI tools, only a few empirical studies have examined the effect of the BI tools on performance (Elbashir et al., 2008) or organizational decision-making (Davenport, 2010). Further, it is not clear how to examine the effect. Wieder et al. (2012) maintain that BI success or quality should be measured around the quality or quality increase of provided data and the quality or quality increase of decisions made in the organization. Rom (2008), however, examines the relationship between the BI tools and MA tasks. To examine the effect of BI tools on MA, this study

tests two models: 1) the use of BI tools as a control variable on MA change (main model, Model 1) and 2) the use of BI tools as an antecedent to changes in data quality, information quality and MA tasks (alternative model, Model 2). The first model implies that BI tools may not be fully integrated with the ERP system but technically separate systems; thus the overall effect may be visible as a change in the MA techniques. The second alternative model assumes integration between the ERP system and BI tools so that the use of the BI tools can be associated with the changes in data quality, information quality and MA tasks.

3. Research Methodology

3.1 Survey and data

Survey data collected through a web-based form was used to test the hypotheses. Hyvönen (2003) argued that small-sized Finnish companies would not have integrated information systems with an analysis-oriented component and systematic MA systems. Therefore, large and medium-sized Finnish companies were targeted. The European Commission (EC, 2011) defines medium-sized enterprises as follows: the number of employees of a medium-sized company is less than 250 but greater than 50; and the turnover is greater than 10 million euro but less than 60 million euro. Using size as a selection criterion, the selected companies can be regarded as medium-sized and large companies. As there was no data available specifically recording whether firms had adopted ERP systems, random sampling was used. To account for the risk that responding firms would not have implemented ERP systems, two questions were included that controlled for time since ERP implementation and scope. Email addresses of CFOs, Finance Managers, Business Controllers and equivalent job positions were collected from Profinder B2B, a database including information about executives and senior management of Finnish companies. This respondent group was chosen as it was expected that the respondents would have knowledge of the effect of ERP systems on MA and the possible changes in MA practice. A total of 1845 companies and 2168 contact emails fulfilled the selection criteria. As the contacts had to be manually collected from the database, the sample was limited to 1300 contact emails and one from each company.

Following Dillman's Tailored Design Method (2000) in the design and administration of the questionnaire, the survey instrument was pre-tested by a group of academics and practitioners and distributed after minor changes by email with a covering letter explaining the aim of the study and response practice. Whenever possible multiple item indicators based on prior studies were used to measure dependent and independent variables. The indicators are listed in Appendix 1. Most control variables were measured as dummy variables.

Table 1: Descriptive statistics on the sample

n = 70	Mean	Median	Std. Deviation	Minimum	Maximum
Industry	1.90	1.00	1.11	0	4.00
Firm_listed	1.30	1.00	0.46	1.00	2.00
Aud_firm	2.90	3.00	0.98	1.00	5.00
Firm_Age	28.94	20.00	25.15	3.00	102.00
ERP_time	10.06	10.000	7.53	0.50	21.00
ERP_inst.	1.27	1.00	0.64	0	2.00
BI_exist	1.64	2.00	0.48	1.00	2.00
ERP_Succ	4.29	4.00	1.56	1.00	7.00
DataQ	4.57	4.667	1.49	1.00	7.00
InfoQ	4.15	3.750	1.58	1.00	7.00
Task	3.92	3.750	1.84	1.00	7.00
Ecy	4.03	3.833	1.73	1.00	7.00
Efs	4.20	4.333	1.75	1.00	7.00

Minimum value 0 indicates missing values
Industry 1= Manufacturing, 2=Trade, 3=Services, 4 = Other
Firm_listed indicates public listing of firm or group 1=No, 2 = Yes
Aud_firm (Auditing firm), 1= Deloitte & Touche, 2 = Ernst & Young, 3 = KPMG, 4 = PwC, 5 = Other
Firm_Age indicates age of firm since establishment, in years
ERP_time indicates time since ERP implementation, in years
ERP_inst indicates scope of implementation, 1 = global, 2 = local
BI_exist measures whether the firm uses BI tools, 1 =no, 2 =yes
ERP_success measures perceived success of ERP implementation, scale 1-7 (1=not at all, 7=to extremely great extent)

The participants were given two weeks to complete the online questionnaire, before two reminders were sent. In the end, 80 responses were collected rendering a response rate of 5.3 per cent. There might be several reasons for the low response rate, but it was noted that some email addresses were incorrect and returned by the system; and a considerable number of approaches generated 'out of office' replies, although care was taken when selecting the time of the distribution. Moreover, some companies use spam filters to avoid receiving this type of email. Thus, it is possible that not all targeted respondents were in fact reached. Finally, among the eighty responses received, six were unusable owing to the firms not having adopted an ERP system, and four responses were incomplete. Therefore, only 70 usable responses were received. The low response rate indicates that care should be taken when using and analysing the data.

The responding companies represent the following different industries: manufacturing (51%), trade (13%), service (26%) and other (10%). The respondents were: CFOs (67%),

business controllers (30%) and chief financial accountants (3%). While the respondents may appear to operate at different hierarchical levels within the organizations, and thus might perceive things differently, a *t*-test indicated no significant differences in mean between the respondent groups CFOs and controllers/accountants. One explanation for this may be that all respondents, despite variations in title, operate on a managerial level, something that could be expected because of the choice of database used to source the email addresses. The average time since ERP implementation was approximately 10 years, but varied from six months to over 20 years. The time the firm had been established varied from 3 to 104 years with a mean of about 29 years. The average turnover was EUR 107 985 000 and the sample included both publicly listed and non-listed companies. All Big4 audit firms were represented. More details on the descriptive data may be found in Table 1.

3.2 New MA techniques and BI tools

Although it is recognized that organizations may have other motives for ERP implementation, the responses of this study indicate that the organization to some extent implemented new MA techniques − new to the organization − after the ERP implementation. The instrument used was adopted from previous studies (Waldron, 2007; Rom 2008). Table 2 illustrates that the most commonly adopted MA technique (61.4%) after the ERP implementation is key performance indicators (KPIs) but also MA techniques such as comparative analysis, customer satisfaction surveys, activity-based costing, target costing and the balance scorecard appear to have increased, although to a lesser extent. A further analysis shows that 12 respondents had adopted one new technique, eight respondents marked two new techniques, 14 respondents reported three new techniques and 18

Table 2: Adoption of new MA techniques

	No. of firms adopting new MA techniques	In percentage
Activity-based costing	14	20,00%
The balanced scorecard	14	20,00%
Comparative analysis (benchmarking)	20	28,57%
Customer satisfaction surveys	19	27,14%
Key Performance Indicators	43	61,43%
Non-financial key performance indicators	18	25,71%
Target Costing	17	24,29%
Life-cycle costing	5	7,14%
Other	4	5,71%

respondents reported four or five new techniques of the proposed list; only 18 respondents (25.7%) had not adopted anything. A more detailed analysis on mean values, conducted by splitting the sample into two groups based on the time since ERP implementation, indicates that on average the organizations have adopted 2.51 new MA techniques three or more years after implementation compared to 0.55 techniques within the first three years (*t*-test, $p < 0.001$). In contrast, late adopters (time since implementation 0-3 years) perceive greater changes in the MA techniques compared to early adopters (time since implementation over 3 years) (*t*-test, $p < 0.001$). Moreover, organizations that have a global ERP installation perceive greater changes in MA techniques and have implemented more MA techniques compared to those pursuing a local ERP installation (*t*-tests, $p < 0.05$).

In addition, 45 organizations (64.3%) reported the use of a BI tool. Organizations using BI tools perceive significantly greater changes in their MA techniques than organizations not using BI tools (*t*-test, $p < 0.01$). In contrast to the ERP implementation, early adopters of BI tools perceive greater changes in the MA techniques compared to late adopters (*t*-test, $p < 0.05$).

4. Results

The research model of this study was tested with the path analytic modelling technique of partial least squares (PLS), using Smart PLS (version 2-M3) (Ringle et al., 2005). PLS estimates the structural model using an iterative OLS regression-like procedure, but does not aim for the optimization of the model, nor does it report on the fit of the whole model (see Chin, 1998). All constructs were modelled using reflective indicators. Our analysis follows the typical two-stage approach (Barclay et al., 1995) where first the reliability and validity of the measurement model is assessed, and then the structural model is assessed.

4.1 Measurement Model

The factor loadings of each item met or exceeded the criteria of 0.6 (Hulland, 1999) as is shown in Table 3. Moreover, the reliability of each variable, assessed using Fornell and Larcker's (1981) measure of composite reliability (CR), is above 0.80, which demonstrates acceptable reliability (Nunnally, 1978). Third, convergent and discriminant validity of each construct, assessed by examining the average variance extracted (AVE) statistics, shows that the AVEs for all constructs are above 0.60, which demonstrates good convergent validity (Chin, 1998; Hair et al., 2010).

Table 3: Estimation of the measurement model parameters

	Original Sample	Sample Mean	Standard Deviation	T Statistics	AVE	CR
Data quality					0.831	0.937
DQ1	0.894	0.894	0.042	21.300		
DQ2	0.957	0.957	0.010	93.291		
DQ3	0.883	0.884	0.038	23.396		
Information quality					0.783	0.935
IQ1	0.925	0.925	0.015	62.747		
IQ2	0.886	0.884	0.025	35.756		
IQ3	0.907	0.908	0.018	49.894		
IQ4	0.818	0.816	0.035	23.484		
MA Tasks					0.863	0.962
T1	0.945	0.947	0.010	94.430		
T2	0.942	0.943	0.012	78.596		
T3	0.923	0.922	0.026	34.874		
T4	0.905	0.903	0.025	36.450		
Efficiency					0.729	0.889
Ecy1	0.767	0.766	0.069	11.099		
Ecy2	0.898	0.897	0.021	42.366		
Ecy3	0.890	0.891	0.028	31.536		
Effectiveness					0.770	0.909
Efs1	0.821	0.820	0.045	18.006		
Efs2	0.908	0.909	0.031	29.674		
Efs3	0.901	0.902	0.028	31.999		
MA_Impact						
C2	1	1	0			
Control Variables						
ERP_Success	1	1	0			
ERP_Scope	1	1	0			
ERP_time	1	1	0			
Firm_Age	1	1	0			
Industry	1	1	0			
Aud_firm	1	1	0			
BI_exist	1	1	0			

Assessing discriminant validity taking into account model parameters and measurement errors, shows that the square roots (diagonal, in bold) of the AVEs are greater than the respective correlations between constructs for all variables bar one (Table 4). Furthermore, although some correlations between the independent variables and dependent variables appear high, no bivariate correlation exceeds the value of 0.9 (Hair et al., 2010), thus providing little indication of multicollinearity. Table 4 is incorporated in Appendix 2.

In addition, cross-loadings were examined to test discriminant validity on the item level. As expected, the loadings of a certain item with its associated construct were all higher on their associated constructs compared to their cross-loadings. These test data results are, however, not included here. In summary, it was concluded that all scales behaved reliably, demonstrated satisfactory convergent and discriminant validity and exhibited adequate psychometric properties.

4.2 Structural Model

The second step in the PLS analysis is the estimation of the specified structural equations, which in this study is done by assessing the size and significance of path coefficients, R-squared (R^2), and Stone-Geisser-Criterion Q-squared (Q^2). R-squared is used to evaluate the PLS model (Chin, 1998). As PLS makes no distributional assumptions, a bootstrapping process (500 samples with replacement) was used to evaluate the statistical significance of each path coefficient (Chin, 1998). Table 5 (main model) and Table 6 (alternative model) present the structural models including the standardized betas and statistical significance as well as outlining the results of the hypothesis testing.

Hypothesis 1 proposed a positive relationship between efficiency and MA_Impact. This hypothesis is rejected by the results as showing a negative, significant association (-0.176, $p < 0.05$). Hypothesis 2 proposed and confirmed a positive relationship between effectiveness and MA_Impact (0.360, $p < 0.01$) and the hypothesis is supported. Hypotheses 3a and 3b proposed a positive relationship between DataQ and efficiency and effectiveness respectively. The results indicate a positive association, but one significant only for effectiveness (0.205, $p < 0.05$). Hypotheses 4a and 4b posited that improvements in InfoQ would positively affect efficiency and effectiveness. The path coefficient shows a significant positive association 0.601 ($p < 0.001$) for efficiency and 0.422 ($p < 0.01$) for effectiveness respectively. Both hypotheses are thus supported. Hypotheses 5a and 5b posited that changes in management accountants' tasks (MA_tasks) would be related to efficiency and effectiveness. The path coefficient shows a positive association (0.293, $p < 0.01$) which supports efficiency, and 0.218 ($p < 0.05$) for effectiveness respectively. Both hypotheses are thus supported. Moreover, the control variables ERP_Success (0.371, $p < 0.01$), ERP_scope (-0.207, $p < 0.01$), ERP_time (-0.084, $p < 0.05$) and BI_use (0.200, $p < 0.01$) appear to significantly and directly affect MA_Impact. The control variables firm age, industry or audit firm are not significant. The main model explains approximately 52 per cent of the variance in MA impact.

Table 5: Structural Model Results (main model, n = 70)

Independent Variables	Dependent Variable			Test of Hypothesis
	MA_Impact			
Efficiency	-0.176**			H1 rejected
Effectiveness	0.360***			H2 supported
		Efficiency	**Effectiveness**	
DataQ		0.085	0.205**	H3a rej., H3b supp.
InfoQ		0.601***	0.422***	H4a,b supported
MA Tasks		0.293***	0.218*	H5a,b supported
Efficiency			0.124*	
Control Variables				
ERP_Success	0.371**			
BI_use	0.200**			
ERP_scope	-0,207**			
ERP_time	-0.084*			
Firm_Age	0.042			
Industry	-0.021			
Aud_firm	-0.009			
Q^2	0.000	0,088	0.214	
R^2	0.523	0.802	0.771	

Path coefficient and (t-value) reported above
*p<0.05; ** p<0.01 *** p<0.001 (one-tailed tests)

Table 6: Structural Model Results (alternative model, n = 70)

Independent Variables	Dependent Variable					
	MA_Impact					
Efficiency	-0.203**					
Effectiveness	0.387***					
		Efficiency	**Effectiveness**			
DataQ		0.084	0.205**			
InfoQ		0.602***	0.423***			
MA Tasks		0.292***	0.217*			
Efficiency			0.124*			
				DataQ	**InfoQ**	**Tasks**
BI use				0.274**	0.070	0.240**
Control Variables						
ERP_Success	0.418**					
ERP_scope	-0,187**					
ERP_time	-0.044					
Firm_Age	0.062*					
Industry	0.019					
Aud_firm	0.029					
Q^2	0.001	0,088	0.214	0.062	0.004	0.050
R^2	0.488	0.802	0.771	0.075	0,005	0.057

Path coefficient and (t-value) reported above, *p<0.05; ** p<0.01 *** p<0.001 (one-tailed tests)

The alternative model (Table 6) tests for BI tools as an antecedent variable to the independent variables data quality, information quality and MA tasks. Everything else is identical to the main model and no hypotheses were stated. The results indicate significant positive relationships between the use of BI tools and DataQ (0.274, p <0.01), and BI tools and MA_tasks (0.240, p <0.01) respectively, but not between BI tools and InfoQ. Besides previous control variables also firm age (0.062, p <0.05) is significant in the alternative model, which explains approximately 49 per cent of the variance in MA impact.

The predictive validity of the parameter estimates could be assessed on a cross-validated redundancy index or a Stone–Geisser Q^2-test (Geisser, 1974; Stone, 1974). As PLS models lack an index for goodness of fit statistics, Tenenhaus et al. (2005) argue that, besides the reliability and validity of constructs and the significance of variance explained, positive Q^2s for all constructs provide sufficient evidence of model fit. The Q^2 results (Table 6), which are above zero, suggest that the model has some predictive relevance.

5. Discussion and Conclusions

This study examines factors that drive change in MA practices, and more specifically whether changes in data quality, information quality, and management accountants' tasks owing to use of an ERP system will have a positive effect on MA practices through improved efficiency and effectiveness. A path model was developed based on previous research, and tested using structural equation modelling with PLS with a sample gathered from 70 Finnish ERP adopters. The research model explains approximately 52 per cent of the variance in management accounting impact, approximately 80 per cent of the variance in efficiency, and approximately 77 per cent of the variance in effectiveness.

This study contributes to accounting literature in numerous ways. It found support for the assertion that increased information quality (InfoQ) enhances both accounting efficiency and effectiveness. The importance of InfoQ in developing and changing MA practices appears to be indirect, in that it is mediated by efficiency and effectiveness. This result would be important to consider when developing and improving MA practices in a company, and it draws attention to the company's internal organization and management. Further, DataQ is merely seen as improving effectiveness, and not as having any significant effect on efficiency. Moreover, the results confirm the importance of implementing changes to the tasks of the management accountants in order to improve effectiveness and efficiency, and indirectly to change MA practices. Somewhat surprisingly though, the results indicate a significant negative relationship between efficiency and changes in MA practices. Thus, enhanced efficiency would not promote changes in MA practices, rather the opposite. While no explanation for this is available in the data, it could indicate that changes in MA techniques do not emerge through improvements in efficiency. In summary, this study contributes by empirically testing and verifying the relationships between various factors related to both data/information quality and accountants' tasks on efficiency and effectiveness and indirectly on change in MA practices. This type of holistic model on these relationships, one empirically tested with survey data in an accounting setting, does not appear to have been examined before, and this study responds to calls for papers that test the IS success model in various contexts (Rai et al., 2002; Petter et al., 2008).

Further, the empirical findings demonstrate a statistically significant influence of a successful ERP implementation as having a direct effect on changes in MA practices. While Sangster et al. (2009) identified increased data quality, improved decision-making and changes in accountants tasks under successful ERP implementations, this study adds to those findings by emphasizing change in MA techniques as associated with successful ERP implementation.

Consistent with reasoning in prior research (Granlund and Malmi, 2002), the results of this study indicate that time since ERP adoption is a significant determinant of changes in MA techniques, but also that the majority of the changes occur within eight years after ERP implementation. Further, late ERP adopters perceive greater changes in MA techniques than early adopters. One possible explanation could be that late adopters perceive the changes as greater because of the short time since ERP implementation. Another explanation could be

that newer software versions include features and functionality that were missing from their predecessors, and which could be driving the changes already at the ERP implementation stage. Some respondents maintained in an open question in the questionnaire that change in MA techniques occurred simultaneously with the ERP implementation, not afterwards. Furthermore, the findings indicate that the scope of installation, local or global, is a significant determinant of changes in MA techniques. This is an important finding, as many organizations in recent years have pursued global ERP implementation. As many previous studies on the attributes of MA change have been conducted at an early stage of ERP implementation and early in the first decade of the century, this study offers an update, and also indicates that change may occur over time.

Another interesting finding is that the use of a BI tool may significantly affect change in MA practices either directly or indirectly as an antecedent of data quality and accountants' tasks. This seems to be a novel result. While this study confirms the findings of Wieder et al. (2012) regarding the significant relationship between BI tools and data quality, it also indicates that the effects of BI tools could be difficult to measure as those may relate to various issues. There may be several explanations for it, one being that the level of integration between the BI tools and the ERP system may differ and influence how the BI tools associate with changes in MA practices. It appears, however, that the ERP system needs additional tools to generate value and facilitate changes in MA practices. Future research should explore the effects of BI tools in more detail in order to better understand how the BI tools would best benefit the accountants' tasks and accounting function overall.

Moreover, an understanding of what drives MA changes in an ERP environment is believed to be important to practitioners, to firms, but also to the research community, as the body of research on changes in MA practices is still rather limited. An enhanced understanding of the effects of ERP systems on MA practices is of major importance within the accounting profession. In practice, factors affecting change in MA practices would be important to consider in the planning, development and management of MA practices in times of change.

It is, however, necessary to recognize some limitations of this study. First, data was obtained at a single point in time, which makes it difficult to infer causality. In future studies, it might be useful to explore the model over a longer period, for example using a longitudinal case study approach. Second, this study suffers from the usual limitations associated with the questionnaire survey method (Oppenheim, 1966). One concern is that responses to the questionnaire may not always reflect practice. Another limitation concerns the scales used to measure the core constructs. Difficulties involve operationalizing the variables and possible problems with self-assessed measurements. In addition, the dependent variable of the study was measured with only one item indicator. Although the single-item scale showed adequate validity and reliability in this study, it is acknowledged that multi-item scales usually demonstrate greater reliability and validity overall. Therefore, the measures used may be relatively crude and perhaps not achieve the depth and intensity of the whole assessment, something that should considered and developed in future studies. Third, one concern with empirical studies is generalizability. Without replication, it cannot

be determined what effect the sample size used has on the generalizability of the results. Moreover, the small sample size and the low response rate also indicate the need for caution in drawing conclusions based on the findings. The respondents worked at the managerial level of their organizations (because they were accessible via emails), but future studies could strive to collect data from respondents carrying out everyday accounting tasks. Such respondents might have different perceptions of changes in MA practices. Finally, it is acknowledged that there will be alternatives to the model used here. For example, the added construct *Tasks* may also be considered an outcome of efficiency/effectiveness instead of an independent variable, considering the theorizing of the feedback loop. Nevertheless, while it is important to recognize other independent variables or antecedents related to the capabilities of the ERP system, and that the organization or the users could be relevant to the research model, the focus of the current study was to test the proposed research model and not to develop and test numerous alternative models.

Therefore, future research could focus on identifying other factors to enhance changes in MA practices. The interesting finding that the use of BI tools significantly affects changes in MA practices merits further analysis. Furthermore, factors in the external environment and beyond the possible capabilities of the individual company would also be worth considering, but were excluded from this study. Given that the practical importance of finding attributes that enhance changes in MA practices in an ERP environment is of interest to both scholars and practitioners, there is considerable potential for further studies in this research area.

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Appendix 1: Measurement instrument

To what extent are the statements below true after the implementation of an ERP system? Please rate using a Likert scale of 1-7, where n/a = *don't know*, 1=*Not at all,* 2=*To a very low extent,* 3=*To a low extent,* 4=*To some extent,* 5=*To a great extent,* 6=*To a very great extent,* 7=*To an extremely great extent*.

Data Quality (DataQ)
DQ1. The recorded data conform better with the actual value (Data Accuracy).
DQ2. All data for a certain variable are recorded (Data Completeness).
DQ3. The representation of the data value is the same in all cases (Data Consistency).

Information Quality (InfoQ)
IQ1. The ERP system provides more real-time information.
IQ2. The ERP system has increased flexibility in information generation.
IQ3. The accuracy of reports and information has improved.
IQ4. Users compile reports more frequently.

MA Tasks
T1. Management accountants and controllers spend less time on routine jobs (cost accounting, data collection, preparing budgets and reports).
T2. Management accountants and controllers spend more time analysing and interpreting data.
T3. Management accountants' and controllers' current tasks involve more business-oriented tasks.
T4. Management accountants' and controllers' current tasks involve more decision-making tasks.

Efficiency
Ecy1. Costs within the management accounting department have been reduced.
Ecy2. The quality of management accounting work has improved.
Ecy3. Management accounting tasks are now performed more efficiently.

Effectiveness
Efs1. Management accounting reports are provided more frequently, systematically and regularly (e.g. daily or weekly reports).
Efs2. The information provided for the ongoing monitoring of decisions and actions is now more useful.
Efs3. Decision-makers are more satisfied with the quality of management accounting information outputs since implementation of the ERP system.

Impact on management accounting practices (MA-Impact)
To what extent… (Likert scale 1–7, as above)
C1. …do you utilize the ERP system to perform budgeting tasks? *(Deleted)*
C2. …has the implementation of the ERP system led to the adoption of new management accounting techniques?

Appendix 2: **Table 4: Discriminant Validity Coefficients (n= 70)**

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1_Aud_Firm	1.000												
2_BI_use	0.168	1.000											
3_MA_impact	0.026	0.289*	1.000										
4_Success	0.009	0.176	0.625**	1.000									
5_Effectiveness	-0.002	0.120	0.581**	0.651**	**0.877**								
6_Efficiency	0.084	0.097	0.534**	0.753**	0.809**	**0.854**							
7_FirmAge	0.174	0.124	0.012	-0.108	-0.134	-0.133	1.000						
8_ERP_scope	-0.014	-0.025	-0.483**	-0.497**	-0.422**	-0.505**	-0.079	1.000					
9_Industry	-0.128	0.154	0.293*	0.376**	0.231*	0.303**	0.089	-0.373*	1.000				
10_MA_tasks	-0.073	0.239*	0.466**	0.567**	0.717**	0.743**	-0.103	-0.382**	0.288**	**0.929**			
11_DataQ	0.050	0.272*	0.676**	0.676**	0.778**	0.759**	-0.100	-0.546**	0.373**	0.603**	**0.912**		
12_InfoQ	0.082	0.070	0.649**	0.788**	0.845**	0.866**	-0.158	-0.528**	0.271*	0.665**	0.827**	**0.885**	
13_ERP_time	-0.004	0.087	-0.284*	-0.334**	-0.263*	-0.355**	0.022	0.345*	-0.390**	-0.258*	-0.240	-0.337**	1.000

Correlations between different constructs in the lower left off-diagonal elements of the matrix.
The square root of the AVE value for each of the constructs along the diagonal (in bold).
* Correlation is significant at the 0.05 level (2-tailed), ** Correlation is significant at the 0.01 level (2-tailed).

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