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Causal Interrelations among market fundamentals: Evidence from the European Telecommunications Sector

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Abstract

This paper investigates the interdependence of stock returns with some other financial variables applied to several European Telecommunications institutions. In particular, using a multivariate vector autoregressive (VAR) approach this study examines the relation, the direction of the relation, as well as the effects among stock returns, index returns, earnings, capital expenditures and interest rate for companies that play major role in their home stock markets. Unlike the fact that many other previous studies have indicated clear findings of the direction of the causality between those variables, this research cannot support a uniform behavior, although, the selected telecommunications companies have many common characteristics.

Keywords: Vector autoregressive analysis, causal relations, impulse responses, financial variable, Telecommunications market

JEL classification: C22, C58, G14, L96

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1. Introduction

Earnings, stock returns and capital expenditures are some of the most important parameters in evaluating financial performance of a company. Of equal importance are the relationships among those variables that can determine to what extent one variable affects the behavior of another. Therefore, it is not surprising to find a lot of interesting research papers examining financial variables, in general, not only with respect to their interrelations but also to what extent their magnitude reflects market and corporate activities. Indeed, identifying and understanding the cross effects between financial variables is a crucial issue to individual and institutional investors, to market analysts, to policy makers and also to corporate managers, since these variables determine their investing and planning decisions, their business performance, their forecasts and of course can help regulatory authorities in deciding their policy and their market reforms.

There is a substantial literature that examines how stock returns are affected from two different sets of factors, known as external and internal factors, as an effort to evaluate financial performance. As external factors are considered basic macroeconomic variables, such as interest rates, gross domestic product, inflation, exchange rates, monetary policy variables and market index returns, see for example Chen *et al* (1986) and Lee (1992), whereas as internal factors are considered fundamental financial variables, such as earnings, capital expenditures and dividends, see for example Campbell & Shiller (1988) and Lee (1998). The objective in the first case is to analyze the behavior of stock returns based on the overall economic activity, whereas in the second case the research is focused only on firm's level basis. Moreover, there is a broad notion that stock returns reflect expectations against

current and future economic development, so their movements display changes in future economic growth. The same belief is valid at a company's level, where most of the times, stock returns reflect the capabilities of the organization to generate future cash flows and retain its operation and profitability.

As an effort to analyze stock prices in relation with some basic financial variables, including causality and interrelations issues, this study considers companies from the European Telecommunications Sector, a sector that normally plays a major role not only in the stock market but also in the overall economic activity of each country. More than that the Telecommunications Market in Europe has a unique feature that all current dominant players in each country come from a former monopolistic regime controlled by their government, known as PTT (Post Telephone and Telegraphs) institutions. Therefore, it will very interesting to examine the financial behavior of these firms that had and still have similar characteristics and investigate whether any conclusion can be made with respect to common behavior.

The remainder of the paper is organized as follows. Section two discusses some of the economic and financial key elements that have been studied for the Telecommunications sector in Europe. Section three presents the market fundamentals with some aspects of their relationship and denotes what the literature indicates about the existence and the direction of their relationship. Section four briefly outlines the VAR methodology and some concepts regarding Granger causality technique and impulse response functions approach. Section five describes the variables used in this study and reports the empirical; results. Finally, the concluding remarks are included in section six.

2. The European Telecommunications Sector

The Telecommunications sector in Europe has changed drastically over the last decade. Due to the inefficiency and lack of performance, the Telecommunications industry had to be deregulated and become competitive, offering better quality of services at lower prices. The deregulation process, which is well described in Thatcher (1999) and Knorr (2002), forced the former state owned monopolistic companies to adjust their operations into the new competitive and well controlled by the regulatory authority environment. These companies have now to pay seriously attention to their financial performance so that funds can be drawn from the market to support their investment decisions. It is worthwhile to mention, that these firms account for over 30% of the market capitalization in their home stock market and even greater total share trading volume, as Boutchkova & Megginson (2000) have indicated.

The liberalization process as well as the magnitude of these firms gave the incentive to many researchers to study the economic and the financial aspects of this industry. A large number of papers focused on regulatory regime issues, the competitive environment between companies, the need for privatization and the overall performance of these firms, see for example Laffont and Tirole (1993 & 2000), Ros (1999), Boylad & Nicoletti (2001), Wallsten (2001), Gual & Thrillas (2004) and Estache *et al.* (2006). Other papers examined the existence of causality between investments in Telecoms and economic growth with some of them supporting the causal direction from Telecom Investments to economic growth (see for example Madden & Savage (1998) and Datta & Agarwal (2004)), whereas other suggesting a bidirectional relationship between the two variables (see for example,

Lee (1994), Yoo & Kwak (2004) and Wolde – Rufael (2007)). Finally, several other studies, such as, for example, Munoz and Amaral (1998), Wright (1999), Savage (2000), Agiakloglou and Yiannelis (2005) and Agiakloglou and Karkalakos (2009), have examined microeconomic aspects of this sector and have estimated price elasticities for international telecommunications demand using different econometric approaches.

Nevertheless, the evolution of the telecommunications sector gave the incentive to several researchers to study the performance of these firms mainly from the financial point of view. For example, Bortolotti *et al* (2002) examined the financial and operating performance of 31 national telecommunications companies that were fully or partially privatized and found that their performance improved significantly by the combination of regulatory changes and privatization, whereas Agiakloglou and Bloutsos (2011) studied the financial risk of these companies and compared their estimates with the market risk obtained by their home countries.

Hence, besides the economic challenging of empirically identifying behaviors of these firms at the macro or microeconomic level, it is still very interesting to study their performance based on their own financial variables. Indeed, the use of financial variables, instead of variables related to economic activities, such as national income, interest rates, competition, privatization and regulation, can provide valuable information with respect to the financial performance and impact of these firms after the liberalization of the industry. Moreover, these variables can also be used to study causal interrelations among them, as well as to determine by how much each variable affects or is affected by others.

3. Internal Factors

There is a variety of papers that examines the relation between stock returns and market fundamentals, such as earnings, capital expenditures, interest rate and indices returns of their home stock market. According to Lamont (1998) earnings have an explanatory power regarding expected future returns, due to the fact that earnings correlate with business conditions, and hence the risk premium of stock returns vary negatively in respect to current business conditions, so investors expect in recession high returns and in blooms low returns. Therefore, since earnings co vary with economic conditions, current earnings can predict future returns. However, it is often argued that earnings are also correlated with future dividends, which affect future returns. Lee (1998), on the other hand, suggests that fundamental variables, such as dividends and earnings, can explain about half percent of the variation in stock returns, mainly in the long term, whereas non fundamental components can explain better short run variation of stock returns. The relation between earnings and stock returns is also examined by Campbell & Shiller (1988) where they concluded that the moving average of real earnings can help the prediction of stock returns, especially when earnings are measured for several years. In this lieu, Fama and French (1988) have indicated that earnings create noise among stock returns due to their volatility, with Lamont (1998) supporting that this noise contains useful information about short term movements in stock returns.

Another important variable that affects stock returns is capital expenditures (CAPEX). According to McConnell & Muscarella (1985) on average basis announcements of increases in planned capital expenditures affect positively stock prices and *vice versa*. The positive relationship between capital expenditures and

stock returns is also indicated by Titman *et al* (2003) due to the fact that increased capital expenditures imply greater investment opportunities and market's confidence in firm's investments decisions. On the other hand, Woolridge (1988) refers to the positive reaction of stock prices to a variety of strategic investment decisions, such as joint ventures, plant and equipment purchases and R&D expenditures, whereas Chung *et al* (1998) support that stock prices are not only affected by the announcement of changes in capital expenditures, but also by the market's assessment of the quality of firms investment opportunity, that plays crucial role.

Despite the fact that most studies support changes in capital expenditures affect stock prices, it may very well be that changes in stock prices affect investment decisions. Indeed, an increase in stock prices may lead firms to increase their investment not only as an effort to expand their business and produce positive signals to the market but also because in this case it will be easy for them to draw funds from the market. For example, Andersen & Subbaraman (1996) pointed out that share prices do cause investment, probably due to the fact that stock prices contain information about expected movements in variables such as cost of capital and returns on capital that are also determinants of investment. Similar result with respect to the direction of causality between stock prices and capital expenditures is addressed by Doan *et al.* (1983) and Fischer & Merton (1984).

Capital expenditures are also related to earnings in the sense that investment decisions determine indirect the level of future income through the profitability of new invested projects. Bar-Yosef *et al* (1987) investigate the causal relations between earnings and investments and they conclude that earnings Granger cause investments, although McFedridge (1978) and Shapiro *et al* (1983), for example, support, as theory claims, the opposite causality direction. In this effort, Amadi (2005) also could not

uniquely identify the direction of causality between these two variables and the results Amadi supports are mixed favorable towards a causality direction from operating income to capital expenditures.

Interest rate is also an important variable determining not only the economic activity of any country but also the financial activity of any company. Bernanke and Blinder (1990) examine the effectiveness of monetary policy through interest rate changes using a VAR model containing four macroeconomic variables, such as money supply, output, price level and interest rate. Patelis (1997), on the other hand, expanded the work of Bernanke and Blinder (1990) by including asset prices in the model and supporting the existence of a clear relationship between interest rates and stock returns. Patelis (1997) argued that since interest rate spreads are a very good proxy variable of monetary policy, and therefore can either increase future cash flows or decrease the discount factor, can, in this way, affect stock returns, which reflect the present value of future cash flows. In addition, Thorbecke (1997) and Ewing (2001) conclude that parameters of monetary policy, like fed funds rate, which are influenced by interest rates, can explain stock returns. Moreover, Chen *et al* (1986) have suggested that indirect indices of interest rates, such as spread between long and short interest rates, as well as spread between high and low grade bonds affect stock prices, since they contain risk that markets reward, whereas Gjerde & Sættem (1999) found that several macroeconomic variables - including interest rate - have negative relationship with stock prices.

Finally, market returns are often used to explain stock returns. This relationship, which was introduced by the pioneer work of Sharpe (1964) and extended by Lintner (1965) and Black (1972), is expressed by the capital asset pricing model, known as CAPM model, and has received a considerable attention in the

literature as an effort to determine the behavior of an asset. However, since this model typically has low explanatory power, several other studies have tried to increase explanatory power by adding more variables. The dominant model that prevails is the three factor model introduced by Fama & French (1992) which includes two more factors, the size of the firms and book-to-market equity, besides market returns, to explain stock returns.

4. VAR Framework

To investigate the relationship among stock returns and other financial variables, an unrestricted Vector Autoregressive (VAR) model presented by Sims (1980) is employed. The VAR approach is induced by the fact that this methodology treats all variables as endogenous, allowing interactions between the variables without any *a priori* restrictions. Moreover, each variable in the system depends not only on its own past values but also on the past values of all other variables included in the system. Therefore, the VAR methodology provides a more vigorous representation of the data generating mechanism, allowing even for linear interdependency among variable in the system.

The VAR model can be expressed as:

$$Z_t = A_0 + \sum_{i=1}^k A_i Z_{t-i} + u_t \quad (1)$$

where Z_t is an (nx1) vector containing each of the n endogenous variables included in the system, A_0 is an (nx1) vector of constants, A_i 's are (nxn) matrices of coefficients for the endogenous variables and u_t is an (nx1) vector of error terms satisfying all necessarily conditions and they are not correlated each other. Another important assumption in the VAR system is that all variables are stationary. Hence, the VAR

system, which involves only lagged variables on its right hand side, called as the reduced form, and given the fact that these variables are not correlated each other and with the error term, can be estimated using ordinary least squares (OLS) method. In fact, Sims (1980) and Doan (1992) argued that the goal of VAR analysis is to determine the interrelationships among variables and not the parameter estimates.

An important aspect of VAR modeling is the impulse response function, a method that allows us to trace out the time path of various shocks on the variables included in the system. As any stationary autoregressive process that can be expressed as a moving average process, VAR model can be written, like wise, as a Vector Moving Average (VMA) model, a model that is expressed in terms of current and past values of the error terms or shocks. This VMA presentation is essential feature of Sims's (1980) methodology and can be presented as:

$$Z_t = \mu + \sum_{i=0}^{\infty} \phi_i w_{t-i} \quad (2)$$

where μ expresses the mean estimates of the endogenous variables, ϕ_i is the function that generates the effects of shocks on the entire time paths of the endogenous variables, where the elements of ϕ_i are the impact multipliers, and w_t is a transformation of u_t using a Choleski decomposition of the variance covariance matrix of the uncorrelated errors. Hence, the impulse response function aims to trace out the response of current and future values of each of the variables contained in the system to a one unit increase in the current value of one of the errors included in the VAR model, assuming that this error returns to zero in a subsequent period and that the other errors of the system are zero, which is quite a vigorous assumption.

In addition, the impulse response function technique can be used to obtain useful information about the direction of the causality between two variables. For

example, no evidence of causality exists if all coefficients of the impact multipliers are zero, i.e., if $\phi_{21}(i) = 0$ for $i > 0$, then the first variable does not cause the second variable. Alternatively, the direction of causality can also be examined through the proposed by Granger (1969) methodology applied to time series data under the assumption that past values can predict current or future values. In this framework, the test for causality for two variables is implemented by regressing each variable on its lagged values and on the lagged values of the other variable and by testing the null hypothesis that all coefficients of the lagged values of the other variable are jointly all zero. Evidence of clear direction of causality one gets if and only if the null hypothesis in one regression is rejected and it is accepted in the other. In this case we say the one variable Granger causes the other.

5. Empirical results

Market fundamentals of ten major European Telecommunications Companies, from ten different countries, are collected to examine their relationship.¹ The data is obtained from different sources on a quarterly basis for the period 1998 to 2011.² However, due to unavailability of some data sets, the sample period is not exactly the same for all firms.³

¹ The European Telecommunications Companies that are used in this study based on the availability of their data are: Austria Telecom (AT), British Telecom (BT), Deutsche Telekom (DT), Hellenic Telecommunications Organization (HTO), KPN Netherlands (KPN), Portugal Telecom (PT), Swiss Com (SC), Telefonica (TEF), Telenor (TEN) and Teliasonera (TS).

² The data is obtained from the annual and quarterly reports, as well as the cash flow statements of each company, the official site of each firm for stock prices, the Yahoo Finance data base for data on European stock indices and from the European Central Bank. Data other than in Euro currency is converted to Euro to allow comparability.

³ In particular, the data sets are the following: AT: 2001Q1 to 2011Q1, BT: 2003Q2 to 2011Q1, DT: 1998Q1 to 2011Q1, HTO: 2004Q1 to 2011Q1, KPN: 2003Q1 to 2011Q1, PT: Portugal Telecom: 1998Q1 to 2011Q1, SC: 1999Q1 to 2011Q1, TEF: 2001Q1 to 2011Q1, TEN: 2001Q2 to 2011Q1 and TS: 2002Q1 to 2011Q1.

The variables that were selected are: a) stock returns (SR) b) earnings (ER), c) capital expenditures (CAPEX), d) market returns (MR) and e) interest rate (IR). In particular, stock and market returns are calculated as $(P_t - P_{t-1})/P_{t-1}$, where P_t denotes price level at period t .⁴ Earnings, without including special effects, such as extraordinary gains or losses, profits or losses from purchases or sales of securities and other financial assets that are not consistent with business operations, are drawn from the quarterly financial statements, published by each company. On the other hand, CAPEX, which are outflows for investment in property, network, plant and equipment, are obtained directly from the quarterly cash flow statements of each company. Finally, the Euribor rate with 3 month maturity is considered as the interest rate since seems to be the most appropriate rate for quarterly data and it is obtained directly from the European Central Bank database.⁵

The Box and Jenkins (1970) methodology aims to select a model with small number of parameters, known as the principal of parsimony, having first correctly defined the generating mechanism of the observed series. Likewise, the VAR methodology tries to adopt small models as an effort not only to identify better the relationship between the variables, and, therefore, to produce better short term forecasts, but also to capture more efficiently the effects of a shock to any other variables. However, there is a debate in the literature whether or not one needs to pay seriously attention to the issue of stationarity of the series. Since the goal of VAR analysis is to determine the interrelationships among variables and not the parameter

⁴ The use of $\ln(P_t / P_{t-1})$ as a proxy variable of returns is not considered since the data set consists of quarterly observations and therefore it would not have been a good proxy variable.

⁵ It is interesting to mention that two more variables are also selected for this study such as investments, which are derived from the quarterly cash flow statements of each firm by adding investments in financial assets to Capex, and earnings before interest, taxes, depreciation and amortization, known as EBITDA, which are directly obtained from the quarterly financial statements of each company. However, since both these variables did not produce any significant results, they were excluded from the empirical analysis.

estimates, several researcher, such as Sims (1980) and Doan (1992), argued that it is not appropriate to use first differences even if the series contain a unit autoregressive root, contrary to the traditional Box and Jenkins analysis which requires during the identification stage to clarify whether the observed series is stationary or non-stationary.

Nevertheless, since VAR analysis considers more than one variable it seems more appropriate to include variables with the same characteristics. In this case, the analysis will be balanced, as it happens in regression analysis, and all series will follow the same generating mechanism. For this purpose, using the Augmented Dickey-Fuller (ADF) test, an effort is made to determine whether all series are stationary or not. It turned down that stock returns, market returns and earning are stationary processes, whereas Euribor and CAPEX are not, except for CAPEX of DT. Application of the ADF test to the first differences of the non-stationary series, showed that the new series are stationary. It is interesting to mention that in all case the ADF test is implemented by a very small to none number of additional terms, where the selection of the augmented terms is based on the Akaike Information Criterion (AIC), and, therefore, as Agiakloglou and Newbold (1991) have indicated, the test will have large power. All of the above findings, with respect to the issue of stationarity, are also supported by the traditional Box and Jenkins (1970) ARIMA analysis.

Next, the VAR analysis is applied to all bivariate cases for the selected five series and the best fitted models selected by the Likelihood Ratio (LR) test are reported on Table 1.⁶ As can be seen from this table, it seems very difficult to draw uniform conclusions regarding the behavior of all firms simply because every firm

⁶The best fitted models are also selected in most cases by the AIC criterion. In cases where the LR test was not applicable the best fitted model was selected by the AIC criterion.

produced significant evidence for different number of relationships. For example, BT supports only one relationship, whereas DT supports six relations. In addition, for any given relationship between two variables the same best fitted VAR model was not chosen by every firm, except for the case of IR and CAPEX, where a VAR(3) model was selected as the best fitted model by all firms.

On the other hand, among all ten bivariate cases, the most important relationship, which is supported by eight out of ten firms, is the one between SR and CAPEX. The relationships between IR – MR and MR – CAPEX are supported by six firms, the ER – CAPEX and the IR – CAPEX by five firms and the SR – ER by four firms. Contrary, to those findings, all other relationships, including the one between SR and MR, were not supported by most firms and therefore will not be considered for further examination.

Indeed, some of the above findings have been explained by the literature. For example, researchers do believe that there is a strong relationship between stock returns and capital expenditures, since an increase in stock prices will rise investment, giving positive signals to the market, to gain better market valuation. In addition, the relationship between capital expenditures and earnings has been studied by Shapiro *et al* (1983) and Bar-Yosef *et al* (1987) claiming that investment decisions do determine the level of future earnings through the profitability of new projects. Moreover, Patelis (1997) has concluded that interest rate affects market returns and Lamont (1998) indicates that earnings have an explanatory power regarding future stock returns. Finally, it is interesting to note that according to the VAR analysis no evidence of the relationship between stock returns and market returns was found, contrary to the CAPM approach. Perhaps, this finding is due to the fact that VAR analysis uses lagged values of the two variables whereas CAPM uses current values.

Table 1
Best Fitted VAR models

Firms	SR - ER	SR - CAPEX	SR - IR	SR - MR	ER - CAPEX	ER - IR	ER - MR	IR - CAPEX	IR - MR	MR - CAPEX
AT					VAR(3)	VAR(1)				VAR(4)
BT		VAR(2)								
DT	VAR(3)	VAR(3)			VAR(4)	VAR(1)*			VAR(1)*	VAR(2)
HTO		VAR(4)*						VAR(3)	VAR(3)	
KPN		VAR(3)*	VAR(1)*	VAR(1)*	VAR(4)				VAR(1)	VAR(3)
PT		VAR(4)						VAR(3)		VAR(3)
SC	VAR(4)	VAR(4)	VAR(1)*		VAR(3)			VAR(3)	VAR(2)	
TEF	VAR(2)	VAR(4)								VAR(4)
TEN					VAR(3)			VAR(3)	VAR(1)	VAR(4)
TES	VAR(4)	VAR(3)					VAR(2)	VAR(3)	VAR(2)*	

Note: * denotes significant estimates at the 10% nominal level, whereas the default is at the 5% nominal level.

The relationships that were supported by most firms, giving strong evidence of their existence, were examined for causality and the results of the Granger causality test are reported on Table 2. Contrary, to VAR analysis, the Granger causality approach did produce evidence of a uniform behavior among relationships. As can be seen from Table 2, stock returns Granger cause capital expenditures (SR → CAPEX), a finding that is also suggested by the literature in the sense that increases in stock prices lead firms to increase their investments. Indeed, as Andersen and Subbaraman (1996) have indicated share prices do cause investments due to the fact that they

contain information about movements in cost of capital and returns on capital that are also determinants of investments. Likewise, capital expenditures cause earnings (CAPEX → ER), given that investments can determine the level of future earnings, through the profitability of new invested projects, as Shapiro (1983) has pointed out. Furthermore, Bar-Yosef *et al* (1987) have argued that current and past investment activity is an important component of future earnings, since investments are undertaken if and only if their expected returns are greater than their opportunity costs.

Table 2
Results for Granger Causality tests

Firms	SR - ER	SR - CAPEX	ER - CAPEX	IR - MR	MR - CAPEX	IR - CAPEX
AT			CAPEX→ER		Bidirectional	
BT		SR→CAPEX				
DT	SR→ER	Bidirectional	CAPEX→ER		MR→CAPEX	
HTO				IR→MR		CAPEX→IR*
KPN			Bidirectional	Bidirectional	MR→CAPEX*	
PT		SR→CAPEX			MR→CAPEX	
SC	SR→ER	SR→CAPEX	CAPEX→ER	IR→MR*		CAPEX→IR
TEF	SR→ER				CAPEX→MR*	
TEN				Bidirectional	MR→CAPEX	CAPEX→IR*
TES	ER→SR			IR→MR		IR→CAPEX

Note: * denotes significant estimates at the 10% nominal level, whereas the default is at the 5% nominal level. The optimal lag length for the implementation of the Granger causality test is selected according to the order of the best fitted VAR model.

It is interesting to note, that, if the property of transitivity does exist in the concept of Granger causality, evidence of this property may arise from Table 2. Based on the above results, stock returns cause capital expenditures ($SR \rightarrow CAPEX$) and capital expenditures cause earnings ($CAPEX \rightarrow ER$). Therefore, one should expect that stock returns will cause earnings, i.e., $SR \rightarrow ER$, if the transitivity property holds. This direction of causality is captured by three out of four firms and only one firm claims the opposite direction. It is relatively easy to understand that earnings cause stock returns, as Lamont (1998) has indicated, in the sense that an increase in earnings will affect positively future stock prices of a company. It is also important to realize that current stock returns will determine future corporate earnings. As the stock price of a company increases, the value of the company also increases, leading to higher future expectations about the overall business activity of the company and, therefore, to higher earnings.

Two more interesting results can be drawn from Table 2. First, interest rate causes market returns ($IR \rightarrow MR$), as it is supported by all firms, including two firms that were suggesting bidirectional relationship, and, second, market returns cause capital expenditures ($MR \rightarrow CAPEX$). It is known that movements in the interest rate determine future market returns, since, for examples, if interest rate decreases, people turn their funds into investments opportunities with higher yields, such as capital markets. The direction of causality between market returns and capital expenditures is also supported by the direction of causality between stock returns and capital expenditures. Indeed, since stock returns are highly correlated with market returns, one expects that these two variables will have similar behavior to capital expenditures.

Finally, it seems very difficult to draw conclusions with respect to the direction of causality between interest rate and capital expenditures, since our data supports more likely a bidirectional relationship between those two variables. Three out of four firms support CAPEX causing IR, with two of them barely at the 10% level of significance, whereas only one firm supports the opposite direction, i.e., IR causes CAPEX. It is fairly easy to explain the direction of causality from IR to CAPEX, in the sense that changes in the interest rate will affect capital expenditures, but it is very difficult intuitively to explain the opposite direction.

In addition to Granger causality, VAR analysis can be used to examine impulse response functions in pairs for each VAR model. The objective in this case is to trace out the response of current and future values of each variable to a one standard deviation increase in the value of the error of the other variable of the VAR model, assuming that this error returns to zero in subsequent period. Moreover, using the impulse response functions technique one can identify whether shocks are absorbed by the system and in what time period length, as well as the magnitude or the effect of the shock in the other variable.

Although, there is no direct link between Granger causality and impulse response functions in the concept of a VAR analysis, one can visualize that these two methods try to explain the behavior of the same variable in two different ways. The Granger causality approach determines the direction of the relationship between two variables which can be used not only to identify the short run behavior of the dependent variable but also to construct short run forecasts based on the systematic part of the regression equation. Contrary, the impulse response function defines what will happen to the same dependent variable if the random part of the regression equation unexpectedly changes.

Therefore, the effects of shocks of error terms to variables are examined using impulse response functions based on Granger causality results. Figure 1 presents lagged responses of earnings to a one standard deviation shock by stock returns. As can be seen from this figure, a shock to earnings as a result of a positive change in stock returns is absorbed by all firms, with TEF absorbing faster the shock and DT having the largest effect in magnitude.

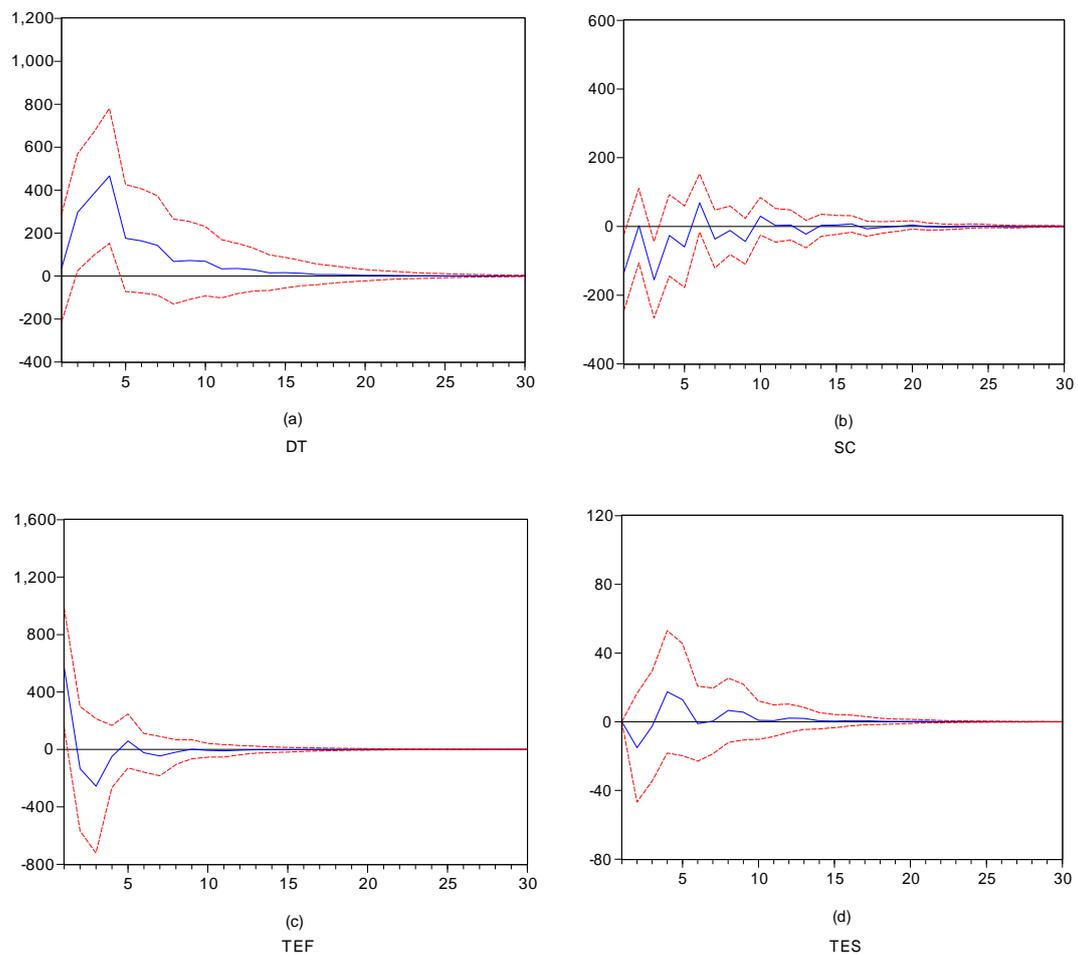


Figure 1
Response of ER to a one standard deviation shock by SR

Similarly, Figure 2 shows how capital expenditures react to a positive shock by stock returns. The interesting part of this figure is that BT and DT absorb the shock of stock returns in a short period of time, whereas PT and SC seem to need a

relatively large period of time to absorb it. DT has the largest effect in magnitude and BT absorbs faster the shock.

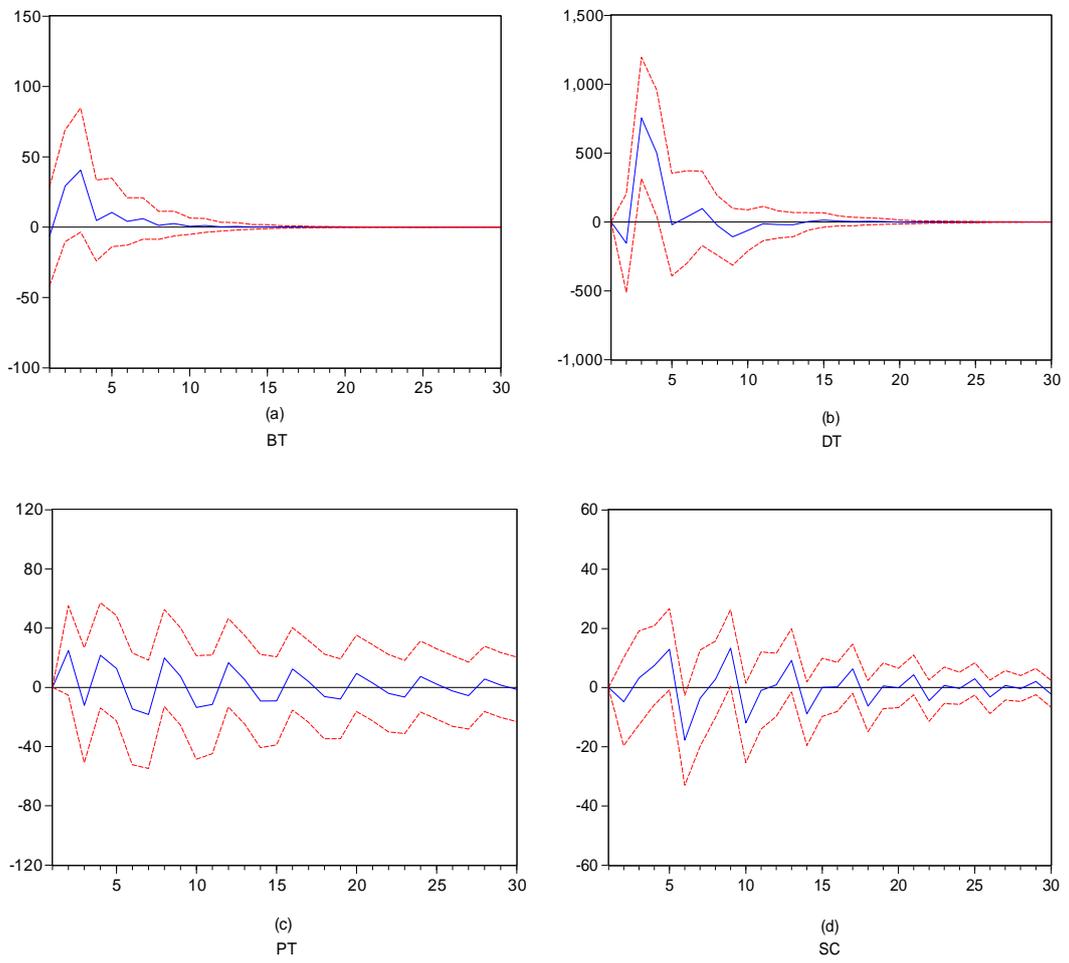


Figure 2
Response of CAPEX to a one standard deviation shock by SR

Figure 3 presents the response of earnings to a one standard deviation shock caused by the error term of capital expenditures. Perhaps, the most interesting feature of this figure is that KPN not only cannot absorb the shock but its effect grows over time. On the other hand, DT fully absorbs the shock, whereas AT and SC seem to need a very lengthy period of time to absorb the shock.

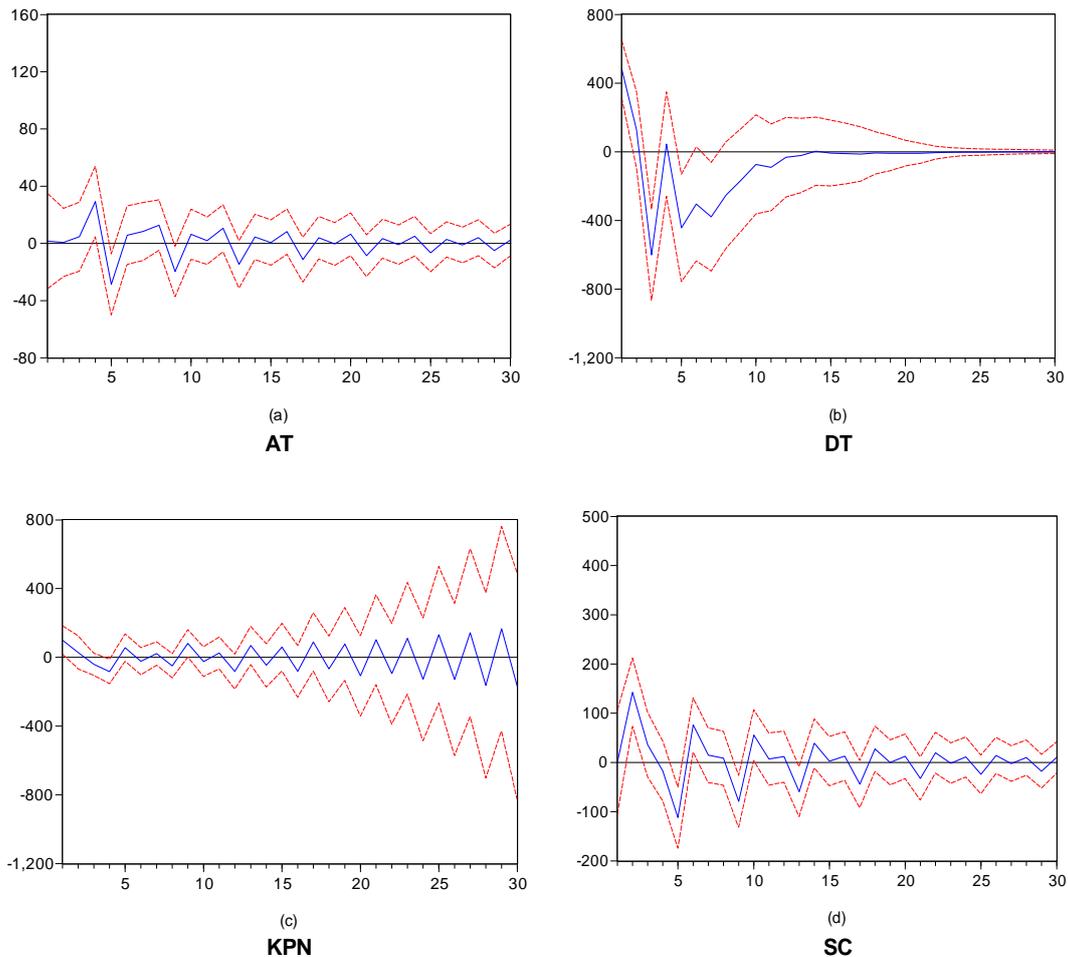


Figure 3
Response of ER to a one standard deviation shock by CAPEX

The shock in market returns caused by the interest rate for several market indices of European countries appears in Figure 4. As can be seen from this figure the shock is fully absorbed by all markets from different countries but at a different rate. The market index of Norway, in which TEN belongs, absorbs faster the shock than any other market index, whereas the market index of Greece, in which HTO belongs, absorbs it much slower and it has the largest effect in magnitude. It is interesting to note that the large capital markets from our data set, such as U.K., Germany and Spain, are missing from this figure. One explanation to this result could be that

changes in interest rate affect more medium and small size capital markets than large markets.

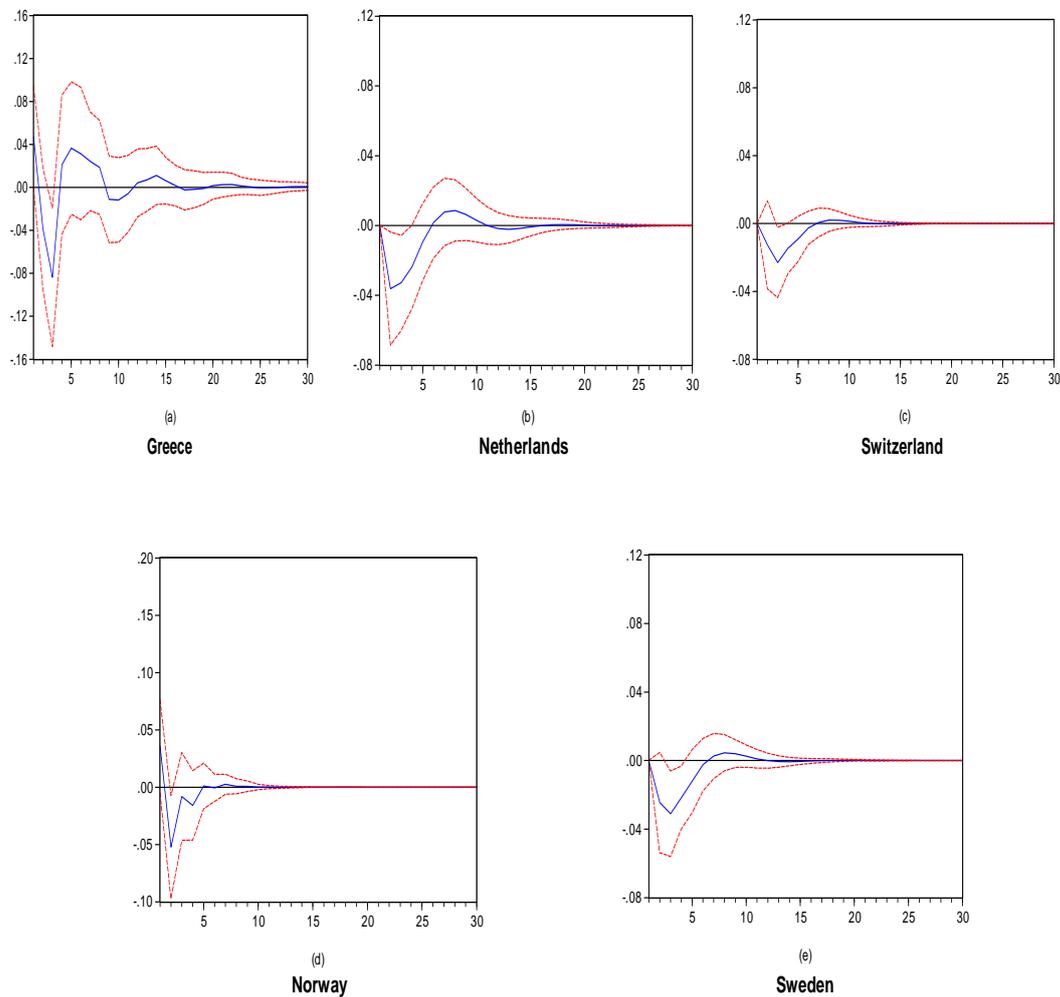


Figure 4
Response of MR to a one standard deviation shock by IR

Finally, Figure 5 depicts the reaction of capital expenditures by a one standard deviation shock in market returns. It appears that only DT and TEN absorb the shock relatively well, whereas for AT, KPN, PT and TEF it is very difficult to draw a conclusion.

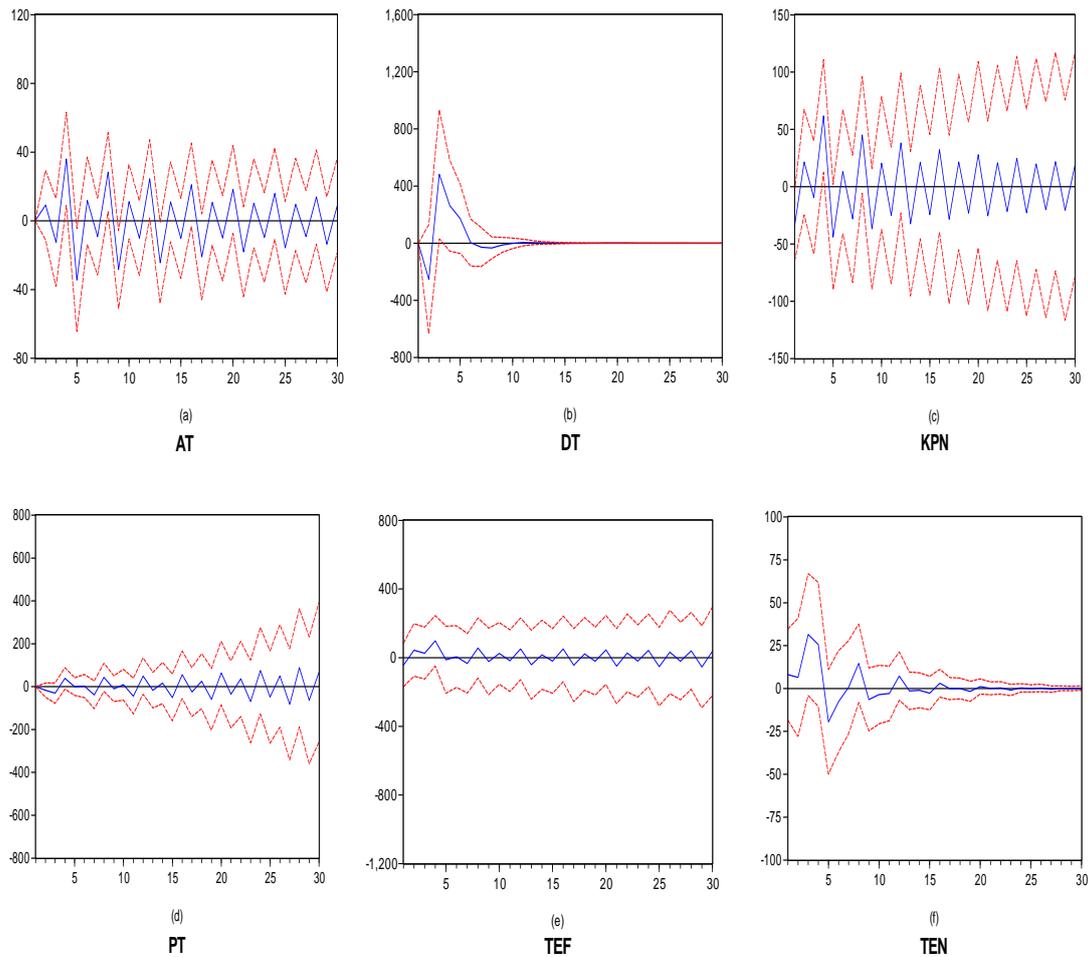


Figure 5
Response of CAPEX to a one standard deviation shock by MR

Like VAR analysis, uniform conclusions regarding the behavior of all bivariate cases for all firms cannot be drawn using the impulse response function analysis. One reason could be that each Telecommunications Company has its own internal factors, such as profitability, investment decisions, size, market environment and strategies, making difficult to perceive a shock in a similar way caused by one variable, despite the fact that all European Telecommunications Companies face the same external macroeconomic factors. Indeed, as can be seen from all the above figures, a shock to one variable cause by another variable has different magnitude and rate of absorption, even though in some cases the shock was never absorbed. Among

all bivariate cases, the relationship between ER and SR did produce evidence of similar behavior, given the fact that a shock to earnings caused by stock returns was absorbed by all four finally used firms. To some extent, evidence of similar behavior can be found between MR and IR, even though these variables represent external macroeconomic factors.

6. Concluding Remarks

Using fundamental variables, such as stock returns, earnings and capital expenditures, of ten major European Telecommunications companies and financial variables, like market returns and interest rate, this study examined the relationship, the direction of the relationship, as well as the effects among those variables by employing a VAR and Granger Causality technique. The reason that the European Telecommunications Sector was selected for the purpose of this analysis is that most companies that belong in this sector have many common characteristics. For example, the companies selected for this study were all former state owned monopolies with significant impact in their home economies and maintain this characteristic even after the liberalization of the industry, having still a dominant role with significant market capitalization and financial value in capital markets. Therefore, it is interesting to examine whether a uniform behavior concerning the relationships and the effects among the selected variables exists.

The empirical results from VAR analysis suggested that among all ten bivariate cases, the most important relationships that were supported by most firms were SR – CAPEX, IR – MR, ER – CAPEX and SR – ER, although each firm could not statistically support the same number of relationships among variables and the

same best fitted VAR model. An interesting finding is that the relationship between SR and MR, which is well documented by the CAPM model, is not supported by all firms on the basis of VAR analysis. Perhaps this result is due to the fact that VAR analysis uses lagged values of the examined variables whereas CAPM uses current values.

Contrary to VAR analysis, Granger causality technique did produce evidence of a uniform behavior with respect to the direction of causality between two variables. In particular, using the best fitted VAR models we found that SR causes CAPEX, CAPEX causes ER, SR cause ER and IR causes MR, results that are also supported by the literature.

Finally, based on the Granger causality results, the best fitted VAR models were used to determine impulse response functions. Like VAR analysis it seems very difficult to draw uniform conclusions not only with respect to the effect of a shock to one variable cause by another variable, but also with respect to the rate of absorption of the shock, if it is absorbed. Among all cases, the relationship between ER and SR showed evidence of consistent behavior of all firms, in the sense that a shock to earnings caused by stock returns will be absorbed. Equivalent results can also be obtained with respect to the absorption rate of a shock to market returns caused by interest rate, although these two variables are macroeconomics variables and not one of the internal financial variables of a firm.

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