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**The New Keynesian Phillips Curve in an Inflation Targeting Country:
The Case of Turkey**

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Abstract

The possible short-run trade-off between the inflation (gap) and the output (gap) remains a critical policy issue for any emerging economy; particularly when an implicit or an explicit inflation targeting monetary policy is considered. The New Keynesian Phillips Curve (NKPC) has recently set up a framework on the trade-off between the inflation (gap) and the difference between the actual output and potential (efficient) output under the assumption of real wage rigidities. In this paper, we estimate the NKPC based on this framework for the Turkish economy over a period of implicit and explicit inflation targeting monetary policy. The results from Generalized Methods of Moments (GMM) estimation suggest that empirical findings are consistent with the theoretical background and the parameter restrictions are satisfied.

1.   Introduction

The relationship between inflation and unemployment was firstly examined by Phillips (1958). His seminal paper has started an endless debate in the macroeconomics literature that the existence of a possible trade-off between stabilizing inflation and unemployment. Phelps (1967; 1968) and Friedman (1968) then suggested that a stable trade-off based on the definition of equilibrium rate of unemployment called as natural rate of unemployment, and on the role of inflation expectation. Phelps (1967; 1968) and Friedman (1968) suggested the existence only of a short-run trade-off, and this did not come from inflation itself but from unexpected shock on inflation. Friedman (1968) indicated that the inflation expectation was an important variable to evaluate nominal wages, and the traditional paper of Phillips (1958) was found biased empirical results just because he did not make a disparity between real and nominal wages. This topic was subsequently

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examined by Lucas (1972) in an incomplete information model. In his model, when there was an increase in the price of goods, producers did not know whether there has been a change in relative prices or this rise has motivated by inflation. The producer rationally responded not only to fraction of the change in relative increasing prices, but also to aggregate inflation. Thus, his/her decision would be to raise production in some proportion in the short-run, and this allowing for a positively sloped supply curve in the short-run. This implication of the positively sloped short-run supply curve gave support to the hypothesis of short-run trade-off. As a consequence, in the short-run, monetary policy might affect the real economic activity.

On the other hand, the New Keynesian literature posited that both prices and wages showed some rigidity due to slowness of the adjustment in a new market condition. The existence of price and wage contracts was among the main reasons to explain price and wage rigidities. Even in the absence of contracts, firms might face menu-costs or fear the distaste of customers for frequent changes in prices. Thus, one should expect slowness of price adjustment. On the theoretical basis of price rigidity, a commonly used framework was firstly proposed by Rotemberg (1982) and Calvo (1983). In their framework, for each period, only a fraction of all firms were able to change prices under some probability, and this was independent from time and remaining firms. The framework of Calvo (1983) has become the point of origin for derivation of the New Keynesian Phillips Curve (NKPC). The standard version of the NKPC has been subject to controversy because it suggested the no trade-off between stabilizing inflation and the output (gap), when it was compared with the original Phillips Curve. However, one can think that a monetary authority that was able to commit itself to stabilize the output gap also can simultaneously stabilize inflation. Proposition of the standard NKPC was clearly contrast to the empirical evidences such as found by Clarida et al. (1999), Gali and Gertler (1999), Gali et al. (2001) and among many others.

Studies of the NKPC have found very different results as to the extent of forward-looking or backward-looking behaviour of price adjustment process. Actually, the hybrid NKPC was an integral part of the standard model of monetary policy. This was due to its microeconomic foundation such as that examined by Clarida et al. (1999), but also the successful estimation of NKPC models on time series data. Actually, a hybrid model was proposed by Gali and Gertler (1999, henceforth GG), who suggested that some firms adopted a backward-looking and others a forward-looking behaviour in the prices adjustment process. Their empirical findings indicated that besides statistically significant price adjustment by the backward-looking rule, it was not quantitatively noteworthy for the United States (US) economy for the period from 1960 to 1997. Also, an alternative approach was used the average real marginal cost (in percentage deviation from steady state level) in substitution of the output gap. Gali et al. (2001, henceforth GGL) showed that a better fitting results to the Euro area and the US data by using this version of the NKPC.

Several papers have overlooked those evidences by using the same data set as well as the GMM methodology, and they raised some empirical issues that questioned the robustness of the results of the GG and the GGL. For instance, Bardsen et al. (2004)

showed the principle that the estimates of the GGL most likely were biased in favour of a significant role for expected (future) inflation just because this variable was found negligible in re-examined models where variables from the instruments set significantly and directly caused inflation. Linde (2005) and Rudd and Whelan (2005; 2006) argued that the upward bias of the forward-looking estimates might be large when estimating the structural-form of the NKPC (as the GG suggested) rather than the closed-form solution of the model. Mavroeidis (2006) also demonstrated that the parameters of the GG were weakly identified and that the US inflation dynamics were consistent with both backward-looking and forward-looking behaviour, whereas real marginal costs appeared to be an irrelevant determinant of inflation.

Gali et al. (2005) replied the some of these criticisms, and they kept going to defence their main conclusion about the importance of the forward-looking behaviour for explaining inflation dynamics. They re-asserted that the NKPC, as the dominance of forward-looking behaviour was robust to choice of estimation procedure and specification bias. By the way, Rudd and Whelan (2007) could not reject the hypothesis that inflation and real marginal costs were completely unrelated when using data of the GG for inflation analysis. However, they used revised labour share data as proxy variable for real marginal costs. Their findings showed that the empirical evidence of the GG was not robust to revisions in data. Furthermore, Kurmann (2007) and Fanelli (2008) re-examined the empirical evidences in a framework of the GG and the GGL by using econometric methods that based on likelihood estimation. Using a reversed estimation technique, Kurmann (2007) showed that the cross-equation restrictions could be considered as constraints of the Vector Autoregressive (VAR) coefficients as the explanatory variable in the hybrid NKPC. In parallel with findings of the GG, Kurmann (2007) concluded that the NKPC based on the same US data could not be rejected by a conventional likelihood-ratio test. Fanelli (2008) also proposed a two step procedure that consists of specifying agents' expectations by using possibly cointegrated VAR models, and he derived at the cross-equation restrictions that the NKPC imposed on the VAR framework. In contrast to findings of the GGL, Fanelli (2008) concluded that the hybrid NKPC based on the same data set was far from being a suitable approach in explaining inflation dynamics of the Euro area. Boug et al. (2010) examined that the evidences of the GGL by using the VAR framework and likelihood based estimation techniques and they paid a particular attention to the stationary and non-stationary (and possibly cointegrated) nature of explanatory variables. Their results showed that the exact as well as the in exact-form of the hybrid NKPC certainly were not suitable into the Euro area data. On the other hand, seminal finding that the inexact hybrid NKPC was a good first approximation to the US inflation dynamics by the GG were seemed to be more suitable in the US data. However, the assumption of the model that the stochastic term formed a sequence of innovations might be problematic as they found that indication of autocorrelation in estimated residuals. The exact-form of the hybrid NKPC was clearly rejected by the US data. Fanelli and Palomba (2011) applied the hybrid NKPC into the Euro area, and they showed that the forward-looking component of inflation dynamics was much larger than the backward-looking component. Furthermore, the sequence of

restrictions implied by the cointegrated NKPC under learning dynamics was not rejected over the period 1984-2005. Nymoen et al. (2012) recently built up a framework for an interpretation of the empirical results of the NKPC for inflation dynamics. Both the rational expectations solution of the structural NKPC and the reduced-form VAR analysis of the multivariate time series properties gave insight about the joint-implications of the evidence in the NKPC literature. They suggested that the unit-root form of non-stationary might be implied for inflation, even though their econometric model initially assumed stationary. The uniqueness and form of a rational expectations solution might depend on whether dynamic homogeneity was present, and on the size of the forward-looking coefficient of the NKPC.

In summary, most monetary authorities in developed economies perceived a trade-off between stabilizing inflation and stabilizing the gap between output and potential or efficient output. However, the standard New Keynesian framework implied no such trade-off. A trade-off between stabilization of the inflation and stabilization of the output gap by the monetary authorities was presented in the NKPC framework of Blanchard and Gali (2007). This possible short-run trade-off between the stabilizing inflation (gap) and the output (gap) remains a critical policy issue for any emerging economy; particularly when an implicit or an explicit inflation targeting monetary policy is considered (Mazali and Divino, 2010). The inflation dynamics of Turkey and inflation targeting monetary policy in Turkey and its effects on exchange rate predictability and stock market volatility has investigated in many papers (Kumar, 2010; Cagli et al., 2011; Gozgor, 2012). However, the Phillips Curve (PC) (particularly the NKPC) is a rather unexplored research topic for Turkey. The PC or the standard NKPC have been examined in a few papers, such as that by Onder (2004; 2009), Yazgan and Yilmazkuday (2005), Kustepeli (2005), Hasanov et al. (2010), Saz (2011), Catik et al. (2011), and Cicek (2012).

However, to the best of our knowledge, there is still no paper that directly estimates the NKPC framework of Blanchard and Gali (2007) for Turkey. As we have already mentioned, a trade-off between stabilization of the inflation and stabilization of the output gap was presented in their NKPC framework. In this paper, we estimate both the PC and the NKPC based on Blanchard and Gali (2007)'s framework for the Turkish economy over a period of implicit and explicit inflation targeting monetary policy. As an emerging economy, Turkey adopted free floating exchange rate regime in February 2001, and then the implicit inflation targeting carried out from January 2002 to December 2005. The explicit inflation targeting started in January 2006. This study focuses on the period over January 2005-June 2012. We select the date of January 2005 as beginning just because unemployment rate data in monthly frequency are only available from this date. We suggest that using monthly inflation and unemployment rates are important for examining the NKPC in any developing economy because higher frequency data generate additional information in the volatility of inflation that is lost on quarterly or annual frequency data.

The remainder of this paper is organized as follows. In the second section we discuss the theoretical backgrounds of the PC and the NKPC. In the third section we elaborate the methodology and the empirical findings, and the fourth section is concluding the remarks.

2.   Theoretical Background

The simplest Phillips Curve model is the traditional Phillips curve of Phillips (1958), and the original equation is given such as (Karanassou et al., 2010, p. 21),

$$\pi_t = c - bu_t + \varepsilon_t \tag{1}$$

In this equation, c and b are positive constants. π_t is rate of inflation, u_t is rate of unemployment and ε_t is the error term. In the static nature of the Equation (1), the steady-state and rate of long-run unemployment are identical. Also, a dynamic extension of the Equation (1) is the so-called traditional Keynesian Phillips curve can be written as follows:

$$\pi_t = c + a\pi_{t-1} - bu_t \tag{2}$$

In the Equation (2), the autoregressive parameter is $|a| < 1$. Similarly to the static case in the Equation (1), there is a long-run trade-off and no natural rate of unemployment.

In the seminal contributions by Phelps (1967; 1968) and Friedman (1968), hypothesis of natural rate of unemployment (u^n) gave rise to the Expectations Augmented Phillips Curve that can be shown as follows:

$$\pi_t = \pi_{t-1} - b(u_t - u^n) \tag{3}$$

In the Equation (3), adaptive expectations are identical to the Expectations Augmented Phillips Curve under the random walk/rational expectations assumption. The main difference between two frameworks is that the random walk/rational expectations are able to separate the short and the long-run (Karanassou et al., 2010, pp. 22-23).

Furthermore, the standard NKPC has some fractions; such as, firms, people, efficient allocation (first best), flexible price equilibrium (second best) and staggered price equilibrium. The standard NKPC can also be written as follows (Blanchard and Gali, 2007, p. 36):

$$\pi_t = \beta E\pi_{t+1} + \kappa(y_t - y_t^*) \tag{4}$$

In the Equation (4), inflation (π_t) is a function of expected future inflation ($E\pi_{t+1}$), of the deviation from actual (y_t) and potential output (y_t^*) namely, the output gap. At this point, Blanchard and Gali (2007) introduced real wage rigidities into the standard NKPC framework, and re-examined flexible price equilibrium (second best) and staggered price equilibrium. Thus, their framework allows policy trade-offs and implications for the output cost of disinflation. They also discussed some alternative approaches, such as distortion shocks, different structure of wage and price setting and the behaviour of inflation (Blanchard and Gali, 2007, pp. 37-51). They derived at the relationship between inflation and unemployment. For this purpose, they firstly and explicitly introduced unemployment. Secondly, they rewrote the inflation equation in terms of unemployment that can be written as follows (Blanchard and Gali, 2007, p. 53):

$$\pi = \frac{1}{1+\beta}\pi(-1) + \frac{\beta}{1+\beta}E\pi(+1) - \frac{\lambda(1-\alpha)(1-\gamma)\phi}{\gamma(1+\beta)}u + \frac{\alpha\lambda}{1+\beta}\Delta v + \zeta \qquad (5)$$

In the Equation (5), inflation is a function of past and expected future inflation, of the unemployment rate (u), and of the change in the real price of the non-produced input (Δv). The term ζ is proportional to $(\pi - E(\pi|-1))$ so it is a white noise, and orthogonal to all variables at $t-1$. On the other hand, λ is the price rigidity and γ is the wage rigidity. At this model, terms of trade shocks on open economy is indirectly described within the real price of the non-produced input in the Equation (5). It is important to note that there are also different "open-economy" frameworks for the NKPC in the literature, such as those examined by Batini et al. (2005), Rumler (2007), Kuttner and Robinson (2010) and Mihailov et al. (2011).

The framework of the NKPC in Equation (5) can be estimated by using Instrumental Variables (IV) or GMM that parameters have certain constraints. Blanchard and Gali (2007) considered the US data. In the next section we discuss the constraints of parameters and examine the Turkish case.

3.   Methodology and Empirical Findings

In this section we estimate the Expectations Augmented Phillips Curve in Equation (3) and the NKPC framework in Equation (5) for the Turkish Economy. Unemployment is the rate of unemployment for population 15 years and over. We calculate the natural rate of unemployment from the long-term unemployment that is obtained from the World Bank Development Indicators. We use the Consumer Price Index (CPI) for actual inflation and inflation expectation because the Central Bank of the Republic of Turkey (CBRT) targets the CPI. Change in the real price of the non-produced input is calculated from the Producer Price Index (PPI) raw material index as same as used in the framework of Blanchard and Gali (2007).

We focus on the period from January 2005 to June 2012, and obtain all related data from the CBRT. As we have already discussed, we select January 2005 as a beginning date of our empirical analysis just because unemployment rate data in monthly frequency are only available from this date. Note that estimated standard deviations are robust to heteroskedasticity and autocorrelation of unknown form in the GMM estimation technique. We report the results from the Expectations Augmented Phillips Curve in Equation (3) and the NPKC in Equation (5) in Table 1.

Results in Table 1 emphasize that the OLS estimation for the Expectations Augmented Phillips Curve equation do not fit with recent data from the Turkish economy. However, as seen in Table 1, all explanatory variables are statistically significant at 5% significance level in the NKPC framework of Blanchard and Gali (2007), and they are efficient, unbiased and consistent. They have also expected and correct signs.

From the consistency perspective, we would like to emphasize that (C1) and (C2) parameters are subject to certain constraints in the estimation. The first constraint

Table 1: Results of the Expectations Augmented (EAPC) and the New Keynesian Phillips Curve (NKPC) Estimations for Turkey (Sample: January 2005-June 2012)

Explanatory Variables	EAPC (OLS) Coefficients	NPKC (GMM) Coefficients
$u_t - u^n$	–0.096 (0.305) [0.681]	-
Inflation Rate (-1) (%) (C1)	0.583 (0.101) [0.000]	0.659 (0.292) [0.028]
Inflation Expectation (%) (C2)	-	0.341 (0.158) [0.035]
Unemployment Rate (u) (C3)	-	–0.122 (0.051) [0.019]
PPI Raw Material Index (Δv) (C4)	-	0.044 (0.008) [0.000]
Jarque-Bera	1.096 [0.43]	0.875 [0.64]
Q(1)	2.175 [0.00]	0.194 [0.66]
Q(2)	0.293 [0.81]	0.231 [0.89]
Q(5)	2.862 [0.72]	3.450 [0.63]
Q(12)	12.11 [0.41]	14.23 [0.29]
J-statistic	-	2.701 [0.91]
Adjusted R-squared	0.32	0.76

Notes: Dependent variable is the rate of inflation (%). Regressions include the constant terms. We use robust standard errors in the Ordinary Least Square (OLS) estimation. The Jarque-Bera shows the test results of the normal distribution (null hypothesis of normally-distributed error terms is valid). Q(1), Q(2), Q(5) and Q(12) statistics are reported for autocorrelation analysis, and results show that there is no remaining autocorrelation in the estimations. Under the null hypothesis of the over-identifying restrictions are valid, the J-statistic of Hansen (1982) tests the validity of the over-identifying restrictions in the GMM estimation. The instruments are inflation rate, unemployment rate, and the PPI raw material index from lag 1 to lag 4 in the GMM estimation. We use the Heteroskedasticity and Autocorrelation Consistent (HAC) estimation weighting matrix of Newey and West (1987) with the quadratic-spectral Kernel, and the bandwidth selection method of Andrews (1991) in the GMM estimation. The optimal number of lag is selected by the observation based selection method of Newey and West (1994). The p-values are in brackets, and standard errors are in parentheses.

is $0.5 \leq (C1) \leq 1$ because $(C1) = 1/[1+\beta]$, and $0 \leq \beta \leq 1$. The estimated value of (C1) is 0.659, and it satisfies this constraint. The second constraint is $0 \leq (C2) \leq 0.5$ because $(C2) = \beta/[1+\beta]$. The estimated value of (C2) is 0.341, and this is also consistent with the theoretical background. The third restriction is $(C1) + (C2) = 1$, and this is already obtained in the estimation (see, Blanchard and Gali 2007, pp. 52-54 for details).

Furthermore, the parameters of (C3) and (C4) are functions of the structural parameters, and they cannot be individually identified. The parameters of price rigidity (λ) and wage rigidity (γ) are the structural parameters. Recall that $(C4) = \alpha\lambda/[1+\beta]$. The estimated value of (C4) is 0.044, and the discount factor (β) can be calculated from (C1)

as $\beta = 0.517$. Thus, we can write $\alpha\lambda = 0.067$ where α is the share of the non-produced input in the production function of Cobb and Douglas (1928). We can also calculate that the wage rigidity in the coefficient of $(C3) = -\lambda(1-\alpha)(1-\gamma)\phi/[\gamma(1+\beta)]$ that can be rewritten as $\gamma = -\lambda\phi(1-\alpha)/[(C3)*(1+\beta)-\lambda\phi(1-\alpha)]$. Also, note that $\lambda = \theta^{-1}(1-\theta)(1-\beta\theta)$.

On the other hand, we can analyze the trade-off between the stabilizing inflation (gap) or the stabilizing output (gap) between actual output and potential (or efficient) output in the presence of a supply shock. In the inflation targeting monetary policy framework, aim of the monetary authority (the CBRT in this study) is to keep inflation steady around the inflation target. In the case of a supply shock, the output gap will be influenced, and this case can be indicated as $\partial(y-y_i)/\partial\upsilon = -(1-\alpha)\Theta/[(1-\alpha)(1-\Theta)] = -\alpha\gamma/[(1-\gamma)*(1+\phi)]$. Thus, $\partial(y-y_i)/\partial\upsilon = -0.163$. Hence, in the case of the monetary authority try to keep inflation steady (as assumed to be certainly implemented in the inflation targeting framework in Turkey), if the non-produced input price increase at 1%, the gap between actual output and potential output will decrease at 0.163% for first period, and the actual output will edge away from efficient output. We can easily calculate the persistence of this supply shock effect by using the autoregressive parameter, and it can be found as $\Theta = 0.194$.

Furthermore, if the monetary authority targets to keep the gap between actual output and potential output as steady, inflation rate will rise. This case can be shown as $d\pi_t/d\upsilon = \lambda\alpha\gamma/[(1-\beta\gamma)[\alpha\gamma+(1-\alpha)]]$, and $d\pi_t/d\upsilon = 0.126$. This finding suggests that if a supply shock increases the non-produced input price at 1%, this will lead to 0.126% increase in next period inflation. Therefore, the monetary authority should decide between the different policy implications that tolerating for 0.163% divergence between actual output and potential output as increasing output gap; allowing for 0.126% increase in the next period inflation; or any trade-off combination of these extremities in policy implications.

4. Concluding Remarks

There is a widespread literature to examine the standard NKPC in developed economies. The standard version of the NKPC has been criticized for not to explain the trade-off between stabilizing the inflation (gap) and stabilizing the output (gap). The NKPC framework, such as that proposed by Blanchard and Gali (2007) has recently set up a framework on the trade-off between the inflation and the difference between actual output and potential (efficient) output under the assumption of real wage rigidities. This possible short-run trade-off between the inflation (gap) and the output (gap) remains a critical policy issue for any emerging economy; particularly when an implicit or an explicit inflation targeting monetary policy is considered. This paper successfully estimates the NKPC equation in the framework of Blanchard and Gali (2007) for the Turkish economy over the period of implicit and explicit inflation targeting monetary policy.

The results from the GMM estimation suggest that the empirical findings are consistent with the theoretical background and the parameter restrictions are satisfied, and also they are efficient and unbiased. Even the original framework of Blanchard and Gali

(2007) used the IV method; the GMM estimation technique in this paper is also well-fitted with the rational expectation nature of the model. We suggest that monetary authority should decide between the different policy implications that tolerating for divergence in output gap, allowing for an increase in the next period inflation, or any trade-off combination of these policy implications.

This study simply shows the NKPC framework of Blanchard and Gali (2007) can successfully be estimated for the recent data from the Turkish economy. Future researches about this topic can investigate several issues of the NKPC dynamics in the Turkish economy. First, one can focus on the data of larger period that includes several supply shocks, monetary shocks or a financial crisis. Second, one can evaluate the NKPC for developing economies in a panel data framework. Third, one can use the different econometric methodology, such as VAR models or the likelihood based estimation techniques. Fourth, one can discuss the impact of the reaction function of the monetary authority or the different monetary policy implications on the NKPC framework, such as that investigated by Kurozumi and Van Zandweghe (2010).

Finally, probably foremost, one can examine the role of inflation expectation in the NKPC framework; particularly it can be constituted by the term structure of government bonds. The relationship between the term structure of government bonds (nominal or real yield curve) and the new Keynesian macroeconomics have recently been well-documented in many front-page papers, such as those by Bekaert et al. (2010), Christensen et al. (2010), Joyce et al. (2010), and Gurkaynak and Wright (2012).

Acknowledgements

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Freight Transport Time Savings and Organizational Performance: A Systemic Approach

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Abstract

This paper investigates the effect of freight transport time savings (FTTS) on the performance of transport consuming companies. In the first part existing methods on FTTS valuation are critically discussed and their limitations are identified. Following, a conceptual model is built introducing an alternative approach for the valuation of FTTS that is based on the system perspective of firms, integrating the disciplines of systems thinking, performance measurement, transport and logistics decision making. Evidence from a Systems Dynamics' simulation experiment on a retailer suggests that the effect of FTTS on performance depends highly on the structure of the firm's transport related processes and decision making process. Through the development and simulation of several scenarios concerning the reaction of the firm to the FTTS, it is concluded that the value of FTTS is sensitive to the type of the reaction and its time profile.

1.   Introduction

Despite the wealth of information on transportation's contribution to the economy, debate continues on the linkages between transportation improvements and economic performance and the relative strength of these links (US DOT FHWA, 2004). Focusing at the micro level, the aim of this paper is to investigate the ways in which improvements in freight transport time and business performance are linked and how to measure the effects between the two. In particular, the paper focuses on the demand side of the transport market,

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that is companies producing and/or trading goods and consuming transport services for two reasons: first due to the serious questioning of the ability of current methods to fully capture the effect of FTTS on such companies and secondly due to the difficulty of performance measurement systems to be implemented and used in practice.

Although FTTS are expected to have a positive effect on carriers' efficiency and effectiveness reducing time related transport costs and improving service, this is not the case for their customers: shippers and consignees. Microeconomic research, particularly cost-benefit analysis (CBA) does not fully account for the benefits of transport improvements that accrue to shippers from cost savings and service improvements (US DOT FHWA, 2004). Furthermore, despite the effort to expand CBA in order to capture the full effect of FTTS for the owners of the freight being transported, serious consideration has been raised regarding the ability of existing data collection methods to safely elicit the value of FTTS (De Jones, 2000; Massiani, 2003; Zambarini and Reggiani 2007a; 2007b).

On the other hand, despite the fact that numerous performance measurement systems (PMS) and measures have been designed a lot of obstacles arise when it comes for their implementation and use in practice (Bourne et al., 2000). In their definition of performance as "doing today what will lead to an outcome of measured value tomorrow" Lebas and Euske conclude that performance is a complex concept that can be expressed as a set of parameters or indicators that are complementary and sometimes contradictory describing the process through which the various types of outcome and results are achieved (Lebas and Euske, 2007, p. 130). According to this view, in order to create something in the future a causal model is necessary, so that the process through which performance is to be created can be identified and managed by firms. Also, conflicting performance measures lead to trade-offs among them that must be made explicit not only in theory but in practice also. Existing PMS such as the Balanced Scorecard by Kaplan and Norton (1992; 1996) focus on mapping the relationships between the factors affecting performance but assume linearity, while in reality there are non-linear interactions, delays and feedback loops making it difficult to understand the process of performance creation.

The key argument of this paper is that the above weaknesses could be addressed through the application of an alternative approach for the evaluation of FTTS. A framework is developed that is based on system dynamics modelling and simulation aiming at the identification of the transport time related factors that affect performance, the understanding of their relationships and possible trade offs and finally the monetization of their effect on performance. In this model Massiani's definition of transport time is used, that is the total time (e.g the number of hours or days) that elapses between the dispatching of a shipment from the consigner until its receipt from the consignee (Massiani, 2003).

The paper is structured as follows. In section 2 we discuss why current methods may fail to fully capture the effects of FTTS on transport consuming companies. In section 3 we develop a procedural framework aiming at identifying the process through which FTTS can create performance. In section 4 we develop an illustrative example based on evidence from a retailing company and finally we conclude with some closing remarks.

2.   Assessing the value of freight transport time savings

In this section we briefly discuss the methods and practices that have been developed and used in order to assess the value of FTTS. After presenting their basic characteristics we proceed with a discussion of their limitations, justifying the need for an alternative approach.

2.1   Current practices

Based on the microeconomic theory, the value of freight transport time savings (VFTTS) is the benefit that derives from a unit reduction in the amount of time necessary to move a shipment from an origin to a specific destination. The US Federal Highway Administration (US DOT FHWA, 2001) classified benefits from FTTS as first, second and third order ones that take place in different time points. First order benefits include immediate time related transport cost reductions to carriers and shippers. Second order gains include reorganization effects for shippers stemming from improvements in logistics and represent additional economic benefits beyond traditional travel time and cost savings. Finally, third order effects include benefits such as improved and new products that derive from improvements in logistics and supply chain management.

Traditional CBA focuses on first order benefits from shorter transport time that include reduced vehicle operating times and reduced costs through optimal routing and fleet configuration for the carriers. Transit times may affect shipper in-transit costs such as for spoilage, and scheduling costs such as for inter-modal transfer delays and port clearance. Under this spectrum, in the short run nothing changes for the shippers except for the cost of freight movement, since they continue to ship the same volume of goods the same distance between the same points (inelastic demand for transport) (US DOT FHWA, 2001).

The reduction in transport cost resulting from the FTTS can be calculated using a general formulation of the transport production cost, taking into consideration the effect of speed under the form (Massiani, 2008):

$$ct(d_\mu,k) = w. \ d_\mu + v. \ d_\mu + k.g(k/d_\mu) \tag{1}$$

where $ct(d\mu,k)$ is the transport cost as a function of travel duration (d_μ) and travel distance (k), w is the hourly cost of the driver, v is the hourly cost of the vehicle and $g(k/d\mu)$ are the vehicle operating costs per kilometre as a function of speed.

Second order, long term reorganization gains include three types of firm's responses that will occur as a result of changes in transport times (Tavasszy, 2008):

- transport reorganization (transport facilities and services markets) that involves changes in routes, type of vehicle, modes of transport with time influencing the amount of inventory in transit and the value of the product;
- inventory reorganization (logistics facilities and services markets) that involves the

number, location and volume of inventories with time determining which clients can be served by which warehouse within service level targets;

- production reorganization (production facilities an goods markets) involving a shift between materials used, changes in production location or basic production technology changes.

Such benefits are very difficult to be monetized and used in CBA but are expected to be 15% above direct user benefits (US DOT, 2004). FTTS enable shippers to buy and ship smaller shipments, lowering the average order quantity both on the supply and the demand side, thereby lowering the average level of inventories. Reduced (time related) transport cost advocates smaller and more frequent shipments. In the case of internal transporting between the facilities of a firm, lower freight transport times translate to lower production times allowing for the materialization of a lean inventory policy. Smaller shipment sizes and order quantities also create other benefits including a more responsive supply chain that results in higher order fill rates and a wider product mix that results in more orders, sales, and profits. Reduced transportation time not only enable shippers to buy from less expensive suppliers but also have a broader range of supplier options, and hence input quality and differentiation. A reduction in transport time can allow a firm to expand its selling market, since the distance covered in a certain amount of time will increase. Small time to market enables firms to be flexible and able to adapt to customer requirements more rapidly increasing customer satisfaction, loyalty and profitability. Reduced transportation times and costs can allow firms to concentrate production and distribution processes in a more limited number of locations, giving them the opportunity to take advantage of possible economies of scale and higher return on asset (US DOT, 2006).

Research has been conducted in order for BCA to account for such benefits and avoid underestimation. Mohring and Williamson (1969) provided the first formal analysis of what has been termed "reorganization effects" demonstrating the validity of using consumer surplus in estimating net benefits of transportation investments including possible logistics re-organization. FHWA's 2001 Freight BCA Study rests on estimating the change in consumer surplus reflected in the 'shift' in the demand curve for freight transport that follows the improvement. In order to calculate benefits of transport improvements, the elasticity of transportation demand (expressed in vehicle miles - VM) with respect to transportation cost (η_C^{VM}) is required, that is expressed as the ratio of the elasticity of transport demand with respect to travel time (η_T^{VM}) and the elasticity of transportation cost with respect to travel time (η_T^C). For the estimation of these elasticities there is a need for surveys designed to capture re-organization effects while the value of travel time savings and reliability is based on surveys using a stated preference methodology (US DOT FHWA, 2001).

A later research by Boston Logistics Group concluded that reorganization effects are firm specific (US DOT, 2006). They categorized firms into six unique Supply Chain Types (extraction; process manufacturing; discrete manufacturing; design-to-order manufacturing; distribution and reselling), that they differentiated according to their

production strategy (flow/continuous vs. batch/cellular); the transportation mode (ship/ railcar, truckload/intermodal, or LTL/small package/air); the order trigger (make to plan, make to stock, assemble to order, make to order, or engineer to order); and the breadth of coverage between the raw material supplier and the end consumer. Based on surveys on real firms they provided rough "first-cut" estimates of second order, supply chain benefits from a 10% transportation improvement. Yet, as they point out their estimates are indicative and preliminary and special indexes were developed for each type of company.

2.2   Limitations

In order to establish a link between savings in transport time and business performance there are numerous information requirements and a heavy reliance on stated and revealed preference studies in order to discover how the firm values transport attributes. Data obtained through RP surveys are cognitively congruent with actual behaviour providing information on how decision-makers really behave through the identification of the current levels of service offered by the transport alternatives of their choice set and their real choice. However, there are practical limitations basically associated with the high survey costs; the inability to distinguish the trade-offs between alternatives; the difficulty to detect the relative importance of variables that do not dominate the observed behaviour; the difficulties in collecting responses for services, alternatives and policies which are entirely new; the ambiguity of the choice set (Morikawa, 1994; Ortúzar and Willumsen, 2011).

In cases where data from real markets are not available for predicting long term and/ or hypothetical behaviour in order to elicit reliable preference functions, stated preference (SP) techniques are used. SP techniques analyse the response to hypothetical choices using contingent valuation (CV), conjoint analysis (CA) and stated choice (SC) methods. Each of the choices has a cost and so by choosing it the respondent indicates how much he or she is willing to pay for having it and this way the value of each alternative is elicited. The data are then subject to econometric modeling techniques such as multinomial logit (MNL) and mixed logit.

In transport research De Jong (2000) concluded that mostly data come from contextual, highly customized SP computer interviews with carriers and shippers who are asked to compare pairs of alternatives, using logit models with linear utility functions. Zambarini and Regiani (2007a; 2007b) and Feo-Valero et al. (2011) reviewed several empirical studies in an attempt to provide a quantitative estimation of the value of freight travel time savings. They confirmed the dominance of SP surveys and behavioral models and showed a remarkable variation in the values that users put on FTTS. Such differences are explained partly by the different methods adopted to collect observations and partly by the influence exerted by contextual factors such as the trip distance, the country where the study is developed, the per-capita GDP, the category of transported goods, the transport unit.

Despite its dominance, there is a lot of criticism regarding the SP method and the ability to elicit safe values of FTTS. SP data are hypothetical and therefore researchers

cannot be certain that should a given situation arise, decision-makers will behave exactly as they said they would in the SP study. Zambarini and Regiani (2007a; 2007b) list several reasons behind 'hypothetical bias' a term used to denote the deviation from real market evidence (Hensher, 2010). First, the reliability of the data obtained by a SP survey strongly depends on the capability of the researcher to describe and choose the alternatives amongst which the firm's representative has to choose. Moreover, it might be the case that the answer does not reflect the behaviour that the respondent to the questionnaire would adopt in a real situation. It may also be the case that the respondent is not aware of all the gains that a saving of travel time might generate for the firm. To overcome some researchers propose the coupling of Stated Preference questions with Revealed Preference questions in order to ascertain the robustness of obtained estimations. Hensher et al. (2005) and Heshner (2010) raised questions about the influence that the design of the experiments has on the behavioral outputs of such models and list several directions for specifications regarding their presentation.

Another issue is the difficulty to identity the decision-maker or makers in a firm. Whereas the individual passenger is easily identified as the decision-maker who undertakes the actual movement in passenger travel models, the decision-making unit for freight modal choice is uncertain. While existing approaches assume that there is a unitary decision-making process in reality there are diverse actors involved in the process coming from the procurement, production, inventory, marketing or distribution department of the firm. They have no control or knowledge of all decisions made throughout the firm's supply chain plus their requirements may be conflicting. What is going to happen if for example the transport manager has different information, opinions and goals than the company owners? (Danielis et al., 2005). Therefore, it is unrealistic to equate the individual (mainly the transport or logistics manager) with the firm in eliciting the VFTTS.

Additionally, it is unrealistic to assume perfect knowledge on the part of the firm, especially when it comes to estimating long term, reorganization effects. FHWA (2001) recommended the use of SP surveys in order to estimate logistics costs savings from FTTS. This translates to a great effort for data collection about logistics decisions of companies while it assumes full information and complete certainty about future decisions. Is this realistic?

According to Forrester (1961) all decisions are based on models, usually mental ones that reflect peoples beliefs about the networks of causes and effects that describe the real world (i.e. the operation of the firm, its structure and its processes). Yet decisions based on mental models are not optimum because people learn to reach their current goals based on their existing mental models that do not change easily. In our case, decision makers usually operate in the context of existing decision rules, strategies, culture and institutions which in turn are derived from existing mental models. This means that a change in transportation time may alter decisions but not decision rules that are anchored on existing mental models (business as usual). In the longer run, decision makers should be able to alter their mental models according to the information feedback they have about the real world. Feedback from the real world stimulates changes in mental models resulting to a new understanding

of the situation leading to new goals, new decision rules, policies and so on (Sterman, 2000).

Yet, there are impediments to learning that hinder the above mechanism. As Morecroft (2007) points out, most people posses a typical event-oriented thinking style that is linear, from problem as event to solution as fix, ignoring possible feedbacks. But even if Senge's (1990) "shift in mind" towards feedback systems thinking is accomplished there are still barriers that hinder the learning procedure and include dynamic complexity (due to the time delays between taking a decision and its effects, the dynamicity and nonlinearity of systems etc.); limited information about the state of the real world; confounding and ambiguous variables; poor scientific reasoning skills leading to judgmental errors and bias; defensive routines and other barriers to effective group processes; decisions implementation failure due to local incentives; asymmetric information and private agendas leading to game playing; and misperceptions of feedback hindering peoples' ability to understand the structure and dynamics of complex systems (Sterman, 2000).

The above suggest that the valuation of time in freight transportation is a much more complex process than it is accounted for in current methods. This stems from the fact that the movement of goods is quite different from the movement of people. Unlike personal travel the decision-maker does not undertake the actual movement and there is likely to be a number of decision-makers, each with different interests that may be conflicting while information is limited. It is therefore unrealistic to use individual models in order to elicit the value of transport time savings. Boston Logistics Group developed indexes for each supply chain type in order to estimate the effect of FTTS (US DOT, 2006). Yet, in this paper it is argued that even the most detailed taxonomy cannot provide safe values for the FTTS. This is due to the fact that the effect of FTTS depends not only on the transported good, the position of the firm in the supply chain and the macro environment of operation but on the firms' reactions to FTTS. Therefore, the key idea of this paper is to focus on the firms' processes in order to understand how they operate and their decision making process in order to anticipate their longer term reactions to FTTS.

3.   A new framework for the valuation of FTTS

3.1   Aim and structure of the framework

The proposed framework is built on the thinking that the value that a firm will put on a FTTS reflects the anticipation on the effect that this saving will have on its financial performance. Bearing in mind the diverse actors this framework tries to integrate, all processes affected by FTTS and trade offs are considered. In order to overcome possible contradictions we do not focus on people' perceptions and beliefs but on the structure of the business processes that are affected by FTTS and use selected performance metrics in order to form causal paths to financial performance. The current structure of business processes reveals the way that business is currently done and reflects the short term responses to FTTS. Changes in decisions and decision rules can then be added in several realistic time

points to capture the medium and long run effects of FTTS. The elasticity of profit with respect to FTTS can then be derived for several time phases.

In this model we consider transport improvements that result to FTTS as exogenous ones. This means that they are the result of investment projects or policies external to the shipper's operations and are presented in the form of sudden changes (in a later version this assumption could be eased in order for the model to be more realistic especially for the estimation of induced traffic). FTTS will first have an impact on the shipper's internal business processes then affect stakeholder relationship and ultimately alter the firm's financial performance (Figure 1).

Figure 1: Generic framework linking FTTS to performance
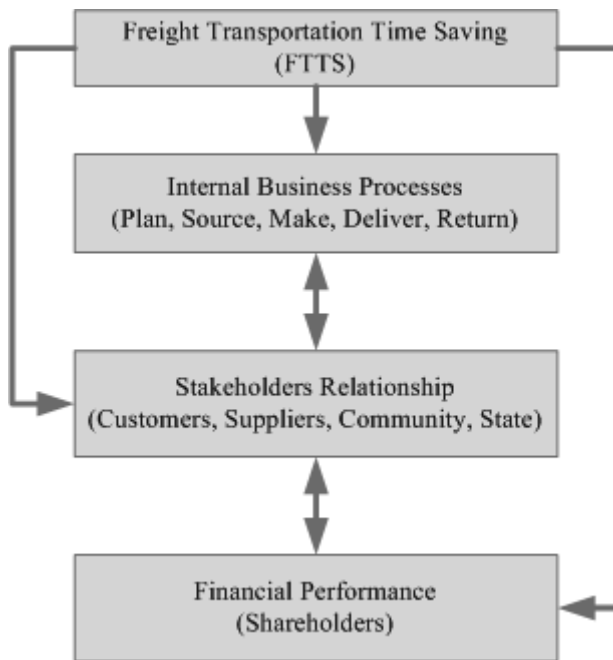
In order to identify the effect of FTTS on internal business processes, we use the process categorization proposed by SCOR: plan, source, make, deliver and return (SCC, 2006; 2008). Further, we use the "stakeholder mix" proposed by the Performance Prism framework so as to assess the effect of changes in internal processes to stakeholder's relationships (Neely et al., 2002). Finally, for the building of the causal mechanisms, we use performance measures that we derive from the existing literature in the field of performance measurement.

Grobler and Schieritz (2005) highlight the methodological difficulties in modeling business processes, since it is difficult to apply pure formal modeling, empirical observation and experimentation in firms. They advocate the use of simulations that share a characteristic feature with classical experiments: the possibility to alter one variable (in our case freight

transport time) and hold all other variables fixed. Simulation models develop according to Morecroft (1988) 'microworlds', do not require specific mathematical forms and provide the possibility to include estimations of difficult to measure (and "soft", qualitative) factors allowing the inclusion of all important parameters based on real world data or on estimates from actors within firms (Grobler and Schieritz, 2005).

3.2   Linking FTTS to internal business processes

The first step is to identify and map the effects of FTTS on internal processes. Based on SCOR, planning refers to the processes that balance aggregate demand and supply to develop a course of action which best meets sourcing, production, delivery and return requirements (SCC, 2006, 2008).

Sourcing refers to the process of obtaining the right materials, at the right place, at the right time, at the right quantity, at the right condition/quality from the right supplier and at the right price (Lambert et al., 1998). Planning in source refers to the development of procurement plans. For companies buying production materials, demand depends on the company's schedule of production and calls for a requirements approach such as MRP (Material's Requirements Planning) and JIT (Just In Time) (Muller, 2003). In both systems, transportation time plays a vital role since is affects Input Inventory Replenishment Time (IIRT), that is the time that elapses between the placing of an order to the supplier and its receipt. IIRT includes order preparation and transmittal, order receipt and entry into supplier's system, order processing, order picking/production and packing by the supplier, transportation time and time for receiving and placing into storage by the customer (Lamber, 1998). In the case of sourcing for resale, demand is influenced by exogenous market conditions (independent) and call for a replenishment approach. The Reorder Point (ROP) and the Economic Order Quantity (EOQ) formulas are mostly used in order to approximate the optimum order point and order quantity (Muller, 2003). In the ROP formula IIRT is taken into account, while for the EOQ formula to work IIRT must be known and stable (Lambert, 1998).

Making, consists of all processes that the company develops in order to transform materials into finished products. In the case of internal transportation between distant assembly lines and warehouses transportation time affects total production time. Planning in make refers to the process of building a Master Production Schedule (MPS) based on actual production orders and replenishment orders (demand) taking into account any possible capacity constrains (production, warehouse, transportation). MPS tells what products are to be produced, in what quantity, and what product must be ready for delivery, taking into account the existing inventories (Kumar and Suresh, 2008). Transportation time needed to move goods between different production facilities affects the scheduling of production.

Delivery comprises of all those processes that elapse between receiving an order from a customer until shipping it to his premises and invoicing him. Transportation is a part of this process affecting total delivery time. Planning in delivery, is conducted through the development of a Distribution Resource Planning (DRP) that takes into account the

Master Schedule (MS) for distributions which identifies product requirements stemming from demand and plans replenishment orders to the higher echelon in order to meet them, the Bill of Distribution (BOD) that contains the distribution network structure of a product and the transportation time associated with each link in the BOD (Ho, 1990; Ross, 2004). The scheduler then would assign gross requirements (product demand) to transportation means on specific dates based on transportation times and quantities and create a shipping schedule (Bookbinder and Heath, 1988).

Finally, planning in return refers to the process of aggregating planned returns and generating a Return Resource Plan (RRP) (Bolstorff and Rosenbau, 2007). Yet this is a very difficult task due to the uncertainty regarding the reason of return (and therefore the further use of the returned item), the amount of returned products and the time of the return. In the case of returned products that can be reused then the finished goods inventory and consequently the MRP system could be affected and also in the case of reproduction the MPS (Fleischmann et al., 1997). Materials inventory could be affected in cases where returned products are used after dis-assembly as materials for production. If returns can be associated with demand (this stands mainly for handling materials, packages and repairs) then planning can be achieved. In cases of stochastic demand for returns then the whole procedure cannot be easily patterned (Guide, 1996; Guide et al., 1997).

3.3   Linking FTTS to stakeholder satisfaction

After having identified and mapped the effect of FTTS on internal processes, the next step is to see how changes in internal processes propagate to affect the effectiveness of the firm that is its relationship with key stakeholders. They mainly include customers, suppliers and ultimately shareholders. According to the Balanced Scorecard performance measurement system causal paths from all the measures on a scorecard should be linked to the financial objective that is the focus for the objectives and measures in all the other scorecard perspectives (Kaplan and Norton, 1996).

3.3.1 Customer and supplier satisfaction

Customer satisfaction and loyalty are affected by the product attributes (quality, price, functionality), the customer relationships (time, dependability, flexibility) and the firm's image and reputation (Kaplan and Norton, 1996).

Based on Slack et al. (2007, p. 39) quality is "consistent conformance to customers expectations" and is affected by transportation time especially in the case of perishable goods and other time sensitive products. Melnyk and Denzler (1996) distinguished between six lead times that have to do with product design and engineering, procurement, production, delivery, order management and other times (i.e. time to respond to a claim). SCOR uses the measure Order Fulfilment Cycle Time (OFCT) as a measure of supply chain responsiveness to include the above mentioned lead times (SCC, 2006, p. 445). Transportation time reductions add value for time competing companies that need small

OFCT but is not always a necessity compared with the associated cost of speed mainly in the cases of easily anticipated demand and low value products (Harrison and Hoek, 2007).

Short delivery times due to small delivery times and available finished goods inventory allows for the delivery of goods at the right time while low return time from customers ensures that the right product will be delivered to the customer and Perfect Order Fulfilment will be achieved.

Flexibility reflects the ability of organizations to exploit opportunities stemming from changes in their environment that stem from new customer needs and wants (Dreyer and Gronhaug, 2004). Companies can react by increasing internal flexibility (focus on their operations) and/or external flexibility (focus on their customers). Transportation time mainly affects external logistics flexibility that refers to the ability of a company to change the place and time of its products delivery (Slack et al. 2007). SCOR (SCC, 2006) uses the metric Upside Supply Chain Flexibility defined as the number of days required to achieve an unplanned sustainable increase in quantities of raw materials (Upside source flexibility); in production (Upside make flexibility); in quantity delivered (Upside deliver flexibility); in the return of raw materials to suppliers (upside source return flexibility); and of finished goods from customers (upside deliver return flexibility) with the assumption of no other constraints. In a similar way, transport time can affect Upside (and respectfully Downside) Supply Chain Adaptability that is defined as the maximum sustainable percentage increase in quantity of raw materials, production, goods delivered and returned that can be achieved in a predefined number of days (SCC, 2006).

Moreover, transportation time can affect the image and reputation of a company especially in the case of companies selling time-sensitive products or trying to differentiate focusing on specific transport strategies that include transportation quality in terms of speed among other attributes (Konings et al., 2008). In such cases an unanticipated increase in transit times will harm a firm's competitive advantage and reputation while a reduction will strengthen its market position.

Supplier Relationship Management (SRM) defines how a company interacts with its suppliers with a desired outcome of a win-win relationship (Lambert and Knemeyer, 2007). Neely et al. (2002, p. 318) point out that the desirable supplier must be fast, right, cheap and easy to do business with. Transportation time affects the total inventory replenishment time justifying the renegotiation with existing suppliers or even the development of new partnerships.

3.3.2 Shareholders' satisfaction

Improvements in the planning and execution of internal processes will benefit a company only when they can be translated into financial performance in the form of revenue growth, cost reduction and better asset utilization (Kaplan and Norton, 1996).

Revenue growth can be affected by FTTS in the case of increased demand and sales due to the reduction of OFCT. Supply Chain Cost is defined by SCOR (2006) as the sum of costs in planning, sourcing, making, delivering and returning. It can be affected indirectly

due to changes in the order quantity and consequently the frequency of orders to supplier and the cost of placing them, the inventory quantity and the cost associated with holding it.

In the area of asset management several measures have been proposed. Among them Cash to Cash Cycle Time (CCCT) is a measure of efficiency of the working capital that represents the time required for a company to convert cash payments to suppliers of inputs to cash receipts from customers (Stewart, 1995; Kaplan and Norton, 1996, p. 58):

$$CCCT = IDS + DR - DP \qquad (2)$$

Inventory Days of Supply (IDS) reflect the number of days "demand" that a given amount of inventory could cover. Usually, a firm keeps enough inventories to cover demand during IIRT. Days Receivable (DR) reflect the time (days) that elapses between selling to customer and collecting cash, while Days Payable (DP) correspond to the time between purchasing from a supplier and paying him. Reducing transportation time leads to a reduction in the inventory days of supply ratio and the cash to cash cycle time.

Savings in transport time affects also the level of inventory as well as the amount of accounts payable (to suppliers) and receivable (from customers) therefore affecting Return on Working Capital, that is expressed as (SCC, 2006):

$$\text{Return on Working Capital} = \frac{\text{Supply Chain Revenues - Supply Chain Cost}}{\text{Inventory + Accounts Receivable - Accounts Payable}} \qquad (3)$$

Finally, reducing production and warehousing locations increases the ratio Return on Supply Chain Fixed Assets according to the expression (SCC, 2006):

$$\text{Return on Supply Chain Fixed Asets} = \frac{\text{Supply Chain Revenues - Supply Chain Cost}}{\text{Fixed Assets used in Source, Make, Deliver, Return}} \qquad (4)$$

4. Developing a simulation experiment

In this section we apply our framework in a retailing company using system dynamics modelling and simulation. First we map the decision rules governing the processes affected by freight transport time and their effect on selected performance measures. Then, we introduce a sudden exogenous change in freight transport time in see the impacts on performance measures.

4.1 Company profile and decision rules

The experiment is held in a retailing company operating in the market of electric devices spare parts. It is part of a traditional supply chain where demand information flowing upstream, beginning with the customers while the producer (supplier) only receives order information from the retailer. For simplicity reasons we model one specific item that is sourced from a manufacturer abroad and then resold to on-site retail customers. The firm's

Inventory Replenishment Time (IRT) is estimated at 26 days and consists of three distinct times: the supplier's order processing time (15 days), the transportation time (10 days) and the time to unload, inspect and store (1 day).

The firm has a clear focus on immediate demand coverage with error free goods (returns are less than 1%) and keeps no backlog, so in the case of stockouts, the sale is lost. Long IRT (26 days) and small storage space is counterbalanced by holding 10 days' sales on inventory. Furthermore, orders are released to supplier based on expected demand (EDD) (estimated at 20 items/day), available inventory of goods (GI), expected receipts from previous orders, IRT, transportation cost (TC) and inventory holding cost (IHC) (estimated at 30% of item value annually). Based on negotiations with the supplier transportation cost is a fixed percentage set at 4% of the price (IP) of the ordered good. Also, the supplier has set a Minimum Order Quantity (MOQ) of 300 items/order. Each item costs 5€ to buy and is sold for 10€. The firm reviews inventory and incoming orders on a daily basis.

Using the above data we build a causal model using Cash Balance (CB) as the primer financial performance measure and Unfilled Orders (UO) as a measure of customer satisfaction. Cash Balance is measured as the difference between inflows from sales and outflows stemming from supply chain processes that include order placing (ordering costs are estimated at 3€/order), transportation cost and inventory holding cost (other non logistics costs are excluded from the model). Unfilled Orders (UO) increase every time an order is not satisfied due to inventory shortage.

4.2   Model description and parameters setting

In the model there are six levels (or stocks) that are represented by rectangles (Figure 2):

- The Orders to be Released (ORS) to supplier, that is the number of items that the firm must order to the supplier and is estimated as the difference between the Necessary Order Rate (NOR) and the Allowed Order Rate (AOR) (items);

- the Supply Line (SL), reflecting the number of goods that have been ordered to the supplier but have not been received yet, estimated as the difference between Order Rate (OR) and Order Receipt Rate (ORR) (items);

- the Goods Inventory (GI), indicating the number of goods available for selling, expressed as the difference between Order Receipt Rate (ORR) and Order Delivery Rate (ODR) (items);

- the Accounts Payable (AB), expressing the amount of money the company owes to supplier resulting from the difference between the Supplier Credit Rate (CR) and the Cash Payments Rate (CP) (€);

- the Cash Balance (CB), resulting from the difference between Cash Inflows (CI) and Cash Outflows (CO) (€);

- the Unfilled Orders (UO), resulting from the rate of unfilled orders (Unfilled Order Rate – UOR), that is orders that have been placed by customers but have not been filled due to the lack of inventory (items).

Each level is an accumulation that is increased by an inflow and decreased by an outflow. Stocks are integrals or state variables while flows are rates or derivatives (expressed as goods/time step), so for every level we have:

$$\text{ORS}_t = \int_{t_0}^{t} (\text{NOR-AOR})ds + \text{ORS}_{t_0} \tag{5}$$

$$SL_t = \int_{t_0}^{t} (\text{OR-ORR})ds + SL_{t_0} \tag{6}$$

$$\text{GI}_t = \int_{t_0}^{t} (\text{ORR-ODR})ds + \text{GI}_{t_0} \tag{7}$$

$$AP_t = \int_{t_0}^{t} (\text{CR-CP})ds + AP_{t_0} \tag{8}$$

$$CB_t = \int_{t_0}^{t} (\text{CI-CO})ds + TP_{t_0} \tag{9}$$

$$UO_t = \int_{t_0}^{t} (\text{UOR})ds + UO_{t_0} \tag{10}$$

Figure 2: Causal model for the simulation experiment
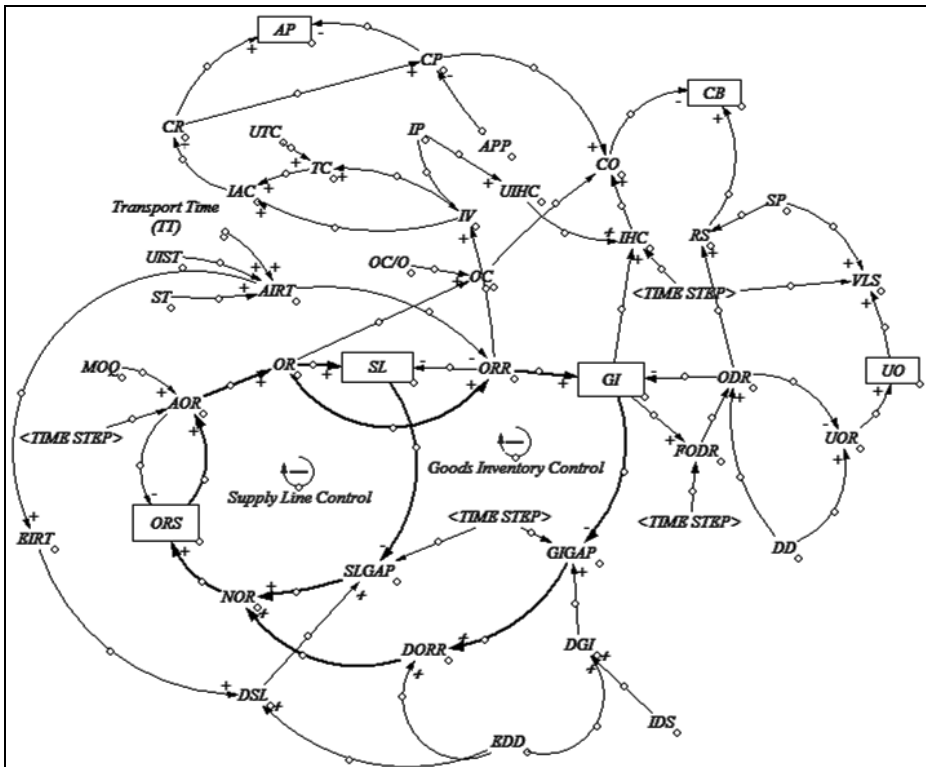
The model is built around two negative feedback loops, the Supply Line Control and the Goods Inventory Control. Feedback loops are the basis of the systems perspective where the typical thinking style is not linear but circular starting from a problem expressed as a discrepancy between a goal and the current situation, moving to a solution and then back to the problem. Problems do not just appear, they spring from other decisions and actions that may have obvious or even hidden side effects (Morecroft, 2007). In this model, Supply Line (SL) and Goods Inventory (GI) reflect the situations while Desired Supply Line (DSL) and Desired Goods Inventory (DGI) are the goals, the desired state of the system. Should there be a gap between the actual and the desired state of the system, then the firm proceeds to corrective action. This means that once a day (Time Step = 1day) the gap between desired and actual supply line (Supply Line Gap – SLGAP) and the gap between desired and actual goods inventory (Goods Inventory Gap – GIGAP) is corrected and a decision is taken whether to release or not an order. Therefore,

$$SLGAP = (DSL-SL)/Time\ Step \qquad (11)$$

$$GIGAP = (DGI-GI)/Time\ Step \qquad (12)$$

The quantity of the order to the supplier depends on these two gaps and the Expected Daily Demand (EDD) but is constrained by the Minimum Order Quantity (MOQ), that is subject to negotiation with the supplier and set at 300 items/order. Desired Supply Line (DSL) and Desired Goods Inventory (DGI) are a function of Expected Inventory Replenishment Time (EIRT), Expected Daily Demand (EDD) and Inventory Days of Supply (IDS).

$$DGI = EDD\ x\ IDS \qquad (13)$$

$$DSL = EDD\ x\ EIRT \qquad (14)$$

Therefore, Necessary Order Rate (NOR) to supplier depends on the Supply Line Gap (SLGAP) and Desired Order Receipt Rate (DORR), that is the sum of the Goods Inventory Gap (GIGAP), the Expected Daily Demand (EDD) and the Minimum Order Quantity (MOQ). In order to keep the formulations robust, we have to ensure that NOR is nonnegative, therefore:

$$NOR = \begin{cases} SLGAP + DORR\,, \text{ if } SLGAP + DORR \geq 0 \\ 0,\ \text{ if } SLGAP + DORR < 0 \end{cases} \qquad (15)$$

$$AOR = \begin{cases} ORS\,, \text{ if } ORS \geq MOQ \\ 0, \text{ if } ORS < MOQ \end{cases} \qquad (16)$$

$$DORR = GIGAP + EDD \qquad (17)$$

Once an order is released to the supplier, then its receipt is realized after Actual Inventory Replenishment Time (AIRT = 26 days), while each receipt increases the Goods Inventory (GI), that is then decreased by Order Delivery Rate (ODR) to customers. AIRT is the sum of Transportation Time (TT), Supplier Time (ST) and internal company time required to Unload Inspect & Store (UIST). Expected Daily Demand (EDD) is anchored at 20 items/day based on the firm's perception. Yet, actual Daily Demand (DD) is modeled following a normal distribution pattern with a Mean (M) value set at 20 items/day and a Standard Deviation (SD) of 5 items/day. Finally, minimum demand observed is 0 items/day and maximum is 40 items/day. The Order Delivery Rate (ODR) to customers is a function of the actual Daily Demand (DD) and the Feasible Order Delivery Rate (FODR) that is determined by the available Goods Inventory (GI) at that day since the company will deliver what is demanded or what it can actually deliver, whichever is less:

$$ODR = \begin{cases} EDD \text{ , if } FODR \geq EDD \\ \\ FODR \text{ , if } FODR < EDD \end{cases} \tag{18}$$

Every time an order from a customer is satisfied then Revenue from Sales (RS) increase triggering Cash Inflows (CI). Every time ordered goods from a supplier are received then the Accounts Payable (AP) increases denoting an obligation towards the supplier that equals the Input Acquisition Cost that is the sum of the Invoice Value of the inputs and their Transportation Cost (IAC = IV + TC). Based on negotiations with the supplier, the company pays 10 days after the receipt of the ordered goods (APP = Average Payment Period = 10 days). Each Cash Payment (CP) to the supplier along with Ordering Costs (CO) and Inventory Holding Cost (IHC) increases the company's Cash Outflows (CO) that is the supply chain cost. Finally, every lost order due to inventory shortages increases the Unfilled Orders (UO) level and accordingly the Value of Lost Sales (VLS), that is a measure of customer dissatisfaction. Actual Daily Demand (DD) is considered to be exogenous and not affected by the level of customer satisfaction, so what the company losses is the revenues from those lost sales.

4.3 Scenarios building and simulation results

Five scenarios are developed in order to see how a reduction in Transportation Time (TT) propagate and affect selected performance measures (Cash Balance (CB) and Unfilled Orders (UO)). In all scenarios, the simulation lasts 600 days. The value of the FTTS is calculated at the end of the simulation as the difference between Cash Balance for each scenario (i = A,B,C,D) and Cash Balance for the Base Case (BC).

$$VFTTS_i = CB_i - CB_{BC} \tag{19}$$

The firm starts at day 1 with a zero Goods Inventory (GI = 0 items) and expects no orders to be received (SL = 0). The assumptions for each scenario are presented in Table 1.

After a reduction at Transportation Time (TT) and Actual Inventory Replenishment Time (AIRT) by 4 days at the 200th day of the simulation, the firm gradually proceeds with changes in decisions rules. The Expected Inventory Replenishment Time (EIRT) adjusts to the new AIRT at the 300th day of the simulation (Scenario B) the Inventory Days of Sales (IDS) is reduced at the 400th day of the simulation (Scenario C) and finally, the company re-negotiates with its supplier and face an increase in transportation cost at the 500th day (scenario D).

Table 1: The value of FTTS for the simulated scenarios

Scenario (i)	Transport Time (TT)	Actual IRT (EIRT)	Expected IRT (EIRT)	Inventory Days of Supply (IDS)	Transport Cost (TC) as % of Input Price	Cash Balance	Value of FTTS
Base Case	10 days	26days	26days	10 days	0,04	51.936,7€	
A	6 days (at day 200)	22days	26days	10 days	0,04	51.812,4€	-124,3€
B	6 days (at day 200)	22days	22days (at day 300)	10 days	0,04	52.877,1€	940,4€
C	6 days (at day 200)	22days	22days (at day 300)	5 days (at day 400)	0,04	51.665,5€	-271,2€
D	6 days (at day 200)	22days	22days (at day 300)	5 days (at day 400)	0,05(at day 500)	51.562,0€	- 374,7€

Based on the results as they are presented in Table 1, scenario B has the greatest FTTS value. In all other cases, the effect of the FTTS is negative. The model allows for the tracing of the reasons behind this behaviour. In all cases the Supply Line (SL) and Goods Inventory (GI) develop a behaviour of oscillation where the state (SL and GI) overshoots its goal (ESL and EGI), reverses and undershoot and so on. The reason behind this behaviour is the two negative feedback loops (Supply Line and Inventory Control) and the delays caused by the Actual Inventory Replenishment Time (AART) and the Minimum Order Quantity (MOQ). Scenarios C and D due to the reduction in Inventory Days of Sale (IDS) have lower level of inventory targets (Desired Goods Inventory - DGI) and therefore lower average inventory leading to lower costs of holding them (Figure 3). Yet, smaller inventory lead to increased Unfilled Orders (UO) compared to the other scenarios (Figure 4) resulting to lower Cash Balance. It is therefore evident that the effect of FTTS on performance is very sensitive not only to the response of the firm but also the timing of this response.

5.   Concluding remarks

In this paper we developed a theoretical framework mapping how exogenous freight transportation time changes may affect performance of a typical organization that consumes transport services The novelty of this approach lies in its holistic systems thinking, according to which organizations are best understood when seen as holistic systems, where

the various processes and their activities interact via a web or relationships and constitute a whole. In systems theory, it is the system's structure (causal links) that determines its behaviour, and if this structure is well understood and explained then a greater insight into the behaviour of complex phenomena can be achieved (Senge, 1990). Evidence from the simulation experiment has shown that under certain operating conditions and decision rules a company may or may not fruitfully exploit freight transport time savings.

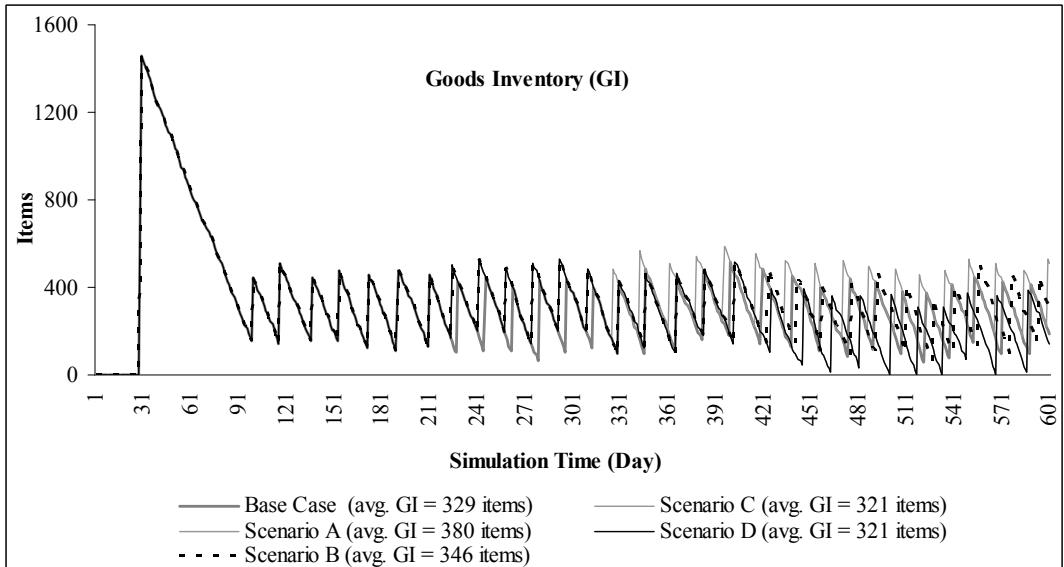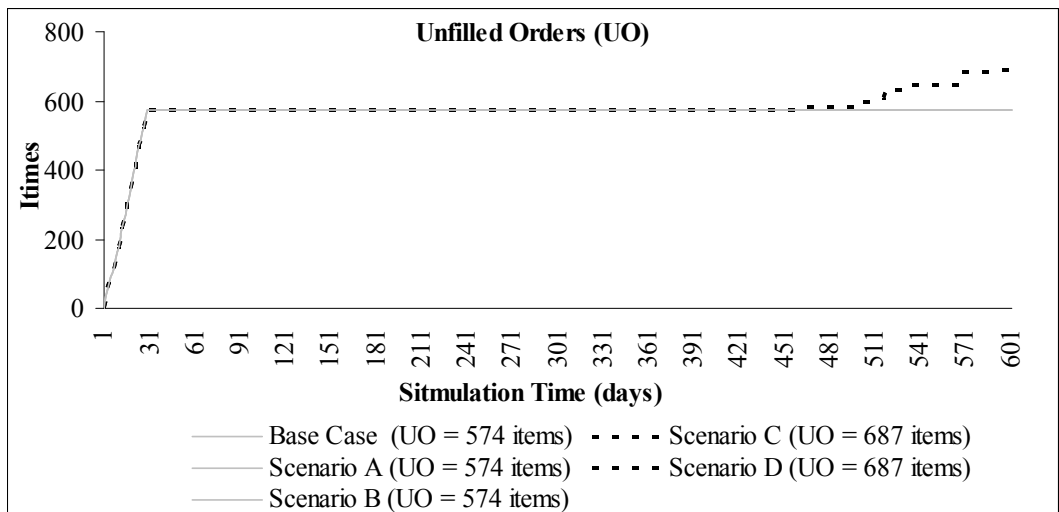**Figure 3: Goods Inventory for all scenarios**

Figure 4: Unfilled Orders for all scenarios

Based on this framework, in order for shippers to estimate the effect that a change in transportation time will have on their performance, first they have to identify how such a change will affect the planning and execution of internal business processes (source, make, deliver, return). The next step is to identify how changes in internal processes affect stakeholders (customer, suppliers, community, regulators and shareholders) so as to develop the appropriate performance measures for each perspective and map the causality links between them. In order to elicit the effect of FTTS on performance and result to quantified conclusions the next step is to consider existing or develop hypothetical scenarios and simulate the causal model.

Using system dynamics modeling and simulation this framework brings new insights into the evaluation of FTTS and it is worth consideration for a number of reasons. First of all it returns time profiles for all variables, from the initial time until the end of the time horizon allowing for comparisons between them with and without the exogenous stimuli (change in transportation time). Also, it allows for the gradual introduction of transportation changes as well as alterations in decision rules and operating conditions of the firm resulting from those changes in a more realistic way. It allows for the introduction of several decision criteria and performance measures as variables of the system participating in several feedback mechanisms and even interact with each other. Moreover, it allows the tracing of all variables' values on a step by step basis and not just at the beginning and the end of the time horizon, however long. Finally, it enables the track and tracing of the causes - parameters and conditions – behind the effects that may hinder or enhance performance.

This approach could be further used for the uncovering of the linkages between improvements (or deteriorations) in other transport attributes (e.g. in transport cost, travel time reliability) and organizational performance. This is a realistic scenario, since transport projects rarely affect only one transport parameter and in this case it is required to assess the joint effect of these changes to performance. Considering that there may be trade offs between them (e.g. a decrease in transport time may result in increased transport cost) and the reactions of the firms, this framework provides a tool for the comprehensive observation of the causalities between transport improvements and organizational performance.

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Positive and negative impact of increased tertiary attainment

Alena Bušíková[1]

Abstract

The theory of human capital clearly states that the investments into the education bring many benefits and are worth the cost. The OECD Education at a Glance analysis provides support for both public and private investing in tertiary education as the net present value is positive for all observed countries. Considering the benefits of education, a growth in tertiary education should be viewed very positively. In this context, the European Strategy Europe 2020 set up one of its main goals for EU27 countries as follows: to increase the educated population so that it reaches 40% (tertiary educated people aged 30-34). This article, on an example of Slovakia, provides an analysis of both positive and negative impact of increased tertiary attainment.

Keywords: higher education, Slovakia, Europe 2020

JEL Classification: I23, I29

1.   Introduction

Human capital, in short, is the intangible capital that people possess including their competencies, knowledge, and attitude. From the economic standpoint, the expenditures on education, training, medical care, etc. are considered the investments in human capital.

The concept of the theory of human capital goes back to Adam Smith, who in his Wealth of Nations (1776), mentions that education makes people more sophisticated and progressive. More formally, the theory of human capital was introduced in 1960 by economist Theodore Schultz and further developed by other economists, most notably Gary Becker, the scholar of Chicago School of Economics and the author of the book, Human Capital (1963). Another representative of the Chicago School of Economics, Jacob Mincer, helped to develop the empirical foundations of human capital theory. Other well-known economists, such as Lucas, Romer, Mankiw, Weil, Denison and Sala-i-Martin, have examined the impact of human capital and education on the economic growth of a country (Lisý, 2003). Many other authors contributed to the development of the theory of human capital; however, the ones mentioned above are certainly the most notable ones.

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Our article concentrates on the investments in tertiary education and discusses positive and negative impact of increased tertiary attainment.

2. The role of education in forming human capital

2.1 Benefits and costs of education

In general, there is no doubt that education provides utility; otherwise, there would not be a need for it. In the short term, it most likely provides the joy of learning; in the long run, it should increase one's productivity for years to come and, most likely, increase a person's earnings for life. In this sense, education can be viewed as an investment because similar to investments in properties or stocks, the investor hopes for a return exceeding the initial cost. Families need to consider the private costs and benefits when choosing how to allocate scarce family resources. From a public policy perspective, governments also need to consider the social costs and benefits of education, vis-à-vis the many alternative uses of the same public funds. According to the economist's model of human behavior, no investment will be made unless the benefits anticipated from the investment are higher than the expected costs, including the opportunity costs (WorldBank, 2002).

The **benefits** of investment in human capital are limitless; however, in classifying the benefits of schooling, Schultz (1963) defines three main streams: present consumption, future consumption (investment), and future producer capability (investment in future capabilities to produce and earn income). The theory of human capital - represented by the notable authors (mostly Schultz, Becker and Mincer; complemented by Mankiw, Romer, Weil, Blaug and Čaplánová) - mostly reflects on these benefits of education: the average income of an educated person is higher than the average income of a less educated individual, the chance of becoming unemployed is lower with a higher level of education, the crime rate diminishes with an increased level of education and the family planning is more coordinated with a higher level of education. On the national level, the theory of human capital often states that the productivity of an educated individual should be higher and subsequently the higher the productivity, the higher the GDP of the economy. Even though it is difficult to measure the relationship between education and productivity, the positive relationship is supported by empirical analysis and can also be presumed by the fact that employers generally pay a higher wage to an educated person. If the increased productivity were not there, the additional costs provided by the employers would be irrational.

Faridi, Malik and Rao (2010) point out that education combined with health improve human capital, raise the productive capacity and are considered the core components of growth and development**.** According to Romer (1986), ''The more people you have prospecting, the more you will be stumbling on rich veins of gold''. Those veins of gold are produced in US graduate schools, especially in PhD science and engineering programs.

All these statements provide a support for the investments in the human capital.

Besides the benefits of education that have already been mentioned, the literature states several other ones: the attitude toward environmental protection is greater when people are more educated; better educated people tend to cope with daily life situations more easily (e.g., dealing with administration); with better educated people, there is a better textbook market; and the children of more educated parents tend to be more educated themselves. Also, countries with higher educated people tend to be more democratic and have fairer elections (Čaplánová, 1999).

On the other hand, there are some indisputable **costs** associated with the education. The theory of human capital distinguishes between the private cost and the public cost in addition to direct costs and indirect costs of education. From the private individual's perspective, the direct costs are the fees families actually pay, plus other out-of-pocket expenses for textbooks, travel and accommodation. The public cost is the payment for buildings, electricity, faculty, librarians, and administrators used in the public education process. From both the private and public perspectives, the indirect costs are the opportunity costs, the time students spend studying and their foregone earnings. Chart 1 depicts the distribution of public and private expenditure on the tertiary education for various countries.

**Figure 1: Distribution of public and private expenditure
on educational institutions (2007)**
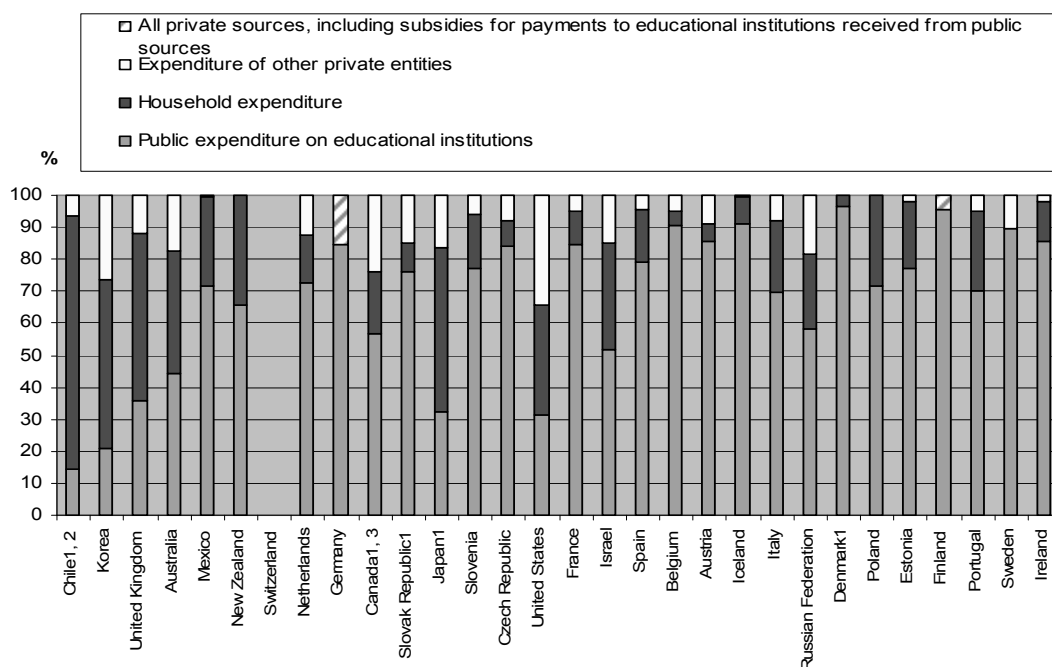
Source: Education at Glance, OECD 2010.

In most countries of the EU, education is predominantly publicly financed. As we can see from the chart, there are several countries where public sources finance above 90% of tertiary education: Belgium, Iceland, Denmark and Finland. On the other hand, there are countries where the public expenditure is below 50%: Chile, Korea, the United Kingdom, Australia, Japan and the United States. The proportion of private funding in countries such as Australia, the United Kingdom and the United States may be affected by the presence of international students, who are usually excluded from receiving public funds.

In the previous sections of this paper, we have described the most common benefits of education and its costs. Without a proper cost-benefit analysis, our main goal – to analyze an impact of the increased tertiary attainment – would be lacking a solid theoretical background. For this reason, the next section of the paper focuses on the return on education.

2.2 Rate of return on investment in education

Once the outlined benefits and costs of education are measured and discounted at an appropriate rate of interest, the essential elements of a cost-benefit analysis are available. There are three basic ways of presenting the cost-benefit analysis: first by means of a benefit-cost ratio, second by calculation of the net present value, and third by calculating the internal rate of return on the investment (Woodhall, 2004). Several economists have tried to measure the relationship between the inputs and outputs in education. At an individual level, Mincer's approach is considered to be the cornerstone of the literature on the relationship between earnings and human capital investments. The classical Mincer approach links the logarithm of average earnings to completed years of schooling and years of experience as follows:

$$\ln w(s,\, x) = \alpha 0 + \rho s\; s + \beta 0 x + \beta 1 x^2 + \varepsilon$$

where s denotes years of schooling, x is experience (Folloni-Vittadini, 2010).

Another economist, Psacharopoulos (1994), has found out that the rate of return is positive for all types of education but the most for primary and secondary education, rather than tertiary education.

The empirical analysis of the 2010 edition of *Education at a Glance* shows that public resources invested in education ultimately pay off in even greater tax revenues. On average across OECD countries, a man with a tertiary education will generate an additional 119,000 USD in income taxes and social contributions over his working life compared to someone with an upper secondary level of education. Even after subtracting the public expenses spent to educate an individual, the remaining 86,809 USD is almost three times the amount of public investment per student in tertiary education. The chart below depicts the net present value (NPV) for selected OECD countries for tertiary education.

**Figure 2: Public and private NPV in selected countries
for tertiary education in dollars (male)[1]**
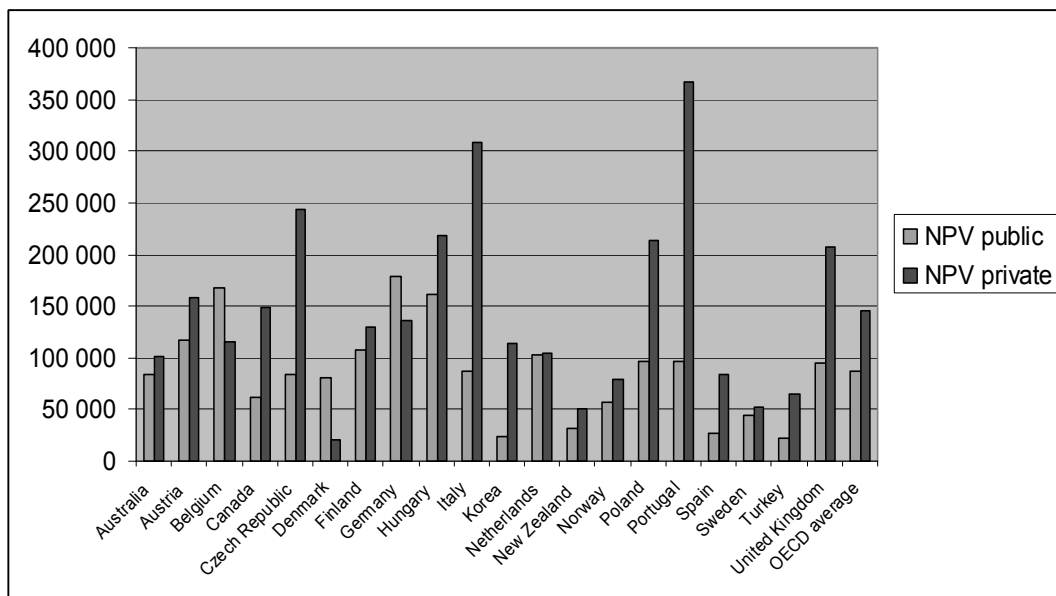
In most countries, the private net present value is higher than the public net present value, with the exceptions being Denmark, Germany and Belgium. Some policy makers like using this as an argument for transferring the costs of education from the public sector to the private sector, e.g., by introducing tuition at public schools. Overall, the net present value for both the private and public sectors is positive, regardless of the country, and ranged from 20,867 USD private net present value in Denmark to 366,728 USD private net present value in Portugal. This analysis provides support for both private and public investing in tertiary education and highlights the positive aspects of education in terms of forming the human capital.

The preceding cost-benefits analysis has provided sufficient evidence of the economic rentability of investment in tertiary education across OECD countries as both public and private net present values are positive. For these reasons, individuals should be motivated to bear costs in the present in order to increase their productive capacity and incomes in the future, just as government should motivate individuals to study.

3.   Analysis of the increased tertiary attainment for the European Union countries

In this context, the European Strategy Europe 2020 set up one of its main goals for EU27 countries as follows: to increase the educated population so that it reaches 40% of

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[1] The NPVs of females display similar results, but lie significantly below those of men.

tertiary educated people aged 30-34 by 2020. The more educated population should bring EU countries many positives on both private and public level.

Despite of the main goal of Europe 2020, several countries do not cope with this target in their national programs perhaps due to the fact that their current tertiary attainment is at a much lower level. (Seventeen countries have their national targets at the same level or above the Europe 2020 headline target but the remaining 9 countries set up the national target at a lower level (Note: UK did not specify the National Reform Program)).

Table 1: National targets of EU27 countries in terms of tertiary attainment

T	E	G	Y	Z	E	K	E	L	S	I	R	U	E	T	T	U	V	T	L	L	T	O	E	I	K
8	7	6	6	2	2	0	0	2	4	2	0	0,3	0	6	0	0	4	3	0	5	0	6,7	0	0	0

Source: Europe 2020 at http://ec.europa.eu/europe2020

The following table indicates the percentage of the tertiary educated people aged 30-34 for the time period of 2000-2010 for EU27 average and Central European countries.

Figure 3: The percentage of tertiary educated people aged 30-34: selected countries
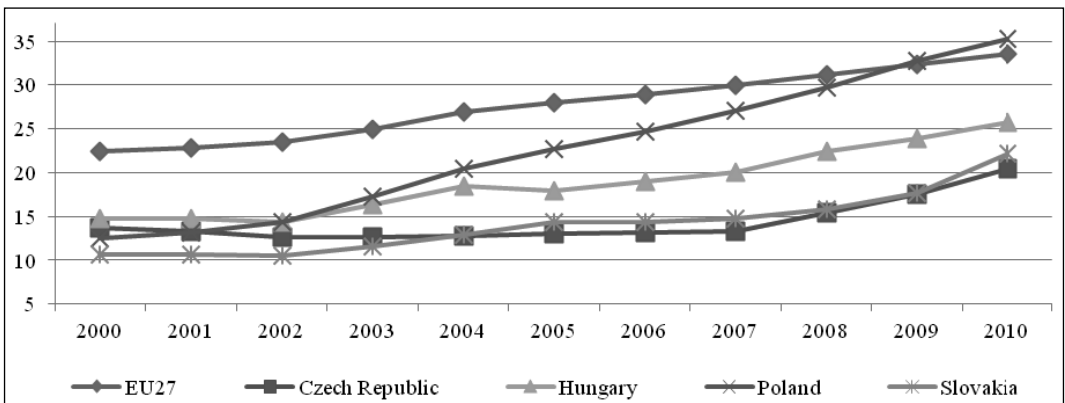
Source: own computation based on the date from Eurostat.

It is obvious that all observed countries' tertiary attainment is at a lower level than both the Europe 2020 target and their national targets; however, all of them have an increasing slope. There is likelihood that if such an increase continues, most of the EU27 countries will be able to reach the target of Strategy Europe 2020 and therefore, have more educated population.

Before we examine the positive and negative impact of increased tertiary attainment on an example of Slovakia, we try to examine the relationship between tertiary attainment and several other factors including the GDP per capita.

Relationship Between Tertiary Attainment and other selected Indicators: correlations and causalities

The impact of such an increased tertiary attainment should have – in regards to the previously described benefits of education – positive impact on several other factors such as GDP per capita. Also, with the increased tertiary attainment, it is expected that the R&D expenditure (expressed as a percentage of GDP) rises and the quality of tertiary educational system in a given country improves.

In the following section of our paper, we try to verify these relationships:

– the tertiary attainment is positively correlated with the GDP per capita of a country,
– the tertiary attainment is positively correlated with the R&D expenditure,
– the tertiary attainment is positively correlated with the quality of tertiary educational system in a given country (using academic rankings as a proxy for measuring the quality of tertiary education in a given country)[2].

The correlation among these indicators is presented in Table 2. Data is extracted from several international databases (Eurostat, OECD Education at a Glance database, the web sites of academic rankings) and serve as a base for constructing the panel data for the period of the years - 2003, 2005, 2007 and 2009 - for EU27 countries in addition to Switzerland, Norway, the United States and Japan. We decided to use the panel data analysis in order to obtain more reliable results by analyzing observations on multiple phenomena observed over multiple times in multiple countries. In this work, only correlation (R) of above 0.5 is determined to be an indicator of a strong correlation between the indicators: if a correlation of above 0.5 is found (whether positive or negative), it indicates that there is a strong relationship between selected knowledge economy indicators and tertiary educational indicators. The advantage of the correlation analysis is that, unlike the regression analysis, it shows how those variables affect each other regardless of the direction. On the other hand, it does not suffice in determining whether there is a cause-and-effect link between the variables (it would instead be determined by regression analysis at the later stage of this paper). At this stage, the correlation analysis suffices as we are interested in testing whether there is a correlation of any kind in between selected two variables and if so, how strong.

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[2] The quality of education is difficult to be measured. Since the statistics rating the tertiary educational system of a given country are not available, we used the reputable academic rankings as a proxy for the quality of education. For the sake of our analysis, we used the Academic Ranking of World Universities (ARWU) and Times Higher Education Ranking (THE) and calculated the percentage of universities ranked in ARWU and THE by country.

Table 2: Correlations between selected indicators (panel data)[3]

	R&D	GDPCAP	TERAT	ARWU
GDPCAP	0,516			
TERAT	0,502	0,518		
ARWU	0,394	0,252	0,138	
THE	0,433	0,281	0,275	0,929

Source: Eurostat, OECD, web sites of ARWU and THE.

The correlation matrix reveal a strong correlation between the tertiary attainment and the GDP per capita of a country (correlation coefficient of 0.518) suggesting that the increased tertiary attainment could increase the productivity of a country and furthermore its GDP (even though at this stage we cannot determine which indicator is the dependent variable and which indicators are the independent variables).

There seems to be a strong correlation (correlation coefficient of 0.502) between the tertiary attainment and the R&D expenditure (R&D) which may mean that with increased number of universities and tertiary students, the government spares more of its GDP on R&D.

Unexpectedly, the correlations between the tertiary attainment and Percentage of universities ranked in Academic Ranking of World Universities by country (ARWU) or Percentage of universities ranked in Times Higher Education by country (THE) have not been confirmed (correlation coefficient of 0,138 and 0,275) suggesting that the countries with higher percentage of tertiary educated people do not necessarily have higher representation of their universities in the international rankings.

Since the quality of universities is what really matters, the question we pose at this moment is to what extent the selected indicators (tertiary attainment, GDP per capita, R&D expenditure in % of GDP and tertiary expenditure) affect the quality of universities (using the Academic Ranking of World Universities and Times Higher Education ranking as a proxy for quality)[4]. In order to examine these hypotheses, a simple regression analysis has been performed.

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[3] R&D – R&D expenditure (both public and private expressed as % of GDP)

GDPCAP – GDP per capita

TEREX – Public expenditure per student, tertiary (% of GDP per capita)

TERAT – Tertiary educational attainment, age group 30-34 as a share on total population age group 30-34

ARWU – Percentage of universities ranked in Academic Ranking of World Universities by country

THE – Percentage of universities ranked in Times Higher Education by country

[4] There is likelihood that these indicators positively affect the success of universities to place highly in the academic rankings. Our expectations are that the higher the tertiary expenditure per student/GDP per capita/R&D expenditure/tertiary educational attainment of a country, the higher the country's chance to succeed in the academic rankings. The regression analysis does not include other indicators to avoid a multicollinearity.

Hypotheses:

H$_0$: there is not enough evidence to confirm the relationship between the success of universities to score well in the international rankings (as dependent variable) and tertiary expenditure per student, GDP per capita, R&D expenditure in % of GDP and tertiary educational attainment (as independent variables).

H$_1$: the success of universities to score well in the international rankings is dependent on tertiary expenditure per student, GDP per capita, R&D expenditure in % of GDP and tertiary educational attainment.

Regression analysis has been performed for the period from 2002 to 2006 for EU27 countries and the US and Japan (but only for those countries for which the data across all variables was available[5]) using Excel. In the first case, the dependent variable is the percentage of universities ranked in Academic Ranking of World Universities by country (ARWU) and the independent variables are tertiary expenditure per student, GDP per capita, R&D expenditure in % of GDP and tertiary educational attainment. In the second case, the dependent variable is the percentage of universities ranked in Times Higher Education by country (THE) and the independent variables remain the same as in the first case. Since there is a time lag in between the changes in the dependent variables, and their effect on the dependent variable, we considered t+3 in the case of dependent variables.

Table 3: Regression results for Academic Rankings (OLS)

Variable	ARWU coefficient	THE coefficient
constant	0,30902 (0.54)	-0,85999 (-1.01)
TEREX	-0,05067 (-3.3)***	-0,03463 (-1.52)
GDPCAP	0.00014 (4.51)***	0,000133 (2.95)***
R&D	0,49581 (2,14)**	0,440449 (1.28)
TERATT	-0,02069 (-1,03)	0,009465 (0.32)
No. of observations	118	118
Adjusted R-squared	0,24245862	0,14142113

Source: own computation based on international databases using Excel.
Note: ** significant at 5%, ***significant at 1%.

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[5] Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, United Kingdom

The results of their regressions indicate the following:

The overall explanatory power of the model (expressed by adjusted R^2) is higher in the case of ARWU being the dependent variable (adjusted $R^2 = 24.25\%$) than in case of THE (adjusted $R^2 = 14.14\%$).

In ARWU regression, there are three independent variables that are statistically significant – tertiary expenditure per student, GDP per capita, and R&D expenditure in % of GDP. The statistical significance of each variable is high as indicated by respected t-statistics. These results show that countries with higher GDP per capita and higher R&D spending are more successful in the world's 500 academic ranking compiled by ARWU (expressed as a percentage of successful universities of a certain country on the total number of universities in the ranking). Unexpectedly, the regression results also show that the tertiary expenditure per student is statistically significant but negative. The tertiary attainment has turned out to be statistically insignificant.

In THE regression, there is only one independent variable that is statistically significant – GDP per capita. This result shows that countries with higher GDP per capita are more successful in the world's 200 academic ranking (expressed as a percentage of successful universities of a certain country on the total number of universities in the ranking). The other three variables (tertiary expenditure per student, tertiary attainment, and R&D expenditure in % of GDP) are statistically insignificant and tertiary expenditure is even negative.

From our results, we can infer that the GDP per capita play the most crucial role from all observed variables in determining the quality of universities as defined by ARWU and THE in addition to the R&D expenditure in % of GDP in the case of ARWU (which is understandable since ARWU uses all research-based indicators).

Even though our regression show more the relationships and not the causality, we can infer that the tertiary attainment (age group 30-34 as a share on total population age group 30-34) is not significant for the success to place highly in the academic ranking. With such an unexpected finding, we further explore the positive and negative impact of increased tertiary attainment on an example of one EU27 country – the Slovak Republic.

Furthermore, we suggest examining other areas related to this study – such as the role of subject or interviewing graduates which, due to the limitations of this paper, has not been performed in this study.

4. Analysis of the increased tertiary attainment for Slovakia

4.1 General information of the Slovak higher education

Slovak higher education has a relatively long tradition dating to 1919 when the first university – Comenius University – was established in the former Czechoslovakia. The second wave of the development of tertiary education was evident in the 1950s and 1960s when the percentage of the tertiary educated workforce in Slovakia reached over 3% (in Czech Republic it was 3.4%). The third period of development was after November 1989 (Verejná politika, 2002). Our further analysis concentrates on this latest period.

The following chart presents the number of universities in Slovakia as well as the number of students per teacher and the number of students per associate professor or professor.

Figure 4: Core data of Slovak higher education system (years 1989-2010)
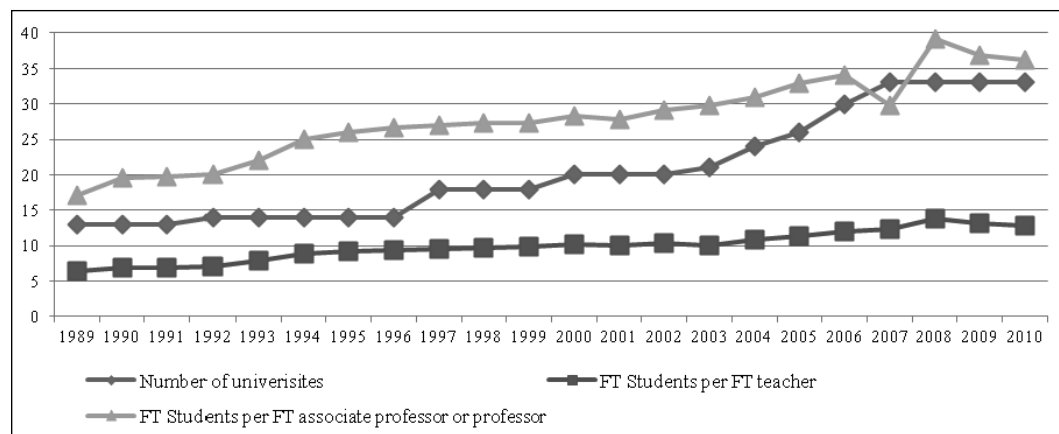
Source: own computation based on data from the Statistical Office of the Slovak Republic and the Institute of Information and Prognoses of Education in Bratislava (UIPS, 2011).

It is evident that the number of universities grew rapidly – in 1989 there were only 13 universities, whereas in 2010 there were 33 universities. The 34th and 35th were established in 2011. The number of students grew at an even higher rate – in 1989 there were 51,299 full time students whereas in 2010 the number exceeded 139,716 (UIPS, 2010). The increase in the number of students naturally transfers into a higher number of graduates and a more educated workforce at the later stage. Considering the benefits of education as outlined before, such rapid growth in tertiary education among the Slovak population should be viewed very positively.

Enlarging the number of tertiary graduates is greatly supported by the European Union and Slovak government as is clear from Europe 2020 and the Slovak National Reform Program. More specifically, as was previously stated, one of the Europe 2020 headline targets is to have the share of people aged 30-34 completing the third level education reach at least 40% by 2020. The previous Slovak Ministry of Education established its target at the same level in the Slovak National Reform Program, thus 40% (Europe 2020).

In 2010, 22.1% of people aged 30-34 in Slovakia had attained tertiary education; therefore, Slovakia at a substantially lower level than both the Europe 2020 target and most of the selected countries. Even though Slovak tertiary attainment is relatively low compared to the other EU countries, it is worth stating that the increase in Slovak tertiary attainment for the period of 2000-2010 was one of the most rapid: tertiary attainment increased 2.08 times in Slovakia whereas the average increase in the EU27 countries was 1.5. Only Poland, Malta, and Luxembourg had a higher increase in tertiary attainment in

the observed time frame (Eurostat, 2012). If such increase continues, there is a probability that the Slovak tertiary attainment will reach the Europe 2020 headtarget of 40%.

In regards to the benefits described earlier in the paper, such an increase should be very prosperous for the country, especially when the unemployment rates are taken into account[6].

On the top of that, the salaries of tertiary graduates are much higher to the salaries of high school graduates which has a positive impact on the individuals but also on the society in terms of collecting larger amounts of taxes paid[7].

4.2   Return on investment in the Slovak Republic

The Slovak Republic is not included in the previously mentioned OECD Education at a Glance study but this deficiency has been, to some extent, compensated for by the analysis of the Slovak Financial Policy Institute (IFP), which estimated the net present value of Slovakia using the OECD methodology. According to the analysis of IFP, the public net present value of a tertiary educated male in Slovakia is 94,903 USD, and the private net present value of a tertiary educated male is 240,994 USD (IFP, 2011). In this regard, a significant observation can be made: the private net present value for a Slovak male is the fourth highest among OECD countries (only Portugal, Italy and the Czech Republic have higher NPVs)[8].

The IFP also provides an analysis of the private internal rate of return of Slovakia and compares it with the other OECD countries. Its findings are rather positive as the private IRR for a tertiary educated male in Slovakia (22%) is much higher than the average IRR of the OECD countries (12%). In fact, the Slovak IRR is the highest after the IRR of the Czech Republic (IFP, 2011). In this context, Belovicsová (2010) suggests increasing the expenditure on Slovak tertiary education and proposes that students bear more significant costs. She views the increased spending on tertiary education as a must to enhance Slovak tertiary education in the knowledge economy.

4.3   Problems accompanying the increase of tertiary educated people for Slovakia

In the previous section, we have described the benefits of increased education and pointed at a fact that Slovak tertiary attainment is on a rise. In this section, we analyze the negative side of the increased tertiary educated workforce. We base our analysis on the theoretical background as well as faculty and employers views on the current Slovak higher education.

In spite of the obvious benefits of the increased tertiary attainment for Slovakia, it

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[6] In Slovakia, the unemployment rate of university graduates is 5.1 (master's degree) whereas the unemployment rate of high school graduates is 13.1 (Eurostat, 2010).

[7] In Slovakia, the average annual earning of a tertiary graduate was 8,304 euros in 2002 whereas the annual earning of a high school graduate was 4,739 euros (Eurostat, 2010).

[8] The private net present value for a Slovak female is the fifth highest from the OECD countries.

also brings many problems, especially due to the fact that the increase has been very rapid. Besides the need for increased government spending, it also presents a challenge for the universities to handle such a massive increase of students (the fourth highest in the EU27; Eurostat 2012), a challenge that universities have been unable to overcome as many authors (Kureková, 2010; ARRA, 2011; Ministry of Education, 2009; and others) refer to a decline in the quality of Slovak higher education. In this matter, several observations are to be made.

First, the increase in the numbers of teachers, associate professors and professors (in the period of 1989-2010) did not keep up with the increase in the student population (Chart 4, UIPS, 2010) and, as a result, the student-teacher ratio has doubled. The increase of over 100 percent more students per teacher in 2010 compared to 1989 is likely to mean 100 percent more workload for tertiary teachers and general staff. On the other hand, Slovak higher education teachers face approximately the same student-teacher ratios as many other countries in the OECD. In Slovakia, the average student-teacher ratio for tertiary education in 2009 was 15.6 students per teacher compared to the OECD average of 14.9 and EU21 average of 15.5 (OECD Education at a Glance, 2011). Palaščáková's (2008) survey reveals that teachers rate the student-teacher ratio as the most significant quality indicator in tertiary education and therefore they may be discontented with the increased number of students per teacher.

Second, the funding for both tertiary education and research has been declining in the last decade, which is generally claimed to be a significant cause of the deterioration of Slovak universities (Palaščáková, 2008; Čaplánová, 2007; and others). Public expenditures on tertiary education, as a percentage of GDP, dropped from 4.18% in 1999 to 3.62% in 2007 (Eurostat) and, similarly, the expenditure per tertiary student (% of GDP per capita) dropped from 32.9% in 1999 to 24% in 2005 (World Bank). The low funding of tertiary education is one of the reasons that negatively influences the quality of tertiary education.

Third, despite of the increased tertiary education within the last decade, none of the Slovak universities has succeeded in placing in the reputable academic rankings – ARWU and THE – which suggests that the quality of Slovak tertiary education is lagging behind its quality.

Last, the results of our teachers' and employers' surveys that we conveyed in the period of April 2011-June 2011 are rather critical of the increased numbers of students and HEIs in Slovakia[9]. 59% of teachers (sample of above 1,300) and 64.5% of employers

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[9] The electronic survey among the academic staff (called the "teachers" herein), students and employers in order to gather the opinions of people who are the most involved in the education process. The questionnaire was distributed by email to more than 7,818 teachers employed at Slovak universities and more than 9,020 students studying at the Slovak universities with the response rate of 20.23% in case of teacher respondents and 15.61% in case of student respondents. The relevant population was obtained from public data, Institute of Information and Prognoses of Education in Bratislava which reports that there are 12,908 teachers employed at HEIs in Slovakia and approximately 221,669 students studying at HEIs in Slovakia (UIPS, 2010). Email addresses were collected from the Websites of universities. In the body of the email, the recipients were guided by the link to the electronic survey placed on the portal www.surveymonkey.com.This paid

(sample of above 250) think that *'there are too many university educated people in Slovakia for the needs of the job market'* and 64% of teachers think that *'the competition of the institutions of higher education in Slovakia (expressed as the number of HEIs) is sufficient.'* Obviously, Slovak teachers and employers share a different opinion than government officials and believe that the number of tertiary educated people is sufficient. Therefore, the target of Europe 2020 that 40% of 30-34 year-olds have a tertiary education does not seem to be supported by people who work most closely with education. What's even more alarming is the fact that both teachers and employers express dissatisfaction with the quality of Slovak higher education. Only 34% of teachers agree that *the quality of tertiary education is better now than in the past*. In terms of employers' responses, 41.6% of them agree with the statement that *University alumni are better prepared to succeed in the job market nowadays than they were in the past* and only 39% agree that *their employees with university education are more productive than their counterparts with high school education*.

Figure 5: The results of teachers' survey regarding the numbers of students and the quality of tertiary education in Slovakia
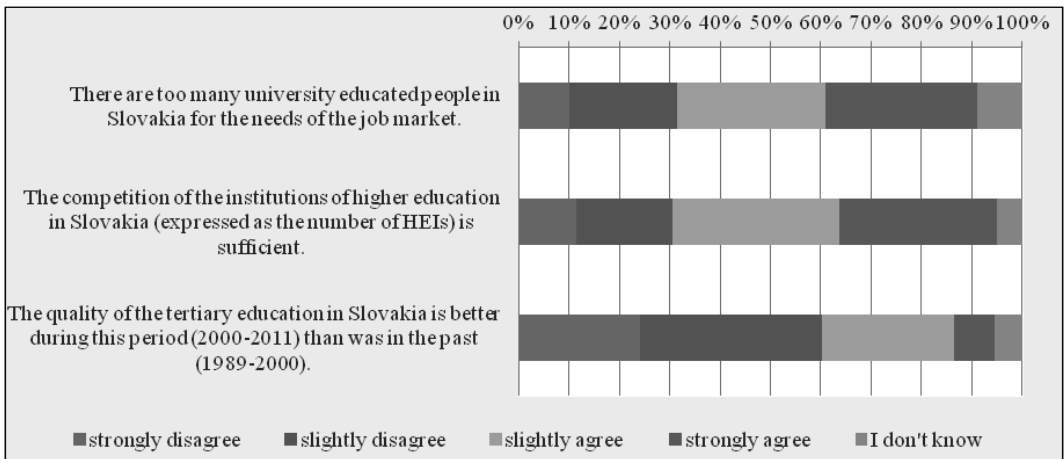
Source: own survey (1387, 1395 and 1404 respondents respectively).

service (if more than 10 questions are posed) played a vital role in collecting 1,582 teachers' responses and 1,408 students' responses. Most Slovak universities were included in the survey with the exception of a few private universities due to the fact that the email addresses of the teachers of private universities are generally not listed on their Websites (the list of universities is provided in the later stage). Nonetheless, not all respondents answered all questions in the survey, which explains the variation in the number of responses for a particular question. Also, a few completed surveys had to be ignored since the respondents did not belong to the observed category (e.g. a student stated that he attends University of Cambridge or a teacher stated that he no longer works at the institution of higher education). The surveys also provided demographic information which can be crucial in determining whether the sample can be considered representative of the population of teachers and students.

Figure 6: The results of employers' survey regarding the numbers of students and the quality of tertiary education in Slovakia
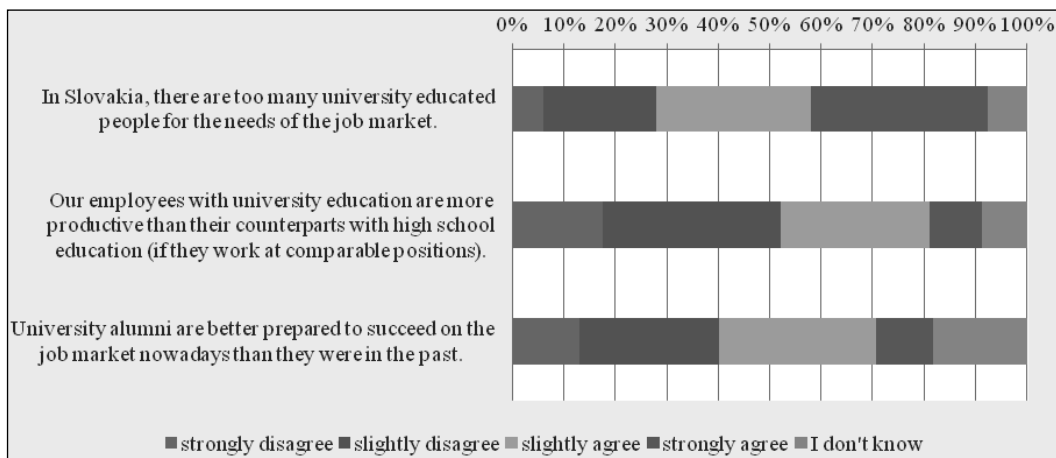
Source: own survey (279, 274 and 274 respondents respectively).

This section provided us with many negatives of the increased tertiary education. It is evident that the increase of tertiary educated people does not seem to be supported by people who have the most to say about the education.

Also, the quality of tertiary education seems to be negatively affected which supports our hypothesis that 'a rise in tertiary attainment has not been accompanied with a rise in quality education in Slovakia'. This is in line with the results of our regression analysis which does not confirm the strong relationship between the tertiary attainment and the quality of tertiary education.

On the top of that, the unemployment of young people in Slovakia has recently been on the rise and the jobless rate among young people in Slovakia was the fifth highest in the European Union in November 2012 (Eurostat, 2012). Sadovská, the analyst of Postova banka added that problems might emerge from the poor links between the education system and the job market (Spectator, 2012).

5.   Conclusion

Based on our previous analysis, Slovak higher education does seem to have more pressing problems with its quality rather than quantity. The plan is that there will be 40% of tertiary educated people aged 30-34 in Slovakia in 2020 which would be in line with the Europe 2020 headline target. There is no doubt that this target is important for the development of human capital in terms of a knowledge economy and if achieved, it would bring many positives to Slovakia and other EU countries that achieve it. On the other hand, as our analysis proves, there are many negatives of such a rapid increase in the tertiary attainment such as increased student-faculty ratio, insufficient funding and most important,

the fact that the quality of Slovak higher education is often rated as deteriorating. For these reasons, we dare to critique the Europe 2020 headline target of increased tertiary attainment (as well as the National Program Reform) and instead lean towards a lower increase on the educated workforce with an emphasis on the quality of the higher education.

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Cost efficiency, Morishima, Allen-Uzawa and Cross-Price elasticities among Irish potato farmers in Dedza district, Malawi

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Abstract

Malawi has experienced a forward shift in its demand for Irish potato (Solanum tuberosum) consumption. Given limited resources at farmers' disposal, meeting the growing demand will require farmers to follow the efficient path of the farm production resources. This paper, therefore, is an attempt to measure the cost efficiency of smallholder Irish potato farmers in Dedza district of Malawi using a translog cost function, inefficiency effect model and input elasticities derived from a system of cost share equations estimated by Iterated Seeming Unrelated Regression method. A multi-stage random sampling technique was used to select 200 Irish potato farmers in Dedza in 2011 from whom input-output data and their prices were obtained. Results indicate that the mean cost efficiency of Irish potato production in Dedza District is 0.67 with scores ranging between 0.15 and 0.94. The cost efficiency differences are significantly explained by non-farm employment, education, credit access, farm experience, degree of specialization, household size and frequency of weeding. The highest input substitution existed between labour and fertilizer, followed by seed-fertilizer. One policy issue is raised; credit should be extended to Irish potato farmers to enable them purchase farm inputs.

1.   Introduction

The agricultural sector has always been an important component of the Republic of Malawi's economy. During the 2000s, agriculture accounted for as much as 35-40% of the Gross Domestic Product (GDP), 92% of overall employment, over 90% of the country's foreign exchange earnings, provided 64% of total income for rural people and contributed

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33.6% to the economic growth. Agriculture supports the manufacturing industry by supplying 65% of the raw materials needed. A significant feature of the Malawi's agriculture is its duality in structure. This dual structure consists of large scale farming, which includes estates sector, and small scale production (GoM, 2007; Damaliphetsa et al., 2007).

Research has shown that cultivation of horticultural crops is a potential alternative source of income to tobacco which is a major income source for most farmers and an important export earner for the country. A horticultural commodity such as Irish potato (*Solanum tuberosum*) has the potential to contribute to household nutrition, food security and income (Kachule and Franzel, 2009). There is, therefore, increasing demand for the Irish potato both in the domestic and export market. The growing population in Malawi, particularly in urban areas, has been a key factor causing increasing consumption of Irish potatoes. There is also evidence that eating habits in urban areas are changing, for example potatoes are substituting *nsima* as main meal (Kauta et al., 2008). As a result, annual consumption of Irish potatoes in Malawi has more than tripled over the past 15 years to a high of 88 kilograms per capita (FAO, 2009).

In an effort to enhance performance of the sector and meet growing demand, the government emphasizes strategies aimed at increasing productivity, developing marketing and agribusiness management skills. It is envisaged that such efforts have the potential to contribute to development of horticultural production, marketing and food processing in Malawi (Kachule and Franzel, 2009; Ray, 2012). However, such efforts would be undermined by inefficiency in resource use.

Efficiency studies have become more relevant in today's world especially in Malawi's agriculture sector which is characterised by resource constraints (Theodoridis and Psychoudakis, 2008). The subject of efficiency in Malawi has received considerable attention in the literature (Chirwa, 2002; Edriss and Simtowe, 2002; Tchale and Sauer, 2007; Maganga, 2012). However, none of such studies has estimated cost efficiency and input elasticities in Irish potato production. Thus, this study aimed at identifying the socio-economic characteristics of the smallholder farmers, estimating the cost efficiency in Irish potato production among smallholder farmers and establishing derived conditional factor demand elasticities, Allen and also Morishima technical substitution elasticities of inputs for cost items such as labour, seedling, fertilizers and land, which play a key role in the production of Irish potato.

The remainder of the paper is organised as follows: The next section presents the specification of the models that we employ and their econometric estimation strategy; the third discusses the data and the results and the last section concludes.

2.   Methodology

2.1   Data

The data used in this study were collected from Dedza district in Malawi in 2011, which is one of high Irish potato producing districts. Dedza is a district in the Central

Region of Malawi. It covers an area of 3,624 km² to the south of the Malawi capital city, Lilongwe, between Mozambique and Lake Malawi with 145,878 households (NSO, 2008). The landscape is a mixture of grassland with granite outcrops, natural woodland and commercial pine plantations on the mountains and some bamboo forest nearer the Lake (DDA, 2001). The wet season is November to April with almost no rainfall at other times. The higher altitudes have moderate temperatures and can be cold in June and July (DDA, 2001).

A Multi-stage sampling technique was undertaken where 200 smallholder Irish potato farmers were selected. The district was clustered into Extension Planning Areas (EPAs) from which one EPA was randomly selected from the District. Secondly, a simple random sampling technique was used to sample two sections from the sampled EPA as secondary sampling units. Thirdly, sections were clustered into villages whereby villages were randomly sampled from each sampled section. Fourthly, from each sampled village, simple random sampling technique was used to select Irish potato farmers proportionately to size (Edriss, 2003). Data were collected using a structured questionnaire and focus group discussions. The questionnaire was designed and pre-tested in the field for its validity and content and to make overall improvement of the same and in line with the objectives of the study. Data were collected on output, input use, prices, socio-economic and institutional variables.

2.2 Theoretical and Econometric Construct

The stochastic frontier cost function model for estimating plot level overall cost efficiency is specified as:

$$C_i = g\,(Y_i,\ W_i;\ \alpha) + \varepsilon_i \qquad i = 1, 2, \ldots n. \tag{1}$$

where C_i represents minimum cost associated with Irish potato production, Y_i represents output produced, W_i represents vector of input prices, α, represents the parameters of the cost function and ε_i represents the composite error term. Using Sheppard's Lemma we obtain

$$\frac{\partial C}{\partial P_i} = X^*(W,Y,\alpha) \tag{2}$$

This corresponds to minimum cost input demand equations (Bravo-Ureta and Evenson, 1994; Bravo-Ureta and Pinheiro, 1997). In the presence of input price information, it would be possible to measure the cost efficiency of the firm under consideration. Substituting farm's input prices and quantity of output in equation (2) yields the cost minimizing input vector. Let X and X^* represent the input vector associated with the technically efficient and the cost-minimising input vectors, respectively. Then, cost efficiency (CE) of the farm is defined as the ratio of input costs associated with input vectors, X and X***** (Coelli et al., 1998), Thus,

$$CE = \frac{W'X}{W'X^*} \tag{3}$$

Cost efficiency was measured using stochastic translog cost frontier function for Irish potato production. The function is specified as follows:

$$\ln c_i = \beta_0 + \sum_{k=1}^{4} \beta_k \ln w_{ki} + \theta_1 \ln y_i + \frac{1}{2}\sum_{k=1}^{4}\sum_{l=1}^{4} \beta_{kl} \ln w_{ki} \ln x_{li} + \frac{1}{2}\theta_2 y^2 + \sum_{k=1}^{4} \beta_{ky} \ln w_k \ln y$$

$$+ v_i + u_i \tag{4}$$

where c_i represents total input cost of the ith farm, w_1 is the average price for a kg of fertilizer, w_2 is the average wage rate per man days of labour per day per hectare, w_3 is the price per kg of tuber, w_4 is the average rental price and y_i Irish potato output. The βs, θs and β_0 are parameters to be estimated. The cost frontier function is estimated using maximum likelihood estimation technique. For a cost function to be well behaved, it must be homogeneous of degree 1 and concave in prices. Imposing linear homogeneity and symmetry restrictions leads to the following relationships between the parameters:

$$\sum \beta_k = 1, \ \sum \beta_{kl} = \sum \beta_{lk} = \sum \beta_{ky} = 0 \tag{5}$$

Concavity is satisfied if the Hessian matrix of second-order derivatives is negative semi-definite. The Hessian matrix is negative semi-definite if (i) the sign of the first leading principal minor is non-positive; (ii) the signs of the further leading principal minors alternate (Chiang, 1984) as;

$$H = \begin{pmatrix} \dfrac{\partial^2 c}{\partial w_1 \partial w_1} & \dfrac{\partial^2 c}{\partial w_1 \partial w_2} & \dfrac{\partial^2 c}{\partial w_1 \partial w_3} & \dfrac{\partial^2 c}{\partial w_1 \partial w_4} \\[2ex] \dfrac{\partial^2 c}{\partial w_2 \partial w_1} & \dfrac{\partial^2 c}{\partial w_2 \partial w_2} & \dfrac{\partial^2 c}{\partial w_2 \partial w_3} & \dfrac{\partial^2 c}{\partial w_2 \partial w_4} \\[2ex] \dfrac{\partial^2 c}{\partial w_3 \partial w_1} & \dfrac{\partial^2 c}{\partial w_3 \partial w_2} & \dfrac{\partial^2 c}{\partial w_3 \partial w_3} & \dfrac{\partial^2 c}{\partial w_3 \partial w_4} \\[2ex] \dfrac{\partial^2 c}{\partial w_4 \partial w_1} & \dfrac{\partial^2 c}{\partial w_4 \partial w_2} & \dfrac{\partial^2 c}{\partial w_4 \partial w_3} & \dfrac{\partial^2 c}{\partial w_4 \partial w_4} \end{pmatrix}$$ with $|H_1| < 0$, $|H_2| > 0$, $|H_3| < 0$ and $|H_4| > 0$

Secondly, curvature restrictions are checked by calculating the Eigen values for the Hessian matrix of input prices. Eigen values need to be negative for the matrix of prices to satisfy concavity (Mulik et al., 2003).

Discovering whether farms are cost efficient might not be important exercise unless an additional effort is made to identify the sources of the inefficiencies. Taking cognisance of this, the study investigated the sources of plot-level cost inefficiencies for the surveyed

farmers. Empirically, the inefficiency model u_i is specified as (;

$$u_i = \varphi_0 + \sum_{r=1}^{9} \varphi_r z_{ri} \tag{6}$$

where, z_i is a vector of farm specific determinants of cost inefficiency, φ are the inefficiency parameter vector to be estimated.

The cost share equation for factor i is derived by differentiating the cost function with respect to $\ln w_i$ following Chiang (1984):

$$\frac{d \ln c}{d \ln w_i} = \alpha + \sum \beta_{kj} \ln w_j + \beta_{ky} \ln y \tag{7}$$

But, using Shephard's Lemma for the penultimate equality:

$$\frac{\partial \ln c}{\partial \ln w_i} = \frac{w_i \partial c}{c \partial w_i} = \frac{w_i x_i}{c} = s_i \tag{8}$$

Therefore:

$$s_i = \alpha + \sum \beta_{kj} \ln w_j + \beta_{ky} y \tag{9}$$

To derive the elasticity of factor demand, which is the change in the quantity of factor i in response to a change in the price of factor j, observe that:

$$x_i = \frac{c}{w_i} s_i \tag{10}$$

$$\lambda_{kj} = \frac{\partial \log x_i}{\partial \log w_j} = \frac{w_j}{x_i} \frac{\partial}{\partial w_j} \left(\frac{c}{w_i} s_i \right) \tag{11}$$

$$= \frac{w_j}{x_i} \left(\frac{c \beta_{kj}}{w_k w_j} + \frac{x_j s_i}{w_k} \right) \text{ (using Shephard's Lemma)}$$

$$= \frac{\beta_{kj}}{s_i} + s_i \left(\frac{w_j x_j}{c} \right) \left(\frac{c}{w_i x_i} \right)$$

Therefore:

$$\lambda_{kj} = \frac{\partial \log x_i}{\partial \log w_j} = \frac{\beta_{kj}}{s_i} + s_j \tag{12}$$

Allen Elasticity of Substitution (AES) is given as:

$$\sigma_{ij} = \frac{\beta_{ii}}{s_i s_j} + 1 \tag{13}$$

$\beta_{ij} = 0$, yields an AES of unity. The expression for the own elasticity of factor demand is (Binswanger, 1974):

$$\lambda_{kk} = \frac{\beta_{ii}}{s_i s_i} + s_i - 1 \tag{14}$$

While the corresponding AES is:

$$\sigma_{ii} = \frac{\beta_{ii}}{s_i s_i} + 1 - s_i \tag{15}$$

Humphrey and Wolkowitz (1976) suggest that own AES can be interpreted as a change in a factor's demand responsiveness to a change in its own price. While, the Morishima elasticities of substitution (MES) were estimated from the factor demand elasticities as $\lambda_{kj} - \lambda_{kk}$. AES do not indicate the curvature or ease of substitution. They are single input - price elasticities and do not relate optimal input ratios to those of input prices. Thus, they cannot provide information on the relative input responsiveness to changes in input prices. In contrast, the MES preserve the salient features of the Hicksian concept in the multifactor context and measure the ease of substitution. The MES are, therefore, sufficient statistics for assessing the effects of changes in the price on relative factor shares (Blackorby and Rusell, 1989).

3. Results and discussion

3.1 Descriptive Statistics

The average statistics of the sampled Irish potato farmers are presented in Table 1. On the average, a typical Irish potato farmer in the district was 45 years old, with 4 years of education, 19 years of farming experience and an average household size of 4.9 persons. The average Irish potato farmer cultivated 0.6 ha, made an average of 1.4 extension contacts in the year, used about 254 kg of fertilizer and 1852 kg of Irish potato, employed 176 man-days of labour and produced an output of 12371 kg/ha of Irish potato per annum. Irish potato production in the district is a male dominated with about 62% of the farmers being males.

3.2 Estimation of Farm Level Cost Efficiency

The stochastic frontier model is specified for the analysis of cost efficiency of farmers in the production of Irish potato in Dedza district. The stochastic cost frontier in Equation 4 is used to estimate the model. The Maximum-Likelihood estimates of the parameters of the Translog frontier cost function are presented in Table 2.

Table 1: Definition of variables and descriptive statistics

Variable	Units	Average	Minimum	Maximum
Age	Years	44.5	28	60
Education	Years	3.5	0	7
Farming Experience	Years	19.7	3	36
Potato plot	Hectares	0.60	0.09	1.38
Land size	Hectares	1.25	0.45	2.13
Land rent	Imputed cost of land	3329	2952	3538
Extension visit	No. of visits	1.4	0	3
Fertilizer	Kg/ha	254	7.6	561
Price of fertilizer	Malawi kwacha/kg	23	16	31
Labour	Person-days/ha/year	176	97	300
Wage rate	Price of labour/month	2700	1145	4284
Irish potato Yield	Kg/ha	12371	8084	19468
Irish potato price	Malawi kwacha/kg	60	45	75
Household size	No of persons	4.25	2	9
Seed price	Malawi Kwacha/kg	215	67	325
Seed quantity	Kg	1852	1134	2652
Gender of household head	1 = Male; 0 = female	-	0	1
Hoes	Number of hoes	3	1	6
Cost of hoes	Total cost of hoes	684	100	2860
Experience	Years in farming	19	3	36
Credit status	1 = access 0 = otherwise	0.34	0	1
Degree of specialization	Potato plot/Total crop acreage	0.31	0.12	0.78
Weeding frequency	Number of times/year	1	0	2
Non-farm employment	1 = yes; 0 = Otherwise	-	0	1
Farmer organization membership	1 = yes; 0 = Otherwise	-	0	1

1 USD = 167 Malawi Kwacha (MK).

The cost function estimates showed that all the linear terms were significant at different conventional levels. Though some quadratic and interactive elements were not significant, most of them were significant hence validating suitability of translog model.

For the cost function, the sigma ($\sigma^2 = 0.65$) and the gamma ($\gamma=0.97$) are quite high and highly significant at 1.0% level. The high and significant value of the sigma square (σ^2) indicates the goodness of fit and correctness of the specified assumption of the composite error terms distribution (Idiong, 2005). In addition, the Wald chi-square statistic for joint test of the model indicates that the model is significant (p <0.01), overly. There was tolerable level of multicollinearity justified by a mean VIF of 3.32 <10 (Edriss, 2003). The homoskedasticity hypothesis was also satisfied as indicated by Breusch Pagan chi-square estimate of 0.042 (p>0.1). Checking for theoretical restrictions on the cost function revealed that the estimated cost function was well behaved for both symmetry and homogeneity. Concavity was also verified firstly by eigenvalues which were all found to be negative.

Secondly, the alternating signs for leading principle minors proved presence of concavity in factor prices beginning with a negative first leading principle minor ($|H_1| < 0$, $|H_2| > 0$, $|H_3| < 0$, $|H_4| > 0$).

The gamma ($\gamma = 0.97$) shows that 97% of the variability in the output of Irish potato farmers that are unexplained by the function is due to cost inefficiency. The predicted cost efficiencies (CE) differ substantially among the farmers, ranging between 0.15 and 0.94 with a mean CE of 0.67. This means that if the average farmer in the sample area were to reach the CE level of its most efficient counterpart, then the average farmer could experience a cost saving of 29% [i.e. (1-(0.67/0.94))x100]. The same computation for the most cost inefficient farmer suggests a gain in cost efficiency of 87% [i.e. (1- (0.12/0.94)) x100].

Table 2: Estimated Translog Stochastic Frontier Cost Function for Irish Potato in Dedza District, Malawi

Variable	Parameter	Coefficient	Std. Err.	t-value	p > |t|
Constant	β_0	849.23***	15	57	0.000
Ln (Price of fertilizer)	β_1	0.167**	0.05	2.8	0.012
Ln(Wage rate)	β_2	0.358***	0.11	3.25	0.000
Ln(Price of Seed)	β_3	0.226***	0.05	4.12	0.000
Ln(Land rent)	β_4	0.249**	0.13	2.00	0.039
Ln(output)	θ_1	0.23*	0.15	1.52	0.088
0.5Ln(Price of fertilizer)^2	β_{11}	-0.67*	0.39	-1.72	0.060
0.5Ln(Wage rate)^2	β_{22}	-0.85	0.93	-0.91	0.321
0.5Ln(Price of Seed)^2	β_{33}	-0.44**	0.17	-2.55	0.022
0.5Ln(Land rent)^2	β_{44}	-0.7*	0.40	-1.20	0.082
0.5Ln(output)^2	θ_2	-1.1	1.183	-0.93	0.455
Ln(Price of fertilizer)×Ln(Wage rate)	β_{12}	0.31	1.55	0.20	0.764
Ln(Price of fertilizer)×Ln(Price of Seed)	β_{13}	0.13*	0.08	1.70	0.062
Ln(Price of fertilizer)×Ln(Land rent)	β_{14}	0.23***	0.07	3.28	0.001
Ln(Wage rate)×Ln(Price of seed)	β_{23}	0.19**	0.09	2.04	0.049
Ln(Wage rate)×Ln(Land rent)	β_{24}	0.35***	0.09	3.75	0.000
Ln(Price of seed)×Ln(Land rent)	β_{34}	0.12***	0.03	4.13	0.000
Ln(Price of fertilizer)×Ln(Output)	θ_3	0.17***	0.05	3.20	0.000
Ln(Wage rate)×Ln(Output)	θ_4	0.32***	0.08	4.00	0.000
Ln(Price of seed)×Ln(Output)	θ_5	0.19***	0.02	7.41	0.000
Ln(Land rent)×Ln(Output)	θ_6	-0.68	0.98	-1.55	0.506
Log-likelihood function		79.12			
Total Variance	σ^2	0.65***	0.07	9.47	0.000
Variance ratio	γ	0.97***	0.051	19.01	0.000
Wald chi2(20)		1203			0.000
Mean VIF		3.32			
Breusch Pagan		0.042			0.729

***, **, *, mean, 1, 5, and 10% significance level, respectively.

And to give a better indication of the distribution of the cost efficiencies, a frequency distribution table of the predicted cost efficiency scores is presented in Table 3. The frequencies of occurrence of the predicted cost efficiency scores indicate that the highest number of farmers have cost efficiencies between 0.76 – 0.80, representing about 14% of the respondents while about 58% of the respondents have CE of 0.61 and above which is an indication that farmers are fairly efficient. That is, the farmers are fairly efficient in producing a pre – determined quantity of Irish potato at a minimum cost for a given level of technology.

Table 3: Distribution of Cost Efficiency for Dedza Irish Potato Production

Cost Efficiency range	Frequency	Percent
< 0.20	6	3.00
0.21 –0.25	6	3.00
0.26 –0.30	9	4.50
0.31 –0.35	8	4.00
0.36 –0.40	10	5.00
0.41 –0.45	11	5.50
0.46 –0.50	11	5.50
0.51 –0.55	12	6.00
0.56 –0.60	12	6.00
0.61 –0.65	18	9.00
0.66 –0.70	14	7.00
0.71 –0.75	20	10.00
0.76 –0.80	28	14.00
0.81 –0.85	22	11.00
0.86 –0.90	8	4.00
0.91 –0.95	5	2.50
Total	**200**	**100.00**

With respect to the sources of efficiency in Table 4, the coefficients of extension visits, education and farm experience were statistically significant at least at 5% significance level. These findings are similar with those of Wadud (2000) and Nwachukwu (2006). With education, farmers have high aptitude to learn and understand new information about farming technologies and calculate gross margins.

While with experience, farmers improve on previous flows they had. In contrast with priori, extension visits decreased cost efficiency. This could be attributed to low extension – farmer ratio in Malawi, in which case, the effectiveness of extension advice is undermined. Non-farm employment significantly reduced cost efficiency among Irish potato farmers. Most probably, it competes with family labour supply to the Irish potato farms. Possible alternative to non-farm employment could be improving access to credit.

Credit access increased cost efficiency (p<0.01). Degree of specialization and household size significantly increased cost efficiency (p<0.01). Degree of specialization enables the farmer to enjoy economies of scale, spread the costs over a large output. Household size is mostly a source of cheap labour that helps to cut on production costs. Weeding was very crucial in the study area as it increased cost efficiency (p<0.01). Programs that encourage farmers to increase their frequency of weeding would be enhancing cost efficiency among Irish potato smallholder farmers.

Table 4: Determinants of Cost Inefficiency of Irish Potato Production

Variable	Coefficient	Std. Err.	t-value	p-value
Intercept term	0.759	0.816	0.93	0.3742
Non-farm employment	0.423***	0.124	3.42	0.0065
Education	-0.876**	0.389	-2.25	0.0482
Extension visits	0.1143***	0.036	3.21	0.0093
Credit status	-0.968***	0.205	-4.72	0.0008
Farm Experience	-0.4493**	0.144	-3.11	0.0110
Degree of specialization	-0.6232***	0.115	-5.437	0.0002
Age	0.2431	12.155	0.02	0.9844
Household size	-0.8654***	0.200	-4.337	0.0014
Frequency of weeding	-0.1123	0.079	-1.43	0.1832

*,** and *** means significant at 10%, 5% and 1% levels.

3.3   Factor Demand Elasticities

The parameters of the system of cost share equations for labour, fertilizer, seed and land were estimated using Iterated Seemingly Unrelated Regression (ISUR) technique. The parameters could be estimated using the ordinary least squares (OLS). However, OLS estimation would yield inefficient results because of the restrictions imposed and the correlation of the error terms across the systems of equations (Zellner, 1962). Breusch Pagan test gave a value of 19.13 (p<0.05) suggesting that the residuals of the estimated cost share equations were correlated, thus using the seemingly unrelated regression technique was appropriate. As the sum of the shares is equal to one and therefore the system is not linearly independent, one of the cost share equations was dropped. The estimated results are presented in Table 5. The coefficients for the price variables in the cost share equations are represented by the diagonal coefficients in Table 5.

Table 5: Cost share parameter estimates – Iterated Seemingly Unrelated Regression

	Inputs			
	Share of fertilizer	**Share of labour**	**Share of seed**	**Share of land**
Regressors	**Coefficients (SE)**	**Coefficients (SE)**	**Coefficients (SE)**	**Coefficients (SE)**
Fertilizer	-0.67(0.356)*	0.31(1.033)	0.13(0.070)*	0.23(0.070)***
Labour		-0.85(0.857)	0.19(0.097)**	0.35(0.089)***
Seed			-0.44(0.192)**	0.12(0.031)*
Land				-0.7(0.402)*
Output	0.17(0.047)***	0.32(0.088)***	0.19(0.057)***	-0.68(1.022)
Intercept	0.167(0.066)**	0.358(0.096)***	0.226(0.064)***	0.249(0.121)**

In parenthesis are standard errors. ***, ** and * denote 1, 5 and 10% significant levels, respectively.

Elasticities of conditional factor demand in Irish potato, calculated from the cost share system of equations, are given in Table 6. Own price elasticities of fertilizer, seedling, labour and land for Irish potato were estimated by Irish potato input demand model as -1.2711, -0.5322, -0.8292 and -1.2218, respectively. Own elasticities of fertilizer and land were elastic and of seedling and labour were inelastic. Ten percent (10%) increase in fertilizer, labour, seedling and land prices will decrease the demands of these inputs by 12.71, 5.32, 8.3 and 12.21%, respectively.

Table 6: Derived Elasticities of Conditional Factor Demand

Price	Fertilizer	Labour	Seed	Land
Fertilizer	**-1.2711**	0.0758	3.5253	-0.6754
Labour	4. 5354	**-0.5322**	-1.0693	0. 6227
Seed	5.4227	-0.8650	**-0. 8292**	0.5617
Land	-3.1117	3.0076	1.0151	**-1.2218**

Source: original calculations.

According to these values, in case of price increase in inputs, the farmer will give up the input of fertilizer the easiest, and this will be followed by land, seedling and labour, respectively. Labour prices had the hardest elasticity among the inputs used for Irish potato production.

A positive sign between two inputs shows substitution relationship between them, while negative sign between them shows complementary relationship. The cross-price effects between seed and labour and between fertilizer and land were negative, suggesting that these pairs of purchased inputs were complements. The rest of the derived cross-price

elasticities of conditional factor demand were positive. Cross price elasticity of fertilizer and labour, fertilizer and land, seed and labour, and between seed and land were inelastic. The highest substitution was between seed and fertilizer, followed by labour-fertilizer.

A 10% increase in fertilizer price increases labour demand by 44.5%, while 10% increase in labour price increases fertilizer demand by 0.8%. A 10% increase in fertilizer price increases seed demand by 54%, while 10% increase in seed price increases fertilizer demand by 36.3%. A 10% increase in fertilizer price decreases land demand by 36%, while 10% increase in land rent decreases fertilizer demand by 7%. This shows strong complementary relationship between fertilizer and land. A 10% increase in labour wage decreases seed demand by 8.7% and 10% price increase in seed decreases labour demand by 13%. A 10% increase in land rent will increase labour and seed demands by 6.2% and 5.6%, respectively. A 10% increase in the wage and price of seed increases demand for land by 30% and 10percent, respectively.

Morishima Technical Substitution Elasticities (MES) are shown in Table 7. As can be seen in the table, the substitution elasticities are higher than zero. Accordingly, it is understood that there is an incomplete substitution between all input pairs in Irish potato production. Here, technical substitution elasticity between seed and fertilizer was found to be 6.25. If fertilizer prices increase when seed prices are stable, fertilizer use will decrease, and more labour (the production factor with lower cost) will be used instead. The decrease in the use of seed will be 6.25% of seed-fertilizer use ratio. Similarly, the decrease in fertilizer use will be 5.07% of labour-fertilizer use ratio, while it will increase land-fertilizer use ratio by 4.9%. A similar situation is also valid for the other inputs, and it appears that these inputs are substitutable inputs, one for the other, for Irish potato, except for land-fertilizer and seed-labour.

Table 7: Allen-Uzawa and Morishima Elasticities of Factor Substitution

	Fertilizer		Labour		Seed		Land	
Price	AES	MES	AES	MES	AES	MES	AES	MES
Fertilizer	-1.332	-	1.1358	1.3469	0.3763	4.7964	0.0976	0.5957
Labour	1.1358	5.0676	-0.4234	-	0.7943	-0.5371	2.5634	1.1549
Seed	0.3763	6.2519	0.7943	-0.0358	-1.0987	-	0.0321	1.3909
Land	0.0976	-1.8899	2.5634	4.1906	0.0321	2.2369	-3.401	-

Source: original calculations.

The Allen Elasticities of Substitution are also presented in Table 6. The Allen partial elasticities of substitution (AES) were calculated at the sample mean of the cost shares for Irish potato production. Positive signs indicate substitution relationships between any pair of inputs. A strong substitution relationship was found between land and labour.

4.   Conclusion

The study analyzed cost efficiency and input elasticities among Irish potato farmers in Dedza district, Malawi, using the stochastic translog cost frontier and system of cost share equations which were estimated by Iterated Seemingly Unrelated Regression (ISUR) technique. The findings of the study showed that Irish potato farmers in Dedza district are not operating at full cost efficiency level such that opportunities exist for improvement in cost efficiency by Irish potato farmers. Education, credit access, farm experience, degree of specialization, household size and frequency of weeding increased cost efficiency. One policy issue is raised: Credit should be extended to Irish potato farmers to enable them to purchase farm inputs. Non-farm employment led to misallocation of the resources employed by Irish potato farmers. Therefore, there is need for households to be linked to microfinance institutions for credit access which can take the place of non-farm employment.

Acknowledgment

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The Impact of Exchange Rate Changes on Disaggregated Agricultural Output in Nigeria: A Two-Stage-Least-Squares Approach

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Abstract

Agriculture was the mainstay of the Nigerian economy prior to independence and immediately after. Agriculture however, has suffered persistent decline since the 1970s with the exchange rate policy being implicated in the misfortune of this sector. Earlier studies on the effect of exchange rate on agricultural output focussed on aggregate output and ignored the possibility of differences in the response of components of agricultural output. Besides, the fact that there may be a possibility of reverse causality between the exchange rate and agricultural output has been ignored in earlier studies. This study attempts to fill these gaps, by investigating the effect of the exchange rate changes on the components of agricultural output using the two-stage-least-squares techniques for the period between 1970 and 2008. The obtained result indicates that there are differences in the way the output of different sub-sectors responds to the exchange rate changes. While the exchange rate changes have negative effects on crop and fishery output, they have positive effects on livestock and forestry. The fact that the real exchange rate has differential effect on the output of the agricultural sub-sectors indicates the need for policy to be put in place to mitigate the adverse consequences of the exchange rate depreciation on crop and fishery output.

Keywords: Exchange rate, Disaggregated, agricultural output and Two-stage-least-squares

JEL Classification: Q17, O13, F31

1.   Introduction

Agriculture was the mainstay of the Nigerian economy before and immediately after independence. It employed more than 70% of the labour force and provided more than 80% of foreign exchange earnings during this time. The agricultural output however suffered from serious setback in the early 1970s, especially with the discovery and production of oil in commercial quantity. The exchange rate policy was implicated in the dismal performance

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of agriculture during this period, as it was argued that the Nigerian currency was overvalued and this discouraged the export and production of agricultural products, while it encouraged the import of food items. Based on this perception, the exchange devalued on a number of occasions in order to attain a realistic exchange rate until the foreign exchange market was eventually liberalised and the exchange rate was made to reflect market forces (with the adoption of the structural adjustment programme in 1986 and the eventual deregulation of the foreign exchange market).

Despite the deregulation of the foreign exchange market and the subsequent depreciation / devaluation of the Nigerian currency, the agricultural sector performance did not improve substantially. The contribution of agriculture to the gross domestic product (GDP) continued to dwindle. Its contribution, which was about 40 % in 1986, went down to about 20% in 1990 (CBN, 2007). Although it increased afterwards, its share never exceeded 40% thereafter, with different sub-sector's contribution changing regularly and food importation rising. It therefore becomes imperative to ask the following questions: to what extent has the adoption of liberal exchange rate policy affected agricultural output? And: does this liberal exchange rate policy have similar or dissimilar impacts on the components of agricultural output? An understanding of this issue would help policymakers identify the role of exchange rate policy in the poor performance of agriculture and facilitate the formulation of appropriate sectoral policy. Based on the above, the main objective of this study is to investigate the impacts of the exchange rate changes on agricultural output, while the specific objectives is to investigate the impacts of the exchange rate changes on the output of different agricultural sub-sectors of the Nigerian economy.

Although several studies have been conducted on the effect of the exchange rate on agricultural output, the majority of these studies focussed on aggregate output and ignored the possibility of differences in the response of the components of agricultural output, which may necessitate differential policy response. Those that examined the effect on sectoral output (for example Yaqub, 2010) did not examine the components of each sector. Moreover, many of these studies did not consider the fact that both the exchange rate and the agricultural output may actually be jointly determined or that there may actually be reverse causality from the exchange rate to agricultural output. For example, the exchange rate depreciation may discourage importation and prompt exportation and production, while in the same vein, improvement in agricultural output and export may strengthen the exchange rate of the domestic currency. This is the gap that this paper tries to fill by investigating the impacts of the real exchange rate changes on the components of the agricultural sector output, given the significance of agriculture for food security and poverty alleviation. The output of the agricultural sector is thus disaggregated into crop output, fishery, livestock and forestry output; the impact of the exchange rate changes on each are then investigated. Moreover, the study adopts the two-stage-least-squares estimation techniques to cater for possible reverse causality and joint determination of the exchange rate and agricultural output. The rest of the paper is structured in six parts. Following this introduction is the discussion of the exchange rate policy and trend in Nigeria. The third section of the paper presents the literature review, while the fourth section discusses the scope of study and

sources of data. The fifth section contains the econometric framework, while the sixth section presents the empirical analysis. The seventh section, which is the last one, is devoted to summary and conclusion.

2.   Exchange Rate Policy and Trend in Nigeria

Oyejide and Ogun (1995) and Ogun (2000) have classified Nigeria's exchange rate regimes since independence into four types (the brief period of confusion between 1972 and 1974 is excluded). These are the fixed rate regime of 1960 to 1970, the adjustable peg regime of 1974 to 1978, the managed float regime of 1978 to 1985, and the flexible exchange rate regime of 1986 to date. The different regimes have implications for the behaviour of the exchange rate. While the period between 1960 and 1986 was characterised by misaligned exchange rate, the market based exchange rate period is characterised by unprecedented volatile exchange rate (Oyejide and Ogun, 1995).

Table 1: Averages of Nominal and Real Effective Exchange Rate
in Nigeria (1970-2007)

Variable	1970-2007	1970-1980	1981-1990	1991-2000	2001-2007	1987-1993
NER	20.09	5.79	32.07	31.87	4.33	39.02
RER	6.19	1.58	16.19	8.49	-6.65	12.13

Note: NER stands for Nominal Exchange Rate, RER stands for Real Exchange Rate.
Source: Computed by the author.

Over the period 1970 to 2007, the nominal exchange rate depreciated on the average at the rate of 20.09%, while the real exchange rate only depreciated at the rate of 6.19% (on the average). The divergence between nominal[1] and real exchange rate[2] depreciation during the period brings out the fact that inflation is higher in Nigeria relative to the foreign trading partners. The average figures hid some important phases in the exchange rate trends. Although both nominal and real exchange rates actually depreciated on the average between 1970 and 1980, the nominal exchange rates depreciated at a higher rate compared with the real exchange rate. Similarly, both nominal and real exchange rates depreciated on the average by 32.07% and 16.19% respectively between 1981 and 1990 (see Table 1). A similar scenario was repeated between 1991 and 2000. However, between 2001 and 2007, the nominal exchange rate depreciated at a lower rate (4.33%), while the real exchange rate actually depreciated by 6.65% on the average, reflecting the relative stability of the nominal exchange rate.

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[1] Nominal exchange rate is defined as the unit of Naira that is exchanged for a unit of the dollar
[2] The real exchange rate is obtained by weighing the nominal exchange rate US Consumer Price Index (CPI) relative to CPI in Nigeria.

3.   Literature Review

The position of the theoretical literature on the effect of the exchange rate on output is divergent. While the traditional view opines that the exchange rate depreciation would expand output by making export cheaper and increasing the price of import, provided the Marshal-Lerner conditions hold[3], the Monetarists conclude that the exchange rate changes leave all real variables unchanged in the long run (Domac, 1977). The Structuralists posit that the exchange rate depreciation has a contractionary effect on output through the combination of demand and supply side effects. This position is based on the fact that many countries that depreciate their currencies are usually import-dependent economies, whose cost of production would escalate with depreciation thereby reducing the availability of inputs and thus curtailing production (Kandil and Mirzaie, 2003).

The empirical evidence of the effect of the exchange rate on output is extensive and mixed. The conclusions differ not only quantitatively but also qualitatively. Differences in conclusions may be due to differences in approach, samples, time frame of study or methodology of study. Four main approaches are used to evaluate the effects of the exchange rate on output (macroeconomic performance in general) according to Agenor (1991) and Taye (1999), among others. The first one, the "before and after" approach, compares relative economic performance before and after the currency is devalued/depreciated, to capture the effects of the change on economic aggregates. The second approach known as "with-without" or "control group" approach, compares the economic performance of devaluing countries with that of non-devaluing countries. The third approach, named "actual-versus-target" approach, focuses on evaluating the actual performance of some macroeconomic aggregates compared to their pre-specified targets using econometric models. The fourth approach uses the simulation technique to examine the impact of changes in the exchange rate on economic activity. While some studies examined the effect of nominal exchange rate changes, others focussed on real exchange rate changes.

Cooper (1971) and Diaz-Alejandro (1963) focussed on nominal devaluation and found that it has contractionary effect on output. Agenor (1991) focussed on real exchange rate, using OLS technique and data from twenty-four developing economies; he found contractionary effects of real exchange rate depreciation. A similar conclusion was arrived at by Bahmani-Oskooee (1998) as well as Taye (1999), with respect to Ethiopia. Studies such as Odusola and Akinlo (2001) and Adewuyi (2005) found expansionary effect of nominal exchange rate depreciation with respect to Nigeria. Ubok-Udom (1999) found contractionary effect using data from 1971 to 1995, contrary to what Odusola and Akinlo as well as Adewuyi found. His analysis may however suffer from the problem of spurious regression since he did not account for the possibility of unit root in the series used or endogeneity problem which Adewuyi and Odusola and Akinlo controlled for. Other studies which found contractionary effects of exchange rate depreciation are those of Kamin and

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[3] Marshal-Lerner condition states that the elasticities of import and export must be higher than unity.

Rogers (2000) and Berument and Pasaogullari (2003). In this study, the real exchange rate is used while the two-stage-least-squares technique is used to cater for the possibility of joint determination of the exchange rate and output and possible reverse causality.

4.   Scope and Sources of Data

The study covers the period between 1970 and 2008; it makes use of annual data on Nigeria for this same period. The Data description, definition and sources are given in Table 2 below:

Table 2: Description and Sources of Data

Variables	Description	Sources
Nominal Exchange rate	This is the Bilateral exchange rate between Nigeria and the USA. It is the monthly average official exchange rate of the Naira vis-à-vis the US dollar	The Central Bank of Nigeria Statistical Bulletin, 2008
Real Exchange Rate	This is the nominal exchange rate weighted by the relative Consumer Price Index (CPI) of Nigeria to USA	Computed by the author
CPI	The CPI is used as a measure of price. It is used to weigh the nominal exchange rate in order to obtain the real exchange rate	WDI CD ROM, 2008
Crop output	This is the GDP of crop sub-sector of agriculture. It is expressed at 1990 Constant Basic Prices	The Central Bank of Nigeria Statistical Bulletin, 2008
Fishery output	This is the GDP of fishery sub-sector of agriculture. It is expressed at 1990 Constant Basic Prices	The Central Bank of Nigeria Statistical Bulletin, 2007
Livestock output	This is the GDP of livestock sub-sector of agriculture. It is expressed at 1990 Constant Basic Prices	The Central Bank of Nigeria Statistical Bulletin, 2007
Forestry output	This is the GDP of forestry sub -sector of agriculture. It is expressed at 1990 Constant Basic Prices	The Central Bank of Nigeria Statistical Bulletin, 2007
Money supply	This is money supply narrowly defined. It consists of currency outside bank and demand deposits	The Central Bank of Nigeria Statistical Bulletin, 2007

5. Econometric Framework

5.1 Theoretical Framework

The theoretical framework for this study is the modified IS-LM framework, which was also adopted by Kandil (2004) and Kandil and Mirzai (2007). In this framework, the output is assumed to be demand determined. The demand side of the economy consists of three markets, namely, the goods, money and the foreign exchange market, all of which must simultaneously be in equilibrium, for the economy to be in equilibrium. Under this condition, the economy attains both internal and external equilibrium, which is the objective of exchange rate management. Each market is explained in turn below.

The goods market

Equilibrium in the goods market is obtained when the demand and supply of goods and services are equal implying that the aggregate planned expenditure is equal to income. The equilibrium condition is given as:

$$y = c + g + i + x - m \tag{1}$$

where y = real income, c = real consumption, g = real government expenditure, i = real investment, x = real export and im = real import.

The components of the goods market is modelled as equations 2 to 6 below:

$$c = \beta_0 + \beta_1 y_t \tag{2}$$

$$g = g \tag{3}$$

$$i = i_0 + i_1 r_t + i_2 y_t \tag{4}$$

$$x_t = x_0 + x_1 e_t + x2 y^f + x_4 y_t \tag{5}$$

$$im_t = im_0 + im_1 y_t + im_2 e_t \tag{6}$$

where r is real interest rate, yf is income of trading partners and e is real interest rate.

Equation 2 expresses real consumption as a function of real income, while equation 3 shows real government expenditure as being autonomous. Equation 4 depicts investment as being determined by real interest rate and real income. Export is shown, in equation 5, to depend on real exchange rate, income of trading partners and domestic income/output, while equation 6 depicts import as being dependent on real income and real exchange rate.

Substituting equations 2, 3, 4, 5 and 6 into equation 1 produces the IS equation, which shows equilibrium condition in the goods market. This is expressed as equation 7 below.

$$y_t = \frac{(\beta_0 + i_0 + x_0 + im_0) + \overline{g} + i_1 r_t + (x_1 + im_2) e_t}{1 - \beta_1 - i_2 - x_4 - im_1} \tag{7}$$

The money market

The money market is modelled along the standard money demand theories. Real money demand is expressed as a function of real income and interest rate; this is shown as equation 8 below.

$$m^d = \theta_0 + \theta_1 y_t + \theta_2 r_t \tag{8}$$

Money demand may also be influenced by exchange rate because economic agents may hold foreign money for speculative purposes (Kandil, 2003). Therefore, the demand for money is expressed as equation 9 to reflect this fact.

$$m^d = \theta_0 + \theta_1 y_t + \theta_2 r_t + \theta_3 e_t \tag{9}$$

Real money supply is equal to the nominal money balances, M, which is assumed to be exogenously determined, deflated by price, P. The money supply is expressed as

$$m^s = \frac{m_t}{p_t} = \overline{m} \tag{10}$$

At equilibrium, money supply equals money demand, thus the money market equilibrium is modelled as equation 11.

$$\overline{m} = \theta_0 + \theta_1 y_t + \theta_2 r_t + \theta_3 e_t \tag{11}$$

Equation 11 can be expressed as 12, which is the LM equation.

$$y_t = \frac{\overline{m}_t - \theta_0 - \theta_2 r_t - \theta_3 e_t}{\theta_1} \tag{12}$$

External Sector

This sector is captured by the balance of payment (BP) equation, which shows different combinations of interest rate and income that ensure equilibrium in the balance of payment (Appleyard and Field, 2001).

The fundamental identity in the BP equation is expressed as

$$B = CA + K \tag{13}$$

where B = balance in the official reserve transactions account.

CA = current account balance

K = capital account balance

$$CA = x - im \tag{14}$$

From equations 5 and 6,

$$CA = x_0 + x_1 e_t + x_2 y^f + x_3 y_t - \left(im_0 + im_1 y_t + im_2 e_t \right) \tag{15}$$

The capital account is expressed as equation 16 below

$$K = \alpha_0 + \alpha_1 r_t \tag{16}$$

Equilibrium in the balance of payment account requires that B is equal to zero. Substituting equations 15 and 16 into equation 13, and by assuming B = 0, makes equation 13 to become:

$$0 = x_0 + x_1 e_t + x_2 y^f + x_3 y_t - im_0 - im_1 y_t - im_2 e_t + \alpha_0 + \alpha_1 r_t \tag{17}$$

Collecting the like terms and simplifying 17, equation 18, which is the BP equation, is obtained:

$$y_t = \frac{-\pi_0 - \pi_1 e_t - \pi_2 y^f - \alpha_1 r_t}{\pi_2} \tag{18}$$

where: $\pi_0 = x_0 + im_0 + \alpha_0$, $\pi_1 = x_1 - im_2$ and $\pi_2 = x_3 - im_1$

Combining equations 7, 12 and 18, which are equilibrium conditions in the goods, money and external sectors respectively, and with series of manipulations, we obtain the equation for output, y, which is

$$y_t = \varphi_0 - \varphi_1 e_t - \varphi_2 y^f - \varphi_3 m_t - \varphi_4 g_t \tag{19}$$

From the derivation above, a change in exchange rate, e, affects output directly through the import and export channels and indirectly though the response of import and export to changes in income brought about by changes in exchange rate. But whether the effect of exchange rate depreciation on output would be negative or positive depends on the strength of the income elasticities of import and export. Where elasticity of export with respect to income is greater than the elasticity of import with respect to income, we may have positive response; otherwise, we have a negative response.

From the discussion above, it is clear that the output effect of exchange rate depreciation is ambiguous *a priori*. The magnitude and direction of effect depend on the size of change (in exchange rate), the relative strength of the import and export elasticities of income. Output is expected to respond positively to government expenditure, provided there is no crowding-out effect of government spending. Income of trading partners is expected to impact positively on output since this would promote demand for export

(all else being equal). Money supply is also expected to promote output growth through reduction in interest rate and stimulation of investment.

5.2 The Empirical Model

Equation 19 is modified by including the stochastic disturbance term. Moreover, because we are interested in disaggregated agricultural output analysis, the output of agriculture is sub-divided into crop, fishery, forestry and livestock. Four equations are thus estimated with output of crop, fishery, forestry and livestock as dependent variables respectively. The empirical model is as presented in equation (20) below:

$$\ln GDP = \beta_0 + \beta_1 \ln REER + \beta_2 \ln y^f + \beta_3 \ln M^s + \beta_4 \ln GOVTEXP + u_1 \tag{20}$$

where *GDP* stands for the output of agricultural output (crop, fishery, forestry and livestock), REER stand for real effective exchange rate, y^f stands for foreign income, M^s is money supply and *GOVTEXP* stands for government expenditure. *ln* before each variable stands for logarithm while *u* stands for the stochastic error term.

6. Empirical Analysis

The models were estimated using the two-stage-least-squares technique in order to capture the possibility of reverse causality. The residuals were thereafter tested for serial correlation using the Breusch-Godfrey LM test. Besides, the model was evaluated to see how well it fits actual data. These results are discussed below. The summary statistics is presented in Table 3.

Table 3: Summary Statistics of Variables

Variables	Observations	Mean	Maximum	Minimum	Std. Dev.
FISHERY (N, Million)	27	4402.97	8135.79	1726.50	1754.20
FORESTRY (N, Million)	27	3288.69	24885.40	1992.00	4324.37
CROPS (N, Million)	27	125531.10	221622.30	67551.80	43682.00
LIVESTOCK (N, Million)	27	10230.15	15654.70	6934.50	2191.58
Real Exch Rate Index	27	226.62	772.50	71.44	201.12
Govt. Expenditure (N, Million)	27	118809.50	947690.00	701.10	214516.10
GDP of Trading Partner ($, Million)	27	7140.43	13246.60	2795.60	3056.86

The average values of output of crop, fishery, forestry and livestock during the period of study are N125,531.10 million, N4402.57 million, N3288.69 and N10,230.15 million respectively. During the period under review, the minimum output for crop is N67,551.89 million while the minimum for fishery is N1726.50. For forestry and livestock, the minimum is N1992.00 million and N6934.50 million respectively. The Maximum for crop, fishery, forestry and livestock are N221622.30 million, N8135.79 million, N24,885.40 million and N15,654.70 million respectively.

Two-Stage-Least- Squares Regression Result

Table 4 below presents the result from the two-stage estimation technique. The results indicate that the real exchange rate has a negative impact on crop output, implying that real exchange rate depreciation has a contractionary effect on crop output. Money supply has a positive effect on crop output but this is not significant. The income of trading partners (represented by the USA GDP) has a positive and significant effect on crop output, while government expenditure has a negative but insignificant effect on crop output. The coefficient of real exchange rate is significant at the 10 percent level. For the fishery output equation, real exchange has a negative but insignificant effect. However, money supply has a positive and significant effect on the fishery output. The income of trading partners and government expenditure has negative and significant effects on fishery's output. As depicted on Table 4, the real exchange rate has a positive and significant effect on forestry and livestock outputs, while money supply has negative effects in both cases. However, the effect of money supply is insignificant in the forestry equation. The income of trading partners has positive effects on forestry and livestock outputs but the effect is insignificant in the forestry equation. Government expenditure has positive and significant effect in the forestry equation, while it has negative and significant effect in the livestock equation. In all the equations, the variables included in the models are able to explain over 60 percent of variation in the dependent variable except in the forestry model where only 24 percent of variation could be explained. The standard error of regression is plausibly low in all cases.

Table 4: Estimated Results of Two-Stage-Least-Squares

|	**Crop**	**Fishery**	**Forestry**	**Livestock**
Constant	6.45(5.51)	19.01(3.06)	-9.18(-0.89)	3.11(3.27)
Real Exch. Rate	-0.05(-1.79)	-0.16(-1.13)	0.47(2.02)	0.04(1.97)
Money Supply	0.03(0.94)	0.51(2.77)	-0.23(-0.74)	-0.08(-2.73)
Inc of Trading Parts	0.59(3.55)	-1.72(-1.96)	1.88(1.28)	0.779(5.92)
Government Exp	-0.01(-1.25)	-0.07(-2.07)	0.08(1.76)	-0.02(-3.98)
Adjusted R^2	0.97	0.60	0.24	0.95
SEE	0.05	0.27	0.44	0.04

To test the robustness of the model, the Breusch-Godfrey Correlation LM test was conducted in order to find out whether the error terms are serially correlated. The results presented in Table 5 below suggest that the null hypothesis of no serial correlation could not be rejected in the cases of fishery, forestry and livestock models, while in the crop model the null hypothesis of no serial correlation could not be accepted. This suggests that there is no problem of serial correlation of error terms in the fishery, forestry and livestock models.

Table 5: Breusch-Godfrey LM test Tesult

	Crop	**Fishery**	**Forestry**	**Livestock**
Breusch-Godfrey Statistics	6.01	4.24	3.02	4.17
Probability Chi-Square(2)	0.05	0.13	0.22	0.12

Furthermore, the graphs of the models were examined to see how well the estimated model is able to track the actual data. The graphs of the actual fitted and residuals for crop, fishery, forestry and livestock are shown in Figures 1, 2, 3 and 4 respectively.

Figure 1: Actual, Fitted and Residual for the Crop Model
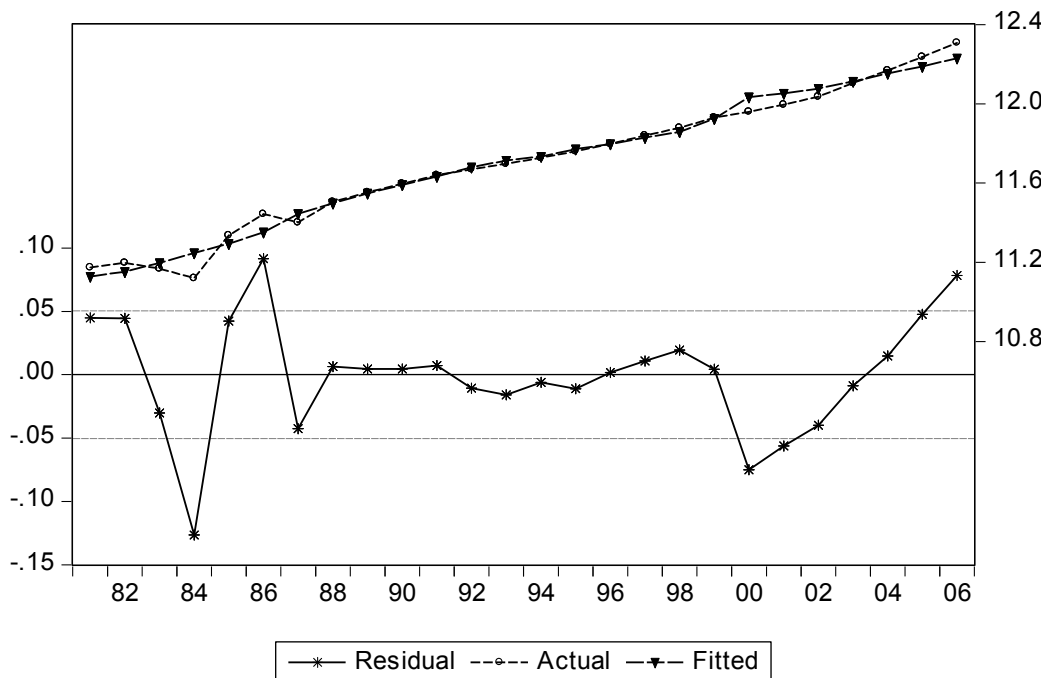
From Figure 1, it can be observed that the fitted line actual tracts the actual very well, indicating a well fitted model. For the fishery model, the fitted line did not tract the actual data very well as shown in Figure 2. However, for the forestry and livestock models, the fitted model track actual data very well, except between 1997 and 1999 in the forestry model, where the tracking is poor (see Figures 3 and 4 for forestry and livestock respectively).

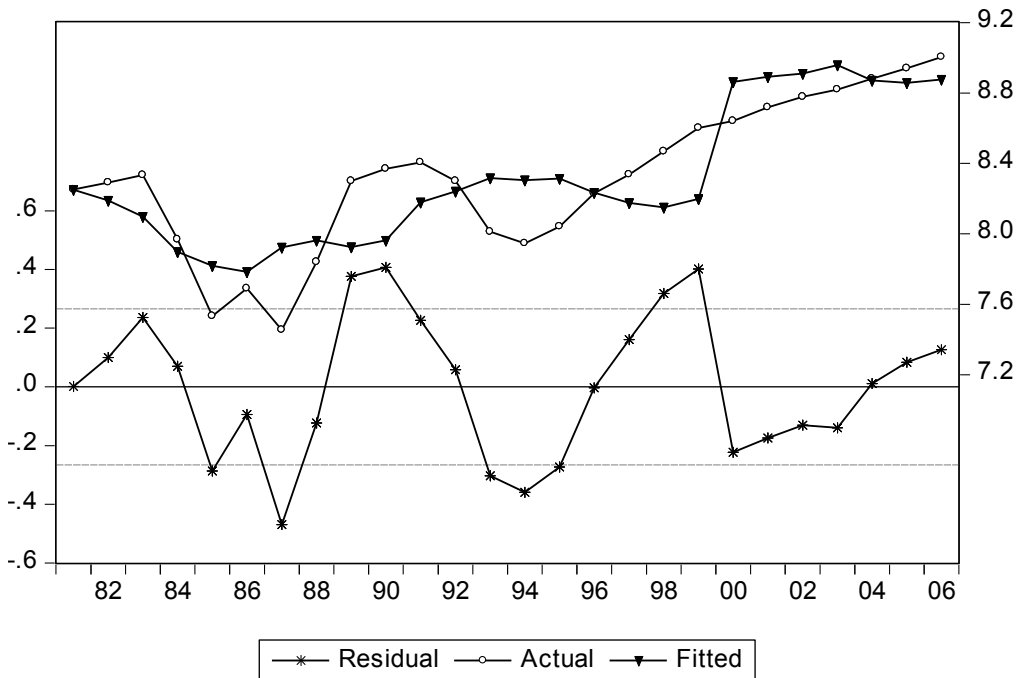**Figure 2: Actual, Fitted and Residual for the Fishery Model**

Figure 3: Actual, Fitted and Residual for the Forestry Model
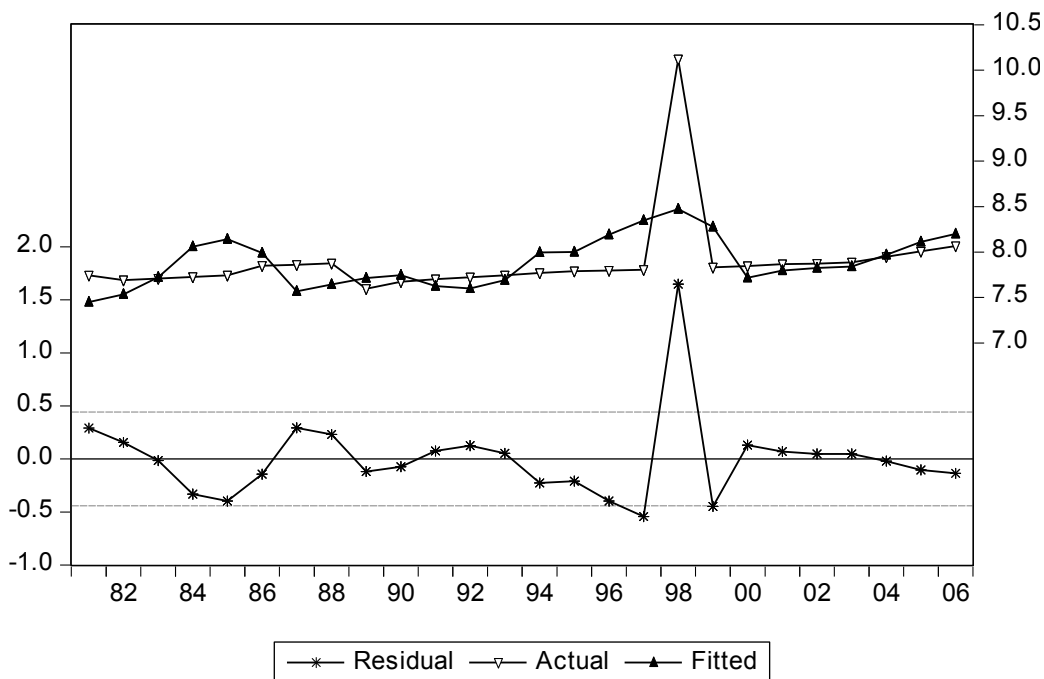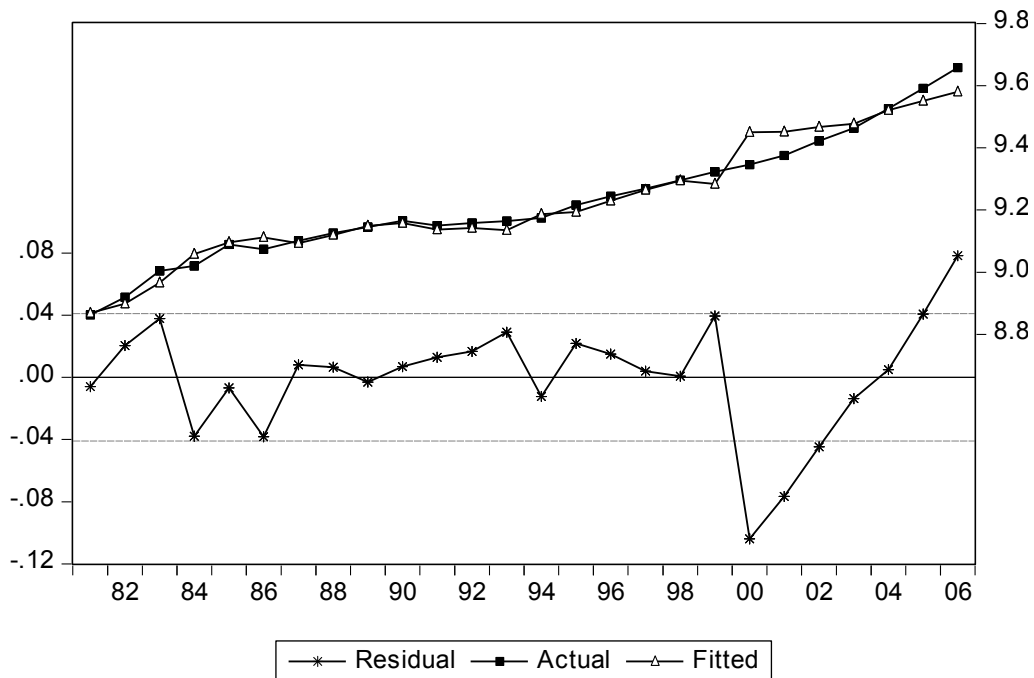

Figure 4: Actual, Fitted and Residual for the Livestock Model

7. Summary and Conclusion

From the analysis presented above we observe that there are differences in the way output of different sub-sectors responds to exchange rate changes. While crop and fishery output have negative relationship with real exchange rate, forestry and livestock output have a positive one. The effect of exchange rate was found to be significant in all cases except in the fishery model. Money supply has significant impact on fishery and livestock output but the effect goes in different direction in both cases. Government expenditure has negative and significant effect on fishery and livestock output. This probably indicates the crowding out effect of government expenditure on private investment. The fact that real exchange rate has differential effect on output of the agricultural sub-sector indicates the need for caution in exchange rate policy and also the need for policy to be put in place to mitigate the adverse consequences of exchange rate depreciation on crop and fishery output.

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Gender differences in work stress, related to organizational conflicts and organizational constrains: An empirical research

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Abstract

In modern era, stress at workplace is a component of employees' and organizations' daily routine. The current research intends to study the gender differences as far as the ways that stress is witnessed in the workplace is concerned. Participants in this study were 231 Greek adults, employed at various workplaces. During their working hours they were asked to fill in a questionnaire which contained two different measurement scales. The main hypothesis was that men would show interpersonal conflicts at workplace to a larger extent; also that both men and women would not be so different on stress that stems from organizational constraints. The research findings did not confirm all the research hypotheses, because men were found to express their stress at a larger extent through interpersonal conflicts with their colleagues as a result of organizational constraints. The research data on the different stress manifestations at workplace are in accord with the relevant bibliography. Finally, this study contributes to the empirical support of the existence of gender differences in stress manifestations at workplace, even though the questionnaire that was used was no validated in Greece.

Keywords: stress, work, gender, research

JEL Classification: J28, J81, D23, O15

1. Introduction

The origins of word "stress" come from mechanics and refer to the exterior pressure that is exerted to an atom and results to this atom's tension (Kahn & Byosiere, 1992). Yet, there is a great disagreement to the definition of stress and not a generally accepted theory for its interpretation. In psychology, stress is defined as "an unpleasant emotional situation that contains feelings of tension, fear or even terror as an answer to a danger whose source is to a large extent unknown or unrecognizable" (Manos, 1997). The stress in the workplace is the stress that manifests itself at workplace and refers to the employees' perception of workplace as threatening (Caplan, 1980).

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It is an indisputable fact that all jobs create stress to the employees in different degree, a stress that can cause changes in the organism's natural function and have consequences for person's health. Especially, job responsibilities that are related with humans are more likely to lead to heart condition, rather than job responsibilities that are related to commodities' management (Arnold et al., 2005; Miner, 1992). Stress at workplace is a main issue that concerns not only the employees, but also the organizations and the community in general. According to "H.S.E." (Health and Safety Executive, 2009), around 500.000 employees in Great Britain feel stress at their workplace in a degree which they are considered negatively affecting their health. Also, more than 5.000 employees feel extremely stressed at their workplace, a stress that costs the British society around GBP 3,7 billion each year. The dominance of workplace stress is high, as it is revealed by a study involving 16.000 European employees, 29% of who believe that their working activities had negative impact for their health (Paoli, 1997). For this reason, it is of great importance to study the workplace stress, because of its harmful consequences both for the employees and for the organization.

Through the years, different interpretation theories of stress have been formulated. The Social Environment Model or "Michigan Model" is an attempt of categorization and representation of the employees' stressors, factors that are mainly attributed to the job characteristics or organization characteristics. Consequential to "Michigan Model" inspection was the Person-environment fit theory (Furnham, 2005). Demand Control Model is another theoretical approach by Karasek and Theorell (1990), according to which, the combination, either additive or multiplied, of high psychological demand conditions, like very fast and/or hard work, and low control in decision making, such as the employee's ability to make specific decisions for his/her work, may lead to intense stress with consequences for health. The theory of imbalance between work efforts and rewards focuses on whether employees are rewarded for the efforts they made. Accordingly, then, to this theory, when a worker receives rewards that are perceived as not so high as his efforts, the resulting emotional response increases the risk of work absence. The essence of this model is the response of the individuals to external demands they are called upon to respond, and the needs arising from the fulfillment of their personal aspirations and expectations (Chmiel, 2000; Furnham, 2005; Siegrist, 1996).

The overview of bibliography showed two different categories of workplace stress factors, the external stressors and the internal stressors. The working conditions in each organization, which include on the one hand the structural elements of workplace and on the other hand the realistic working conditions, are part of the external stressors. The physical design of workplace, the working complexity, the introduction of new technology may become stress factors. (Arnold et al., 2005; Schultz, 1998). The workload, working hours and shift work, play a role in the occurrence of work-related stress.

The organizational climate and the organization's management are equally potential stressful working factors (Arnold et al., 2005; Furnham, 2005; Schultz & Schultz, 1998). An extremely interesting finding of modern bibliography is the fact that the contact with other people at workplace may constitute a main source of stress, as well as a source for support (Makin Cooper & Cox, 1996). The present research examines two exogenous factors of

stress, namely the organizational constraints and the interpersonal conflicts. Both these factors can have negative effects on the work environment. According to Sliter et al (2011), interpersonal conflicts within the working framework are influencing employees' behavior both among themselves and in relation to their customers. Furthermore, interpersonal conflicts are associated with adverse effects in the employment context. Agreeableness, as a personality characteristic and social support, absorb the emotional tensions arising from conflicts (Ilies et al., 2011). In addition, emotional exhaustion and oppression caused by interpersonal conflicts exacerbated by passive coping strategies of problem (Dijkstraa et al., 2009).

The second category of workplace factors consists of the internal or personal stress factors. Gender, the object of the current study, is an interesting internal stress factor in the workplace, including both the social and biological gender.

Gender, in the context of organizational psychology contemporary research, is examined as a factor influencing stress in relation to welfare issues (O'Neil & Davis, 2011), job satisfaction (Aydin Uysal & Sarier, 2012; Steenbergen et al., 2011), work-family conflict and production deviance (Ferguson Carlson, Hunter & Whitten, 2012), work performance (Olorunsola, 2012), and productivity (Hasanzadeh Shirbeigi & Olazadeh, 2012).

According to the bibliography, gender plays an important role in the manner that a person would express his/her stress, a stress whose source may differ depending on his/her duties. Taking into consideration that personal characteristics, like social gender, may affect the workplace stress manifestations (Gianakos, 2000; 2002), it is important to clarify that a big part of modern research consists of issues relevant to stress and work satisfaction with regard to the distinction between work family and social supporting framework (Cavaiola et al., 2012; Innstrand et al., 2009). After the gradual increase of women's participation in the job market, some researchers begun to employ female subjects in their research samples, but only few of them were changing their initial hypotheses. As a result, women appeared to be in a more inferior position than men. (Long & Cox, 2000). Several studies in recent years study the gender in the manifestation of work-related stress. In their research in Taiwanese, employees in bank branches, Yu-Chi & Keng-Yu (2010), wanted to identify the differences between the social role of gender in relation to job stress. Specifically, participants had to complete two questionnaires, one for the social characteristics of masculinity and femininity and one for work-related stress. The results showed that the subjects with more masculine characteristics exhibited less stress levels compared to the subjects who had higher scores in feminine characteristics. Furthermore, they found that a comparison of stress and biological sex did not make any difference. Also, Meško Videmšek, Štihec, Meško-Štok & Karpljuk (2010), in their research concerning 85 managers in Slovenia, found that female managers have higher stress levels and more severe anxiety symptoms compared with the male participants. In a study among 400 teachers in Pakistan in primary and secondary schools, it was found that gender is a very strong predictor of teachers' stress (Rubina, Sadaf, & Masood, 2011). Agagiotou (2011), studied the effect of work stress, job commitment and emotional intelligence of social workers, and she found that female social workers exhibited higher levels of anxiety than

male. In addition, Galanakis et al (2009), identified differences in job stress between the sexes. However, these differences annihilated when the factors "years of education" and "marital status" were also examined.

A decisive factor and basic reason for the existence of gender differences, regarding stress manifestations, is the existence of differences between the stress stimulus that the two gender encounter in their workplace and their exposure range to different stimulus types (Bekker, Nijssen, Hens, 2001).

The current study aims to cover the research gaps which have aroused in relation to the workplace stress and gender differences in terms of its manifestations. Particularly, it plans to study the gender effect on stress manifestations at workplace. A decisive role in the formulation of research hypotheses played the increased presence of women in up to now male-dominated workplaces. According to the bibliography, the roles that are assigned at workplace have led women to perceive their working conditions differently (Bekker et al., 2001), as also their treatment as passive presence in organizations without central or contending roles towards men who usually have a different action motif (Cooper & Davidson, 1983). Hence, the following hypotheses had aroused: firstly, men would have higher stress levels related to interpersonal conflict in their workplace than women (Hypothesis 1), secondly, both men and women will have the same levels of stress attributed to organizational constraints which means same degree of difficulty to accomplish their job duties (Hypothesis 2).

2.   Method

The current study is a poll research which uses inventories in order to collect data. This type of research was chosen because it makes possible for data collection from a large number of participants in various workplaces and occupations. Furthermore, the use of inventories is a method characterized by small time consumption and low printing cost of the questionnaires (Kostaridou-Eukleidi, 1999).

2.1   Participants

In the present study, among the 231 Greek adults with an average age of 37.5 years (S.D.=10,35 & R=40) that participated voluntarily, 94 were men and 137 were women. All participants were at least 18 years old and had Greek nationality. The male participants' sample consisted of nurses (N=2), auto electricians (N=6), production machine operators (N=7), pharmacists (N=3), doctors (N=8), secondary school teachers (N=4), graphic designers (N=2), accountants (N=4), vendors (N=13), administrative staff (N=24), supervisors in industry and crafts (N=8), militaries (N=8), librarians (N=1), workers (N=3). The female participants' sample consisted of nurses (N=15), pharmacists (N=9), doctors (N=4), workers in cloth production (N=5), secondary school teachers (N=9), graphic designers (N=11), accountants (N=14), shopping assistants (N=15), administrative staff (N=35), supervisors in industries and crafts (N=5), militaries (N=2), librarians (N=9), and workers (N=5).

2.2   Measures

In the current study, a work stress questionnaire and pencils or pens were used for the collection of data. The work stress questionnaire that was used was the one of Paul E. Spector and Steve M. Jex (1998), translated by Nikolaou I. Assistant Professor of Organizational Behavior at Athens University of Economics and Business. More specifically, the questionnaire consists of 38 closed-ended questions and examines the interpersonal conflicts at workplace, the organizational constrains, the quantitative workload, as well as the physical symptoms related to workplace stress. However, the present paper presents only two scales of the aforementioned questionnaire which consist of 15 questions. More specifically, the interpersonal conflict factor arises by the use of Interpersonal Conflict at Work Scale (ICAWS), and consists of four questions with five possible answers: never, rarely, sometimes, quite often, and often. This factor aims to investigate colleagues' relationship qualities, as well as the frequency at which each participant is involved in disputes and behaves badly to his colleagues. The score each respondent can have on this scale is between four and twenty points, with higher scores indicating more conflicts within the working framework. The internal consistency of estimated reliability is stated by the authors at .74 in Cronbach's Alpha scale. The organizational constraint factor emerges from the use of Organizational Constraints Scale (OCS) and consists of 11 questions with five possible answers: Less than once a month or never, One or two times per month, Once or twice per week, Once or twice per day, Several times per day. This scale aims to investigate those factors or situations that hinder employees from performing their work properly. The score each employee can reach in this scale ranges from 11 to 55, with higher scores indicating greater difficulties in work performance. According to the creator, the Cronbach's Alpha scale is not a sufficient method for calculating the reliability of this scale. Finally, in the beginning of the questionnaire, respondents had to answer some demographic questions such as the gender.

2.3   Procedure

Questionnaires were distributed and answered to in the participants' workplace, aiming to save time and give to our subjects a sense of familiarity. Participants took part in the procedure with the permission of their supervisors. Participants had oral instructions about the completion of the questionnaire. Instructions were also available on the questionnaires. More specifically, participants were asked to complete all questions without exception, by specifying to which extent the frequency of their experience is presented in each question. Participants had the right to give only one answer. The administration of the questionnaires was done both individually and in groups, depending on the conditions and the directions provided by the participating companies. None of the participants needed more than 20 minutes to complete filling the questionnaire.

2.4   Results

For the analysis of this survey results, an independent-samples t-test was conducted

to compare men and women, in order to find if there are gender differences in expression of work stress. As we can see in Table 1, the results with statistic significance $p < .05$, show that there is a significant difference between men and women in the way they express stress in workplaces. More specifically, men (N = 94) are those who express more work stress not only in the interpersonal conflict scale [t (229) = 2.45], but also in organizational constraint scale [t (229) = 2.37]. In detail, as Table 2 shows, men are involved in disagreements with their colleagues more often than women [t (229) = 2.86] and they were treated with rudeness form their colleagues [t (229) = 2.4]. Also, male subjects found it difficult or impossible to work due to incorrect instructions [t (229) = 2.96], inadequate equipment or supplies [t (229) = 2.04] or lack of necessary information about what to do and how to do it at any given moment [t (229) = 1.51]. Finally, male subjects found it difficult to work when they were interrupted by others [t (229) = 1.56].

Table 1: T-test for comparison of Means in work related stress expression by gender

	Males N = 94		Females N = 137			
Factors	M.	S.D.	M.	S.D.	t	p
Interpersonal Conflict at Work Scale	9.65	3.29	8.73	2.40	2.45	0.01
Organizational Constraints Scale	20.56	11.55	17.65	7.15	2.37	0.00

Table 2: T-test for comparison of Means in work related stress expression by gender

	Males N = 94		Females N = 137			
Questions	M.	S.D.	M.	S.D.	t	p
Q.1: How often do you get into arguments with others at work?	2.71	1.05	2.35	0.86	2.86	0.01
Q.3: How often are people rude to you at work?	2.65	1.15	2.33	0.87	2.4	0.00
Q.4: How often do other people do nasty things to you at work?	2.14	1.08	2.06	0.84	0.63	0.02
Q. 10: Poor equipment or supplies.	2.24	1.49	1.88	1.19	2.04	0.00
Q. 11: Organizational rules and procedures.	2.08	1.44	1.78	1.10	1.81	0.00
Q. 12: Other employs.	2.07	1.32	1.74	1.08	2.08	0.03
Q. 13: Your supervisor.	1.92	1.42	1.52	1.01	2.5	0.00
Q. 14: Lack of equipment or supplies.	2.12	1.53	1.84	1.25	1.51	0.00
Q. 15: Inadequate training.	1.78	1.21	1.45	0.84	2.4	0.00
Q. 16: Interruptions by other people.	2.17	1.32	1.93	1.04	1.56	0.00
Q. 17: Lack of necessary information about what to do or how to do it.	2.17	1.5	1.9	1.17	1.51	0.00
Q. 18: Conflicting job demands.	2	1.32	1.69	1.06	2	0.04
Q. 20: Incorrect instructions.	2.25	1.48	1.77	0.99	2.96	0.00

2.5   Results Discussion

The difference in how organizations function may be a factor that explains the differences between the two genders in the way that they express stress related to work (Matuszek, Nelson, Quick, 1995). According to our first hypothesis (Hypothesis 1), it was expected that male subjects will experience higher levels of work stress related to interpersonal conflicts in workplace. A study conducted in England by Cherry (1978), in about 1.500 young male adults shown that a sizable amount of the sample was under frustration during their work. This finding may explain the fact that in our study, male subjects proved to experience higher levels of stress in the field of interpersonal conflicts with their colleagues. This finding confirms our first scientific hypothesis about the men having higher levels of work related stress due to interpersonal conflicts (Hypothesis 1). The emergence of the existence of gender differences in interpersonal conflicts is very important, because, as shown by O'Neil & Davis (2011), interpersonal tensions in work are associated with less satisfaction derived from work and more chances for work turnover. It should be also noted, that Slišković & Seršić (2011), in contrast to our research, found that women associate and assistant professors showed more stress related to interpersonal relationships, unlike their male colleagues, a finding which can be explained by using this particular sample.

Furthermore, regarding our second research hypothesis (Hypothesis 2), in which equal levels of stress between the two genders were expected due to organizational constrains in the workplace, the results did not confirm our hypothesis. The result analysis showed that, in comparison with women, men have higher levels of stress related to organizational constrains, due to the incorrect instructions they receive, the lack of supplies and specific information necessary for their work performance, and the interruptions of their collogues as the most stressful conditions. These results contradict the results of Slišković & Seršić (2011) in academics, where assistants were experiencing more stress levels than men in matters having to do with teaching material shortages and technical issues.

3.   Conclusions

Despite the fact that gender has been studied heavily in the past in relation to work-related stress (Caplan, 1980), today still continues to be investigated as a variable, showing thereby the importance of gender in the workplace context (Rubina et al., 2011; Meško et al., 2010; Agagiotou, 2011; Galanakis et al., 2009)

The current research study examines the effect of gender in workplace stress manifestation. For the investigation of this effect, the Spector & Jex (1998) questionnaire, which measures workplace stress and consists of four scales, was used. The paper presents two scales, the interpersonal conflicts and the organizational constraints ones. From the 231 adults that provided answers to the questionnaire, 94 were male and 137 were female.

The data processing, which did not confirm both hypotheses, revealed that men demonstrate higher stress levels in interpersonal conflicts' scale and in organizational

constraints' scale. Taking into consideration both the employees' and organizations' need for a less stressful and more productive workplace, the present study intends to contribute both in theoretical and practical level by showing the different gender stress manifestation at workplace. On a theoretical level, the study aims to contribute to a better understanding of stress manifestations, as they differed in men and women. On a practical level, the contribution of this study lies in the utilization of research data by organizations' managers, in order to adjust working conditions to employees' demands by taking gender into account. Through the study of the economic consequences of workplace stress to organizations (Health and Safety Executive, 2009), the adoption of a workplace stress reduction policy appears necessary for the increase of productivity and psychological and physical well-being of employees as the ulterior motive. Therefore, the present research findings can be used for stress prevention at workplace.

Taking into consideration that the current study was conducted during the economic crisis, with increased fear and stress for an imminent layoff, it appears reasonable to repeat the research in the future. Even though that gender appears to collate with stress, the research analyses affirm only some degree of applicability, but not a causal relation between them, whereas the existence of stress manifestations could be attributed to the personal characteristics of the employees. Although there was an effort to have a sample of a wide range of workplaces, the final choice was based on their easy access, either due to organization's policy or due to employees' reluctance. Additionally, there was an out of proportion representation of gender per job, as well as an out of proportion representation of gender in whole. Another limitation of the study was the lack of a questionnaire validated in Greek population, which made the use of a translated American questionnaire compulsory.

A proposal for future research would be a corresponding study which could be made by using a validated tool, as long as it is available, and by using a sample with better analogy regarding gender and occupation. The use of a quantified questionnaire instrument, as it was the case in this study, has advantages concerning results generalization but it may not be able to identify other factors, possibly important, causing stress in the employment context. For this reason, the use of qualitative techniques might identify other significant sources of stress in the workplace.

Last but not least, and given the lack of a relevant bibliography, a new research challenge could be the study of the relation between workplace satisfaction and workplace stress.

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The External Finance Premium and the Financial Accelerator:
The Case of Turkey

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Abstract

The monetary transmission mechanisms have influence on saving and investment decisions of firms and households by affecting their balance sheets. This study examines the effects of monetary policy through the balance sheet channel (also known as 'financial accelerator'), which affects net worth, liquidity and spending of firms and households through external finance premium. The aim of this study is to analyze the effect of monetary contraction which raised the external finance premium and thus the effect of the increase in the external finance premium which diminishes output for Turkey over the period of 2003:01-2010:08 by using VAR (vector autoregressive models), impulse-response analysis and forecast error variance decomposition. The results indicate that contractionary monetary policy shock, which led to increased external finance premium, negatively affected the manufacturing sector and decreased total output. In other words, the monetary shock negatively affected firms' balance sheets in the short-run.

Keywords: Financial Accelerator, External Finance Premium, Turkey

JEL Classification: E52, C32, E44

1.   Introduction

In recent years, many developed and developing countries have been implementing various instruments of fiscal and monetary policies to achieve macroeconomic goals such as development, redistribution of income, growth, employment creation, and financial stabilization (Georgantopoulos and Tsamis, 2012). Monetary policy is regulated as a set of decisions by the central bank. It affects the amount of money, the costs, and the expectations of households and firms to achieve ultimate goals. The central bank as an implementing agency of monetary policy, monitors operational and/or intermediate targets by using indirect monetary tools, such as required reserve, discount rate, open market operations. Moreover, it manages the expectations of aggregate demand, aggregate output,

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and inflation through the monetary channels towards these goals. In this framework, the monetary transmission mechanism can be viewed as a way of affecting the spending, saving, and investment decision making of firms and households through the central bank's transmission channels.

Despite concurrence among economists regarding the direct and indirect effects of monetary policy implementation on the real economy, changes in theoretical approaches over time have led to a lack of consensus about which transmission mechanism is more efficient when affecting real variables.

The classifications of the monetary transmission mechanism have generally been accepted as the traditional interest rate channel, the credit channel, and the other asset price channel. However, in recent years, the expectations channel has also gained usage within these classifications. Although the monetary transmission channel is comprised of these various channels, it is mainly based on two main channels: "the money channel" and "the credit channel".

Within this scope, the main aim of this study is to analyze the balance sheet channel, which is one of the three basic non-neoclassical credit channels: (i) effects on credit supply from government interventions in credit markets, (ii) the bank-based channels (bank lending channel and bank capital channel) and (iii) the "balance-sheet channel". In particular, this study will focus on the effect of a contractionary monetary policy in Turkey on the balance sheet channel, also known as 'financial accelerator' and external premium, which is caused by a change in total output and general price level. For this purpose, VAR (vector auto-regression models) method will be utilized to analyze the period of 2003:01-2010:08. To the best of our knowledge, there have been a limited number of studies that analyze the monetary transmission mechanism credit view in Turkey. Moreover, these studies have generally focused on the presence of the bank lending channel in the Turkish economy. In this context, apart from other studies, the main contribution of this study to the literature is to analyze the monetary transmission mechanism 'balance sheet channel' (financial accelerator) for Turkey.

We start our analysis by reviewing the credit channel (credit view) and its sub-titles; effects on credit supply from government interventions in credit markets, the bank-based channel and the balance sheet channel. Section three includes a summary of the empirical work on the balance-sheet channel, where few studies have conducted analyses for Turkey. Section four describes the empirical work, where the VAR method was utilized to analyze the effectiveness of the balance-sheet channel in Turkey. Section 5 presents the Conclusion of the study.

2.   Non-neoclassical Channels: The Credit View

Monetary transmission can be categorized into two basic types: neoclassical channels, in which financial markets are perfect and non-neoclassical channels that involve financial market imperfections (Boivin et al., 2010). Non-neoclassical transmission mechanism channels may emerge from government interference in markets or through imperfections

in private markets. In this context, asymmetric information or market segmentation leads to barriers in effectiveness of the functioning of financial markets. Non-neoclassical transmission mechanisms involving market imperfections in credit markets are referred to as a "credit view". The credit channel (credit view) is considered to be a set of factors that produces and extends the effects of the traditional interest rate channel. It is considered quite difficult to explain the response, magnitude, and timing of macroeconomic variables in relation to monetary shocks only through the traditional interest rate channel. Therefore, to eliminate these difficulties in the use of the credit channel is considered.

According to the credit channel, as a result of the direct effects of monetary policy on interest rates, external finance premium also changes. Increases in external finance premium also increase credit market disruptions. This additional effect on the external finance premium increases the impact of monetary policy on the cost of borrowing (as a result of the effects on real expenditure and activities) (Bernanke and Gertler, 1995).

In this context, there are three basic non-neoclassical credit channels: effects on credit supply from government interventions in credit markets, the bank-based channels, and the balance-sheet channel (Mishkin, 1995; Boivin et al*., *2010).

2.1   Effects on Credit Supply from Government Interventions in Credit Markets

In order to achieve policy objectives (redistribution or stimulation of investment), free functioning of credit markets is often inhibited by governments. Especially in the USA, government intervention has been important in financing housing, such as through mortgage credits. Until the 1980's, thrift institutions (savings and loan associations) were the primary issuers of residential mortgages. These thrift institutions primarily made long-term, fixed-rate mortgage loans in their local areas, using funds provided by local time deposits. Under the scope of this process, the regulatory requirements that thrifts issue long-term mortgages and Regulation Q ceilings led to an important channel of monetary transmission involving credit supply. There were two effects that led to a decline in the supply of credit to the mortgage market when the Federal Reserve tightened policy (raised interest rates). This process operates as follows (Boivin et al*., *2010):

$i \Rightarrow$ *cost of funds for the thrifts* $\Rightarrow$ *income from fixed rate mortgages* $\downarrow \Rightarrow$ *net interest income* $\downarrow \Rightarrow$ *willingness to issue mortgages* $\downarrow \Rightarrow$ *credit supply* $\downarrow$ $\qquad$ (1)

Secondly;

$i \Rightarrow$ *rates > deposit rate ceilings* $\Rightarrow$ *depositors withdraw their funds from thrifts and commercial banks and put into higher yielding securities (this process is called disintermediation)* $\Rightarrow$ *mortgage credit* $\downarrow \Rightarrow$ *residential contraction activity* $\downarrow$ $\qquad$ (2)

On the other hand, the central banks' effect on the external finance premium is described with two connections. One of them is the bank-based channel, which is also known as the narrow bank lending channel. The bank-based channel focuses on the

possible effects of monetary implementations on a deposit banks' loan supply. The second connection is the broad credit channel. The broad credit channel is also referred to as the balance sheet channel or financial accelerator. The balance sheet channel intimates the effects of changes in monetary policies on debtors' balance sheets and income statements (Cecchetti, 1995; Neyer, 2007; Bernanke and Gertler, 1995).

2.2 Bank - Based Channels

There are two bank-based transmission channels. Due to the imperfect substitution of bank loans, banks play a significant role in the transmission process of both channels.

2.2.1 Traditional Bank Lending Channel

Banks play a key role in transformation of savings into investments and through attracting savings they ensure the economic growth of the country (Bairamli and Kostoglou, 2010). According to the bank lending channel, banks play an effective role in the financial system because of their special tools to solve asymmetric information[1] problems in credit markets. Because of banks' special role in the financial markets, certain borrowers (generally bank-dependent small-sized firms) can access credit markets through banks. It is worth mentioning that an important implication of the bank lending channel is that monetary policy will have a greater effect on expenditure by smaller firms. In this context, due to large firms receiving funds not only through banks but also directly through stock and bond markets, small firms are more dependent on bank loans than large firms (Boivin et al., 2010).

Under the assumption of non-substitutability of retail bank deposits with other sources of funds, the process of the bank lending channel is as follows. Contractionary monetary policy affects markets negatively through credit channels -or- the credit channel. Implementation of contractionary monetary policy leads to a decrease in bank deposits, which subsequently precipitates a decrease in bank loans. Contraction in the quantity of loans supply also decrease total output. This process operates as follows (Mishkin, 1996):

$$M \downarrow \Rightarrow bank\ deposits \downarrow \Rightarrow bank\ loans \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow \qquad (3)$$

2.2.2 Bank Capital Channel

The bank capital channel is another bank channel, according to which, the state of the balance sheets for banks and other financial intermediaries has an important impact on

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[1] Generally, there are two asymmetric information problems in the credit markets: adverse selection and moral hazard. Adverse selection occurs as a result of lack of information through inadequate investigation by lenders of the borrowers before signing a loan contract. Conversely, moral hazard occurs when lenders cannot determine whether borrowers use credit within the stated purpose in the loan contract after the credit assignment.

lending. A drop in asset prices can lead to losses in a bank's loan portfolio, or alternatively, a drop in credit quality may also decrease the value of bank assets. This may result from a reluctance of borrowers to pay back their loans. Losses of bank assets can generate diminution of bank capital. The shortage of bank capital can also lead to a cutback in the supply of bank credit. As a result of this process, bank-dependent borrowers are no longer able to access credit, forcing them to reduce consumption and ultimately aggregate demand will fall. On the other hand, in the bank capital channel, expansionary monetary policy boosts bank capital and then lending, therefore aggregate demand will increase through more spending of bank-dependent borrowers (Boivin et al., 2010).

2.3 Balance Sheet Channel

The balance sheet channel, also known as the 'financial accelerator' or broad credit channel, highlights the relationships of net worth, liquidity and spending of firms and households (Hubbard, 2008). In this context, the net worth and liquidity of firms and households determines their credibility. The effects of monetary policy in the balance sheet channel are assessed in terms of firms and households (Bernanke and Gertler, 1995; Gertler and Gilschrist, 1994; Gallegati, 2005; Boivin et al., 2010).

2.3.1 The Effects of Firms' Balance Sheet

Similar to the bank lending channel, the balance sheet channel also arises from the presence of asymmetric information problems in credit markets. As a result of implementation of contractionary monetary policy *(M)*, stock prices fall *(Pe)* and when firms' net worth falls, they will be able to find less amount of loan in the credit market.

When a firm's net worth falls, adverse selection and moral hazard problems increase in credit markets. Lower net worth indicates that the lender can require less collateral. This suggests that the possible losses that arise from adverse selection can be higher. Thereby, the available volume of credit to finance investment spending will decrease. Moreover, a reduction in the value of a firm's shares increases the probability of the firm entering risky investment projects, thereby reducing the probability of debt payment while also increasing the moral hazard problem. As a result, a reduction in firms' net worth increases adverse selection and moral hazard, thus banks tend towards credit rationing, which leads to a contraction in the supply of loan contracts. A contraction of loan supply decreases investment spending and total output. This process operates as follows:

$$M \downarrow \Rightarrow Pe \downarrow \Rightarrow \textit{adverse selection} \uparrow \Rightarrow \textit{moral hazard} \uparrow \Rightarrow \textit{loans} \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow \qquad (4)$$

In sum, contractionary monetary policy (increase in interest rates) which is also defined as the 'direct effect' of monetary policy to financial position of firms', leads to a decrease in firms' net worth, thereby rendering a decrease in the worth of collateral. The drop of a firm's net worth negatively affects debtor credibility (Bernanke and Gertler,

1995; Mishkin, 1995; Holtemöller, 2002; Hubbard, 2008). These internal fluctuations in the debtors' balance sheet gradually expand and broaden, causing conjectural fluctuations (Bernanke and Gertler, 1995). In other words, smaller shocks gradually increase and transform into major shocks, which adversely affect the economy. Because of this process, the balance sheet is called a 'financial accelerator' (Fender, 2000). Many empirical studies also indicate that these fluctuations affect firms' fixed investments, inventories, and other decisions regarding factor demands (balance sheets and cash flows).

Another way that monetary policy affects firms' balance sheets is through "cash flow". Cash flow is defined as the difference between a firm's cash receipts and cash expenditures. The most important feature of the cash flow channel is the short-term nominal interest rate which affects cash flow. Therefore, interest payments on short term debt affect cash flow (rather than long term debts). Apart from the traditional interest rate channel, which advocates investment spending affected by the real interest rate rather than nominal interest rates, the concept of interest in this process is the nominal interest rate (Mishkin, 1996). In the cash flow channel, a firm's net cash flow and collateral value are indirectly affected by monetary tightening. The schematic process operates as follows:

$$M\downarrow \Rightarrow i\uparrow \Rightarrow cash\ flow \downarrow \Rightarrow adverse\ selection \uparrow and\ moral\ hazard \uparrow \Rightarrow loans \downarrow \Rightarrow I\downarrow \Rightarrow Y\downarrow$$

$$(5)$$

Due to a firm's inability to adapt their short term fixed or semi-fixed (wages and interest payments) costs to contractionary monetary policy (increase in interest rates), which leads to a reduction in consumption spending, the firms' income level decreases. This leads to a gradual increase in financial deficit. In order to cope with the cash shortage, firms tend towards short-term borrowing, leading to increases in short-term interest payments. This eventually causes a decrease in a firm's net worth and credibility (Bernanke and Gertler, 1995). This drop generates an increase in external finance premium.

Under the assumption of non-substitutability of external finance and internal finance, the extent of the external finance premium is determined by a borrower's net worth (Oliner and Rudebusch, 1996). A borrower's net worth is comprised of liquid assets and marketable collateral. The interest debate between borrowers and banks will decline when debtors possess a strong financial structure (high net worth). High net worth for debtors means that these debtors have opportunities to invest by using their own possibilities (such as issuing securities and through banks), therefore, increasing the bargaining of loan interest between debtors and banks. If a borrower's net worth is not high, external finance premium increases.

As a result, tight (contractionary) monetary policy causes asymmetric information problems and alters the risk perception of banks. Banks may demand more marketable collateral from debtors because of a drop in cash flow of debtors and decreases in their wealth. Additionally, banks add uncontrollable and imponderable risks to external finance premium. Therefore, external finance becomes more costly compared to internal finance, with a gradually increasing gap (Fender, 2000). In this case, a bank's alteration of agreement

conditions causes debtors to seek alternative resources. Resource seeking also reveals the differences between small and large scale firms. This indicates a strong correlation between the scale of firms and external finance premium (Gertler and Gilchrist, 1994).

Contactionary monetary shocks affect small firms more than large firms (Gertler and Gilchrist, 1994; Fender, 2000; Oliner and Rudebusch, 1996)[2]. When banks increase premiums, large firms tend to seek financing through the bond market or other short-term fund resources. In this case, large firms can sustain their production and investment temporarily, despite income decreases (short term interest payments result in profit reduction). Consequently their stocks increase. However, small firms use their accumulated stocks in order to cope with cash shortages (Bernanke and Gertler, 1995) because they encounter high agency costs due to their worsening financial position, forcing them to access loans (Walsh, 1998). This situation obstructs the increase of small firms' short-term debts. As a result, small firms contract their production and decrease prices.

The balance sheet channel also affects firms through the unexpected price level channel. As debt payments are fixed in nominal terms by means of contracts, an unexpected increase in prices decreases a firm's liabilities in real terms and increases the real value of the firm's assets. Expansionary monetary policy creates an unexpected increase in the general price level, which leads to an increase in a firm's net worth, thus reducing adverse selection and moral hazard. This expands the supply of loans, and through the increase of investment spending, total output level and economic activity increase. This mechanism operates as follows:

M $\Rightarrow$ unexpected Pe$\Rightarrow$ real net worth of assets $\Rightarrow$ adverse selection $\downarrow$ and moral hazard $\downarrow$ $\Rightarrow$ loans$\Rightarrow$ I $\Rightarrow$ Y (6)

2.3.2 Effects of the Household Balance Sheet

The balance sheet channel pays particular attention to the effects of monetary implementations on a firm's balance sheet. However, the balance sheet channel also affects households. The balance sheet channel operates through consumer spending, especially durable consumer goods and housing expenditures. For example, due to contractionary monetary policy, a decrease in bank loans to those who do not have access to other credit channels, leads to a decrease in expenditures on durable consumer goods and housing.

Similarly, an increase in interest rates due to contractionary monetary policy negatively affects household liquidity, causing deterioration in the balance sheet structure. This situation is defined as the 'liquidity effect'. According to the liquidity effect, the effectiveness of the balance sheet on consumer spending is more than the lenders'

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[2] According to Gertler and Gilchrist (1994), small firms are the enterprises which meet the funding needs through banks with low value collateral and high corporate risk and technology flexible structure. However large firms have adverse characteristics.

desire to provide credit. Durable consumer goods and houses are not liquid[3]because of an asymmetric information problem. A shock that reduces income leads to a decrease in consumers' liquidity and thus leads them to sell their durable consumer goods and houses due to their needs. In this case, consumers are concerned about not selling their assets at real worth and assuming a loss. In contrast, if consumers deposit their financial assets into more liquid assets (e.g. stocks and bonds), they can convert them easily to cash a market value. If consumers presume a financial bottleneck, they prefer to invest in more liquid assets than illiquid or low liquidity assets, such as durable consumer goods and houses.

The consumer balance sheet structure leads them to estimate the probability of a financial bottleneck (financial distress). If consumers hold more liquidity in terms of their debts, their financial bottleneck forecast will be lower. In this context, consumers tend to purchase greater amounts of durable consumer goods and houses (Mishkin, 1996; Gür, 1993). However, the contractionary monetary policy adversely affects the functioning of the mechanism. As a result of tight monetary policy, interest rates increase and the liquidity of assets (such as durable consumer goods and houses) and stock prices drop. Thereby, consumer cash flow contracts and the likelihood of encountering a financial bottleneck increases. Spending on durable consumer goods and houses decreases, and as a result, total demand decreases. The process of monetary contraction operates as follows:

$$M \downarrow \Rightarrow i \Rightarrow \textit{financial assets} \downarrow \Rightarrow \textit{probability of financial bottleneck} \Rightarrow \textit{durable consumer goods and housing expenditures} \downarrow \Rightarrow Y \downarrow \qquad (7)$$

or,

$$M \downarrow \Rightarrow Pe \downarrow \Rightarrow \textit{financial assets} \downarrow \Rightarrow \textit{probability of financial bottleneck} \Rightarrow \textit{durable consumer goods and housing expenditures} \downarrow \Rightarrow Y \downarrow \qquad (8)$$

Apart from these effects, the balance sheet channel also affects households through another way: An increase in housing prices leads to more potential collateral for the homeowner. This situation can also improve the amount and terms of credit available to these households. That is to say, higher housing prices can reduce the external finance premium or relax constraints on the quantity of credit available to a household. The importance of this process depends on how costly it is to withdraw housing equity and on the efficiency of mortgage markets that enable homeowners to overcome credit constraints. In this context, countries with better-developed mortgage markets can be more sensitive to increases in housing prices, as well as consumer spending (Boivin et al., 2010).

## 3.	Recent Empirical Studies of Credit Channel

The monetary transmission mechanism credit channel, considering the modern outward-oriented financial system, has been a very complex process. It essentially operates

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[3] Liquidity implies the conversion of assets into cash.

according to a country's financial structure and banking sector. For this reason, studies that have examined various countries can be differentiated in terms of interpretations and conclusions. Even in studies that have analyzed the same countries, interpretive differences arise from the use of different variables in explaining the mechanism. A few examples of international studies regarding credit channel and balance sheet channel are listed below.

The studies which analyzed the operation of the credit channel for various countries can be summarized as follows: Bernanke and Blinder (1992), Holtemöller (2003), Suzuki (2004), Hülsewig et al. (2006), Suzuki (2008), Lungu (2008). As regards to conclusion, Bernanke and Blinder (1992) revealed that the monetary transmission mechanism works with bank credits for the USA and the federal interest rate is also seen as an important indicator measuring monetary policy activity. Holtemöller (2003) and Hülsewig et al. (2006) found the effective operation of the credit channel in Germany. The results of Suzuki (2004) revealed that the importance of the bank lending channel in the monetary transmission mechanism and the effectiveness of the credit channel are decreasing for Australia. Another study of Suzuki (2008) analyzed the international credit view for Australia and New Zealand and the results revealed that the supply schedule of loans shifts left in New Zealand following a monetary tightening in Australia. By using seven variables, Lungu (2008) found mixed evidence for the bank lending channel in Botswana, Malawi, Namibia, and Zambia.

In regards to the balance sheet channel (broad credit channel) Oliner and Rudebusch (1996), Holtemöller (2002), de Bondt (2004), Angelopoulou and Gibson (2007), Hung and Pfau (2008) used the VAR model for different countries. Oliner and Rudebusch (1996) found that the effectiveness of balance sheet channel in small firms is higher than large firms in the USA. Holtemöller (2002) analyzed the bank-based channel and the balance sheet channel in Germany and found the effectiveness and relevance of a credit channel, and also found empirical support for the operation of the balance sheet channel. The results of de Bondt (2004) revealed that a small rate of change in loan interest rates can create a large-scale effect on the real economy through the external finance premium for the Euro region. Angelopoulou and Gibson (2007) found that the UK firms demonstrated greater investment sensitivity to cash flow during periods of tight monetary policy. Hung and Pfau (2008) found that the credit and exchange rate channels are more important than the interest rate channel, and rather than the balance sheet channel, the bank lending channel is operating in Vietnam.

Studies of monetary transmission mechanisms in Turkey are generally focused on the traditional interest rate channel and the exchange rate channel. However, a few studies have analyzed the credit channel and, instead of the balance sheet channel they placed particular emphasis on the bank lending channel such as Çavuşoğlu (2002), Gür (2003), Öztürkler and Çermikli (2007), Aktaş and Taş (2007), Ziaei (2009), Örnek (2009) and Erdoğan and Beşballı (2009). In this context, the studies focused on the bank lending channel by using the VAR model under the credit channel for Turkey, are discussed below.

The results of Çavuşoğlu (2002) indicate that bank lending behavior is influenced significantly by bank-specific factors, such as the balance sheet strength and the quality of

the asset portfolio, and by debt sales to the banking system. While Gür (2003) and Erdoğan and Beşballı (2009) found a favorable structure for this mechanism to operate, Gür (2003) pointed out the two important obstacles constraining the operation of the credit channel and Erdoğan and Beşballı (2009) mention the partial operation of this channel in Turkey. For the period of 1990-2006 Öztürkler and Çermikli (2007) found a unilateral relationship from monetary policy shocks to real credit, and a two-way relationship between real credit and industrial production. Aktaş and Taş (2007) found evidence that the bank lending channel of the monetary policy transmission mechanism is operating through the capital adequacy of Turkish banks. Utilizing Johanson cointegration and dynamic ordinary least square tests, Ziaei (2009) found that bank lending channel is likely to be an effective monetary transmission mechanism in Middle East and North Africa (MENA) countries which included Turkey. For the period of 1990-2006, Örnek (2009) found that the traditional interest rate and exchange rate channels seem to be effective in Turkey, yet no statistically significant results were found regarding the existence of equity price and bank credit channels.

4. Empirical Analysis

4.1 Method and Data Selection

In this study, the balance sheet channel of monetary transmission was tested for Turkey during the period of 2003:01-2010:08, by using the VAR method. Greene (1993) made the case that the VAR model is the more suitable and effective than other structural models to investigate the dynamic relationship between variables. According to Sims (1980), if there is a simultaneous relationship between the variables used in the economic model, all of the variables used in the model should be considered to be endogenous. This means that each equation's reduced form will consist of the same set of explanatory variables. Therefore, the researcher is not concerned with whether the variables included in the model are endogenous (internal) or exogenous (external) and this facilitates prediction (Asteriou and Hall, 2007).

In this study, the articles of Holtemöller (2003, 2002) were taken into consideration in the selection of variables. The primary aspect of the balance sheet channel is: Contractionary monetary policy that generates an increase in external finance premium leads to a decrease in the borrowing power of firms and households and thereby decreases total output. In this context, these effects are questioned with five variables by using an unrestricted VAR model.

In this framework, the hypothesis analyzed can be written as follows:

H_1: *Monetary contraction raises the external finance premium.*

H_2: *Increased external finance premium diminishes output level.*

In this model, money, goods, and credit markets are in interaction with each other. Hereunder, the variables used in the model are:

(i) to represent total output level of the good market (seasonally adjusted industrial production index (2005=100) was used, (ii) to represent the money market, broad money supply, (*M3* money supply) was used and (iii) to represent openness of the Turkish economy, the real effective exchange rate was used. The general price level was measured with the consumer price index (2005=100). In the analysis the broad money variable was used instead of short-term interest rate because as stated in monthly bulletin of ECB (2011:63-64), *"The volume of broad money in the economy is the result of the interaction of the banking sector (including the central bank) with the money holding sector, consisting of households, nonfinancial corporations, the general government other than central government, as well as non-monetary financial intermediaries. Broad money comprises currency in circulation and close substitutes, such as bank deposits, and is informative for aggregate spending and inflation"*. Moreover, Lebe and Bayat (2011) did not use overnight interest rate variable which is generally used to represent short-term interest rate. And they also added that money supply was an important variable to analyse the ultimate goal of the central bank of Turkey. In the study of Holtemöller (2003), the external finance premium (*efp*) was calculated by the method of Friedman and Kuttner (1992): the spread between the interest rate on loans and the yield on government bonds. De Bondt (1999) also used the same method in his study. Nonetheless, the external finance premium is calculated differently in many studies, yet it is generally calculated as the variation between corporate bonds and the yield on government bonds (Friedman and Kuttner, 1992; Boivin et al., 2010). However, it is known that corporate bonds are very few or almost non-existent in Turkey. According to the Istanbul Stock Exchange (ISE), only two firms issued corporate bonds in 2010, and there were no corporate bond issuances in 2011. For this reason, Holtemöller's calculation method of the external finance premium is more suitable for Turkey, in which the universal banking system is widespread. *"Following Holtemöller (2003), this spread is in general positive due to a risk premium and a liquidity premium. And also, these variables are not constant and presumably monetary policy can affect them"*.

Internal variables which were included in the VAR model are represented respectively: broad money *"rm3"*, real effective exchange rate *"reer"*, external finance premium *"efp"*, consumer price index *"cpi"* and industrial production index *"ipi"*. The theoretical framework was taken into consideration in the ranking of the variables. *"rm3"* was deflated with *"cpi"* (2005 = 100). *"reer"* with a base year of 2003 was converted to a base year of 2005. The variables of *"reer"* and interest rates on loans were obtained from the Central Bank of the Republic of Turkey (CBRT), the yield on government bond (3 months) was supplied by ISE and the data set of other variables used in the model was provided by International Monetary Fund (IMF)-International Financial Statistics (IFS). The ordering of the variables was determined according to the monetary transmission mechanism theory.

In this framework, the VAR model, which was used to analyze the effects of financial accelerator on the real economy (total output) for Turkey, is as follows:

$$x_t = (rm3_t, reer_t, efp_t, ipi_t, cpi_t)$$

4.2 Preliminary Tests of VAR Model

Initially, all series should be processed for the VAR analysis. As a first step, in order to become variables independent from unit values (to arrive at the same level) logarithms of all variables were taken except *'efp'*. No seasonal effect was found for the variables after the analysis of seasonality.

As a second step, all variables were tested, whether stationary or not, because all variables are required to be stationary in VAR models. In this context, the Augmented Dickey-Fuller (ADF) test was implemented, which is a commonly used test found in the majority of analyses examined for our study. Initially, the stationarity of all variables were tested in their levels and variables were found to contain unit roots. After taking their first differences, it was found that all variables were stationary. This means that all variables in the model were stationary in their first difference *I(I),* as reported in Table 1.

Table 1: ADF unit root test results[4]

Variables	Level			1st differences			Result
	τ_μ	τ_τ	τ	τ_μ	τ_τ	τ	
Rm3	-1.368	-1.182	2.783	**-9.840(0)**	-9.911	-9.085	*I(I)*
reer	-2.111	-2.916	0.997	-7.726	-7.734	**-7.622(1)**	*I(I)*
efp	-0.944	-2.658	1.807	**-6.560(0)**	-6.578	-1.492	*I(I)*
cpi	-2.288	-1.068	3.101	**-6.897(2)**	-7.066	-3.689	*I(I)*
ipi	-1.802	-2.498	1.005	-4.034	-4.080	**-3.910(3)**	*I(I)*

Notes: Bold numbers indicate statistically significant series at 5%; parenthetical numbers indicate optimal lag length.

Before estimating a VAR model, it is essential to determine the optimal lag length of the model. To determine the optimal (appropriate) lag length, Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC) and Hannan-Quinn (HQ) were used. The results that were found according to these criteria are reported in Table 2. Table 2 provides the results of the optimal lag length for the model, respectively: LR, FPE, AIC and HQ "one"; SC "zero". Within the framework of these results, it was determined that the

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[4] Statistics show that, $\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_\tau$ (τ_μ statistics with intercept), $\Delta Y_t = \mu + \beta t + \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_\tau$ (τ_t statistics with trend and intercept) and $\Delta Y_t = \delta Y_{t-1} + \sum_{j=1}^{p} \delta_i \Delta Y_{t-j} + \varepsilon_\tau$ (τ statistics without trend and intercept (none)) respectively (Sevüktekin and Nargeleçekenler, 2007).

appropriate lag length of the model is one that is also supported by the LR, FPE, AIC and HQ tests.

Table 2: VAR lag order selection criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	9.14E-13	-13.53126	**-13.38555***	-13.47272
1	**99.64227***	**4.58e-13***	**-14.22291***	-13.34863	**-13.87167***

Notes: Bold numbers and * symbols indicate the optimal lag lengths for the relevant tests.

Figure 1 reports that the inverse roots of AR characteristic polynomials lie within the unit circle. These findings indicate that there is no issue in terms of stability of the one-lag VAR model.

Figure 1: Inverse roots of the AR characteristic polynomial
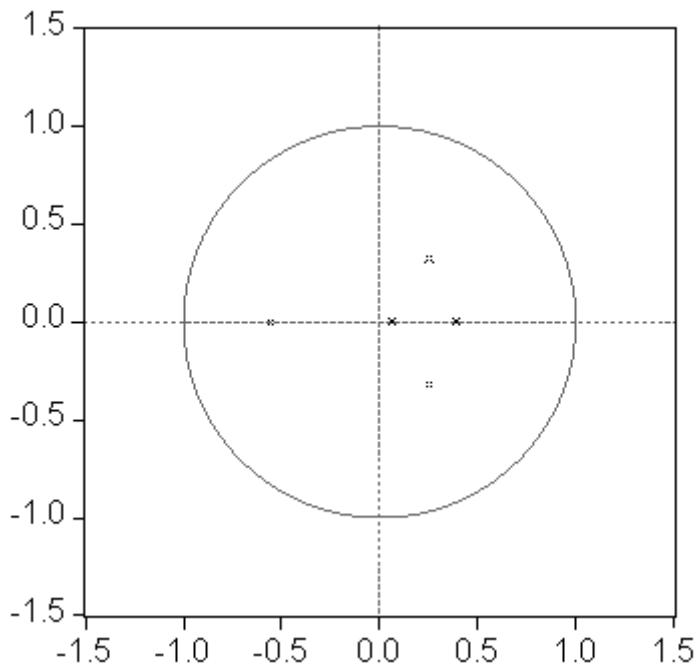
The Lagrange Multiplier (LM) test was applied to the model's error term in order to determine whether there is an autocorrelation. Table 3 shows the results of autocorrelation. In this context, given that marginal significance level (probability) values are greater than 0.05 for the first lags, H_0 hypothesis that is based on the assumption of no autocorrelation

can not be rejected (i.e., H_0 accepted) for the LM test of the model (lag length is one). Finally, LM test results reveal that there is no autocorrelation in error terms.

Table 3: VAR residual serial correlation LM test

Lags	LM-Stat.	Prob.
1	28.672	0.278

The reliability of the model, with a determined lag length of one, was tested on the basis of 5% significance level with four diagnostic tests, respectively: Breusch-Godfrey Serial Correlation LM Test and Autoregressive Conditional Heteroskedasticity, ARCH LM, White Heteroskedasticity, and Ramsey Reset Tests. The results of these diagnostic tests were reported in Table 4. The findings reveal that the H_0 null hypothesis can not be rejected based on the following assumptions: no serial correlation in error terms, no ARCH structure, correct specification of the model, and variance of error terms are constant. In other words, the diagnostic test results confirmed the reliability of the model at the 0.05 significance level. The structural break in the model was tested by using the CUSUM Test and the results did not find any structural break in the time period.

Table 4: Model - diagnostic test results

Diagnostic Tests	*P-Values-χ^2*
Breusch-Godfrey Serial Correlation LM Test	0.877
ARCH Test	0.908
White Heteroskedasticity Test	0.864
Ramsey Reset Test	0.716

4.3 Variance Decomposition Results

The variance decomposition method was used to overcome the obstacles in the interpretation of the parameters in the VAR model and to determine the source of the changes that occurred in a variable.

From the optimal one-lag VAR model to the results of variance decomposition for twenty five periods, all variance in the fundamental source of variables was their own shock. The variance of the *'rm3'* and *'efp'* variables' secondary source averaged 2.83% and 20.37% with the *'reer'* variable, respectively. In the long and mid-term, the fundamental sources of change in the *'reer'* variable were its own shock. In addition, the secondary

source was aggregated at 5.77% with *'efp'* and the third source was aggregated at 4.12% with '*rm3*'. In the relevant period, the sources of change in the *'ipi'* variable averaged 10.59% with the *'efp'* and *'rm3'* variables averaging 9.18%. As a result, it was determined that in the changes of the *'cpi'* variable, the effect of the *'efp'* variable was lower than the other variables. It can be argued that money supply is more efficient on the general price level than the total output, in the aforementioned time period. This is also supported by the results of the impulse-response function.

4.4   Impulse- Response Analysis

The response of other variables to one standard broad money shock, obtained for eighteen periods in one-lag VAR model, was reported in Figure 2. It is shown that the horizontal axis indicates the time period following the shocks as monthly and the vertical axis indicates a rational response of the variables of the model. In this analysis, the necessary confidence interval (± 2 SE) for the impulse-response functions was provided by using Monte Carlo simulations.

As shown in Figure 2, the response of the broad money to its own shock decreased from the beginning to the end of the second term. The response of the *'rm3'* variable indicates monetary contraction. A decrease in the broad money transforms domestic deposits into more productive investment instruments than foreign deposits. For this reason, foreign capital flow into the country increases. Therefore, increase in the amount of foreign currency in the country leads to a downward pressure on the exchange rate. In other words, the response of exchange to the increase of broad money diminished from starting period to the end of the third period. The *'reer'* variable response disappears after the third period. The response of the *'efp'* variable to a negative monetary shock is upward from the beginning to the end of third period. The effect of the shock on the *'efp'* variable disappears after the third period. The response of *'efp'* variable is also in line with the theory. After the monetary contraction, due to an increase caused by the *'efp'* variable, the *'ipi'* variable decreased 100 % from the beginning to the end of the second period and decreased to the level of -0.003. In other words, it can be said that the *'ipi'* variable is sensitive to changes in the *'efp'* variable. The response of the *'ipi'* variable is in line with the results of variance decomposition. However, it is found that the *'cpi'* variable is insensitive to the shocks originated from the *'rm3'* variable in the relevant period. It can be said that responses of the variables to the negative monetary shock disappear, on average, in the second period. In many studies, it is found that the effects of monetary shocks on variables last a short time in Turkey (Çiçek (2005); Öztürkler and Çermikli (2007); Demiralp (2007). In this context, it is necessary to examine the reasons of this situation in a further study.

Figure 2: Impulse-response results of VAR model
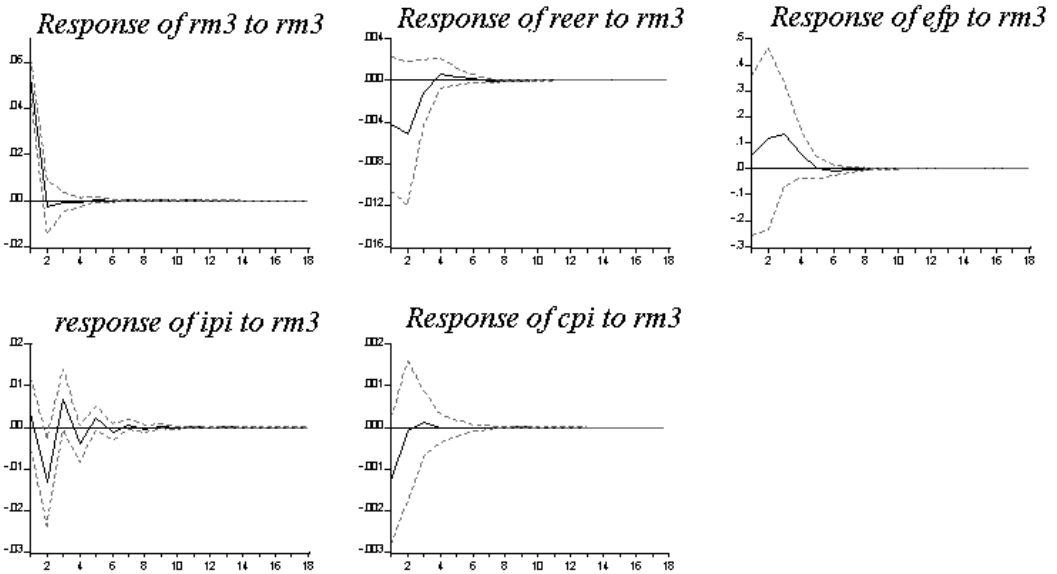
5. Conclusion

In this study, we tested the following hypotheses: (i) Monetary contraction raises the external finance premium; (ii) increased external finance premium diminishes output for the period of 2003:01 and 2010:08. The results suggest that restrictive monetary shock, which leads to an increase in external finance premium, affected the manufacturing sector negatively, thus decreasing total output. As the manufacturing industry is highly sensitive to bank loan rates in Turkey, they quickly respond to a rapid shock.

These results can be explained as follows: To achieve the ultimate goal, price stability, for the withdrawal of the money from market in a coordinated manner with the treasury, the central bank especially uses the open market operations as a tool. In this case, deposit into the bank account will decrease. During a negative shock, in Turkey, people prefer to invest in risk free Treasury bond. This process reduces the banks' willingness to lend and loan interest rates increase. Moreover, the rise of the rate of return on Treasury bill, which was used for calculating the external finance premium, also reveals the prevention from the decrease in the demand for this instrument. This stemmed from the budget deficit of the country. All these processes cause a decrease in the output level. To sum up, the empirical findings verified the examined hypotheses in this study. Contractionary monetary policy tends to increase refinancing costs. In other words, the external finance premium affected the output in the balance sheet channel negatively. However, these findings indicate that the balance sheet channel is not enough by itself to connect a link between the real economy

and money market and capital market. There is still a number of open-ended questions. For this reason, it will be useful the long-run relationships (cointegration vectors) between the considered variables to be identified in a further study.

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