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EVALUATION OF SMALL SAMPLE ESTIMATORS OF OUTLIERS INFESTED SIMULTANEOUS EQUATION MODEL: A MONTE CARLO APPROACH

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Abstract:

In practice, data collected in a broad range of applications frequently contain one or more atypical observations called outlier. A single outlier can have a large distorting influence on a classical statistical method that is optimal under the assumption of normality or linearity. Many estimation procedures proposed by researchers to handle simultaneous equation models are based on the assumptions that give little consideration to atypical data, thus the need to investigate the distorting effects of outliers in simultaneous equations estimation methods.

In this study, we compare the performance of five estimators (OLS, 2SLS, 3SLS, GMM and W2SLS) of simultaneous equations model parameters at small sample sizes (n) 15, 20 and 25; first order autocorrelation levels (ρ) 0.3, 0.6 and 0.9 of the error terms, when the series are perturbed at zero, one and two times. The estimators are adjudged using the minimum criteria of Bias, Variance and RMSE criteria on the 135 scenarios, each replicated 10,000 times.

Identical results were obtained for the 2SLS and W2SLS methods since there are no restrictions on the parameters. The system methods clearly performed better than the single equation counterparts. Generally, the estimates obtained for the just identified equation are better than those of the over identified counterpart. Surprisingly, the ranking of the various techniques on the basis of their small sample properties does not reveal any distinguishable feature according to whether there is outlier(s) in the data or not and at the different level of correlation, but all the estimators behave asymptotically. On the BIAS criterion, the best method is OLS in the just identified equation, followed by 3SLS in most cases especially where the pollution level is zero for all the three autocorrelation levels considered. The GMM and 2WSLS struggled for the third and last positions. However, in the over identified case, 3SLS is leading closely followed by GMM in most cases (when rho is 0.9 for all sample sizes considered) and OLS in few other cases (especially at rho = 0.3 and 0.6 and for N = 20 and 25 with single/double pollution levels), it is expected that we would be able to identify or suggest the best method to use when we have the scenario depicted above.

Keywords: outlier, small sample, simultaneous equations, autoregressive error terms.

JEL Classification: C15, C13

1. Introduction

In practice, data collected in a broad range of applications frequently contain one or more *atypical observations* called *outliers*; that is, observations that are well separated from the majority or "bulk" of the data, or in some way deviate from the general pattern of the data. A single outlier can have a large distorting influence on a classical statistical method that is optimal under the assumption of normality or linearity. The presence of outlier in a data set can lead to inflated error rates and substantial distortions of parameter and statistic estimates when using parametric or nonparametric test (Zimmerman 1998). As a matter of fact, the effects of outliers will pervade through all the equations and the estimated structural parameters in them. These effects are so intricately pervasive that it is very difficult to assess the influence of outliers on the estimated structural parameters (Mishra 2008). Osborne *et al.* (2001) confirmed empirically that researchers rarely report checking for outliers of any sort, by reporting that authors reported testing assumptions of the statistical procedure(s) used in their studies, including checking for the presence of outliers, only 8% of the time.

Many estimation procedures have been proposed by researchers to handle simultaneous equation models. These procedures are based on the assumptions that stochastic terms be normally distributed and existence of zero correlation between pairs of random deviates. These assumptions give little consideration to atypical data, thus there is the need to investigate the distorting effects of outliers on each of the methods and determine the best estimation procedure under the influence of outliers and when the errors are not well behaved. Any relationship of econometric theory will almost certainly belong to a system of simultaneous equations whose parameters may be estimated by various simultaneous equation estimation techniques. The problem frequently faced is the choice of the best estimation technique.

To assess the quality and appropriateness of estimators, we are always interested in their statistical properties. For most estimators, these can only be derived in a "large sample" context, (*asymptotic properties*). One estimation procedure may, for example, be selected over another because it is known to provide consistent and asymptotically efficient parameter estimates under certain stochastic environments. Such a heavy reliance on asymptotic theory can and does lead to serious problems of bias (in estimation) and low levels of inferential accuracy when sample sizes are small and asymptotic formulae poorly represent sampling behaviour. This has been acknowledged in mathematical statistics since the seminar work of R.A. Fisher (1925), who recognised very early the limitations of asymptotic machinery, when he wrote; *"Little experience is sufficient to show that the traditional machinery of statistical processes is wholly unsuited to the needs of practical research. Not only does it take cannon to shoot a sparrow, but it misses the sparrow! The elaborate mechanism built on the theory of infinitely large samples is not accurate enough for simple laboratory data. Only by systematically tackling small sample problems on their merits does it seem possible to apply accurate tests to practical data"* (Olaomi, and Shangodoyin 2010).

2. The Model

Simultaneous equations models have the form

$$\mathrm{B}y_i = \Gamma x_i + e_i, \qquad i = 1, \ldots, n \tag{1}$$

where $x_i \in R^p$ are the vectors of *exogenous variables*, $y_i \in R^q$ are the *endogenous variables*, and the disturbances $e_i \in R^q$ are i.i.d random vectors with mean 0 and covariance matrix Σ. The matrices $\mathrm{B} \in R^{2\times2}$, $\Gamma \in R^{2\times3}$ and $\Sigma \in R^{2\times2}$ are the unknown parameters of the system.

We can write *the structural form* of the model (1) more compactly as:

$$Y\mathrm{B}' = X\Gamma' + E \tag{2}$$

where Y, X and E are the matrices with rows y_i', x_i' and e_i', respectively. The vectors x_i' s are fixed and uncorrelated with the e_i' s.

Hence,

$$\begin{bmatrix} Y_{1t} \\ Y_{2t} \end{bmatrix} \begin{bmatrix} 1 & -\beta_{12} \\ -\beta_{21} & 1 \end{bmatrix} = \begin{bmatrix} X_{1t} \\ X_{2t} \\ X_{3t} \end{bmatrix} \begin{bmatrix} \gamma_{11} & 0 \\ 0 & \gamma_{22} \\ 0 & \gamma_{23} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{3}$$

Model specification includes restrictions on Γ and B such that some coefficients must be 0 or 1 without which they would not be identifiable.

The *reduced form* of the model $By_i = \Gamma x_i + e_i$ which is equivalent to $y_i = B^{-1}\Gamma x_i + B^{-1} e_i$ is given by

$$y_i = \Pi x_i + u_i \tag{4}$$

where $\Pi = \mathrm{B}^{-1}\Gamma$ and $u_i = \mathrm{B}^{-1} e_i$

The matrix Π can be consistently estimated from (4) by applying the least squares estimator (LSE) to each coordinate, but one cannot in general get Γ and B from it, except in certain circumstances ("exact identifiably").

For our study, we chose the model:

$$y_1 = ay_2 + cx_1 + u_1$$
$$y_2 = by_2 + dx_2 + ex_3 + u_2 \quad (5)$$

where y_1 and y_2 are endogenous, x_1, x_2 and x_3, standard normally distributed, exogenous and u_1, u_2 autoregressive of order one, with varying parameters 0.3, 0.6 and 0.9. The initial parameters were arbitrarily chosen as a = 0.5, b = 0.8, c = d = e = 1. The first and second equations are just identified and over identified respectively.

2.1 Estimation methods

The parameters of a structural equations of a system of simultaneous equations can be estimated either by single equation methods where one equation of the system is solved at a time, or by complete systems techniques where the solution of all equations in the system is done simultaneously and the estimation of the parameters of all the coefficients of the system are solved for at the same time.

Simultaneous equations models are an important tool in econometrics. They are an extension of the multivariate linear model (MLM). While their correctness in specific situations may be open to criticisms, there is no doubt that they constitute an interesting field of research for statisticians. In particular, research on the effects of outliers on estimation procedures, and on methods robust with respect to outliers, seems to be scanty (Maronna, and Yohai 1994).

The choice of estimation technique is somewhat dependent on many factors ranging from the identifiability status of the equations of the model, the available information concerning the other equations of the system, various statistical properties of the parameters estimates, the computational complexity of the technique, the magnitude of the perturbations or outliers present in the data and several other factors Koutsoyiannis (2001).

Another factor that is useful in the ranking of the various techniques, namely the general rule that estimators which are obtained from methods using more information are more efficient. The single equation estimation methods lead to estimates that are consistent but generally not asymptotically efficient. The reason for the lack of asymptotic efficiency is the disregard of the correlation of the disturbances across equations. Another explanation for the lack of asymptotic efficiency is that single equation estimators do not take into account prior restrictions on other equations in the model (Kmenta 1971). In general, it is intuitively clear that the more information we use in estimating a structural parameter, the more efficient the estimate will be, that is the closer they are to the true parameter (Koutsoyiannis 2001).

All simultaneous equation estimation methods have some desirable asymptotic properties. These properties become effective in large samples, but since samples are mostly small in practice (Kmenta 1971, and Johnston 1972), we would be more interested in knowing the small sample properties of these estimators.

Theoretical ranking of the various econometric techniques on the basis of the asymptotic properties is important when the sample size is sufficiently large. However, as mentioned earlier, researchers seldom get large samples hence they usually work with small samples, the asymptotic properties of the estimates are of little assistance in their choice of technique.

Traditionally, the ranking has been based on some ‘small-sample properties’ which are considered as ‘desirable’ or ‘optimal’ for the estimate to possess (Adepoju, and Olaomi 2009). These properties are unbiasedness, minimum variance, minimum mean square error and the proportion of wrong inferences about the significance of the parameters by using a particular econometric method (Koutsoyiannis 2001). The problem of choice of estimation technique is by no means a simple task. This problem has been discussed to a great extent in econometric literature, yet no conclusive evidence as to the ranking of the various econometric techniques has been achieved (Adepoju, and Olaomi 2009) especially when the available data is plagued with the problem of influential observations or outliers.

We give a brief explanation of each of the methods used in the estimation process of our model.

2.1.1 Ordinary Least Squares

This technique minimizes the sum-of-squared residuals for each equation, accounting for any cross-equation restrictions on the parameters of the system. If there are no such restrictions, this method is identical to estimating each equation using single-equation ordinary least squares. It is not consistent, for the regressors are not uncorrelated with the disturbances.

2.1.2 Two - stage east squares

The two-stage least squares (2SLS) is an appropriate technique when some of the right-hand side variables are correlated with the error terms and there is neither heteroskedasticity, nor contemporaneous correlation in the residuals. The method of *two-stage least squares (2SLS)* avoids this pitfall of the OLS by first regressing the *y's* on the *x's* (first stage) and then estimating the parameters by applying OLS (with the restrictions) to (3), but with the *y's* on the right-hand side replaced by the fitted values $\widehat{Y}=\left(X'X\right)^{-1}X'Y$ (second stage). This method is consistent. However, it is in general not asymptotically efficient, for the estimation for equation *j* does not take into account the information contained in the other equations.

2.1.3 Weighted two-stage least squares

The weighted two-stage least squares (WTSLS) estimator is an appropriate technique when some of the right-hand side variables are correlated with the error terms, and there is heteroskedasticity, but no contemporaneous correlation in the residuals.

TSLS is first applies to the un-weighted system. The results from this estimation are used to form the equation weights, based upon the estimated equation variances. If there are no cross-equation restrictions, these first-stage results will be identical to unweighted single-equation 2SLS.

2.1.4 Three-stage least squares

Three-stage least squares (3SLS) is the two-stage least squares version of the Seemingly Unrelated Regression method. It is an appropriate technique when right-hand side variables are correlated with the error terms, and there is both heteroskedasticity, and contemporaneous correlation in the residuals.

2SLS is applies to the unweighted system, enforcing any cross-equation parameter restrictions. These estimates are used to form an estimate of the full cross-equation covariance matrix which, in turn, is used to transform the equations to eliminate the cross-equation correlation. 2SLS is applied to the transformed model.

2.1.5 Generalized method of moments (GMM)

The GMM estimator belongs to a class of estimators known as M-estimators that are defined by minimizing some criterion function. GMM is a robust estimator in that it does not require information of the exact distribution of the disturbances.

GMM estimation is based upon the assumption that the disturbances in the equations are uncorrelated with a set of instrumental variables. The GMM estimator selects parameter estimates so that the correlations between the instruments and disturbances are as close to zero as possible, as defined by a criterion function. By choosing the weighting matrix in the criterion function appropriately, GMM can be made robust to heteroskedasticity and/or autocorrelation of unknown form.

Many standard estimators can be set up as special cases of GMM. For example, the ordinary least squares estimator can be viewed as a GMM estimator, based upon the conditions that each of the right-hand side variables is uncorrelated with the residual.

2.2 Experimental Framework

The small sample properties of the various econometric techniques have been studied from simulated data in what are known as *Monte Carlo Studies,* and not with direct application of the techniques to actual observations. We use Monte-Carlo approach for the investigation due to the fact that when the covariance between the independent variable and the autocorrelated error terms is non-zero, the problem is near intractable by analytical procedure. Also the properties of FGLS estimators vary depending on the form of the variance – covariance matrix, and often the quality of this variance – covariance matrix cannot be neatly summarized.

This study is thus conducted using a Monte Carlo Experiments using a two-equation model of a just identified and an over identified equations. The degree of autocorrelation affects the efficiency of the estimators (Kmenta 1971, and Johnston 1972). Consequently, we investigate the sensitivity of the estimators to the degree of autocorrelation by varying rho (ρ) from 0.3, to 0.6 and 0.9. We also found out the effect of the outliers using three scenarios of no outlier, single and double outliers injected into the endogenous variable. Correlation of the independent variable and the error terms at significant level 1%, 2% and 5% on the estimators. The effect of sample size was also investigated by varying the sample size (N) from 15, 20 and 25 each replicated 10,000 times. Evaluation of the estimators was done using the Bias, Variance and the RMSE criteria.

Using model (5), a value U_o (for specified sample size) was generated by drawing a random value ε_o from N(0,1) and dividing by $\sqrt{(1-\rho^2)}$. Successive values of ε_t drawn from N(0,1) were used to calculate an autoregressive U_t. Each X_t was generated as N(0,1) ranging and fixed while the initial values for y_1 and y_2 were arbitrarily chosen to be N(0,1) random values. The initial parameters were arbitrarily chosen as a = 0.5, b = 0.8, c = d = e = 1. This procedure is repeated for all ρ, n and pollution levels. $Y_{ts.}$ are thus computed using the model (5). A total of 10,000 replications were performed for each sample size. The data generations and estimations were done via the E-Views package.

3. Simulation Results

The results are presented in three tables. Table 1 to 3 show the table of average biases, sum of variances and sum of RMSE of estimates for n = 15, n = 20 and n = 60 respectively. We present the ranking of the various estimation techniques when the data are contaminated with various magnitudes of outliers.

The preliminary result, using the univariate GLM, revealed that, using the Bias, variance and the RMSE criteria on both equations, the estimates differ significantly from each other. The estimates from 3SLS and GMM are not significantly different but each significantly different from the other methods; estimates from OLS, 2SLS and W2SLS are not significantly different from each other using both Variance and RMSE criteria while OLS estimates are significantly different from those of the other methods using the Bias criterion. On the sample size n, in the Bias criterion, the estimates are significantly different from each other by sample size while estimates at n = 15 and n = 25 are significantly different from each other but each not significantly different with those at n = 20 in the Variance and RMSE criteria. The estimates also differ by pollution levels as there is significant difference in the level of pollution. We observe a surprise result in the estimates by autocorrelation level, at all criteria types, Bias, Variance and RMSE, the estimates are not significantly different.

Looking at Eq. 2, the variance of the estimates by all classifications is not significantly different, while in the RMSE, the 3SLS estimates are significantly different from others but GMM. The estimates Biases show 3SLS significantly different from others while GMM and OLS do not differ significantly but GMM differ significantly from W2SLS and 2SLS. Pollution level significantly different from each other and estimates at n = 15 differ significantly from those at n = 20 and n = 25, both the later insignificantly different.

Using the minimum criteria of Bias, Variance and RMSE, It could be seen that identical results were obtained for the 2SLS and W2SLS methods, hence in summarizing the results, both methods were combined using the abbreviation 2WSLS (that is, 2SLS and W2SLS).

Comparing the system methods with the single equation methods, we observed that the latter clearly performed better than the former. Generally, the estimates obtained for equation two (over identified equation) are more bias robust than those of equation one, the just identified equation. For the Variance and RMSE criteria, the estimates obtained for equation one (just identified) are generally better.

Surprisingly, the ranking of the various techniques on the basis of their small sample properties does not reveal any distinguishable feature according to whether there is outlier(s) in the data or not and at the different level of correlation, but all the estimators perform well asymptotically.

On the criterion of the BIAS the best method is OLS in the first equation, followed by 3SLS in most cases especially where the pollution level is zero for all the three autocorrelation levels considered. The GMM and 2WSLS struggle for the third and last positions. However, in the over identified case, 3SLS is leading closely followed by GMM in most cases (when rho = 0.9 for all sample sizes considered) and OLS in few other cases (especially at rho = 0.3 and 0.6 and for N = 20 and 25 with single/double pollution levels).

OLS also ranks highest on the criterion of variance for both equations. In both equations, OLS is conspicuously followed by 2WSLS with GMM and 3SLS interchangeably assuming the third and last positions.

Using RMSE as the basis for ranking the performance of these methods, OLS is clearly ranks first followed by 2WSLS in most cases.

4. Conclusion

We have investigated the effects of outliers on a two-equation simultaneous model, where one equation is just identified and the other is over identified. Surprisingly, the ranking of the various techniques on the basis of their small sample properties does not reveal any distinguishable feature according to whether there is outlier(s) in the data or not and at the different level of correlation. This corroborates (Mishra 2008) that these effects are so intricately pervasive that it is very difficult to assess the influence of outliers on the estimated structural parameters. It is expected that we would be able to identify or suggest the best method to use when we have the scenario depicted above. From the experiment, we recommend system equation method for estimation and if possible, models should be made to be just identified.

References

[1] Adepoju, A.A., and Olaomi, J.O. 2009. Ranking of Simultaneous Equation Techniques to Small Sample Properties and Correlated Random Deviates. *Journal of Mathematics and Statistics,* 5 (4): 260-265.

[2] Grubbs, F.E. 1969. Procedure for Identifying Outlying Observations in Samples. *Technimetrics*, 11: 1 – 12.

[3] Huber, P.J. 1981. *Robust Statistics*. John Wiley & Sons, Inc, New York, 1- 20.

[4] Johnston, J. 1972. *Econometric Methods*. 2nd Ed., McGraw-Hill, New York, 437.

[5] Kmenta, J. 1971. *Elements of Econometrics*. Macmillian, New York, 655.

[6] Koutsoyiannis, A. 2003. *Theory of Econometrics: An introductory Exposition of Econometric Methods.* 2nd Ed., Palgrave Publishers Ltd., New York, USA, ISBN: 0-333-77822-7, 498-511.

[7] Maronna, R.A., Martin, R.D., and Yohai, V. J. 2006. *Robust Statistics: Theory and Methods*. John Wiley & Sons, Ltd. ISBN: 0-470-01092-4. 37 – 84.

[8] Maronna, R.A., and Yohai, V.J. 1994. Robust Estimation in Simultaneous Equations Models. *Statistics and Econometrics* Series: 14, working paper 94-37.

[9] Mishra, S.K. 2008. Robust Two-Stage Least Squares: Some Monte Carlo Experiments. MPRA paper no. 9737M. (Online at http://mpra.ub.uni-muenchen.de/9737/).

[10] Olaomi, O.J, and Shangodoyin, D.K. 2010. *Comparative Study of Estimators in Autocorrelated-Endogenized Linear Model*. Interstat. (USA) May 2010, no. 6: 1-10.

[11] Osborne, J.W, Christian, W.R.I, and Gunter, J.S. 2001. *Educational psychology from a statistician's perspective: A review of the quantitative quality of our field.* Paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA.

[12] Zimmerman, D.W. 1998. Invalidation of parametric and nonparametric statistical tests by concurrent violation of two assumptions. *Journal of Experimental Education,* 67 (1): 55 - 68.

Table 1. Performances of estimators based on bias criterion

Method	n -->	15			20			25	
	Rho\Pol_Lev	0	1	2	0	1	2	0	1
OLS	0.3	-2.388	-2.357	-2.627	-2.408	-2.388	-2.615	-2.297	-2.262
	0.6	-2.381	-2.330	-2.612	-2.397	-2.356	-2.594	-2.300	-2.242
	0.9	-2.362	-2.247	-2.571	-2.360	-2.251	-2.520	-2.311	-2.182
2SLS	0.3	-2.265	-2.045	-2.618	-2.286	-2.105	-2.684	-2.172	-1.949
	0.6	-2.274	-2.023	-2.593	-2.288	-2.085	-2.651	-2.203	-1.961
	0.9	-2.285	-1.963	-2.507	-2.281	-1.997	-2.545	-2.290	-2.038
3SLS	0.3	-2.283	-2.005	-2.352	-2.301	-2.142	-2.554	-2.192	-1.990
	0.6	-2.307	-2.027	-2.408	-2.322	-2.158	-2.520	-2.243	-2.057
	0.9	-2.330	-2.111	-2.533	-2.364	-2.220	-2.487	-2.390	-2.354
GMM	0.3	-2.258	-2.049	-2.433	-2.291	-2.143	-2.539	-2.179	-2.149
	0.6	-2.270	-2.036	-2.413	-2.297	-2.130	-2.492	-2.215	-2.132
	0.9	-2.282	-1.994	-2.411	-2.303	-2.070	-2.378	-2.324	-2.138
W2SLS	0.3	-2.265	-2.045	-2.618	-2.286	-2.105	-2.684	-2.172	-1.949
	0.6	-2.274	-2.023	-2.593	-2.288	-2.085	-2.651	-2.203	-1.961
	0.9	-2.285	-1.963	-2.507	-2.281	-1.997	-2.545	-2.290	-2.038
OLS	0.3	-0.014	-0.967	-1.024	0.006	-0.784	-0.773	-0.001	-0.634
	0.6	-0.029	-0.973	-1.029	0.054	-0.715	-0.692	0.001	-0.601
	0.9	0.056	-0.834	-0.891	0.494	-0.121	-0.074	0.036	-0.135
2SLS	0.3	-0.021	-0.896	-1.148	-0.011	-0.608	0.180	-0.004	-0.229
	0.6	-0.040	-0.910	-1.192	0.036	-0.554	0.297	0.001	-0.186
	0.9	-0.016	-0.857	-1.127	0.413	-0.085	1.120	0.034	0.334
3SLS	0.3	-0.157	-1.303	-1.836	-0.238	-1.188	-0.220	-0.150	-0.836
	0.6	-0.692	-1.326	-1.885	-0.257	-1.152	-1.006	-0.279	-0.768
	0.9	-0.473	-1.299	-2.060	-0.292	-0.885	-2.628	-0.859	-1.236
GMM	0.3	0.011	-0.874	-1.406	-0.090	-0.593	-2.205	-0.057	-0.239
	0.6	-0.193	-0.939	-1.451	-0.050	-0.588	-0.414	-0.089	-0.146
	0.9	-0.223	-0.932	-1.611	0.193	-0.252	-2.361	-0.321	-0.061
W2SLS	0.3	-0.021	-0.896	-1.148	-0.011	-0.608	0.180	-0.004	-0.229
	0.6	-0.040	-0.910	-1.192	0.036	-0.554	0.297	0.001	-0.186
	0.9	-0.016	-0.857	-1.127	0.413	-0.085	1.120	0.034	0.334

Table 2. Performances of estimators based on variance criterion

Method	n -->	15			20			25	
	Rho\Pol_Lev	0	1	2	0	1	2	0	1
OLS	0.3	0.031	0.087	0.128	0.021	0.056	0.090	0.015	0.028
	0.6	0.032	0.079	0.119	0.024	0.052	0.084	0.016	0.028
	0.9	0.053	0.088	0.103	0.046	0.062	0.068	0.027	0.034
2SLS	0.3	0.444	0.452	0.527	0.366	0.465	0.757	0.330	0.841
	0.6	0.341	0.414	0.654	0.321	0.442	0.726	0.274	0.745
	0.9	0.464	0.577	0.765	0.396	0.645	0.766	0.203	0.287
3SLS	0.3	0.531	0.575	1.428	2.152	0.450	1.021	0.632	0.879
	0.6	0.458	0.550	3.683	0.700	0.382	1.307	0.415	0.918
	0.9	11.225	1.280	1.984	1.204	2.138	1.297	0.666	0.446
GMM	0.3	0.783	1.062	1.392	1.495	0.645	2.270	0.631	0.791
	0.6	0.681	1.422	1.980	0.605	0.499	1.690	0.398	0.678
	0.9	3.994	1.121	3.563	0.691	1.120	0.771	0.445	0.451
W2SLS	0.3	0.444	0.452	0.527	0.366	0.465	0.757	0.330	0.841
	0.6	0.341	0.414	0.654	0.321	0.442	0.726	0.274	0.745
	0.9	0.464	0.577	0.765	0.396	0.645	0.766	0.203	0.287
OLS	0.3	0.201	0.680	0.752	0.143	0.398	0.414	0.116	0.284
	0.6	0.270	0.771	0.867	0.207	0.467	0.447	0.159	0.323
	0.9	0.647	1.292	1.419	0.536	0.775	0.724	0.404	0.512
2SLS	0.3	0.744	0.661	1.891	0.476	0.384	8.451	0.329	0.396
	0.6	6.164	0.795	2.172	0.787	0.477	10.790	0.777	0.851
	0.9	2.962	1.449	9.736	2.668	1.162	19.272	2.430	2.070
3SLS	0.3	4.774	0.913	169.147	4.945	0.704	2768.421	0.744	19.334
	0.6	40.182.668	1.207	8.249	5.481	0.866	7.583.066	4.154	16.364
	0.9	21.971	1.808	88.460	38.779	2.149	1.317.523	17.383	56.396
GMM	0.3	17.698	0.825	16.998	3.359	0.656	8.131.088	0.856	3.000
	0.6	987.136	0.977	7.324	2.645	0.717	5.689.112	1.512	28.388
	0.9	9.426	1.730	193.525	11.074	1.682	1.590.237	9.304	75.199
W2SLS	0.3	0.744	0.661	1.891	0.476	0.384	8.451	0.329	0.396
	0.6	6.164	0.795	2.172	0.787	0.477	10.790	0.777	0.851
	0.9	2.962	1.449	9.736	2.668	1.162	19.272	2.430	2.070

Table 3. Performances of estimators based on MSE criterion

Method	n -->	15			20			25	
	Rho\Pol_Lev	0	1	2	0	1	2	0	1
OLS	0.3	2.406	2.398	2.672	2.421	2.414	2.648	2.307	2.278
	0.6	2.399	2.368	2.655	2.411	2.382	2.625	2.311	2.258
	0.9	2.394	2.295	2.611	2.387	2.287	2.549	2.328	2.204
2SLS	0.3	2.559	2.369	2.810	2.523	2.423	2.935	2.436	2.621
	0.6	2.499	2.334	2.835	2.497	2.401	2.901	2.408	2.568
	0.9	2.567	2.406	2.818	2.533	2.500	2.839	2.407	2.275
3SLS	0.3	2.614	2.414	2.917	3.249	2.428	2.906	2.622	2.626
	0.6	2.583	2.409	3.611	2.701	2.404	2.989	2.520	2.654
	0.9	5.203	2.794	3.258	2.954	3.196	2.979	2.718	2.581
GMM	0.3	2.732	2.719	2.962	3.016	2.555	3.278	2.620	2.655
	0.6	2.679	2.854	3.150	2.647	2.473	3.086	2.493	2.582
	0.9	3.778	2.701	3.650	2.692	2.775	2.701	2.563	2.426
W2SLS	0.3	2.559	2.369	2.810	2.523	2.423	2.935	2.436	2.621
	0.6	2.499	2.334	2.835	2.497	2.401	2.901	2.408	2.568
	0.9	2.567	2.406	2.818	2.533	2.500	2.839	2.407	2.275
OLS	0.3	0.730	1.977	2.104	0.619	1.667	1.729	0.551	1.354
	0.6	0.847	2.044	2.188	0.747	1.733	1.765	0.640	1.367
	0.9	1.345	2.348	2.507	1.345	2.033	2.072	1.019	1.405
2SLS	0.3	1.475	1.835	2.907	1.183	1.512	4.820	0.977	1.301
	0.6	4.217	1.945	3.077	1.519	1.610	5.285	1.492	1.688
	0.9	2.937	2.365	5.642	2.835	2.189	7.226	2.650	2.542
3SLS	0.3	3.599	2.141	22.468	3.667	1.901	83.784	1.436	7.473
	0.6	338.595	2.349	5.443	3.949	2.009	131.260	3.316	5.931
	0.9	7.480	2.690	16.206	10.490	2.714	56.760	7.000	12.600
GMM	0.3	6.867	1.917	7.341	3.061	1.661	145.580	1.521	2.977
	0.6	53.033	2.060	5.082	2.692	1.734	114.023	2.058	7.608
	0.9	5.150	2.551	23.878	5.574	2.451	64.437	5.201	13.958
W2SLS	0.3	1.475	1.835	2.907	1.183	1.512	4.820	0.977	1.301
	0.6	4.217	1.945	3.077	1.519	1.610	5.285	1.492	1.688
	0.9	2.937	2.365	5.642	2.835	2.189	7.226	2.650	2.542

COMPUTATIONAL MODELLING OF THE PARALLEL LOGISTIC SYSTEM

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Abstract

The paper highlights the problem of mathematical modelling of the highly complex logistic system consisting of parallel production lines. Each production route is arranged in a series of stands equipped with manufacturing machines. It is assumed that all production lines are identical. Each production stand performs a manufacturing operation with the use of the specified tool. Tools get worn out and require either regeneration or immediate replacement. The tool subjected to regeneration can be regenerated a certain number of times only. When this number is reached, the tool must be replaced with a new one. The logistic system is controlled by a determined heuristic algorithm. The production process is optimized by means of the stated criterion respecting defined bounds. Adequate equations of state illustrate the flow of charge material. The time scaling method in order to search for the satisfactory solution with the use of the simulation method is proposed.

Key words: modelling, parallel logistic system, simulation, heuristic algorithms, time-scaling.

JEL Classification: C02, C51, C61, C69, M29.

1. Introduction

Processes in logistic systems are planned and controlled operatively. The flow of charge material is tunnelled precisely so that the production output is maximal within the minimal possible time at the lowest allowable costs where the main goals remain realizing the customers' orders by the assumed time as well as meeting their quality needs. Complex data analysis may result in finding proper solution to the cost cutting issue. Deterministic systems used for these purposes do not involve any randomness in the development of subsequent states of the logistic system (Bucki, Chramcov 2011). Therefore, such a model will always produce the same output from a given initial state. Stochastic ordering is a fundamental guide for decision making under uncertainty. It is also an essential tool in the study of structural properties of complex stochastic systems (Sobotka 2010). Systems of linear discrete equations require determining corresponding initial data which generate bounded solutions (Bastinec, Diblik 2008). Case studies prove that production can be optimized by means of transformation production procedures. In multi stage job problems, simple priority dispatching rules such as shortest processing time and earliest due date can be used to obtain solutions of minimum total processing time, but may not sometimes give sequences as expected that are close to optimal (Shaked, Shanthikumar 2007).

2. Modelling and simulations of logistic systems as a fundamental support of their management

Currently, much attention is being paid to the significant role of logistics in all types of business and especially manufacturing companies with reference both to the total supply chain and to its individual links, the so-called "internal logistic system". Rationalization of activity in the logistics sphere leads to lowered production costs and increased quality.

The proper logistic management encompasses a set of decisions which embrace strategic, operational and tactical levels and include the supply chain structure (number of echelons required and number of facilities per echelon), the selection of the inventory management policy, the assignment of each market region to one or more locations, the selection of suppliers for sub-assemblies, components and materials, the optimization of transports and connections. In general, management performs integration functions which coordinates all logistics activities as well as integrates logistic activities with other functions including marketing, sales manufacturing, finance and information technology

(Stock 2001). More often than before management is supported by the use of information technologies that allows, among other things, an effective creation of models and implementation of simulation.

Modelling and simulation is a discipline for developing a level of understanding of the interaction of the parts of a system, and of the system as a whole (Pidd 2004). Simulation is a tool for change management. In general, simulation and above all computer simulation is a powerful tool to observe the behaviour of logistic system, assess their efficiency level, evaluate new management solutions, identify the most suitable configuration and optimize the whole distribution channel. It is evident that the logistics is one of the support areas of all business and production activities (Suchánek, Bucki 2011). All activities can be described by appropriate models and simulated. In practice we can often meet a number of very specific models and simulations used for the support of different business or manufacturing activities. As an example we can mention simulation of the conduct of company in the marketplace, simulation approach to facilitate manufacturing system design (Fandiño, Wang 2010), simulation for reducing risk of a mining optimization project (Chinbat 2009), agent-based simulation of financial market (Spišák, Šperka 2011), etc. By means of simulation models, researchers are enabled to quantify the benefits resulting from supply chain management in order to support decision making either at strategic, tactical or operational level (ACQuipedia Article 2011).

3. General assumptions

Let us model a sample logistic structure which is controlled by means of decisions made in a deterministic way. The problem itself consists in determining the sequence of elements of the order vector which are to be realized subsequently. The proposed heuristic algorithms choose the required element on which certain operations are carried out. We assume that every decision about production, replacement or regeneration is made for a period of production activity defined as the stage. The state of orders decreases after each production decision which influences the state of the whole logistic system at each stage *k*, $k = 1,...,K$. The lost flow capacity criterion is used on condition that it is associated by adequate bounds. Assuming that the results of calculations which are made for a chosen heuristic algorithm do not deliver a satisfactory solution, there is a need to test other algorithms.

Let us introduce the vector of orders $Z = [z_n]$ where z_n - the *n-th* production order (given in conventional units), $n = 1,...,N$. We also assume that each *n-th* product is made from the universal charge which is placed in the conventional vector of charges *W*.

The logistic system presented hereby consists of *I* parallel manufacturing subsystems - routes. Each *i-th* subsystem, consists of *J* production stands arranged in series, $i = 1,...,I$. Realized products are passed subsequently through each stand in the *i-th* subsystem. There are buffer stores between production stands. It is assumed that the capacity of buffer stores is not limited. There is no buffer store before the first production stand in each route. Each *j-th* production stand located in the *i-th* row of the logistic system can carry out an operation on the *n-th* product. It is assumed that each production stand placed in the *j-th* column of any manufacturing subsystem realizes the same operation with the use of the identical tool. Moreover, it is also assumed that $I < N$. The *n-th* product is passed through each production stand in the defined route. However in certain stands no operation on it may be required. Production activity is realized in a parallel way. Firstly, the free production route with the lowest number *i,* $i = 1,...,I$ is chosen. Then a heuristic algorithm chooses the product to be realized in this route. Realization of all numbers of units of the *n-th* product must be completed in the predefined route. Production is understood as realizing different orders in parallel manufacturing routes.

Let us introduce the vector of regeneration plants $R = [r_j]$, $j = 1,...,J$ (the *j-th* regeneration plant regenerates tools which are used in each manufacturing stand placed in the *j-th* column of the discussed logistic system) where $r_j = 1$ if the stand is active. The problem highlighted in the paper consists in finding the optimal sequence of production decisions which are meant to send totally worn out tools to the *j-th* regeneration plant - r_j . The given tool can be regenerated only a pre-defined number of times. If this number is exceeded, the tool is excluded from the production process and must be replaced by a new one. However, in certain columns there are stands whose tools cannot be regenerated and must be replaced ($r_j = 0$) by new ones.

The flow of the order elements in the logistic system formed on the basis of the discussed assumptions is shown below as the structure matrix of the logistic system at the *k-th* stage (1):

$$W \Rightarrow \left\{ \begin{matrix} \underset{r_1 \hookleftarrow}{e^k_{1,1}} & \rightarrow b_{1,1} & \rightarrow \ldots & \rightarrow b_{1,j-1} & \rightarrow & \underset{r_j \hookleftarrow}{e^k_{1,j}} & \rightarrow b_{1,j} & \rightarrow \ldots & \rightarrow b_{1,J-1} & \rightarrow & \underset{r_J \hookleftarrow}{e^k_{1,J}} \\ \vdots & & & & & \vdots & & & & & \vdots \\ \underset{r_1 \hookleftarrow}{e^k_{i,1}} & \rightarrow b_{i,1} & \rightarrow \ldots & \rightarrow b_{i,j-1} & \rightarrow & \underset{r_j \hookleftarrow}{e^k_{i,j}} & \rightarrow b_{i,j} & \rightarrow \ldots & \rightarrow b_{i,J-1} & \rightarrow & \underset{r_J \hookleftarrow}{e^k_{i,J}} \\ \vdots & & & & & \vdots & & & & & \vdots \\ \underset{r_1 \hookleftarrow}{e^k_{I,1}} & \rightarrow b_{I,1} & \rightarrow \ldots & \rightarrow b_{I,j-1} & \rightarrow & \underset{r_j \hookleftarrow}{e^k_{I,j}} & \rightarrow b_{I,j} & \rightarrow \ldots & \rightarrow b_{I,J-1} & \rightarrow & \underset{r_J \hookleftarrow}{e^k_{I,J}} \end{matrix} \right\} \Rightarrow \begin{bmatrix} z_1 \\ \cdots \\ z_n \\ \cdots \\ z_N \end{bmatrix} \qquad (1)$$

where: $\underset{r_j \hookleftarrow}{e^k_{i,j}} = \begin{cases} 1 & \text{if active,} \\ 0 & \text{otherwise.} \end{cases}$ and $b_{i,j} = \begin{cases} 1 & \text{if the buffer store is necessary,} \\ 0 & \text{otherwise.} \end{cases}$

and at the same time $\underset{i}{\forall} b_{i,J} = 0$, $i = 1,\ldots, I$

The life matrix of the logistic system for a brand new set of tools is defined: $G = [g_{n,j}]$, $j = 1,\ldots, J$, $n = 1,\ldots, N$ where $g_{n,j}$ is the number of units of the *n-th* product which can be realized in any production stand in the *j-th* column before its tool is completely worn out and requires an immediate replacement with either a regenerated or new tool.

Let $S_n^{k-1} = \left[s(n)_{i,j}^{k-1}\right]$ be the matrix of state of the logistic system for the *n-th* product realization at the stage $k-1$ where $s(n)_{i,j}^{k-1}$ is the number of units of the *n-th* product realized in the stand in the *i-th* row of the *j-th* column with the use of the installed tool up till the stage $k-1$.

Let $P_n^{k-1} = \left[p(n)_{i,j}^{k-1}\right]$ be the matrix of the flow capacity of the logistic system for the *n-th* product realization at the stage $k-1$ where $p(n)_{i,j}^{k-1}$ is the number of units of the *n-th* product which still can be realized in the stand in the *i-th* row of the *j-th* column. If $\underset{1 \le i \le I}{\forall} p_{i,1}^k = 0$, then the *n-th* order awaits for completing the regeneration process in the conventional vector of charges and subsequent installing a new tool to enter the production system.

On the basis of the above assumptions we can determine the flow capacity of the production stand in the *i-th* row of the *j-th* column for the *n-th* element of the order vector Z at the stage $k-1$: $p(n)_{i,j}^{k-1} = g_j - s(n)_{i,j}^{k-1}$

The manufacturing procedure consists in realizing orders in parallel production routes in sequence. It is assumed that manufacturing another order element in a route can begin when the previously realized one leaves the route. Its disadvantage consists in the need of waiting for completing the manufacturing process of a certain product in this route before resuming it again for the next one. This results in not using the available flow capacity of the whole production system. Moreover, during the production course tools must be replaced. The replacement process of the determined tool is ignited when the production stand cannot realize the whole unit of the order vector element. The state of the system has to be recalculated when any decision is made in the system.

Let us define the matrix of production times for the *n-th* product, $n = 1,\ldots, N$ in the production stand in the *j-th* column $T^{pr} = \left[\tau_{n,j}^{pr}\right]$. If the *n-th* product is not realized in the production stand in the *j-th* column but for hypothetical reasons must be passed through it, then $\tau_{n,j}^{pr} = 0$.

On the basis of the above, the following equation must be introduced (2):

$$\left(\tau_{n,j}^{pr} > \tau_{n,j+1}^{pr} \quad \Rightarrow \quad b_{i,j} = 1\right) \wedge \left(\tau_{n,j}^{pr} \leq \tau_{n,j+1}^{pr} \quad \Rightarrow \quad b_{i,j} = 0\right) \tag{2}$$

Let us define the vector of replacement times for the tools in the logistic system $T^{repl} = \left[\tau_j^{repl}\right]$ where τ_j^{repl} - the replacement time of the tool in the production stand in the *j-th* column.

Let us introduce the production rate vector $V = \left[v_n\right]$. Its element v_n is the number of units of the *n-th* product made in the defined time unit in the *i-th* production line, $i = 1,...,I$.

In order to calculate the total manufacturing time of all elements of the vector *Z*, it is necessary to take into account the production time, the replacement time and, finally, the regeneration time. The order realization time can be optimized by either employing more production lines at the same time to realize the *n-th* element or replacing tools only then, when they are fully worn or optimizing the regeneration process so that the tool after regeneration is available on demand. The total order realization time *T* is calculated beginning with the moment when the first chosen *n-th* element enters the logistic system till the moment when the last element of the order vector leaves any stand in the *J-th* column.

4. Equations of state

The state of the discussed parallel logistic system changes in case of manufacturing the *n-th* product as follows (3):

$$S_n^0 \rightarrow S_n^1 \rightarrow ... \rightarrow S_n^k \rightarrow ... \rightarrow S_n^K \tag{3}$$

The state of the production stand in case of production the *n-th* product changes consequently (4):

$$s(n)_{i,j}^0 \rightarrow s(n)_{i,j}^1 \rightarrow ... \rightarrow s(n)_{i,j}^k \rightarrow ... \rightarrow s(n)_{i,j}^K \tag{4}$$

Assuming that x_n^k is the number of units of the *n-th* vector element to be realized at the *k-th* stage, we can present the following equations (5):

$$s(n)_{i,j}^k = \begin{cases} 0 & \text{if the tool is replaced in the } i\text{-}th \text{ stand of the } j\text{-}th \text{ column at the stage } k\text{-1} \\ s(n)_{i,j}^{k-1} + x_n^k & \text{if the } n\text{-}th \text{ product is realized in the } i\text{-}th \text{ stand of the } j\text{-}th \text{ column at the stage } k\text{-1}, \\ s(n)_{i,j}^{k-1} & \text{otherwise.} \end{cases} \tag{5}$$

The order vector changes after every production decision:

$$Z^0 \rightarrow Z^1 \rightarrow ... \rightarrow Z^k \rightarrow ... \rightarrow Z^K$$

The order vector is modified after every decision about production (6):

$$z_n^k = \begin{cases} z_n^{k-1} - x_n^k & \text{if the number of units } x_n^k \text{ of the } n\text{-}th \text{ order is realized at the } k\text{-}th \text{ stage,} \\ z_n^{k-1} & \text{otherwise.} \end{cases} \tag{6}$$

5. Heuristic algorithms

In order to control the choice of the order vector elements we need to implement heuristics which determine elements of the order vector Z^k for the production process. The chosen amount of the *n-th* order is sent to the determined route as long as $\underset{n}{\forall} z_n = 0$, $n = 1,..., N$.

The following control algorithms for production are put forward:

The algorithm of the maximal order (h_{max}) chooses the biggest order vector element *a*, $1 \le a \le N$ to be manufactured. To produce the element z_a^k the condition $z_a^k = \max_{1 \le n \le N} z_n^{k-1}$ must be met.

The algorithm of the minimal order (h_{min}) chooses the smallest order vector element *a*, $1 \le a \le N$ to be manufactured. To produce the element z_a^k the condition $z_a^k = \min_{1 \le n \le N} z_n^{k-1}$ must be met.

Should the above algorithms fail to deliver an expected solution, random choice of products for manufacturing may be the only way of minimizing the production time if other available algorithms fail to deliver a satisfactory solution. This problem can be solved by the simulation method repeating calculations thousands of times. The results of such research for a certain criterion generate a histogram approximated by a normal distribution. The best up-to-date time scale gives criterion index q. In case of a minimization problem, probability $P(t < q)$ can be expressed. It means further simulation experiments may let us obtain a better time scale, with the index $t < q$. If the boundary value of this probability is given (e.g. 1%), it is the condition to finish the experiments.

6. Time scaling by the simulation method

The general block diagram of time scaling with the use of the simulation method is shown in Figure 1.

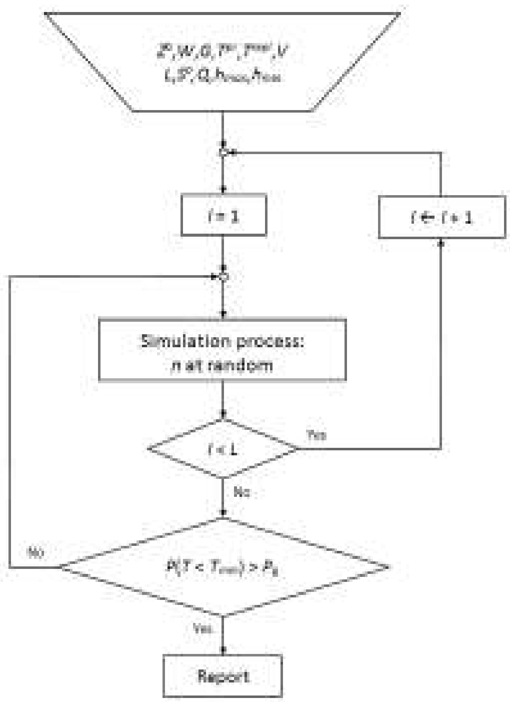

Figure 1. Searching for the best time schedule

Source: the author's scheme.

The problem consists in determining the best random time scale and the probability of obtaining a better time scale by means of the subsequent simulation procedure.

For the given serial production system being in the initial state S^0, the best time scale of manufactured orders Z^0 must be determined. The simulation process should consist in determining the manufactured order number n at random and determining the successive state S^k on the basis of the given state.

Let L be the number of random time scales. As a consequence, indexes $Q^l,\ l = 1,..., L$ are calculated for each random time scale. The number L can be assumed optionally.

For a chosen optimization index of time scales (e.g. time T of orders Z manufacturing) the following data can be logged:

- indexes T^l of random time scales,
- the best time scale at the present moment which is characterized by T_{min}.

After finishing L simulation experiments, a histogram is obtained (for indexes T^l) and the probability of obtaining a better time scale than presently the best available is calculated $P(T < T_{\min})$. If this probability is bigger than the assumed boundary value (e.g. 1%), the next L experiments are carried out which means L random time scales are determined. The evaluation procedure of the best time scale at the present moment is repeated.

7. The lost flow capacity criterion

Let us assume that $p(n)_{i,j}^k$ is the unused flow capacity of a tool in the given stand generated while manufacturing the *n-th* product. The total order realization time can be minimized by reducing the lost flow capacity of tools (the so-called residual pass) as other processes (e.g. the time of tool replacement is defined) cannot be shortened. Let q^k be amount of lost capacity of tools and $y_{i,j}^k = 1$ indicate the replacement procedure at the *k-th* stage, otherwise $y_{i,j}^k = 0$. Therefore, the maximal possible use of tools is the most important goal and leads to implementing the lost flow capacity criterion (7):

$$Q = \sum_{k=1}^{K} q^k = \sum_{k=1}^{K}\sum_{n=1}^{N}\sum_{i=1}^{I}\sum_{j=1}^{J} y_{i,j}^k\, p(n)_{i,j}^k \rightarrow \min \tag{7}$$

along with the tool replacement bound $\sum_{j=1}^{J} y_{i,j}^k \tau_j^{repl} \le c$ and the order bound $\sum_{n=1}^{N} x_n^k \le z_n^0$ where:

c - the maximal allowable tool replacement time.

The lost flow capacity criterion is reduced to the replacement time of tools and order bounds.

8. Conclusions

The need for carrying out a computer simulation must be met in order to project the logistic production system which will be able to realize the order in the shortest possible time at the lowest possible costs. To achieve this, more criteria ought to be implemented i.e. the production maximization criterion as well as the minimal tool replacement criterion. To verify the correctness of this kind of modelling, there must also be a multi-criterion model with adequate bounds created. Another idea accelerating the order realization process consists in beginning realization of the next element of the order vector without having to wait for completing manufacturing the remaining units of the *n-th* element which means an immediate employing the stand with no current manufacturing duty. However, it requires implementing sub-control for each *i-th* production line. Moreover, regeneration procedures ought to be introduced and discussed in detail in further works. In order to control the choice of the line we need to implement heuristics which determine the subsystem for producing the order on the basis of the flow capacity of the routes.

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References

[1] ACQuipedia Article. 2011. Modelling & Simulation (M&S) for Logistics: Classes of M&S. Online Retrieved 10th October, 2011. URL: https://acc.dau.mil/CommunityBrowser.aspx?id=395198.

[2] Bastinec, J., Diblik, J. 2008. On Initial Data Generating Bounded Solutions of Linear Discrete Equations. *Journal of Applied Mathematics*. Vol. 1, No. 2: 111-116.

[3] Bucki, R., Chramcov, B. 2011. Modelling and Simulation of the Order Realization in the Serial Production System. *International Journal of Mathematical Models and Methods in Applied Sciences*. Vol. 5, Issue 7: 1233-1240.

[4] Chinbat, U. 2009. Using Simulation for Reducing Risk of a Mining Optimization Project. In *International Journal of Simulation Modelling*, Vol. 8, No. 3.

[5] Fandiño, P.J., and Wang, Q. 2010. A Simulation Approach to Facilitate Manufacturing System Design. In *International Journal of Simulation Modelling*, Vol. 9, No. 3.

[6] Modrák, V., and Pandian, R.S. 2010. Flow Shop Scheduling Algorithm to Minimize Completion Time for *n*-jobs *m*-machines Problem. *Tehnicki Vjesnik,* 17 (3): 273-278.

[7] Pidd, M. 2004. Computer Simulation in Management Science. 5th Ed. New York: Wiley.

[8] Shaked, M., Shanthikumar, J.G. 2007. Stochastic Orders. *Springer Series in Statistics*, XVI, 475 p.

[9] Sobotka, A. 2010. Simulation modelling for logistics re-engineering in the construction company. In *Construction Management and Economics*, Vol. 18, No. 2.

[10] Spišák, M., Šperka, R. 2011. Agent-based Simulation of Financial Market. 2011 Global Business Conference, Proceedings. Best paper in Finance and Accounting Track.

[11] Suchánek, P., Bucki, R. 2011. Method of Supply Chain Optimization in E-commerce, *Journal of Applied Economic Science*, Vol. VI, Issue 3(17), Fall 2011: 257 – 263.

[12] Stock, J.R. 2001. Strategic Logistics Management. 4th Ed. New York City: McGraw-Hill Publishing Co.

ASPECTS OF THE ECONOMIC DEVELOPMENT IN RURAL AREAS OF ALBANIA. CASE STUDY KORCA REGION

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Abstract:
Rural development is a European concern. The rural areas have great potential to create productive jobs and wealth. In Albania more than half of the population lives in rural areas and agriculture is the main source of income and employment. This paper focuses primarily in general situation of rural areas in Albania, in analyse the present situation, problems and difficulties. The problems of rural development are focused in: the concentration and allocation of the population, the diseconomies of the distance, equal accesses in the public services, the secure network for people and the physic infrastructure toward the social one. Region of Korca in Albania is chosen as a case study area to provide a detailed analysis of education system and health care services in mountainous areas of Region. The paper finally concludes with suggestions for rural policies.

Keywords: rural development, mountainous areas, Albania.

JEL Classification: R11; R58

1. Introduction

Albania is mostly a mountainous country and more than half the population lives in rural areas. The economy of rural Albania is greatly based on the agricultural sector. The potential of rural areas to drive the economy, create productive jobs, improve food security, address environmental and climate change concerns, act as a buffer during crises and generally to promote sustainable and balanced growth, is now widely recognized (ILO 2011). Mountainous areas in Albania have great development potentials. These potentials are underdeveloped and life conditions in these areas are inferior to those of other regions of Albania. This is because the sensitivity of government, parliament, civil society, etc. towards mountains is limited. Rural people and excluded groups have low possibilities to enter the labour market or income generating activities. The paper gives an overall picture of the situation of rural areas in Albania, making use of statistical data and exploring case study based evidence.

2. Geographical and socio-economic context of Albania

2.1. Geographical context

Albania is a small, mostly mountainous country lying on the western seaboard of the Balkan Peninsula. Covering a total land area of 28.748 km^2, the main geographic regions are the coastal lowlands, the intermediate hill country and the mountain ranges rising to altitudes of more than 2000 meters above sea level. Only 16% of the land lies below 100 m, 55% falls between 100 and 1000 m and 29% is above 1000 m. Thus the land used for agriculture is often quite sloping, with only about 44% of the agricultural land having a slope of less than 5%. The population is about 3.2 million. The overall population density is relatively high, at 116 per km^2 (INSTAT[1] 2010).

[1] Institute of Statistics of Albania

Figure 1. Map of Albania

Source: http://www.infoalb.net/01oalbansku/albania-map.jpg

2.2. Socio-economic context

Albania has come a long way since its transition to a market economy starting in the 1990s. Despite many challenges, a sound reform program was implemented, resulting in output and income growth (World Bank 2007). Albania's impressive 7.1% annual real GDP growth between 1998 and 2008, along with an increase in wages and pensions between 2005 and 2008, has been accompanied by a massive reduction in poverty. The absolute poverty rate fell from 25.4% in 2002 to 18.5% in 2005 and to 12.4% in 2008 (Viertel, and Nikolovska 2010). However, poverty in the Albania is still at a relatively high level. As in many countries, the incidence of poverty is highest in rural areas vs. urban areas. Albania is today characterized by area-based poverty consisting of:

- High number of small, less-integrated rural communities;
- Isolated or periphery geographic situations;
- High and growing number of disadvantaged communities;

The poverty represents many dimensions:

- Low or very low revenue level;
- Level of health risk, due to lack of appropriate level of sanitary services;
- Growth of the illiterate population, or the poor level of the education;
- Limited assess in the decision making process.

Disparity in the revenue is becoming a problematic phenomenon compared to the other regional countries.

Territorial consequences:

- Weak infrastructure;
- Weak institutional coverage;
- Lack of services;
- Limited information access;
- Lack of human resources;
- High unemployment.

Consequences for individuals:

- Low qualification;
- Growing exclusion and discrimination;
- Aid dependency;
- Widespread practice of usury;
- Increasing health and social problems;
- Criminality.

Agriculture continues to be the foundation of Albania's economy, with around 60% of the labour force working in agriculture and related fields (rural population is estimated to be 56% of the total population). Approximately 23% of GDP is generated by the sector (World Bank 2007). Agriculture (farming) sector represents the dominant economic activity in rural areas, with two-thirds of the rural population employed in agriculture. Despite the impressive performance of the economy, agriculture in Albania, still face many problems. Actually small farms dominate the agriculture sector. They produce for home consumption, private traders, agro-processors and input suppliers. Production systems remain basic, many farms are too small and fragmented to be viable, physical infrastructure is poor, and private sector activity has yet to fully fill the vacuum left by defunct state processing and marketing agencies (MAFCP[2] 2007). Thus, while impressive, the changes to date are only the beginning of the transformation process.

The non-farm rural sector is an increasingly important element of the rural economy. Current non-farm development is minimal and informal in character. It is restricted to low-grade construction, small technical and personal services, and petty trade. Only about 20% of non-farm enterprises are located in rural areas (INSTAT 2010). In addition, over the last decade, the economy has grown fastest in and around the country's principal lowland urban areas, where the concentration of factors of production has allowed better and quicker returns to investment. While agriculture has been successful in underpinning food security, it remains essentially subsistence oriented. Limited agricultural surpluses are reflected by low agro-business development. In addition, the development of the non-farm rural economy has suffered from a severe lack of institutional arrangements needed for its development. Remittances have a positive impact on investment in rural areas. While remittances help to provide the opportunity to start a business, improved access to financial resources for the start-up of non-farm business in rural areas would be needed to jump-start the development. Limited opportunities for off-farm employment are an obstacle to the further rationalization of agricultural production and the realization of the benefits of economies of scale. There has been a steady reduction in skills of the rural labour force through ageing, migration, and the absence of education and training of new entrants. The combined effects of these factors have resulted in a persistent situation of structural unemployment in the countryside.

Rural infrastructure is underdeveloped. Migration has placed intense pressure on infrastructure services in coastal plains and urban centre and has decreased it in rapidly depopulating areas. This vicious circle makes it difficult to strike a balance between the high demand and need for infrastructure services in more populated areas in the plains and the equally critical infrastructure needs in the more remote and less densely populated regions. Finding this balance will be critical for the development of Albania over the coming years.

The water supply and sanitation sector in rural areas faces severe problems. Improvements in water supply of rural areas will be closely linked with the decentralization process in which the local governments will be responsible for its operation. A rural water and sanitation strategy has been prepared[3].

Rehabilitation of irrigation and draining systems needs to be continued over the coming years. Water user associations (WUA) have proven to be good vehicles to manage irrigation infrastructure and water distribution on the local level and have tremendously improved the access and management of the water resources on the local levels (MAFCP 2007). Building on these successes, more attention will need to be given to the capacity building of the authorities for coordinating and facilitating the operation of the large canals while maintaining the concept of a user managed system. In addition, farmers should receive more advice on the efficient use of irrigation water and improved management of the resource as well as sustainable handling. The road network in rural areas is still very poor or in bad condition. Maintenance issue of rural roads has been neglected in the last decade. While a number of roads have been upgraded with donor assistance in the last few years, and most of the construction and rehabilitation of rural roads has been decentralized to the communities, conditions have not improved significantly in the more remote areas. Very little maintenance is conducted even on newly

[2] Ministry of Agriculture, Food and Consumer Protection.

[3] National Water Supply and Sanitation Strategy 2009 an action plan for the water sector aimed at improving the performance of the water utilities through monitoring of a set of performance targets and benchmarks, taking into account the decentralization process of the sector.

constructed roads due to both lack of funding, and lack of capacity and organization. Rural road improvement has an important impact on the rural economy.

According to assessments, most Albanians believed that the quality of education has declined over the past 10 years, that education levels have fallen, and that illiteracy is emerging, particularly in rural areas and some newly formed per-urban settlements. Many parents, teachers, school administrators, and political leaders believe that poor teaching quality and reduced student attendance were the principal reasons for the decline (De Soto *et al.* 2003). Enrolment numbers have declined more steeply in rural areas than in urban areas except at the preschool level (Berryman 2000). Per-urban locations, often inhabited by migrated rural poor, are predicted to have below average enrolment rates. Analysis also shows that the quality of the schools has an effect on the enrolment rates, thus reducing the attendance even further in rural areas.

3. Education and medical rural services issues in the remote mountainous areas in Korca Region

3.1. Education issues

The Region of Korca stretches in the South-eastern part of Albania. The Region represents an area of 3.697 km2. Mountains occupy 58% of the areas, 17% is occupied by hills and25% by fields[4]. As in the entire Region of Korca, in the rural areas, too, such as mountainous area, special care should be taken that the regional strategy, in good fit with the Ministry of Education and Science "Education for All" Strategy, should be seriously implemented so that every child receives quality mandatory education.

The free movements of the population entail depopulation of rural areas and consequently a drastic decrease of student enrolment in these areas. Were we to make a synopsis of the state of the art of education in these areas, the following characteristics would strike:

- School drop in these areas is at low level: 1-2 pupils. Even so, the reasons behind these drop outs relate to the rugged terrain, and lack of school within reasonable distances and not to underestimation of their children's education by their parents, as might be the case in some of the per urban and urban areas;
- There is a high level of interest on the part of pupils to learn and acquire knowledge and skill as evidenced by inspections and controls. A number of massive activities organized in these areas with the wide participation of pupils are a testimony to their desire to learn;
- Free movement of the population especially towards the urban areas has created two pictures: (a) classes with 2-3 pupils; and (b) multi grade classes, both at lower and upper elementary school which lowers the standards of teaching and learning;
- Migration of qualified teachers and the lack of incentives on the part of qualified teachers to accept employment given especially the difficult accommodation and living conditions in these areas, has forced the Regional Educational Directorate to recruit as teachers people without pedagogical training, sometimes even people with secondary education. Such phenomenon has caused and will continue to cause the further deterioration of teaching and learning quality;
- Inspections, controls and reports reveal drastic shortages of teaching materials, laboratories and other demonstrating equipment are in short supply thus lowering educational standards.

Tables below present a picture of the number of students and teachers in the mountainous areas (Korca District).

(To estimate the number of students in the remote mountainous areas, the regions of Voskopojë, Vithkuq, Lozhan, Liqenas, Moglicë and Lekas have been taken into account).

[4] These data were available on the website of the INSTAT: http://www.instat.gov.al

Table 1. Number of students in the remote mountainous areas

Total number of pupils at Region's level	19.177
Pupils in towns	6.511
Pupils in villages	12.666
Pupils in remote areas	1.590

Source: Korca Region Statistical Office 2010.

As seen from the table above, pupils in the zones of Voskopojë, Vithkuq, Lozhan, Liqenas, Moglicë and Lekas account for 9.5% of the pupils in the region, or 14.7% of the pupils in the villages.

If we were to look at the teacher/pupil ratio at region or zone level, the picture is as follows:

Table 2. The teacher/pupil ratio

Teacher/pupil ratio in the towns	1:17.6
Teacher/pupil ratio in the villages	1:17.5
Teacher/pupil ratio in the mountainous areas	1:10.8

Source: Korca Region Statistical Office 2010.

As regards the number of multi grade classes and the number of pupils in these classes, the region has a total of 685 single grade classes and 196 or 29% multi grade classes. In the six zones taken into account the number of classes and their type is presented in the table below:

Table 3. The number of classes

Commune	Single grade classes	Multi grade classes
Voskopoja	6	9
Vithkuqi	-	12
Lozhan	4	24
Liqenas	12	11
Moglicë	1	23
Lekas	1	10
Total	24	89

Source: Korca Region Statistical Office 2010.

As seen, in these 6 zones, lessons are taken primarily in multi-grade classes, the number of which accounts for 45% of the total number of multi grade classes in the region. Whereas the number of pupils and teachers per zone is as follows:

Table 4. The number of pupils and teachers per zone

Zone	No. of pupils	No. of teachers	Ratio teacher/pupil
Voskopoja	252	22	1:11
Vithkuqi	262	22	1:12
Lozhani	357	35	1:10
Liqenas	414	31	1:13
Moglicë	293	27	1:11.5
Lekas	92	10	1:9

Source: Korca Region Statistical Office 2010.

In the entire region, there are 27 classes that do not cross the threshold of 9 pupils per class. Presently, it has become a necessity that local government bodies and schools enter a serious dialogue on the possibility of concentrating these schools in the centre of the areas. Especially now that the system is into nine years of elementary education, school concentration and construction of dormitories for pupils would produce positive impacts in several aspects.

Thus, in the zone of Moglica, and Lekasi, the centre of which offers suitable premises, with a certain level of investment, these premises can be turned into dormitories to house pupils of grades 5-9, thus addressing the following issues: single grade classes will be established to provide real conditions for improving the quality of teaching; - the qualified teachers will be rationally employed: qualified staff living in the area (residents of the area) will be employed in teaching, which will undoubtedly be an improvement compared to the present unqualified people that teach in the area; - the learning and teaching materials, scarce as they may be, will be concentrated in the central school and will be used efficiently to serve a greater number of pupils; - in-service teacher training may be better and more efficiently organized and will yield better results than the present efforts to train unprofessional people; opportunities are created to open up summer schools in the more remote areas with the involvement of qualified teachers; a more effective interaction will be created between the school and local government; in the social aspect, the interaction: local government/community/school will place school at the centre of social life in the area, while the school premises may be used for socializing and sports events.

3.2. Medical rural services

Medical Rural Services has been emphasized, the cost of medical care per person in rural are increase and other social factors have brought after 90'rural zone have lost hospitals and medical staff (MoH[5] 2004). Distance from the centre, the level of nutrition, living conditions in general, agricultural labour difficulties, etc, make the necessary existence of more appropriate health care services. There are villages without doctors and pharmacists, mainly in the mountainous areas. Almost in every centre of communes there is a health centre and every village has an ambulance with the permanent presence of a nurse and midwife and the weekly visit of a doctor. In mountainous areas health service faces a number of problems:

- Lack of medical specialists, especially in remote communes, lack of medical equipment, lack of medication, distance from health centres especially in the larger communes, reduced work time of doctors etc.
- Problems in providing specialized assistance to pregnant.
- Low level of the health care culture of the people.

[5] Ministry of Health of Albania, 2004. Strategy for the development of the Albanian healthcare system.

Some of the reasons behind the situation are:

- social and economic inequality;
- lengthy or repeated periods of unemployment;
- poverty and social exclusion;
- damaging agents such as psychological, biological, chemical or physical, which relate to risky conditions.

Main priorities are to insure full public health care services for all the population regardless of the level of income and gradually to reduce the differences that exist in public health service between urban and rural areas. Priorities area should be the preventive services.

4. Main directions of sustainable development in the region of Korca

Rural development should take the region as an integrated unit, not only on the territorial aspect, but also economic, social and cultural. This means that development in every commune or area should contribute to the development of the region as a whole. Given the assessments of the rural development as of present, the main elements supporting the sustainable development of the rural area include:

- continuous decentralization, increasing participatory processes, increasing the capacities of the communes;
- consolidating land ownership and developing the land market;
- integrating agricultural sector development with the development of the rural areas as a whole;
- developing rural infrastructure as a precondition for improving the quality of life and creating a business enabling environment;
- developing services to assist farmers;
- developing services to benefit the social development of the rural communities;
- developing natural resources in an integrated way.

From the social point of view, although the region's rural development strategy aims the reduction of poverty and the improvement of the quality of life for the communities of these areas, it does not necessarily intend to stall the population's migration from the rural areas towards the urban areas. Focusing on the integrated development of the rural area would give people the opportunity to make informed decision to either stay and work in these areas, or leave for another location.

4.1. Decentralization of powers and increased participation of the communities in development processes

The design and implementation of the strategy of rural development is closely related with the strengthening of powers of local governments, more specifically the communes. It is now an established fact that ministries and other agencies of central governance have already designed strategies and plans to transfer some of their competences in the various fields of economic and social activity to the communes. Thus, the Ministry of Transport and Public Works has its own strategy. The Water Regulatory Entity has its relevant strategy. However, a clear definition of responsibilities of communes should be made with regard to shared resources. In the entire decentralization efforts, it is necessary to match responsibilities with available financing. Otherwise competence without money would take the communities nowhere. It is common knowledge that the creation of a number of new taxes and transferring revenue generation from the central to the local government would take a lot of time. This means that the budgets for local governments will continue to remain dependent upon the central government budget. However, it is important to start a well thought out system of establishing and collecting taxes for the rural families. Registration of immovable property and the implementation of property taxes based on market value will increase the source of income.

Communes have the right and obligation to:

- Prepare and implement local economic development plans,
- Prepare and implement local plans to encourage small business,
- Issue construction permits,
- Ensure proper maintenance and operation of school facilities and primary health care facilities,
- Manage forests and pastures ownerships and distribution of their rights to rural people,

Regional Councils functions are quite unclear. Efforts are being made to develop a policy paper on the role and functions of the regional Council with still no concrete results. Those having said regional councils currently perform a number of coordination functions, including:

- Coordination the preparation and implementation of regional development plans,
- Coordinating the identification and prioritization of inter-communes/municipalities projects,
- Construction permit issuance (and urban planning in general) on behalf of communes
- Maintaining road infrastructure,
- Arbitrating distribution of infrastructure funds to communes.
- Development of a new package of laws to consider urban planning, and land management affecting the communes' functions as well has already been prepared and is awaiting for approval.

In national level, the priorities are:

1. Improving quality of life in rural areas and promote diversified economic activities through the creation of new jobs.
2. Develop the capacity of institutions to planning, manage and coordinate activities supporting rural development.
3. Providing adequate infrastructure or renovation of existing networks is in favour of access to the entire territory and consequently for growth of rural communities and attracting investment.
5. Networks obsolete water supply and sanitation should be improved in rural areas is very limited.
6. The introduction of information technology in rural areas is also important.
7. Preservation of historic and cultural heritage of rural areas is important to maintain their real identity. This makes the revival and protection of rural heritage integral part of rural development policy (MAFCP 2007).

5. The importance of LEADER[6] approach

LEADER is a European Community Initiative for assisting rural communities in improving the quality of life and economic prosperity in their local area (EC 2006). The approach it uses means a successful methodology for sustainable local development. Experience has shown that LEADER can make a real difference to the daily lives of people in rural areas by playing an important role in encouraging innovative responses to rural problems. It addresses issues like participatory democracy, specific ways of local governance, cross sector decision-making, bottom-up approach and stretching the definition of accountability – clearly strengthening local democracy in the process.

LEADER has a comprehensive and multi-sector character, bringing in innovation and diversification into the local economy, identified with a "bottom-up" approach, but in partnership with a "top-down" view. Therefore it can be described as an "experimental workshop", where those who can "bring in money" to rural areas meet people with innovative ideas. This experience particularly originates from 30 years work on methodological approach of integrated rural development in the old and new EU Member States, especially Sweden and Hungary but also almost all other new EU Member States[7]. Of special interest for Albania may be the rural experience from neighbouring countries in the region that have had a similar transitional period of economy, such as FYROM, Serbia, Croatia or Slovenia. These experiences have two important advantages: the programs are not only running with success and are well documented, thus making the experiences readily adjustable, but they were adopted in a transitional environment that serves with several additional lessons learned making it perhaps more relevant than that of more developed rural economies in the EU.

[6] It is an acronym meaning "Liaison Entre Actions de Développement de l'Économie Rurale" i.e. "Links between Actions for the Development of the Rural Economy". It is an innovative approach within EU rural development policy that produces results regardless of climate or the degree of rural/agricultural development, designed to address issues of local/rural development, strengthening local democracy and private-public partnerships

[7] Council Regulation (EC) No 1085/2006 establishing an Instrument for Pre-Accession Assistance (IPA).

5.1. National rural development network

Common Agriculture Policy (CAP) is a prior policy of the European Union, which uses almost 50% of the community, founds (Ciună 2009). Howsoever difficult this undertaking towards a European reality for rural development might appear, it is imperative to understand that there is no other way but to stroll towards this reality. Supportive of this might be the establishment of the National Rural Development Network, as a partnership-building mechanism at the national and local level.

The purpose of a national rural development network would be:

- To create synergies of all actors in the processes of rural development.
- To stimulate exchange of information, ideas and good practices among actors and stakeholders.
- To stimulate cooperation among stakeholders.

In the old EU member states, generally, the National Rural Development Network has come as a bottom-up initiative, and it still exists as such. Even in the new EU member states (post-communist ones), these networks were generally developed from a bottom-up perspective. However, in most of these countries, respective Ministries of Agriculture have established national networks as well, mainly deriving from their obligations under the sustainable agricultural process.

As a matter of fact, existence of two networks, one from the civil society and the other from the Ministries has not always offered a positive experience. On the contrary, relations have been unprofitable due to competition sense between the two. However, the bottom-up approach is more vital because it tells on the maturity and the active role of civil society.

Thus, another raising tight spot is whether the establishment of a National Rural Development Network is too premature for Albania's situation. On the other hand, this policy brief is mainly stimulated by the conviction that there is so much work to be done in Albania in this field , that efforts from both approaches are required (top-down and bottom-up) , and that the process should be oriented with national synergy. Furthermore, investments should focus more on the line central institutions, and the process should be supported through concrete funds, in order to accelerate the time and to build skilful structures that will be able to later absorb the EU IPARD funds[8]. On this purpose, the above presented schemes offer a thorough plan on where, to what extent and how we should invest to prepare stakeholders to start engaging within the frames of new European policies and practices related to rural development.

6. Conclusions and recommendations

1. Mountainous areas in Albania have great development potentials but the sensitivity of society towards mountains is limited. Mountainous areas are rich in natural resources. These areas have great potentials for the development of agriculture in general and horticulture and small livestock in particular, as well as for the development of tourism and handicrafts. These potentials, however, are underdeveloped and therefore life conditions in these areas are inferior to those of other regions of Albania. This is because the sensitivity of government, parliament, civil society, etc. towards mountains is limited.

2. The impact of policies depend heavily on policy ownership and pressure of interests groups The mediocre impact of policies on mountain area development and mountainous areas people's lives is due to insufficient policy ownership and lack of pressure from organized advocacy groups.

3. Every strategic framework should be part of a politically recognized integrated planning system in order for it to be sustained experience in Albania shows that initiative has not been part of a politically recognised system. Therefore, for a strategic framework to be sustained, it should be part of the politically recognized planning system.

[8] IPA is an integrated Pre-Accession Instrument to assist candidate and potential candidate countries. Of specific interest is the newly launched IPA/IPARD program. Instrument for Pre-Accession Assistance to Agricultural and Rural Development concerns the Pre/accession and Candidate countries in the Balkans. Depending on the negotiation status, countries like Albania can profit funds from Institutional Building and Cross-Border Cooperation.

4. Consolidate SARD - (M) (Sustainable Agriculture and Rural Development in Mountainous Areas) policies into a unique document and assign responsibility to Rural Development Strategy structure as a policy body and to MADA (Mountain Area Development Agency) as an operational agency. That having said, numerous aspects of sustainable agriculture and rural development in mountainous areas are being addressed in several strategic framework. Consolidation of different aspects of SARD-M policies in a unique document may prove to be beneficial. The consolidated document should be accompanied by an action plan based on measures already contained in already existing strategic framework.

5. Improve access and ownership security to land resources. Transfer of rights to forest and pastures is a major factor contributing to improved economic, social and environment situation of mountainous areas. Proceeding fast with the reform of transferring usufruct and ownership rights on forest and pastures to communities – foreseen in both the Environment Strategy and Forest and Pasture Strategy - is obviously of paramount importance. This is equally important everywhere in mountainous areas but it is more pressing in most remote areas where arable land is critically limited and where pressure is exercised on forest and pastures is too high. Preparing and implementing policies intended to promote the land market is an economically, socially and environmentally beneficial policy, given the depopulation of rural areas, especially mountainous remote areas. With the complexity of land markets, a policy that will motivate land rent may prove beneficial in bringing existing idle land into economic use.

6. Support pilot value chain projects to set examples for mountain area development Interventions in mountainous areas should embrace complete value chains (inputs, farming, processing, transport and marketing) rather than parts of the chains. Support to pilot value chains development projects for limited sectors with comparative advantages can set examples which may prove to have a beneficial multiplying effect. MADA may play a coordinating and broker role among different stakeholders and agencies. Based on value chain studies, government may develop value chain policies for fruit and small livestock sectors, for instance, to address the most important value chain bottlenecks carefully choosing working policy options. The processing level should have a special focus. This is in line with broader Government Albania policy: the Government Programme considers a shift from subsistence to market-oriented agriculture underpinned by the development of agro-industry as a key aim (Government of Albania 2007).

Potentials of mountainous areas are continuous; so are the constraints and diversities. Therefore, sometimes it is rather inappropriate to mechanically develop projects and programmes that respect administrative or even political (between countries) borders. Therefore, sometimes projects and programmes will have to involve several administrative or local government units within each country or even several countries when it comes joint country projects. Such an approach may prove helpful even in terms of qualifying for EU structural funds. Such logic is also valid in terms of cross-border projects regarding natural resources protection and development, cross-border trade, transport and tourism, etc.

References

[1] Berryman, S.E. 2000. *Albania's Education Sector: Problems and Promise*, paper, World Bank.

[2] Ciună, S. 2009. Agriculture Policy of the European Union and Romanian Agriculture Modernization. Paper presented at the 3rd International Conference on "Further Challenges for a Competitive Management", October 23-24, in Craiova, Romania. http://cesmaa.uv.ro/about_cesmaa/Book_of_Abstracts_2009.pdf

[3] De Soto, H., Gordon, P., Gëdeshi, I., and Sinoimeri, Z. 2003. *Poverty in Albania: A Qualitative Assessment,* technical paper no 520, World Bank.

[4] European Commission (EC). 2006. Council Regulation (EC) No 1085/2006 establishing an Instrument for Pre-Accession Assistance (IPA). *Official Journal of the European Union*. http://eacea.ec.europa.eu/tempus/documents/tempus_ipa.pdf.

[5] European Communities. 2006. Leader Approach a Basic Guide. *Fact Sheet*. Luxembourg. http://www.nuleader.eu/leaderfactsheet.pdf.

[6] Government of Albania. 2007. *Rural Cross-Cutting Development Strategy*, Tirana.

[7] Government of Albania. 2009. *National Water Supply and Sanitation Strategy 2009*, Tirana.

[8] International Labour Organization (ILO). 2011. *Unleashing rural development through productive employment and decent work: Building on 40 years of ILO work in rural areas,* GB.310/ESP/1, 310th Session, Geneva. http://www.ilo.org/public/libdoc/ilo/GB/310/GB.310_ESP_1_engl.pdf.

[9] Institute of Statistics of Albania (INSTAT). 2010. *Albania in Figures 2010*. Tirana. http://www.instat.gov.al.

[10] Ministry of Agriculture, Food and Consumer Protection (MAFCP). 2007. *Inter-sectorial Rural Development Strategy of Albania,* 2007-2013, Tirana.

[11] Ministry of Health. 2004. *Strategy for the Development of the Albanian Healthcare System*, Tirana.

[12] Viertel, E., and Nikolovska, M. 2010. *Albania Review of Human Resources Development*, European Training Foundation, ETF, Luxembourg.

[13] World Bank. 2007. *Integrating Environment into Agriculture and Forestry. Progress and Prospects in Eastern Europe and Central Asia*, Vol. II, Albania, World Bank.

OFFSHORING AND EMPLOYMENT STRUCTURE: EVIDENCE FROM CHINA

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Abstract:
This paper analyses the change (1995-2009) and its reasons (Berman Decomposition 1993) of employment structure in China's industrial sectors. Then we test the impact of offshoring on the employment structure based on China's panel data as a whole and by sector. The conclusion shows that China's overall employment structure in industrial sectors has been improving. The increase of skilled labour in the technology-intensive sectors obviously optimizes overall employment structure, while labour/resource-intensive and primary production sectors are both lag behind. Comparing with inter-industry change, labour-saving technology progress or rise in intra-industry productivity should be the main drivers of employment structure optimization. Significant sector differences in the impact of material offshoring and narrow material offshoring on employment structure exist, and service offshoring appears to promotes employment structure overall. Accordingly, we propose policy suggestions about the development of China's employment market in response to the new international division of labour.

Keywords: offshoring, China, industrial sector, employment structure.

JEL Classification: F02, F16

1. Introduction

If enterprises transfer their relatively low efficiency production abroad, they can focus more on comparatively superior activities, thus cutting costs and promoting overall productivity. These enterprises organize production and participate in international division of labour in the form of offshoring. Since the 1980s, as economic globalization has increased, more and more enterprises have embraced offshoring. According to Feenstra, and Hanson (1996), the proportion of the US intermediate imports increased from 5.3% (1972) to 11.6% (1990). Of all the OECD exports of manufactured goods in 1990, the intermediate imports accounted for 21% of total trade value. This figure has grown by 30% from 1970 to 1990 (Hummels *et al.* 2001).

However, it is a concern that if the production activities are transferred abroad, the corresponding domestic employment will decrease. Developed countries worry that large increases in offshoring penalize domestic unskilled labour. The World Bank estimates that 1%-5% of employment in the western Group of Seven is being transferred to those developing countries providing services offshore. Moreover, according to Forrester (2010), there will be 3.3 million jobs and USD136 billion wages moving abroad in 2015 from the US (McCarthy 2011) In fact, the crash of the labour market led by offshoring is greater than that suggests. Taking into account the income differentia and labour demand elasticity, manufacturing workers in developed countries become cleaners, telecom salespersons and truckers. Offshoring can change the labour demand structure, making different types of labour move between occupations (Falk, and Koebel 2002).

In the last decade, China has undertaken substantial offshoring from developed countries, while also importing the intermediate inputs largely from developed countries (Zhibiao Liu, and Fuxiang Wu

2006; Xinqiao Ping 2005). Nowadays offshoring has become an intermediary by which China accelerates its integration into the global division of labour. However, compared with developed countries, China still has an imprecise understanding of how offshoring affects the domestic labour market. Since China has an abundance of labour, it is unclear whether the development of offshoring will result in similar adjustments to the employment structure. This paper reports empirical research on the effect of offshoring on the employment structures in China's industrial sectors. It extends or corrects previous country-tests aimed at the US and other western countries while providing a policy basis on which to optimize the employment structure guide the labour flows and implement the employment strategy.

2. Literature Review

The research on the impact of offshoring on employment structure has mainly targeted developed countries. Feenstra, and Hanson (1995) proposed that, as the promotion of offshoring rose in northern countries, the ratio of skilled labour to unskilled labour would keep in line or increase, and it seems that offshoring and technology innovation have the same function (Feenstra 1998). Arndt, (1997) Egger (2002), and Egger, and Falkinger (2003) believed that offshoring was the reason why the relative demand for unskilled labour went down in a single-sector model. On the contrary, the multidisciplinary study based on the H-O model showed that offshoring increased wages and employment within the unskilled labour-intensive sectors.

In contrast, Chinese scholars have different answers to this question (Yi Xu, and Erzhen Zhang, 2008; Zhongchang Chen, and Hongqi Ma 2010). Bin Sheng, and Tao Ma (2008) examined the effect of intermediate trade on the elasticity of labour demand in industrial sectors by dynamic panel data models. The results show that the change of wages has a negative effect on the sector-demand for labour, with the labour/resource-intensive sectors suffering from the greatest elasticity of labour demand. But the impact of intermediate trade varies by sector, and that impact is weaker than the variables of outputs and wages. An empirical study from Amiti, and Wei (2004) indicated that when using 450 sectors, the negative effect of material offshoring on employment is 0.5%; when using 96 sectors, the negative effect disappears. This means the increase of output and labour demand from other sectors within similar industries counteracts the negative effect on employment.

Berman, Bound, and Griliches (1993) analyzed the shift from unskilled labour to skilled labour that happened in US manufacturing industries in the 1980s. They thought that offshoring's weak role could not be the main reason for the shift. However, country-tests by other researchers concluded that offshoring could explain the change of domestic employment structure to some extent. Feenstra, and Hanson (1996) tested the impact of offshoring on the relative demand for skilled labour. The result showed that, from 1979 to 1985, 31-51% of the shift from unskilled labour to skilled was due to the promotion of offshoring in US manufacturing. Using panel data of 21 Austria manufacturing sectors (1990-1998), Egger, and Egger (2005) suggested that relative employment of skilled labour was significantly increased by offshoring, and the spill over effects of offshoring accounted for about two thirds of the impact of offshoring on employment. Studying UK input-output tables (1982-1996), Hijzen, Gorg, and Hine (2004) found significant negative impacts of offshoring on unskilled labour demand. Offshoring was the main reason for the change of employment structure in UK manufacturing. Falzoni, and Tajoli (2009) pointed out that offshoring had no significant impact on Italian employment as a whole, but the impact on employment structure showed obvious sector differences. For technology-intensive sectors, offshoring contributed to the optimizing of the employment structure; for non-technology-intensive sectors, some adverse effects occurred. Egger, Pfaffermayr, and Weber (2003) also used the Logit model with dynamic fixed effects to research the impact of offshoring on labour transfer between industries. Offshoring decreased both the existing and potential employment in manufacturing industries.

The existing literature on how offshoring affects the change of employment structure has made considerable progress but these country studies are inconclusive and lack cross-country applicability. What will happen in the large Chinese labour market when China is in a period of accelerating development of offshoring?

In the second part of this paper we calculate the proportion of skilled labour by sector to measure the change of employment structure. At the same time, using Berman *et al.*'s (1993) method, we analyze this change by inter- and intra-industry. In the third part, we use the econometric equation based on the production function (Greenaway *et al.* 1998), as well as variables and the data description. In the fourth part we compare and discuss the overall regression and each sector's regression. We present our conclusions in the fifth part.

3. Employment Structure of China's Industrial Sectors

China's employment structure has changed greatly since the 1980s, caused by economic globalization as well as a deepening market economy and domestic technical progress. Following the evolution of the industrial structure, the mass transfer of labour among the agricultural, manufacturing and service industries became a significant feature. However, the main industry to absorb the labour force showed obvious differences in technology, factor intensity, and scale among industrial sectors, resulting in an increase in the proportion of industrial employment but a decrease in the absolute numbers (Meici Yu 2008). One important reason was that China's industrial sectors had the fastest technological progress and the highest degree of export-orientation. The impact of the sector-differences on the various types of employment was intensified further by factor bias and internationalization of production. For example, the rapid development of technology-intensive sectors increased the demand for skilled labour, while work was relatively scarce in the primary production and labour and resource-intensive product sectors. This reduced the relative demand for unskilled labour.

3.1 Changes in Employment Structure of China's Industrial Sectors: 1995-2009

In order to agree with the sector classification calculating offshoring rate used in the third part of this paper, we used three input-output tables provided by the *National Bureau of Statistics of China* (124 sectors in 1997, 122 sectors in 2002 and 135 sectors in 2007) to correspond with two-digital sector classifications in the *China Statistical Yearbook*. To ensure sector characteristics and calculation consistency, sector classifications from different data were combined or partitioned to gain 28 representative industrial sectors[9] in China. Using technical skills, factor intensity and scale characteristics, all sectors were classified as primary production sectors (A), labour and resource-intensive production sectors (B) and technology-intensive production sectors (C) [10] in line with the UNCTAD (2002) classification (2002).

In general, employment structure includes regional structure, sector structure and technological structure. Technological structure is usually measured by the ratio of technical/skilled to non-technical/unskilled workers. Different countries have different statistical standards for these two labour types. In the popular *Annual Survey of U.S Manufacturing*, labour is divided into non-productive and productive, regarded as the metrics of skilled and unskilled labour (Feenstra, and Hanson 1996). Falzonj, and Tajoli (2008) proposed three metrics for the technical structure of labour: "white collar" and "blue collar", differentiated by the technology intensity[11], and the level of education.

[9] Due to space limitation, input-output tables, the corresponding table of *China Statistical Yearbook* and industrial sectors in this paper are not shown. The author can provide these separately, if interested.

[10] Primary production sectors: 1. Agro-food processing, 1. Food manufacturing, 1. Beverage manufacturing, 1. Tobacco; 2. Chemical fibre manufacturing; 3. Non-ferrous metal smelting and rolling processing; Labour and resource intensive products sectors: 4. Textiles, 4. Textile and garment, shoes, hat manufacturing, 5. Leather, fur, feathers (down) products, 6. Wood processing and wood, bamboo, rattan, brown, straw products, 7. Furniture, 8. Paper and paper products, 9. Petroleum processing, coking and nuclear fuel processing, 10. Non-metallic mineral products, 11. Printing and reproduction of recorded media, 12. Cultural, educational and sports products; Technology-intensive products sectors: 13. Chemical materials and chemical products, 14. Pharmaceutical manufacturing, 15. Rubber products, 16. Plastic products, 17. Ferrous metal smelting and rolling processing, 18. Fabricated metal products, 19. General equipment manufacturing, 20. Special equipment manufacturing, 21. Transportation equipment manufacturing, 22. Electrical machinery and equipment manufacturing, 23. Communications equipment, computers and other electronic equipment manufacturing, 24. Instrumentation and office machinery manufacturing. The sector number corresponds with the sector order in table 1 below.

[11] (1) "White collar" refers to management, "Blue collar" refers to common workers, apprentices and family workers; (2) It estimates average technology intensity of one sector by wage equation (Bruno *et al.* 2008). The labor is considered to be skilled if higher than the average and unskilled if lower.

The statistics available in China lack sector details of the labour population by educational level or vocational skills. Thus, we used the technical employment working in large/medium-sized enterprises in industrial sectors as the proxy variable for skilled labour. Using data from the *China Statistical Yearbook of Science and Technology,* the proportion of sector skilled labour to sector total employment was regarded as the metric for the employment structure of China's industrial sectors.

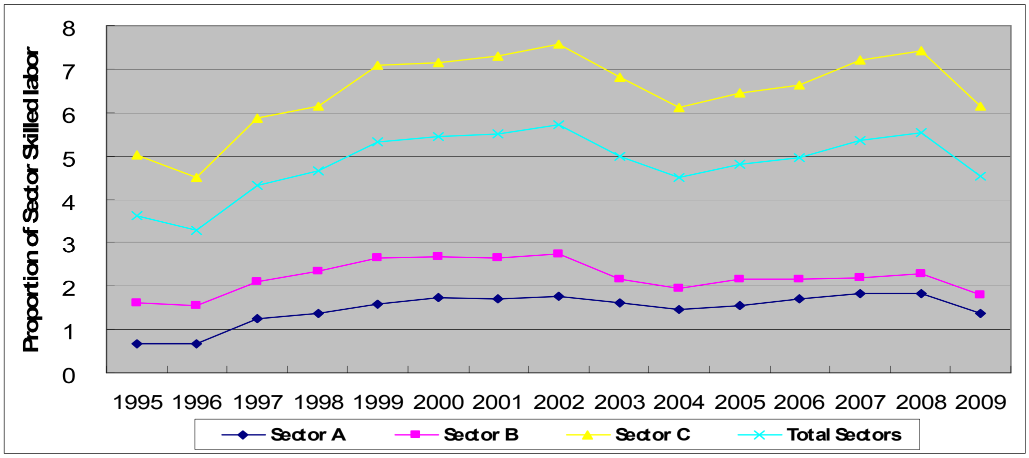

Figure 1. Changes in Employment Structure of China's Industrial Sectors (1995-2009)

According to Figure 1, the proportion of skilled labour in all sectors continued to increase from 3.3% in 1996 to 5.71% 2002. It decreased in the next year and rose to 5.54% between 2004 and 2008, which indicated that the employment structure of the industrial sectors continued to optimize during most of the observed years. The three types of sectors have all shown a similar trend. The largest increase existed in the proportion of skilled labour in the technology-intensive sectors, which reached 22%, while it reached 11% for the labour and resource intensive production sectors. Although the figure for the primary production sectors doubled, the absolute value of the proportion was small. Thus, the increase of proportion of skilled labour in technology-intensive production sectors played a significant role in optimizing China's industrial sectors' employment structure. However, the labour and resource intensive production sectors and primary production sectors have fallen behind.

3.2 Berman decomposition of change in employment structure

The employment structure of the industrial sectors overall was optimized during 1995–2009, and the three types of sectors showed similar trends, while the impact from other sectors on the whole structure change showed significant differences. The first reason offered for this change is the internal structure change within the sectors. For example, hi-technology and skill-based scale expansion as well as the relative reduction of resource and low-technology intensive sectors caused more demand for skilled labour. The second reason is the decreased demand for un-skilled labour led by labour-saving technological progress and the promotion of productivity, the former is an inter-industry reason, the latter an intra-industry reason. Using the factorization method referred to as Berman decomposition (Berman *et al.*, 1993), we analyzed the fundamental reason for the change of employment structure in China's industry sectors.

ΔS is defined as the optimization index of employment structure. S_i is the proportion of skilled labour in i sector. $\overline{S_i}$ is the mean value of S_i in the observed period. L_i is the proportion of i sector's employment in total employment. $\overline{L_i}$ is the mean value of L_i in the observed period. Then the index of employment structure optimization ΔS can be written as follows:

$$\Delta S = \sum_i \Delta L_i \overline{S_i} + \sum_i \Delta S_i \overline{L_i} \tag{1}$$

The left of equation (1) measures the overall change of skilled labour proportion in all sectors. Where the value is positive, showing an increase in the proportion of skilled labour, employment structure is optimized. In the negative, the employment structure gets worse. The right of equation (1) carries out factor decomposition on ΔS. The first item is the impact of sector structure change (inter-industry reason), the second item is the impact of demand change for the two types of labour inside the sector (intra-industry reason). We calculated the index of employment structure optimization of 28 sectors for the period 1995–2009. The results are shown in Table 1.

Table 1. Optimization index of employment structure in China's industry sectors

Sector	ΔL_i	$\overline{L_i}$	ΔS_i	$\overline{S_i}$	$\Delta L_i \overline{S_i}$	$\Delta S_i \overline{L_i}$	ΔS
1*	0.13	7.87	1.00	2.47	0.32	7.86	8.18
2	-0.65	1.18	1.35	4.78	-3.13	1.60	-1.53
3	0.19	3.04	0.76	5.21	1.01	2.31	3.33
4**	-5.29	14.03	0.07	1.78	-9.44	1.02	-8.42
5	2.72	2.17	-1.13	0.98	2.67	-2.46	0.21
6	0.23	0.59	1.46	1.89	0.43	0.87	1.29
7	0.95	0.59	-0.77	1.58	1.49	-0.45	1.04
8	-0.65	2.06	1.33	2.66	-1.72	2.74	1.02
9	-0.16	2.03	-2.03	4.50	-0.73	-4.12	-4.85
10	-2.10	6.08	1.13	2.73	-5.71	6.87	1.15
11	-0.05	0.82	1.83	1.88	-0.09	1.50	1.41
12	1.19	1.02	-1.28	1.77	2.10	-1.30	0.80
13	-3.08	7.62	3.27	5.16	-15.90	24.92	9.02
14	0.31	2.49	5.65	6.99	2.16	14.07	16.23
15	-0.23	1.45	0.84	3.57	-0.82	1.22	0.40
16	1.24	1.65	0.23	3.40	4.23	0.38	4.61
17	-3.12	8.49	0.24	5.11	-15.92	2.04	-13.88
18	0.83	2.29	0.88	3.57	2.96	2.01	4.97
19	-2.62	6.23	2.70	7.54	-19.75	16.83	-2.91
20	-2.44	4.90	3.60	7.36	-17.95	17.65	-0.30
21	-0.27	8.62	-0.74	8.38	-2.23	-6.38	-8.61
22	3.11	5.74	0.80	7.08	22.02	4.59	26.61
23	9.71	7.54	-2.72	8.74	84.94	-20.52	64.42
24	0.05	1.50	0.11	7.78	0.36	0.16	0.52
Total					31.29	73.40	104.69

Notes: * agro-food processing, food manufacturing, beverage manufacturing, tobacco belonging to sector A are combined into sector 1 "Foods processing and manufacturing". ** textile, textile and garment, footwear, headgear manufacturing belonging to sector B are combined into sector 2 "Textile".

The overall change of the proportion of skilled labour was 104.69 of which 31.29 was inter-industry change and 73.40 intra-industry change. Obviously, compared with change of sector structure, labour-saving technological progress or promotion of production within one sector is the major impetus for overall optimization in China's employment structure. To further illustrate the impact of the change, we calculated the optimization index of employment structure by sector.

Table 2. Optimization index of employment structure of three types of sectors: 1995-2009

	$\Delta L_i \overline{S_i}$	$\Delta S_i \overline{L_i}$	ΔS
Sector A	-1.79	11.74	9.94
Sector B	-11.01	4.69	-6.33
Sector C	44.00	58.47	102.47

As shown in Table 2, the intra-industry factor is, in each case, the main reason for employment structure optimization. The ΔS of technology-intensive production sectors is 102.47, showing that a large increase in the proportion of skilled labour has a significant effect on the employment structure optimization. Primary production sectors show a stronger optimization role than labour and resource intensive production sectors. This is consistent with the result in Table 1 and described in Figure 1. However, the analyses over the 15 years hide any positive or negative impacts of specific events during the period.

In this paper, we re-calculated the optimization index of employment structure using a time period of two years, producing 14 periods in total. This removed the subjectivity of time selection while enabling the detailed observation and comparison of the optimization levels in each sector.

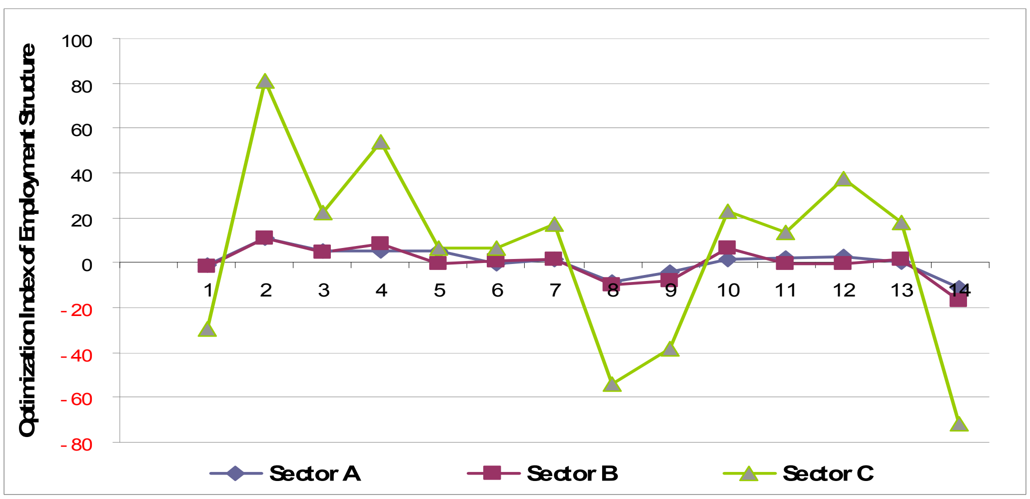

Figure 2. ΔS Change of different sectors in 14 periods

As Figure 2 indicated, there were more periods of employment structure optimization in the three sectors and they had a more consistent pattern. During 2002–2003 and 2008–2009, not only did the proportion of skilled labour in the three sectors decrease, but the ΔS was negative. In most of the other years, the change of employment structure was the most significant in the technology-intensive production sectors, with the primary production sectors and labour and resource intensive sectors having similar patterns. Then, we used the change of employment structure overall and in the three sectors as the sample. We analyzed intra-industry reasons for the change. We tested the impact on the employment structure of China's industry sectors from the technology process, from productivity promotion with new patterns of global labour division, and the sector's own characteristics.

4. Model Equations and Variables Data
4.1 Econometric model

Based on Greenaway et al. (1998), we assumed that sector i in t period subject to Cobb-Douglas function,

$$Y_{it} = A^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} \tag{2}$$

where Y_{it} is actual output of sector i in t period, A denotes the technology associated with the output, K_{it} and L_{it} correspond to material capital and labour input, γ, α and β are the elasticity coefficients of every variable. In production equilibrium, if the margin product of labour is w_{it} and that of material capital is r_{it}, then

$$\begin{cases} w_{it} = A^{\gamma} K_{it}^{\alpha} \beta L_{it}^{\beta-1} \\ r_{it} = A^{\gamma} L_{it}^{\beta} \alpha K_{it}^{\alpha-1} \end{cases} \tag{3}$$

$$\frac{w_{it}}{r_{it}} = \frac{K_{it}^{\alpha} \beta L_{it}^{\beta-1}}{L_{it}^{\beta} \alpha K_{it}^{\alpha-1}} = \frac{K_{it}\beta}{L_{it}\alpha} \Rightarrow K_{it} = \frac{w_{it}}{r_{it}} \frac{L_{it}\alpha}{\beta} \tag{4}$$

Take (4) into (2),

$$Y_{it} = A^{\gamma} K_{it}^{\alpha} L_{it}^{\beta} = A^{\gamma} \left(\frac{w_{it}}{r_{it}} \frac{L_{it}\alpha}{\beta}\right)^{\alpha} L_{it}^{\beta} \tag{5}$$

Assuming that the marginal product price depends on material capital input K_{it}, that is permanent assets bought by the manufacturers and used in production are deducted in proportion to the sale (5) becomes

$$Y_{it} = A^{\gamma} \left(\frac{w_{it}}{r_{it}} \frac{L_{it}\alpha}{\beta}\right)^{\alpha} L_{it}^{\beta} = A^{\gamma} w_{it}^{\alpha} L_{it}^{\alpha+\beta} \left(\frac{\alpha}{\beta}\right)^{\alpha} K_{it}^{-\alpha} \tag{6}$$

In general, technology changes with time T_i and is assumed to reflect R&D input RD_{it} and offshoring O_{it}.

$$A_{it}^{\gamma} = e^{\rho_0 T_i} RD_{it}^{\rho_1} O_{it}^{\rho_2} \tag{7}$$

Merging (7) into (6), take both sides of the logarithmic,

$$\ln Y_{it} = \gamma\rho_0 T_i + \gamma\rho_1 \ln RD_{it} + \gamma\rho_2 \ln O_{it} + \alpha \ln w_{it} + (\alpha+\beta)\ln L_{it} + \alpha \ln\left(\frac{\alpha}{\beta}\right) - \alpha \ln K_{it} \tag{8}$$

Assume that the labour input L_{it} of sector i in t period consist of skilled labour $L_{it}(skilled)$ and unskilled labour $L_{it}(unskilled)$.

$$S_{it} = \frac{L_{it}(skilled)}{L_{it}} \tag{9}$$

Take (9) in (8),

$$(\alpha+\beta)\ln S_{it} = \gamma\rho_0 T_i + \gamma\rho_1 \ln RD_{it} + \gamma\rho_2 \ln O_{it} + \alpha \ln w_{it} + (\alpha+\beta) L_{it}(skilled)$$
$$+\alpha \ln(\frac{\alpha}{\beta}) - \alpha \ln K_{it} - \ln Y_{it} \tag{10}$$

In addition, introducing the proportion of employment in multi-national enterprises in China $inFDI_{it}$, that is the employment share of internal foreign direct investment enterprises. $L_{it}(skilled)$ in equation (10) is replaced by L_{it} and $inFDI_{it}$. Finally, we integrate the impact of export and import on real output into the econometric equation. Based on equation (10), we construct the model equation as follows:

$$S_{it} = \eta_0 + \sum_j \eta_1 \ln RD_{i,t-j} + \sum_j \eta_2 O_{i,t-j} + \sum_j \eta_3 \ln w_{i,t-j} + \sum_j \eta_4 \ln L_{i,t-j}$$
$$+\sum_j \eta_5 \ln K_{i,t-j} + \sum_j \eta_6 \ln Y_{i,t-j} + \sum_j \eta_7 \ln EXP_{i,t-j} + \sum_j \eta_8 \ln IMP_{i,t-j}$$
$$+\sum_j \eta_9 inFDI_{i,t-j} + \lambda_i + T_i + \mu_{it} \tag{11}$$

In order to test the cross-period impact of independent variables on dependent variables, equation (11) uses the dynamic form. In it the offshoring item $O_{i,t-j}$ has three forms: material offshoring $O_{m,i,t-j}$ (Model I); service offshoring $O_{s,i,t-j}$ (Model II); and narrow material offshoring $O_{nm,i,t-j}$ (Model III). η_0 is the intercept, λ_i is the sector specific effect, and μ_{it} is the error.

4.2 Variables Data

The variables involved in the econometric test are employment structure, R&D inputs, offshoring rate, average wages, labour inputs, material capital inputs, real output, exports, imports and employment share of multi-national enterprises in China. All are three-year partition panel data in 28 sectors in 1997, 2002 and 2007[12].

Employment Structure. Technical workers in large/medium enterprises of industry sectors were taken as a substitute variable for skilled labour. We used the ratio of sector skilled labour population to sector total employment, getting our data from the *China Statistical Yearbook of Science and Technology* and the *China Statistical Yearbook* respectively.

R&D Input. We used expenditure data from *"the science and technology funds in large/medium enterprises"* from the *China Statistical Yearbook of Science and Technology.* Taking 1997 as the benchmark we adjusted the nominal R&D expenditure to the real expenditure using the sector investment price index from the *China Statistical Yearbook* and *China Statistical Yearbook of Technological Economy.*

Offshoring Rate. We get the sector intermediate imports by complete consumption coefficient matrix and intermediate imports from input-output tables, which break though "the same proportion assumption" (Cai 2011), Therefore in this paper, material offshoring rate, service offshoring rate and narrow offshoring rate were measured and calculated by DJ index (Daveri, and Jona-Lasinio 2008).

Average Wages Sector average nominal wages (*China Statistical Yearbook of Labour*) were converted into a constant value by CPI (*China's Cities (Countries) Living and Price Yearbook*), taking 1997 as the benchmark.

Real Output and Labour Inputs. The ratio of sector annual industrial added value to annual labour inputs can be expressed as real output per capita. The former was converted into a constant value (1997 benchmark) using the index of industrial production price from the *China Industrial*

[12] In this paper, the authors use input-output tables to calculate the off-shoring rate. China's input-output tables are made every five years with the bottom being 2 and 7. Every five years, with the bottom being 0 and 5, the extension tables of input-output tables are made. Prior to 1997 the extension tables and the input-output tables lack sector import data, the authors used these three input-output tables: 1997(124 sectors), 2002(122 sectors) and 2007(135 sectors).

Economy Statistical Yearbook. The latter is the sector employment population from the *China Statistical Yearbook*.

Material Capital Inputs. Currently, domestic scholars focus on nationwide or province capital stock (XiaoLu Wang, and Gang Fan 2000), and research into the capital stock of industrial sectors is comparatively rare. We selected the annual balance of sector net fixed assets published by *China Industrial Economy Statistical Yearbook* as material capital inputs, which we converted into constant value (1997 benchmark) using the index of industrial production price.

Exports and Imports. The export and import volumes from UN COMTRADE database were converted from the three-digit sector statistics in the *Standard International Trade Classification* (SITC, Rev.3) into 28 sectors. Because the original trade data were in USD, we converted them into RMB using annual middle exchange rate (*International Finance Statistical Yearbook*, IMF), and then into a constant value (1997 benchmark) by CPI.

Employment Share of Multi-national Enterprises in China. This was the proportion of employment population in foreign-funded enterprises in one sector compared to the total employment in that sector. The data were obtained from the *China Statistical Yearbook.*

5. Regression Analysis

5.1 Model recognition

Because the sample has a comparatively short time span, biased estimating would burn out if taking POLS and GLS. We can reduce the bias by a weighted cross-section regression or we can consider P2SLS and GMM. Differential GMM eliminates the endogeneity, while losing parts of the sample data. For three-year partition panel data, the differential strongly affects the data integrity. Systematic GMM can offset sample data loss. However, in terms of our model, we cannot predetermine the horizontal interference of offshoring, and systematic GMM usually means that the equation cannot be resolved. In this paper we have applied P2SLS. In addition, in order to clarify the impact of offshoring on current and lagged sector employment structure, we selected one period as the longest lag period for independent variables in this limited sample.

5.2 Regression Results

The results of the endogeneity test show that the variable $inFDI_{it}$ clearly possesses endogeneity[13]. We differentiated equation (11) to eliminate the sector fixed effects. Then we made the endogenous variables lagged 1 or 2 periods and other exogenous variables as instrumental variables of endogenous independent variables. Here material offshoring, service offshoring and narrow material offshoring are introduced to regression equation (11),

Table 3. Regression results on panel data of 28 Sectors (dependent variable S_{it})

Independent variables	Model I	Model II	Model III
$O_{m,i,t-j}$	-4.1198**		
$O_{s,i,t-j}$		6.0508**	
$O_{nm,i,t-j}$			5.3498**
RD_{it}	4.2807***	4.2807***	4.4307***
w_{it}	-4.5907	-3.1707	-7.1907
L_{it}	0.0024*	0.0028*	0.0024
K_{it}	0.0005***	0.0005***	0.0005***
Y_{it}	-0.0007***	-0.0006***	-0.0006***

[13] The authors use the two-step method to test the endogeneity of variables. Limited by the length of the paper, full results are not displayed. They are available from the authors, on request.

Independent variables	Model I	Model II	Model III
EXP_{it}	-2.4605***	-2.6105***	-2.6205***
IMP_{it}	-2.8206	-6.7706	-2.0205**
$inFDI_{it}$	-0.0036	-0.0051	-0.0010
S_{it} (-1)	1.0608	0.9767***	0.9639***
Hausman P	0.5668	0.9341	0.3623
Adj.R-Squared	0.8480	0.8325	0.8038

Notes: *, ** and *** indicate levels of significance of 10%, 5% and 1% respectively.

The results in Table 3 indicate that all control variables except the offshoring show similar levels of significance and symbols of their marginal effects are basically the same. Thus the models are comparatively robust and can explain the change of sector employment structure. The impact of the three kinds of offshoring on sector employment structure is significant. Material offshoring has a negative impact on the optimization of the employment structure, whereas service offshoring optimizes the employment structure to the maximum extent (6.05). The increase of material intermediate input from own sectors also has a positive impact on sector employment structure optimization.

It is of note that every 1% increase of R&D inputs increases by 4% the proportion of sector skilled labour. Those results remain the same for different types of offshoring. There are similar findings for material capital input, real output and exports. Specifically, every 1% increase of material capital input leads to 0.0005 increase in the proportion; every 1% increase of real output causes about 0.0006 decrease in the proportion; every 1% increase of exports contributes 2.5% to that decrease. Obviously, when the real outputs and exports rise considerably, the sector employment structure tends to deteriorate. A possible reason is that material production needs the most productive workers, and these numbers cannot increase rapidly in a very short time period. Average wages, employment share of multi-national enterprises in China and imports have little effect on the employment structure. However, the current skilled labour proportion has a positive effect on the next period, a self-fulfilling expectation. Finally, Table 4 indicates separate regression results for primary production sectors, labour and resource intensive production sectors and technology-intensive production sectors. In contrast to total sectors, material offshoring in primary production sectors promotes employment structure optimization, and narrow material offshoring has a positive effect and the effect of service offshoring is not significant. The situation for labour and resource intensive production sectors is similar. The differences show us that the increase of material intermediate inputs from the sector itself decrease the skilled labour proportion. In the technology-intensive sectors, all three types of offshoring significantly promote the employment structure, with service offshoring being the strongest.

In addition, under the influence of offshoring, the impact of real output and exports show sector differences in employment structure. The significance and direction of R&D inputs and material capital inputs are basically consistent. In the primary production sectors and labour and resource intensive production sectors, the increase of employment in multi-national enterprises in China is harmful for the optimization of China's employment structure.

Table 4. Regression results by three types of sectors (dependent variable S_{it})

	Sector A			Sector B			Sector C		
Indep Variable	Model I	Model II	Model III	Model I	Model II	Model III	Model I	Model II	Model III
$O_{m,i,t-j}$	8.776**			5.920*			18.203**		
$O_{s,i,t-j}$		-4.760			67.879			221.868*	
$O_{nm,i,t-j}$			18.019*			-11.536*			20.780**
RD_{it}	1.271	6.001***	-5.581	-3.221*	-4.321**	-3.991**	1.211	2.651*	1.311

	Sector A			Sector B			Sector C		
RD_{it} (-1)		3.551***	8.041					-6.511*	
w_{it}	8.141***	-1.201**	-1.051	-1.221***	-1.191***	-1.381***	-2.011	-4.131	-1.631
w_{it} (-1)								-5.131	1.861
L_{it}	-0.014***	-0.022***	-0.020***	-0.008***	-0.011***	-0.010***	0.011	0.016	-0.001
K_{it}	0.002***	0.002***	0.002***	0.001**	0.001***	0.001***	-0.001**	-0.001**	-0.001***
Y_{it}	-0.001***	-0.001***	-0.0003	0.0007	-0.0002	-0.0002	0.0005	0.0005	0.0007
EXP_{it}	-2.291	5.561***	3.981	2.201	2.851*	2.371*	-7.171**	-5.261	-6.711*
IMP_{it}	-6.471***	-6.761***	-9.571***	-3.361	3.511	7.561*	3.051	5.081	2.551
$inFDI_{it}$	-0.077*	-0.027***	-0.013	-0.045***	-0.044***	-0.040***	-0.060	0.012	-0.067
Hausman P	0.859	1.000	0.100	0.560	0.341	0.612	0.647	0.991	0.885
Adj.R-Squared	0.455	0.475	0.492	0.842	0.836	0.855	0.494	0.574	0.542

Notes: *, **, and *** indicate levels of significance of 10%, 5% and 1% respectively

6. Conclusions

Compared with other research, the regression results showing that offshoring contributes to the transfer from unskilled labour to skilled labour are very close to the conclusions drawn by Feenstra, and Hanson (1995, 1996), and Egger, and Egger (2005). Also, the impact of various types of offshoring on employment structure has significant differences by sector (Falzoni, and Tajoli 2009).

With the new international division of labour, a wave of offshoring has been sweeping all around the world. It not only becomes an important way to blend into the global division of labour and participate in global competition, but also increasingly links to the technology process, productivity promotion as well as the income gap within one country. China, as a big developing country, has undertaken a large quantity of offshoring from developed countries over a long period. Over the past decade the materials and services have been regarded as intermediate inputs, which play a role in the process of national economic development by specialization and factor substitution. This period is the key to the changes in the domestic labour market. In this structural revolution, it is production internationalization in which the offshoring plays an important role. We found that the employment structure of China's industrial sectors is continuing to optimize. Intra-industry labour-saving technological progress or productivity promotion is the driving force for China's employment structure optimization. Among all the factors, service offshoring promotes overall employment structure optimization to the maximum extent, and the impact of material offshoring and narrow material offshoring show significant sector differences. Therefore, we can further clarify the relationship between the international division of labour and the domestic labour market, which shows China integrating into and leading globalization and pushing forward the development of China's labour market.

Promote sector productivity and technology intensity; speed up the transformation of the labour market. After 2005, China passed Lewis' first turning point and entered a period of limited labour supply. To respond to this significant change and seize the favourable opportunity, China should accelerate restructuring of the employment structure by promoting productivity and technology intensity in all sectors.

Advance service import; use the effect of offshoring on specialization, spillover and learning. Compared with material offshoring and material inputs from the sector itself, the increase of intermediate service inputs can promote more demand for unproductive labour and with import spillover and learning, it could lead to the transfer from unskilled labour to skilled labour. Together with the enhancement of individual employability, the whole competitiveness of the labour market is promoted.

Attach importance to the effect of non-physical capital in the labour market. The effect of increasing R&D inputs and material capital on sector structure adjustment enhances the flow and relocation of the labour factor. But there is a more or less negative effect of the material on structure optimization. Thus, the optimization and restructuring of labour depend to a certain extent on the accumulation of non-physical capital.

Carry on differentiated development strategies for offshoring according to sector characteristics. The positive impact of offshoring on the employment structure is very significant. However, it should be highlighted that different types of offshoring affect the employment structure in primary, labour and resource intensive, and technology-intensive production sectors in different ways. The inter-industry/inter-sector labour flow ought to be coordinated to realize the dual goals of promoting increases in, and quality of, employment.

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References

[1] Amiti, M., and Wei, S. 2004. Services Outsourcing, Production and Employment: Evidence from the US, IMF working paper, No. 04186.

[2] Arndt, W. 1997. Globalization and the Open Economy, *North American Journal of Economics and Finance*, 8: 71-79.

[3] Berman, E., Bound, J., and Griliches, Z. 1993. Changes in the Demand for Skilled Labour within US Manufacturing Industries: Evidence from the Annual Survey of Manufacturing, NBER working paper, No. 4255.

[4] Cai, Hongbo. 2011. Offshoring and Labour Productivity: Evidence from China. *The Journal of Quantitative & Technical Economics*, 1: 63-75, *in Chinese.*

[5] Chen, Zhongchang, and Hongqi Ma. 2010. Employment Effect of Different types of Offshoring in China's Manufacturing, *China Industrial Economy*, 4: 79-88, *in Chinese.*

[6] Daveri, F., and Jona-Lasinio, C. 2008. Offshoring and Productivity Growth in the Italian Manufacturing Industries, *CESifo Economic Studies*, 54(3): 414-450.

[7] Egger, P. 2002. An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials. *The World Economy*, 25(2): 297-312.

[8] Egger, P., Pfaffermayr, M., and Weber, A. 2003. Sectoral Adjustment of Employment: The Impact of Outsourcing and Trade at the Micro Level, IZA Discussion Papers, No. 921.

[9] Egger, H., and Falkinger, J. 2003. The Distributional Effects of International Outsourcing in a 2×2 Production Model. *Journal of Economic and Finance*, 14: 189-206.

[10] Egger, H., and Egger, P. 2005. Labour Market Effects of Outsourcing under Industrial Interdependence. *International Review of Economics and Finance*, 14(3): 349-363.

[11] Falk, M., and Koebel, B.M. 2002. Outsourcing, Imports and Labour Demand. *The Scandinavian Journal of Economics*, 104: 567-586.

[12] Falzoni, A., and Tajoli, L. 2008. Offshoring and the Skill Composition of Employment in the Italian Manufacturing Industries, Università Commerciale Luigi Bocconi Working Paper.

[13] Feenstra, C., and Hanson, G. 1995. Foreign Investment, Outsourcing and Relative Wages, NBER working paper, No.5121.

[14] Feenstra, C., and Hanson, G. 1996. Globalization, Outsourcing and Wage Inequality, *American Economic Review*, 86(2): 240-245.

[15] Feenstra, C. 1998. Integration of Trade and Disintegration of Production in the Global Economy, *The Journal of Economic Perspective*, 12(4): 31-50.

[16] Feenstra, C., and Hanson, G. 1999. The Impact of Outsourcing and High-technology Capital on Wages: Estimates for the United States, 1979-1990, *Quarterly Journal of Economics*, 114: 907-940.

[17] Greenaway, D., Hine, R.C., and Wright, P. 1998. An Empirical Assessment of the Impact of Trade on Employment in the United Kingdom, Research Paper University of Nottingham.

[18] Hijzen, A., Gorg, H., and Hine, R. 2004. International Outsourcing and the Skill Structure of Labour Demand in the UK, IZA discussion paper, No. 1249.

[19] Hmmels, D., Jun Ishii, and Kei-Mu, Yi. 2001. The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*, 54: 75-96.

[20] Liu, Zhibiao, and Fuxiang, Wu. 2006 .Trade Integration and Production Non-integration. *Social Science in China*, 2: 80-92, *in Chinese.*

[21] McCarthy, J. 2010. 3.3 Million US Services Jobs To Go Offshore, Forrester Research Paper.

[22] Ping, Xinqiao *et al.* 2005. Vertical Specialization, Intra-industry Trade and Sino-US Trade Relation, China Centre for Economic Research working paper, No.C2005005, *in Chinese.*

[23] Sheng, Bin, and Tao, Ma. 2008. Effect of Intermediate Goods Trade on China's Labour Demand Change, *World Economy*, 3: 12-20, *in Chinese.*

[24] Wang, Xiaolu, and Gang, Fan. 2000. *Sustainability of China's Economy Growth*, Economy Science Press, *in Chinese.*

[25] Xu, Yi, and Erzhen, Zhang. 2008. Outsourcing and Productivity: Evidence from China, *Economic Research Journal*, 1: 103-113, *in Chinese.*

[26] Yu, Meici. 2008. Effect of Industrial Products Trade on China's Industry Sectors Employment, *Chinese Journal of Population Science*, 4: 22-29, *in Chinese.*

MODELLING OF THE INTERREGIONAL MIGRATION IN SLOVAKIA

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Abstract:
In the paper, panel data model of the interregional migration among 79 districts in Slovakia within 2005-2010 periods was estimated. Explanatory factors of unemployment, real wages and density of population were considered threefold: in the district inflow, outflow and net inflow models. In most cases, the factors were proved to be statistically significant. Besides, the fact that most developed regions were characterised by relatively high level of migration activities if compared to the underdeveloped regions, was also observed.

Keywords: migration, districts, panel data, Slovakia, spatial analysis.

JEL Classification: J61, J62, P25, R10, R23

1. Introduction

Economic growth as a main predisposition for economic well-being is often considered in his aggregate form neglecting the regional specifics. However, following exclusively the global economic indicators (like GDP growth, inflation, unemployment) in economic policy implies usually regional disparities and lagging of underdeveloped regions. Public spending paid to remove the regional imbalances can be inefficient as described by Daniele (2009). On the other hand, it seems that flexible character of the labour market enabling moving among regions inside the domestic economy deepens the regional disparities, but contributes to the economic growth in general. That is a reason for study the migration not just as a social phenomenon but also as a factor significantly influencing the economic growth, unemployment and also the regional disparities. The aim of our paper is to provide a research of the interregional migration at the level of LAU1- 79 districts of Slovakia. We tried to prove that the factors of unemployment, real wages and population density play significant role for both the interregional inflows and outflows. However, outer migration (migration from/to Slovakia) is out of scope of this paper.

There are few reasons for that. Firstly, there exist barriers, such as language, cultural barriers or socials linkages, for many migrants, which motivate them to stay or move within Slovakia. According to empirical study (Bahna 2008), 40.7% of people participating in research would never move to another country. Another 24.7% prefer to work abroad but live in Slovakia. Preferences in working and living abroad were accepted mainly by younger people and people from towns. Another disadvantage of foreign migration is that there is a preferable variable, which has the main significance to moving – wage level. As the Bahna´s study says, migrants moving abroad are often working on low-qualifications job. From that point of view, the internal migration seems to be more stable and consistent regarding to its structure. Secondly, we would like to investigate migration in the light of regional disparities, that means, see the more and less developed regions in Slovakia, its migration activity and urbanization and suburbanization processes.

The structure of paper is following. In the next section, we briefly review some of the similar studies in transitive and developed European countries. Section 3 describes the interregional migration situation in Slovakia in general. Section 4 introduces the database and the panel data analysis with results interpretation used in the research. Summary of the main research results is previewed in conclusion.

2. Literature review

Fidrmuc (2004) described the migration – gross inflows and outflows as well as net inflows - of regions in Central European Countries (CEC). He claimed that migration didn't play significant role in decreasing regional unemployment and wage differentials. On the other hand, these two variables were statistically significant regarding the impact on the net migration. Furthermore, the decline of migration in CEC was noticed basically due to growing regional disparities after transition. In his later paper (Fidrmuc 2005), he investigated the significance of unemployment and wages in relation to the migration flows (during the transition from central planning to a market economy) in Czech Republic and found out that economic factors did not play significant role in migration patterns although they can influence future migration expectation. According to his research present migration is more matter of social and demographic factors. Similar research, but analyzing Baltic countries, was made by Hazans (2003). He concluded that migration reacts on unemployment and wage changes in the expected manner, i.e. population moves to regions with high level of wages and low unemployment. The next part of his study based on panel data regression showed that factors such as age and education can decrease (age) or increase (education) likelihood of international migration.

Also ethnic minorities and females migrated interregional more frequently. Hazan´s study was later completed by Bloze (2009), who was observing a relationship between interregional mobility at the municipal level and the local housing structure in Lithuania. As the panel data analysis showed, in the expected manner there was positive relationship between internal migration and level of income and negative correlated relationship between migration and unemployment. On the other side, there was no response of mobility to family relations. As regards to houses markets, significant positive influence of level of construction of dwellings on migration flows appeared. One of the latest papers dealing with inter-regional migration in relation to the wages and unemployment factors was performed by Silaghi, and Ghatak (2011). They used the cross-section SUR (Seemingly Unrelated Regression) estimation for analyzing panel data from regions of Romania and found out that wages in the origin regions had a significant impact on the internal migration flows as far as the unemployment did not.

The similar methodology, as in research studies in transitive countries, was used also for developed countries. E.g. Biswas, and McHardy (2008) observed intra UK- migration among its four regions and found out that it was growing over the time. Using panel data analysis, they examined the influence of changes in regional GDP (per capita) and unemployment level on the regional emigration. They were not proved to be statistically significant although Ghatak, and Levine (1996) explored the significant relation on the international level. In another study, Etzo (2010) presented how are the gross migration flows between regions in Italy influenced by chosen economic determinants. The study was based on gravity model with PUSH (variables in origin region) and PULL (variables in destination region) factors. Using the Fixed effect vector decomposition estimator he found out, that GDP per capita is a main determinant with impact on migration flows (it was stronger in sending than destination region). The unemployment and infrastructures endowment level appeared also with robust result but just in sending region.

3. Inter-district migration in Slovakia

The inner migration in Slovakia confirms two stylized facts. The first one indicates the migrants moving to the most developed centres – districts of Bratislava, and Košice (urbanisation effect). This city ward migration is primarily motivated by the economic motives and is prevailing in the transition period in general. The second one is associated with the process of suburbanisation (Berg *et al.* 1982), i.e. flows going out of the industry areas, or cities (core), mostly to the nearest villages or smaller towns (periphery).

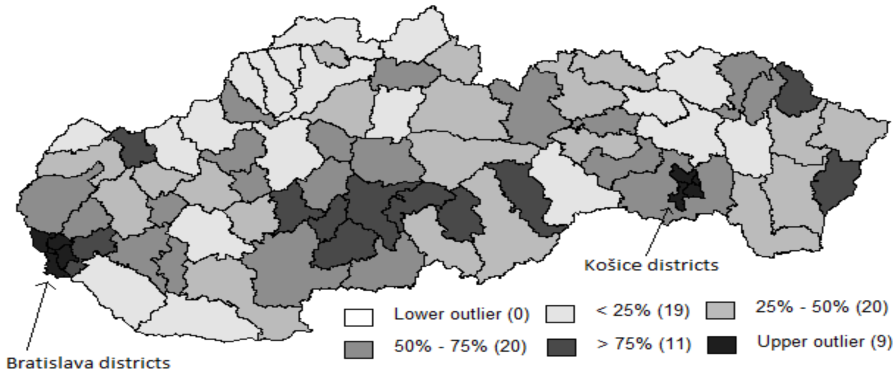

Figure 1. Districts outflows quartiles (averages of 2005-2010).
[Košice and Bratislava districts are coloured in black]

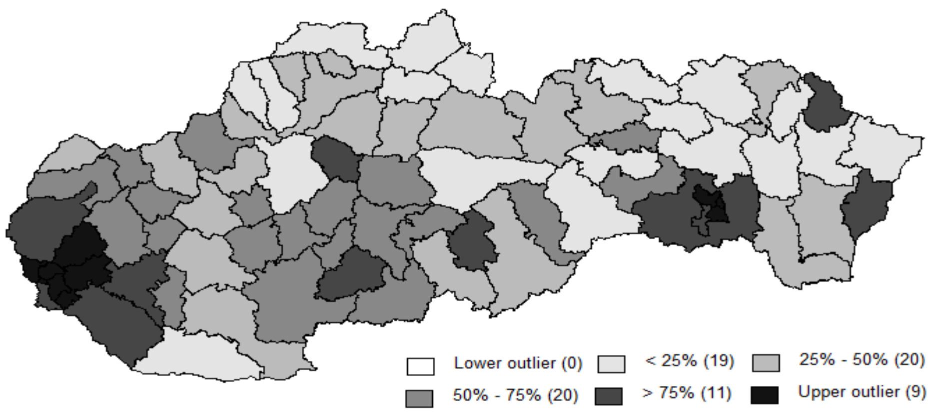

Figure 2. Districts inflows quartiles (averages of 2005-2010)

In Slovakia, the suburbanization process started in the earlier 1990´s. Rural districts surrounding Bratislava, and Košice having extreme high inflow rates represent typical examples of this trend. Moreover, depending on conditions for commuting (e.g. infrastructure), migrants move even further. As the traffic infrastructure is most developed around the Bratislava region (Bratislava lies at the crossing of three highway and five railway routes of international importance), it seems to be the reason why twelve districts surrounding Bratislava have above-median inflow rates. This is not the case of Košice (to be a starting point of just one short-distance highway route (35 kilometres) and crossing of four railway routs mostly of regional importance) where just one village district surrounding Košice city absorbs the outflows from Košice. On the other hand, the outflow rates of Košice and Bratislava recorded rates of outflows became upper outliers of our 79 districts sample (see Figure 1 and 2). This can be interpreted as the suburbanization effect. The economic stimulus for interregional migration is often discussed. In their seminal contributions, Todaro (1969), and Harris, and Todaro (1970) identified real wage gaps and the possibility of finding employment as the major factors behind immigration. Significance of these factors was consequently tested in number of papers (some of them were listed in introduction) and we were also inspired by their methodology. The significant divergence of the economic development with the underdeveloped areas mostly in the east (besides Košice) and south-east Slovakia on one side and the developed areas of the western part of the country on the other side create sufficient conditions for interregional migration. The underdeveloped regions are characterised by high level of unemployment (15% in the east vs. 7.3% in the west Slovakia) and low wage rates (€664 in the west (Bratislava itself has €951) vs. €540 in the east Slovakia) if compared with the western part of the country (see Figure 3, 4).

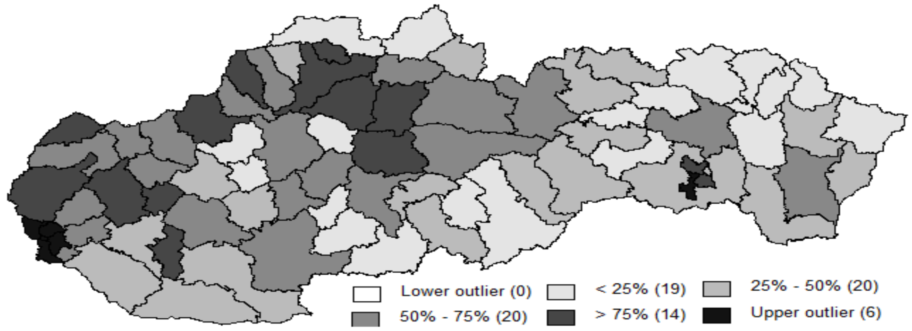

Figure 3. Distribution of the real wage rate quartiles in Slovakia (averages of 2005-2010)

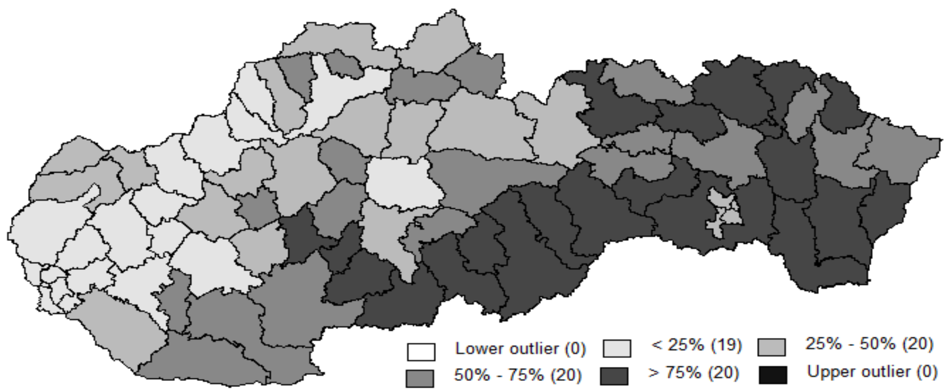

Figure 4. Distribution of the unemployment rate quartiles in Slovakia (averages of 2005-2010)

The development of the Slovak interregional migration was relatively stable during the researched period. In Figure 5, the aggregated interregional flows for the 79 districts during the discussed periods are displayed. The highest volume of migration moves (49 078) was captured in 2006. During that time, there was a period of an economic development resulting in the rapid economic growth (2005-2007), which may have stimulated people to move. In this year, the real wages were growing the most from the observed years (6.4% compared to the year 2008). On the other hand, in 2009 we see an almost 10% decline in a migration activity, which may have been connected to uncertainty caused by economic recession period (2008-2009). The real wages growth was only 0.5 % in that year. In 2010, the number of total interregional moves returned approximately back to the level from 2008. The situation seemed to be stabilized and real wages rose up in 2.4% (see Figure 5).

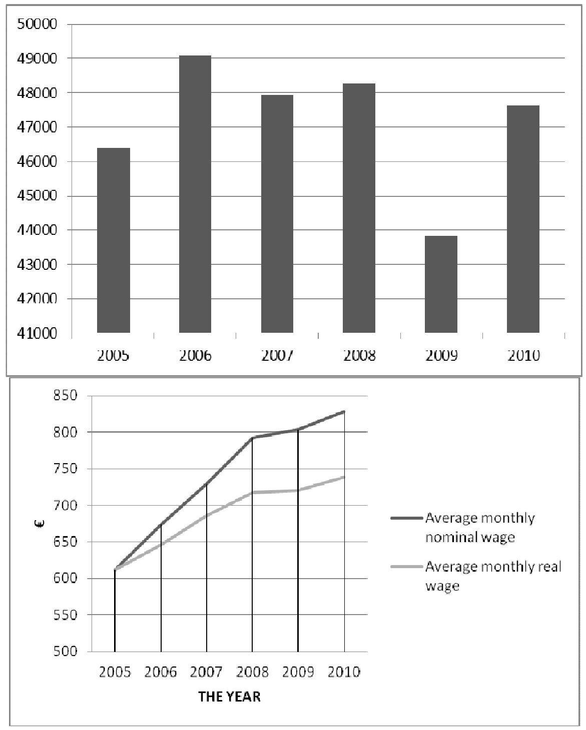

Figure 5. Frequency of aggregated interregional flows in Slovakia (left) and real and nominal wage indices (right)

4. Panel data analysis

District panel data were downloaded from the regional statistical database of the Slovak Statistical Office. The annual data cover time period 2005-2010 and panel covered of 79 districts. The database consisted of the migration inflows (variable *Inflow*), outflows (*Outflow*) and balance of inflows and outflows (*NetInflow*). The variables were expressed as the shares of the inflow (outflow, net inflow) on the total district population. Following research of Fidrmuc (2004), the real wages (variable *Wage*), the unemployment (*Unemp*) and the district population density (*Density*) were chosen as the explanatory variables. The variable *Density* was included to measure the suburbanization and urbanization effects. As the time period under investigation covered 2008-2009 crisis fall as well as 2005-2007 period of enormous GDP growth (in 2007 the GDP growth exceeded ten %), the real wage and unemployment data were expressed as the ratio to the overall mean in the actual year. Thus, the hectic up-down oscillations of the time series were stabilized. Before doing some econometric analysis, the problem of considerable high correlation among the explanatory variables (corr(*Wage*, *Unemp*) = -0.58, corr(*Wage*, *Density*)=0.66) should be solved. That is, why the *Wage* variable was regressed by the *Density* and *Unemp* variables and regression residuals were stored as a new *Wage* variable, which does not contain any *Unemp* and *Density* variables influence. It enabled to diminish potential problem of multicollinearity as well as improved the ceteris paribus interpretation of the estimated regression coefficients. On the other hand, we should be aware of the correct interpretation of the reconstructed variable *Wage*. As both unemployment and wages may be endogenous to migration, we decided to lag them by one year. This lag has also quite obvious interpretation, which is based on the lagging of the economic decisions (decision to migrate) after the development of the real factors.

Estimating the pooled regression, we included the time dummy variables to stabilise the residuals autocorrelation and to diminish the insufficient specification bias. In the process of model testing, the insignificant dummies were excluded. To diminish the problem of the heteroskedasticity and pertaining autocorrelation of residuals, the heteroskedasticity and autocorrelation consistent (HAC) covariance matrix estimation was estimated. The obtained results are given in Table 1.

Table 1. Pooling regressions

	Inflow	Outflow	Net Inflow
Const	10.336***	7.166***	3.047**
Wage	15.541***	6.389*	9.121***
Unempl.	-2.326**	-0.010	-2.222**
Density	0.005***	0.008***	-0.004***
Dummy 2006*	x	0.312***	x
Dummy 2007*	x	x	x
Dummy 2008*	x	x	x
Dummy 2009*	-0.894***	-0.818***	x
Dummy 2010*	x	x	x
F-test	67.133***	194.540***	36.910***

Notes: x denotes insignificant variables excluded from the model; ***, **, * denotes statistical significance at 1%, 5% and 10% levels.
Source: Author's calculations.

The pooling regression specified above does not take into account the districts heterogeneity. That is, why we detected (based on the F specification test) the significant individual (district) effects in all three cases. This fact led us to extend the research by the Panel data methodology and regressions were estimated as with the Fixed effects or the Random effects one way (individual effect) models. The results are given in Table 2.

Table 2. Panel regressions

Item	Inflow		Outflow		Net inflow	
	Between	Panel reg.	Between	Panel reg.	Between	Panel reg.
Const	10.251***	7.734***	7.109***	4.633	3.140***	1.420***
Wage	15.889***	8.434***	6.648**	2.079	9.241**	6.657***
Unempl.	-2.402**	-0.258	-0.102	0.293	-2.300***	-0.877*
Density	0.005***	0.006***	0.008***	0.016	-0.003***	-0.003***
Dummy 2006*		x		x		x
Dummy 2007*		0.318**		0.362***		x
Dummy 2008*		x		x		x
Dummy 2009*		x		x		x
Dummy 2010*		-0.820***		-0.796***		x
(F)ixed / (R)andom ef.		(R)	67.55***	(F)		(R)
Breusch – Pagan test		696.000***				609.700***
F-test	18.063***		67.55***	165.410***	7.934***	
Hausman test		11.157**				7.537*

Notes: x – denotes excluded insignificant dummies; ***, **, * denotes statistical significance at 1%, 5% and 10% levels, respectively.
Source: Author's calculations

Here, two views are presented. The between model provides the information on the general long term trends in the citizens mobility and, on the other side, the panel random / fixed effects regression explains the short term reactions of the mobility extracting the individual and time specific components. Our results demonstrate some intuitive facts:

1. Migration inflow statistically significantly depends on all factors under consideration. The estimated signs are in line with our expectations: Real wages positively motivate citizens to immigrate and, on the other hand, the high regional unemployment discourages immigrants. Positive sign of the regression coefficient estimated for *Density* factor is in line with the hypothesis that the industrialised centres with high concentration of population are always connected with high level of mobility (no matter if immigration (urbanization effect) or emigration (suburbanization effect) is considered);
2. Considering migration outflow regression, both the between model and the fixed effects models estimated the *Real Wage* regression coefficient with positive sign. This fact can be surprising but can also be explained by the mobility costs. It means that the mobility is too costly for the low income people living in the regions with low level of wages. In this phenomenon, the decisive fact is that the estimated *Wage* regression coefficient in case of the outflow regression is lower than in the inflow regression (15,889 vs. 6,648). The *Unemp* regression coefficients are both statistically non significant and have opposite signs. It would mean that the high level of unemployment does not stimulate people to emigrate;
3. In the case of the Net inflow models, estimation results in case of both models were in line with our expectations. It was declared that (a) the real wages stimulate net inflow; (b) the unemployment decreases net inflow and (c) net inflow diminishes with rising of population density. The third fact was observed in Slovakia in the last decade, where people from industrialised cities moved to the near countryside.

5. Conclusion and policy implications

In this paper, we discussed the interregional migration in the light of impact of the unemployment rate, real wages and density. Two migration trends were observed in Slovakia, the first one indicating immigration to the most economic developed centres (Bratislava, and Košice) and the second one as a result of suburbanization processes, i.e. emigration from these centres to the suburban areas, mostly rural districts surrounding Bratislava, and Košice.

To summarize implications of our research, a panel data analysis demonstrated three intuitive facts. First, the inflows were remarkable influenced by all of the considered factors so that high real wages motivate migrants to move, high unemployment rate dissuades from immigration and the districts with high density are usually the most active ones, where people migrate to or from. This was an expected result and it explained strong economic-orientated motivation of people to move.

Secondly, both the between and the fixed effects models considered the influence of real wages on outflow rates as statistically significant with regression coefficient having the positive sign, which we explained basically as a problem of low income level people, who are not capable of migration due to the cost of moving, because regions with higher income level have also higher rents or price level of properties. Furthermore, the case of increasing income level, which caused an increase in outflow rate, could confirm suburbanisation processes. With the higher income, migrants invest their money to build or buy houses on periphery with consecutive moving. On the other side, unemployment, according to the results of estimations, does not support emigration, although we expected that increase in unemployment would rise in migration outflows. This can be partly explained with commuting to the work to the nearest developed region. Commuters usually do not change place of living (stay to live in an original region) and start to work in a neighbourhood region. The southern part of Slovakia is a typical example, where people have a possibility to work in Hungary or Austria. Besides that, it should be pointed out that outflows are more than inflows connected to the international migration and the results could be significant if considering international migration.

Finally, concerning net inflow models, all coefficients for explanatory variables were statistically significant.

References

[1] Bahna M. 2008. Attitudes towards Labour Migration Abroad. Institute for Sociology of Slovak Academy of Sciences, http://www.sociologia.sav.sk/cms/uploaded/1202_attach_bahna_migracia.pdf (accessed March 2nd, 2012).

[2] Berg, L. van den, Drwet, R., Klaasen, L.H., Rossi, A.,Vijverberg, C.H.T. 1982. *Urban Europe: A Study of Growth and Decline*, Oxford: Pergamon Press.

[3] Biswas, T., McHardy, J., and Nolan, M. 2008. Inter-regional Migration: The UK Experience. The Sheffield Economics research paper (SERP), SERP number: 2008003.

[4] Bloze, G. 2009. Interregional Migration and Housing Structure in an East European Transition Country: A View of Lithuania 2001-2008. *Baltic Journal of Economics*, 9 (2): 47-66.

[5] Daniele, V. 2009. Public Spending and Regional Convergence in Italy. *Journal of Applied Economic Sciences,* Vol. 4, 2(8): 336-346.

[6] Etzo, I. 2008. Determinants of Interregional Migration in Italy: A Panel Data Analysis. MRPA paper No. 8367.

[7] Fidrmuc, J. 2004. Migration and Regional Adjustment to Asymmetric Shocks in Transition Economies. *Journal of Comparative Economics,* 32 (2): 230-247.

[8] Fidrmuc, J. 2005. Labour Mobility during Transition: Evidence from Czech Republic. William Davidson Institute Working Paper Number 767.

[9] Gajdoš, P., and Moravanská, K. 2008. Suburbanization in the Slovakia. Institute for Sociology of Slovak Academy of Sciences, http://www.sociologia.sav.sk/cms/uploaded/1242_attach_suburbanizacia.pdf (accessed March 2nd, 2012).

[10] Ghatak, S., Levine, P.J., and Price, W.S. 1996. Migration Theories and Evidence: An Assessment. *Journal of Economic Surveys*, 10: 159-98.

[11] Harris, J., and Todaro, M. 1970. Migration, Unemployment and Development: A Two-Sector Analysis. *American Economic Review*, 60: 126-142.

[12] Hazans, M. 2003. Determinants of Inter-regional Migration in the Baltic States. Zentrum für Europäische Integrationforschung (ZEI) - Research papers, B 17-2003.

[13] Silaghi M.L., and Gatak, S. 2011. Why Do Not They Move from Urban to Rural Areas? Inter-regional Migration in Romania. *Romanian Journal for Economic Forecasting*, 1: 143-158.

[14] Todaro, M.P. 1969. A Model of Labour Migration and Urban Unemployment in Less Developed Countries. *American Economic Review*, 59: 138–48.

[15] Zhan, K.H., and Song, S. 2003. Rural–urban Migration and Urbanization in China: Evidence from Time-series and Cross-section Analyses. *China Economic Review*, 14: 386-400.

THE EFFECT OF FINANCIAL RATIOS ON THE FIRM VALUE: EVIDENCE FROM TURKEY[14]

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Abstract:

This study examines the effect of financial ratios on firm value. For this purpose, the firms in the sectors of Food-Drink-Tobacco and Basic Metal Industry involved in ISE 100 index are examined. In the study, the relation between firm value and financial ratios are analyzed by panel data analysis. In the analysis 36 firms operating in these sectors between 2002 and 2009 have been analyzed. The dependent variable of the study is firm value; the independent variables are financial ratios. As a result, it has been found out by panel data analysis that financial ratios influence the firm value. There is a significant and positive relation between receivables turnover and firm value; there is a significant and negative relation between inventory turnover and return on equity. No significant relation has been detected between the other ratios.

Key words: firm value, financial ratios, panel data analysis.

JEL Classification: G17, G32, H32.

1. Introduction

The relation between firm value and financial ratios has been paid great attention in financial areas in recent years and various academic studies have been done about this issue. While investors invest on the firms, by the help of stocks, they are to measure the risk level of the firms. Hence, as investors invest on the stocks of the firms, they will have to analyze factors that are special for these firms and influencing the income they are going to provide in an accurate and meaningful way. As they are special for the firms, financial ratios are able to provide the investors with the information of the real value of the firms. Return on stocks may be influenced by the speculative actions of variable markets whose return on stocks is low and especially whose market depths are not much.

Firm value is attained from the results of analysis of cash flow expected to be created and firm's assets, organizational structure, the technology used and human resources. Not only shareholders but also the creditors providing financial loan to the firms have rights on the assets of the firms. Because, when a firm is dissolution, receivables of the creditors are paid earlier compared to the shareholders' invested capital. Therefore, firm value is equal to total of firm's net financial debt (after liquid assets and stocks are decreased) and values of the share (Chammbers 2009, 14).

Firm value is one of the concepts that have been developed for accounting the real value of the firms more realistically considering the concept of market value. Firm value is a concept demonstrating the value of the firm purified from the cash and cash equivalents and financial debts as regards to the concept of market value (Ilgaz 2010, 23). In our study, the concept that we used as firm value can be expressed below:

Firm value = Market value – Total Financial Debts - (Liquid assets + Marketable Securities)

2. Literature Review

Ferri, and Jones (1979**)** examined the relation between financial structure of the firm, and its industrial class, size, variability in income and operating leverage. They stated that debts structure of the firms is related to the sectorial class of the firm and the magnitude of the firm but this relation is not positive. Moreover, they pointed that income variability has no relation with the debt structure of the firm and operating leverage is not effective on the %age of the debts of the firm.

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[14] This study was summarized and corrected from the Thesis that was prepared by Arif SAVSAR in consultation with Assistant Prof. Süleyman Serdar Karaca.

Masulis (1983) examined the influence of the change in the debt level on firm value and concluded that change in debt level has a change on firm value as well. As a conclusion, he demonstrated that both stock price and firm value can be explained positively with the change on the debt level of the firm and level of operating leverage.

Eugene, and French (1998) tried to predict what kind of relation dividend payout and debt structures of the firm value have by the cross-sectional regression model. He could measure how profitability control variable and regression that is set have influence on dividends and taxation of the debt. Basic tax hypothesis points out that value has negative relation with dividends and positive relation with debts. However they found the opposite in their study. They concluded that dividends and debt structures transfer the information about the unanswered profitability by a series of control variables. This information about profitability obscures any tax effects of financial decisions.

Baldemir, and Süslü (2008) examined the influence of short term debts on the change of stock prices. Analysis was made for 75 firms registered to ISE- 100 Index. Initially, simple least squares analysis was implemented by using the changes in the stocks of the firms and the ones in short-term debts and the change in coefficients were regarded as meaningless. The model is not significant in either R^2 or F statistics. This case takes us to the result that M-M theory is not valid for Turkish economy. Hence, it was concluded that there is no relation between the stock prices and debt/shareholders' equity.

Martani, and Khairurizka (2009) examined the value relevance of accounting information inexplaining stock return. In their study, they used profitability, liquidity, leverage, market ratio, size and cash flow as proxies of accounting information. Cumulative abnormal return and market adjusted return were used as stock return variables. The samples of the study were listed companies in manufacturing industries that actively trading in Indonesia Stock Market. The study found that profitability, turnover and market ratio has significant impact to the stock return.

Cheng *et al.* (2010) researched the leverage effect on firm value by threshold panel regression. They used ROE as firm value, total debt/total assets ratio as the threshold value. They pointed out there is a threshold relation between debt ratio and firm value. They also exhibited that when debt ratio is lower than 53.97 % firm value can be increased by debt; when it is between 53.97% and 70.48% a decrease starts and there is a decreasing trend when it is between 70.48% and 75.26 %.

Chowdhury, and Chowdhury (2010) tested the influence of debt-equity structure on the value of shares given different sizes, industries and growth opportunities with the companies incorporated in Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE) of Bangladesh. The interesting finding of this paper suggested that maximizing the wealth of shareholders requires a perfect combination of debt and equity, whereas cost of capital has a negative correlation in this decision and it has to be as minim as possible. This was also seen that by changing the capital structure composition a firm can increase its value in the market. Nonetheless, this could be a significant policy implication for finance managers, because they can utilize debt to form optimal capital structure to maximize the wealth of shareholders.

3. Data and Method

3.1. Data

Analysis comprises the financial ratios and firm values attained from 2002-2009 financial tables of 36 firms from the firms whose data can be reached easily and which are registered to ISE in Food-Drink-Tobacco sector, Basic Metal Industry sector and Energy sector. Firms that are used in the analysis are listed below:

Table 1. Firms that are used in the analysis

N	FIRM	N	FIRM	N	FIRM	N	FIRM	N	FIRM	N	FIRM	N	FIRM
1	AEFES	6	BANVT	11	DARDL	16	ERSU	21	KONFRT	26	PENGD	31	SEKER
2	AKENR	7	BRSAN	12	DEMSAS	17	FENIS	22	KRDMD	27	PINET	32	SELGD
3	AKSU	8	BURCE	13	DOKTS	18	FRIGO	23	KRSTL	28	PINSU	33	TATKS
4	ALYAG	9	CELHA	14	ERBOS	19	IZDMC	24	KRVTS	29	PNSUT	34	TBORG
5	AYEN	10	CEMTS	15	EREGLI	20	KENT	25	MERKO	30	SARKY	35	TUKAS
												36	ZOREN

The variables that are derived from the close of the year financial tables of the firms stated in Table 1 are shown in Table 2.

Table 2. Variables used in the model

Liquidity Ratios	Current Ratio (CR)	Current Assets/ Short Term Liabilities (STL)
	Acid-Test Ratio (ATR)	(Current Assets– Inventory) / STL
	Cash Ratio (CASH)	Liquid Assets + Marketable Securities /STL
Financial Structure Ratios	Financial Leverage Ratio (FL)	Total Debt / Total Passive
	Short Term Liabilities / Total Assets (STL)	STL / Total Assets
	Long Term Liabilities(LTL) / Total Assets	UVYK / Total Assets
	Financial Ratios (FINR)	Equity / Total Debt
Activity Ratios	Inventory Turnover (IT)	Cost of the Sales / Average Inventories
	Accounts Receivable Turnover (ART)	Net Sales / Average Trade Receivables
	Asset Turnover (AT)	Net Sales / Total Assets
Profitability Ratios	Net Profit Margin (NPM)	Net Profit/Sales
	Return on Equity(ROE)	Net Profit/ Equity
	Return on Assets (ROA)	Net Profit / Total Assets
Stock Performance Ratios	P /E Ratio (PE)	Price / Earnings
	M /B (MB)	Market to book value ratio
	EPS	Earnings Per Share

The variables used in the model are stated in Table.2. Totally 288 observation of 36 firms that are in 8 years are included in the model. Variables are expressed in terms of ratios.

3.2. Method

Whether the dependent variable –Firm Value- is explained by independent variables –financial ratios- or not is analyzed in this study. When the facts that the data is horizontal section, that the data cannot form a constant regression line and that the statistical meanings of partial regression models are small are considered, usage of panel data method was obligatory. By means of panel data analysis horizontal data can be dealt as a whole and regression equation can be predicted (Baltagi 2004, 4-9). The panel used has the qualification of balanced panel data and the regression models that are to be predicted are presented below:

$$FV_{it} = \alpha_i + \beta_1\, CR_{it} + \beta_2\, ATR_{it} + \beta_3\, CASH_{it} + \beta_4\, FL_{it} + \beta_5\, STL_{it} + \beta_6\, LTL_{it} + \beta_7 F\dot{I}NR_{it} + \beta_8 IT_{it} + \beta_9 ART_{it} + \beta_{10}\, AT_{it} + \beta_{11}\, NPM_{it} + \beta_{12}\, ROE_{it} + \beta_{13}\, ROA_{it} + \beta_{14}\, PE_{it} + \beta_{15}\, MB_{it} + \beta_{16}\, EPS_{it} + e_{it}$$

The model is based on the effect of financial ratios on firm value. Our hypotheses are:

H_o: Financial ratios have no effect on firm value.

H_1: Financial ratios have effect on firm value.

4. Analysis and Findings

4.1. Analysis

In the first step of the analysis, whether the series are stationary or not was determined by applying unit root test to each variable. A great number of panel unit root tests were developed in order for searching the stationary between panel series. In the study, of the root tests, Levin, Lin, and Chu (LLC) (2202), Im, Pesaran, and Shin (IPS) (2003), Generalized Dickey Fuller (ADF) (1979) tests were used. While null hypothesis about the existence of common unit root is tested in Levin, Lin, and Chu test, null hypothesis about the existence of individual unit root is tested in Im, Peseran, and Chin test. In addition to this, the existence of panel unit root is tested by ADF test in the series (Yıldız *et al.* 2010, 100). EViews 6.0 econometric package is used in the analysis. The test results of panel unit root test are exhibited in Table.3.

Table 3. Test Result of panel unit root

Variables	Methods					
	LLC		ADF		IPS	
	Statistical Values	Probability values	Statistical Values	Probability values	Statistical Values	Probability values
FV	-183.535	0.0000	197.995	0.0000	-712.549	0.0000
CR	-113.001	0.0000	127.705	0.0001	-303.412	0.0012
ATR	-964.611	0.0000	132.807	0.0000	-266.341	0.0039
CASH	-181.334	0.0000	142.579	0.0000	-390.623	0.0000
FL	-148.820	0.0000	152.674	0.0000	-468.525	0.0000
STL	-386.099	0.0000	204.396	0.0000	-103.841	0.0000
LTL	-867.310	0.0000	102.907	0.0064	-199.791	0.0229
FİNR	-785.246	0.0000	102.783	0.0101	-190.666	0.0283
IT	-122.726	0.0000	187.187	0.0000	-658.652	0.0000
ATR	-115.929	0.0000	129.997	0.0000	-367.054	0.0000
AT	-209.621	0.0000	172.322	0.0000	-617.395	0.0000
NPM	-936.530	0.0000	139.538	0.0000	-351.615	0.0002
ROA	-831.137	0.0000	134.589	0.0000	-319.653	0.0007
ROE	-243.847	0.0000	191.393	0.0000	-769.220	0.0000
PE	-104.411	0.0000	170.827	0.0000	-136.057	0.0000
MB	-566.108	0.0000	156.347	0.0000	-365.777	0.0001
EPS	-291.400	0.0000	140.364	0.0000	-738.667	0.0000
The results obtained are assessed 5% significance.						

The hypotheses are set for each test as seen below:
H_0: There is a general unit root in the series.
H_1: There is no general unit root in the series.

When the panel unit root test results are examined, it is generally seen that unit root does not exist in series. As seen in Table 3, since p values are lower than critical value 0.05, the H_0 hypothesis that states the series includes unit root has been declined. The relation between the variables can be predicted by means of panel data prediction methods after determining that the series are fixed. So as to predict the relation between the variables, there are 2 different basic panel prediction methods in terms of hypothesis about how the fixed term is. The fixed is same for all sections in the method of least squares (Karaca, and Vergil 2010, 1213).

There are 2 methods assuming that the fixed may change in accordance with sections. These methods are Fixed Effects Method and Random Effects Methods. Which of these two methods “fixed effect” (the prediction of a different fixed coefficient for each unit taking place in the panel) or “random effect” (obtaining the prediction of a different fixed coefficient for each unit in the panel randomly) (Yapraklı 2008, 307) is going to be valid is determined by Hausman Test.

Hausman Test Hypothesis is set in order to determine either Fixed Effects or Random Effects are to be chosen.

H : Random effects exist.
H_1: Random effects do not exist.

Table 4. Hausman test results (Sectional Data Random Effects Test)

Test Summary	Ki-Square Statistics	Ki-Square Probability degree	Probability
Random Section	18.937119	16	0.2719

As seen in the Table 4 the probability degree is above 5% and therefore zero hypotheses cannot be rejected, in other words, random effects are observed in horizontal sections and time dimension. As a result, panel regression analysis is to be analyzed via bidirectional random effects method. Before the panel regression analyses, whether there is an autocorrelation in data series has been examined by Breusch-Godfrey LM test. The Hypotheses of Breusch-Godfrey LM test:

H_0: There is an autocorrelation.

H_1: There is no autocorrelation.

Table 5. Breusch-Godfrey Serial Correlation LM Test

F-Statistics	4.423651	Probability F(1.270)	0.0364
Obs*R- Square	4.642499	Prob.Chi-Square(1)	0.0312

F-statistics = 4.423651, p–value = 0.0364<0.05, H_0 (Absence Hypothesis) is to be rejected, namely there is an autocorrelation.

The existence of heteroskedastic in this model means that misestimating of the variances by parameter predictors and this leads the interval estimation, t and F tests (that are going to be done) to be incorrect (Sümer 2006, 18).

Whether variability skedascity problem can be observed or not is assessed by Heteroskedascity test. Hypothesis:

H_0: Surpluses have constant variance.

H_1: Surpluses have heteroskedascity.

Table 6. Results of White Heteroskedasticity

F-Statistics	0.219080	Probability F(16.271)	0.9995

As F-statistics = 0.720574, p–value = 0.9995>0.05, H_0 will be accepted and statistically surpluses have constant variance in the level of significance.

The problem of heteroskedascity is not faced in the model. Autocorrelation problem in the model is solved by correcting the standard errors by White's cross-section coefficient covariance method. By means of this method not only different error variances in each cross-section but also the correlation problem between cross-sections are to be solved (Yıldız *et al*. 2010, 102).

4.2. Findings

Panel Data Analysis results composed for financial ratios variables explaining firm value variable are shown in Table 7.

Table 7. Panel data analysis results

Dependent Variable: FV				
Method: Panel EGLS (Cross-section random effects)				
Sample: 2002 2009				
Periods included: 8				
Cross-sections included: 36				
Total panel (balanced) observations: 288				
White cross-section standard errors & covariance (d.f. corrected)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	1.803.695	0.740531	2.435.680	0.0155
ART	0.000114	2.54E-05	4.478.114	0.0000
AT	-0.309004	0.236119	-1.308.680	0.1918
ATR	-0.046171	0.107764	-0.428440	0.6687
FL	0.347838	5.300.398	0.065625	0.9477
CR	0.087622	0.143451	0.610814	0.5418
FINR	-0.096575	0.077616	-1.244.269	0.2145
PE	-0.000183	0.000627	-0.292529	0.7701
EPS	0.156931	0.173337	0.905351	0.3661
STLO	-1.653.221	5.489.838	-0.301142	0.7635
CASH	-0.078220	0.125595	-0.622798	0.5339
MB	-0.029949	0.040158	-0.745790	0.4564
ROA	-0.628185	1.896.877	-0.331168	0.7408
ROE	-0.005457	0.001433	-3.807.656	0.0002
NPM	0.383977	0.614967	0.624387	0.5329
IT	-4.91E-05	2.37E-05	-2.066.814	0.0397
LTL	0.549489	5.212.632	0.105415	0.9161
R-squared	0.194886	Mean dependent var		1.153.576
Adjusted R-squared	0.147352	S.D. dependent var		4.486.405
S.E. of regression	4.142.700	Sum squared resid		4.650.891
F-statistic	4.099.892	Durbin-Watson stat		2.424.252
Prob(F-statistic)	0.000000			

As the result of the analysis, R^2 is 0.194886, namely, approximately 20 % of the changes occurring in the firm value which is a dependent variable is explained by the changes in financial ratios that are independent variables.

When the analysis results are considered, F-statistical value is 4.099892 and probability value p is 0.00000. These results point out that R^2 value is meaningful and namely it is not incorrect to say that namely independent variables influence dependent variable in the level of 20% together. In addition, when examined, F statistics value is more than 4 and this shows that the independent variables chosen are correct.

When analyzed in general, the hypothesis of the study "H_1: Financial ratios have an effect on the firm value." is seen to be accepted. The effects of financial ratios on firm value are seen in Table.8.

Table 8. The effect of financial ratios on firm value

Variables	Findings		The Relation with Firm Value	The Direction of Firm Value
	Coefficient	0.000114		
ATR	T statistics value	4.478114	SIGNIFICANT	POSITIVE
	P probability value	0		
	Coefficient	-4.91E-05		
IT	T statistical value	-2.066814	SIGNIFICANT	NEGATIVE
	P probability value	0.0397		
	Coefficient	-0.005457		
ROE	T statistical value	-3.807656	SIGNIFICANT	NEGATIVE
	P probability value	0.002		

5. Conclusion

In this study, the relation between the financial ratios and firm value is tested by means of panel data analysis. In the analysis, dependent variable is firm value; independent variable is financial ratios. When analyzed in general, as the result of panel data analysis, the hypothesis of the study "H_1: Financial ratios have an effect on the firm value." is seen to be accepted.

When the results of panel data analysis are regarded, the hypothesis "Financial ratios have an effect on firm value" is supported at the rate of 20%. That is, financial ratios explain and influence the firm value at the rate of 20%.

When the ratios related to firm value, it has been defined that Accounts Receivable turnover is meaningful and positive; Stock turnover is meaningful and negative; Equity Capital productivity is meaningful and negative. There is no relation between other financial ratios used in the analysis and firm value.

References

[1] Baldemir, E., Süslü, B. 2008. The Effect of Fırms' Short Run Dept on the Prıce Varıatıon of Assets The Modıglıanı-Mıller Theory. *Dokuz Eylül Üniversitesi İktisadi Ve İdari Bilimler Fakültesi Dergisi*, Vol.23, no.2: 259-268.

[2] Baltagi, B. 2004. *Econometric Analysis of Panel Data*, Third Edition, New York: John Wiley and Sons.

[3] Chambers, N. 2009. *Firma Değerlemesi*, Beta Yayınları, İstanbul.

[4] Cheng, Yu-Shu, Yi-Pei, Liu, and Chu-Yang, Chien 2010. Capital Structure and Firm Value in China: A Panel Threshold Regression Analysis. *African Journal of Business Management*, Vol. 4, no.12: 2500-2507.

[5] Chowdhury, A., Suman, P. Chowdhury. 2010. Impact of Capital Structure on Firm's Value: Evidence From Bangladesh, *Business and Economic Horizons*, Vol. 3, Issue3: 111-122.

[6] Dickey, D.A., Fuller, W.A. 1979. Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*. Vol.74: 427-431.

[7] Eugene F., Kenneth, R.1998. Taxes, Financing Decisions and Firm Value. *The Journal of Finance*, Vol. 53, Issue3: 819-843.

[8] Ferri, M.G.,Wesley, H.J. 1979. Determinants of Financial Structure: A New Methodological Approach, *The Journal of Finance*, Vol.34, No 3: 631-644.

[9] Im, K.S., Pesaran, M.H., Shin, Y. 2003. Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*. Vol. 115: 53-74.

[10] Karaca, C.,Vergil, H. 2010. The Effects of International Capital Movements through Developing Countries on Economic Growth: The Panel Data Analysis, *Ege Akademik Bakış*, Cilt No: 10, Sayı 4: 1207-1216.

[11] Levin, A., Lin, C.F., Chu, C.S.J. 2002. Unit Root Tests İn Panel Data: Asymptotic and Finite-Sample Properties. *Journal of Econometrics*. Vol.108: 1-24.

[12] Martini, D.M., Rahfiani, K. 2009. The Effect of Financial Ratios, Firm Size and Cash Flow from Operating Activities in the Interim Report to the Stock Return. *Chinese Business Review*, Vol.8, no.6: 44-55.

[13] Masulis, R.W. 1983. The Impact of Capital Structure Change on Firm Value: Some Estimates. *The Journal of Finance*, Vol.38, no.1: 107-126.

[14] Sümer, Kağan K. 2006. White'nin Heteroskedisite Tutarlı Kovaryans Matrisi Tahmini Yoluyla Heteroskedasite Altında Model Tahmini, Ekonometri Ve İstatistik Dergisi, Sayı 4: 12-28.

[15] Yapraklı, S. 2008. The Effect of Institutional Structure on Economic Growth: An Application for Upper-Middle Income Countries. *Ege Akademik Bakış Dergisi*, pp. 301-317.

[16] Yıldız, B., Korkmaz, T., Gökbulut, İlker R. 2010. Testing the validity of CAPM in ISE national 100 index with panel data analysis, Vol. 39, no 1: 95-105, İstanbul Üniversitesi İşletme Fakültesi Dergisi.

EXPLORING THE EFFECT OF TRADE BALANCE AND INDUSTRIAL PRODUCTIONS ON NATIONAL DEBT

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Abstract:
The goal of the current research is to examine structural determinants of national debt levels. Mainstream economic theory holds government revenues and expenditures as the major causes of budget deficits and the accumulation of national debt. This paper adopts a somehow different approach, considering industrial production and trade balance as major causes of a country's debt. In order to test the validity of this hypothesis, it examines the relationship between national debt, government revenues and expenditures, industrial production and trade balance in an econometric model. The data used come from Eurostat and they concern 26 European economies.

Keywords: national debt, trade balance, industrial production, panel data analysis.

JEL Classification: E23, H62, H63

1. Introduction

The goal of the current research is to examine structural determinants of national debt levels. Mainstream economic theory holds public spending as the major cause of budget deficits and the accumulation of national debt. This paper adopts a somehow different approach, considering industrial production and trade balance as major causes of a country's debt. In order to test the validity of this hypothesis, it examines the relationship between national debt, industrial production, trade balance and government revenues and expenditures in an econometric model using data from 26 European economies.

2. The Greek case

The main motive for the current research lies in the intense deficit and debt problem faced by the Greek economy. The Greek annual deficit grew from 5 € billion in 2000, to 36 € billion in 2009 (7fold), while the value of the country's GDP grew from 137 € billion in 2000, to 235 € billion in 2009 (2fold). As a result the value of the country's public debt grew from 140 € billion (103.4% of GDP) in 2000, to 298 € billion (126.8% of GDP) in 2009. Faced with a huge deficit and debt problem, the Greek economy has a hard time convincing capital markets about its ability to repay loans. This is translated in higher interest rates, which inflate the lending cost and undermine the country's long term financial and political stability.

The balance of government revenues and expenditures is considered as the primary factor for the creation of budget deficits and the accumulation of public debt. When government expenditures outweigh revenues, the government has to face the deficit problem by turning to capital markets for borrowing funds. The height of the Greek governments' expenditures as % of GDP lied between 44% in 2000 and 53% in 2009. The average value of government expenditures for the 26 countries examined was 44.7%. By this observation we can conclude that the height of Greek government expenditures, as % of GDP, is not significantly higher than the rest of the countries examined. The highest % of GDP for government expenditures is observed in Sweden, 58% in 1998 and 55% in 2009, but this country is not faced with an intense debt problem (69% of GDP in 1998 and 41.9% in 2009). Regarding government revenues, again the difference between Greek government's revenues for the 12 year period, do not vary significantly from the European average. The average value of government revenues as % of GDP for the 26 economies examined was 43.2%, while for Greece it was 39.8%. These observations provide the motive for examining other factors that may affect yearly deficit and public debt levels, which are often overlooked by domestic economists.

Greece has a very low industrial production value as %age of GDP - only 24%, which is the lowest from the 26 countries examined. The value of the goods and services produced in 2009 was only 47 € billions. The rate of 24% is far from the 26 countries' average industrial production value as %age of GDP, which is 60%. The maximum value is met in Czech Republic, were industrial production value reached 120% of GDP in 2009. Moreover Greece's low industrial production has a declining rate since 2003 (from 26% of GDP to 20% in 2009). This can also be observed by the country's Index of Industrial Production (2005=100) (Table 1).

Table 1. Greek Index of Industrial Production 2000-2010

Year	I.I.P. (2005=100)
2010	83.88
2009	89.86
2008	98.72
2007	103.21
2006	100.91
2005	100.02
2004	101.65
2003	101.09
2002	100.46
2001	100.34
2000	103.77

Source: Eurostat.

The values of the Index present a steady yearly decline, particularly during the last 3 years, with a decrease of 17% from the 2005 value.

The trade gap is another structural problem of the Greek economy which is related with the decline in industrial production. Because domestic industrial production is so low, the country has to turn to imports in order to satisfy the needs of the domestic market. This, in combination with the fact that the country's exports are very low, creates a large trade deficit. This was -17 € billion in 1998 and -28 € billion in 2009 (reaching -48 € billion in 2008). As % of GDP the trade deficit average value for the 12 years examined (1998-2009) was -15.5%. The average value of trade balance for the 26 countries examined was -5% of GDP, with a minimum value of -35% of GDP (Cyprus for the year 2008) and a maximum of 17% (Norway for year 2008).

The question that arises from these observations is the following: is there a connection between public debt, industrial production and trade balance? In order to answer this question we apply a multiple regression model based on panel data with debt as the dependant variable and trade balance, industrial production, government revenues and expenditures as the independent ones.

3. Literature review

The current economic crisis gave an incentive to the shift the focus of the literature on the topic of public or government debt. A quite interesting attempt was made by Neck, R., and Sturm, J.E. (2008) who edited a book that questions the public debt's sustainability in relationship with a growing public sector. Research sample were EU countries and the USA, and the main goal was to find out whether the development of public debt in the United States and six EU countries was sustainable--that is, whether fiscal policies in these countries can be continued without creating the potential for government bankruptcy. The sustainability of public debt should be dealt with as a challenge not only to public policy design but also to economic theory. Findings showed that, apart from Italy, the rest of the sample countries could control their sustainable public debt and were able to return to a sustainable path after a period of unsustainability.

The problem of managing public debt was analysed by Nadim Hanif M. (2002) focusing on the public debt of Pakistan. Similarities with the Greek case can be found in the fact that, instead of applying fiscal measures, the government of Pakistan resorted to borrowing in order to finance the deficit. Therefore, there was an increase in liabilities which, in combination with poor debt management, resulted in a serious economic problem. The researcher believes that public debt is not so much a big problem per se, but it is its management that counts, in order to make it sustainable.

Another major topic is that of economic growth in countries affected by the economic crisis. Presbitero, A.F. (2010) focuses on the current economic crisis and he tries to investigate the impact of public debt on growth in advanced and emerging countries. His results show that, on a panel of low- and middle-income countries over the period 1990-2007, public debt has a negative impact on output growth up to a threshold of 90 % of GDP, beyond which its effect becomes irrelevant. This non-linear effect can be explained by country-specific factors since debt overhang is a growth constraint only in countries with sound macroeconomic policies and stable institutions.

Hervey, and Merkel (2000) examined the effect of the US trade deficit on the economy. They conclusions were that the effects of the trade deficit were not necessarily negative for the US economy. The increase in goods imports was justified by the fact that most of the imported goods were used in the production of capital goods. Consequently increased imports were used in order to increase productivity and restructure the spectrum of the US industry. Increased borrowing was also justified by this fact, with borrowed funds taking the form of an investment in order to fund new industrial production. In the case of the EU, Koukouritakis (2003) attempted to estimate the effects on Greek trade balance due to the EU accession. He used a full trade model, since Greece relies on imported inputs for export production. The study notes that after the accession, the country had to liberalize its trade by abolishing all barriers, such as tariffs, quotas, financial stringencies, indirect taxes on imports and export subsidies. The gradual abolition of all protective and promoted measures on trade after the EU accession increased the trade deficit. As far exporting is concerned, the effects due to the abolition of export subsidies were quite small. After the EU accession, imports substituted for a large part of the country's domestic production, an effect that implies trade creation and improvement in terms of static welfare.

4. Methodology

Model Specification

The model used has the following form:

(1) DEBT = ***f*** (TRDBAL, INDPRO, GOVEXP, GOVREV)

The model's basic assumption is that a country's general government debt (DEBT) is affected by the value of its trade balance (TRDBAL), industrial production (INDPRO), government expenditures (GOVEXP) and government revenues (GOVREV). Trade balance, industrial production and government revenues are expected to be negatively correlated with debt, while government expenditures are expected to be positively correlated.

Data Sources. All the data used come from the European Statistical Agency's (Eurostat) statistical database. The data used concern the following 26 European economies: Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom and Norway and they regard 12 consequent years, from 1998 to 2009. Missing values were treated by using the average value for in-between missing values and the value of the previous or following year for the rest. %age of missing values was 1.8% (29 values out of 1560), and most of them were met in the industrial sector production values (manufacturing, mining and quarrying and electricity, gas and water supply) than had to be added in order to calculate total production value for each country.

Variable Specification

DEBT (DEBT). Debt was measured by each country's consolidated general government gross debt at nominal value outstanding at the end of the year, as %age of its Gross Domestic Product. In Eurostat the general government sector comprises central government, state government, local government, and social security funds. Debt is valued at nominal value and foreign currency debt is converted into national currency using end-year market exchange rates. GDP used as a denominator is the gross domestic product at current market prices. GDP is the basic measure of a country's overall economic health and it is equal to the sum of the gross value-added of all resident institutional units (i.e. industries) engaged in production, plus any taxes, and minus any subsidies, on products not included in the value of their outputs.

TRADE BALANCE (TRDBAL). Trade balance for each country was measured as the value of its trade balance (positive or negative) (in millions of Euros) as % age of its GDP. The balance of trade is the difference between the monetary value of exports and imports of output in an economy over a certain period. A positive balance is known as a trade surplus if it consists of exporting more than is imported; a negative balance is referred to as a trade deficit or, informally, a trade gap. The value of trade balance used includes both goods and services.

INDUSTRIAL PRODUCTION (INDPRO). Industrial production was measured by each country's value of industrial production as % age of its GDP. Industrial production value was calculated as the sum of the values generated by 3 industrial production sectors: manufacturing – mining, quarrying and electricity - gas and water supply. As the total industrial production value was not available in the Eurostat website, the values of the three sectors had to be added in order to calculate it. These 3 sectors are also used by Eurostat for the calculation of the Index of Industrial Production. However, the values from the Eurostat database for the 3 sectors' production value were available until 2007. In order to calculate the production value for the missing years (2008, 2009) the sum of the 3 sectors was multiplied by the % age change of the Index of Industrial production (2005=100), which was available from EUROSTAT.

GOVERNMENT EXPENDITURES (GOVEXP). The government expenditures variable was measured by each country's total general government expenditure as % age of its GDP. Total general government expenditure refers to all the money spent by a country's government.

GOVERNMENT REVENUES (GOVREV). The government revenues variable was measured by each country's total general government revenue as % age of its GDP. According to Eurostat, total general government revenues refer to all the money collected by a country's government from the following sources: market output, output for own final use, payments for the other non-market output, taxes on production and imports, other subsidies on production, receivable property income, current taxes on income, wealth, etc., social contributions, other current transfers and capital transfers.

Table 2. Descriptive Statistics

Variable	DEBT	TRDBAL	INDPRO	GOVEXP	GOVREV
Countries	26	26	26	26	26
Years	12	12	12	12	12
Observations	312	312	312	312	312
Min	3,7	-35,4	17,7	33,2	31,7
Max	126,8	4,31	120,6	58,8	59,6
Mean	48,4	-9,5	60,6	44,7	43,2
Standard Deviation	27,7	8,19	18,5	5,9	6,9
Description	General government debt as % of GDP	Value of trade balance as % of GDP	Industrial production value as % of GDP	Total government expenditures as % of GDP	Total government revenues as % of GDP
Data Source	Eurostat database	Eurostat database	Eurostat database	Eurostat database	Eurostat database

5. Results

The regression results were as follows:

Table 3. Regression results

	Estimated results	
	Standardized Coefficients	**t values**
constant c	-36,015	-2,082**
trade balance %	0,118	1,459*
industrial production %	-0,118	-2,143**
government expenditure %	0,765	10,092***
government revenue %	-0,360	-3,935***

R	R square adjusted	St. error of the estimate	DW statistic	F statistic	Significance
0.581	0.329	22,49	0,225	39,168	0

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

By substituting the results of the panel analysis we get:

$$Debt_t = c + b_1 trdbal + b_2 indpro + b_3 gov\ exp + b_4 govrev \Rightarrow$$
$$\Rightarrow Debt_t = -36{,}015 + 0{,}118 trbal - 0{,}118 indpro + 0{,}765\ gov\ exp - 0{,}360 govrev \quad (1)$$

The method used in the analysis of the panel data model is the fixed method. The goal is to analyze the impact of each explanatory variable on the dependant variable, meaning national debt levels. Firstly it can be noticed that the econometric evaluation of the results imply that there is a satisfactory level of goodness of fit (R square), while the F statistic denotes an overall significance of the regression. The standard error of the estimation is not very large. Bearing in mind that standard errors measure the statistical reliability of the coefficient estimates, and that the larger the standard errors, the more statistical noise in the estimates, the results are acceptable.

The estimates of government revenues and industrial production seem to have a weak negative effect on government debt, while trade balance and government expenditures a positive one.

By observing the regressions residuals plot it can noticed that there is no heteroskedasticity problem, and by looking at the VIFs (Variance Inflation Factors) it can be concluded that there is no multicollinearity problem. However, the concern for autocorrelation sings is verified by the low DW statistic of 0.225. Autocorrelation is a problem frequently met in time series models, created by the lack of stagnation in the data and can also be verified by the fact the R square is higher than the DW value (Chalkos 2006).

The proposed remedy for this problem is the use of the first differences. This means that the 1st observation of the dependent variable will be $\Delta Y = Y_t - Y_{t-1}$, while for the dependent variables will be $\Delta X = X_t - X_{t-1}$, the 2nd observation $\Delta X = X_{t-1} - X_{t-2}$, and so on. In its general form, our model will be:

$$Debt_t - Debt_{t-1} = c + \beta_2 (trbal_t - trbal_{t-1}) + \beta_3 (inpro_t - inpro_{t-1}) + \beta_4 (govexp_t - govexp_{t-1}) + \beta_5 (govrev_t - govrev_{t-1}) + (u_t - u_{t-1}) \quad (2)$$

The results of the regression using the first differences method are:

Table 4. Regression results using first differences

			Estimated results		
			Standardized Coefficients		**t values**
constant c			-0,213		-0,388
trade balance %			0.118		2,221**
industrial production %			-0.076		-1,462
government expenditure %			0.537		8,445***
government revenue %			-0,144		-2,483**
R	**R square adjusted**	**St. error of the estimate**	**DW statistic**	**F statistic**	**Significance**
0.548	0.291	-	2.046	32,767	0

*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

Even though the signs of the coefficients did not change, the econometric tests improve dramatically, focusing on the DW statistic and the F statistic (the SE value was not given by the statistical program). Since the danger of autocorrelation and heteroskedasticity is eliminated, we can carry on with the results' explanation.

The trade balance variable has a positive coefficient (0,118), which means that according to the tests, trade balance has a positive effect on national debt levels. Even though this variable was expected to have a negative effect on national debt, the tests have shown that as trade balance rises, debt levels rise as well. The initial hypothesis, that as a country improves its trade balance it reduces its national debt, is not verified by the data.

The industrial production variable estimated coefficient (-0,076) reveals that there is negative correlation between national debt and industrial production. As industrial production rises, national debt levels decrease. The initial hypothesis about the negative relationship between the two can be verified. The government expenditures variable has a positive relationship with public debt, as expected. The more government expenditures rise, the larger is the need for borrowing and the larger the consequent accumulation of national debt.

Finally, the government revenues variable has a negative effect on national debt, also as expected. This means that the more government revenues rise, the more national debt decreases.

Robustness of the results. The results of the regression were checked for multicollinearity, heteroskedasticity and autocorrelation problems. The autocorrelation problem noticed in the first regression was corrected by applying the first differences method. The lack of multicollinearity can be verified by the low VIFs (Variance Inflation factors), which are all under 2. The lack of heteroskedasticity can be verified by the regression's residuals plots. Appendix 1 presents the residuals distribution, and as it can be seen from the graph the residuals are distributed normally. Appendix 2 presents the relationship between the dependent variable (DEBT) and the residuals. Appendix 3 is the residuals scatter-plot diagram, from which it can be observed that the residuals are indeed distributed randomly around 0.

6. Conclusions

The goal of the current study was to test the effect of trade balance, industrial production and government expenditures on public debt levels. The conclusions of the study can be drawn from the regressions' results. Industrial production was found to have a negative effect on public debt, meaning that an increase in industrial production value can lower public debt levels. Government revenues were found to have a negative effect on public debt levels, meaning that an increase in government revenues can also decrease public debt. Government expenditures were found to have a positive effect on public debt levels, meaning that an increase in government expenditures can increase public debt. Trade balance was expected to have a negative effect on public debt, however this hypothesis cannot be verified form the regression results. The validity of the test's results can be verified in a future research, by expanding the sample and by using data from non-European countries as well.

References

[1] Chalkos, G. 2006. *Econometrics, Theory and Practice: Instructions for Eviews,* Minitab, SPSS & Excel, Gkiourdas.

[2] Creel, J., Saraceno, F. 2009. Wealth effects and public debt in an endogenous growth model, Documents de Travail de l'OFCE from Observatoire Francais des Conjonctures Economiques (OFCE), no. 2009-35.

[3] Eurostat. 2011. http://epp.eurostat.ec.europa.eu (accessed November 1st 2011).

[4] Hanif Nadim, M. 2002. Public Debt Management. MPRA paper no. 10212, University Library of Munich-Germany. pp. 40-72.

[5] Hervey, J.L., Merkel, L.S. 2000. A Record Current Account Deficit: Causes and Implications. *Economic Perspectives*, 24(4): 3-12.

[6] Koukouritakis, M. 2003. Trade effects due to the EU accession: the case of Greece. University of Cyprus - Department of Economics, discussion paper 2003-05.

[7] Misztral, P. 2010, Public Debt and Economic Growth in the European Union*. Journal of Applied Economic Sciences*, 5 (3): 292-302.

[8] Neck, R., Sturm, J.E. 2008. *Sustainability of Public Debt*, Vol. 1, MIT Press Cambridge, Massachusetts London, England.

[9] Presbitero, A.F. 2010. Total public debt and growth in developing countries, Centro Studi Luca D' Agliano, Development Studies-Working papers, no. 300.

APPENDICES

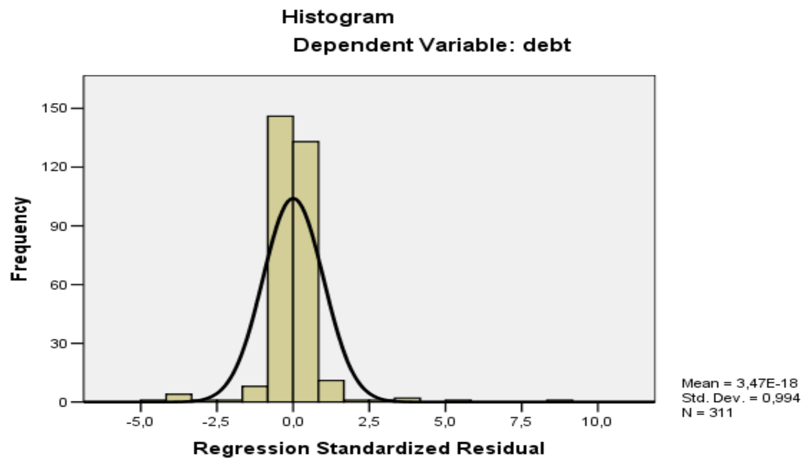

Figure 1. Residuals distribution histogram

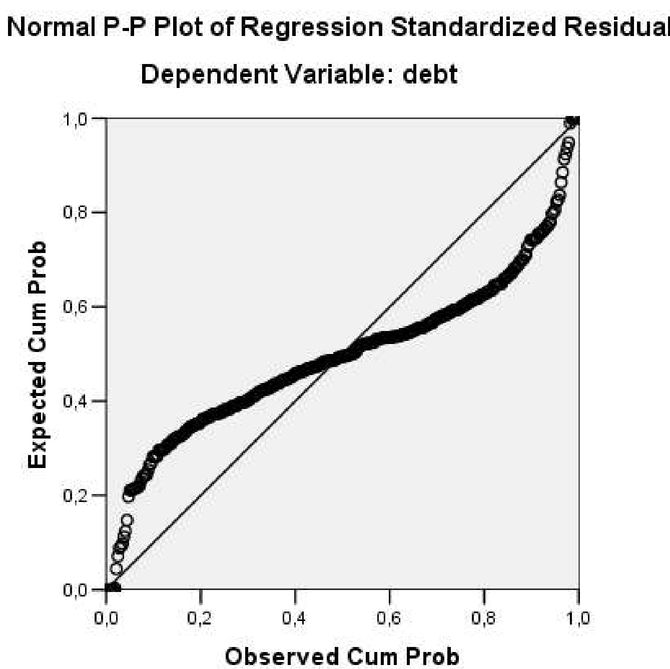

Figure 2. Regression's standardized residuals diagram

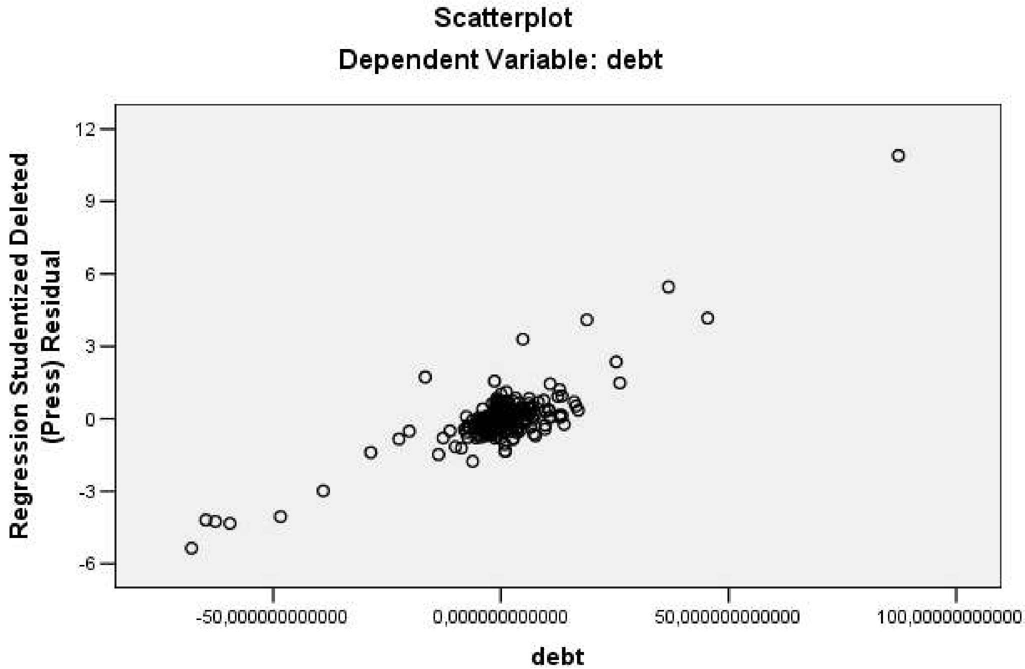

Figure 3. Residual dispersion diagram

EVALUATION OF DEPENDENCE OF OCCURRENCE OF RISK EVENTS IN LOGISTICS ON RISK FACTORS BY MEANS OF SOMERS' D COEFFICIENT

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Abstract:

The objective of this article is an empirical measurement of the dependencies of selected ordinal variables in order to obtain incentives for risk management in logistics. The article is aimed at assessing an asymmetric dependency of two variables, namely the dependence of occurrence of risk events in logistics on risk factors. Somers' d coefficient was used to measure the dependence, as it is the only one allowing unilateral dependence measurement. The article provides detailed explanation of the procedure used to calculate the Somers' d coefficient (calculated using partial calculations of the number of concordant and discordant pairs etc.) and its subsequent evaluation in terms of reliability (using significance level 1%, 5% and 10%). The resulting values are presented in several tables, depending on the used evaluation criteria - risk factors in logistics with the greatest dependence with the significance level of 1%, the most important groups of risk factors and risk factors with repetition for at least four risk events. The testing was performed using data collected through the medium of a questionnaire survey conducted in 2010 within the scope of SGS in the Czech Republic and Slovakia.

Keywords: asymmetric dependence, Somers' D, risk in logistics.

JEL Classification: C19, M11, M19

1. Introduction

The issue of risk management keeps its permanent position in company management. Its necessity is particularly urgent in the time of overcoming the current economic crisis. The research carried out by SGS (Student Grant Competition), dealing with supply chains with emphasis on the risks and costs and the possibility of using simulation techniques, was based on a questionnaire survey in companies. We have used the questionnaire survey in order to find out what logistic risks the companies are exposed to in terms of their occurrence and impact, which risk factors are seen as the most important, what trends in the occurrence of risk factors they expect in the next three years and what the situation is in risk management when the primary use of prevention tools and cooperation within the supply chain are considered.

The questionnaire survey, in addition to other analyzes (analysis of frequency, variability in response etc.), has shown the need to analyze the dependence of the respondents' answers, particularly asymmetric (unilateral) dependence of risk events on the risk factors, in order to identify the risk factors that are most commonly involved in the formation of specific risk events.

2. Description of the problem and the mathematic formulation

As mentioned above, the objective of this article is to measure the impact of the most significant risk factors on the occurrence of selected risk events in order to obtain the incentives for risk management in logistics.

A risk is defined (ČSN ISO 31000, 2010) as the effect of uncertainty on achieving the objectives. The effect is seen as a deviation from the expected state (positive and / or negative). Risk event arises by the action of a risk factor and the given object. The level of risk is expressed as a combination of effects and the possibility of their occurrence. Risk management process according to ISO 31000 (2010) is a dynamic and iterative process, at the beginning of which the organization's objectives, understanding of the internal and external organization environment and the established criteria for risk assessment are expressed. This is followed by the risk evaluation that includes the risk identification, risk analysis and risk assessment. The process continues by treatment of risks, involving the selection of one or more ways to change the risk, as well as by application of selected measures. The cross-section activities include the communication with both external and internal interested parties about the risks and the measures taken in order to deal with the risks, and monitoring and reviewing all stages of the risk management process.

Mutual dependence of the processes is a typical feature of logistics. Disorders arising in one part of the chain can spread across the entire chain. That is why it is necessary for risk management in logistics to be based on an integral approach and cooperation of the participating subjects. Risk management in logistics, which is characterized by elements of cooperation and coordination, is referred to as Supply Chain Risk Management (Waters 2007). All members of the chain should work together for their mutual benefit in such a way to reduce the overall vulnerability. Waters (2007) recognizes that full integration of supply chain risk management is more of an idealism, which is not attainable, but he urges that the chains should try to get closer to this imaginary target.

Figure 1 shows the group variables which will include the observed dependencies, i.e. the existing risk factors are marked as B and the occurrence of adverse events is named A1. Since in our case, they were ordinal variables for which we want to test the asymmetric (unilateral) dependency, we will deal with Somers' d test in detail.

Somers' d coefficient d_{yx} is calculated using the following formula: (Pecáková 2008)

$$d_{yx} = \frac{C - D}{C + D + T_y} \tag{1}$$

where: T_y represents the number of couples identical only in their *y* value, calculated as:

$$T_y = \sum_i \sum_j n_{ij} \sum_{h>i} \sum_{k=j} n_{hk} \tag{2}$$

C determines the concordant pairs of units in the set (they are created if both variables have higher value for one unit than for the other) and their number is determined as:

$$C = \sum_i \sum_j n_{ij} \sum_{h>i} \sum_{k>j} n_{hk} \tag{3}$$

D presents the number of discordant pairs (in case of these pairs, one variable of one unit has higher and the other one lower values than in case of the other unit). The number of discordant pairs is calculated as:

$$D = \sum_i \sum_j n_{ij} \sum_{h>i} \sum_{k<j} n_{hk} \tag{4}$$

Before we start occupying ourselves with the calculation of the Somers' coefficient itself, it is necessary to define the hypotheses:

Zero hypothesis H_0 = Somers' coefficient $d = 0$, *X, Y are independent;* the risk event is independent on the risk factor.

Alternative hypothesis H_1 = Somers' coefficient $d \neq 0$, *X, Y are asymmetrically dependent; the risk event is dependent on the risk factor.*

In the initial test we are going to determine the dependent and independent variables. The independent variable (marked X) is represented by all risk factors grouped into five categories of risks, namely:

- B1 risks on demand side;
- B2 supply risks (both on the purchase, and distribution side);
- B3 risks of internal processes;
- B4 management risks (internal and inter-company) and finally;
- B5 environmental risks.

Since the risk factors affect the occurrence of adverse events, these events will be considered as a dependent variable (marked Y).

For each value of dependence we also assess the statistical significance. The statistical significance was marked using the symbols of *, **, ***, which are allocated according to the degree of reliability (90%, 95%, 99%). The dependence values without this marking are not statistically significant, i.e. the statistical value of dependence is equal to zero, i.e. independent. The values with more * represent statistical significance with a higher level of reliability.

2.1 Input data

A questionnaire survey has been chosen to obtain the input data, mainly because of the possibility to acquire a wider range of data to be used for sorting and further analysis. The respondents were people from the production, production-distribution or distribution companies working as logistics managers, or purchasing managers or specialists, production or distribution managers. Another criterion used in the selection of respondents was the representation of various elements of the logistic chain, different fields, categories of small, medium and large companies, different types of companies according to the rate of repetition of activities etc.

The questionnaire consisted of six main parts. Due to the content of the article, we will address only 2 selected areas, namely: A1 the occurrence of adverse events and B existing risk factors (both areas consisted of closed questions). Figure 1 describes the relationship between the areas of questions. Area A2 was dealing with the consequences of adverse events; however they were monitored for other purposes. SGS investigators have identified 10 types of adverse events (area A), 5 groups of risk factors and 46 sub-factors (area B) – they have allocated codes according to their affiliation to a group of risk factors.

A1.1	non-fulfilment of negotiated contract terms against customers	A 1 – occurrence of adverse events
A1.2	need to fulfil supplies to customers in parts with increased costs	
A1.3	problems with the quality against customers	
A1.4	lack of inventories	
A1.5	surplus of inventories	
A1.6	depreciation of inventories	
A1.7	rejecting of contracts on account of unrealizable requirements of customers	
A1.8	lack of contracts	
A1.9	incapability to stand prices negotiated with customer	
A1.10	cancelling of semi-finished contracts by customers	

B – risk factors	risks on the demand side	B1
	supply risks (both on the purchase, and distribution side)	B2
	risks of internal processes	B3
	management risks (internal and inter-company)	B4
	environmental risks	B5

Figure 1. Research areas in the questionnaire and the links among them.

Source: the author's figure.

The questionnaire used various combinations of closed and open questions, identifying information about the position of the organization in the structure of the supply chain, about the field of activity, company size, position of the respondent, company ownership etc. A respondent had to express his/her opinion related to a number of statements by selecting certain level from the provided scale for each of the closed questions. In each part, the respondents had a chance to add further statements. The scales of answers have been selected as six-levels in order to limit the tendency of respondents to give average (neutral) response. Each type of question had the most favourable situation represented by level 1, level 6 represented the least favourable situation. For example, part A - Adverse events in logistics - question A1 "Which of the following adverse events have occurred in your company in the last two years?" *The scale of occurrence* is shown in Table 1.

Table 1. Scale of occurrence of adverse events (area A1)

1 – never	4 – often
2 – very rarely	5 – very often
3 – sometimes	6 – all the time

Source: the author's table.

For Part B - Risk factors in logistics and the question "Which of the following risk factors are typical for your company?" The scale was different (see Table 2). There were also other scales in the questionnaire in other areas of questions, but because they are not part of the case being solved, we will not deal with them.

Table 2. Scale of occurrence of risk factors (area B)

1 – not at all	4 - partial (sometimes)
2 – negligible, irregular	5 – prevailing
3 – negligible regular	6 – complete

Source: the author's table.

The respondents were mostly from the Czech Republic and partly from Slovakia. From the total number of 84 returned questionnaires, one was blank, and therefore invalid, one has not been included in the processing by mistake. 82 questionnaires have been processed. The ordinal variables from the returned questionnaires have been put into MS Excel file and the data have been exported to SPSS. This way, a database has been created in SP.

2.2. Problem solution

Due to the time demands and complexity of the Somers' coefficient calculation, its conversion will be illustrated in one case only (namely the dependence of risk events A 1.8 "lack of contracts" on risk factor B1.1 "dependency on a small number of big customers") - the following dependencies will be calculated by SPSS software.

The contingent table (Table 3) shows the dependence of occurrence of risk event A1.8 (lack of contracts) on risk factor B1.1 (dependency on a small number of big customers).

The data selected in contingent table (Table 3) will be used to carry out partial calculations necessary to determine the Somers' coefficient. First, we calculate the number of concordant pairs using the formula (3):

$$\begin{aligned}C &= 3\cdot(5+6+1+1+2+1+4+13+1+2+1+7+13+4+1+3+1)+\\ &3\cdot(6+1+2+1+13+1+2+1+13+4+1+3+1)+1\cdot(1+1+1+2+1+4+3+1)+\\ &3\cdot(7+13+4+1+3+1)+3\cdot(1+3+1)+5\cdot(2+1+13+1+2+1+13+4+1+3+1)+\\ &6\cdot(1+1+2+1+4+3+1)+1\cdot(2+1+1)+1\cdot(13+1+2+1+13+4+1+3+1)+\\ &2\cdot(1+2+1+4+3+1)+1\cdot(2+1+1)+4\cdot(13+4+1+3+1)+13\cdot(4+3+1)+1\cdot(1)+\\ &7\cdot(1+3+1)+13\cdot(3+1)+4\cdot(1)=1104\end{aligned}$$

Table 3. Contingent table of dependencies of occurrence of event A1.8 on risk factor B1.1

		A 1.8						Total
		Never	*Very rarely*	*Sometimes*	*Often*	*Very often*	*All the time*	
B1.1	*Not at all*	3	3	1	0	0	0	7
	Negligible, irregular	0	5	6	1	0	0	12
	Negligible, regular	0	1	2	1	0	0	4
	Partial (sometimes)	3	4	13	1	2	1	24
	Prevailing	3	7	13	4	0	0	27
	Complete	0	0	1	3	1	0	5
Total		**9**	**20**	**36**	**10**	**3**	**1**	**79**

Source: the author's work in SPSS software.

We can continue by defining the number of discordant pairs using the formula (4):

$$D=1\cdot(5+1+3+4+3+7)+3\cdot(3+3)+1\cdot(1+2+3+4+13+3+7+13+1)+$$
$$6\cdot(1+3+4+3+7)+5\cdot(3+3)+1\cdot(3+4+13+3+7+13+1)+2\cdot(3+4+3+7)+$$
$$1\cdot(3+3)+1\cdot(3+7+13+4+1+3+1)+2\cdot(3+7+13+4+1+3)+1\cdot(3+7+13+1)+$$
$$13\cdot(3+7)+4\cdot(3)+4\cdot(1)=574$$

To make the calculation of the Somers' coefficient complete, we also need to calculate item T_y (i.e. number of pairs identical only in Y) – using the formula (2).

$$T_y=3\cdot(3+3)+3\cdot(3)+3\cdot(5+1+4+7)+5\cdot(1+4+7)+1\cdot(4+7)+4\cdot(7)+$$
$$1\cdot(6+2+13+13+1)+6\cdot(2+13+13+1)+2\cdot(13+13+1)+13\cdot(13+1)+13\cdot(1)+$$
$$1\cdot(1+1+4+3)+1\cdot(1+4+3)+1\cdot(4+3)+4\cdot(3)+2\cdot(1)=673$$

Once the entries into formula (1) used to calculate the Somers' coefficient d_{yx} have been completed, we will acquire the final value of the coefficient:

$$d_{yx}=\frac{C-D}{C+D+T_y}=\frac{1104-574}{1104+574+673}=\frac{530}{2351}=0,225$$

Dependence of risk event A1.8 on the risk factor B1.1 reaches the value of 0.225. However, to evaluate the hypotheses, we need to know whether the value of Somers' d is statistically significant or insignificant; and whether the variables X and Y are dependent or independent. To be able to determine the significance of this factor, the SPSS has tested the dependence of occurrence of selected event A1.8 on risk factor B1.1 through the medium of the Somers' d coefficient.

The output of SPSS software is presented in Table 4 which includes both the calculated value of the symmetric dependence and the value of the asymmetric dependence of occurrence of risk event A1.8 on risk factor B1.1, and it is also expresses the statistical significance of the relation. For better orientation in the table, the monitored values of asymmetric dependence are highlighted in gray, while:

- *Value* - calculated Somers' d coefficient which indicates the strength of relation between two variables;
- *Asymptotic Standard Error* (abbreviated as Asymp. Std. Error) – standard deviation of Somers' coefficient (H_0 is not taken into consideration)***;***
- *Approximate T* (abb. Approx. T) – tested value for the evaluation of significance of d statistics (using standard deviation of the coefficient, while H_0 is assumed);
- *Approximate Significance* (abb. Approx. Sig.) – determines the significance of relation strength.

Table 4. Output table of dependence according to Somers' d coefficient in SPSS

Directional Measures						
			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.234	.094	2.420	.016
		A1.8 Dependent	.225	.090	2.420	.016
		B1.1 Dependent	.243	.100	2.420	.016
a. Not assuming the null hypothesis.						
b. Using the asymptotic standard error assuming the null hypothesis.						

Source: the author's work in SPSS software

Symbols: ***, **, * have been assigned manually to the individual dependencies in order to evaluate the statistical significance of relation strength according to the following intervals (see Table 5):

Table 5. Value intervals of Approx. Significance determining the significance of dependence (with concrete level of reliability)

Symbols of significance	Interval for assigning Approx. Sig. of Somers´ d to a level of significance α	Level of significance α	Reliability $1-\alpha$
***	0 =< h ≤ 0,01	0.01	99%
**	0,01 < h ≤ 0,05	0.05	95%
*	0,05 < h ≤ 0,10	0.10	90%
insignificant	0,10 < h		Lower than 90%

Source: the author's table.

Having done all the necessary calculations, we have discovered that the relation $d_{yx} = 0$ *describing the independence of X and Y doesn't work. As a result of that, hypothesis* H_0 *is not correct. It is obvious from Table 4 that the test statistics is located in the critical field W and the p-value is 0.016. We reject zero hypothesis on the basis of this fact and we confirm the alternative hypothesis (d=0.225). Variables X and Y are asymmetrically dependent, and the concrete occurrence of risk event A1.8 depends on a risk factor B1.1. at significance levels of* α *= 0.05 a 0.1.*

We are going to proceed in similar way in examining the dependence of occurrence of risk event A1.8 (and other significant events) on all partial risk factors.

Previous calculations in SPSS (and subsequent analysis of box plots and scatter graphs) have shown that out of 10 risk events the following 7 risk events will be considered as significant: A1.8, A1.7, A1.1, A1.2, A1.3, A1.4 and A1.5.

We have gradually tested the dependence of occurrence of each selected risk event on all 46 risk factors in SPSS through the use of Somers' d coefficient. Test results are presented in the table in Excel (see Annex 1), where all values of dependence of occurrence of risk events on risk factors with defined significance are converted. The results are colour coded – red colour identifies risk factors with ***, orange with **, green with * and the insignificant risk factors are erased for better transparency.

3. Interpretation of results, discussions

3.1 Factors with the greatest impact at significance level of $\alpha = 0.01$

The dependencies with the highest statistical significance (i.e. with symbol ***) have been selected for each of the events and they have been arranged according to the size of asymmetric Somers' d coefficient d in the tables in descending order.

The discovered relation momentum at the highest level of significance has revealed a character of positive dependence and their values ranged from 0.232 *** to 0.668 *** (for B5.8 factor - strikes). The number of factors at the highest level of significance (with ***) ranged from 5 (for events A3 and A7) up to 27 events for A1- non-fulfilment of negotiated contract terms against customers.

Due to a large number of risk factors for specific risk events, we will take into account only those with the real highest dependence value.

The highest dependence of occurrence of risk event A1.8 - Lack of contracts has been calculated for the risk factors (see Table 6.)

Table 6. Impact of the most significant risk factors on event A8 – Lack of contracts according to Somers´ d coefficient

The most important risk factors affecting the event A8 – Lack of contracts	The value of Somer's d test
B4.2 - Insufficient procedures for price calculation and economical effectiveness assessment	0.405***
B4.4 - Unclear responsibility between external partners	0.361***
B3.2 - Low quality against negotiated requirements	0.331***
B3.5 - dependency of processes on the know-how of several key employees	0.315***
B5.2 - Difficulties with loans gaining for covering of logistic costs	0.311***
B4.12 - Unsatisfactory level of the methodology for manufacture planning and processing (long time horizon of planning, slow reactions on changes, missing capacity calculations)	0.308***
B4.3 - Unclear responsibility of logistic chains inside a company	0.294***
B3.6 - Financing of operations	0.274***
B4.14 - Non-utilization of indicators for logistic services level between companies	0.267***
B1.6 - Problems of customers with payments	0.265***
B4.13 - Non-utilization of indicators for logistic services level inside a company	0.242***

Source: the author's table.

Event A1.7 – Rejecting of contracts on account of unrealizable requirements of customers has reached the highest dependence with risk factors presented in Table 7.

Table 7. Impact of the most significant risk factors on event A7 – Rejecting of contracts on account of unrealizable requirements of customers according to Somers´ d coefficient

The most important risk factors affecting the event A7 - rejecting of contracts on account of unrealizable requirements of customers	The value of Somer's d test
B4.14 - Non-utilization of indicators for logistic services level between companies	0.442***
B4.13 - Non-utilization of indicators for logistic services level inside a company	0.389***
B4.12 - Unsatisfactory level of the methodology for manufacture planning and processing (long time horizon of planning, slow reactions on changes, missing capacity calculations)	0.343***
B2.5 - Insufficient of items on market leading to high price	0.256***
B1.2 - High requirements of customers on the terms of delivery	0.245***

Source: the author's table.

For event A1.1 – Non-fulfilment of negotiated contract terms against customers, the most significant risk factors were (see Table 8):

Table 8. Impact of the most significant risk factors on event A1 – Non-fulfilment of negotiated contract terms against customers according to Somers´ d coefficient

The most important risk factors affecting the event A1 – non-fulfilment of negotiated contract terms against customers	The value of Somer's d test
B3.3 - Unreliability of manufacturing facilities, storage systems, information systems	0.478***
B5.8 – Strikes	0.472***
B4.10 - Inadequate system of demand prediction	0.424***
B3.5 - Dependency of processes on the know-how of several key employees	0.396***
B4.12 - Unsatisfactory level of the methodology for manufacture planning and processing (long time horizon of planning, slow reactions on changes, missing capacity calculations)	0.392***
B3.1 - Complexity of internal logistic chains (many processes, flows, components)	0.372***
B3.2 - Low quality against negotiated requirements	0.350***
B3.4 - Error rate of employees in the manufacture, warehouses, and by maintenance	0.342***
B2.9 - Dependency of the flow process on means of transport	0.338***
B2.3 - Long terms of delivery of suppliers with regard to demand changeability	0.331***
B1.2 - High requirements of customers on the terms of delivery	0.327***
B4.4 - Unclear responsibility between external partners	0.322***
B4.1 - Insufficient or low-quality technical documentations of manufacture	0.320***
B5.9 - Treat of mass leavings of employees to firms with better conditions	0.317***
B4.5 - Non-existence of well-documented procedures for orders handling, purchasing, manufacture planning and realizing	0.314***
B4.11 – Small seriousness and objectivity in suppliers selecting and evaluating	0.307***
B2.5 - Insufficient of items on market leading to high price	0.306***
B4.13 - Non-utilization of indicators for logistic services level inside a company	0.306***
B4.6 - Wrong communication between departments of purchase – manufacture – sales	0.304***
B4.3 - Unclear responsibility of logistic chains inside a company	0.302***

The most important risk factors affecting the event A1 – non-fulfilment of negotiated contract terms against customers	The value of Somer's d test
B4.15 - Inadequate measurement and controlling of logistic costs	0.298***
B2.2 – Risk of suppliers' bankruptcy	0.289***
B4.2 - Insufficient procedures for price calculation and economical effectiveness assessment	0.285***
B4.14 - Non-utilization of indicators for logistic services level between companies	0.283***
B1.3 - High and irregular fluctuations in demand	0.262***
B2.4 - Problems with the service level of deliveries (quality, delivery terms reliability, quantity, cover documents)	0.253***
B4.9 - Insufficient level of inventory management system (evidence and replenishment)	0.250***

Source: the author's table.

Occurrence of risk event A1.2 – Need to fulfil supplies to customers in parts with increased costs, is influenced by risk factors (see Table 9):

Table 9. Impact of the most significant risk factors on event
A2 – need to fulfil supplies to customers in parts with increased costs according to Somers´ d coefficient

The most important risk factors affecting the event A2 – need to fulfil supplies to customers in parts with increased costs	The value of Somer's d test
B3.3 - Unreliability of manufacturing facilities, storage systems, information systems	0.349***
B4.11 – Small seriousness and objectivity in suppliers selecting and evaluating	0.308***
B3.2 - Low quality against negotiated requirements	0.281***
B3.5 - Dependency of processes on the know-how of several key employees	0.278***
B3.1 - Complexity of internal logistic chains (many processes, flows, components)	0.273***
B4.3 - Unclear responsibility of logistic chains inside a company	0.258***
B4.1 - Insufficient or low-quality technical documentations of manufacture	0.255***
B3.4 - Error rate of employees in the manufacture, warehouses, and by maintenance	0.245***
B1.2 - High requirements of customers on the terms of delivery	0.242***

Source: the author's table.

In case of event A1.3 – Problems with the quality against customers, the most significant risk factor is (see Table 10):

Table 10. Impact of the most significant risk factors on event
A3 – problems with the quality against customers according to Somers' d coefficient

The most important risk factors affecting the event A3 – Problems with the quality against customers	The value of Somer's d test
B3.2 - Low quality against negotiated requirements	0.326***
B3.5 - Dependency of processes on the know-how of several key employees	0.247***
B3.4 - Error rate of employees in the manufacture, warehouses, and by maintenance	0.243***
B4.7 - Wrong communication with suppliers	0.240***
B4.8 - Wrong communication with customers	0.213***

Source: the author's table.

Event A1.4– Lack of inventories is to the most extent influenced by risk factors (see Table 11):

Table 11. Impact of the most significant risk factors on event A4 – Lack of inventories according to Somers' d coefficient

The most important risk factors affecting the event A4 – Lack of inventories	The value of Somer's d test
B5.8 – Strikes	0.668***
B2.9 - Dependency of the flow process on means of transport	0.454***
B2.4 - Problems with the service level of deliveries (quality, delivery terms reliability, quantity, cover documents)	0.450***
B2.3 - Long terms of delivery of suppliers with regard to demand changeability	0.442***
B2.7 – Suppliers are located in a distant and hardly accessible territory	0.366***
B2.2 – Risk of suppliers' bankruptcy	0.352***
B2.8 - Complexity of SC by reason of many interfaces (purchase, distribution, trans-shipments, controls between various subjects)	0.336***
B2.6 - Suppliers do not provide important information about treating problems on time	0.333***
B4.5 - Non-existence of well-documented procedures for orders handling, purchasing, manufacture planning and realizing	0.327***
B3.1 - Complexity of internal logistic chains (many processes, flows, components)	0.326***
B4.6 - Wrong communication between departments of purchase – manufacture – sales	0.311***
B1.2 - High requirements of customers on the terms of delivery	0.262***
B4.10 - Inadequate system of demand prediction	0.260***
B3.5 - Dependency of processes on the know-how of several key employees	0.251***
B4.11 – Small seriousness and objectivity in suppliers selecting and evaluating	0.239***
B3.4 - Error rate of employees in the manufacture, warehouses, and by maintenance	0.233***
B2.5 - Insufficient of items on market leading to high price	0.232***

Source: the author's table.

And the last monitored occurrence of event A1.5 – Surplus of inventories, has shown the highest dependence with risk factors (see Table 12):

Table 12. Impact of the most significant risk factors on event A5 – Surplus of inventories according to Somers' d coefficient

The most important risk factors affecting the event A5 – Surplus of inventories	The value of Somer's d test
B4.1 - Insufficient or low-quality technical documentations of manufacture	0.329***
B2.4 - Problems with the service level of deliveries (quality, delivery terms reliability, quantity, cover documents)	0.323***
B4.8 - Wrong communication with customers	0.308***
B3.1 - Complexity of internal logistic chains (many processes, flows, components)	0.298***
B3.4 - Error rate of employees in the manufacture, warehouses, and by maintenance	0.295***
B4.12 - Unsatisfactory level of the methodology for manufacture planning and processing (long time horizon of planning, slow reactions on changes, missing capacity calculations)	0.281***

The most important risk factors affecting the event A5 – Surplus of inventories	The value of Somer's d test
B4.9 - Insufficient level of inventory management system (evidence and replenishment)	0.275***
B4.11 – Small seriousness and objectivity in suppliers selecting and evaluating	0.250***
B3.5 - Dependency of processes on the know-how of several key employees	0.248***
B4.4 - Unclear responsibility between external partners	0.247***
B4.6 - Wrong communication between departments of purchase – manufacture – sales	0.234***

Source: the author's table.

3.2 The most significant groups of risk factors

The frequency of the most significant risk factors for concrete risk events can be found in Table 13. In case of event A1.8 - Lack of contracts, the most frequent category was B4 – Management risks (internal and inter-company). Also in case of event A1.1 – B Non - fulfilment of negotiated contract terms against customers, A1.7 - Rejecting of contracts on account of unrealizable requirements of customers and A1.5 - Surplus of inventories, B4 - Category has been the most frequent group. This reveals the shortcomings in communication within the company and beyond, poorly defined responsibilities, inadequate use of indicators for measuring logistic performance and controlling of logistic costs etc.

The risk of the internal processes has been listed as the leading cause of risk event A1.2 - Need to fulfil supplies to customers in parts with increased costs. This is connected with the complexity of the internal supply chain, unreliable manufacturing equipment, error rate of workers and also dependence of the process on the know-how of a few employees. Delivery of goods at lower quality than agreed represented another cause.

Table 13. Frequency of occurrence of the most significant risk factors (with ***) for selected risk events

Risk events	*Groups of risk factors*				
	B1 – Risks on the demand side	*B2 - Supply risks*	*B3 – Risks of internal processes*	*B4 – Management risks*	*B5 – Enviromental risks*
A8	B1.6		B3.2, B3.5, B3.6	B4.2, B4.3, B4.4, B4.12, B4.13, B4.14	B5.2
A7	B1.2	B2.5		B4.12, B4.13, B4.14	
A1	B1.2, B1.3	B2.2, B2.3, B2.4, B2.5, B2.9	B3.1, B3.2, B3.3, B3.4, B3.5	B4.1, B4.2, B4.3, B4.4, B4.5, B4.6, B4.9, B4.10, B4.11, B4.12, B4.13, B4.14, B4.15	B5.8, B5.9
A2	B1.2		B3.1, B3.2, B3.3, B3.4, B3.5	B4.1, B4.3, B4.11	
A3		B3.2	B3.4, B3.5	B4.7, B4.8	
A4	B1.2	B2.2, B2.3, B2.4, B2.5, B2.6, B2.7, B2.8, B2.9	B3.1, B3.4, B3.5	B4.5, B4.6, B4.10, B4.11	B5.8
A5		B2.4	B3.1, B3.4, B3.5	B4.1, B4.4, B4.6, B4.8, B4.9, B4.11, B4.12	

Source: the author's table.

In case of event A1.3 - Problems with the quality against customers, the answer is not clear. This type of event is caused both by the risks of internal processes (group B3) and by the management risks (group B4). Event A1.4 - Lack of inventories is clearly influenced by risk factors B2, which means supply risks.

3.3 Risk factors repeated at least in four risk events

Another selection of risk factors can be made on the basis of their repeated occurrence in more risk events. Four occurrences of the same risk factor will be regarded as sufficient number of repetitions, in other words, the given risk factor must contain at least four red values (with ***) in the set of the selected risk events. Table 14 provides an overview.

Table 14. Risk factors with *** which were repeated at least in four selected risk events

Risk factors	*Risk events*						
	A8	*A7*	*A1*	*A2*	*A3*	*A4*	*A5*
B1.2		0,245***	0,327***	0,242***		0,262***	
B3.1			0,372***	0,273***		0,326***	0,298***
B3.2	0,331***		0,350***	0,281***	0,326***		
B3.4			0,342***	0,245***	0,243***	0,233***	0,295***
B3.5	0,315***		0,396***	0,278***	0,247***	0,251***	0,248***
B4.11			0,307***	0,308***		0,239***	0,25***
B4.12	0,308***	0,343***	0,392***				0,281***

Source: the author's table.

We have come to a conclusion that the most significant risk factors according to these criteria are:

- B1.2 – high requirements of customers on the terms of delivery;
- B3.1 – complexity of internal logistic chains (many processes, flows, components);
- B3.2 – low quality against negotiated requirements;
- B3.4 – error rate of employees in the manufacture, warehouses, and by maintenance;
- B3.5 – dependency of processes on the know-how of several key employees;
- B4.11 – small seriousness and objectivity in suppliers selecting and evaluating;
- B4.12 – unsatisfactory level of the methodology for manufacture planning and processing (long time horizon of planning, slow reactions on changes, missing capacity calculations).

Some of the risk factors were named more than four times. The most frequent dependencies of risk factors were recorded for two factors: B3.4 and B3.5. Even though from the point of view of the relationship strength this is not the highest dependence, taking into account the fact that they influence more events at the same time, it would be more suitable to pay attention to these described risk factors and to work on their minimization.

4. Conclusion

The article is focused on testing the dependency of two variables, namely the dependence of the occurrence of risk events on a risk factor. We have used the Somers' d testing statistic which allows monitoring of unilateral (asymmetric) dependence of data having the character of ordinal variables, which had been obtained by a questionnaire survey.

A mathematical model has been formulated as a hypothesis of the dependence, respectively independence of two variables (risk factor, marked X - independent variable, risk event, marked Y - dependent variable). The relationship between two variables was initially calculated manually to provide a clear illustration, but because if time-consuming nature of the calculations, the remaining ones were performed using SPSS software. The output of the software was represented by a table showing the strength of relationship between the variables and also the p-value used for assessing the significance of the relationship strength (i.e. the significance level at which the given hypothesis α is valid). The data from the individual tables have been grouped into more complex tables for their better explanatory ability.

The analysis of dependencies has set apart the relatively strong factors such as internal processes and management factors. This has been confirmed by Table 13 of the Frequency of occurrence of the most important risk factor (with ***) for selected risk events as well as by Table 14 Risk factors with ***, which were repeated at least during four selected risk events. The types of risk factors described above have prevailed in both types of tables. In terms of repetition, the leading risk factors were B3.4 - error rate of employees in the manufacture, warehouses, and by maintenance and B3.5 - dependency of processes on the know-how of several key employees - appearing in more than four risk events. Based on these results, it is necessary to raise attention in human resources area as well (e.g. by selecting competent and skilled workers, or through contractual treatment of the labour relations in terms of retaining the know-how in the factory).

The outcomes of this analysis, however, should be combined with other analyses – they deepen and complement the outcomes of B area analysis - risk factors, where the presence of risk factors have been researched, but without relation to adverse events.

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References

[1] Agresti, A. 2007. *An Introduction to Categorical Data Analysis.* JohnWiley & Sons, Inc.

[2] Bogdanoiu, C. 2009. Activity Based Cost from the Perspective of Competitive Advantage. *Journal of Applied Economic Sciences*, Vol. IV, Issue 1(7), http://cesmaa.uv.ro/journals/jaes/files/Past_Issue_JAES_VolumeIV_Spring2009.pdf.

[3] ČSN ISO 31000. 2010. Management rizik – Principy a směrnice.

[4] Dejnega, O. 2011. Method Time Driven Activity Based Costing – Literature Review. *Journal of Applied Economic Sciences,* Vol. VI, Issue 1(15), http://cesmaa.uv.ro/journals/jaes/files/Volume_VI_Issue1_15__Spring2011_abstracts.pdf.

[5] Macurová, P., Hančlová, J., Tvrdoň, L., Černý, J., Dejnega, O., and Minárová, A. 2011. *Řízení rizik v logistice.* SAEI.

[6] Macurová, P., Minárová, A., and Dejnega, O.2011. Zacházení s riziky v logistice. *Scientific papers of University of Pardubice - Series D* 20*:* 65-79.

[7] Macurová, P., Hančlová, J., Minárová, A., Dejnega, O., Černý, J., and Tvrdoň, L. 2011. Rizika v logistice – poznatky zprůzkumu. *Littera Scripta* 4(1): 41-52.

[8] Newson, R. 2006. Confidence intervals for rank statistics: Somers' D and extensions. *The Stata Journal* 6, no. 3, http://www.stata-journal.com/article.html?article=snp15_6.

[9] Norušis, J.M. 2010. *PASW Statistics 18. Guide to Data Analysis.* Prentice Hall Inc.

[10] Pecáková, I. 2008. *Statistika vterénních průzkumech.* Professional Publishing.

[11] Řezanková, H. 2010. *Analýza dat zdotazníkových šetření.* Professional Publishing.

[12] Waters, D. 2007. *Supply chain risk management.* Kogan Page.

[13] Yaffee, A.R. 2003. Common Correlation and Reliability Analysis with SPSS for Windows. http://www.nyu.edu/its/statistics/Docs/correlate.html.

ANNEX 1

Results of Somers' d – test of dependence of events on risk factors

	A1.8	A1.7	A1.2	A1.3	A1.4	A1.1	A1.5
B1.1	0,225**					-0,006	
B1.2	0,221**	0,245***	0,242***	0,162**	0,262***	0,327***	0,192**
B1.3			0,212**	0,138*	0,208**	0,262***	0,241**
B1.4						0,134	
B1.5					0,194**	0,158*	0,155*
B1.6	0,265***					-0,084	-0,213**
B2.1						0,065	
B2.2				0,161*	0,352***	0,289***	0,241**
B2.3					0,442***	0,331***	0,216**
B2.4				0,144*	0,45***	0,253***	0,323***
B2.5		0,256***			0,232***	0,306***	
B2.6					0,333***	0,219**	
B2.7		0,184**			0,366***	0,248**	
B2.8					0,336***	0,206**	
B2.9			0,192*	0,147*	0,454***	0,338***	
B2.10					0,29**	0,202*	0,238**
B3.1	0,161*		0,273***	0,162*	0,326***	0,372***	0,298***
B3.2	0,331***	0,245**	0,281***	0,326***		0,35***	
B3.3	0,192**	0,198**	0,349***	0,181**	0,19**	0,478***	0,207**
B3.4	0,181*		0,245***	0,243***	0,233***	0,342***	0,295***
B3.5	0,315***		0,278***	0,247***	0,251***	0,396***	0,248***
B3.6	0,274***		0,203**		0,181*	0,104	
B4.1	0,226**		0,255***			0,32***	0,329***
B4.2	0,405***	0,174**	0,197**	0,156**		0,285***	0,166*
B4.3	0,294***	0,189**	0,258***	0,15*	0,185*	0,302***	0,191**
B4.4	0,361***	0,2*	0,186*		0,222**	0,322***	0,247***
B4.5		0,246**	0,203*		0,327***	0,314***	0,221**
B4.6	0,2**	0,182**		0,199**	0,311***	0,304***	0,234***
B4.7	0,183*			0,24***	0,211**	0,197**	0,205**
B4.8				0,213***	0,235**	0,201**	0,308***
B4.9	0,188**				0,181**	0,25***	0,275***
B4.10		0,227**	0,199**	0,191**	0,26***	0,424***	0,174*
B4.11		0,173*	0,308***		0,239***	0,307***	0,25***
B4.12	0,308***	0,343***	0,177*	0,133*	0,24**	0,392***	0,281***
B4.13	0,242***	0,389***				0,306***	0,189**
B4.14	0,267***	0,442***				0,283***	
B4.15	0,218**	0,25**				0,298***	0,16*
B5.1			0,168*			0,204**	
B5.2	0,311***					0,14	
B5.3			0,179*			0,204**	
B5.4					0,279**	0,27**	
B5.5	-0,211*	0,23**				0,138	
B5.6				-0,251*	0,408**	0,117	
B5.7					0,601*	0,573	
B5.8					0,668***	0,472***	
B5.9	0,214**	0,209**	0,231**	0,205**	0,158*	0,317***	

Source: the author's work.

CORPORATE GOVERNANCE IN INDIA: STUDY OF the TOP 100 FIRMS

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Abstract:
The concept of corporate governance is centuries old but it has gained a lot of momentum in last two decades in India. This paper studies the corporate governance practices in the top 100 companies in India. We find that in all industries irrespective of sector all companies practice some sort of corporate governance at least as said in their annual reports due to mandatory requirements. The primary driver mentioned behind the corporate governance practices is the interest of the stakeholders. The chemical/ fertilizer/ some manufacturing industries have certain incentives to follow the corporate governance practices in the form of carbon credits. We find that the corporate governance practices have a major impact on the performance of the companies. We see that the companies have no major plans to change their corporate governance practices in near future.

Key words: corporate governance, strategy, India, top companies.

JEL Clasiffication: L1

1. Introduction

The concept of corporate governance is centuries old but it gain prominence globally after a string of high profile corporate scandals. In India also the concept has gained a lot of momentum in last two decades. Exposed malpractices in 2008 at Satyam Computer Services Limited (SCL), the fourth largest software company from India, again brought the spotlight on corporate governance.

The Confederation of Indian Industry (CII) was the first one to come up with the Code of Desirable Corporate Governance in 1998. The Ramakrishna Commission on Public Sector Undertakings (PSU's) corporate governance emphasized autonomy in professionalizing the board, providing incentives for the top management, accountability, autonomy in price fixation, strengthening investors interface, power to dispose of assets, providing for elected directors, setting up a pre-investigation board, freedom in investing within certain limits, and power to enter a joint venture (Ramakrishna Commission Report, 1999). Securities Exchange Commission of India (SEBI), appointed K. Birla Corporate Governance Committee report was accepted in 2000 and it became clause 49 of the listing agreement of every Indian stock exchange. The latest effort in this direction is the Companies Bill 2011 from Ministry of Corporate Affairs, Government of India.

In India, companies with good corporate governance measures are easily able to borrow money from financial institutions as compared to companies with poor corporate governance measures. Moreover, there is evidence that mutual funds have invested money in companies with a good corporate governance track record as compared to companies with a poor CG track record (Mohanty 2003). Good corporate governance helps an organization achieve several objectives and some of the more important ones include: Developing appropriate strategies that result in the achievement of stakeholder objectives; Attracting, motivating and retaining talent; creating a secure and prosperous operating environment and improving operational performance; and, Managing and mitigating risk and protecting and enhancing the company's reputation (KPMG 2009).

The problem of corporate in India is different from that of the Anglo-Saxon environment because the exploitation of minority shareholders by the dominant shareholders is the problem in India whereas exploitation of shareholders by the managers is the problem in the Anglo-Saxon environment. Further in the Indian context, the capital market is more capable of disciplining the majority shareholders than the regulators (Chakrabarti 2005). Majority of the respondents believe that while corporate governance should be practiced through principle-based standards and moderate regulations, there is a need for stronger regulatory review and exemplary enforcement (KPMG 2009). While India has undertaken numerous reforms in corporate governance over the past decade, especially in the area of company boards, independent directors and disclosure and accounting standards, certain critical areas remain to be addressed—particularly relating to the accountability of promoters (controlling shareholders), the regulation of related party transactions, and the governance of the audit profession (ACGA 2010).

This paper studies the corporate governance practices in top 100 firms in India. This paper consists of four parts including the introductory part. The next part elaborates the research methodology. The third part presents the findings and discussions on the practice of strategy in Indian context. The last part is conclusion of the chapter.

2. Research methodology

The study tries to find answers for five questions on corporate governance issues in top 100 companies. The five questions are namely:

- Whether the companies are looking into corporate governance practices?
- How are they doing it?
- Why are they doing it?
- How is it making an impact on performance?

and lastly,

- What are the future plans?

These five questions were decided by studying existing literature and discussion with experts. Key words were identified for some of the questions for corporate governance based on the strategic literature and were used for the study.

The selection of the top companies for study is based on the Corporate Database Prowess of the Center for Monitoring Indian Economy (CMIE). CMIE is India's largest and most comprehensive database on firms operating in India. Prowess is a database of large and medium Indian firms containing detailed information on over 20,000 firms. The database comprises all companies traded on India's major stock exchanges and several others including the central public sector enterprises and covers most of the organised industrial activities, Banking and organised financial and other services sectors in India. The companies enclosed in Prowess account for 75 per cent of all corporate taxes and make up 95 per cent of excise duty collected by the Government of India (CMIE 2009).

The top 100 companies are selected based on total revenue over 1990-2008 time periods. We have taken ten year time period which is reasonable long for business performance. Only those companies are selected which were there each year among the top companies and absence for a year leads to rejection. Some new companies started recently could not make into the list as they were not present over the ten year time period. The list of companies is given in Annexure 1. This work is based on secondary data collected from the annual report and websites of companies.

3. Findings and discussion

A. The current state of corporate governance i.e. Are they doing it?

In today’s business, in all industries irrespective of sector all companies practise corporate governance at least as said in their annual reports. In our study of 100 companies in India apart from only ‘Satyam’ all the other 99 companies practise corporate governance in some form or the other.

B. How are they doing it?

We have segregated the different sectors and we have the following findings about the different sectors.

1. In the banks we find compliance with the various rules and regulation are the key pillars behind their corporate governance practices.
2. In some government banks the remuneration committee is missing, their compensation being fixed by the government himself.
3. SEBI has guidelines about what the composition of the board of directors should be. Due to more than the allowed number of directorships of the directors some companies like Rashtriya Chemicals & Fertilizers Ltd. do not conform to the listing agreements.
4. In the metals and minerals sector some companies do not follow transparency to the utmost in form of the procedure of their board composition or disclosure or remuneration practices
5. Though most companies have disclosure practices but still the disclosure is only up to the point where the interests of the company are not harmed.

6. Based on our study of the annual reports we find that companies like Punj Lloyd or Crompton Greaves follow the rules of corporate governance and implements it stringently.

C. Why are they doing it?

When we tried to identify the key reasons for following of corporate governance measures by the different Indian companies we find that

1. The primary driver behind the corporate governance practices is the interest of the stakeholders.
2. The chemical/ fertiliser/some manufacturing industries have certain incentives to follow the corporate governance practices in the form of carbon credits.
3. For parent companies corporate governance helps in proper synchronisation of the different divisions and the proper allocation of resources.
4. The main advantage of corporate governance is the competitive advantage or building the brand reputation.
5. Generally in the b2b transaction the corporate governance image is a pivotal part behind building customer retention and customer acquisition.
6. Government banks follow corporate governance measures to be transparent and to comply with the rules to the utmost.

D. Impact on performance

In case of the performance, we find that the corporate governance practices have a major impact on the performance of the companies. Except for Satyam the impact has always been positive. Corporate governance impact performance in the following ways:

1. Building brand image to stakeholders by transparency and other ethical practices.
2. Bringing order to a company.
3. Building vision, mission of the company.
4. Compliance with regulation enhancing company image.

E. Future plans

Except for Satyam where the future course will be decided by the buyers of the firm, we see that the other 99 companies have no plans to change their corporate governance practices in near future.

4. Conclusion & directions for future research

We find that in all industries irrespective of sector all companies practice some sort of corporate governance at least as said in their annual reports due to mandatory requirements. The primary driver mentioned behind the corporate governance practices is the interest of the stakeholders. Based on our study of the annual reports we find that companies like Punj Lloyd or Crompton Greaves follow the rules of corporate governance and implements it stringently.

The chemical/ fertilizer/ some manufacturing industries have certain incentives to follow the corporate governance practices in the form of carbon credits. We find that the corporate governance practices have a major impact on the performance of the companies. We see that the companies have no major plans to change their corporate governance practices in near future.

This study tried to answer five key questions related to corporate governance in Top 100 companies from India. Future studies can undertake more in-depth analysis of each question raised here.

ANNEXURE 1

Table 1. TOP 100 Companies

Indian Oil Corpn. Ltd.
Reliance Industries Ltd.
Bharat Petroleum Corpn. Ltd.
Hindustan Petroleum Corpn. Ltd.
Oil & Natural Gas Corpn. Ltd.
State Bank Of India
Steel Authority Of India Ltd.
N T P C Ltd.
I C I C I Bank Ltd.
Mangalore Refinery & Petrochemicals Ltd.
Tata Motors Ltd.
Chennai Petroleum Corpn. Ltd.
M M T C Ltd.
Larsen & Toubro Ltd.
Bharat Heavy Electricals Ltd.
Tata Steel Ltd.
I T C Ltd.
Hindalco Industries Ltd.
Maruti Suzuki India Ltd.
G A I L (India) Ltd.
Wipro Ltd.
Infosys Technologies Ltd.
Canara Bank
Punjab National Bank
State Trading Corpn. Of India Ltd.
Bank Of India
Sterlite Industries (India) Ltd.
Bank Of Baroda
Mahindra & Mahindra Ltd.
Hero Honda Motors Ltd.
H D F C Bank Ltd.
H C L Infosystems Ltd.
Indian Farmers Fertiliser Co-Op. Ltd.
Grasim Industries Ltd.
Essar Steel Ltd.
Adani Enterprises Ltd.
Indian Potash Ltd.
Rashtriya Ispat Nigam Ltd.
Ruchi Soya Inds. Ltd.
Union Bank Of India
Ispat Industries Ltd.
I D B I Bank Ltd.
Hindustan Zinc Ltd.
South Eastern Coalfields Ltd.
Jet Airways (India) Ltd.
Ashok Leyland Ltd.
Indian Overseas Bank
Central Bank Of India
Housing Development Finance Corpn. Ltd.
Syndicate Bank
Axis Bank Ltd.
Citibank N A.
Satyam Computer Services Ltd.
Oriental Bank Of Commerce

Indian Oil Corpn. Ltd.
Uco Bank
Reliance Infrastructure Ltd.
Allahabad Bank
Standard Chartered Bank
Hongkong & Shanghai Banking Corpn. Ltd.
Northern Coalfields Ltd.
Bongaigaon Refinery & Petrochemicals Ltd.
Oil India Ltd.
Indian Bank
Tata Power Co. Ltd.
National Bank For Agriculture & Rural Development
N M D C Ltd.
National Aluminium Co. Ltd.
Mahanagar Telephone Nigam Ltd.
Rashtriya Chemicals & Fertilizers Ltd.
Corporation Bank
Power Grid Corpn. Of India Ltd.
State Bank Of Hyderabad
Power Finance Corpn. Ltd.
Andhra Bank
Honda Siel Cars India Ltd.
State Bank Of Patiala
Tata Chemicals Ltd.
Tata Sons Ltd.
Bharat Aluminium Co. Ltd.
H C L Technologies Ltd.
Bhushan Steel Ltd.
Punj Lloyd Ltd.
Vijaya Bank
Crompton Greaves Ltd.
Cipla Ltd.
Bharat Electronics Ltd.
Eastern Coalfields Ltd.
Apollo Tyres Ltd.
Aditya Birla Nuvo Ltd.
United Bank Of India
Nuclear Power Corpn. Of India Ltd.
National Fertilizers Ltd.
Asian Paints Ltd.
Shipping Corpn. Of India Ltd.
Century Textiles & Inds. Ltd.
Bank Of Maharashtra
Godrej & Boyce Mfg. Co. Ltd.
Coromandel Fertilisers Ltd.
State Bank Of Travancore
Gujarat State Fertilizers & Chemicals Ltd.

ANNEXURE 2

Table 2. Industry classification of top 100 companies

Sector	Total
Auto Sector	7
Banking and Financial Services Institutions (BFSI)	32
Capital Goods	5
Chemical & Fertilizer	9
Coal Mining	3
Diversified	5
FMCG	3
Metal	14
Oil, Power and Gas	14
Technology	6
Transportation	2
Grand Total	100

References

[1] ACGA. 2010. ACGA White Paper on Corporate Governance in India, ACGA http://www.acga-asia.org/public/files/ACGA_India_White_Paper_Final_Jan19_2010.pdf.

[2] Centre for monitoring Indian Economy (CMIE). 2009. CMIE PROWESS Database.

[3] Chakrabarti, R. 2005. Corporate Governance in India, Evolution and Challenges, College of Management, Georgia Tech http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN023826.pdf.

[4] KPMG 2009. The state of corporate governance in India, KPMG http://www.in.kpmg.com/tl_files/pictures/cg%20survey%20report.pdf.

[5] Kumar Mangalam Birla Committee Report on Corporate Governance. 1999. SEBI http://www.sebi.com/press/corpgov.html.

[6] Mohanty, P. 2003. Institutional Investors and Corporate Governance in India, National Stock Exchange Research paper no. 42.

[7] Ramakrishna Commission 1999. Ramakrishna Commission Report on PSU Corporate Governance, 1999 http://www.sebi.com/press/corpgov.html.

DETECTION OF NONLINEAR EVENTS IN TURKISH STOCK MARKET

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Abstract:

In this study, we test the nonlinear dependence in the Turkish stock market namely, Istanbul stock exchange-100 over the period 2 January 1988 - 31 December 2010 by employing Hinich (1996) portmanteau test statistic jointly with Hinich, and Patterson (2005) non-overlapped windowed testing procedure. Finding nonlinear episodes in the stock returns, we identify which economic and political events trigger the nonlinearity. The results show not only national but also international economic and politic events cause the episodic nonlinearity in the returns.

Keywords: Event detection, nonlinearity, stock market, Turkey.

JEL Classification: C12**.**

1. Introduction

Over the last thirty years, exploring nonlinear behaviour of financial and economic time series has received great attention as statistical and econometrics methodologies have been developed, and computers have become more efficient (see Brooks *et al.* 1999; Swanson, and Franses 1999, among others). Especially since the study of Hinich, and Patterson (1985) in which they studied nonlinearities of the New York stock exchange, there have been a lot of studies in the literature to uncover the nonlinear characteristics of both developed and developing markets.

The sources of nonlinearity in stock markets can be explained in several ways; the timings of reactions of market participants against to the new information incorporated into the stock prices can be different from each other, furthermore, attitudes of investors towards risk and expected returns (Campbell *et al.* 1996), presence of market frictions and transaction costs (McMillan 2003), diversity in agents' beliefs (Brock, and LeBaron 1996; Brock, and Hommes 1998), nonlinear feedback mechanisms in price movements (Antoniou *et al.* 1997), and market imperfections (Lim, and Hinich 2005) can be other explanations for the nonlinearity.

This study tests the nonlinear dependence in Turkish stock market namely Istanbul stock exchange-100 (ISE) by employing Hinich (1996) bicorrelation test statistics jointly with Hinich, and Patterson (2005) non-overlapped windowed approach. Thus we can test the nonlinear dependence and uncover which events cause this nonlinearity. An important point to focus on is that the results of this methodology show not only national but also international events can have effect on nonlinear dependency. For example, Romero-Meza *et al.* (2007) find that the attack of Iraq to Kuwait, and as a result the increase in the price of oil is one of the reasons of nonlinearity in the Chilean stock market. This paper proceeds as follows. The next section outlines the econometric methodology. Section 3 describes the data and presents empirical results. The final section concludes the paper.

2. Econometric methodology

The procedure of Hinich, and Patterson (2005) divides the full sample into equal length non-overlapped time windows and applies a battery of statistics to each. Let the sequence $y(t)$ shows the time series under investigate and n denotes the length of the window, then k^{th} window can be demonstrated as; $\{y(t_k), y(t_k+1), y(t_k+2), ..., y(t_k+n-1)\}$ and $(k+1)^{th}$ window, that is, the next non-overlapped window can be formulated as $\{y(t_{k+1}), y(t_{k+1}+1), y(t_{k+1}+2), ..., y(t_{k+1}+n-1)\}$ where $t_{k+1} = t_k + n$.

Before applying the Hinich (1996) bicorrelation test statistic (denoted as H statistic) to the data, the data in each window standardized as follows:

$$Z(t) = \frac{y(t) - m_y}{s_y} \qquad t = 1,2,3,...,n$$

Where $z(t)$ is standardized observations and m_y, s_y show the sample mean and standard deviation within each window, respectively. Next, for each time windows we apply following H statistic.

$$H = \sum_{s=2}^{L} \sum_{r=1}^{s-1} G^2(r,s)$$

Where $G(r,s) = \sqrt{(n-s)}C_{ZZZ}(r,s)$ and $C_{ZZZ}(r,s) = (n-s)^{-1} \sum_{t=1}^{n-s} Z(t)Z(t+r)Z(t+s) = 0$ for $0 \le r \le s$. $C_{ZZZ}(r,s)$ shows the sample bicorrelation coefficient. The H statistic is chi-squared distributed with $L(L-1)/2$ where L is the number of lags in the windows which are specified as $L = n^b$ with $0 < b < 0.5$. b is determined by the researcher, on the other hand, Hinich, and Patterson (2005) recommend to use of $b = 0.4$ based on results from Monte Carlo simulations to provide a valid approximation to the asymptotic theory and also to maximize the power of the test. Length of each window is also determined by the researcher. Brooks, and Hinich (1998) state that the window length (n) should be sufficiently long to apply the test validly and yet short enough for identifying the events that trigger the nonlinear dependence.

In this test, the null and alternative hypotheses can be showed as follows:

$H_0 : C_{ZZZ}(r,s) = E\left[Z(t)Z(t+r)Z(t+s)\right] = 0$ for all r,s except when $r = s = 0$.

$H_A : C_{ZZZ}(r,s) \ne 0$ for at least one pair of r and s pairs.

That is, the null hypothesis that the process within each window has zero bicorrelation is tested against the alternative of nonlinear dependence exists in the data generating process.

3. Data and empirical results

This study employs daily closing prices of the ISE from 2 January 1988 to 31 December 2010 (8,018 observations) which is obtained from the electronic data delivery system of the Central Bank of the Republic of Turkey. We transform the data into continuously compounded daily returns using $r_t = \ln(p_t - p_{t-1})$ where p_t shows the closing price in day t (Brock *et al.* 1991).

To ensure rejection of the null hypothesis is, due only to nonlinear dependencies, we remove linear dependence, using an AR(p) model at the first step. We use Akaike, and Schwartz information criteria to select the appropriate lag order. Table 1 presents the values of the criteria for different lag lengths.

Table 1. Results of the Information Criteria

Information Criteria	Lag Lengths 0	1	2	3	4	5	6	7	8
Akaike	4.5692	4.5602*	4.5604	4.5607	4.5609	4.5611	4.5609	4.5611	4.5609
Schwartz	4.5700	4.5619*	4.5631	4.5635	4.5645	4.5656	4.5664	4.5676	4.5672

Note: * shows the optimal lag length.

As seen in Table 1, one is chosen as the optimal lag length. After estimating AR(1) as the appropriate model, we proceed to the analysis with the residuals of the AR(1) model. We select the length of each window (n) as 35, which gives a total of 225 windows. Table 2 presents the H statistic results using the non-overlapped windowed approach for the return series.

Table 2. Results of the Hinich Bicorrelation test

Market Index	Total number of windows	Total number of windows with significant H statistics	Dates of significant windows
Istanbul Stock Exchange	225	4	24/05 - 27/06/1988
			07/08- 11/09/1988
			10/04 -17/05/1989
			16/11 -20/12/2000

The third column of Table 2 shows the total number of significant windows where the null hypothesis of zero bi-correlation is rejected by H statistic, in other words nonlinear dependence in these windows could not be rejected. The %age of nonlinear windows is 1.75%, which shows the ISE return series exhibits nonlinearity in a few short episodes, but in the remaining time, the series are characterized by pure noise. The cause of the nonlinearities is another issue of interest. Thus, the dates of significant windows are presented in the fourth column of Table 2, so the key events which cause the non-linear market behaviour can be identified.

In the first significant window's date interval, the prime minister, Turgut Ozal survived an assassination attempt (18 June 1988). In the second interval, the Iran-Iraq war, which had started in September 1980, ended (20 August 1988). In the third window, the gold market officially opened under supervision of the Central Bank of the Republic of Turkey (10 April 1989) and the Council of Ministers received vote of confidence (11 April 1989). In the last significant window the November 2000 liquidity crisis broke out (22 November 2000) and overnight interest rates rose to 1700 % (1 December 2000).

The results of this study complement the study of Antoniou *et al.* (1997). Their analysis period spans from 1988 - 1993, and they find significant nonlinearity in 1988 and 1990 only. This study also finds two periods in 1988 as nonlinear. Unlike their study, there is not any nonlinear dependence in 1990 but a significant window is found in 1989.

The main contributions of this study can be summarized as follows; to the best of author's knowledge, this is the first study which investigates the episodic nonlinearity in the ISE and identifies which positive/negative national and international events cause this nonlinearity. Also, the findings show that the underlying nonlinear generation process of the ISE is not persistent; that is the nonlinear dependencies appear only infrequently and temporary. Although the existence of nonlinearity shows there is a possibility of return predictability, the investors cannot benefit it by predicting the future movements using historical prices because the dependencies disappear before they can be exploited and also the events which cause the nonlinearity are difficult to determine.

4. Conclusion

This study investigates episodic nonlinearity in Turkish Stock Market namely Istanbul stock exchange-100 (ISE) using the Hinich portmanteau test jointly with Hinich-Patterson non-overlapped window procedure over the period 2 January 1988 - 31 December 2010. The results show nonlinearity has an episodic characteristic in the ISE, which is one of the reasons for the forecasting models' low performance since the timing of the dependencies is difficult to know. The study also identifies which national and international economic and politic events are the causes of this nonlinearity.

References

[1] Antoniou A., Ergul, N., and Holmes, P. 1997. Market Efficiency, Thin Trading and Non-Linear Behaviour: Evidence from an Emerging Market. *European Financial Management* 3(2): 175-90.

[2] Brock, W.A., and Hommes, C. 1998. Heterogeneous Beliefs and Routes to Chaos in a Simple Asset Pricing Model, *Journal of Economic Dynamics and Control* 22: 1235-74.

[3] Brock, W.A., Hsiesh, D. and LeBaron, B. 1991. *Nonlinear Dynamics, Chaos and Instability Statistical Theory and Economic Evidence*, MIT Press, Cambridge.

[4] Brock, W.A., and LeBaron, B. 1996. A Dynamic Structural Model for Stock Return Volatility and Trading Volume. *Review of Economics and Statistics* 78: 94–110.

[5] Brooks, C., and Hinich, M.J. 1998. Episodic Nonstationarity in Exchange Rates. *Applied Economics Letters* 5(11):719-22.

[5] Brooks, C., and Hinich, M.J., and Smith, M. 1999. Nonlinear Evolution in High Frequency U.K. Stock Returns and Volume, in *Nonlinear Time Series Analysis of Economic and Financial Data,* (Ed.) P. Rothman, Kluwer Academic Publishers: 165-178.

[6] Campbell, J.Y., Lo, W.A., and MacKinlay, A C. 1997, *The Econometrics of Financial Markets*, Princeton University Press, Princeton.

[7] Hinich, M.J. 1996. Testing for Dependence in the Input to a Linear Time Series Model. *Journal of Nonparametric Statistics* 6:205-21.

[8] Hinich, M.J., and Patterson, D.M. 1985. Evidence of Nonlinearity in Daily Stock Returns. *Journal of Business and Economic Statistics* 3: 69-77.

[9] Hinich, M.J., and Patterson, D.M. 2005. Detecting Epochs of Transient Dependence in White Noise, in *Money, Measurement and Computation,* (Eds.) Belongia, M., and Binner, J., Palgrave Macmillian, pp. 61-75.

[10] Lim, K.P., and Hinich, M. J. 2005. Cross-Temporal Universality of Non-Linear Dependencies in Asian Stock Markets. *Economics Bulletin* 7(1): 1-6.

[11] McMillan, D.G. 2003. Non-Linear Predictability of UK Stock Market Returns, *Oxford Bulletin of Economics and Statistics* 65(5): 557-73.

[12] Romero-Meza, R., Bonilla, C., and Hinich, M. 2007. Nonlinear Event Detection in the Chilean Stock Market. *Applied Economics Letters* 14(13): 987-91.

[13] Swanson, N.R., and Franses, H.P. 1999. Nonlinear Econometric Modelling: A Selective Review, in *Nonlinear Time Series Analysis of Economic and Financial Data,* (Ed.) P. Rothman, Kluwer Academic Publishers, pp. 87-109.