Chapter 6

Macroeconomic Correlations Analyzed Multiple Regression Model*

- **Some Theoretical Aspects**

There are many transformations which can be considered but we shall focus on a specific class characterized by the relation:

$$\lambda = \int g(z)w(z)\,dz$$

In this formula, $g(z) = E(\tilde{y}|\tilde{z} = z)$ and $w(z)$ is a weight function which is either scalar or vectorial and satisfies $w(z)=0$ if $f_{marg}(z) = 0$, which is natural since $g(z)$ is defined only if $f_{marg}(z) > 0$. The parameter of interest λ is scalar or vectorial.

This class of transformation is justified by the properties of the resulting estimator λ and, meantime, by its relevance as regards many issues of applied econometrics, which are special situations of these analyses.

Before entering into details, we notice the fact that this transformation does not insert the over-determination of the conditions on the variables distribution.

We shall[21] estimate the mean of the regression differentials. We have seen that the parametrical estimation of a regression erroneously specified does not allow us to consistently estimate the differentials of this function in a certain point. In many econometrical issues, the differentials are parameters of interest. The estimation is possible but its rate of convergence is very slow and, consequently, requires a large sample. Nevertheless, in many applications it is enough to estimate the mean of the regression differentials, namely:

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* This chapter includes elements presented in the article *Model of Regression used to Analyze the Macroeconomic Correlations*, RRS Supplement no. 1/2014, authors prof. Constantin Anghelache PhD, prof. Radu Titus Marinescu PhD, Adina Mihaela Dinu PhD Student, Daniel Dumitrescu PhD Student, Diana Valentina Soare PhD Student

[21] Romanian Statistical Review – Supplement December 2013

$$\lambda = \int \partial^{\alpha} g(z) \nu(z)\, dz$$

where α is a multiple index of the derivation and ∂^{α} is the derivation defined by this multiple index. The function $\nu(z)$ is a density on the explanatory variable which can be equal to $f_m(z)$, the density of the actual explanatory variable being studied. We shall analyze the under-additively test.

In order to illustrate this situation, let's assume that the function C is the function cost which associates an expected cost with the quantities of the different products z. The economic theory is interested in the under-additively C, namely it is:

$$C\left(\sum_{j=1}^{p} z_j\right) \leq \left(\sum_{j=1}^{p} C(z_j)\right)$$

- **Which means that**, the cost of a company producing $\sum_{j=1}^{p} z_j$, **is lower than the cost of several companies each producing** z_j. The above property must be true for each p and each sequence $(z_1, \dots, z_p)$. It is easy to show that this property is equivalent to the property which will be explicitly shown by the content. If φ is the density $(z_1, \dots, z_p)$, $\tilde{\varphi}$ the density of the sum$z_1 + \cdots + z_p$ and φ_j the density z_j, than, it is equivalent with the fact that for each φ, we have:

$$\int C(u)\, \tilde{\varphi}(u) du \leq \sum_{j=1}^{p} \int C(z_j)\, \varphi_j(z_j) dz_j$$

The reciprocal is resulting by taking into account the distribution on $(z_1, \dots, z_p)$ focused in one point. Now, we shall approach the under-additively test. The previous relation suggests that there is a λ defined, namely:

$$w(z) = \tilde{\varphi}(z) - \sum_{j=1}^{p} \varphi_j(z)$$

the sign of this parameter having to be tested.

The estimation of λ defined can be made in two modes.

The first variant consists of the estimation of g followed by the calculation.

The second approach avoids the estimation g and is based on the particularity given by the utilized (final) function:

$$\frac{1}{n}\sum_{i=1}^{n} y_t \frac{w(z_i)}{f_{marg}(z_i)}$$

This condition is seldom satisfied. We can replace f_{marg} with a parametrical or non-parametrical estimation.

Implicitly, we assume that **w** is given. In practice, **iv can be partially or totally unknown** (since it is, for instance, a function of f_{marg}) **and thus w must** be replaced by an estimation.

The main asymptotic result is the convergence rate $\hat{\lambda}_n$ at λ. Indeed, we know:

$$\sqrt{n}\left(\hat{\lambda}_n - \lambda\right) \rightarrow N(0, V),$$

in the frame regularity conditionings and under the condition that the bands width have an adequate asymptotic behavior. In order to limit the problems of dimensioning or to impose certain restrictions originating in the economic theory, we often assume that the conditioned probability g(z), which is a function of the variables q, depends in fact on the functions of a reduced number of variables and, possibly, on certain parameters. In fact, there are two points of view being expressed: either we assume that g is actually restricted to this specific form or we are searching for the best approximation g through an element satisfying the considered restrictions.

- **Analysis of correlation between Total Production and transport production computed using Eviews**

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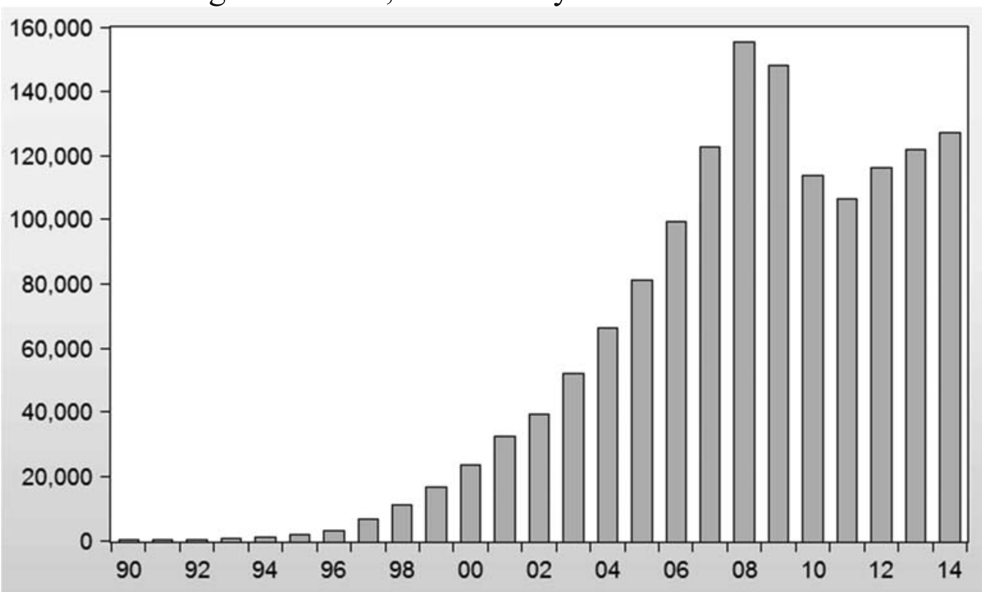
Year	**Transport production (services)**	**Total production**
	x	**y**
1990	13.39	102.83
1991	57.72	268.32

Year	**Transport production (services)**	**Total production**
	x	**y**
1992	178.62	788.97
1993	529.36	2478.45
1994	1095.77	6110.13
1995	1709.11	8770.97
1996	2928.51	13256.23
1997	6686.29	29947.45
1998	11170.9	43824.56
1999	16755.44	63554.66
2000	23628.67	93588.17
2001	32245.72	137906.86
2002	39167.05	177998.99
2003	52125.19	216582.99
2004	66274.65	287210.69
2005	81336.84	318079.84
2006	99362.38	376604.28
2007	122688.54	456099.28
2008	155534.21	596096.15
2009	148044.13	586272.83
2010	113817.86	606316.1
2011	106618.2	634053.16
2012	116453.35	665745.86
2013	121745.95	696002.33
2014	127038.67	726258.83

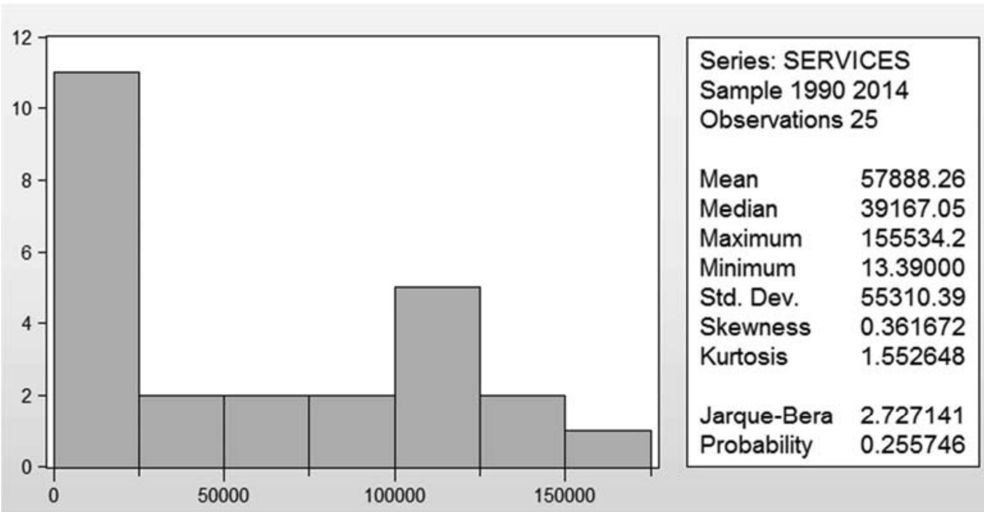
Another important branch in correlation with the total production is represented by transport services.

The period analyzed is 1990-2014 and we can observe that the correlation between the two indicators is significant for 2008 and 2009, because the SERVICES evolution depends on the total production.

The evolution of labor force in the branch of services in Romania during 1990-2014, as drawn by Eviews:



Statistical tests over the correlations between total production and the labor force in the branch services in Romania 1990-2014 were calculated in Eviews:



To estimate the regression model parameters, we used the software Eiews in which we defined an equation that has as outcome variables the labor force, and Total Production in the branch of services in Romania. Estimation method defined in the program is the method of least squares.

Based on the above data, by using Eviews, we have obtained the following results:

Sample: 1990 2014
Included observations: 25
TOTAL_PRODUCTION= SERVICES*C(2)+C(1)

	Coefficient	Std. Error	t-Statistic	Prob.
C(2)	4.702596	0.275235	17.08573	0.0000
C(1)	-2468.326	21825.16	-0.113095	0.9109

R-squared	0.926966	Mean dependent var	269756.8
Adjusted R-squared	0.923791	S.D. dependent var	270154.6
S.E. of regression	74578.96	Akaike info criterion	25.35372
Sum squared resid	1.28E+11	Schwarz criterion	25.45123
Log likelihood	-314.9215	Hannan-Quinn criter.	25.38077
F-statistic	291.9223	Durbin-Watson stat	0.324920
Prob(F-statistic)	0.000000		

From the above, simple regression model describing the relationship between the three macroeconomic indicators that are are the subject of previously determined may be given in the form of equation as follows:

TOTAL_PRODUCTION = SERVICES * 4,702596 – 2468,326