Economic Development, Technological Change, and Growth

Econometrics Applying to the Interdisciplinary Studies

Romeo-Victor Ionescu[1]

Abstract: The paper deals with the idea that econometrics represents a useful instrument for thye economic analysis, even at regional level. According to the labor market conditions, econometrics allows several techniques in order to estimate the structural parameters of an a priori specified system of simultaneous stochastic equations. Moreover, the econometric approach highlights the labor system function as to maximize the employees' number and labor demand, or to minimize the unemployment rate. A distinct part of the analysis covers the regional econometric approach in connection to regional location and optimum models. The main conclusion of the analysis is that econometrics is able to force the knowledge limits not only in regional economics. The analysis and the conclusions are supported by pertinent diagrams and mathematical relations.

Keywords: econometric approach; regional labour market; regional location models; regional optimal solution.

JEL Classification: C10; C21; R12; R59

1. General Approach

It seems to be easy to connect econometrics to the interdisciplinary studies. According to its historical definition, econometrics covers principles, methods and techniques from statistics, economics and mathematics, which are able to support the understanding of the quantitative realities from the economy (Frisch, 1933).

Practically, under the econometrics approach, the economic phenomena can be analysed using statistical data and mathematic models.

The importance of the econometrics was supported by the first Nobel Prize in Economics, which was awarded by Ragnar Frisch, in 1969.

[1] Professor, PhD, Danubius University of Galati, Faculty of Economic Sciences, Romania, Address: 3 Galati Blvd, 800654 Galati, Romania, Tel.: +40744553161, Fax: +40372 361 290. Corresponding author: romeo.v.ionescu@univ-danubius.ro.

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The restrictive definition of econometrics supports the use of the stochastic random models (Rottier G., 1961). As a result, econometrics supposes the existence of an economic theory related to the researched phenomenon which is able to build an economic model. Moreover, it implies the ability to apply the statistical induction methods in order to verify the economic theory assumptions, to build and to resolve the econometric model.

An interesting approach is that which considers that econometrics as "the art and science of using statistical methods for measurement of economic relations" (Chow, 1983).

On the other hand, econometrics is more than simply regression. It covers all methods of statistical inference used to produce quantitative economic statements (Christ, 1966).

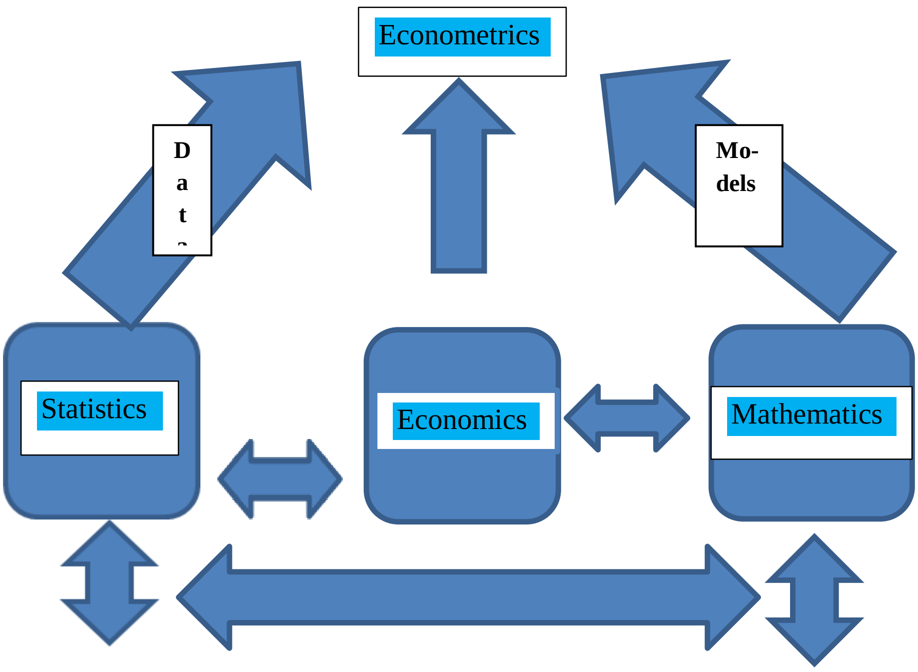

Figure 1. Historical approach of econometrics

Source: Personal Contribution

In defining their field, many econometricians would emphasize those techniques - typically extensions or adaptations of regression analysis - created to cope with the special problems that often arise in estimating economic relations. Those that particularly come to mind are techniques to measure and eliminate autocorrelation among residuals and to model lagged relationships among variables in regressions on time series data.

For many practitioners, however, the term "econometrics" when coupled with "modelling" tends to have an even more specialized meaning. It applies especially to the body of techniques utilized to estimate the parameters of economic systems (WPI, 2006).

2 Labor Market and the Econometrics' Approach

The labor market is a sum of many interdependent variables and the relationships among them. It can be analyzed as a cybernetic system, starting to the problem identification (see Figure 2).

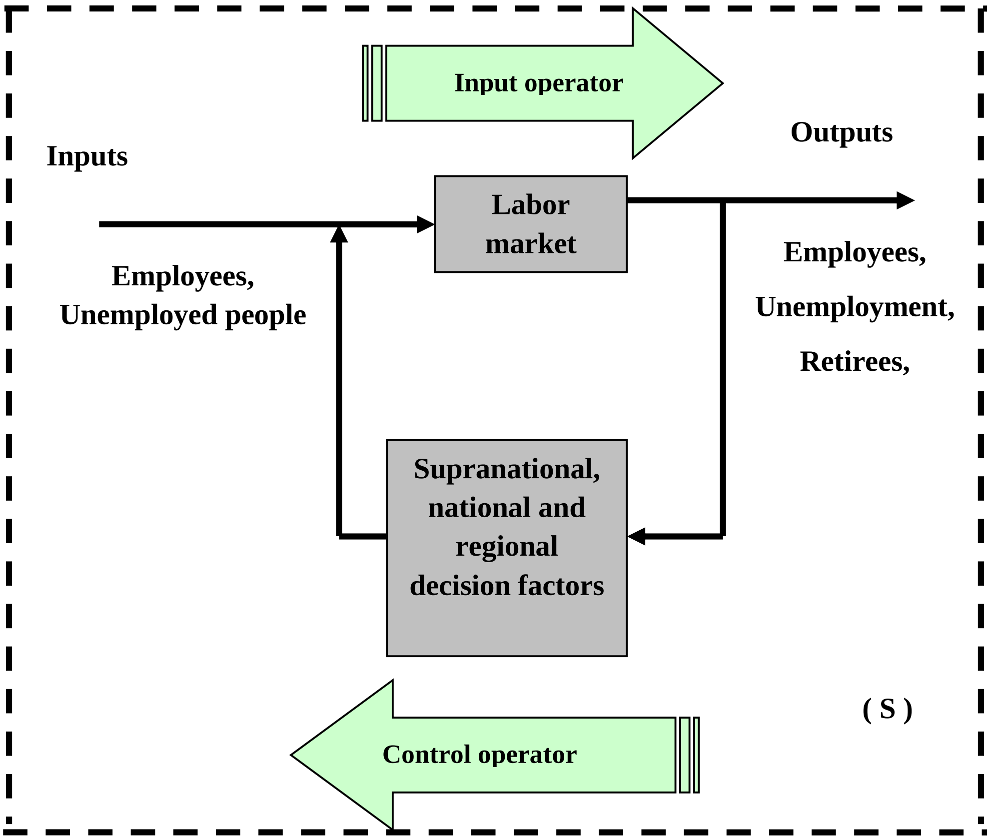

Figure 2. Labor market as cybernetic system

Source: Personal Contribution

Under the cybernetic system approach, the labor market's inputs and outputs can be observable and controllable. As a result, the labor market has: structure, status, transformation, inputs, outputs, behavior and function.

The system (S) structure (SS) depends on elements lot (E) and its connections (C), as in the following equation:

$$SS^{(S)} = (E^{(S)}, C^{(S)}) \quad (1)$$

The system behavior depends on its structure. The system status expresses quantities which characterize the structure of the system at a moment in time. For the labor market, we talk about statistical data connected to unemployment, employees, labor skills, labor cost, etc.

The transformation (T) represents the system crossing from a status to another and from one structure to another.

$$T^{(S)} = (SS_1^{(S)} \longrightarrow SS_i^{(S)}) \quad (2)$$

The input represents the effect of the system-environment connection and covers the environment action on the system.

The output is the effect of the same connection, but it covers the system action on the environment.

The system behavior means the full range of actions made by the system, which support the outputs change as a reaction to the inputs change, in order to achieve its function.

The labor system function is to maximize the employees' number and labor demand, or to minimize the unemployment rate.

According to Figure 2, the control element covers the supranational, national and regional decisional factors. The control operator represents the financial and economic interventionist instruments. The input operator represents the inputs change as a result of the economic policy.

From the operational point of view, the variable output is compared to the wanted level. The optimal criterion is obtained when the difference between the two indicators' values is minimal.

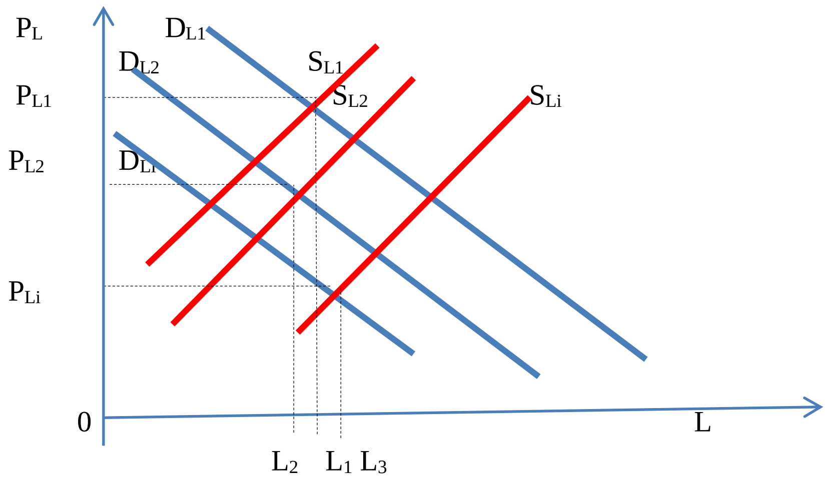

Figure 3. Labour market under the econometrics approach

Source: Personal Contribution

On the labor market, the relative equilibrium is found at the intersection of the labor demand (D_L) and supply (S_L) curves. According to the equilibrium point, is established a specific labor price (P_L). Econometrics has to estimate both the labor demand and supply functions using the empirical observations.

The most likely outcome is the movement of both curves (D_L and S_L) yielding a pattern of the labor price (P_L), the quantity intersection points from which econometrics will be unable, without further information, to distinguish the labor demand curve from the labor supply curve or estimate the parameters of either. This is the identification problem in econometrics.

Every individual observed demand and supply leads to a unique labor price and a unique labor level on the market, as in Figure 3.

In Figure 3, the labor price (PL) and the labor level (L) are determined by the solution of two simultaneous equations. As a result, the labor price and the labor level are jointly determined.

There are several techniques used to estimate the structural parameters of an a priori specified system of simultaneous stochastic equations. These include indirect least squares, two stage least squares, instrumental variables, three stage least squares, full information maximum likelihood, limited information maximum likelihood, etc.

Under the indirect least squares approach, the labor market evolution can be forecasted using the hypothesized labor demand function as:

$$D_L = a + b_1 P_L + b_2(\Delta Inv) + b_3 Inv + u_d, \quad (3)$$

where: D_L – labor demand; P_L – labor prices; ΔInv – change in direct investment in the economic activity; Inv – total direct investment in the economic activity.

If we suppose further that the labor prices depend linearly to the labor demand, as well as an index of the investment costs (C) and the investment efficiency (E).

As a result, there are two simultaneous relationships between the labor demand and the labor prices. In order to determine simultaneously the variables, we can use the above labor demand function and the labor prices equation:

$$P_L = e + d_1 C + d_2 E + d_3 D_L + u_s \quad (4)$$

By introducing the equation (4) in the equation (3), the new equation becomes:

$$D_L = a + b_1(e + d_1 C + d_2 E + d_3 D_L) + b_2(\Delta Inv) + b_3 Inv \quad (5)$$

Under the multiple regression procedure, D_L may be regressed on C, E, ΔInv and Inv. The result will be an equation with quantitative estimates of the parameters:

$$D_L = \frac{a+b_1 e}{1-b_1 d_3} + \frac{b_1 d_1}{1-b_1 d_3} C + \frac{b_1 d_2}{1-b_1 d_3} E + \frac{b_2}{1-b_1 d_3} (\Delta Inv) + \frac{b}{1-b_1 d_3} Inv \quad (6)$$

An alternative econometrics approach is two stage least squares regression. It consist in estimating an equation for labor prices by regressing P_L on all independent variables in the demand function for D_L, plus other determinants as C and E, which do not appear in the demand function. The result of the first stage regression is the equation:

$$\widehat{P_L} = \hat{\imath} + \widehat{\jmath_1} C + \widehat{\jmath_2} E + \widehat{\jmath_3}(\Delta Inv) + \widehat{\jmath_4} Inv \quad (7)$$

In the second stage, D_L is regressed on Inv, ΔInv and P_L:

$$D_L = \hat{a} + \widehat{b_1}\hat{P} + \widehat{b_2}(\Delta Inv) + \widehat{b_3} Inv \quad (8)$$

The regression coefficients obtained from the equation (8) are unbiased, consistent estimators of the parameters of the original labor demand function.

3 Econ-physics Models under the Econometric Approach

The need to find better economic models led to the idea of using concepts, methods and models from other sciences and to adapt them, in order to model the economic reality.

Under the common elements from economics and physics, the next model is based on the potential energy of the factors' connection and was built as a new location model used by the regional economics (Ionescu R., 2008).

Nowadays, the problem connected to the firm's regional location is very important. This implies the maximum profit criterion, which corresponds to the minimum costs criterion.

Under the pure economic approach, the location decision implies a simple averages' calculation for the average total cost (connected to the used inputs) and the transport costs (as Weber's model). The transport cost covers the expenditures with the final goods until they arrive on the markets.

Weber realized a simultaneous analysis under the profit maximization and the transport costs minimization. The model was developed by Richardson, who considered the transport costs dependent to the Euclidian distance. As a result, he was focused on the transport costs' minimization (Richardson H., 1986).

In order to simplify the problem, Richardson considered a company which combines the m_1 and m_2 inputs from the M_1 and M_2 regions to produce the output m_3 which is sold in the M_3 region.

Using the statistical observations, the average transport cost function can be defined as that from the equation (9). Moreover, this objective function has to be minimized:

$$[min]T = tm_1d_1 + tm_2d_2 + tm_3d_3, \qquad (9)$$

where: t – average transport cost, d_i – the Euclidian distance between the optimal location point K and the rare materials sources and the market location, as well.

Perreur tried to define a three points' problem in order to solve it using the geometric problem of the three points (two rare materials sources and one market) (Perreur F., 1988). These points form a triangle. Inside of it, is the optimal location for the analyzed company.

In order to estimate this location point, Weber proposed a material index calculated as a ratio between the rare materials' value and the final good's value.

If the index's value is greater than 1, the location point has been near the rare materials' sources. On the other hand, if the index's value is less than 1, the location point has been neat the market, as in Figure 4.

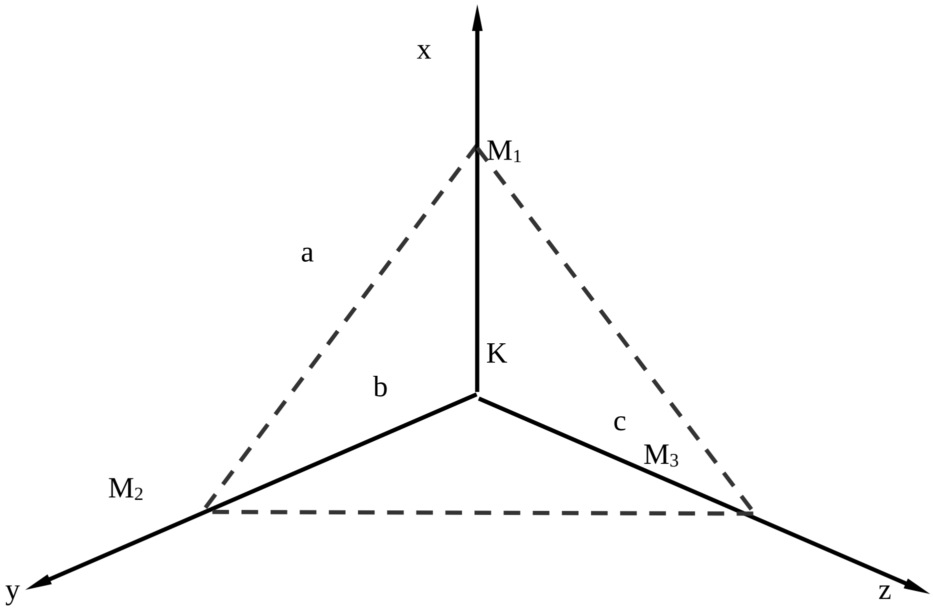

Figure 4. The triangle solution

Palander developed Weber's model by defining the concepts of isocosts mass and isoplan curves given by the points of the identical total transport costs.

We consider that we found a better solution to this problem. Our model is based on the idea that there are A_i points which can define the goods' input sources in a specific region, B_j points as the rare materials' input sources for the same region and C_k points as destinations of the final goods in that region.

These A_i, B_j and C_k points form alternatively the vertexes of a triangle. As a result, a first progress of the analysis is to generalize the number of the location sources and markets as unlimited (Ionescu R., 2009, 2014).

Under this new approach, the objective function connected to the optimal regional location company is:

$$[min]T = P_i q_i d_i + P_j q_j d_j + P_k q_k d_k, \quad (10)$$

where: $i = \left(\overline{1,u}\right), j = \left(\overline{1,w}\right), k = \left(\overline{1,p}\right)$

We used the same notations in the new objective function:

P_i, P_j, P_k – the average transport costs of the goods or rare materials;

q_i, q_j, q_k – the transported final goods or rare materials quantities;

d_i, d_j, d_k – the transport distances for the rare materials and final goods connected to the company's location in the region.

This equations system defines a forces field which is able to direct the company's localization in the region. There is a force for every point from the internal triangles ABC, like in Figure 5.

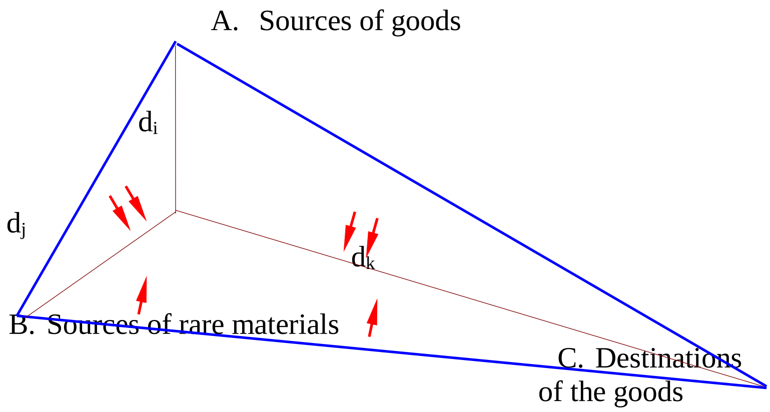

Figure 5. T transport cost surface

Source: Personal Contribution

The intensity of this force is given by the transport cost surface's slope T in the same point. This slope is zero in that point in which the cost is minim.

The Figure 5 represents a simplification of the problem to a three-dimensional space. On the other hand, this framework allows adding new elements for the analysis.

Using the potential models, we can affirm that there is a regional mass m_x where the companies have to locate. This mass m_x is connected to all other masses m_y from the location forces' field.

The next step is to use Newton's potential gravitational formula: $\frac{Gm_x m_y}{d_y}$. As a result, the initial equations system has to be complete with new terms, like the following: $\frac{Gm_x m_i}{d_i}; \frac{Gm_x m_j}{d_j}; \frac{Gm_x m_k}{d_k}$.

Every new term supports the appearance of a supplementary force. On the other hand, it is necessary to spotlight the effects of the feedback connections, as well. The potential energy of the connections, together with the $\frac{Gm_x m_y}{d_y}$ term, action like a mass and seem to be a supplementary mass which is able to form a supplementary potential energy and a supplementary connection, as well. Let's name these feedback terms as:

$$Fa^{(1)}, Fb^{(1)}, Fc^{(1)}.$$

But these feedback effects represent potential energies or connections which have their own masses. As a result, we can create a succession of feedback effects which are adding one after other:

$$Fa^{(2)}, Fb^{(2)}, Fc^{(2)}$$
$$Fa^{(3)}, Fb^{(3)}, Fc^{(3)}$$
$$\vdots$$
$$Fa^{(n)}, Fb^{(n)}, Fc^{(n)}.$$

The next step is to consider all supplementary terms for the objective function, which becomes:

$$[min]T = \sum_i P_i q_i d_i + \sum_i \frac{Gm_x m_i}{d_i} + \sum_i F_i^{(1)} + \cdots \sum_i F_i^{(n)} \quad (11)$$

The positive terms represent the costs and the negative terms represent the revenues, as in Figure 6.

At least, the location enterprises' decision needs a supplementary analysis of the regional socio-demographical and political conditions. These aspects are not included into this model. But they can be synthesized under a quantitative analysis using a well-balanced system which is able to establish specific regional priorities.

We propose to analyze more locations which can cover not only the optimal solution, but some suboptimal solutions, as well. One of these suboptimal solutions should become more favorable under new socio-demographical and political criteria and transform into a global optimal solution.

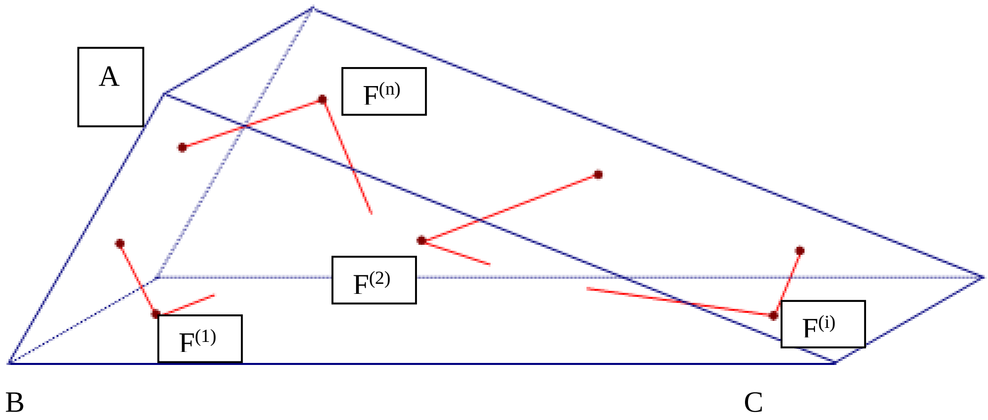

Figure 6. The location forces field
Source: Personal Contribution

The main advantage for this model is that it is able to quantify an unlimited number of variables. Moreover, it can develop the location theory for an unlimited number of rare materials sources and markets, as well.

4 Conclusion

As method of knowledge, econometrics has its limits. But the knowledge has to go up to those limits, in order to force them. Often, the exceeding of these limits cannot be made with quantitative methods, but only with purely rational methods or even just intuitive methods. As a result, the econometrical knowledge of the phenomena represents a stage or a step of the knowledge process.

In many cases, this method does not resolve, but on the contrary, it creates or better discovers contradictions and cracks in our knowledge.

On the other hand, the reality unfolds researcher in contradictory issues.

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