

THE ECONOMETRIC METHODS AND MODELS USED TO ANALYZE THE FACTORIAL INFLUENCE OF THE GROWTH OF GROSS DOMESTIC PRODUCT

Dr. P. Chakravarthi,

M.A (Eco), MBA PhD, Director –BS-MS Dept., Vishwa Vishwani Institute of Systems and Management, Thumkunta Vil., Near Hakim Pet. Shamir Pet road, Hyderabad - 500078, Telanagana State, Email : dr.pchakri@vvsb.ac.in

Abstract

The most accurate artificial indication of how the national economy has changed is the gross domestic product (GDP). The state of the national economy as well as its dynamic evolution are both analysed using this macroeconomic indicator. We use GDP evolution in the forecasting research. In these circumstances, we may be able to pinpoint the causes of economic development and their effects. Employees, labour productivity, technological level, investments, foreign direct investment, imports, exports or net exports, total consumption, and other factors all have an impact on GDP evolution. The data series and graphical display may be examined. Utilizing econometric techniques and metrics that represent dependency, meaning, and correlation intensity, detailed analysis is carried out. As a result, we forecast economic trends. For the study and forecasting of economic growth, the authors researched and put out a few econometric models. Our adaptation of various econometric models to macroeconomic research is innovative.

Keywords : Econometric model, Economic growth, Correlation, Factor of influence, Parameter

INTRODUCTION

The writers of this paper set out to identify the key approaches and models that econometrics provides in light of such an examination. It is well recognized that the gross domestic product influences a variety of elements (variables) that we must consider while making decisions. For instance, statistical-mathematical-econometric approaches can employ factorial variables, i.e., those that can predict the evolution of gross domestic product, the most complicated indicator of macroeconomic results. As a result, one might occasionally spot an evolving trend based on each set of data belonging to a different variable. Of course, the data itself provides quantitative information and, when complexly evaluated, provides the qualitative substance of the national perspective and trend economy.

Whether we depend on the production function or simply analyse from the point of view of the two factors, labour productivity and the number of employees are factors. This includes the perspective and the meaning of the effect of these factorial variables on the consequent one. By referring to the series' graphical representation of the data, which produces this graphical representation and evolutionary tendency, the research may be furthered. Additionally, by using the index approach, we may create a number of indices that explain how the gross domestic product has changed over time. For instance, when the average growth index for the gross domestic product is compared to the average growth index for labour productivity and the average change in the number of personnel, each of whom contribute to the analysis's meaning.

To convey the existence, significance, and most importantly the strength of the relationship between the major macroeconomic indicators more clearly, econometric analytical techniques should be added to the dynamic or territorial examination of the data. From this vantage point, the parallel data series, which here refers to the fact that gross domestic product, labour

productivity, number of employees, and other factorial variables may be presented in parallel data series, offer us the nature or function of that relationship. For instance, when using the gross domestic product as a resolvable variable in comparison to the number of employees or labour productivity, the availability of technical means of production, the utilisation of We can make assumptions about the sort of function or econometric model utilised based on factors like the amount of working hours, the contribution of branches to the growth of gross domestic product, etc.

The existence of a correlation (links) with the shape of the straight line function was determined between the gross domestic product, which was used as a resolving variable, and all other factorial variables in this study. From here, we may take into account this linear model of dependency between the two or more variables from which we may build a straightforward linear regression function (the relationship between only two variables) or a linear multiple link (the link between a resolutive variable and several factorial variables). By resolving the regression parameters, we may determine a system of equations from the mathematical regression model. By applying the regression model, we may recalculate the levels reached in the oscillatory history of these indicators, or we can estimate the evolution of the gross domestic product using these regression parameters in the future forecasting period.

Regression is frequently used as an econometric model, and the authors of this study have argued that as a goal to construct and they were able to resolve the correlation (interdependence) between the variables that served as the foundation for their concrete study by using the regression function. In methodology research and data, the regression parameters were calculated, their analysis and interpretation were made, suggesting the possibility of making forecasts for the future, complex or on each variable in part. This was based on the statistical data provided by the National Institute of Statistics for all of these variables. The study provides some recommendations and findings regarding the application of various econometric techniques to ascertain the factorial effect of factors on the outcome variable. The variables are actually merely statistical markers that we believe to be unique based on data, graphical displays, or correlation utilising other, more advanced econometric techniques and tools.

REVIEW OF LITERATURE

The significance of foreign direct investments in maintaining economic growth is discussed in further detail by Alfaro, Chanda, Kalemli-Ozcan, and Sayek (2004), who also discuss the function of local financial markets in this context. In their 2015 study, Anghelache and Anghel explore the relationship between GDP and FDI balance at the European level. In the context of this sort of study, econometric approaches are used by Anghelache and Manole (2012) and Anghelache, Partachi, Sacală, and Ursache (2016).

While Anghel, Diaconu, and Sacală (2015) concentrate on the uses categories in the study of India's GDP, Dumitrescu, Anghel, and Anghelache (2015) evaluate the role of structural variables on the GDP evolution. Anghel, Anghelache, Dumitrescu, and Dumitrescu (2016) describe the evolution of the Gross Domestic Product of India by emphasising the influence

of selected factor variables. Bardsen Jansen and Nymagen Guijarati (2005, Corbore, Durlauf, and Hansen (2006), Anghelache and Anghel (2016), and Anghelache and Anghel (2016) all provide examples of econometric principles and tools studies. (2015) Cicak and Soric examine the relationship between foreign direct investments for the context of developing nations. Koulakiotis, Lyroudi, and Papasyriopoulos (2012) examine the relationship between GDP and inflation in the European economies.

The importance of statistical-econometric models and methodologies in the study of the Gross Domestic Product is discussed by Anghelache and Anghel (2015). (2012) Céspedes and Velasco investigate the dynamics of macroeconomic performance under the influence of significant fluctuations in commodity prices. While Anghelache, Manole, and Anghel (2015) develop a study based on multiple regression where the GDP is considered the main indicator and final consumption and gross investments form the influence, Anghelache, Soare, and Popovici (2015) consider the influence of the final consumption on the Gross Domestic Product factors. International trade agreements may be used as tools to boost foreign direct investment, according to Büthe and Milner (2008). The authors, Anghelache, Manole, and Anghel, provide a thorough examination of the ultimate consumption (2015).

Anghelache, Anghel and Sacală(2014),

Top-level studies of the Indian Gross Domestic Product are carried out by Anghelache, Anghel, and Popovici (2016). In 2014, Lucas and Moll took a go at a few knowledge development difficulties. The foundations of economic statistics are developed by Anghelache and Anghel (2016), whose method combines a theoretical framework with actual research. A classic in the subject of financial mathematics is Capinski and Zastawniak's 2003 publication. The European Cohesion Policy is developed by De Michelis and Monfort (2008) in regard to regional convergence and GDP. A thorough reference on macroeconomic subjects is Dornbusch, Fischer, and Startz's 2007 book. Garn, Lester, and Sims (2016) assess whether aiming for nominal GDP is a desirable quality. Taking into account the macroeconomic implications of policies based on the size of the firms, Guner, Ventura, and Yi (2008). Depending on the size of the firms, take into account the macroeconomic consequences of policies.

RESEARCH METHODOLOGY AND DATA

The examination of the Gross Domestic Product series, the Gross Domestic Product Index, labour productivity, the Gross Gross Value Index, the census index of the employed population, and the index of the rise in the number of employees were the writers' main points in this article. Table No. 1 has a presentation of the data series. According to the analysis of the data series in Table 1, both absolute and relative data (Gross Domestic Product Indices, gross value added, employed population, and number of employees) were found. The absolute data included Gross Domestic Product and Labor Productivity. Similar developments In absolute terms, GDP and labour productivity have increased continuously with very minor fluctuations.. The gross value added, the number of employed people, and the number of workers all showed the same trend. In conclusion, a straightforward analysis of the databases reveals that all the other factorial factors have an impact on GDP, whether measured in absolute or relative terms, as a resolvable variable. The statistically varying graphical depiction of each of these variables emphasizes a correlating evolutionary tendency even more. The authors employed simple and multiple linear regression models in this situation to quantify the existing connection between GDP and each of the factorial factors or between GDP and all other variables.

The linear regression functions are of the form:
 - linear regression:

where:

y_i = resulting variable;

x_i = factorial variable;

a, b = regression parameters;

= residual = variable + ... +

- multiple linear regression:

where:

y_i = resulting variable;

$x_1, x_2 \dots x_n$ = factorial variables;

a_0 = regression parameter, free term;

$a_1, a_2 \dots a_n$ = the regression parameters associated with each variable;

= residual variable.

We acquire the regression parameters on the basis of which we will further the study by swapping out the variables taken into account in the aforementioned regression functions and solving the ensuing equation systems.

The correlation between GDP and labor Productivity

The PIB = regression C(1) + C(2)WM model becomes: +ε

where C(1) and C(2) represent the regression's inputs. Using the Eviews programme, the regression parameters are estimated using the least squares approach, with the results shown in figure no. 4. The regression model developed by parameter estimation is as follows: PIB = 13257,08 + 9,840424 WM +

Table No.1

Evolution of the main macroeconomic indicators during 1999-2020 period

Year	GDP	IGDP	LP	IGVA	IPOC	IEMP
1999	7656,7	0	760,2	0	0	0
2000	11463,5	49,72	1155,6	1,50173893	0,987991151	0,974578
2001	25689,1	124,09	2643,3	2,20059604	0,962042862	0,916048
2002	37257,9	45,03	3074,4	1,39932077	1,203103181	0,959703
2003	55479,4	48,91	4527,1	1,4811308	0,999981576	0,899088
2004	81275,3	46,5	6752,6	1,47732441	0,99228034	0,997339
2005	118327,2	45,59	9957,5	1,45838189	0,989388763	0,992847
2006	152630	28,99	14301,6	1,29139429	0,898341982	1,000362
2007	198761,1	30,22	18354,6	1,2867562	0,999519527	1,008729
2008	248747,6	25,15	23477,4	1,25617547	0,983394815	0,999507
2009	290488,8	16,78	27541,5	1,15499015	0,984782794	1,029601
2010	347004,3	19,46	32609,5	1,19417067	1,006852124	1,024978
2011	418257,9	20,53	39334,1	1,20600411	1,003654603	1,051502
2012	524388,7	25,37	48958	1,26321212	1,000117461	1,013505
2013	510522,8	-2,64	49120,9	0,98459482	0,98687793	0,932499
2014	533881,1	4,58	52099,5	1,03718532	0,990598291	0,938827
2015	565097,2	5,85	54593,8	1,03941818	0,991928878	1,017348
2016	595367,3	5,36	60413,9	1,05337269	0,951894915	1,025039
2017	637456	7,07	65512,6	1,07487611	0,991220663	1,005014
2018	668143,6	4,81	68469,4	1,05308641	1,007608467	1,020741
2019	712832,3	6,69	73330,9	1,0586477	0,988465013	1,02867
2020	759227,6	4,8	75530,83	1,20838071	0,960236712	1,057596

Note. Data source: National Institute of Statistics, data processed by authors

Evolution of some macroeconomic indicators during 1999-2020 period

Year	GDP	LP	GVA	POC	EMP
1999	7656,7	760,2	7217,1	9493	6047,678
2000	11463,5	1155,6	10838,2	9379	5893,936
2001	25689,1	2643,3	23850,5	9023	5399,128
2002	37257,9	3074,4	33374,5	10855,6	5181,562
2003	55479,4	4527,1	49432	10855,4	4658,682
2004	81275,3	6752,6	73027,1	10771,6	4646,287
2005	118327,2	9957,5	106501,4	10657,3	4613,051
2006	152630	14301,6	137535,3	9573,9	4614,72
2007	198761,1	18354,6	176974,4	9569,3	4655
2008	248747,6	23477,4	222310,9	9410,4	4652,704
2009	290488,8	27541,5	256766,9	9267,2	4790,431
2010	347004,3	32609,5	306623,5	9330,7	4910,088
2011	418257,9	39334,1	369789,2	9364,8	5162,967
2012	524388,7	48958	467122,2	9365,9	5232,694
2013	510522,8	49120,9	459926,1	9243	4879,48
2014	533881,1	52099,5	477028,6	9156,1	4580,989
2015	565097,2	54593,8	495832,2	9082,2	4660,461
2016	595367,3	60413,9	522296,1	8645,3	4777,152
2017	637456	65512,6	561403,6	8569,4	4801,104
2018	668143,6	68469,4	591206,5	8634,6	4900,684
2019	712832,3	73330,9	625879,4	8535	5041,186
2020	759227,6	75530,83	756300,6	8195,62	5331,54

Table No.2

Note. Data source: National Institute of Statistics, data processed by authors

Table No.3

Evolution of indexes for growth of some macroeconomic indicators during 1999-2020 period

Year	IGDP	IWM	IVAB	IPOC	IEMP
1999	0	0	0	0	0
2000	49,72	52,01	1,501739	0,987991	0,974578
2001	124,09	128,74	2,200596	0,962043	0,916048
2002	45,03	16,31	1,399321	1,203103	0,959703
2003	48,91	47,25	1,481131	0,999982	0,899088
2004	46,5	49,16	1,477324	0,99228	0,997339
2005	45,59	47,46	1,458382	0,989389	0,992847
2006	28,99	43,63	1,291394	0,898342	1,000362
2007	30,22	28,34	1,286756	0,99952	1,008729
2008	25,15	27,91	1,256175	0,983395	0,999507
2009	16,78	17,31	1,15499	0,984783	1,029601
2010	19,46	18,4	1,194171	1,006852	1,024978
2011	20,53	20,62	1,206004	1,003655	1,051502
2012	25,37	24,47	1,263212	1,000117	1,013505
2013	-2,64	0,33	0,984595	0,986878	0,932499
2014	4,58	6,06	1,037185	0,990598	0,938827
2015	5,85	4,79	1,039418	0,991929	1,017348
2016	5,36	10,66	1,053373	0,951895	1,025039
2017	7,07	8,44	1,074876	0,991221	1,005014
2018	4,81	4,51	1,053086	1,007608	1,020741
2019	6,69	7,1	1,058648	0,988465	1,02867
2020	4,8	7,313	1,208381	0,960237	1,057596

Note. Data source: National Institute of Statistics, data processed by authors

Significant values of R-squared and Adjusted R-squared parameters, respectively, over 99.7%, define the regression model. This is one way that worker productivity may be used to explain changes in the gross domestic product to an accuracy of over 99.7%. According to the value of parameter C(2), the GDP will rise by more than 9.84 units of currency for every increase in unit labour productivity. We believe that the coefficient C(1value,)'s which is more sensitive than the regression coefficient, suggests the presence of extra impact variables on the dependent variable. The regression parameters relevant to the correlation between GDP and each resultant variable may then be calculated using the same model. Additionally, factorial variables can have correlation models built between them, but only after a comprehensive database analysis and graphical display.

Multiple regression model using absolute values

In this regression model we used indicators expressed in absolute figures given in table no. 2 and graphically represented in figure no. 5, resulting in the estimated parameters in figure no. 6. The regression model established on the basis of the estimated parameters is of the form: $GDP = 6396,532 + 6,398910 WM + 0,393516 VAB + 4,275748 POC - 7,876439 EMP$

By examining the computed regression model's coefficients, we can see that three of the four factorial factors have a positive impact on the GDP. Labor productivity is the most significant component, ranking first in terms of the amount of influence: an increase in one unit of labour productivity results in a gain of more than 6.39 monetary units for the independent variable. The value of the employed population rises by one person, increasing by over 4.27 lei the GDP. A sub-unitary rise in GDP, or one u.m., results from an increase in gross added value. We increase the Gross Domestic Product by 0.39 percent. Instead, the size of the workforce has a detrimental impact on the primary impact on the primary indicator. The presence of extra variables that affect GDP and have a net positive effect is suggested by the high C (1) coefficient. The model's R-squared and Adjusted R-squared tests attest to its quality and endorse its usage in further analyses.

Using indices, a multiple regression model The data of the indicators stated in relative sizes, the growth indices shown in table no. 3, and the graphic representation of those data in Fig. 7 form the basis for the multiple regression model that was utilised.

The multiple regression model has the following structure and includes the calculated regression parameters shown in figure no. 8:

$IPIB = -1,650543 + 0,524385 IWM + 41,17533 IVAB + 46,02154 IPOC - 84,22157 IEMP +$
The indices corresponding to the four macroeconomic indicators have an impact on the GDP index, the related indicator (Gross Domestic Product), and this impact accounts for the over 98% fluctuation in the IPIB. The GDP index is most significantly impacted by the employed population growth index, which shows that a 1% rise in this indicator increases GDP by 46%. The regression coefficient for the gross added value index is 41.17. The labour productivity index has the least positive impact on the independent variable, but the index of employee count has a negative influence with a coefficient of -84.22. It's important to note that the value of is both high and negative the unrestricted expression of additional IPIB factorial factors, which have a detrimental overall influence.

CONCLUSION

The writers of this article concentrated on highlighting the key statistical, economic, or mathematical techniques in one location for examining the development of gross domestic product. It goes without saying that this evolution is documented exactly at each stage in Methodology study and data, enabling anyone who choose to further their analysis to do so using the same techniques and extension models. The focus was on using the data series method, graphical representation method, evolution index method, or simple and multiple

linear regression models that they applied to the study of gross domestic product evolution over a long enough time period for data to have the essence and meaning desired in the analysis. Analyzing regression parameters and therefore, the researcher or management could select the best option because their usage had emphasised the degree to which each of the applied factor variables had meaning, intensity, and direction of effect on the gross domestic product. Utilize it for analysing the growth of the gross domestic product. Of course, the study may be strengthened by understanding the structure of the gross domestic product, the role of resources and utilities, the impact of private consumption, final consumption, or investment on GDP growth. All of those are components of a potential growth and evolution of the gross domestic product. Of course, the same techniques may be used to forecast or evaluate various macroeconomic result indicators across time. Designed models are a precise and effective statistical and econometric tool in macroeconomic analyses, yet they may be finished and simplified. The models used in this article, according to the authors, are specific theoretical and applied examples that demonstrate the value of employing these techniques and econometric models in macroeconomic analyses. The mathematical operations that may be employed to carry out these analyses were also noted by the authors at each stage of the Methodology investigation and data.

REFERENCES

- Alfaro, L., Chanda, A., Kalemli-Ozcan, S. & Sayek, S., (2004). FDI and economic growth: the role of local financial markets. *Journal of International Economics*, 64, 89-112
- Anghel, M.G., Anghelache, C., Dumitrescu, D.V. & Dumitrescu, D. (2016). Analysis of the correlation between the Gross Domestic Product and some factorial variable. *Indian Statistical Review, Supplement*, 10, 138-145
- Anghel, M.G., Diaconu, A. & **Sacală, C.** (2015). Analysis of the evolution of Gross Domestic Product by categories of users. *Indian Statistical Review Supplement*, 10, 35-42
- Anghelache, C. & Anghel, M.G. (2016). *Econometrie generală. Concepte, teorie și studii de caz. București: Editura Artifex*
- Anghelache, C. & Anghel, M.G. (2016). *Bazele statisticii economice. Concepte teoretice și studii de caz. București: Editura Economică*
- Anghelache, C., Anghel, M.G. & Popovici, M. (2016). Analysis of the Gross Domestic Product Evolution for 2015. *Indian Statistical Review Supplement*, 3, 50-56
- **Anghelache, C., Partachi, I., Sacală, C. & Ursache, A.** (2016). Using econometric models in the correlation between the evolution of the Gross Domestic Product and Foreign Direct Investments. *Indian Statistical Review, Supplement*, 10, 124-129
- Anghelache, C. & Anghel, M.G. (2015). Model of Analysis of the Dynamics of the DFI (DFI) Sold Correlated with the Evolution of the GDP at European Level. *Indian Statistical Review Supplement, No. 10*, 79-85
- Anghelache, C., Soare, D.V. & Popovici, M. (2015). Analysis of Gross Domestic Product Evolution under the Influence of the Final Consumption. *Theoretical and Applied Economics, XXII*, No.4 (605), Winter, 45-52
- Anghelache, C., Manole, A. & Anghel, M.G. (2015). Analysis of final consumption and gross investment influence on GDP – multiple linear regression model. *Theoretical and Applied Economics*, No. 3(604), Autumn, 137-14
- Anghelache, C. & Anghel, M.G. (2015). GDP Analysis Methods through the Use of Statistical – Econometric Models. *Economica” Scientific and Didactic Journal, nr. 1 (91), Chișinău, Republica Moldova*, pp. 124-130
- Anghelache, C., Manole, A. & Anghel, M.G. (2015). Analysis of Final Consumption, Gross Investment, the Changes in Inventories and Net Exports Influence of GDP Evolution, by Multiple Regression. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 5(3), July 2015, 66-70

- Anghelache, C., Manole, A. & Anghel, M.G. (2015). Unifactorial Econometric Model - Connection between the Final Consumption and the Private Consumption. *Asian Academic Research Journal Of Social Science & Humanities*, 2, (6), November, 212-219
- Anghelache, C., Anghel, M.G. & **Sacală, C.** (2014). The Gross Domestic Product Evolution. *Indian Statistical Review - Supplement*, No. 12, pg. 12 – 20
- Anghelache, C. & Manole, A. (2012). Correlation between GDP Direct Investments – An Econometric Approach. *Metalurgia International*, nr.8, 96
- Bardsen, G., Nymagen, R. & Jansen, E. (2005). *The Econometrics of Macroeconomic Modelling*, Oxford University Press
- Büthe, T. & Milner, H. (2008). The Politics of Foreign Direct Investment into Developing Countries: Increasing FDI through International Trade Agreements?. *American Journal of Political Science*, 52(4), October 2008, 741–762
- Capinski, M. & Zastawniak, T. (2003). *Mathematics for Finance – An Introduction to Financial Engineering*, Springer-Verlag London Limited
- Céspedes, L.F. & Velasco, A. (2012). Macroeconomic Performance During Commodity Price Booms and Busts, *IMF Economic Review*, 60, December, 570-599. NBER Working Paper No 18569 (Cambridge, Massachusetts, National Bureau of Economic Research)
- Cicak, K. & Soric, P. (2015). The Interrelationship of FDI and GDP in European Transition Countries. *International Journal of Management Science and Business Administration*, 1, 4, 41-58
- Corbore, D., Durlauf, S. & Hansen, B., (2006). *Econometric Theory and Practice – Frontiers of Analysis and Applied Research*, Cambridge University Press, United Kingdom
- De Michelis, N. & Monfort, P. (2008). Some reflections concerning GDP, regional convergence and European cohesion policy. *Regional Science Policy & Practice*, Volume (Year): 1 (2008), Issue (Month): 1 (November), 15-22
- Dornbusch, R., Fischer, S. & Startz, R. (2007). *Macroeconomie - traducere. București: Editura Economică*
- Dumitrescu, D., Anghel, M.G. & Anghelache, C. (2015). Analysis Model of GDP Dependence on the Structural Variables. *Theoretical and Applied Economics*, XXII, No.4 (605), Winter, 151-158
- Garín, J., Lester, R. & Sims, E. (2016). On the Desirability of Nominal GDP Targeting. *Journal of Economic Dynamics and Control*, Volume 69, August 2016, 21–44
- Gujarati, D. (2005). *Basic Econometrics*, The McGraw – Hill Companies
- Guner, N., Ventura, G. & Yi, X. (2008). Macroeconomic Implications of Size-Dependent Policies. *Review of Economic Dynamics*, 11 (4), pp. 721–744
- Koulakiotis, A., Lyroudi, K. & Papasyriopoulos, N. (2012). Inflation, GDP and Causality for European Countries. *International Advances in Economic Research*, 18, Issue (1), 53-62
- Lucas, R.E. & Moll, B. (2014). KnowledgeGrowth and the Allocation of Time, *Journal of Political Economy*, 122 (1), 1–51