THEORETICAL CONSIDERATIONS REGARDING THE MAIN MACROECONOMIC PROPORTIONS AND CORRELATIONS

Prof. Alexandru MANOLE PhD
„Artifex„, University of Bucharest

Assoc. prof. Mădălina-Gabriela ANGHEL PhD
„Artifex„, University of Bucharest

Alexandru BADIU Ph.D Student
Bucharest University of Economic Studies

Doina AVRAML Ph.D Student
Bucharest University of Economic Studies

Abstract

Macroeconomic analysis is reduced, most often the interpretation of how they have evolved and results indicators, particularly gross domestic product. Macroeconomic studies reveal that a number of other variables (indicators) calculated at this level but clearly the trend of future macroeconomic developments. Thus inflation, unemployment, economic growth, etc. have a close correlation with how it has evolved GDP. The pace of evolving macroeconomic indicators expressing the connection between these sizes and suggest future evolution trend.

Studying literature and concludes that results from macroeconomic indicators (GDP, PIN, VN, VND) and other macroeconomic indicators calculated at a number of correlations and proportions. The authors have proposed in this article to highlight the main theoretical about correlations and proportions are established at the macroeconomic level. Will be analyzed and will do is specify where all the macroeconomic correlations identified. These correlations and proportions are completed by statistical and mathematical relationships, on which you can perform static analysis, dynamic or structured. The focus is on identifying and analyzing correlations core growth. The theoretical elements can be used in concrete and comprehensive analysis. In this respect in the (relationships) can be used mathematical identified existing data. Then the concrete results can predict trends for forecasting future work.

Keywords: correlation rate, unemployment, inflation, economic growth.

JEL Classification: E60, F40
Introduction

Study subject of this article proposes an analysis on complex theoretical correlation between macroeconomic variables.

Any economic program is comprised of a set of policy measures designed to achieve the main macroeconomic policy objectives that - usually - are: growth, employment, price stability and improving the balance of payments.

These targets are measured by four fundamental variables, sometimes called key macroeconomic variables, through which we measure, correlate and analyze the performance of any economy: GDP growth rate; The unemployment rate, measured as either the level at the end of each year, either as annual average; The inflation rate, measured either by the growth rate of the GDP deflator, either by average monthly growth rate of consumer prices; Current account balance of the balance of payments.

The four variable- allow objective evaluation of the major internal and external macroeconomic imbalances, and help monitor changes that have occurred in the economy and help create adequate policies in order to achieve future goals.

Between the four macroeconomic variables important correlations are established. Also, between them and other macroeconomic indicators close connections exist.

Literature review


Data and methodology

The relationship between GDP growth and unemployment rate
At theoretical level, the link is clear: when the economy is in recession phase, characterized by decelerating GDP growth (RPIB), unemployment rate (UR) increases; when there is economic expansion, RPIB increases, while UR declines. This inverse correlation is known as Okun’s law. Analyzed on the US economy, the law materialized in the following relationship:

\[ RPIB_{t/t-1} = 3\% - 2(RSt_{t} - RSt_{t-1}) \]  

where:
- \( RPIB_{t/t-1} \) = GDP growth during the period t to t-1;
- 3\% = GDP growth trend (trend relative to time);
- \( RSt_{t}, RSt_{t-1} \) = The unemployment rate in period t or t-1.

If unemployment remains the same, GDP will grow by about 3%. For every percentage point increase in unemployment rate, the pace of GDP growth will decrease by percentage points to 3%. For example, if the increase in the current unemployment rate is from 6% to 8%, the real RPIB will be

\[ RPIB = 3-2(8-6) = -1\% \]  

Another way of writing the previous relationship:

\[ RS_{t+1} = RSt - 0,5(RPIB_{t/t-1} - 3) \]  

We can note that unemployment in the current period will be higher or lower than the previous period, as RPIB will be higher or lower than the trend growth (3%).

In other words, if we want to reduce unemployment with 1 percent point we need RPIB to achieve a growth of 5%:

\[ RS_{t+1} - RSt - 0,5(5 – 3 = -1) \]
This relationship is statistical in nature, and is not valid for any country, only for the US and only for the stages where Okun did the research. Such a statistical relationship can be derived for each country, depending on the specific stages of each country.

Statistics analysis, in Romania’s economy in recent years has led us to the conclusion that Okun’s law is valid, but - obviously - in a specific form tailored for Romania.

First, the trend of economic growth was considered the average annual GDP growth during 1980-1989, calculated at 1.4%.

Secondly, in the period 1990-1993 we cannot determine any statistical relationship between stable GDP growth and unemployment rate although it is obvious for the inverse correlation between the two variables.

Thirdly, since 1994 we can establish a OKUN type relationship between the change in unemployment rate and change to the pace of GDP growth, specifying that the connection lagging (out of phase): GDP growth in period t, over the trend registered (1.4%) led to a reduction in unemployment in the next period t + 1.

The derived relationships is as follows:
\[ R_{St+1} = R_{St} + \alpha(R_{PIBt/t-1} - 1,4) \] (5)

where \( \alpha \) \((-0.4; -0.45)\)

In other words, GDP growth rate in year t by 1 percentage point above the trend has reduced the unemployment rate in year t + 1 by about 0.4 percentage points.

Moreover, the GPD change only partly explains the evolution of GDP unemployment.

Much stronger was the influence exercised on unemployment rate by the lower average interest rate on bank loans given to businesses.

Between the two variables we have identified a direct correlation and of strong intensity.

**The correlation between inflation and unemployment rate**

Analysis of the statistical data series - especially those in developed countries, until 1973 when the „oil shock” began - highlighted a simple and stable reverse correlation, between inflation and unemployment.

In other words, between inflation and unemployment there is a compensation relationship which is that a lower unemployment can be achieved by accepting higher inflation or inflation can be reduced by accepting more unemployment. This inverse correlation is given by the Philips curve.
The compensation relationship shown above applies only on short-term, and is as follows:

$$R_t = R_{t-1} + \alpha(R_S - R_{NS})$$  \hspace{1cm} (6)

in these conditions, the actual inflation rate (RI) depends only on two factors:

- inertial component defined by expected inflation, which can be substituted by previous inflation ($R_{t-1}$);
- a cyclical component defined by current unemployment deviation ($R_S$) than the natural rate of unemployment ($R_{NS}$).

From the formula we can deduce that as long as unemployment remains at its natural level, the inflation rate does not change. Accordingly, if the unemployment rate rises above its natural level, than the inflation rate will register some reduction that depends on parameter $\alpha$ (decreasing slope of the curve of Philips).

After the oil crisis in the 70s it was observed that the relationship between inflation and unemployment is not so simple. The inflation rate is actually influenced by a third factor ($\varepsilon$) namely by the shock felt in the aggregate supply (changes in nominal GDP due, for example, in the large increases of the prices for some products).

$$R_t = R_{t-1} - \alpha(R_S - R_{NS}) + \varepsilon$$  \hspace{1cm} (7)

There is a possibility that – on the long term – inflation and unemployment in certain periods may not comply with the deduced Philips inverse correlation. Developments of the two variables will be written - on a series of short Philips curves drawn on short term periods.
Average levels recorded on inflation rate and unemployment rate in Romania, can be analyzed using the Philips curve.

**Correlation between the growth rate of GPD and inflation rate**

As GDP is calculated at current prices or in comparable prices, one can speak of nominal or real evolution of this indicator.

The nominal evolution is described by the following relationship:

\[
IPI_B = \frac{PIB_t^{\text{ct}}}{PIB_0^{\text{ct}}} \tag{8}
\]

\[
RPIB_n = IPIB_n - 1 \tag{9}
\]

\[
PIB_t^{\text{comp}} = \frac{PIB_1^{\text{ct}}}{D} \tag{10}
\]

\[
IPIB_r = \frac{PIB_1^{\text{comp}}}{PIB_0^{\text{comp}}} \cdot \frac{PIB_1^{\text{comp}}}{PIB_0^{\text{ct}}} \tag{11}
\]

\[
RPIB_r = IPIB_r - 1 \tag{12}
\]

\[
IPIB_n = IPIB_r \cdot D \tag{13}
\]

\[
RPIB_n = RPIB_r + RI + RPIB_r \cdot RI \tag{14}
\]

**Basical correlations of economic growth**

The synthetic indicator that characterizing economic growth is the total GDP or per capita GDP, expressed by his volume and pace of growth. In these circumstances, economic growth is defined as a complex process of increasing the size of the national economy results based on the combination and use of direct production inputs: labor, fixed capital and consumption of working capital equipment.

Intensive development of economy assumes GDP growth through more efficient use of existing manpower resources, assets and materials. In contrast, extensive development refers to growth which occurs by increasing the volume of the three resources.

Concerns in shaping a theory of economic growth has generated a broad debate on growth factors, interdependencies between them and their contributions to achieving results and usable statistical methods and macroeconomic analysis.

The balanced development of the national economy is conditioned by the existence of three correlations between base levels and changes (absolute and relative) of aggregates results (usually GDP), on the one hand, and the
main factors of economic growth, on the other part. These correlations must be ensured both in the overall economy and in each branch.

- Firstly, the GDP depends on the volume of work consumed, measured in the national economy through employment \( \sum T \)3, and the quality and intensity of the work performed, measured by social productivity of labor \( \bar{W} \).

\[
P_{IB} = \bar{W} \cdot \sum T - \text{the national economy.} \tag{16}
\]

The relationship can be analyzed through the same indicators in each branch.

\[
V_{AB} = W \cdot T - \text{at the level of a branch, where:}
\]

\[
V_{AB} = \text{Gross Value Added (GVA)}.
\]

The first relationship, if it is transferred in dynamics it becomes:

\[
1P_{IB} = \bar{W} \cdot 1\sum T \tag{17}
\]

or:

\[
R_{P_{IB}} + 1 = (R\bar{W} + 1) \cdot (R\sum T + 1) \tag{18}
\]

where:

\[
I = \text{growth index of each indicator};
\]

\[
R = \text{growth rate of each indicator}.
\]

By developing, the last relationship can be written as a correlation between the growth rates.

\[
R_{P_{IB}} = R\bar{W} + R\sum T + R\bar{W} \cdot R\sum T \tag{19}
\]

This relationship can be applied in different ways depending on how common influence is treated:

- we can ignore the common influence, when at least one of the growth rates recorded significant value;
- or we can give common influence to either the quality or quantity factor.

\[
R_{P_{IB}} = R\bar{W} + R\sum T + R\sum T = R\bar{W} (1 + R\sum T) + R\sum T = R\bar{W} \cdot 1\sum T + R\sum T \tag{20}
\]

or

\[
R_{P_{IB}} = R\bar{W} + R\sum T + R\bar{W} \cdot R\sum T = R\bar{W} + R\sum T (1 + R\bar{W}) = R\bar{W} \cdot R\sum T \cdot I\bar{W} \tag{21}
\]

or we can spread the influence of each common factor, either equally or proportionately with independent influences (pure).
• Secondly, the GDP is analyzed by main element of national wealth - Fixed assets (∑F) – and the average efficiency of using them (]\bar{E}\n\)

\[PIB = E \cdot \sum F\]

at national economic level

\[VAB = E \cdot F\] – at branch level.

(22)

(23)

Similar to the point shown at A, the correlation between GDP growth rates and of the influence factors is as follows:

\[RPIB = R\bar{E} + R\bar{\sum F} + R\bar{E} \cdot R\bar{\sum F}\]

where:

R\bar{E} - intensive influence factor

R\bar{\sum F} - extensive influence factor

R\bar{E} \cdot R\bar{\sum F} - common influence

• Thirdly, the GDP depends on the volume of consumed material resource assets (∑C) and the average efficiency of using them (]\bar{M}\n\)

\[PIB = \bar{M} \cdot \sum C\] - the national economy.

\[VAB = M \cdot C\] - at the level of a branch

Correlation between the growth rates is as follows:

\[RPIB = R\bar{M} + R\bar{\sum C} + R\bar{M} \cdot R\bar{\sum C}\]

where:

R\bar{M} - intensive influence factor

R\bar{\sum C} - extensive influence factor

R\bar{M} \cdot R\bar{\sum C} - common influence

The correlations presented refers to a single element of the production process: either labor, capital assets or material consumption. In this way, GDP change is attributed entirely to one of the three factors, apart from the other two.

As the three resources simultaneously act in the production process, normally the modification of GDP should be their correlated result.

We cannot simply summarize the intensive influences from each element and then the extensive influences from each element because the total will not be identical in size, with relative growth of GDP.

Following were proposed some methods of calculation allowing to establish to what extent the development of the national economy is done intensively and to what extent is done extensively, relative to all three resources put together.

The highlight is the correlations between relative changes in GDP and the growth rates of factors for each resource separately.

\[RPIB = R\sum T + R\bar{W} \cdot I\sum T\]

(26)

\[RPIB = R\sum F + R\bar{E} \cdot I\sum F\]

(27)

\[RPIB = R\sum C + R\bar{M} \cdot I\sum C\]

(28)

where:

R\sum C - extensive influence factor

R\bar{M} \cdot I\sum C - intensive influence factor
To arrive at a formula that would combine extensive and intensive influences of the three factors taken together, every influence will be corrected from each element by one factor:

GT for labor, GF for fixed capital, GC for consumption of materials, coefficients established such that:

\[ GT + GF + GC = 1(100) \] (29)

These coefficients could be:

- the weight of the mass of each factor in the total cost of the factors that can be expressed as percentage of net value added (VAN), of depreciation (A) and material consumption (or intermediate consumption - CI) in total gross output (PB).

\[ GT = GF = GC = 33,3\% \] (30)

- the calculated weights each factor based on elasticity (E) in relation to production, elasticity expressed as the ratio between the relative increase in GDP and relative growth of each resource:

\[
\begin{align*}
\beta_T &= \sum E \\
\beta_F &= \sum F \\
\beta_C &= \sum C \\
\end{align*}
\] (31)

where:

\[ \sum E = \text{elasticity sum of the three resources.} \]

This method has the disadvantage of not being applicable in the case of negative elasticity.

Under these conditions we can write a relationship showing intensive and extensive contribution to GDP growth of three resources:

\[
\begin{align*}
ET &= \frac{RPIB}{RT} \\
EF &= \frac{RPIB}{RF} \\
EC &= \frac{RPIB}{RC} \\
GT &= \frac{ET}{\Sigma E} \\
GF &= \frac{EF}{\Sigma E} \\
GC &= \frac{EC}{\Sigma E} \\
\end{align*}
\] (32)

where:

- The influence of labor
- The influence of fixed capital
- The influence of the material consumption
- Total extensive influence
- Total intensive influence.

The above relations can be used to analyze the dynamics of GDP starting from influencing factors that have medium characters and total indicators. Using this variant - in a first phase of macroeconomic analysis - involves
checking the homogeneity of the economy in terms of representativeness average and qualitative factors calculated through the next level.

Checking the homogeneity can be achieved by analyzing the coefficient of variation (v) calculated as the ratio of standard deviation (σ) and the average level of the indicator:

For example: in case of labor productivity the following relationship is used:

\[ v = \frac{\sigma_W}{\bar{W}} = \sqrt{\frac{\sum (W - \bar{W})^2}{\sum W}} \cdot 100 \]  

where:

\( W, T \) = labor productivity and the number of employees at each branch.

It is estimated that if the coefficient of variation recorded a value of over 35-40%, the average is not representative, and the contributing factors to GDP growth will be distorted, because the average causes leveling of individual values at branch level. As a result - in the second phase of macroeconomic analysis – it is necessary to determine the contribution of the branches, followed by their influence on GDP growth resulting from the aggregation of contributions set out in the branches.

In these circumstances the three correlations can be analyzed according to the following relationship:

\[ PIB = \sum W \cdot T \]  
\[ PIB = \sum E \cdot F \]  
\[ PIB = \sum M \cdot C \]

In every case – two factors of influence are highlighted:

• qualitative factor (intensive) at branch level (W, E, M);
• quantitative factor (extensively) at branch level (T, F, C).

Previous relationships can be studied on the basis of factorial systems involving changes in the influence structure of branches for each resource:

\[ PIB = \sum W \cdot T = \sum (W \cdot YT) \cdot \sum T \]  
\[ PIB = \sum E \cdot F = \sum (E \cdot YF) \cdot \sum F \]  
\[ PIB = \sum M \cdot C = \sum (M \cdot YM) \cdot \sum C \]

The three influence factors are:

• qualitative factor (intensive) at branch level (W,E,M);
• structural factor (YT, YF, YM);
• quantitative factor (extensively) at national economy level (\( \sum T \), \( \sum F \), \( \sum C \)).

The analysis can be deepened by taking into account the correlation between labor productivity and efficiency of fixed capital:
We have calculated the following formulas:
\[ \bar{W} = \bar{E} \cdot \bar{Z} \] - at national economy level
\[ W = E \cdot Z \] - at branch level
defined as:
\[ Z = \text{fixed labor endowment funds} \]

Starting from the same relationships, the GDP can be determined using the following formulas:
\[ \text{PIB} = \sum W \cdot T = OE \cdot Z \cdot T \]

Depending on the goals of the research and the quality of available data when analyzing the GDP growth, any of the relationships in this paragraph may be used. Obviously, the most complex - through the number and importance of the factors taken into account and the highlighted correlation between the indicators of efficiency - is the last relationship, which is still used for determining the contribution of each element to the change of the GDP.

Conclusions

In this article we have tried to highlight that the correlations established between macroeconomic variables in order to interpret the interdependence between them. We also tried to establish and proportions (ie amend an indicator influence on other macroeconomic indicators). They have established statistical and mathematical, using evidence will express the trends at this level. Thus we analyzed aspects such as the relationship between GDP and unemployment rates; the correlation between inflation and unemployment; the correlation between the economic growth rate, the growth rate of GDP and inflation; basic correlations of economic growth (GDP correlation between workload and used / consumed, the correlation between GDP and fixed capital used, the correlation between GDP and material resources consumed). In these cases it followed the establishment of national resources proportions consumption. The results can be presented theoretical arguments / possibilities of deepening studies by using statistical and econometric methods and models (dynamic series, indices method, regression function).

References


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