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Analysis of Relationship between Net Wage and Consumer Price Index

Ioan Dolca, Mirela Nicolov

*Faculty of Economic Sciences, University of Oradea

Abstract

In the present paper is presented an econometric analysis of the relationship between net salary and consumer price index. After a brief historical overview will be review the calculating statistics for selected variables and coefficients and will be presented the obtained values. We will study the relationship between variables. It will be realized the cloud of points and will be applied Fisher test. The intensity of selected variables will be study too and some forms of relationship between the two chose variables will be done. Student test is applied. It will be performed the parameter estimation for regression functions and Akaike's criterion will be applied. The homoscedasticity assumptions, graphical method, Durbin-Watson test will be applied. All econometric study will is done using the software E-View 4.

Keywords: Econometric Modeling, Econometric Software, Forecasting and Prediction Methods; Simulation Methods, Data Collection and Data Estimation Methodology; Computer Programs, Wage Level and Structure, Net wage, Consumer price index, Factor Income Distribution, Model Construction and Estimation, Model Evaluation, Validation, and Selection, Forecasting and Prediction Methods.

1. Introduction

In the present paper an econometric analysis of the relationship between the net wage and consumer price index is done. A brief historical overview will be presented. The calculating statistics for selected variables and coefficients will be presented such as mean, median, standard deviation, simple variation coefficient, asymmetry an vaulting

* Corresponding author

E-mail addresses nicolovmirela@gmail.com (M. Nicolov)
coefficient. It will be explored further the relationship between variables. It will be studied the cloud of points and
will apply Fisher's exact test. Study of the intensity relations between the selected variables, that plausible forms of
relationship between the two variables chosen was applied by using the Student test. Will perform parameter
estimation for the obtained regression functions. Further will find the highest-performance regression equation by
applying Akaike's criterion, namely the White test. Also the check for homoscedasticity assumptions, the using of the
graphical method, and applying the Durbin-Watson test will be done. In the end we will draw the conclusions and
references.

2. Contents and theories

Price and price theory occupies a central place in economic science. The price as an economic phenomenon. It’s
generally direct perception was done by definition from antiquity of Aristotle and Xenophon. The price represents the
amount of money that the purchaser is willing and can provide the manufacturer (seller) in exchange for goods which
he presents it on the open market.

In statistical practice, the situation is the relative prices of different fields determines comparing the price dynamics
in these areas (branch, geographic area, etc.). General price index is related with situation when the index is less
specific than general, relative prices fall and vice versa, is specified in Gavrila&Tatu’s paper from 2009.

Regardless of optics in which it is viewed, the price measure something. There is an important question: "What
measure the price?". The main economic schools have given different known explanations for price theories. Very
different answers can be grouped into three main theories: Classical theory of price, neoclassic price theory, modern
theory of price joint together. In different papers and practical actions of economic agents, they coexist. In the classical
theory, the price has its support in the economic value of goods subject transactions, the value determined by the use
of factors of production and câtremuneration claimed by their owners. The situation of the open market makes the
price to be exactly at the economic value, but under normal conditions, it does not break the base object – the economic
value by the unit cost and marginal was specified in Gavrila & Tatu (2009).

Subjective theory of price, present the neoclassical school who founded the economic theory where the price
reflects the utility value and marginal rarity that good, or the amount that was compared to solvable request. Economic
value and a good price are even higher as marginal usefulness. Its economic value is higher and is more rare. The two
factors that determines the value and price-utility of the marginal economic and rarity - can act in the same direction
or in different directions. The difference between classical theory and primary neoclasical cause which determines the
result of the price. After the classics, price express themselves mainly production conditions of goods, how it is
obtained by combining the factors of production and consumption. Manufacturer is the "conductor prices". To
neoclassical price is determined by market conditions. The way they are perceived and show its rarity and marginal
usefulness and its decisive role in the formation and evolution belonging to the purchaser price specified
Gavrila&Tatu(2009).

Price has an important economic role and economic influence decisions and actions by his unity office. In light of
these features, the price is a lever to influence economic and financial balance of substantial economic.

Factor price functions are those of economic progress and the allocation of resources, in the extent to which prices
are correct, in the sense that reflects the effective rarity, marginal costs and marginal social utilities. Various free
economic goods form by confrontation between demand and offer in conditions of straightforward and correctly
competition. Prices are not just for measurement of the various components of economic activities a community and
global trade economy. Promoted through their particular interests follow achieving economic and social objectives,
it tries corrections for economic activity and behavior.

Consumer Price Index is a mathematical relation defined by:

\[ IPC = \frac{\sum q_1 P_1}{\sum q_1 P_0} \]

where: \( q_1 \) = the necessary goods for subsistence of population,
\( P_1 \) and \( P_0 \) are the price level in the current and the base.

This index is called the Paasche-type aggregate price index, and is a more efficient way of calculating inflation.
However, Paasche-type index requires updating quantities of goods consumed, making it an expensive indicator.
Consequently, in Romania is used Laspeyres type aggregate price index, which does not update the quantities of goods consumed.

Laspeyres index formula is as follows:

$$IPC = \frac{\sum q_0.P_1}{\sum q_0.P_0}$$

where: $q_0$ = goods necessary subsistence population,

$P_1$ and $P_0$ = the price level in the current and the base; Assets taken into account in calculating the consumer price index are: food and non-food goods services. There are considered necessary for widespread use.

A persistent finding in the wage determination literature is a positive link between firm size and wages (Majumdar, 2010)

**Natural and modern wage**

In current language, pay is remuneration. Over time, the nature of wage was presented in different ways. Thus, classical political economy in the nineteenth century, have developped two theories of wage specifies Paul Tanase Ghita in his paper from 2009(Paul Tanase Ghita, 2009).

Natural wage theory reveals that what is paid is the minimum necessary for the existence of the employee and his family, which can not be exceeded downwards, whereas the existence wage becomes impossible for growing, birth, which would increase supply of working and due to a sharp wage to its natural level. This very clear idea from Ricardo was assumed by Marx. But he believes that wages are necessary for a normal-existence and can not be opposed to the increases of unemployment. After these logic ideas Ricardo gave us the same signal.

Wage fund theory was introduced initially by A. Smith, and devised by J. Stuart Mill, which consider that the wage is the result of a report from payroll, an amount of capital that is predominantly to pay wages and number of urge which are in position to engage. From this point of view the wage can not be changed because the technical progress which attract an increased capital stock and this will reduce the wage bill. This will grow up and offer an working force and wage to be maintained.

The early twentieth century has become the theory of incremental productivity. Today is one of the most widely accepted and used in explaining the wages. It belongs to the neoclassical explanation of wage labor costs to utility too. Employee addresses this through the concept of anutility, as an expression of the relation between effort and reward he got to make job offers to be an increasing function of the real wage. The capitalist labor productivity marginal utility of that term under the law of decreasing returns, is also in decreasing. Thanks to this, the demand for labor is a function of decreasing of the present wage. In this context, wage labor cost breaks represents an amount corresponding to a certain ratio of usefulness work for employee and capitalist labor productivity when marginal desutility are equal.

The origin of wage yields directly from the primary income and is derived from participation to the economic activity. It releas productiv contribution of the employees. Direct wage can be wage per unit of time (hour, day, week, month). It is easy to apply and take account of the worker effort but is unable to stimulate efficiency and to base any definite relationship between settle down work and wage or piece in agreement that estimate wage from employee productivity. This is expressed in physical units mixed with raw progressive wage which tries to be reconciled employee benefits per unit of time of the agreement. Social wage or indirectly, independently wage of the worker express themselves the consideration given to a person for its family. This includes allowances for children and families with many children, single grants awarded in certain situations health insurance, payment for their holidays or pensions.

If we analyse the economic activity and keep in mind those who achieved we find that there are, says Paul Tanase Ghita (2009): the relation of wage and cost for whom is paying. Labor costs has multiple components: efficiency wages, expenses for staff and low prices or gratuitousness granted individually or collectively by the company for his employees; wage reservedly for who receives wage is the retention for pensions and unemployment benefits, direct taxes on income pay for their employees.

Usually cost and wage income are different.

Nominal and real wages

Nominal wage is the sum received by the employee and real wages, the quantity of goods and services that can be purchased with nominal wage and nominal wage price index corrected which represent the living cost. This express
the purchasing power of the employees. It is currently being developed the new wage theory, particularly the wage income.

In modern economies, the role of wages, the income becomes more complex under many changes that it affects a very different way. Thus considered the price of labor with all assigned insufficiency in this respect, direct and indirect source of income for the majority of the population, incentive instrument individually or collectively, tool positioning of individuals in the social hierarchy.

Overall net average earning economy

Gross wage includes net income per employee instead of making income.

Net wage is the difference between gross income and deductible expenses. Mandatory contributions and business expenses granted only for the place where the basic function of the employee are applied.

Wage earnings are due and payable after holding employee contributions required by the employer, payroll taxes and other deductions.

The simplest situation for the employer involves the gross wage in USD, resulting monthly earnings after deduction and payment of mandatory contributions and payroll taxes monthly.

Exploring the macroeconomic implications of downward nominal wage rigidity from a theoretical and an empirical perspective. Elsby found in 2009 that these effects are likely to be small (Elsby, 2009). Tobin argued that, if workers are reluctant to accept reductions in their nominal wages, a certain amount of inflation may “grease the wheels” of the labour market by easing reductions in real labour costs. An explicit model of worker resistance to nominal wage cuts, reveals that firms will compress wage increases as well as wage cuts in the presence of downward wage rigidity. This compression of wage increases culminates in the prediction that worker resistance to wage cuts has no effect on aggregate wage growth in the model, challenging a common intuition in previous empirical literature on downward wage rigidity (Tobin, 1972; Elsby, 2009).

3. Research Methodology

Data’s were taken from the site: www.insse.ro from data base tempo online of the National Statistics Institut, from the next categories: consumer price index from: https://statistici.insse.ro/ipc/?page=ipc1&lang=ro and medium net wage from: http://www.insse.ro/cms/rw/pages/castiguri91-2010.ro.do.

Variables are as follows:

X – Independent variable – The wage medium net per total economy for the period :January 2000 - September 2010;

Y – dependent variable: montly consumer price index ( represented in %) for the period : January 2000- September 2010.

Table 1: X – Independent variable :Medium net wage per total economy for January 2000 - September 2010; Y – dependent variable: consumer price monthly index for January 2000- September 2010, Source: www.insse.ro

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Salarnet</td>
<td>IPCtotal</td>
<td>Salarnet</td>
</tr>
<tr>
<td>Month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>172.5990</td>
<td>373.06</td>
<td>273.8029</td>
</tr>
<tr>
<td>February</td>
<td>174.8052</td>
<td>365.15</td>
<td>259.6213</td>
</tr>
<tr>
<td>March</td>
<td>190.6989</td>
<td>358.72</td>
<td>281.9240</td>
</tr>
<tr>
<td>April</td>
<td>213.5867</td>
<td>342.34</td>
<td>302.5138</td>
</tr>
<tr>
<td>Mai</td>
<td>202.9622</td>
<td>336.22</td>
<td>291.5299</td>
</tr>
<tr>
<td>June</td>
<td>210.3644</td>
<td>326.95</td>
<td>298.1495</td>
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<tr>
<td>July</td>
<td>217.1977</td>
<td>313.54</td>
<td>312.3279</td>
</tr>
<tr>
<td>August</td>
<td>222.0361</td>
<td>307.89</td>
<td>313.5210</td>
</tr>
<tr>
<td>September</td>
<td>227.2967</td>
<td>299.47</td>
<td>312.4899</td>
</tr>
<tr>
<td>October</td>
<td>235.7201</td>
<td>291.42</td>
<td>321.0425</td>
</tr>
<tr>
<td>November</td>
<td>249.7493</td>
<td>283.38</td>
<td>331.4260</td>
</tr>
</tbody>
</table>
4. Results

- Calculation of values and statistical coefficients

Table 2: Mean, median, Standard deviation (Std. Dev.) and coefficient of simply variation, Skewness and Kurtosis for X – independent variable as medium net wage for the period January 2000 - September 2010; Y – dependent variable: monthly consumer price index for the period: January 2000- September 2010. The number of the registered variable is k=129. (Author’s calculus)
### X: SALARNET

Mean = \( \bar{X} = 777.2788 \)

Median = 723

Std. Dev. = 414.3176: \( \sigma_X = 414.3176 \)

Simply variation Coefficient – Cv = 53.3039% > 40%.

The conclusion is: series X – which represent the medium net wage between January 2000 and September 2010 is an inhomogeneity series (all the datas are in RON)

Skewness = \( \alpha = 0.275 > 0 \) – positive asymmetry

Kurtosis = \( \beta = 1.696340 < 3 \) – platycurve variable.

### Y: IPC total

Mean = \( \bar{Y} = 164.4312 \)

Median = 139.09.

Std. Dev. = 65.067: \( \sigma_Y = 65.067 \)

Simply variation Coefficient – Cv = 39.57095%.

The conclusion is that considered series consumer price index between January 2000 and September 2010 is a homogeneity series.

Skewness = \( \alpha = 1.4875 > 0 \) positive asymmetry

Kurtosis = \( \beta = 4.5050 > 3 \) – leptocurve variable.

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**Source:** Authors calculus

- **Fisher Test. Relationship Intensity**

  Value of the correlation ratio of the sample is R-squared = 0.677044 = \( R^2 \) (the obtained value of simulation from EViews). The correlation ratio \( R^2 \) is between 0 and 1 and gives us how strong is the relationship between the two variables. If the value of \( R^2 \) is nearby 1, the relationship between the two variables in the sample is a strong one.

  We have the next situations:
  - \( R^2 \in [0;0.5] \) - a very weak bond;
  - \( R^2 \in [0.5;0.75] \) - a bond from weak to medium intensity;
  - \( R^2 \in [0.75;1] \) - a strong bond.

  In our case \( R^2 = 0.677044 \) – and the link is with medium intensity.

  Below there is a generalisation of the total of the values by using Fisher's exact test:

  It consider the assumptions:
  - H0: \( R^2 = 0 \) - There is no relationship between variables in the total data
  - H1: R2 is different of zero – there is the alternative hypothesis.

  Using Fisher test for H0 and H1 are chosen the hypothesis: which is much closed to be truth.
Fisher test involves two steps:

- Step 1: Determination of

\[ F_{\text{calc}} = \frac{R^2}{1 - R^2} \cdot \frac{T - k}{k - 1} \]

Where: \( R^2 = 0.677044 \), \( T = 129 \) - number of observations, \( K = 2 \) – number of the estimated parameters (X and Y) is \( F_{\text{statistic}} \) from E-View

\( F_{\text{calc}} = 269.3390 \) is the value for \( F_{\text{statistic}} \) from simulations in Eviews

- Step 2: compare \( F_{\text{calc}} \) with \( F_{\text{tab}} \)

For 120 data for the probability of 95% according to Mester, (2008) is \( F_{\text{tab}} = 3.84 \)

If \( F_{\text{calc}} < F_{\text{tab}} \), hypothesis that \( H_0 \) is accepted and if \( F_{\text{calc}} > F_{\text{tab}} \) we accept the alternative hypothesis \( H_1 \).

In our case \( F_{\text{calc}} = 269.3390 > F_{\text{tab}} = 3.84 \) so we accept the alternative hypothesis \( H_1 \).

Probability is checked in the case of \( F_{\text{statistic}} = 0 \), so the probability of accepting the null hypothesis is 0 so there is no link between X and Y.

So there is a relationship between net wage and total consumer price index.

- Different forms of the relationship between two variables. Student test. Parameter estimation for regression functions

The appearance of the points cloud gave us the bond form. How are the dots on the chart shows if there is a link between variables or not. If points are grouped close by, the bond is very strong. When we are dealing with a narrow width of the cloud of points, means that the intensity of the relationship between variables is large.

![Points Cloud](source: Authors calculus)

Starting from points cloud appearance in this particular case is formulated the hypotheses:

It is assumed that between the two variables there is a linear relation: \( Y = C(1) + C(2) \cdot X \)

where \( X = Y = \text{IPCTotal and Salarnet} \).

From the simulation we obtain: \( C(1) = -0.129463 \) and \( C(2) = 265.0603 \).

So the linear equation that represents the dependence of Salarnet IPCTotal is

\( \text{IPCTotal} = -0.129463 +265.0603 \cdot \text{Salarnet} + \varepsilon \)

Where \( \varepsilon \) is the error.

To generalize the results related to the both parameters we apply Student test:
for parameter C (1) we have for the value \( t_{\text{calc}} = -16.41155 \).
For the probability of 95\%, the \( t_{\text{tab}} = 1.96 \).

In conclusion parameter C (1) they differ significantly from 0 to the total population.

If we apply Student test for parameter C(2): we have for the value \( t_{\text{calc}} = 38.18032 \) and \( t_{\text{tab}} = 1.96 \) for the probability of 95\%. So C (2) they differ significantly from zero to the total population.

It is assumed that there is a logarithmic relation: \( \text{IPCTOTAL} = \log (\text{SALARNET}) \cdot C (2) + C (1) \)

Where C (1) and C = 808.8881 (2) = -99.32473

So we can write equation legatură between the two variables:
\( \text{IPCTOTAL} = -99.32473 \cdot \log (\text{SALARNET}) + 808.8881 \)

To generalize the results we apply Student test and we observ: for C (1): \( t_{\text{calc}} = 37.16471 \), for C (2): \( t_{\text{calc}} = -29.74051 \), and \( t_{\text{tab}} = 1.96 \) for a 95\%. In both cases the parameter C(1) and C(2) differs substantially from 0 for the total population.

Akaike’s criterion.

Regression equations required to choose that one which is the best performance. According to Akaike Criterion, a model is even better as by the Akaike info Criterion has the small value. This criterion captures the true behavior of the dependent variable based on the independent variable. For the two regression equations for the dataset studied Salarnet and IPCtotal between January 2000 and September 2010 we have the next situations: for the situation of a linear regression equation, Akaike info Criterion has the value 10.07387 and for the situation of an logarithmic equation, Akaike info Criterion has the value 9.136951. In conclusion logarithical regression equation represents better the relationship between the two variables because Akaike info Criterion for logarithmic model that has a lower value than in case of the linear case.

White test. Homoscedasticity Hypotheses

Logarithmic model estimation results are obtained by using White test results:

Interested in the value of the sample correlation level R-squared = 0.337434 and afferent Fischer test value is: \( F_{\text{-statistic}} = 32.08481 \)

Fisher test value for testing significance correlation ratio is \( F_{\text{tab}} = 4 \) for the probability of 95\%.

Assumptions that are issued are:
H0: \( R^2 = 0 \) (the model is homoscedastic)
H1: \( R^2 \neq 0 \) (the model is heteroscedastic)

If the obtained value for \( F_{\text{calc}} = 32.08481 \) > \( F_{\text{tab}} = 4 \), the considered model is heteroscedastic.

From simulation we obtained: \( DW_{\text{calc}} = 0.051912 \) and comparing this with with \( d_1 = 1.72 \) and \( d_2 = 1.75 \) Durbin-Watson distribution table according to a convenient choice between 0.05 and 0.01, depending on the number of exogenous measurements \( k = 1 \) and observed values \( T = 129 \).

For our case: \( \alpha = 0.05, k = 1, T = 129 \) observables, \( d_1 = 1.72 \) and \( d_2 = 1 \). (Mester,2008:p.199)

Durbin-Watson test. Assumption of independence of errors

To apply the Durbin Watson test, first time we make the next assumptions:
H0: errors are independent
H1: errors are dependent

From simulation we obtained: \( DW_{\text{calc}} = 0.051912 \). This value is then compared with \( d_1 = 1.72 \) and \( d_2 = 1.75 \) from the Durbin-Watson distribution table. If we choose a convenient value for \( \alpha \), placed between 0.05 and 0.01, depending on the number of exogenous measurements \( k = 1 \) and observed values \( T = 129 \).

For our case, according to Mester,(2008),pag.199: are used the next values: \( \alpha = 0.05, k = 1, T = 129 \) observable, \( d_1 = 1.72 \) and \( d_2 = 1 \).
In our case: \( DW_{calc} = 0.051912 \) and \( d_1 = 1.72 \) si \( d_2 = 1.75 \), so we have the situation of: \( 0 \leq DW_{calc} \leq d_1 \). This is the case of positive autocorrelation, and the errors are not independent, they are in the situation of an positive autocorrelation. So if the errors are in a situation of an positive autocorrelation, the considered model can’t be used in forecasting.

**Jarque Berra test**

Jaque Berra test of the obtained value give the value: \( JB_{calc} = 23.87744 \). Now the assumptions are:

- H0: errors are normally distributed: N (0.1)
- H1: errors are not normally distributed N (0,1)

Decision rules are:

- If \( JB_{calc} \leq \chi^2_{tab(a,2)} \) we accepts H0 and errors are normally distributed,
- If \( JB_{calc} > \chi^2_{tab(a,2)} \) we accepts H1 and the hypothesis of normality of errors is rejected.

In our case \( JB_{calc} = 23.8744 \) and \( \chi^2_{tab(a,2)} = 5.99 \), that respect the decision rule 2: \( JB_{calc} > \chi^2_{tab(a,2)} \), so is rejected the assumption of normality of errors and the errors are not normally distributed.

5. **Conclusions**

Relationship between the two variables Y and X is an inverse intensity relationship between variables. Strong connections between variables is considered.

Logarithmic regression equation best represents the relationship between the two variables:

\[
IPCTOTAL = -99.32473 \log (SALARNET) + 808.8881.
\]

Equation is determined by using Eviews software complemented with results obtained from Excel.

The considered model is heteroscedastic.

In relation to errors we can say: in 2000-2001, 2007-2010 the most errors are positive and are negative in 2001-2007. At all times the errors are correlated, not independent. Errors are not normally distributed. Such errors are placed in positive aucorelate model.

These can not be used in forecasting.

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