Abstract.
The economies that have technical change system operate with a process of rising wages. The idea that an economic system reaches a situation of equilibrium means a big advance in its understanding. But if wages change through time there is not a system in equilibrium, a system which does not move or does not change. With rising wages the whole system changes through time but there is also an internal change of the economic system. Wages are not only a quantity that influence the income of persons but they are also a price that enters in all the economic calculations of firms and entrepreuneurs. Given their importance, rising wages make the economy to change through time. This system is an evolutionary economic framework.

The process of rising wages makes the adjustment of the system more complex. There has to be an equilibrium between the absolute levels of the variables and also another equilibrium between the rates of increase of the economy, wages and employment. This leads to the possibility of the existence of a situation of unemployment.

The paper explains briefly the historical evidence of the evolution of wages and the theoretical reasons for the rise of wages. And afterwards the relation between the rise of wages and the process of growth. An important part of the total growth of an economy is due to the growth of wages. Development needs a process of rising wages, which means a great improvement in the standard of living of the population.

Words: Technical Change, Wages, Evolutionary Frameworks, Adjustments
EAEPE Research Area D Innovation and Technological Change
Is realistic an economic system with rising wages?. Although it can seem a little surprising, this is a realistic description of the economic system in the case of countries that have technical change. The paper tries to explain the characteristics of this economic framework but before it explains the historical evidence of the evolution of wages and the reasons for the rise of wages.

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The paper explains briefly the historical evidence of the evolution of wages and the theoretical reasons for the rise of wages. And afterwards the relation between the rise of wages and the process of growth. An important part of the total growth of an economy is due to the growth of wages. Development needs a process of rising wages.

Related to rising wages two other questions with social consequences. The employment, or the unemployment persistence, and the process of rising wages which means a great improvement in the standard of living of the population.
I. HISTORICAL EVIDENCE OF THE EVOLUTION OF WAGES

The economies that have technical change system operate with a process of rising wages. The first point is to present the evidence of the evolution of wages in those economies with have incorporated technical and economic progress.

The historical facts confirm the evidence of the growth of wages. Economic historians show in their work that the growth of wages has been occurring for a long time in countries that have incorporated capital, technical and organizational progress to production. There are also data about growing wages in official publications, some of which extend to more than fifty years.

Graphs that reflect the evolutions of wages in countries that have, or have had, technical change are shown in Appendix I. Wages in Economic History and in Recent Decades.
II. THEORETICAL REASONS FOR THE RISE OF WAGES.

There are theoretical reasons for the rise of wages in economies with technical change specially when the technical change is applied to consumer industries. This paper does not enter into the explanation of the theoretical reasons that make wages grow in economies with technical progress. The paper “Technical Change and Rising Wages in a Closed Economy” presented at the International J.A Schumpeter Society Conference analyses the influence of technical change the compensation of employees. A brief abstract is exposed here.

When production is carried out with new methods and new equipment, the production of the firms tends to grow. Usually it is considered that more capital and technical progress produces an increase in the physical quantities produced (Smith A. 1776). This applies specially to the production of consumer goods.

The bigger quantities of goods (and services) produced have to be absorbed in the market. Therefore, to maintain the growth process there must be an increase in demand. Bigger demand asks for prior bigger incomes. As wages are the most important source of incomes, wages have normally to grow to have an increase in incomes. The increase in wages generates, through bigger incomes and consumption, a bigger demand that absorbs the growing production level of goods and services. This also applies in the case of consumer goods.

In a closed economy the physical output of consumer goods -\(O(a)\) multiplied by their price -\(p(a)\) , must equal the total compensation of labour, that is, total employment –\(L\)- multiplied by wages –\(w\)- :

\[
O(a) \ p(a) = L \ w.
\]

After the introduction of technical change in the consumer industries:

\[
O' (a) \ p' (a) = L' \ w'
\]

If physical output of consumer goods increases:

\[
O' (a) > O(a)
\]
There is an increase in the real compensation of employees. (in a closed economy). This increase is due in part to the increase of employment and in part to the growth of real wages. In the long run, both employment and real wages have increased.

Growing employment can also cause growing incomes (it is related to the increase in wages), but if there is an increase in labour productivity, there should have to be a process of growing (real) wages to maintain correspondence between supply and demand in the process of growth.

The paper presented to the International Schumpeter Society Conference 2006, Nice, illustrates these relationships, briefly presented here. A conclusion of that paper is that in a closed economy, after the introduction of technical change in the consumer industries there must be an increase in the real compensation of employees. This increase is usually due in part to the increase of employment and also to the growth of real wages.

The theoretical conclusions of the model that analyses the influence of technical growth on wages (in a closed economy) are however confirmed by the historical and statistical evidence of the growth of wages presented in the previous point.

III. AN EVOLUTIONARY ECONOMIC FRAMEWORK

The introduction of a modification in the production methods leads to the need of a rise in wages. As there is continuity in the process of technological change, as it happens continually there will be a permanent process of increasing wages

These conclusions lead to the existence of an economic system in which wages grow normally through time. As has been stated in the beginning of the paper this is not a
kind of stationary model which repeats itself period after period. The economy changes through time and really changes quite a lot while a system in equilibrium is a system which does not move, or does not change.

With rising wages, the economic system changes continuously. In fact it is an evolutionary economic framework. In an economic framework like this there are many aspects to take into consideration and to develop. Some considerations have been mentioned at the beginning of the paper. There will be in the system a continuous series of equilibria, a series of moving equilibria.

In a system like this the concept of demand will change. As the income of the most important part of the population (the employees) changes with the time the demand for the consumer goods will be also changed through time. The concept of demand will be the corresponding to a certain moment but will be different from the preceding period or the following period.

The concept of supply will be influenced also by the movements of wages. The cost of labour is about two thirds of the total cost of an economy. Evidently is very different in the different firms. But if wages rise the direct repercussion will be direct but in the case that the increase in labour productivity (which is simply the cocient between production and labour) allows the increase in wages can be absorbed and does not influence the prices

But this in fact is something which is possible because in fact it is the increase in productivity as a consequence of technical change and capital accumulation that leads to the need for rising wages

All possibly equilibria of the system will be even influenced by its own moving characteristics. The expectations of economic agents that takes decisions about the future, for instance, will be affected by the growth of wages. It will be taken when established by consumers (that are in its most important part employees) about its pattern of consumption, and also of their capacity for borrowing.
And also by businessmen when deciding about investment: they will have to try to use as less labour as possible for a unit of product. There was in the investment decision of engineers the formula of saving labour. But this formula also helps to establish the conditions for increasing technical change that permits rising wages.

In this system the concept of competition is more dynamic. It is not a concept of perfect competition. It depends on the ability of the firms to be able to live with a process of rising wages. The firms which are more able to live will have an advantage over the firms that do not have such capacity. In fact this ability can be, and usually it is a source of incentive for the increase of wages by the firms that have the ability of living with higher wages and that also take advantage for their production of the increasing ‘extent of the market’ that results from the increase in demand that it is usually associated with the increase in wages.

It is possible to find economic reasons for the increase of wages out of a process of competition to add to the social circumstances that normally accompany the fixing of wages.

Equilibrium is a big concept in economic theory, as anywhere else. The idea that an economic system reaches a situation of equilibrium when the forces of supply and demand apply together means a big advance in the understanding of a system. But the economic system has additionally an internal change. Technical change leads to rising wages that makes the economic framework not stationary. The equilibrium no longer exists in time and the economy becomes an evolutionary economic system.

IV. THE ADJUSTMENT OF AN EVOLUTIONARY ECONOMIC SYSTEM

As the economy has to grow it has to reach an equilibrium between the growth of wages and the growth of employment. In the model it is the product of $L w$ which has to grow.
The economy has to reach a kind of equilibrium between the level of Income (Y), the level of employment (L) and the level of Wages (w). But it also has to reach an equilibrium between the rates of growth of Income, g(Y), the rate of growth of wages, g(w) and the rate of growth of employment, g(L).

The growth of the economy goes in a certain portion to the compensation of labor. It can go to the increase of employment and to the increase of wages. Or one of these aspects can take advantage over the other. Therefore before there has been a total absorption of the available employment, the rise of wages of certain parts of employment can difficult the increase of employment and the total disappearance of unemployment.

It is rather complex to have a perfect adjustment of all of these levels and of their rates of growth at any moment. There will be a process of rising wages but there will be possibly a certain amount of unemployment which does not disappear before the circumstances of the labour market changes with possibly

The level of unemployment can act as a good reference of the adjustment of the total system. If the unemployment rate increases there is an indication about the need for a certain reduction in the rate of growth of wages.

Phillips says that with a certain level of unemployment there is less inflation. That means that with high unemployment there will be a smaller level of the rate of growth of wages and consequently a smaller level of inflation. It seems that the economic system had in the level of unemployment a reference he economic system has points of reference. But nevertheless the complexity of the process of adjustment makes the totality of the adjustment difficult in every moment and therefore the possibility of the persistence of unemployment. There will be a trade-off between the rate of unemployment and the rate of growth of wages.
V. RISING WAGES AND GROWTH

In this part of the paper is analyzed the relations between the growth of wages and the growth of the economy and in the following the consequences of this relation with the developments of countries.

To analyse the influence of wages in the growth of the economy, a new relation is considered, the Economic Production Function,

\[ Y = Lw + Ki. \]

In this relation \(-L\) is number of workers or hours; \(-K\) is the amount of capital; \(-w\) is wages and \(-i\) is the rate of interest.

The Economic Production Function complies with the data of the US in the last sixty years and shows that the growth of wages plays an important role in the growth of the economy as it is shown in the following lines.

**Increase of production. Factors**

From the Economic Production Function, the increase in production in a certain period is

\[ \Delta Y = w \Delta L + i \Delta K + (L + \Delta L) \Delta w + (K + \Delta K) \Delta i \]

This increase in production is to the increase of four components.

- Increase of employees \( w \Delta L \)
- Increase of capital \( i \Delta K \)
- Increase of wages \( (L + \Delta L) \Delta w \)
- Increase of interest \( (K + \Delta K) \Delta i \)

The relation shows that the increase in production can be due to the increase in the (physical) amounts of labour (\( \Delta L \)) and capital (\( \Delta K \)) and also of the evolutions of the prices of labour (\( \Delta w, \) wages) and capital (\( \Delta i, \) interest).
**Importance of the Sources of Growth in the Long Run**

The rate of increase of total production is:

\[
\Delta Y = Lw_{Y} \Delta L_{Y} + Ki_{Y} \Delta K_{Y} + Lw_{Y} L_{Y} + Aw_{Y} L_{Y} w_{Y} + Ki_{Y} K_{Y} + \Delta K_{Y} i_{Y}
\]

The rate of increase of the product depends on the four factors: Two factors that reflect the increase of resources:

- Rate of growth due to wages: \(Lw_{Y} L_{Y} w_{Y}\)
- Rate of growth due to capital: \(Ki_{Y} \Delta K_{Y}\)

And two factors that reflect the increase in the retributions of the resources are:

- Rate of growth due to hours: \(Lw_{Y} L_{Y}\)
- Rate of change due to interest: \(Ki_{Y} K_{Y} + \Delta K_{Y} i_{Y}\)

The importance of each factor in the long run is seen after the study of the influence that each element have in the rate of increase of the production. It can be estimated for USA with the data for the last fifty years (Note 1). The average contribution of each factor to the growth of output:
<table>
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<tr>
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<th>Nominal</th>
<th>Real</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>1. Growth of Output $\Delta Y$</td>
<td>7.07</td>
<td>3.65</td>
</tr>
<tr>
<td></td>
<td>$Y$</td>
<td></td>
</tr>
<tr>
<td>2. Growth due to growth to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Wages $L_w L + \Delta L w$</td>
<td>3.87</td>
<td>1.48</td>
</tr>
<tr>
<td></td>
<td>$Y L w$</td>
<td></td>
</tr>
<tr>
<td>-Capital $K_i \Delta K$</td>
<td>2.14</td>
<td>1.11</td>
</tr>
<tr>
<td></td>
<td>$Y K$</td>
<td></td>
</tr>
<tr>
<td>-Hours $L_w L$</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>$Y L$</td>
<td></td>
</tr>
<tr>
<td>-Interest $K_i K + \Delta K i$</td>
<td>-0.13</td>
<td>-0.12</td>
</tr>
<tr>
<td></td>
<td>$Y K i$</td>
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The total contribution of the factors is different between the rate of growth of output probably due to the different source of statistical data. The sum of the total contribution of the factors are:

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<tr>
<td></td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Growth of Output $\Delta Y$</td>
<td>6.90</td>
<td>3.49</td>
</tr>
<tr>
<td></td>
<td>$Y$</td>
<td></td>
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</table>
The proportion that each factor contributes to this rate of growth is

<table>
<thead>
<tr>
<th></th>
<th>Nominal</th>
<th>Real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages</td>
<td>56.1</td>
<td>42.4</td>
</tr>
<tr>
<td>Capital</td>
<td>31.0</td>
<td>31.8</td>
</tr>
<tr>
<td>Hours</td>
<td>14.8</td>
<td>29.2</td>
</tr>
<tr>
<td>Interest</td>
<td>-1.9</td>
<td>-3.4</td>
</tr>
</tbody>
</table>

The total contribution of each factor, labour –sum of hours and wages- and capital – sum of capital and rate of interest- is:

<table>
<thead>
<tr>
<th></th>
<th>Nominal</th>
<th>Real</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>70.9</td>
<td>71.6</td>
</tr>
<tr>
<td>Capital</td>
<td>29.0</td>
<td>28.3</td>
</tr>
</tbody>
</table>

The increase in wages is very important and has a big influence in the increase of production, \( (L + \Delta L) \Delta w \). This factor explains the evolution of production that the production function usually used, \( Y = f(L,K) \), cannot explain. The rate of interest, which shows certain stability, does not influence production in the long run.

**Wages and Growth**

The incomes relation shows that the growth of wages plays an important role in the growth of the economy. The US economy, for instance, has grown because the wages and salaries of its workers and employees have grown. Or what is also true, wages and salaries have to rise for the economy to grow.
The importance of the growth of wages in the growth of the economy implies a modification of the conception of the way that growth happens. The growth of an economy relies in an important way in the growth of wages.

As the growth of wages is related to technical change, this has also an important influence on growth. See Appendix II. Note on Growth and Technology.

V. DEVELOPMENT

This role of wages permits also understands the differences between the developments of the different countries. In the developed countries there is usually a process of growing wages and therefore there is growth. In the not developed countries frequently there have not been such a process of growing wages. It points, in an increasingly global world, where are the real differences between countries and why sometimes the differences diminish and why in other cases they increase.

In the developing countries there are sometimes increases in wages and therefore growth. The growth of wages is sometimes very strong beacuse they part from very los levels and consequently the growth of the economy is also very strong. But sometimes in the (not) developing countries there is not growth of wages and therefore neither growth. See Appendix III. Wages in Development. Differences between countries

VI SOCIAL CONSEQUENCES

Prosperity in all social classes

There is in an evolutionary economic framwork with a process of rising wages the possibility of the persistense of unemployment, a big problem for society (and for economic theory as Solow says)
But the evolution of wages also indicates that markets economies with technical change lead to economic development and also lead to increasing welfare of employees. The increase in the level of wages and in the level of labor income has allowed an increasing degree of satisfaction of necessities.

From a social point of view the evolution of wages is probably the most important aspect in the evolution of the economies. They affect the welfare of the principal part of the population of each country. The tendencies of wages is probably for its great social significance the main basis to justify (or not to justify) the social role of capital markets economies.

**NOTES**

Note 1. The data of nominal output (\(Y\)), labour (\(L\)) and wages (\(w\)) are from BLS, Productivity and Costs (\(L\) expressed in hours and and \(w\) nominal compensation per hour) The values of capital (\(K\)) is from the BEA. The rate of growth of the rate of interest is calculated from the rate of interest collected the cocient between the non-labor income of NIPA and the Fixed Assets, both from de Bureau of Economic Analysis. D. of C. USA.

To estimate the contribution of each factor to the growth of output It is considered that the labour and capital shares are:

\[
\frac{Lw}{Y} = h_L = 0.7 \quad \text{and} \quad \frac{Ki}{Y} = h_K = 0.3
\]

Therefore the average values in the period 1951-2000 in the US are:
Appendix I.- Wages in Economic History and in Recent Decades.

As the growth of wages is a rather novel statement it can be of interest to know what has happened to wages in economic history. Some of the available information about the evolution of wages is reflected in the following graphs and data:

Graph 1 shows the evolution of real earnings in the UK from 1790. Charles Feinstein (1995) and the real earnings in the US from 1775 to 1975, Samuel H. Williamson (2003).

GRAPH 1
REAL WAGES UK AND US (1790=100)
Graph 2 shows the evolution of real earnings in several European countries from 1850 to 1939.

**GRAPH 2**

**EUROPEAN COUNTRIES. REAL WAGES 1850-1938**

Economic historians have shown in their work that the growth of wages has been occurring for a long time in countries that have incorporated capital, technical and organizational progress to production. In those countries the growth of wages has been occurring for a long time.

The increase of wages has been more extended in the last sixty years. There are also data about wages in official publications which show that wages have been growing. **Graph 3** reflects evolution of real wages in the last decades in the US., UK., Japan and Spain. Data from other countries can also be included to show that the process of growth of (real) wages that has been happening in them.
Many factors influence the process of history and this also applies to the evolution of wages but the graphs which are shown reflect the growth of wages in economies with capital accumulation and innovation.

Appendix II. Note on Growth and Technology.

At the root of processes of rising wages and, therefore, of growth of the economies are the introduction of new capital goods and new methods of production. Behind the economic and the social progress of societies are the process of innovations.

The usual affirmations is that growth is the consequence of growth of resources, labour and capital, and technical change. In the present paper growth is the consequence of the
growth of resources, labour and capital, and the growth of wages. But this does not mean that technical change is not important for growth.

As has been said technical change leads to rising wages. The paper “Technical Change and Rising Wages in a Closed Economy” presented at the International J.A Schumpeter Society Conference analyses the influence of technical change in the compensation of employees. A conclusion of that paper is that in a closed economy, after the introduction of technical change in the consumer industries there must be an increase in the real compensation of employees. This increase is usually due in part to the increase of employment and also to the growth of real wages.

As the rises of wages leads to the growth of output as has been shown in this paper, technical change plays an important role in the process that produces growth of output.

Appendix III. Wages in Development. Differences between countries

There are two points. One is the absence of the process of increasing wages. The other is the existence of a great increase in wages because they part from a very low level and that leads to strong rates of growth of the economy.

Absence of increasing Wages

The role of wages in growth permits also understands one important difference between the developments of the different countries. In the developed countries there has been are usually a process of capital accumulations and innovations in production methods and consequently also growing wages as indicated above. In the developing countries this process has started later and usually is much smaller. In the countries with small development frequently there is not even today such a process. Graph 4 shows the real manufacturing wages in the some African sub-saharan countries in 1990-2000 according to the International Labour Office.
Graph 5 shows the real manufacturing wages in the developed countries in the same period,
Graphs 4 and 5 show the evolution of wages in several sub-saharan african countries and in several rich countries. There are many differences and those differences in wages explain in an important part the differences in development.

The developing countries have to establish economic systems that allow, through new methods of production, to engage in processes of growing wages (or incomes) of their workers and employees. The annual increment in the compensation of employees influences the annual increase of the National Income.

**Extensión of the process of real wages**

The process of rising wages has extended to other countries in the last two decades. It is possible to mention China and India, and try to give some data about their evolution of wages.


Graphs 7 shows evolution of real wages in India in 1983, 1993 and 1999 according to Bhalla Surjit S. and Das, Tirthatanmoy (2005),”

These countries have important growth in wages and also important rates of growth of the economy as there is a relation between the growth of wages and the growth of the economy.
GRAPH 6
CHINA. REAL EARNINGS (1990-2003)

GRAPH 7
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Ministry of Health, Labour and Welfare, Statistics and Information Department, Japan