# Rising prices after a new technique introduction

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## Abstract

We try to demonstrate that, from a theoretical point of view, the introduction of new production techniques of goods and services, produces an increase of the ratio "prices divided by their corresponding values" when the wage is fixed, and, in addition, makes it possible, a lower set of prices at the previous rate of profit.

Current measures of inflation do not detect such price increases and normally interpret product prices bundled with more a product features as a price decrease. Also, when two economies with different innovation levels, interchange products and services, the one with a more intense innovation gives less live labour per unit of price to the other and gets a quantity of labour proportionally higher than before.

## Definitions

We use[2], a Leontieff matrix and the wage is expressed as a basket of goods. The resulting prices system is as follows:

$$P' = (1+r)P'\left(\begin{bmatrix} a11 & a12 & \dots & a1n \\ a21 & a21 & \dots & a2n \\ \dots & \dots & \dots & \dots \\ an1 & an2 & \dots & ann \end{bmatrix} + \begin{bmatrix} b1l1 & b1l2 & \dots & b1ln \\ b2l1 & b2l2 & \dots & b2ln \\ \dots & \dots & \dots & \dots \\ bnl1 & bnl2 & \dots & bnln \end{bmatrix}\right) \quad (1)$$

That can also be expressed this way:

$$P' = (1+r)P'(A+BL') \quad (2)$$

and this way:

$$P' = (1+r)P'BL' + (1+r)P'(A) \quad (3)$$

and also this way:

$$P' = (1+r)P'BL'(I - A(1+r))^{-1} \quad (4)$$

P', is the row vector of prices
r, is the rate of profit
a1i,….ani (column of the matrix), are the necessary inputs to produce a unit of product i
B is the column vector that corresponds to the basket of goods where components: b1,... bn, are the quantities of good, 1 to n, that need to be consumed to reproduce a unit of work

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L' is a row vector where components l1,….,.ln, are the quantities of work needed to produce a unit of product of branches, 1 to n

Assumptions are, A is a non-descomposable and productive matrix, a case of simple production is considered and only operating capital exists. In order to evaluate, under these conditions, a new technical procedure to produce a good, the new price of the product – calculated with the technique intended to apply - is compared to the existing one, to verify if it is lower, at the current prices.

**Conditions for an increase of the ratio "prices divided by values" after a new technique is applied**

It has been already demonstrated by Vegara (2) that taking the wage as a unit ( $P' x B$ ), prices are always higher than its values - as can be, also, checked in the example in the Excel file annex, page 1, enclosed -. The prices, in system represented in anyone of (1) to (4) expressions, are relative and need to be normalized, with a unit of measure.

It can be demonstrated now that after a new technique is introduced, the prices (using the same units), divided by its corresponding values, increase. It can be deduced by comparing expressions of prices (5) and values (7) before and after a new technique introduction. The increase is due to the fact that the rate of profit is higher than before whereas the A matrix is equal for prices and values expressions both before and after the introduction of a new technique, though it has changed due to the new technique employed.

Prices system in wage units is:

$$P'_w = (1+r) x \mathrm{L}' x ((1+r)A + (1+r)^2 A^2 + \ldots + (1+r)^k A^k + \ldots) \quad (5)$$

Expression equivalent to:

$$P'_w = (1+r)\mathrm{L}'(I - A(1+r))^{-1} \quad (6)$$

Labour values are calculated this way

$$\Lambda' = \mathrm{L}'(A + A^2 + \ldots + A^k + \ldots) \quad (7)$$

Expression equivalent to:

$$\Lambda' = L'(I - A)^{-1} \quad (8)$$

What remains to be seen is if this holds when prices are measured with an absolute unit, like value, because the wage unit used depends on the prices of the system.

We proceed assuming that the wage in prices is equal to the wage in value terms, in the normal prices system – the one with wage expressed by a basket of goods and advanced - (9) or (1) to (4):

$$P' = (1+r)P'BL'((1+r)A + (1+r)^2 A^2 + ... + (1+r)^k A^k + ..) \quad (9)$$

By doing that, relative prices are, from now on, set.

With this assumption:

$$P'B = \Lambda' B \quad (10)$$

we get:

$$P'_{W\Lambda} = (1+r)\Lambda' BL'((1+r)A + (1+r)^2 A^2 + ... + (1+r)^k A^k + ...) \quad (11)$$

The wage is the product of values vector by the wage goods vector and is a scalar.

The prices are now expressed in wage value units. Comparing expressions (5) and (11) it can be seen that these prices are equal to the product of the prices in wage units by the wage amount expressed in value terms (see the example in Excel file annex, page 2) in the following way:

$$(P_{w1})\Lambda_1 B \quad (12)$$

and

$$(P_{w0})\Lambda_0 B \quad (13)$$

Where

$P_{w1}$ is the prices vector after the new technique has been introduced

$(P_{w0})$ is the prices vector before the new technique has been introduced

$\Lambda_1$ is the values vector after the new technique has been introduced

$\Lambda_0$ is the values vector before the new technique has been introduced

According to what has been demonstrated before, prices increase in relation to values when measured in wage units:

$$(P_{w1}/\Lambda_1) > (P_{w0}/\Lambda_0) \quad (14)$$

If we now calculate this ratio but, instead of using as a unit of measure the wage units we use the prices obtained substituting the wage price by the wage value - prices in wage value units - we obtain the following expression:

$(P_{w1}/\Lambda_1)\Lambda_1 B > (P_{w0}/\Lambda_0)\Lambda_0 B$ (15)

We can deduce from it that if the wage in terms of value after the technical change, is lower enough, it could compensate the increase of some ratio: “price divided by labour value” - as can be seen in the example in the Excel file annex, page 2 -. This would make that the “greater than” operator in (15) would not be true for some or all prices-values ratio.

It is also clear that if the wage was to be kept the same in value terms as before the new technique is applied – considering, for instance, that the monetary wage has a higher purchasing power as a consequence of technical change -, the prices divided by values, would increase.

The decrease in the wage in terms of value could imply that even though the rate of profit has increased, the prices have decreased. In the Excel file annex, page 2 example, it happens so.

## Conditions for a decrease of prices after a new technique is applied

It can be demonstrated - Vegara (2) demonstrates this - that after a technical change, if the rate of profit is kept at the previous level, the new prices are lower than the existing ones, measuring both in wage units. It can be expressed this way:

$$\frac{P'_{W1}}{P'_{W0}} = \frac{(1+r)L_1'((1+r)A_1 + (1+r)^2 A_1^{\,2} + \ldots + (1+r)^k A_1^{\,k} + \ldots)}{(1+r)L_0'((1+r)A_0 + (1+r)^2 A_0^{\,2} + \ldots + (1+r)^k A_0^{\,k} + \ldots)} < 1 \quad (16)$$

In the case of prices in wage value units, the comparison is as follows:

$$\frac{P'_{W\Lambda 1}}{P'_{W\Lambda 0}} = \frac{(1+r)\Lambda_1' BL_1'((1+r)A_1 + (1+r)^2 A_1^{\,2} + \ldots + (1+r)^k A_1^{\,k} + \ldots)}{(1+r)\Lambda_0' BL_0'((1+r)A_0 + (1+r)^2 A_0^{\,2} + \ldots + (1+r)^k A_0^{\,k} + \ldots)} \quad (17)$$

As the wage goods in value terms $\Lambda'_1 B$ are lower than before it is obvious that the new prices will always be lower.

## Summing up

Prices measured in terms of wage units divided by labour values increase after a new technique has been introduced. It was already known that these prices were higher than the corresponding values.

Prices measured in wage value units, divided by labour values increase if the wage is kept at the same level than before the new technique has been applied. If the wage is fixed at the level of the actual value of the goods basket (after the introduction of the technique and consequently is lower) it could compensate the increase of the ratio prices measured in wage units divided by its corresponding labour values.

Prices measured in terms of wage unit when the rate of profit is kept at the same level that had before the introduction of a new technique are lower than the existing ones before the change of technique.

This is also true when prices are in wage value units - obtained when the price and the value of wage are made equal -. In Excel file annex, page 2 example, all the prices measured when the wage price and value are equalized, decrease after the new technique though the rate of profit has increased.

A price in wage value units can be lower than its labour value both before and after the introduction of the new technique, as can be seen in Excel file annex, page 2 example with one price.

**Consequences of what has been said**

We see that prices increase with regard to values if they are measured in wage value units, provided that the monetary expression of wage remains constant – and whatever wage is fixed, when measured in wage units –. When measuring inflation we could consider any increase in the ratio prices-values as an increase of prices regardless of the observable price (up or down) variation.

We see that prices do decrease in wage value units, at least if the rate of profit is kept at the level previous to the technical change. When measuring inflation, we could consider that – maintaining the monetary expression of wage constant - prices increase if they are above those determined with the new production technical conditions at the previously existing rate of profit, provided that a change in productivity – maintaining equal the rate of profit - could allow a further decrease of prices if it was entirely devoted to lower prices -.

According to the two previous paragraphs, when considering a product’s increase of quality at the same price and the calculation of prices at constant quality, this is to say, reducing them if the quality bundled in the same price, increases, it could well happen that, in reality, there has been an increase of prices.

Prices measured making the wage price equal to the wage value are prices expressed in wage value units. As the wage intervenes in the price determination, a reduction of the wage increases the content of labour represented in a product price.

When comparing the weight of the embodied labour in the product price measured in prices expressed in wage value units with regards to the live labour expressed in wage value terms, there is always an overvaluation, whatever the level at what the wage is fixed, in favour of the owners of the first due to the presence of the rate of profit affecting values incorporated in previous periods.

When comparing commodities and services from areas where the rate of technological development is uneven, the areas with greater innovation rate increase the live labour in exchange of their commodities, raising in this way a technological unequal interchange due to the fact that prices represent each time less labour content in comparison. The problem for the developed areas can be the realization of an extended production to compensate possible constant costs increases. The promotion of technology transfer to less developed countries is needed to compensate this phenomenon.