INCREASED LABOR PRODUCTIVITY THROUGH LABOR FORCE RESTRUCTURING.
DID THE ROMANIAN ECONOMY LOSE ITS HIGH SKILLED LABOR FORCE

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Abstract. *Romanian economy is facing a brain drain challenge due to key factors as the wage gap and the employment opportunity gap. In this context the paper uses the exogenous growth approach and looks at the historical pattern of sectorial output, employment and potential output. This pattern offers insights into the extent of highly skilled labor force lost in connection with pressures coming from the dynamics of production.*

Keywords: *potential output, wage gap, highly skilled labor force.*

JEL: O40, O47, E24

1. Introduction

The current paper investigates the historical patterns of output, employment and potential output focusing on three sectors of the Romanian economy: Machinery, Transport Equipment, Electrical and Optical Equipment.

It seeks to answer two main questions: Did higher output translate into higher labor demand?; Did higher productivity translate into higher labor demand?

The analysis was done using the methodology commonly employed by the exogenous growth theory, namely the Cobb-Douglas production function (Solow 1956, Swan 1956, Lucas 1990). From this perspective (see Solow 1956, Swan 1956) the economic growth factors are represented by: a) capital accumulation; b) population and labor force growth; c) the technological process that leads to productivity increases.

To calculate potential output the Hodrick-Prescott filter was used.

In terms of novelty, the paper: a) builds the Cobb-Douglas functions and estimates the total factor productivity at the sectorial level and b) estimates potential output at the sectorial level.

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2. Theoretical approach

The Cobb-Douglas production function takes into account labor, capital and total factor productivity in generating the output.

$$y_t = A_t L_t^\alpha K_t^\beta \tag{1}$$

Where A represent the total factor productivity, Y the sectoral output, L labor, K capital and $\beta = 1 - \alpha$.

Alpha and beta represent the elasticity of capital and labor respectively and are determined by technologies and the economic conditions. The studies for Romania suggest a value 0.65 for alpha (Dobrescu, 2006; Altar, 2010 and Galatescu et al., 2007).

The labor force was represented by employed population. For the analyzed period 1995-2009 the data were taken from WIOD, Economic and social account (Timmer et al. 2015, Genty 2012). For 2010-2014 the Eurostat data were used. The choice was due to availability of the data for gross fixed capital formation and initial year capital stock from WIOD.

The perpetual inventory method was used to estimate the capital stock

$$K_t = K_{t-1}(1-\delta) + FBCF_t. \tag{2}$$

Where K represents the capital stock, δ is the depreciation rate and FBCF represents the gross fixed capital formation.

The technical characteristics of the capital variates between sectors, justifying the usage of specific depreciation rates.

Table 1

Depreciation rates employed in the analysis

Sector	Depreciation rate
Machinery, n.e.c.	7.1%
Electrical and Optical Equipment	7.6%
Transport Equipment	9.0%

Source: Timmer et al. 2012.

The total factor productivity was calculated starting from relation 1 as:

$$A_t = \frac{Y_t}{L_t^\alpha K_t^\beta}. \tag{3}$$

Where the notations remain unchanged.

Potential output was defined based on the Cobb-Douglas production function:

$$y_t^* = A_t^* L_t^{*\alpha} K_t^{*\beta}. \tag{4}$$

Where * indicates the potential level of the factors the rest of the notations remains unchanged.

The estimation of the potential level was done using the Hodrick-Prescott filer (Hodrick and Prescott 1997). The filter decomposes the analyzed series in a cyclical and a trend component based on the formula:

$$\sum_{t=1}^{T}(x_t - x^*_t)^2 + \lambda \sum_{t=2}^{T-1}((x^*_{t+1} - x^*_t) - (x^*_t - x^*_{t-1}))^2.$$

(5)

Where λ penalizes the variation around the trend

The analysis was based on annual data, thus a value of 100 was used for λ consistent with the ones employed in the literature (see Hodrick and Prescott, 1997 for details).

The output gap was calculated as:

$$DP_t = \frac{Y_{s,t} - Y_{s,t}^*}{Y_{s,t}^*} \; x \; 100.$$

(6)

Were DP represent the output gap, Y_s sectorial production, Y_s^* potential sectorial production

3. Results and discussions

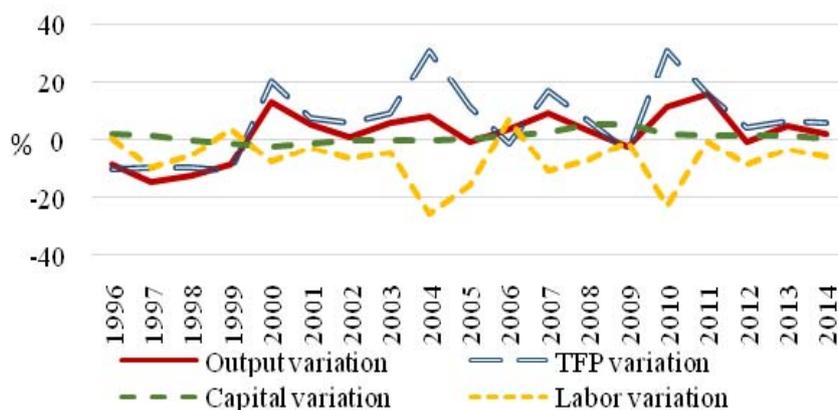The output dynamics in the Machinery, n.e.c. sector was mainly correlated with total factor productivity (TFP).

Figure 1. The dynamics of the growth factors – Machinery, Nec (1995-2014).

Source: Own computations.

The Pearson correlation between output and TFP was 0.91 for 1996-2004 decreasing to 0.72 for 2005-2014. Negative values for the correlation

were registered in the case of capital (–0.69 for 1996-2004 and –0.16 for 2005-2014) and labor (–0.37 for 1996-2004 and –0.12 for 2005-2014).

The economic crisis had a reduced impact on the sectorial output, but had a highly negative impact on the labor force, suggesting a process of labor restructuring. This evolution is also visible the Average annual growth rates. Moreover the increase in TFP negatively correlates with the labor force.

Table 2

Average annual growth rates – Machinery, n.e.c (1996-2014)

Average annual growth rates	**1996-2004**	**2005-2008**	**2009-2014**	**2005-2014**
Output	–1.4	4.0	5.1	4.7
Total factor productivity	3.7	8.4	9.9	9.3
Capital stock	–0.1	2.6	2.3	2.4
Labor	–6.5	–6.9	–7.1	–7.0

Source: Own computations.

The impact of labor restructuring in visible in the impact of the factor in the sectorial output growth.

Table 3

Growth factor decomposition – Machinery, n.e.c (1996-2014)

%	**1996-2004**	**2005-2008**	**2009-2014**	**2005-2014**
Total factor productivity	37.0	57.7	60.7	59.6
Capital	0.3	6.5	5.4	5.8
Labor	62.7	35.8	33.9	34.6

Source: Own computations

It is interesting to note the low impact of capital, just 5.8 percent for 2005-2014, illustrating the decapitalization of important enterprises in the sector.
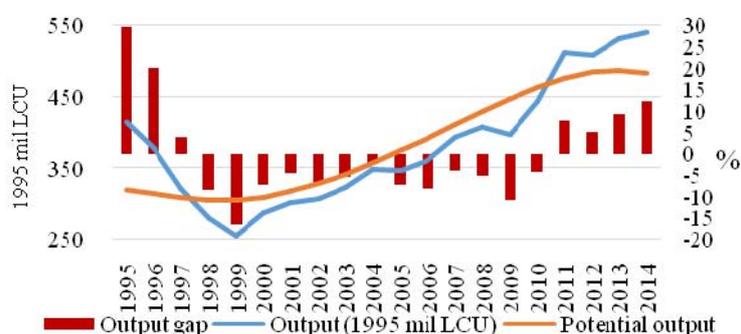

Figure 2. Potential output and the output gap – Machinery, n.e.c (1995–2014).

Source: Own computations.

The output is above its' potential, the output gap was 12.2 in 2014. This signals that the sectors reached a growth limit. New sources of growth must be envisage and labor can play a decisive role in this regard, taking into account that it is well below potential in the sector.

The output dynamics in the Electrical and Optical Equipment mainly correlated before 2005 with labor (0.57 for 1996-2004) and after 2005 with total factor productivity (0.90 in 2005-2014).
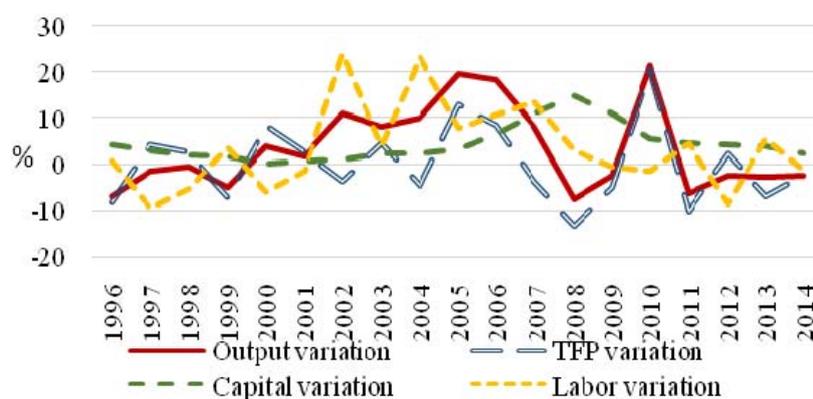

Figure 3. The dynamics of the growth factors – Electrical and Optical Equipment
(1995-2014)

The Pearson correlation between output and total factor productivity was 0.25 for 1996-2004, increasing to 0.9 for 2005-2014. Negative values for the correlation were registered for the capital stock (–0.06 for 1996-2004 and –0.22 for 2005-2014).

The labor force restructuring played an important role illustrated by the negative correlation with TFP, –0.24 for 1996-2014. In contrast to Machinery, n.e.c. sector the labor force registered on average a positive dynamics.

Table 4

Average annual growth rates – Electrical and Optical Equipment (1996-2014)

Average annual growth rates	1996-2004	2005-2008	2009-2014	2005-2014
Output	2.3	9.7	0.9	4.4
Total factor productivity	–0.3	0.9	–0.4	0.1
Capital stock	2.0	8.9	5.3	6.7
Labor	3.6	8.7	–0.5	3.2

Labor and capital were the main factors explaining the output growth in the sector. On average the TFP growth in the sector were much lower in comparison with Machinery, n.e.c. sector.

Table 5

Growth factor decomposition – Electrical and Optical Equipment (1996-2014)

%	1996-2004	2005-2008	2009-2014	2005-2014
Total factor productivity	15.7	4.0	29.4	8.7
Capital	22.1	34.1	58.5	49.2
Labor	62.2	61.9	12.1	42.2

Source: Own computations

About half of the output growth for 2005-2014 was explained by capital and about 42% by labor. This illustrates the role of the capital stock in reducing the economic impact of the economic crisis.
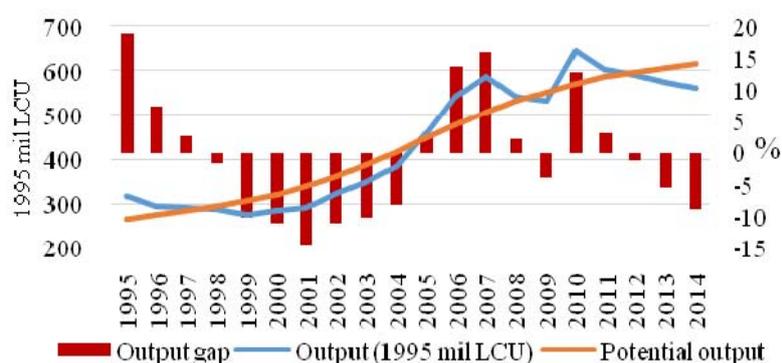

Figure 4. Potential output and the output gap – Electrical and Optical Equipment (1995-2014)

Source: Own computations.

The sectorial output is bellow potential signaling that the sector has room to growth. Given the dynamic of the productive factors this growth can came from labor and increases in productivity.

The output dynamics in the Transport Equipment sector mainly correlated before 2004 with capital (0.7 for 1996-2004) and after 2004 with total factor productivity (0.5 in 2005-2014).

The Pearson correlation with the sectorial output was positive for all factors. On average the highest values were registered for TFP (0.43 for 1996-2004 and 0.5 for 2005-2014) and capital (0.7 for 1996-2004 and 0.21 for 2005-2014).
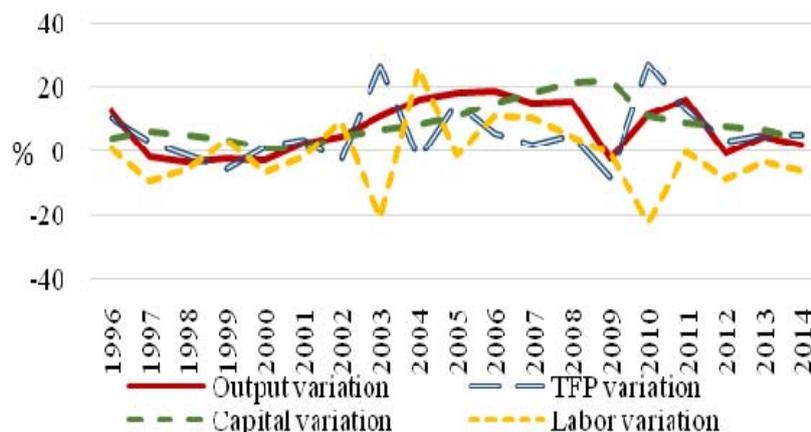
Figure 5. The dynamics of the growth factors – Transport Equipment (1995-2014).

Source: Own computations.

Labor's dynamics was characterized by high volatility linked to the restructuring process of important enterprises in the sector. This ensured that the sectorial output registered a positive dynamics in the analyzed period.

The role of labor restructuring in the sector in visible in the average annual growth rates.

Table 6

Average annual growth rates – Transport Equipment (1996-2014)

Average annual growth rates	1996-2004	2005-2008	2009-2014	2005-2014
Output	3.9	16.7	5.1	9.7
Total factor productivity	3.5	6.7	7.3	7.1
Capital stock	4.3	16.2	9.8	12.3
Labor	–0.7	6.1	–7.1	–1.8

Source: Own computations.

The positive dynamics of the capital stock correlated with the dynamics of labor force point to the ample restructuring process in the sector. Some of privatization were successful like in the case of Dacia, other less successful. An important example in this direction is Roman Brasov with produced approximatively 13.000 trucks and employed 20.000 persons in 1989 and in 2002 were producing only approximatively 700 trucks. Fallowing the companies' restructuring in 2003 the number of employees dropped to 8600.

Table 7

Growth factor decomposition – Transport Equipment (1996-2014)

%	1996-2004	2005-2008	2009-2014	2005-2014
Total factor productivity	56.4	41.6	44.3	54.1
Capital	26.7	33.9	21.8	33.5
Labor	16.9	24.5	33.9	12.4

Source: Own computations.

More than half of the sectorial output dynamics for 2005-2014 was explained by total factor productivity pointing out to the impact of the ample restructuring process. This is also underlined by the dynamics of the capital stock which explained around 34% of the output growth in 2005-2014.
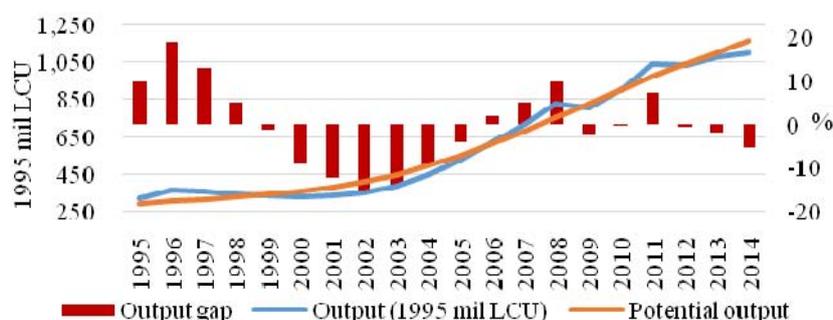

Figure 6. Potential output and the output gap – Transport Equipment (1995-2014).

Source: Own computations

The sectorial output gap was –5.4 in 2014, indicating existing room for growth. In terms of the production factors, the labor factor is below its' potential reflecting the capacity of the sector to absorb supplementary labor force. Total factor productivity is bellow potential as well pointing out to existing room for productivity improvements.

4. Conclusions

The results suggest that the correlation between output and labor is not strongly positive. On the contrary labor restructuring was one of the main instruments used and an easy alternative to fight the economic crisis.

Labor restructuring had positive effects on the total factor productivity, suggesting that the direction of causality is from labor to productivity and not the other way around.

These results point out to the potential vulnerability in respect to the labor force. The analyzed sectors employed highly skilled labor force. Moreover this shrinkage of the labor force comes as the wages and salaries are well below the EU average. This suggests that Romania is in danger of losing some of its' high skilled labor force.

Further contextualization depicts an even more complicated picture. The labor restructuring took place in the context in which Romania has one of the lowest hourly labor cost in EU at 3.9 euro in 2015, well below the EU28 average at 19 euros. These raises questions regarding the capacity of the analyzed sectors to keep and attract the highly skilled labor force.

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