Growth and Technology: The new economy in the 2000'S CEE countries and Romania

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ABSTRACT
We use a concept of the new economy based on ICT and the inherent internal capacity to change the production patterns of producers. Thus, our results indicate that ICT is the main growth contributor (catching-up) of the years 2000 between inputs (Romania) and probably the main explication for the movement of the economies to economic growth based on the accumulation of capital and technology (CEE); large jumps and fluctuations of the technological factor probably reflect the cumulative effects of restructuring, narrowing the state sector and labor savings. We conjecture that, especially in Romania, the wave of restructuring is generated by the ICT boom; similarly, the growth contribution from labor quality is probably reflecting the massive mobilization of technology in the mid 2000s. The technological “mantra” of the new economy- faster, better, cheaper - seems to be supported by mutations in Romania and CEE economies.

KEY WORDS
ICT, technology, New Economy, economic growth, neoclassic perspectives

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1. Literature review
Studies on the economic growth for the year 2000 are generally missing. Although Romania is undergoing an economic boom that extends over a period of almost 6 years (2003-2008), the economic academic environment has not yet approached this growth from a rigorous microeconomic perspective. Especially macroeconomic influences are prevalent, involving a range of topics more or less influenced by journalism, international reports or governmental policies, as reform and fiscal policies, macroeconomic balance, etc. Micro-oriented literature is almost without exception introductory, conceptual and/or analytical, whatever its theoretical branch.

We seek to meet the goal of microeconomic perspective on growth and provide an explanation in terms of neoclassical conceptions. Thus, we introduce a model based on individual, decreasing returns and returns to scale constant which we expand to capture a distinction between ICT factors (Information and Communication Technology) and non-ICT used by the new methodology of growth. In these circumstances, we get a series of results that indicate major changes in composition and the production process, with a significant opening of CEE countries.
and Romania to technologies and production patterns of the new economy. In regional perspective, Romania is part of the trend growth of post-socialist CEE countries (Central & Eastern Europe), with long and difficult transitions in the 1990s such as Bulgaria or the Czech Republic, but with growth jumps of the catching-up or even leap-frogging type in 2000s; the growth largely overlaps with ICT investment boom, suggesting that there has been a massive mobilization of capital and technology. We use the methodology and the EU KLEMS & Conference Board database for the values of inputs and outputs and cover a period of 12 years, 1997-2008.

2. Conceptual Preliminaries in Brief

We use in this paper a concept of the new economy reflecting the technological mantra of ICT – faster, better, cheaper (Jorgenson, 2004). Thus, the new economy is based on ICT technology, reflecting low costs and high marginal products; the main difference from conventional types of capital is that it shows high depreciation rates. In these circumstances, the investment boom reflects both the rapid decline of prices (31% per year) and high rates of efficiency of ICT (doubling every 18 months according to Moore’s Law) based on the high technological progress of ICT sectors (Jorgenson, 2001), and also the fact that entrepreneurs have chosen to alter the production patterns, substituting ICT for other types of inputs (Jorgenson and Stiroh, 1999, 2000). The dot-com collapse (2000) and the recession in the U.S. sites (2001/2) have affected investment in ICT in 2000, but are nevertheless far from exhausting the technological mantra of the new economy. Thus, the increase went to the reallocation of factors and a more efficient use of ICT mainly reflected by the productivity of strong users of ICT sectors (Bosworth and Triplett, 2007; Basu and Fernald, 2008), while emerging economies reflect a growing shift to massive capital mobilization and ICT (Jorgenson and Vu, 2006, 2009).

You may note that this concept of the new economy reflects a neoclassical perspective on growth, which is considered limited explanatory. A number of alternative positions seek to suggest that the difference between investment and technological progress, which a neoclassical conception makes to indicate that the investor can internalize the investment yields without any advantage in exchange for benefits from spillovers, externalities etc., produced in another place, does not satisfy the whole concept of technology and efficiency (increasing), strongly associated with ICT at the microeconomic level. Thus, ICT indicates a huge potential of human technological complementarity, highlighted by the organizational literature and/or the skill biased technical change theory (Bresnahan, 1997), and by historical analogies with the technology for the General Purpose (GPT) type, that irreversibly marked the historical past and the trend growth, such as the steam motor, the electric motor or dynamo, the telegraph etc. (David, 1990); the main suggestion is that the economy reflects a major shift towards intangible forms of inputs and increasing yields. Thus, investing a dollar in computers and information technology equipment, managers invest another $10 to reorganize their social systems of information and production to use the new technology more efficiently (Zysman and Weber, 2000); a concept of decreasing returns, which generally characterizes the tangible capital and makes of the capital accumulation the main source of technical progress, suggesting an internalization of costs, and limiting the investment to a marginal level of internal optimality; on the contrary, a concept of increasing returns shows that the company can benefit from knowledge or experience of other companies, a recipe, a blueprint etc., without to internalize their production costs. In these circumstances, the globalization as deregulation in growth and integration of the global markets for capital, goods and labor, the competition growth and the technological revolution based heavily on the nature General Purpose Technology of ICT seem to be a new mantra of the new economy; a number of studies consider
data processing, digitization and Internet technology as tools of thought, that enhance the brain power in the economy and change the legal and political structure of the society (Cohen, DeLong and Zysman, 2000; Zysman and Weber, 2000).

From this angle, the explanations and the perspective on economy are a permanent temptation for economists, providing a concept of the new economy employing the process and product changes at all levels of the economy. But instead they encounter too great observation difficulties (Van Ark and Hulten, 2007) and therefore arouse doubts that Stiroh expressed as follows: “Until one finds convincing evidence of economic spillovers and productivity gains, the importance of these ideas must be viewed cautiously” (Stiroh, 2000). Similarly, Schreyer (2000) argues that the possibility of interpreting the technological factor as an index of advantages derived from the widespread use of ICT (ICT as GPT), as positive externalities, spillovers, returns to scale and technological progress, is reduced especially in terms of obtaining unbiased results (Schreyer, 2000).

Meanwhile, van Ark insists that the most powerful explanations of the economic growth are those that combine investments, efficient use of resources, invention and innovation focusing on historical, institutional and political factors (Van Ark, 1999). And Sharpe writes that: “it is better to work with industry productivity estimates that are comprehensive, even if part of the data is recognized to be of poor quality, than to be limited to incomplete data sets of higher quality” (Sharpe, 2002).

3. Methodology and Growth: A Neoclassical Perspective

ICT products and services represent output in high-tech industries and input in ICT-using sectors. Thus, ICT affects growth through two major channels: production and productivity growth in ICT-using sectors. The role and contributions of ICT to growth is the main challenge for the CEE national methodologies which will follow on; on reasons of internal methodology we will not develop a sectoral analysis on dual method of Domar (Apostol, 2010). Significantly, at a 10% of ICT investments, output value is increased by an average of 0.45 percentage points; for medium developed economies, an increase of 10% is equivalent to an increase in output values of 0.8 points (Vu, 2005; Piatkowski, 2004).

We develop a model that is based on constant returns to scale and separate ICT capital of non-ICT and labor. The output is a function of capital, labor and technological progress via Cobb-Douglas and Solow.

ICT Capital comprises the methodology EU KLEMS computer hardware, software and communication equipment, and non-ICT capital non-residential constructions, industrial patterns, transport equipment and machinery (Chen et al., 2010). In the equation of growth, inputs are expressed as deep capital, working hours and quality work. The technological factor is another term for Slow’s residual, is formulated as an augmentation Hicks neutral growth in our calculations and is equivalent to Total Factor Productivity (TFP).

Details below provide some procedural methodology by which input and output values are obtained.

Output per se is made especially in the form of services. The difference between a conventional formulation of the capital stock and the flow of capital services reflects the difference between total capital stock, which is a concept of wealth, and productive capital stock, which means that property incorporates income expectations that are reported to a yield period (Oliner and Sichel, 2000; Schreyer, 2000). The combination between the depreciation rate, acquisition costs and use and time efficiency give the rent cost of capital; the effect of taxation is
not included. In other words the cost of rent reflects the marginal product type and allows differentiation of service stocks, allowing observation of growth in capital quality (Jorgenson, 2004).

Geometric rate of depreciation for non-ICT capital goods is 7.5% per year. By comparison, ICT knows high rates of depreciation, for example 29.5% (hardware), 31.5% (software) and 11.5% (communication equipment). Values of rates of depreciation are standard in growth calculations (Piatkowski, 2003).

Conventional inputs are deflating to an index of inflation. Deflating ICT is more problematic, especially for the intensity of price quality ratio. Deflator shows that ICT prices are falling in relation to the increase in quality.

A procedure for calculating the increase in quality of labor attributed reflect changes in labor composition depending on three competent levels, low skilled, medium skilled and highly skilled, and is obtained as a difference between growth of hours worked and labor factor contribution.

We use Hick’s neutral technological factor as augmentation of unexplained growth factors in the quality and quantity; neutrality requires that the rate of factor substitution between inputs remains constant, and technological progress is built.

For applications, we use the database EU KLEMS & Conference Board for inputs and outputs values. For a detailed exposure of measurement procedures, see Methodological Notes (Conference Board).

With these specifications our model can be formulated as follows:

1) \( Y = A \times F(K, L) \),

Where \( Y \) is output, \( K \) capital, \( L \) labor, and \( A \) technological factor or Solow’s residual, as difference between output and growth of inputs.

We rewrite the relationship to include ICT and non-ICT inputs and outputs. Thus,

2) \( Y = Y^{ICT}_t + Y^{non-ICT}_t = A_t F(K^{ICT}_t, K^{non-ICT}_t, L_t) \),

Where subscript \( t \) is time, \( Y \) output expressed in value added, \( Y^{ICT}_t \) output ICT, \( Y^{non-ICT}_t \) output of non-ICT goods and services. \( K^{ICT}_t \) is ICT input, \( K^{non-ICT}_t \) another capital/ non-ICT capital, \( L_t \) labor and \( A_t \) technological factor, identified in this relationship as Hicks’ neutral augmentative. In other words, growth of output in any time \( (t) \) expressed as value added \( (Y) \) is provided by outputs ICT \( (Y^{ICT}_t) \) and non-ICT \( (Y^{non-ICT}_t) \). Outputs are produced in their turn by input ICT \( (K^{ICT}_t) \), input non-ICT \( (K^{non-ICT}_t) \), input labor \( (L_t) \) and technological factor or Solow’s residual \( (A_t) \).

Because we affirm that the growth reflects constant returns to scale, the relationship above can be rewritten as follows:

3) \( dY_t = w^{ICT}_t \, dY^{ICT}_t + w^{non-ICT}_t \, dY^{non-ICT}_t = v^{ICT}_t \, dK^{ICT}_t + v^{non-ICT}_t \, dK^{non-ICT}_t + v_L \, dL_t + dA_t \),

Where \( d \) indicates rate of change or variation in output / factors, and values \( w^{ICT} \) and \( w^{non-ICT} \) express the weights per se of ICT output, respectively non-ICT. Summed weights are equal to 1. Similarly, values \( v^{ICT} \), \( v^{non-ICT} \) and \( v_L \) are nominal shares of ICT capital, non-ICT capital and labor.

We take into account the contribution of ICT to productivity growth. In these circumstances, we rewrite the relationship above as follows:

4) \( dY_t - dH_t = v^{ICT}_t \, (dK^{ICT}_t - dH_t) + v^{non-ICT}_t \, (dK^{non-ICT}_t - dH_t) + dA_t \),

Where \( H_t \) denotes hours worked/total employment and labor productivity is indicated by ratio: \( Y_t/H_t \).

Extraction procedure of Hicks’ neutral augmented factor is as follows:

5) \( dTFP_t = dY_t - v_L \, dL_t - v^{ICT}_t \, dK^{ICT}_t - v^{non-ICT}_t \, dK^{non-ICT}_t \)

The growth is a standard form which implies constant returns to scale and is extended to include the contributions of ICT capital to productivity growth. The main advantage is its simplicity and can be applied including in emerging economies, knowing higher development gaps on wider
levels of economy. From reasons of space, we did not include procedures to extract the flow of services, the rate of depreciation etc., which can be found in Methodological Notes.

In the CEE, the main contribution is provided by the TFP factor (Fig. 1), for example in the case of Romania and Bulgaria, with values over 100%. The contributions from labor and capital are the lowest, especially in the first period (1997-2000). This means that the positive and high results of the TFP suggests the presence of some cumulative effects derived from the restructuring and labor savings, provided mainly toward the Western markets (van Ark and Piatkowski, 2004; Iradian, 2007; Apostol, 2011).

Significantly, capital and labor inputs are experiencing a strong incremental path (the input labor hours is much more fluctuating), which overlaps with a sizable decline in the growth of factor technology. This suggests that the growth based mainly on cumulative effects and the savings with the workforce began to give way to an increase based on the accumulation of capital and labor. For the quality of labor (and overlapping with ICT) reflect accentuated contributions until close to the end the period, this suggest the strong presence of structural changes in the economy generated mainly by the accumulation of ICT. As for Romania, the ICT capital knows at the level of region a decline towards the end, suggesting the economies shift toward the accumulation of conventional capital and labor (the output of the labor input increases towards the end of the period) and lower values of TFP.

Our results indicate a shift of growth from negative growth and divergence between 1997-2000 to one based on restructuring, massive mobilization of ICT capital (Fig.2) and output type levels of catching-up, between 2001-2008. Romania is no exception at the level of region, especially among prolonged transition economies. Increase in importance of ICT technology mantra undoubtedly reflects the new economy (faster, better, cheaper), developments in the international transfer of technology and national success in terms of restructuring and implementation of market institutions and liberalization of telecommunication market in 2000.
Thus, between 1997-2000, ICT reflects an increase of 0.081 percentage points, while non-ICT capital contributions, working hours and TFP are negative. On the contrary, during 2001-2004 a jump of TFP is reflected, which probably explained the cumulative benefits derived from restructuring, a number of reforms introduced in the telecommunications market, narrowing the state sector and savings from job drain to other western markets and/or agriculture (self-consumption) that functioned as an employer of last resort (Dăianu, 2004; Van Ark and Piatkowski, 2004). ICT contributions reflect a strong incremental path, with 0.64 points, while the contributions of working hours remain negative. Contributions of labor quality are maintained in positive change and high, although declining in this period. The explanation may be provided by imbalances in the market and increased medium and high skilled workers. Thus, massive workforce supplied on other markets or in agriculture is low skilled, while the domestic market starts to absorb more and more medium and high qualified skilled workers; it coincides with the economy moving towards a growth driven mainly by the massive mobilization of new technologies and an obvious increase in the contribution of labor quality by 0.23 percentage points, to end the period of 2005-2008. Significantly, non-ICT capital contribution is kept between 2001-2004 negative, probably explained by the inefficiency of industry state sectors, loss of markets through measures to shift to a market economy, and loss of workforce since the second half of the 1990, equivalent to a decreasing marginal product of capital. On the contrary, 2005-2008 showed an increase of less than 1 percentage point for non-ICT input, while ICT and TFP factors reflect substantial increases, the first with more than 1 percentage point, and the last with 3.84. The last one reflects a positive and high growth but declining from the previous period, suggesting a shift to the raising of capital growth, while ICT reports a decline since 2006, coinciding with a substantial return to contributions from non-ICT. This reflects changes in domestic economic policy agenda since 2005/6, moving towards ICT least using sectors such as industry, construction and agriculture; the major impact is reflected in a growth of contributions of labor, which further reflects an increase in employment/ occupation in these sectors and probably an increase in labor costs (revenue growth). Thus, contributions of work for the first time become positive and high for a longer period of time, while the contributions of ICT are in decline; ICT is strongly declining in 2007/8, probably reflecting the U.S. subprime crash and tribulations of international financial markets; a sustained growth in this period of non-ICT capital in the poor ICT- using sectors can be explained only by the support of domestic economic policies.
Considering the decline in recent years, ICT remains probably the main contributor to growth between inputs (Fig. 3); the large but fluctuating contributions of the technological factor TFP reflect the advantages derived from restructuring, narrowing of the state sector and the labor savings. Once exhausted, TFP will come to reflect much lower values and close to scores recorded by inputs, becoming a better indicator of the level of technology used. Working hours and labor quality factors undoubtedly reflect the effects deriving from restructuring and the narrowing of the state sector, as police reorientation in the second half of 2000 to less ICT using sectors; the increase in the quality of work reflects an increase in the level of education, perhaps stimulated by the massive mobilization of ICT in the mid 20s.

In the context of CEE, Romania reflects a growth trajectory of specific countries with long and difficult transition. Thus, with the Czech Republic and Bulgaria, Romania indicates a period of divergent growth (1997-2000), assisted in 2000 by two periods of catching-up. By reasons of simplicity, we consider the two periods as one. Slovenia, Poland or Hungary reflect much better scores in this period, suggesting that there transactions towards an economy and market institutions were shorter and efficient. On the contrary, the period 2001-2008 reflects very strong returns of prolonged transition economies. Thus, output growth of catching-up type overlap with investment boom in ICT, while economies of catching-up growth already recorded in the late 90s reflect lower results. However, investments in ICT indicate a major increase in importance throughout CEE, while the technological factor TFP reflects a decline, suggesting both an exhaustion of the benefits of restructuring and a shift of growth to massive mobilization of capital and technology, with implications for domestic labor market (Oliner and Sichel, 2000). The ICT boom of this period undoubtedly reflects the technological mantra of the new economy: ICT is a type of input with high rates of depreciation and high marginal products, causing entrepreneurs to alter production patterns and other less efficient factors to replace ICT.
4. Conclusions

Perhaps the main novelty of the new economy is orienting savings towards mobilizing new technologies and highly qualified workforce. Low costs and high rates of efficiency caused entrepreneurs to make massive investments in ICT, suggesting this as a special type of technology with implications on patterns and the process of production; a whole organizational literature suggests that there are massive investments in intangible capital and/or complementary to ICT. However, it is difficult to separate ICT boom of the growth boom of the 2000s, probably explained from cumulative effects derived from restructuring and the narrowing of the state sector, increasing consumption, the income provided from abroad, a real increase in productivity stimulated by the accumulation of ICT capital, increasing the contribution from work and low-return sectors of ICT users, towards the end. There is no doubt that the wave of restructuring and liberalizations is generated mainly by investment in ICT at this time and the need to adapt the production process, so that benefits of new technologies can be exploited more efficiently, and increasing contributions from the quality of work seem to reflect the increase in education and a relevant and intuitive association with massive mobilization of technology overlap.

References


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Legend: Author calculation based on the data provided by The Conference Board

Table: CEE Countries