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Sectoral Features of Economic and Employment Growth in Various OECD Countries

Introduction

The existence of labour economics is justified by the fact that in industrialized countries, a large proportion of the population is made up of wage-earners or those who aspiring to become employees. Nowadays, labour economics covers a very large range of economic and social problems, such as the causes of labour market imperfections i.e. unduly low employment, durable involuntary unemployment and large-scale financial recessions within business cycles etc., which have played a greater role in recent macroeconomic research *(Cahuc–Zylberberg 2010).*

The contribution of labour to economic growth became especially popular in historical research after the rise of human capital theories advocated by *Becker (1964)* and *Schultz (1961*) and growth theories first formalised by *Solow (1956).* Later, *Nakamura (1981:263)* defined human capital as 'labour skills, managerial skills, and entrepreneurial and innovative abilities - plus such physical attributes as health and strength'. Meanwhile, the early years of 1970s, and, later the oil crisis eventually revealed that it takes more than just physical and human capital to generate economic growth *(Földvári and Leeuwen 2007)*. This made it possible to introduce human capital into new theories dealing with economic growth.

In the first human capital augmented models, pioneered by *Lucas (1988)*, human capital was inserted as a factor of production similar to physical and labour accumulation. A consequence of this extension of the original Solow-model was that GDP growth was positively influenced by human capital (HC). Human capital, in this approach, is exemplified as skills, which are embodied in a worker and are also a rival and excludable good *(Barro–Sala-i-Martin 2004)*. In another model, pioneered later on by *Romer (1990)*, the neo-classical growth model is followed in the sense that technological growth works on GDP growth through the level of human capital. In this case HC produces new technologies directly because it is used as an input in R&D related activities and is visible in the skills (knowledge and ideas) of a worker. Consequently, in the latter case HC is non-rival and partly-excludable.

Recently, there have been serious debates attempting to explain how HC might influence productivity. Meanwhile, the effect of human capital on economic growth is usually reflected in low positive and significant coefficients *(Barro–Lee 1993), (Cohen–Soto 2001)* etc., except in the famous study of *Benhabib and Spiegel (1994)*. Thus, empirical results found that investment at the level of education, ceteris paribus, might not produce economic growth *(Gwartney et al. 1999).*

The purpose of this research study is to investigate the valid relationships between employment, physical capital accumulation and productivity growth. In our hypothesis, we assumed that productivity growth varies in the performance of different labour-skilled employees. The rest of this study is structured as follows. In the next sections I describe the features of output and employment growth with common descriptive statistics. In my estimations I follow a specific taxonomy to identify the characteristics of output and employment growth tendencies in different labour-skilled branches over the previous decade. Then, I demonstrate a dynamic regression model with cross-industry panel data in order to investigate how employment affects economic growth per capita. The study ends with some policy implications and a conclusion. My motivation is not only to suggest feasible point of reference for policy-makers to enhance better productivity growth performance in different sectors, but also to outline further research directions in this sectoral perspective.

Industry structure analysis and taxonomy

A unique database has been constructed for the analysis of economic and employment growth by the EU KLEMS (2003) Project. This project aims to create a database which include measures of economic growth, productivity, employment creation, capital formation and technological change at the industry level for various OECD countries from 1970 onwards. The last (March 2011) release of KLEMS database provides data up to 2007 for a limited set of variables in different industries. Hence, in our estimations we should expand the given time series of gross value added[1] (GVA) in constant (1995) prices and numbers of persons engaged in 56 separate industries[2] to calculate economic and employment growth performance. In my dynamic model specification I also need the share of investment within output for each OECD country, which is available from the Penn World Table, included in *Heston et al. (2006)*.

In my estimations I followed a specific taxonomy that was introduced by *van Ark et al. (2003)* to identify the features of output and employment growth tendencies. This approach focused on labour skills and was defined by educational attainment. However, the taxonomy distinguishes four groups ranging from high to low-skilled intensive branches. The skill levels in Eurostat are based on the International Standard Classification of Education - 1976 (from ISCED 0 to 6). The table below lists the taxonomy of industries divided into four different groups:

Table 1. Skill taxonomy of all industries (with ISIC Rev 3.)

1. High skilled (HS): Mineral oil refining, coke and nuclear fuel (23); Chemicals (24); Office machinery (30); Radio, television and communications equipment (32); Electronic valves and tubes (321); Telecommunication equipment (322); Radio and television receivers (323); Financial intermediation, except insurance and pension funding (65); Insurance and pension funding, except compulsory social security (66); Activities auxiliary to financial intermediation (67); Real estate activities (70); Computer and related activities (72); Research & development (73); Other business services (74); Public administration and defence; compulsory social security (75); Education (80).
2. High-intermediate skilled (HIS): Medical, precision & optical instruments (33); Scientific instruments (331); Other instruments (33-331); Other transport equipment (35); Building and repairing of ships and boats (351); Aircraft and spacecraft (353); Railroad equipment and transport equipment (352+359); Electricity, gas and water supply (40-41); Air transport (62); Supporting and auxiliary transport activities; activities of travel agencies (63); Communications (64); Renting of machinery & equipment (71); Health and social work (85).
3. Low-intermediate skilled (LIS): Wood & products of wood and cork (20); Pulp, paper & paper products (21); Printing & publishing (22); Fabricated metal products (28); Mechanical engineering (29); Electrical machinery and apparatus (31); Insulated wire (313); Other electrical machinery & apparatus (31-313); Construction (45); Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel (50); Wholesale trade and

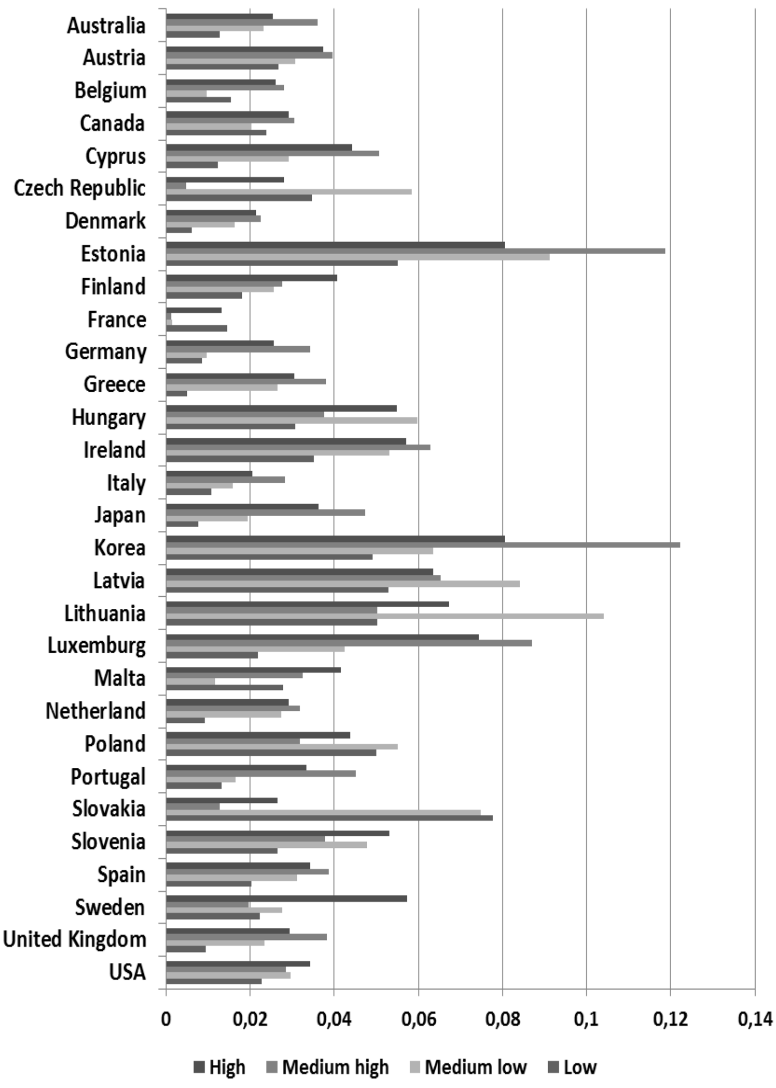
[1] Gross value added (GVA) is a measure used in economics as the value of goods and services produced in an area, industry or sector. Gross value added is equivalent to output (GDP) less intermediate consumption.
[2] Industries were separated by Indicators of activities for Industry and Services, based on ISIC Rev 3.

commission trade, except of motor vehicles and motorcycles (51); Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52); Inland transport (60); Water transport (61).
4. Low skilled (LS): Agriculture (01); Forestry (02); Fishing (05); Mining and quarrying (10-14); Food, drink & tobacco (15-16); Textiles (17); Clothing (18); Leather and footwear (19); Rubber & plastics (25); Non-metallic mineral products (26); Basic metals (27); Motor vehicles (34); Furniture, miscellaneous manufacturing; recycling (36-37); Hotels & catering (55); Other community, social and personal services (90-93).

Source: van Ark et al. (2003:60-61).

The purpose of this section is to describe the demand structure of industries in the OECD. This section looks at economic performance in the EU-25 and four other OECD countries contrasted with the USA during the periods between 1980 to 2007. My analysis begins with an examination of value added, which is one of the indicators most readily associated with increases in output growth. Economic growth is defined here as the growth of Gross Value Added at constant prices. The average growth rates in the four different labour-skilled branches of the examined countries are shown in Figure (1).

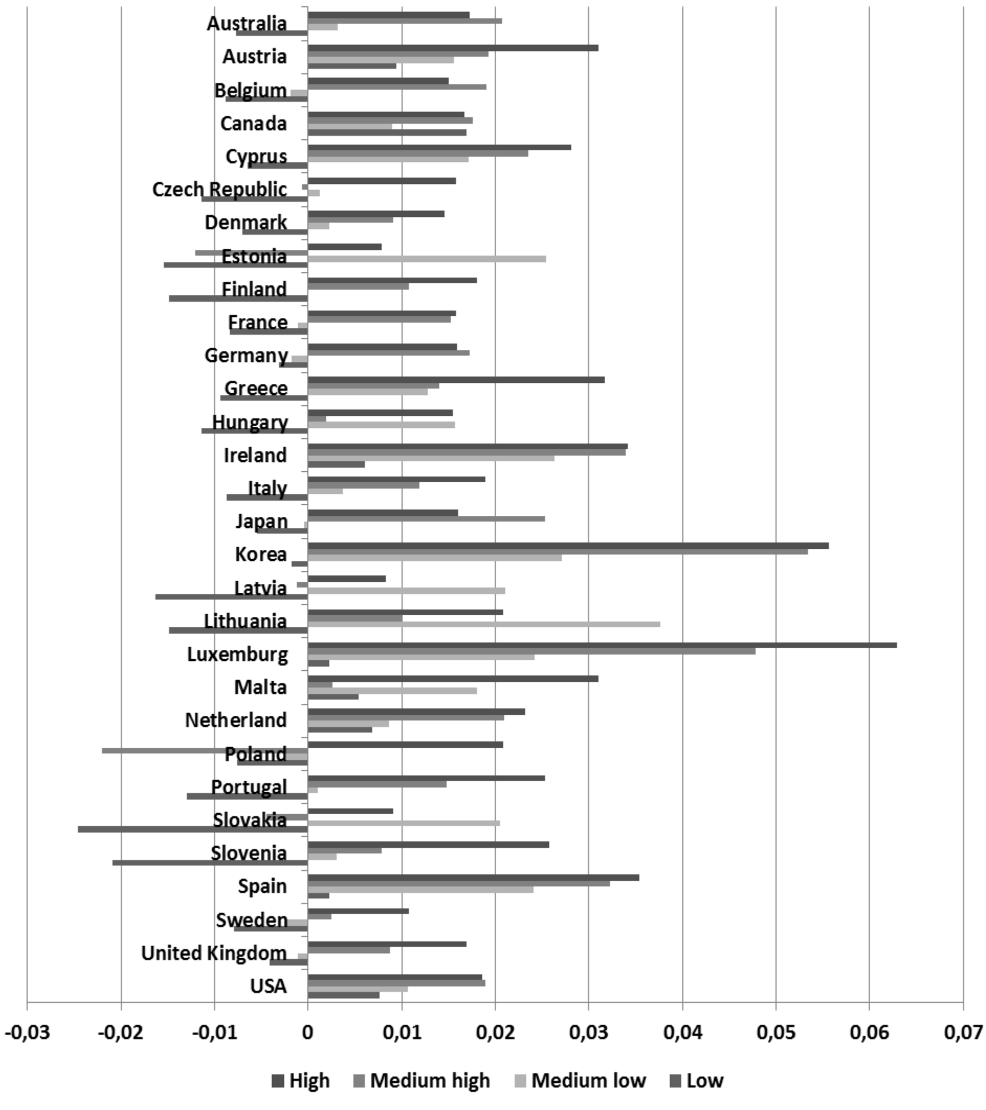
*Figure 1. Average economic growth rates of OECD countries, 1980-2007**



Source: own calculation based on EC KLEMS (2013).
*Notes: *1995-2007 at CYP, CZE, EST, HUN, LTU, LTV, MLT, POL, SLK, SLV.*

As Figure 1 suggests, the greatest growth in value added occurred in most of high and high-intermediate (HS and HIS) skilled branches and the lowest rate of growth was typical in the low-skilled (LIS and LS) industries. Obviously, cross country variation ranged from 1% to 12%. Although growth rates vary substantially across countries, the rate of output growth is roughly constant over long periods of time in all branches. In some other EU member countries there was a much larger proportion of value added in high-skilled industries than with the USA averages, except for the economic performance of the Czech Republic and Slovakia, where machinery and vehicle industries improved more markedly than the high skilled industries in the period 1995-2007.

*Figure 2. Average employment growth rates of OECD countries, 1980-2007**



Source: own calculation based on EC KLEMS (2013).
*Notes: *1995-2007 at CYP, CZE, EST, HUN, LTU, LTV, MLT, POL, SLK, SLV.*

Figure 2 reflects employment growth rates in the same industries and time periods. Here similarities appear in the performances of each sector and over time. The average annual employment growth rates in HS and HIS branches, in all examined countries, were greater than in the lower skilled ones. This might anticipate an increasing role of human capital in labour demand. Furthermore, I should also mention that employment growth was controversially negative in several low-skilled (LS) industries, as it was in the USA.

Industry structure should be described by using the distribution of value added and employment to the aggregate level of OECD countries. Table 2 represents value added and employment shares of the aggregate OECD performance over three years (1980, 1995 and 2007). In the OECD countries, in 1980, the major proportion of economic growth stemmed from the LS and LIS sectors, but particularly by 2007 the high-skilled sectors were already enjoying the highest level of growth. Although, the total distribution position differs across the OECD, we can conclude that the high-skilled branches have achieved better economic growth than the lower ones. When we estimate employment performance, the same tendencies in sectoral shifts also seems to occur. From 1980 to 2007 in HS and HIS branches the employment share obviously increased, but the decreasing employment of low-skilled workers was still higher than in our estimations.

Table 2. Output (GVA) and employment distribution (%) of OECD countries in each labour skilled sector, 1980-2007

GVA	**High**	**Medium high**	**Medium low**	**Low**
1980*	32.60%	8,17%	31,87%	27,36%
1995	36.56%	9,96%	32,25%	21,23%
2007	43.39%	14,52%	24,75%	17,34%
Employment	**High**	**Medium high**	**Medium low**	**Low**
1980*	24.96%	12.24%	32.90%	29.91%
1995	28.88%	13.83%	31.65%	25.64%
2007	31.86%	15.09%	29.87%	23.18%

Source: own calculation based on EC KLEMS (2013).
*Notes: *except CYP, CZE, EST, HUN, LTU, LTV, MLT, POL, SLK, SLV.*

Dynamic productivity changes: the econometric evidence

Now, let me start by initiating an empirical investigation to test what kind of relationship exists between labour productivity (GVA per capita) and employment. Here, following the mainstream economic growth literature I choose a well-known conditional convergence model specification previously promoted by *Barro and Sala-i-Martin (1997)*. The growth formula in the standard model can be written as:

$$\frac{\dot{y}_i}{y_i} - \gamma = G\left[\frac{y_i}{y}, \left(\frac{y_i^*}{y}\right)\right] \tag{1}$$

The partial derivatives of function G satisfy $H_1<0$ and $H_2>0$. The value [y] represents productivity growth in a follower country [i]. The long run steady state output per capita value [y*] depends on the neoclassical parameters, such as government policies, willingness to save etc. Consequently, higher values of these factors might increase [y*].

In Equation 1 [γ] is the growth rate of a leading economy, which could be identified as the average growth rate of output per worker in a set of advanced countries. In my estimations I choose the USA, as the technology-leader country. Furthermore I assume that all followers have the same leaders. Hence, the cost of mitigation and rates of technological change should be exactly the same for all follower countries. The conditional convergence can be measured in this case with the variation of (y_i/y), as the ratio of the follower's output per worker divided by the USA's productivity performance for the same year.

Descriptive analysis is only able to detect the direct contribution of the structural shifts at industry level to aggregate economic and employment growth performance. After having demonstrated the existence of a systematic relationship between the industrial structure of labour and economic growth, I will examine the impact of employment on economic growth per capita. Taking into account new endogenous growth theories my model specification includes the lagged dependent variables among the repressors'. However, unlike the neoclassical approach long-run economic growth should be determined within the models rather than being exogenously assumed *(Czeglédi 2010).* A dynamic specification requires the special instrumentation of these lagged endogenous variables, for which we engaged the empirically offered GMM estimators developed by *Arellano and Bond* (1991). These methods employ lagged levels of the dependent and predetermined variables, as well as differences between the exogenous variables as instruments.

In my dynamic model specification the economy tends toward long run equilibrium. The extent of economic growth generally affects the rate at which per capita output approaches its steady state value. After taking the first difference of the dependent variable, our basic model assumes the following formula, which is tested in each of the different labour skilled sectors:

$$\Delta \ln Y_{it} = \beta_o + \beta_1 \Delta \ln Y_{it-1} + \beta_2 \ln(INV)_{it} + \beta_3 \ln(n + g + \delta)_{it} + e_{it} \qquad (2)$$ [3]

The dependent variable $[Y_{i,t}]$ is the ratio of real GVA per capita of a follower country and the output of the USA (y_i/y) for the period [t] and country [i] at a constant price (1995). The first independent variable refers to the lagged productivity growth and the next variable represents the share of investment [INV] within sectoral output in each country. Thus, [n] is the average growth rate of labour and the addition of long run technological growth and depreciation rates [g]+[δ] are assumed to be constant (0.05), as in *Mankiw et al.(1992)*. Finally, [e] is the error term.

Long run GVA per capita, investment and engaged employment variables are available between 1980 and 2007 from the databases. Moreover, the cross country panel datas is generated by the five year averages of 1980, 1985, 1990, 1995, 2000 and 2005. All in all, we have an unbalanced panel of 29 countries to evaluate the relationship between employment and long run GDP per capita in four different labour skilled sectors.

Table 3 represents the corresponding results of my estimations. Although, the two-step GMM estimator should be theoretically preferred experimentally, both procedures appear to produce similar outcomes, so I only present the first one results. At the bottom section of the table can be seen the common results of AR(1) and Wald tests to demonstrate the lack of autocorrelation and over-identifying restrictions. The significance levels of the tests in all models suggest that the dynamic specification should be preferred.

The impact of the lagged GVA per capita, however, is not robust in the high-skilled (HS) sectors[4], although in the other branches there are significant positive z-statistics. This relationship, ceteris paribus, implies the existence of convergence among the leader and follower countries. Moreover, I also claim that the impact of the convergence on productivity depends on the labour intensity of each sector. In other worlds, the higher the skill level of a sector the more the GDP per capita growth. According to the neoclassical growth theories an increase in the share of investment within output acts pro-cyclically and has a positive effect on productivity growth. Thus, in my results, the employment growth attainment is negatively related to the growth of per capita output in long run. Hence, employment is controversially correlated with productivity growth in both sectors. Moreover, the effect of labour accumulation on productivity growth does not seem to be large in both sectors. The

[3] Note: Δvar - variable in first differences, Δvar_{t-1} - lagged differences, ln - in logarithm.

[4] Lack of significance means that changing investment does not indicate productivity growth in this branch, at a given level of output per capita and other determinants.

coefficients range from circa -0.5% to -1%. Obviously, if employment increase the high-skill intensive (HS) branches might affect productivity least of all.

Table 3. Dynamic panel regression of real GDP (GVA) per capita, 1980-2007

Dependent variable: $\Delta\ln(Y)_{it}$				
Independent variables	High	Medium high	Medium low	Low
constant	0.0109	**0.05826**	0.0052	**0.0258**
	(0.64)	(2.92)**	(0.49)	(1.96)**
$\Delta\ln(Y)_{it-1}$	-0.292	**0,4568**	**0.2899**	**0.2202**
	(-1.13)	(3.86)*	(1.86)*	(1.54)*
$\ln(INV)_{it}$	**0.0922**	**0.2247**	**0.4058**	**0.1368**
	(1.59)*	(2.38)**	(5.17)***	(2.02)**
$\ln(n_i+g+\delta)_t$	**−0.5006**	**−1.0086**	**−0.5644**	**−0.5244**
	(-2.70)***	(-5.81)***	(-4.49)***	(-4.04)***
Number of observations	78	78	78	78
Number of countries	29	29	29	29
Number of instruments	6	6	6	6
Wald-test	(9.72)***	(41.43)***	(41.81)***	(39.45)***
AR-test	(-2.83)***	(-2.43)***	(-3.45)***	(-3.35)***

Source: own calculation based on EC KLEMS (2013) and Heston, Summers and Aten (2006) databases.
*Notes: * Heteroscedasticity robust z-statistics are in parentheses. Letters in the upper index refer to significance: ***: significance at 1 per cent, **: 5 per cent, *: 10 per cent. P-values without an index mean that the coefficient is not significant even at the 10 per cent level.*

Conclusions

In this study two objectives were declared. My first objective was to analyse economic growth and labour productivity tendencies for the period 1980-2007 in various OECD countries. The industrial structure was described by the distribution of value added and employment growth. From my empirical results I claim that in all of the OECD countries the highest growth rate of output was in the high-skilled industries. The average annual employment growth rates in the (HS) and (HIS) branches were higher than in the lower skilled (LIS and LS) sectors. This anticipates the increasing role of human capital in labour demand. In the EU-15 countries the highest proportion of economic growth stemmed from the (HS) sectors, and the employment share in these branches obviously increased, but in the (LS) sectors it decreased in the EU member countries as well.

The second objective was to examine the relationship between physical capital, employment and productivity growth. The impact of the lagged output per capita resulted in a positive and significant z-statistics, which implies the existence of convergence among the leader and follower countries. Thus, the speed of convergence depends on the labour intensity of each sector. My results also show that according to the neoclassical growth theories, an increase in the share of investment within output acts pro-cyclically and has a positive effect on productivity growth. Moreover, my dynamic panel regression model yields a valid negative relationship between labour and productivity growth in both of the sectors. All in all, I found that the high-skill (HS) intensive branches might affect productivity growth least of all.

As a consequence, I consider the following government policy suggestion for policy makers from my model representation. Given that mainstream macro policies aim to promote stable long run economic growth, it is recommend assisting the high-skilled employment branches if this affects the basic economic demand structure. In particular, my analysis suggests that policy makers must try to increase the degree of competition in labour markets; i.e. by motivating skilled workers to learn more for better productivity growth.

From this this perspective an additional research direction has emerged in this study. I argue that the human capital theoretical perspective is relevant since it extends the achievements and the existing frontiers of macroeconomic growth theories. Although, these approaches state that labour highly correlate with output growth in the long run, they also emphasize that human capital is one of the main resources of economic growth. However, my empirical findings could only demonstrate the negative impact of employment on productivity growth, since there is currently no unambiguous evidence to identify the valid relationship between these economic determinants in different labour-skilled sectors. Hence, further research in these diffusion approaches could be fruitful.

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