Human Capital and Economic Growth by Municipalities in Slovenia

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This article presents the analysis of the nature of economic growth of the Slovenian economy at the aggregate level and at the level of Slovenian municipalities for the period 1996–2002. The aggregate cross-sectoral time series dataset and the regional cross-sectional time series dataset are used to econometrically test the significance of labour reallocation between sectors and municipalities on the nature of economic growth of the Slovenian economy. For this purpose we compare estimates of average and marginal stochastic frontier production functions. The estimated parameters of these two groups of production functions clearly indicate an inefficient use of human capital in the Slovenian economy during the analysed period. The uncompleted process of sectoral labour reallocation is found as the main factor that has a negative impact on the growth of total factor productivity in the Slovenian economy.

Key Words: economic growth, sectoral reallocation of labour, total factor productivity, stochastic frontier model
JEL *Classification:* 015, 040

Introduction

Previous studies of the economic performance and growth of the Slovenian economy during the transition from a socialist to a market economy raise an interesting theoretical and empirical question regarding the role of human capital in these processes. Orazem and Vodopivec (1995) described winner and loser associations through prevalence of winners' returns to education and to a lesser extent to experience. Bojnec and Konings (1999) conducted an analysis on the magnitude and dynamics of job

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creation and job destruction at the micro-level using a sample of Slovenian firms and compared the results with some other transition countries. Bojnec et al. (2003) found that human capital plays a crucial role in the intersectoral labour mobility among agriculture, industry and services. Bojnec (2003) found that regional location with associated economic and human capital structures is an important factor that causes differences in the level of economic development by statistical regions in Slovenia. Novak (2004) found a significant contribution of human capital to the aggregate economic growth in Slovenia, but with a negative influence of human capital on the growth of total factor productivity.

In this article we present the analysis of the nature of economic growth of the Slovenian economy at the aggregate level and at the level of Slovenian municipalities for the period 1996–2002. The research was conducted on the basis of the aggregate cross-sectoral time series data. Additionally, we test the significance of labour reallocation on the nature of economic growth of the Slovenian economy using the regional cross-sectional time series data. The in-depth analysis at the municipality level was necessary to obtain a sufficient number of observations for testing statistical-significance of the parameters associated with labour reallocation.

For the period 1996–2002, each time series dataset offers only 7 observations. The disaggregated dataset offers observations for each analysed variable by 174 Slovenian municipalities. This provides an appropriate database for robust statistical estimations. The disaggregated dataset by municipalities enables us to investigate the characteristics of the economic growth in Slovenia during the second stage of transition. For this purpose we use the stochastic frontier production function and the average production function framework.

We draw the following conclusions: first, human capital brings an important contribution to the aggregate growth; second, the uncompleted process of sectoral labour reallocation is found as the main factor that limits the contribution of human capital to the growth of total factor productivity in the Slovenian economy; third, the comparison between the estimated parameters of the stochastic frontier production function and the average production function clearly indicates an inefficient use of human capital in the Slovenian economy.

The following section briefly introduces a theoretical background of the role of human capital in economic growth. We then present the methodology used for analysing the role of human capital to the nature of economic growth in Slovenia between the years 1996 and 2002. The final section concludes with the main findings.

Theoretical Background on the Role of Human Capital in Economic Growth

Human capital is defined as a factor of economic growth, which captures the abilities, skills and knowledge of workers (Romer 1994). It plays a dual role in the process of economic growth. First, it is a factor of production, and second, it is a source of innovation (Mincer, 1989, 1). The human capital literature is dichotomised between two basic frameworks: that of Becker (1964) and that of Lucas (1988). They emphasize human capital as an alternative source of sustained growth (similar to the technological progress). Second, there is Schumpeter's growth literature, which is based on the work of Nelson and Phelps (1966). This stream of literature highlights the importance of human capital stock (and not its accumulation) for economic growth.

Regardless of which theoretical framework is used, human capital can be regarded as a production factor and can be simply built into the model of economic growth. The most popular in empirical literature on human capital and economic growth in advanced market economies are growth regressions proposed by Barro and Sala-i-Martin (1995), empirical analysis conducted by Mankiw et al. (1992), and researches by Benhabin and Spiegel (1994). There exists also a body of literature and empirical analysis on the role of human capital in transition countries. Conventional wisdom holds that transition countries are well endowed with human capital, which is consistent with the main findings by Barro and Lee (2001). They emphasised that most human capital indicators are better placed in transition countries than in OECD countries, but on the contrary Boeri (2000) argued that the skills acquired in transition economies are over specialised, lowering labour force mobility across industries and consequently impeding economic progress.

The worker's mobility across industries plays a crucial role in former transition economies. The resource allocation during the old system was not based on market principles. Under different distortions and redistributions, the great majority of workers were employed in state-owned enterprises. When the transition process began, the market forces were allowed to determine the economic activity. With economic liberalisation and deregulation of economic activities structural adjustment policies were introduced that induced structural changes and adjustments.

Different capital structures have moved from less productive industries towards more productive ones. As we present further, labour force adjustments in Slovenia seem to be slow, thus reducing the speed of productivity growth. As long as a predominant proportion of workers are employed in less productive industries and not in more productive ones, the aggregate growth of productivity will stay below the level that hinders the economic development.

Since the productivity growth is a crucial factor of international competitiveness, the hypothesis that sectoral reallocation of labour force in transition economies is the key factor of progress and economic growth, is plausible. We limit our empirical analysis to the Slovenian economy.

Methodological Framework

For estimating the impact of labour force movements between industries the McCombie's (1980) methodological framework and, alternatively, the econometric estimation approach of elasticity coefficients are the most commonly used frameworks.

McCombie's Decomposition Method

McCombie (1980, 104–106) developed an original framework for quantifying the impact of sectoral reallocation of workers from low towards high productivity industries on the growth of total factor productivity. The starting point of McCombie's decomposition method is the calculation of the average labour productivity growth rate at the aggregate level:

$$\rho = \sqrt[T]{\frac{P_T}{P_0}} \tag{1}$$

where ρ denotes the growth rate coefficient of labour productivity, P_T denotes the aggregate level of labour productivity in the terminal year, P_0 denotes the aggregate level of labour productivity in the base year, while T denotes the terminal year.

The level of labour productivity at time t for the whole economy is calculated as:

$$P_t = \sum_{i=1}^{n} \left[\frac{Q_{i,t}}{E_{i,t}} \cdot \frac{E_{i,t}}{E_t} \right] = \sum_{i=t}^{n} [P_{i,t} \cdot a_{i,t}] \tag{2}$$

where P, Q, E are the levels of labour productivity, output and employment, i denotes the industry and a denotes the share of industry i's employment in total employment. From definition (2) it follows that the aggregate productivity depends on two different factors. First, on the industry's specific productivity of labour, and second, on the number of workers employed in each industry. Hence the growth of the employment-share in industries with a higher productivity level will raise the aggregate productivity, and vice versa will lower it in industries with a lower productivity level. The labour movement between industries is only one factor that influences the aggregate productivity. This impact, according to McCombie (1980), is described as the structural component. The impact of all other factors is described as the standardized component. The evaluation of these two components derives from expression (1). Taking the natural logarithm of (1) and considering (2) we get:

$$\ln(\rho) = \ln\left(\sqrt[T]{\frac{P_T}{P_0}}\right) = \frac{1}{T}\left[\ln\left(\sum_{i=1}^{n} P_{i,T}\cdot a_{i,T}\right) - \ln\left(\sum_{i=1}^{n} P_{i,0}\cdot a_{i,0}\right)\right]. \quad (3)$$

For estimating the standardized component of the aggregate productivity growth we extract from (3) the impact of the structural changes and introduce the assumption $a_{i,0} = a_{i,T}$:

$$\frac{1}{T}\left[\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,0}\right) - \ln\left(\sum_{1=i}^{n} P_{i,0}\cdot a_{i,0}\right)\right] = p^{*}, \quad (4)$$

where p^{*} denotes the standardized component of the aggregate labour productivity.

If we subtract the standardized component of the aggregate productivity (4) from the aggregate productivity (3), we obtain the structural component (5) as follows:

$$\frac{1}{T}\left[\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,T}\right) - \ln\left(\sum_{1=i}^{n} P_{i,0}\cdot a_{i,0}\right)\right] - \frac{1}{T}\left[\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,0}\right) - \ln\left(\sum_{1=i}^{n} P_{i,0}\cdot a_{i,0}\right)\right] =$$

$$\frac{1}{T}\left[\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,T}\right) - \ln\left(\sum_{1=i}^{n} P_{i,0}\cdot a_{i,0}\right) - \ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,0}\right) + \ln\left(\sum_{1=i}^{n} P_{i,0}\cdot a_{i,0}\right)\right] =$$

$$\frac{1}{T}\left[\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,T}\right)-\ln\left(\sum_{1=i}^{n} P_{i,T}\cdot a_{i,0}\right)\right]=p^{**}, \quad (5)$$

where p^{**} denotes the structural component of the aggregate productivity growth.

ECONOMETRIC FRAMEWORK

Within an econometric approach, the estimates of the elasticity model are commonly used for measuring the impact of structural adjustment processes on the growth of separate economic variables. More specifically, we are trying to quantify the extent of labour movements from less productive industries towards more productive ones and their impacts on the growth of aggregate productivity in order to investigate the magnitude of a 1% increase in these movements. Novak (2004) developed a convenient framework for conducting this kind of analysis. His framework contains three separate parts: first, the correlation analysis; second, the estimation of a logit model; and third, the estimation of the elasticity model.

The basic idea is to estimate the following model:

$$y_2 = f(x_3), \quad (6)$$

where y_2 denotes the contribution of the total factor productivity to the economic growth and x_3 the extent of sectoral reallocation of labour force towards productive industries. The variable x_3 is calculated as the difference between the share size of workers employed in productive industries in the terminal year and the share size of workers employed in productive industries in the base year (see next section). The greater and more positive this difference, the greater is the process of structural adjustment in the period between the terminal and the base year. The equation (6) can be specified as an ordinary elasticity model (7):

$$y_2 = \alpha_0 x_3^{\alpha_1}\exp(e)/^{\ln} \Rightarrow \ln(y_2) = \ln(\alpha_0) + \alpha_1\ln[x_3] + e, \quad (7)$$

or as the logit model (8):

$$L_r = \left(\frac{P(y_3 = 1|x_3)}{1 - P(y_3 = 1|x_3)}\right) = \beta_0 + \beta_1 x_3 + e. \quad (8)$$

Using the econometric framework, we are faced with a specific problem. We need a sufficient number of observations for dependent and explanatory variables. Namely, we acquire a combination of data on the contribution of total factor productivity to the growth using the estimates of production function and those of the growth accounting framework, which are further explained. But the time period 1996–2003 provides only 7 observations. Hence, the time series data are not appropriate even for the aggregate production function estimates.

The problem can be resolved by introducing another dimension in our analysis, i. e. the observation at the municipality level. If we combine the sectoral dimension (about 30 industries according to NACE classification) with the period of seven years, the panel data framework can be established to estimate production functions at the municipality level. This procedure can assure a sufficient number of observations for the dependent variable (the contribution of the total factor productivity to the economic growth) and the explanatory variable (the amount of sectoral reallocation of labour force towards more productive industries).

Data Used

We employ the proposed econometric framework as well as McCombie's framework. The methodological details and belonging empirical estimates are discussed in the following section.

Within the econometric framework we use a three-stage procedure. First, we estimate production functions at the level of municipalities. Real value added expressed in 1996 constant prices is used as the dependent variable, while the producer price index (*PPI*) acts as a deflator, where $PPI_{1996} = 100$. As the first explanatory variable we use the variable of the effective labour force that was calculated according to Barro in Lee's (1994) methodological framework:

$$x_1 = HKI \cdot L, \text{ where} \tag{9}$$

$$HKI = \sum_{j=1}^{k} W_j \cdot K_j. \tag{10}$$

where the symbols mean:

x_1 – variable that measures the amount of human capital expressed in terms of effective labour force used for production,

HKI – human capital index,

L – labour force expressed as number of employees,

w_j – coefficient of relative real wage for j-th level of acquired education,

K_j – share of employed people (labour force) with j-th level of acquired education.

As the second explanatory variable we use the amount of capital as a production factor. This variable is expressed in terms of tangible fixed assets, and is also expressed in 1996 constant prices.

At the second stage we estimate the contribution of each separate production factor (physical capital, human capital and total factor productivity) to past growth.

At the third stage we estimate the elasticity model and logit model. In the case of the elasticity model the dependent variable measures the contribution of total factor productivity to economic growth (we have 147 estimates on this variable since we provide estimates of the production function for 147 municipalities). The explanatory variable measures the amount of sectoral reallocation of labour force from less productive industries towards more productive ones and was calculated as follows:

$$x_3 = \Omega_{2002} - \Omega_{1996}, \text{ where} \tag{11}$$

$$\Omega_{1996} = \frac{LP_{1996}}{LD_{1996}} \text{ and} \tag{12}$$

$$\Omega_{2002} = \frac{LP_{2002}}{LD_{2002}}. \tag{13}$$

Symbols:

x^{3} – variable that measures the sectoral labour reallocation expressed as the change in the share of labour force employed in the propulsive industries with respect to labour force employed in the digressive industries,

Ω_{2002} – variable that measures the share of labour force employed in the propulsive industries with respect to labour force employed in the digressive industries in the year 2002,

Ω_{1996} – variable that measures the share of labour force employed in the propulsive industries with respect to labour force employed in the digressive industries in the year 1996,

LP_{1996} – variable that measures labour force employed in the propulsive industries in the year 1996,

LD_{1996} – variable that measures labour force employed in the digressive industries in the year 1996,

LP_{2002} – variable that measures labour force employed in the digressive industries in the year 2002,

LD_{1996} – variable that measures labour force employed in the propulsive industries in the year 2002.

For estimating the logit model we take the same explanatory variable as in the case of the ordinary elasticity model, while the dependent variable takes value 1 if the contribution of total factor productivity to economic growth was more than 50% and 0 if it was less than 50%.

All needed data for conducting the empirical estimates were acquired from the Statistical Office of the Republic of Slovenia.

Empirical Framework

ESTIMATION OF AVERAGE AND STOCHASTIC FRONTIER PRODUCTION FUNCTIONS

The role of human capital and the nature of economic growth are derived from the comparison of the estimated production function coefficients, particularly the elasticity of output pertaining to human capital. However, there exist two different production function frameworks, which are used for economic analysis: first, the average production function framework and second, the marginal stochastic frontier production function framework. The advantage of the stochastic frontier model is that it considers inefficiency and random disturbances and can therefore explain why production at a certain moment in time is not at the technological frontier. On the other hand, the average production function approach assumes that production is at the technological frontier. Hence, this approach does not distinguish between technological progress and efficiency gains to explain why total factor productivity is changing. This difference can be used for detecting possible inefficiency in production. Namely, if there exists a large difference between estimated coefficients of the stochastic frontier production function and aggregate production function, this means that production factors are not used efficiently. To answer this question we estimate the aggregate production function as defined in equation (9). First, we estimate it as the average production function using the convenient ordinary least square (OLS) estimator for panel data. Second, we estimate the same model as the marginal stochastic frontier production function.

$$y = \left[\left(\beta_0 x_1^{\beta_1} x_2^{\beta_2}\right) \exp(\varepsilon)\right]. \tag{14}$$

where the symbols mean:

y – variable that measures the amount of produced output,

β_0 – constant term that expresses the level of total factor productivity,

x_1 – variable that measures the amount of used production factor human capital,

β_1 – coefficient of elasticity,
x_2 – variable that measures the amount of used production factor physical capital,
β_2 – coefficient of elasticity,
ε – error term.

The stochastic production frontier models were first introduced by Aigner et al. (1977) and Meeusen and van den Broeck (1977). The nature of the stochastic frontier production function can be best derived from the average production function model (such as in equation 14) that is appropriate only for economies without inefficiency. A fundamental element of the stochastic frontier production function is that an economy produces less than it might due to inefficiency. The production function that considers this standpoint is specified as follows:

$$y = \left[\left(\beta_0 x_1^{\beta_1} x_2^{\beta_2}\right)\exp(\varepsilon)\right]\delta, \tag{15}$$

where the symbols mean:
y – variable that measures the amount of produced output,
β_0 – constant term that expresses the level of total factor productivity,
x_1 – variable that measures the amount of used production factor human capital,
β_1 – coefficient of elasticity,
x_2 – variable that measures the amount of used production factor physical capital,
β_2 – coefficient of elasticity,
ε – error term.
δ – term of technical inefficiency.

The value for δ must be in an interval $(0, 1]$. If $\delta = 1$, then the economy is achieving the maximum output with the technology embodied in the production function (see equation (15)). Since output is assumed to be strictly positive, the degree of technical efficiency is also assumed to be strictly positive.

Taking the natural logarithms of equation (15) and defining we get:

$$\ln(y) = [\ln(\beta_0) + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + \varepsilon] - u. \tag{16}$$

Note: Definitions of symbols are reported in equation (15).

Since u is subtracted from $\ln(y)$ the restriction $0 < \delta \leq 1$ implies that $u \geq 0$. For estimating the parameters of the stochastic frontier production model (and also the average production function with the OLS estimator) the statistical package Stata 8 is used in calculations that provide

TABLE 1 Econometric estimates of aggregate average and aggregate marginal stochastic frontier production functions

	(1)	(2)	(3)
ε_{y_1,x_1}	0.507	0.321	0.662
ε_{y_1,x_2}	0.312	0.501	0.149
β_0	3.876	4.232	2.661
$\varepsilon_{y_1,x_1} + \varepsilon_{y_1,x_2}$	0.819	0.822	0.811

Note: Column headings as follows: (1) aggregate average production function, (2) aggregate marginal stochastic frontier production function, (3) aggregate average production function.

ε_{y_1,x_1} – coefficient of elasticity of output pertaining to human capital,
ε_{y_1,x_2} – coefficient of elasticity of output pertaining to physical capital,
β_0 – constant term.

Source: Novak 2003.

a Maximum-likelihood estimator for a time-invariant, time-varying decay stochastic frontier production function model, and for a truncated-normal random variable $u \overset{\text{iid}}{\sim} N^+(\mu, \sigma_\mu^2)$.

The estimates are presented in table 1. The first column shows estimates of the average production function using the OLS estimator while the second column gives estimates of the marginal stochastic frontier production function using the Maximum-likelihood estimator for the time invariant model.

The comparison of results of the estimated average and stochastic frontier production function does not indicate any large differences. We could make an assertion that persistent differences are due to different estimators used. But of special interest are ratios of estimated parameters. In the average production function, the estimated parameters pertaining to human capital are in both cases higher than the estimated parameters pertaining to physical capital. Yet, the estimated parameters of the marginal stochastic frontier aggregate production function exhibit opposite values. The estimated parameter pertaining to physical capital is greater than the estimated parameter pertaining to human capital.

The differences detected between the two estimates are quite important from an economic point of view. We are faced with two different measures of economic policy, the objective of which is to achieve a faster economic growth. If our starting points are estimates of the average production function we will support the growth of human capital. The increase of human capital by 1% is associated with the increase of output by

0.507%, whereby the increase of physical capital by 1% is associated with the increase of output by only 0.312%. But if our starting points are estimates of the aggregate stochastic frontier production function the advice for policy makers will be the opposite. In this case the increase of physical capital will be more appropriate as it would produce a higher economic growth. The increase of physical capital by 1% is associated with the increase of output by 0.501%, whereby the increase of human capital by 1% is associated with the increase of output by only 0.321%. An interesting feature of the results is also decreasing returns to scale in both production function models (in the average and in the marginal stochastic frontier).

This swap of estimated coefficients that is conditional on the selected framework of the production function suggests an inefficient use of one or both production factors. Foundations for this statement arise from the methodological features of the marginal stochastic frontier model compared with the average production function. As we have highlighted, there is no distinction between technological progress and technical efficiency within the average production function framework. It is assumed that production factors are used efficiently. As we know, this is not the case within the framework of the stochastic frontier production function that permits also inefficiency.

The existence of inefficiency is demonstrated by the distance of the actual production from the production frontier. The increasing inefficiency reduces the value of the estimated elasticity coefficients of output pertaining to the production factor that is used inefficiently. In our case the highest value of the coefficient of elasticity of human capital is significant in the average production function framework that postulates its efficient use. This coefficient is lower than is the relevant coefficient of elasticity, which is estimated within the stochastic frontier framework suggesting the existence of inefficiency. Therefore, we confirm that human capital is the production factor that is used inefficiently in the Slovenian economy. We therefore conduct the growth accounting analytical framework, which is based on the estimated parameters of the average aggregate production function and the stochastic frontier aggregate production function. Results are summarised in table 2.

As we can see from the results, the contribution of physical capital to economic growth (approximately 56%) remains constant regardless of the production function framework used. This is obviously not the case for the contribution of human capital to economic growth, which is significantly lower than within the stochastic frontier framework. This

TABLE 2 Estimates of growth accounting model

	(1)	(2)	(3)
δ	25.27	25.52	28.87
γ	56.67	56.72	56.04
y_2	18.06	19.76	15.09

Note: Column headings as follows: (1) aggregate average production function, (2) aggregate average production function, (3) aggregate average production function.

δ – contribution of human capital to economic growth in %,
γ – contribution of physical capital to economic growth in %,
y_2 – contribution of total factor productivity to economic growth in %.

Source: Novak 2003.

indicates that there exists a potential for a more efficient use of human capital that can increase its contribution to economic growth.

Structural and Standardised Component of Aggregate Productivity Growth

From the comparison of the estimated parameters of the average and the stochastic frontier production functions, and the related results from the growth accounting equations we can conclude that during the period 1996–2002 human capital (as a production factor) was used inefficiently. That was the main reason for the decreasing returns to scale at the aggregate level.

This fact raises a question about the main reasons leading to the inefficient use of human capital in the Slovenian economy. Some results from our earlier analysis (Novak 2003) indicated that this could be related to the uncompleted process of sectoral labour reallocation towards more propulsive industries with a greater labour productivity in terms of value-added per employee. As we found, one of the key characteristics of structural adjustments that occurred in the Slovenian economy between the years 1996 and 2002 was only a marginal change in the labour reallocation from less productive industries (decreasing industries) towards more productive and propulsive ones. In 1996 about 61% of labour was employed in industries with an average productivity that was lower than the average productivity in the Slovenian economy as a whole. By 2002 this share fell to approximately 60%. The required deeper structural changes of labour reallocation and a sufficient adjustment were obviously not made during the analysed period.

McCombie (1991, 70–85) argued that the uncompleted process of sectoral reallocation of labour could negatively affect the growth of aggregate productivity, which is the main source of the intensive nature of economic growth. We follow his methodology to decompose the growth rate of aggregate productivity in the Slovenian economy during the period 1996–2002 into a structural component that measures the contribution of sectoral reallocation of labour to the growth of aggregate productivity, and into the standardised component that measures the contribution of other factors to the growth of aggregate productivity using the following fundamental equation (McCombie 1991, 74):

$$p = \left(\frac{1}{T}\right) \cdot \left\{ \left[\ln\left(\sum_i P_{i,T} \cdot a_{i,0}\right) - \ln\left(\sum_i P_{i,0} \cdot a_{i,0}\right) \right] + \left[\ln\left(\sum_i P_{i,T} \cdot a_{i,T}\right) - \ln\left(\sum_i P_{i,T} \cdot a_{i,0}\right) \right] \right\}. \quad (17)$$

The standardised growth component is defined as the aggregate productivity growth that would have occurred if all sectors had experienced the same growth rate of employment, i. e. if their employment had grown at the same rate as that of the total employment. This standardised component is expressed in the first square brackets. The structural component of the aggregate productivity growth is caused by the labour reallocation from less productive industries towards more propulsive ones, which is leading to changes in the sectoral structure of employment in the national economy.

According to NACE propulsive sectors, i. e. industries with labour productivity that is greater than the average labour productivity in the whole economy, are: CA Mining and quarrying of energy materials, CB Mining and quarrying of non energy materials, DE Manufacturing of paper, publishing and printing, DG Manufacturing of chemicals products and man-made fibres, E Electricity, gas and water supply, I Transport, storage and communication, J Financial intermediation, K Real estate, renting and business activities, L Public administration and defence, M Education, N Health and social work, and O Other social and personal services. Note that the results can be biased to government policies and associated policy transfers that had been in place at a time prior to Slovenia's accession to the European Union (EU).

Digressive (or declining, lagging behind) industries are those experiencing a labour productivity which is lower than the average productivity of the whole economy.

TABLE 3 Calculation of the standardized and structural components of the aggregate productivity growth in the Slovenian economy between the years 1996 and 2002

$\ln \sum_i P_{i,T} \cdot a_{i,0}$	$\ln \sum_i P_{i,0} \cdot a_{i,0}$	$\ln \sum_i P_{i,T} \cdot a_{i,T}$	T
8.12595	7.44173	8.10703	7

Data needed for calculating the standardized and structural components of the aggregate productivity growth in the Slovenian economy are summarised in table 3.

The first column shows the natural log of aggregate productivity in 2002 (terminal year) under the assumption that the sectoral structure of labour is the same as in 1996 (base year); the second column gives the natural log of aggregate productivity in the base year, while the third column shows the natural log of aggregate productivity in the terminal year. The last column represents the value of the terminal year. Using these data we calculate the structural and standardized components of the aggregate productivity growth as follows:

$$p = p^{st} + p^{s} \tag{18}$$

$$= \frac{1}{T} \cdot \left[\ln\left(\sum_i P_{i,T} \cdot a_{i,0} \right) - \ln\left(\sum_i P_{i,0} \cdot a_{i,0} \right) \right]$$

$$+ \frac{1}{T} \cdot \left[\ln\left(\sum_i P_{i,T} \cdot a_{i,T} \right) - \ln\left(\sum_i P_{i,T} \cdot a_{i,0} \right) \right] \tag{19}$$

$$= \frac{1}{7} \cdot [8.12595 - 7.44173] + \frac{1}{7}[8.10703 - 8.12595]$$

$$= 1.09971,$$

where the symbols mean:

p^{st} – the structural component of the aggregate productivity growth,
p^{s} – the standardised component of the aggregate productivity growth.
Source: Own calculations.

The results support our hypothesis on the deterioration in the sectoral structure of labour in the Slovenian economy during the period 1996–2002. This is revealed in particular by the negative contribution of the structural change of labour to the aggregate factor productivity growth.

On the basis of the empirical results of the estimated average and stochastic frontier production functions, extended by the growth accounting framework and the standardised and structural component of the aggregate productivity growth, we can now explain the nature and causes of the economic growth of the Slovenian economy between the years 1996 and 2002. Extensive economic growth was characterised by decreasing returns to scale, which caused an inefficient use of human capital. The main reason for this inefficient use was the uncompleted process of sectoral labour reallocations. We can clearly confirm that the labour force with the embodied technological knowledge (i. e. human capital) remains inefficiently allocated across industries.

Impact of Sectoral Labour Reallocation on the Nature of Economic Growth

We finally discuss the significance of the impact of sectoral labour reallocation on the nature of economic growth. For conducting this test we need a sufficient number of observations for the variable expressing the nature of economic growth and for the variable expressing labour reallocation towards propulsive industries. For satisfying this criterion we extended our empirical analysis from the cross-sectoral time series analysis to the regional cross-sectoral time series analysis. Hence we estimated the stochastic frontier production functions together with the related growth accounting equations for 147 Slovenian municipalities. On this basis we calculated a coefficient of the sectoral labour reallocation for each Slovenian municipality.

Our objective is to explain the nature of the Slovenian economic growth during the analysed period. We are trying to find out if there exists any significant impact of labour reallocation across industries on the extensive nature of economic growth in the Slovenian economy. We use estimates of the correlation coefficient, the coefficient of elasticity, and odds ratios from the logit model. The theoretical specifications used in the empirical investigation are presented below.

Coefficient of correlation

$$r = \frac{\sum[(x_3 - \bar{x}_3)(y_2 - \bar{y}_2)]}{(n-1)\sigma_{x_3}\sigma_{y_2}} \tag{20}$$

Elasticity model

$$y_2 = \alpha_0 x_3^{\alpha_1} \exp(e)/^{\ln} \Rightarrow \ln(y_2) = \ln(\alpha_0) + \alpha_1 \ln[x_3] + e \tag{21}$$

Logit model

$$L_r = \left(\frac{P(y_3 = 1|x_3)}{1 - P(y_3 = 1|x_3)}\right) = \beta_0 + \beta_1 x_3 + e \tag{22}$$

TABLE 4 Theoretical specifications of the coefficient of correlation, elasticity model and logit model

Coefficient of correlation	$r = 0.45$
Coefficient of elasticity	$\alpha_1 = 0.54$ [$p = 0.0000$]
Odds ratio	$\vartheta = 2.287$

Source: Own calculations.

Symbols:
r – coefficient of correlation,
x_3 – variable that measures the sectoral reallocation of labour,
$\bar{x}_3$ – average value of the variable x_3,
y_2 – variable that measures the nature of economic growth in terms of the contribution of the total factor productivity to economic growth,
$\bar{y}_2$ – average value of the variable y_2,
n – number of observations,
σ_{x_3} – standard deviation for variable x_3,
σ_{y_2} – standard deviation for variable y_2,
α_0 – regression constant,
α_1 – coefficient of elasticity,
e – error term,
L – logit (logarithm of odds ratio),
y_3 – binary dependent variable with value 1 if the nature of the observed municipality's economic growth was intensive (i. e. the contribution of total factor productivity exceeded 50%) or value 0 if the nature of economic growth of the selected municipality was extensive (i. e. the contribution of physical and human capital to economic growth together exceeded 50%),
P – probability that the nature of economic growth is intensive.

The estimates of the correlation coefficient, the coefficient of elasticity, the logit and odds ratio are reported in table 4.

The coefficient of correlation indicates the medium linear relationship between the contribution of total factor productivity and labour reallocation towards propulsive industries (both variables are expressed in natural logarithms). The high statistically significant coefficient of elasticity indicates that the percentage increase of labour reallocation towards propulsive industries induces an increase of the contribution of total factor productivity by 0.542% (a relatively substantial influence). Statistically significant is also the estimated parameter of the logit model. The odds ratio indicates the increase of the odds intensive growth by 2.287 times if the share of the labour force employed in propulsive industries compared to the share of the labour force employed in the digressive industries rises by one percentage point.

Conclusions and Policy Implications

During transition to a market economy and the process of Slovenian adjustments to EU membership, the majority of the Slovenian economic growth was determined by an extensive growth of labour and capital. We have more specifically analysed the nature of economic growth in the Slovenian economy in the period 1996–2002 in order to determine the reasons for decreasing returns to scale. We have applied the average production function and the stochastic frontier production function and estimated the parameters of the municipality production functions on the basis of cross-sectional and time series data. Using these pooled econometric approaches and the results obtained we developed growth accounting equations for 147 Slovenian municipalities and thus estimated the contributions of each particular production factor (physical capital, human capital and total factor productivity) to the municipality output growth. We have analysed the main factors that are important for the economic growth and development of municipalities. The in-depth econometric analysis at the municipality level was also necessary to obtain a sufficient number of observations for testing statistical significance of the parameters associated with labour reallocation.

We have econometrically tested the significance of the labour reallocation process to the nature of economic growth in the Slovenian economy using the municipality cross-sectional time series data. We found that the main reason for decreasing returns to scale in the Slovenian economy in the period 1996–2002 was an inefficient use of human capital in the production process. One of the main constraints responsible for this inefficiency was the uncompleted structural labour reallocation from decreasing industries towards more propulsive ones. Empirical results of the coefficient of correlation, the coefficient of elasticity and the odds ratio of the estimated logit model clearly indicate that the reallocation of labour towards propulsive industries has statistically significantly influenced the rise of total factor productivity. The labour force with the embodied technological knowledge (i. e. human capital) remains inefficiently allocated across industries.

It is obvious that the uncompleted process of sectoral reallocation of the labour force impedes the growth of total factor productivity. Hence, to accelerate the economic growth those measures of economic policy should be pursued that would accelerate the process of sectoral reallocation of labour from low productive industries towards high productive ones. Following the classical economic theory, differences in relative wages between industries should be the appropriate force to provide incentives for labour transfer from less productive industries (with lower wages) towards more productive ones (with higher wages). This is an issue for future research, which is also concerned with some other factors. First, it should be emphasized that the migration between industries is more likely to be concerned with the expected earnings over the working life than with current wage differences. Second, migration of a worker from one industry to another can be connected with the regional migration that raises the costs of migration. If expected costs exceeded the expected benefits from higher wage, the labour reallocation would be hindered and less likely to occur.

Structural changes in the economy are a constituent part of the economic growth process, where labour movements across industries aim to maximize lifetime incomes over the expected costs of movements.

The decision to migrate is likely to depend on an individual's confidence in own abilities to respond to changes in the labour market. This can depend on the number of different factors that are inherent to each individual worker. The level of acquired education with embodied human, social and some other pertaining capitals are variables that express the worker's confirmation and ability to move subject to the lifetime income maximization. Additionally, there is the nature and the level of acquired education. Overly specialized skills may impede an individual from finding a job in other industries or may require additional efforts and investments. He/she can improve his/her abilities and competitiveness in the labour market by participating in lifelong learning which is becoming a common practice today. While in the short run economic policy measures seem to persuade the worker to change the industry and also migrate into another region, on the long run the education policy is the key factor that improves knowledge and skills allowing each individual to respond quickly to structural changes. Successful reallocation of labour among industries as well as among regions is closely connected with the individual's skills acquired during the period of active education and permanent formal and informal lifelong learning.

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