
인적자원이 지역경제성장에 미치는 효과: 미국 카운티 데이터를 이용한 실증연구

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Effects of Human Capital on Regional Growth: Evidence from US County Data

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요약 본 논문에서는 인적자원과 노동시장환경이 경제성장과정에 있어서의 역할을 실증 분석하고자 하였다. 이를 위해 미국의 50개 주 전역의 3062개 카운티의 데이터를 활용하였다. 먼저, 실증분석 결과는 카운티들 간의 소득수렴을 보여주었다, 둘째, 인적자원은 경제성장 제고효과가 있는 반면, 교육지출은 경제성장을 저해하는 것으로 나타났다. 셋째, 실업률은 지역경제성장과 부정적인 상관관계가 있는 반면, 순이주율은 이와 반대로 긍정적인 관계가 있는 것을 밝혀졌다. 마지막으로 전체샘플 카운티들을 저소득 그룹과 고소득 그룹으로 양분된 뒤에도 위와 같은 주요 실증분석 결과는 대부분의 경우에서 변함없이 통계적으로 실효성이 있는 것으로 나타났다.

주제어 : 인적자원, 교육, 지역, 경제성장, 실업, 이주

Abstract The purpose of the paper is to empirically investigate the role of human capital and labour market conditions in the growth process. To do so, cross-sectional data for 3062 counties across 50 states of the US. Firstly, findings from the empirical estimation suggest income convergence among US counties. Secondly, the stock of human capital appears to have the growth enhancing effect while education expenditures turn out to retard economic growth. Thirdly, it is found that the unemployment rate would have a negative association with regional growth whereas the net migration rate is likely to have a positive relationship with growth. Once the sample counties are divided into both the poor group and the rich group, finally, such main empirical results overall remain unchanged and statistically significant.

Key Words : human capital, education, regions, economic growth, unemployment, migration

1. Introduction

A vast number of growth studies have attempted to develop theoretical frameworks to explain the economic growth process and empirically seek supportive evidence of their theoretical predictions, such as various determinants of economic growth and the hypothesis of income convergence among countries or regions. On the one hand, one of main strands of the

growth literature focuses on identifying main engines of economic growth which were called absorptive capacity for economic development in the earlier literature. Main deriving forces of growth that have been identified include the stock of physical capital, savings, human capital accumulation, population growth, R&D activities, international trade, government expenditures, social infrastructure, and so forth.[14][21]

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Received: January 31, 2013, Revised: February 14, 2013, Accepted: February 20, 2013

*This work is supported by the Academic Research Fund(Special Research Project) of Research Institute of Business and Economics, Cheongju University for the period of 2011-2013.

On the other hand, the inspiring study by Barro reignites the debate on income convergence by emphasising the importance of understanding the concept of convergence and provide empirical evidence of convergence between poor countries and rich countries.[4] The early empirical growth studies tend to utilise national level data for the cross-country analysis and then began to pay the attention to regional growth and convergence among sub-national economies in the US and the EU.

However, most previous studies on regional growth of the US focus on main cities and large-scaled regions such as states and regional divisions rather than local sub-state regions. There would be several different reference regions for Americans in their economic decision-makings, such as the (federal) US, state, and local counties. For instance, individuals' economic behaviours would be affected by various social and economic conditions, taxation and public services at different levels of sub-federal jurisdictions such as state and county levels.[12][22] Among many others, a series of growth studies by Barro and Sala-i-Martin report empirical evidence of income convergence among states of the US.[5][17]

By contrast, a relatively large number of studies not only analyse growth patterns of EU member states but also pay a close attention to EU regions at sub-state levels.[5][17][9] In particular, EU sub-state regions used in Barro and Sala-i-Martin are commonly considered the appropriate size of territory that is comparable with US counties.[9] To the best of my knowledge, however, none of the regional growth studies has covered all counties across the US although there is a large body of the literature that investigate growth of county-level economies in one particular state or a set of states. Therefore, it would be appropriate to look for complementary evidence of determinants of economic growth that derives from sub-state data, namely, 3062 counties in 50 states of the US. Among many determinants of economic growth, the study focuses on highlighting the role of

human capital and labour market conditions in the growth process of US counties although regional convergence between these local economies is also examined.

In the rest of the paper, first, the following section surveys the growth literature that focuses on the variables of interest that are related to human capital and labour markets. Section 3 briefly describes county-level data of the US and estimation methods for the county growth analysis. Then, section 4 report empirical results for the main hypothesis that the county growth rate varies inversely with initial income and unemployment rates and positively with human capital, *ceteris paribus*. For the robustness test, the sample is split into two groups: one for poor counties and another for rich counties. Finally, main findings are summarized in Section 5.

2. Literature Survey

This section surveys the relevant literature in order to provide background information and clarify the research objectives. This brief survey discusses the literature of economic growth on the following issues: income convergence, the relationship between human capital and growth and the association between labour market conditions and growth.

2.1 Income Convergence

A classical study by Sollow addressed the concept of convergence between poor economies and rich economies in terms of per capita income more than half a century ago and since then, income convergence has been one of the hot issues discussed in the growth literature.[19] Due to diminishing marginal returns to capital, in the context of classical theory, poor economies with higher returns to capital would grow faster than rich economies.[6] There would be a consensus of empirical evidence of the presence of convergence between countries around the world,

between US states, and between EU states.[4][6][5]

For sub-state regions, in contrast, mixed results are reported from empirical studies as far as convergence is concerned. Among EU regions, for instance, some studies reveal convergence while others find non-convergence.[5][9] In the case of the US, even though there exist a few studies that use county-level data, the focus of these studies was not on regional growth of county economies.[14] In an Amos' study, for instance, county level data were used but only to measure the within-state inequality of county average income in order to analyse the relationship between growth, inequality in personal income and regional income at the state level.[3] In order to fill this gap in the literature, therefore, it would be appropriate to seek new evidence of convergence among counties across the US.

2.2 Human Capital

Traditional absorptive capacity for economic development and productivity growth includes human-capital based capacity alongside of physical capital based capacity.[13][19] In some cross-country growth analyses, the starting level of per capita real income alone appear to have no association with the growth rate of per capita real income, indicating that there is no unconditional convergence which accords with a Lucas' model that assumes constant returns to capital which includes human capital.[4][13] However, using school enrollment rates as proxies for human capital, the hypothesis of conditional convergence is confirmed for a given level of human capital. This implies that human capital plays a special role in the light of endogenous growth theory. In a Romer's model, human capital is the key input to the research sector, which generates the new products or ideas that underlie technological progress.[16] Thus, a follower country with more human capital tends to grow faster because it catches up more rapidly to the technological leader.

2.3 Labour Markets and Growth

In the recent growth literature, there is a development to model the relationship between growth and unemployment. A labour model is developed to introduce growth into an efficiency wage framework in an attempt to find causal links between growth and unemployment.[11] In the light of the labour turnover and efficiency-wage theory, workers are ready to quit or shirk whenever they realize that their wages are unsatisfactory due to a gap from other neighbouring firms' wages.[20] In this sense, an increase of wages in other firms systematically raises wages for a given firm and the firm is more likely to cut jobs. In another model, unemployment is shown to have a negative effect on growth by introducing unemployment into the Solow model.[10] Nevertheless, other theoretical studies provide an ambiguous prediction that the impact of unemployment on growth would possibly be either positive or negative.[8]

On the other hand, in the light of new growth theory, human capital is set to be the main source of knowledge accumulation. Productivity growth is propelled by knowledge spillover, workers' learning and R&D activities.[15][16] In this regard, the inflow of labour force from other regions would increase the stock of human capital and the rate of learning and in turn foster economic growth for the host regions. A stylized fact is well accepted that the volume of regional migration within the US is considerable, which is also found from the data used in this study.

3. Data and Empirical Methods

In this section, I endeavour to test for the empirical evidence of positive effects of human capital on regional growth using US county data. Before reporting the estimation results, I briefly describe the US county data and estimation methods used for the analysis.

3.1 Data

In this study, I use Regional Economic Information System, U.S. Bureau of Economic Analysis (REIS, BEA) and County and City Data Book 1988, U.S. Bureau of the Census (CCDB88, BOC) so that a set of cross-section data is constructed that includes almost all counties in the US. The data consist of 3062 counties in 50 states for the period of 1982–2006.¹⁾ The REIS data that are currently available cover the period of 1969–2011 for 3448 counties and cities while the CCDB88 data cover some particular years in early 1980s for 3137 counties in all the US states. In the sample, 3062 counties are included after 70 counties are dropped from REIS and 75 counties are dropped from CCDB88 due to the unavailability and mismatching of the data.

3.2 Estimation Methods for Growth

The estimation strategy utilized is to run Barro-type regressions of the average county growth rate to test the hypothesis that the growth rate varies inversely with initial income and positively with human capital, *ceteris paribus*. I employ this estimation model due to the limited data availability for some key variables, such as education attainment, unemployment rates and migration rates.²⁾

Two types of cross-sectional regression are used in order to see if estimated coefficients of interest are robust to alternative specifications. The benchmark regression method is the pooled ordinary least square (OLS) model without state dummies on the basis of the assumption of a common intercept for all counties in the US. In the alternative model, dummies for US states are added to the benchmark OLS regressions in order to capture all the state specific effects for the county economies in accordance with the studies of

Barro and Sala-i-Martin for the EU local regions.^{3)[5]} Since county variables are very likely correlated with the state effects, it would be appropriate to use the least squares dummy variables (LSDV).

Following the usual manner in growth regression models, the dependent variable is the average rate of county growth of real per capita GDP (hereafter, income) over the period between 1982 and 2006. The main specifications to test are as follows. Firstly, the coefficient on initial income is hypothesized to be negative, implying income convergence between counties. For this initial income variable, results of the estimation without state dummies would imply regional convergence between states while those with dummies suggest convergence within states. Secondly, the share of education expenditures in income and the rate of education attainment are included in the regressions to reflect the effect of the investment in human capital and the stock of human capital, respectively that are expected to be positive. Two additional labour-market variables are also added, such as the unemployment rate and the net (in)migration (hereafter, migration) rate. Coefficients for the unemployment rate is hypothesized to be negative, implying their inverse association with county growth.³⁾ The net migration rate is added to test if the US inter-county migration trends have contributed to county growth.

Finally, I divide the sample into two groups and test the hypotheses for the robustness check: one group for rich counties whose income exceeds the state average income and the other one for poor counties whose income is below the state income. The poor group consists of 2499 counties and the rich group comprises 563 counties.

1) The state of District of Columbia is excluded from the sample because it does not consist of any counties. The full lists of counties used or dropped and the detailed information on sources and definitions of data can be provided on request.

2) For instance, data on county unemployment rates and education attainment rates which cover all the sample counties are not available for the initial year 1982 and thus alternatively the closest available years 1986 and 1980 are used, respectively. The problem with data availability is a main reason why it is not convenient to use panel methods that thus are left for a future study.

3) These initial variables are predetermined, fixed before error terms are realized in regressions and thus can be treated as weakly exogenous as long as error terms are not serially correlated.

(Table 1) US County Growth Regressions

| Regressors | 1 | 2 | 3 | 4DM | 5DM | 6DM |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Per Capita Income 1982 (log) | -0.0138* (-14.6) | -0.0121* (-17.2) | -0.0164* (-17.5) | -0.0149* (-14.1) | -0.0105* (-12.1) | -0.0165* (-16.4) |
| Unemployment Rate 1986 | -0.0298* (-10.0) | -0.0330* (-11.6) | -0.0272* (-9.3) | -0.0154* (-4.04) | -0.0309* (-8.6) | -0.0153* (-4.4) |
| Rate of Schooling 12 or more years, 1980 | 0.0077* (6.1) | | 0.0106* (8.2) | 0.0234* (13.04) | | 0.0234* (13.2) |
| Government Education Expenditure, 1982 | | -0.0257* (-4.1) | -0.0333* (-4.9) | | -0.0186* (-2.4) | -0.0155* (-2.1) |
| Net Migration Rate 1980 | | | 0.0439* (5.3) | | | 0.0281* (3.4) |
| Constant/State Dummies | 0.1457* (16.8) | 0.1363* (19.8) | 0.1712* (19.7) | Yes | Yes | Yes |
| Adjusted R ² | 0.146 | 0.147 | 0.176 | 0.344 | 0.304 | 0.355 |
| D-W | 1.59 | 1.622 | 1.59 | 2.00 | 2.00 | 2.00 |
| F | 175.3 | 176.4 | 126.2 | .. | .. | .. |
| Included Obs | 3062 | 3053 | 2939 | 3062 | 3053 | 2939 |

4. Findings from US County Data

In this section, I report the results of growth regressions for US counties. This estimation analysis focuses on the effects on county growth of variables for human capital and labour market conditions in addition to the test of the catching-up effect of income among US counties. In Table 1, I report the regression results estimated with the whole sample and the first part presents the results from POLS regressions without state dummies while the second part is for those with state dummies. Table 2 presents the results of the growth estimation for the group of poor counties while Table 3 presents the results for the group of rich counties. The same tests made in Table 1 are replicated for the robustness test in Tables 2 and 3.⁴⁾ I will report heteroskedasticity robust estimators whenever necessary.⁵⁾

4.1 Regional Convergence

The coefficient for initial county income reflects income convergence that poor counties catch up with rich counties in terms of real per capita personal income. The coefficients of initial income presented on

the first row in Table 1 all are significantly negative at the 1 percent level. This result implies that an increase of US\$ 10,000 in the initial income from one county to another leads to a decrease in the growth rate of income by 0.7 to 0.87 percent points per annum.⁶⁾ Since there is a gap of about \$30,000 of real per capita income between the poorest county and the richest county in 1982, the annual growth rate for the initially poorest county would be 2 percent point higher than that for the richest county. Once state dummies are added, the magnitudes of estimated coefficients of initial income remain almost unchanged and statistically meaningful. The application of the Barro-type log-linear growth regressions would provide a bit more accurate speed of convergence but that does not seem to alter the basic findings of the pattern of convergence obtained here.

According to Tables 2 and 3, the speed of convergence among poor counties is observed to be faster than that for rich counties although coefficients on initial income estimated in regressions with state dummies for the rich group are not statistically significant, suggesting that there would be no convergence among rich counties within their

4) It should be noted that according to the results of Wald coefficient tests for both groups, the estimated coefficients for all variables do not significantly differ from those for the whole sample except for those mentioned here. This is not reported here.

5) The t statistics are obtained from White heteroskedasticity consistent standard errors & covariance estimation. Ordinary t statistics cannot be used in the case that the likelihood ratio statistics reject the null hypothesis of homoskedasticity at the 5 percent level. This is because the OLS estimators are no longer efficient although they are still unbiased and consistent. The t statistics are reported within parentheses beneath the coefficients and *Significant at 5% in all tables.

6) This is calculated by running regressions using actual values of initial real income instead of logged values. Unconditional county convergence seems slower (4.7%) compared to conditional convergence (7 to 8%).

〈Table 2〉 US County Growth Regressions: Poor Group

| Regressors | 1 | 2 | 3 | 4DM | 5DM | 6DM |
|---|---------------------|---------------------|---------------------|----------------------|---------------------|---------------------|
| Per Capita Income 1982 (log) | -0.0186* (-21.1) | -0.0158* (-23.4) | -0.0199* (-21.1) | -0.01951* (-19.8) | -0.0154* (-16.1) | -0.0203* (-19.1) |
| Unemployment Rate 1986 | -0.0302* (-11.1) | -0.0327* (-11.6) | -0.0284* (-10.0) | -0.0191* (-5.7) | -0.0296* (-8.4) | -0.0168* (-5.0) |
| Rate of Schooling 12 or more years, 1980 | 0.0079* (6.3) | | 0.0092* (7.0) | 0.0212* (11.6) | | 0.0205* (11.0) |
| Government Education Expenditure, 1982 | | -0.0085 (-1.5) | -0.0172* (-2.8) | | -0.0132 (-1.8) | -0.0097 (-1.4) |
| Net Migration Rate 1980 | | | 0.0284* (3.5) | | | 0.0313* (3.5) |
| Constant/State Dummies | 0.1919* (23.9) | 0.1698* (25.7) | 0.2046* (23.6) | Yes | Yes | Yes |
| Adjusted R ² | 0.231 | 0.216 | 0.243 | 0.373 | 0.330 | 0.380 |
| D-W | 1.63 | 1.65 | 1.62 | 1.98 | 1.97 | 1.98 |
| F | 251.7 | 229.9 | 154.3 | .. | .. | .. |
| Included Obs | 2499 | 2494 | 2393 | 2499 | 2494 | 2393 |

〈Table 3〉 US County Growth Regressions: Rich Group

| Regressors | 1 | 2 | 3 | 4DM | 5DM | 6DM |
|---|--------------------|--------------------|--------------------|-------------------|--------------------|--------------------|
| Per Capita Income 1982 (log) | -0.0073* (-2.3) | -0.0045* (-2.1) | -0.0121* (-4.8) | -0.0036 (-0.9) | -0.0027 (-0.7) | -0.0102* (-2.9) |
| Unemployment Rate 1986 | -0.0367* (-3.2) | -0.0427* (-4.7) | -0.0291* (-2.8) | 0.0003 (0.02) | -0.0373* (-3.4) | -0.0102 (-0.8) |
| Rate of Schooling 12 or more years, 1980 | 0.0148* (3.3) | | 0.0218* (5.3) | 0.0339* (6.5) | | 0.0299* (5.8) |
| Government Education Expenditure, 1982 | | -0.2326* (-8.1) | -0.2345* (-7.8) | | -0.1816* (-4.8) | -0.1644* (-4.2) |
| Net Migration Rate 1980 | | | 0.0417* (2.2) | | | 0.0117 (0.6) |
| Constant/State Dummies | 0.0793* (2.7) | 0.0716* (3.3) | 0.1306* (5.5) | Yes | Yes | Yes |
| Adjusted R ² | 0.06 | 0.20 | 0.250 | 0.460 | 0.458 | 0.501 |
| D-W | 1.44 | 1.58 | 1.24 | 2.27 | 2.47 | 1.99 |
| F | 12.9 | 47.63 | 37.4 | .. | .. | .. |
| Included Obs | 563 | 559 | 546 | 563 | 559 | 546 |

respective states. Despite this, the overall results are clearly evident for the presence of convergence among counties between states as well as within states across the US.

4.2 Effects of Education

Two human capital related variables included in the specifications, such as education attainments and education expenditures, are hypothesized to have a positive association with the growth rate for a given level of income. On the one hand, the rate of education attainments is considered as a typical proxy for the stock of human capital, measured here by the ratio of population at least having completed secondary education to total population of 25 year old and over. As expected, the third row of Table 1 presents estimated coefficients for the education attainment variable and they all appear to be positive and statistically significant at the 1% level. In Tables 2 and

3, the split of the sample into two groups does not alter the overall results for both groups compared with those from the full sample. This finding suggests that there exists the growth enhancing effect of the stock of human capital. On the other hand, I also add the share of education expenditures in income to see if investment in human capital has a positive influence on long-term economic growth. In contrast to the hypothesis, however, coefficients on education expenditures turn out to be negative and statistically significant in all specifications as presented on the fourth row of Table 1. Estimated coefficients for this variable reported in Tables 2 and 3 turn out to still be negative and statistically significant for the rich group while those for the poor group appear to be statistically not significant. Such contrasting results would possibly imply that spending on education may have not been efficiently spent and even have hindered economic growth of local economies, particularly in rich counties,

over the past three decades in the US.

4.3 Effects of Unemployment and Migration

In addition, I examine the effect of two labour-market variables, such as the rate of unemployment and the rate of net migration in total population as they would reflect the stock and flow of human capital. The second rows of Table 1 shows that unemployment is likely to have a negative association with economic growth, which is statistically significant in all specifications. According to Tables 2 and 3, the negative relationship of unemployment with growth remains almost unchanged for the poor group of counties whilst, for the rich group, this adverse effect turns out to be stronger but statistically fragile.

The final variable to consider is the net migration rate that may reflect the impact of an inflow of human capital. A change in net population for a given county is equal to birth less death plus this net migration.⁷⁾ In the fifth row of Table 1, the initial rate of net migration moving into a host county turns out to have a positive effect on county growth, which is statistically significant. Once the sample is divided into two groups, positive coefficients on net migration remain significant among poor counties but the size of these coefficients is smaller than that obtained with the whole sample. For rich counties, in comparison, this growth enhancing effect of net migration remains unchanged in terms of its magnitude but, once state dummies are added, this effect turns out to be insignificant. Similar to education attainment, the inclusion of this variable for internal migration within the US does not alter estimated effects of unemployment as well as those of human capital related variables.

5. Conclusion

The paper investigates the role of human capital and

labour market conditions in the growth process using a large set of cross-section data for all counties of the US. Main findings provide supportive evidence of income convergence among counties while county income convergence within states is only obtained from both the full sample and the group of poor counties. More importantly, the stock of human capital measured by education attainment appears to have a positive association with long-term economic growth and this growth-enhancing effect is observed to still be statistically significant for both poor and rich groups. In contrast, education expenditures turn out to impede economic growth and this negative effect of investment in human capital was not statistically significant among poor counties. Finally, unemployment rates are found to have a negative impact on income growth while the net migration rate turns out to have a positive association with economic growth of the US counties.

As far as discerned from the empirical evidence found from the two proxies for human capital, the contrasting results reported would have a potential bearing on policy makings in the field of regional development and cohesion at the county level. The stock of human capital plays a vital role in the growth process and thus governments possibly at all levels in the US may need to choose optimal policies for education development and job creation for the young and future generations.[1] A more sound governance system and administration innovation of local governments should take place in order to efficiently spend government expenditures on schooling and ultimately improve returns to education investment and productivity growth.[2]

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7) This number of observations drops when migration variables added to regressions because migration data are not available for about 100 counties.

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