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REGIONAL ANALYSIS OF IMPACT OF EMPLOYMENT ON INEQUALITY AND GROWTH IN INFORMATION AND TECHNOLOGY INTENSIVE SECTORS

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ABSTRACT

Purpose- The aim of this study is to analyse the impact of qualified labour force in information and technology intensive sectors both on inequality and growth at the regional level.

Methodology- The impact of employment in the knowledge and technology intensive sectors on regional growth and regional inequality is analysed with fixed effect model. Data range is between 2008 and 2015 at level 1 for Turkey

Findings- According to the results of the analysis, technology-oriented human capital is positively influencing growth. In addition, there is a positive correlation between public spending and employment rates and growth. There is no significant relationship between migration, import-export data and growth. In relation to human capital and inequality, human capital increases regional inequalities. But public expenditures reduce regional disparities. On the other hand there is no statistically significant relation between export and import data and regional inequality.

Conclusion- The results of the study show that qualified labour force in the information and technology intensive sectors increases both regional growth and regional inequality.

Keywords: Technology, human capital, qualified labour force, regional ınequality, regional growth.
JEL Codes: O33, J24, R11

1. INTRODUCTION

The influence of the human capital on the economy has become more and more important in recent years, albeit understood in the old centuries. The human capital emphasis that began with the adage of Alfred Marshall in 1890 that "the most valuable asset of the entire capital is investment in human capital" continued with Benjamin Franklin putting education investments at the forefront and deepened with Gary Becker's book that emphasized the importance of investment in education in 1964 (Bergheim, 2005: 6), and later on handled in a number of studies including Frank (1960), Arrow (1962), Nelson and Phelps (1966), and Mincer (1984).

In these studies, the role of human capital and technology on economic growth were emphasized until the 1980s, and technology and human capital were accepted as exogenous variables. In contrast to the classical growth theories, the endogenous growth theories developed since the 1980s have considered human capital and technology as endogenous

variables. Importance of human capital in economic growth was increased after Romer (1990) saw technological development as endogenous variable and Lucas (1988) put forward human capital in economic growth. And this emphasis put forth by many researchers including mainly by Romer (1986, 1990), Lucas (1993), Becker et al. (1990), and Barro (1992, 1998).

Human capital, which plays an important role in modern growth theories, is at the centre of the growth process at macroeconomic context, and plays a decisive role in income distribution by causing wage differentials at the microeconomic context. Human capital, which plays a key role in sustainable development, is seen not only being a cause in the economic growth process, but also as a consequence of the developments brought by economic growth (Mincer, 1996: 29). The impact of human capital on economic growth is explained by two channels in the context of relationship between human capital and economic growth.

The first is the direct effect of the human capital that allows technological development. According to the direct impact channel if there are no incentives to generate new ideas, innovative activities will not take place or will occur at a slow pace. In the second channel, human capital directly affects production. In this transmission channel, human capital increases production by physical capital function. Technological developments that have a positive effect on the qualified labour force bring about economic growth by increasing total factor productivity (Fedderke, 2005: 2).

When we look at the relationship between human capital and inequality, one of the most important factors in determining income inequalities is human capital (Mahmood and Noor, 2014: 40), and the most significant transmission channel of human capital on inequality is technological developments. In the early stages of technological development, inequality increases as several high-income persons monopolize technologically advanced sectors. In the process, inequality decreases with the increase in participation in technology-intensive sectors and the inclusion of more labour in technology (Barro, 1999: 9). The widespread and rising qualified labour force also brings innovation together, and this process cyclically increases the need for qualified labour force (Eicher and Penalosa; 2011: 174).

When human capital is analysed at the regional level, there are great differences in educational opportunities between rural and urban areas. In many countries, urban education standards are far above the educational standards in the rural areas (Spagat, 2002: 28). This brings human capital inequality between regions. Human capital inequality negatively affects the growth performance of countries by causing growth differences between regions.

In this study, the impact of the qualified labour force on growth and inequality is analysed at the regional level. The mutual relationship between these variables is examined separately because the human capital has different impacts on economic growth and inequality. The impact of the qualified labour force in the information and technology intensive sectors on growth and inequality is analysed by panel data econometrics. This study is based on the data at level 1 in the period of 2008-2015, and the variable of regional Gini is taken as the dependent variable in the relationship of human capital and inequality. And the dependent variable is the regional GDP variable per capita in the relationship of the human capital and growth.

2. LITERATURE REVIEW

Ojha et al. (2013) analysed the effect of human capital and technology on growth and inequality using the computable general equilibrium (cge) models in India in 2004-2030. According to the results of the study, physical capital is at the forefront in economic growth and income inequality in the short term while human capital plays a more effective role in the long term growth but increases the inequalities even more. In addition, the simultaneous use of physical and human capital, including technology, has a more widespread effect on growth.

Woźniak and Jabłoński (2012) studied the relationship between human capital, economic growth and inequality with the fixed effect regression model in OECD countries between 1994 and 2008; and found that there is a positive relationship between human capital and economic growth. On the other hand, in the study that groups social inequalities, they found that the impact of human capital on inequalities differs from group to group. Fleisher et al. (2010) analysed the relationship between human capital, technology, inequality and growth by the fixed effect method in the Chinese economy in 1983-2001. According to the study, human capital positively influences economic growth by increasing productivity per worker and total factor productivity. Another finding of the study is that human capital is an effective factor in reducing regional disparities.

Fleisher (2005) analysed the relationship between foreign direct investment, factor productivity, human capital and inequality using the least squares method in 1949-1989 in China. According to the results of the analysis, human capital positively affects the total factor productivity. In addition, technology is spreading from rich regions to poor regions, so that inequality tends to decrease. Galor and Tsiddon (1997) tested the relationship between technology, inequality, and economic growth in the US economy by Cohort analysis. According to the study, inequality increases in the early periods of technological development.

Technological developments stimulate technology and growth by increasing labour force mobility and via this process increase the quantity of labour force in technology intensive sectors. However, as technology becomes more accessible over time, mobility of human capital reduces and this process leads to a reduction of inequalities. On the other hand, this slows down the pace of technological development and negatively affects economic growth. In addition, decreasing of the density of human capital in technology-intensive sectors slows economic growth by reducing major technological breakthroughs. In addition to the studies addressing the relationship between human capital, growth and inequality, there are many studies that separately address the relationship between these variables.

When we look at studies analysing the human capital-growth relationship, human capital has positive impacts on economic growth in the studies by Ghulam et al.(2017, 12 Asian countries), Su and Liu (2016, China), Teixeira and Queirós (2016, mainly OECD and Central Europe and Mediterranean countries), Li and Wang (2016, China), Pelinescu (2015, EU countries), Mgadmi and Rachdi (2014, Tunisia), Banerjee and Roy (2014, India), Dias and Tebaldib (2012, 61 countries), Zhang and Zhuang (2011, China), Ding and Knight (2011, China), Cuaresma et al. (2009, Europe 255 regions), Digdowiseiso (2009, Indonesia), Kar and Ağır (2006, Turkey), Mingyong et al. (2006, China), Fuente and Doménech (2006, 21 OECD countries), and Perotti (1996, 67 countries). Čadil et al. (2014) have not found any impact of human capital on growth in their work on level 2 regions in EU countries.

When we look at studies that deal with the relation between human capital and inequality; human capital reduces inequality in the studies by Qin et al. (2016, China), Shahpari and Davoudi (2014, Iran), Jiang et al. (2011, China), and Digdowiseiso (2009, Indonesia). Human capital increases inequality in the studies by Rodríguez and Tselios (2009, 102 regions in the EU), and Checchi (2001, 113 countries).

3. METHODOLOGY

3.1. Data and Method

In this study, the impact of qualified labour force in the knowledge and technology intensive sectors on inequality and growth is analysed at the level 1 between 2008-2015 in Turkey by using panel data method. The analysis is categorized as Model 1 and Model 2. In Model 1, human capital-growth relationship is analysed, while in Model 2, human capital-inequality relation is analysed. In the analysis, fixed and random effects models are estimated first and Hausman test is used to determine which model to use. Eviews and Stata package programs are used in the analyses.

In model 1, GDP per capita is given in regional terms to represent growth as a dependent variable. As independent variables, qualified labour force in knowledge and technology intensive sectors, received and given internal migrations, export and import figures per capita, public investment expenditures as representative to public expenditure (total of expenditures of health, education, etc.) and employment data are used.

In Model 2, regional Gini data are used to express inequality as a dependent variable. As independent variables, the qualified labour force in the knowledge and technology intensive sectors, received and given internal migration, per capita export and import data, and public investment expenditures as representative to public expenditures (total of expenditures of health, education, etc.) are used.

In Model 1 and Model 2, two models are estimated as fixed effect model (FEM) and random effect model (REM) in panel data analysis and Hausman test is used to determine which model to use. According to Hausman test result, fixed effect model (FEM) is decided in Model 1 and Model 2. Relevant variables were obtained from TURKSTAT regional data and the Ministry of Development.

Model 1 and Model 2 for the variables used in the panel regression analysis are shown below.

Model 1: Model used to measure regional growth (FEM)

$$LGDP_{it} = \alpha_i + \beta_1 LMIGO_{it} + \beta_2 LMIGI_{it} + \beta_3 LHC_{it} + \beta_4 LGV_{it} + \beta_5 LEX_{it} + \beta_6 LIM_{it} + + \beta_7 EMP_{it} + u_{it}$$

$LGDP_{it}$ = regional growth
$LMIGO_{it}$ = receiving internal migration variable
$LMIGI_{it}$ = sending internal migration variable
LHC_{it} = qualified labour force variable in information and technology intensive sectors
LGV_{it} = public expenditures
LEX_{it} = export variable
LIM_{it} = import variable
EMP_{it} = employment rate

Model 2: Model used to measure regional inequality (FEM Model)

$$LGN_{it} = \alpha_i + \beta_1 LMIGI_{it} + \beta_2 LMIGO_{it} + \beta_3 LHC_{it} + \beta_4 LGV_{it} + \beta_5 LEX_{\mathrm{l}t} + \beta_6 LIM_{it} + u_{it}$$

LGN_{it} = $regional\ gini\ index$
$LMIGI_{it}$ = receiving internal migration variable
$LMIGO_{it}$= sending internal migration variable
LHC_{it} = qualified labor force variable in information and technology intensive sectors
LGV_{it} = public expenditures
LEX_{it} = export variable
LIM_{it} = import variable

Note: L in the model expresses the logarithm of the corresponding variable.

3.2. Descriptive Statistics

Descriptive statistics in model 1 and model 2 are included separately in the study. Table 1 shows descriptive statistics between qualified labour force and growth in information and technology intensive sectors, and Table 2 shows descriptive statistics on the relationship between qualified labour force and regional inequality in information and technology intensive sectors.

When Table 1 is examined, per capita GDP representing regional growth is the highest in Istanbul (2014) and the lowest in Southeast Anatolia (2008). Employment in the information and technology intensive sectors is highest in Istanbul (2014) and lowest in northeastern Anatolia (2008). The lowest internal immigration region is Northeast Anatolia (2008) and the highest internal immigration region is İstanbul (2015).

When we look at internal emigration rates, the least emigrant region is West Marmara (2008), while the region with the highest emigration is Istanbul (2014). Eastern Marmara (2008) is the region with the highest exports per capita and Istanbul (2009) is the region with the lowest exports per capita. While Istanbul (2013) is the first place in import per capita, Middle Eastern Anatolia (2008) is at the last place. Public investment expenditures are highest in Western Anatolia (2014) and lowest in Northeastern Anatolia (2009). The region with the highest employment is the Eastern Black Sea region (2008) and the region with the lowest employment is the Southeast Anatolia (2009) region.

Table 1: Model 1 Descriptive Statistics

	LNGDP	LNHC	LNINMIG	LNOUTMIG	LNEX	LNIMP	LNGOV	EMP
Mean	9.619879	5.728519	11.91097	11.96207	6.545079	6.364444	14.22372	45.22857
Median	9.607197	5.554697	11.87159	12.00802	6.544443	6.510989	14.20628	45.70000
Maximum	10.68384	7.345042	13.01799	12.95905	8.663715	9.228082	15.53330	57.60000
Minimum	8.784264	4.371976	10.95102	11.24443	4.290459	3.332205	12.79367	30.00000
Std. Dev.	0.439538	0.792021	0.485042	0.369222	1.094060	1.492715	0.591936	6.099290

Table 2 analyses the relationship between qualified labour force and regional inequality in information and technology intensive sectors. When Table 2 is examined, it is seen that the region with the highest inequality is the Mediterranean and the region with the lowest inequality is the East Marmara. The descriptive statistics of the other independent variables have the same values as in Model 1.

Table 2: Model 2 Descriptive Statistics

	LNGINI	LNINMIG	LNOUTMIGR	LNHC	LNGOV	LNEX	LNIMP
Mean	-1.003626	11.91097	11.96207	5.728519	14.22372	6.545079	6.364444
Median	-0.994252	11.87159	12.00802	5.554697	14.20628	6.544443	6.510989
Maximum	-0.835013	13.01799	12.95905	7.345042	15.53330	8.663715	9.228082
Minimum	-1.130164	10.95102	11.24443	4.371976	12.79367	4.290459	3.332205
Std. Dev.	0.061927	0.485042	0.369222	0.792021	0.591936	1.094060	1.492715

Table 3 shows the correlation matrix covering the relationship between human capital and regional growth. According to the table results, there is a positive relationship between growth and qualified labour force, migration rates, per capita imports, public expenditures and employment. There is a negative relationship between growth and exports.

Table 3: Model 1 Correlation Matrix

	LNGDP	LNHC	LNINMIGR	LNOUTMIG	LNEX	LNIMP	LNGOV	EMP
LNGDP	1							
LNHM	0.789295	1						
LNINMIGR	0.733364	0.954294	1					
LNOUTMIG	0.484362	0.788566	0.866036	1				
LNEX	-0.065680	-0.055069	-0.109167	-0.127229	1			
LNIMP	0.746514	0.915574	0.912088	0.738311	0.063709	1		
LNGOV	0.607006	0.711319	0.721074	0.730532	-0.055143	0.628302	1	
EMP	0.354149	-0.028766	-0.088272	-0.248665	0.047793	-0.093082	-0.103954	1

The correlation matrix analysing the relationship between human capital and regional inequality is given in Table 4. When Table 4 is examined, it is seen that there is a positive relationship between regional inequality and qualified labour force and migration. There is a negative relationship between regional inequality and immigration, public expenditure, and exports and imports.

Table 4: Model 2 Correlation Matrix

	LNGINI	LNINMIGR	LNOUTMIGR	LNHC	LNGOV	LNEX	LNIMP
LNGINI	1						
LNINMIGR	-0.069429	1					
LNOUTMIGR	0.060095	0.866036	1				
LNHM	0.006241	0.954294	0.788566	1			
LNGOV	-0.073589	0.721074	0.730532	0.711319	1		
LNEX	-0.212407	-0.109167	-0.127229	-0.055069	-0.055143	1	
LNIMP	-0.126541	0.912088	0.738311	0.915574	0.628302	0.063709	1

4. FINDINGS

Firstly, the Hausman test is used to determine which of the random effects or fixed effects models to use in the model. In the Hausman test to determine whether the model is a random effect model or a fixed effect model, hypotheses are:

H_0 = There are random effects

H_1 = No random effects

Table 5: Hausman Test Statistics Results

Test Result	Chi Square Statistics	Probability	Model to Use
Cross-Section Random Effects (Model 1)	37.32	0.00	Fixed effects model
Cross-Section Random Effects (Model 2)	41.19	0.00	Fixed effects model

In the Hausman test, when the probability values of Model 1 and Model 2 are examined, it is seen that p≤0.05. Accordingly, in both models, the H_0hypothesis is rejected at the 1% significance level and the result is that the fixed effect method should be used. After the model was determined, autocorrelation and heteroscedasticity problems were encountered in the tests performed to determine whether autocorrelation and heteroscedasticity existed in the series. After autocorrelation and heteroscedasticity removed from series the results are shown in Table 6 and Table 7.

Table 6: Model 1 Analysis Results

Variable	Coefficient	Standard error	t-statistics	Probability
LNHC	0.4430655	0.1613295	2.75	0.006
LNINMIG	0.1228272	0.1840213	0.67	0.504
LNOUTMIGR	0.0030185	0.1899093	0.02	0.987
LNEX	0.1070056	0.0700773	1.53	0.127
LNIMP	-0.0491092	0.0918441	-0.53	0.593
LNGOV	0.235461	0.0779742	3.02	0.003
EMP	0.020835	0.0082276	2.53	0.011

C	0.9033937	3.207856	0.28	0.778
observations	84			
Number of groups	12			
F-statistics (probability)	0.00			

Table 6, where the relationship between skilled labour force and growth is analysed, appears to have a total of 84 observations of 12 regions at level 1 bases. When the F-statistics results are examined, it is concluded that the probability value is equal to zero, i.e. the model is meaningful as a whole. When the model is analysed, a positive and statistically significant relationship is found between the qualified labour force and growth in information and technology intensive sectors at the level of 1%. In other words, technology-oriented human capital is positively influencing growth. In addition, there is a positive correlation between public spending and employment rates and growth at the level of 5% significance. There is no significant relationship between migration, import-export data and growth.

Table 7: Model 2 Analysis Results

Variable	Coefficient	Standard error	t-statistics	Probability
LNINMIGR	-0.0633959	0.0521249	-1.22	0.224
LOUTNMIGR	0.0923928	0.0487756	1.89	0.058
LNEX	-0.0079275	0.0099508	-0.80	0.426
LNIMP	-0.0245218	0.0222648	-1.10	0.271
LNHC	0.0666584	0.0383719	1.74	0.082
LNGOV	-0.0471579	0.0114543	-4.12	0.000
C	-0.8568686	0.5356984	-1.60	0.110
observations	84			
Number of groups	12			
F-statistics (probability)	0.00			

Table 7, where regional inequality and qualified labour force are analysed, shows that there are 84 observations belonging to 12 regions based on level 1. According to the results of the analysis, a statistically significant and positive relationship is found between the qualified labour force in the information and technology intensive sectors and regional inequality at the level of 10% significance. In other words, human capital increases regional inequalities. There is a positive relationship between emigration and regional inequality at the level of 10% significance, but no relation between immigration and inequality is found. On the other hand, there is no statistically significant relation between export and import data and regional inequality. Public expenditures are meaningful and negative on regional inequality at the level of 1% significance. In other words, public expenditures reduce regional disparities.

5. CONCLUSION

The effect of the human capital on economic growth and inequality is realized through two channels. The first of these is education and expenditure on education, which has a decisive role in human capital. Education increases the quality of the labour force and the qualified labour force leads to productivity increases. Increased productivity, on the one hand, increases the income inequality between qualified and unqualified labour force, on the other hand it plays a fast-moving role in economic growth. The second transmission channel is technological development. When human capital is evaluated from a technology perspective, the need for qualified labour force increases with technological development; the need for a qualified workforce is increasing wage inequalities in the first stages of technological development, where demand growth is more than supply growth. However, with the widespread use of technology, inequalities decline due to the supply increase in the qualified labour market. On the other hand, human capital increases by increasing of quality of the labour force. Increased human capital stock plays a crucial role in economic growth with increases in productivity and production.

In this study, the impact of qualified labour force in knowledge and technology intensive sectors on regional growth and regional inequality is analysed by panel data method within the scope of Level 1 regions (12 regions) in Turkey between 2008 and 2015. According to the results of the study in which the fixed effects model is used, the technology-focused human capital increases both economic growth and inequality. When the findings for the effect of technology-oriented human capital on regional inequality are examined, it is seen that the results are parallel to the literature due to the short term is taken as basis.

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