JENA ECONOMIC RESEARCH PAPERS

2016 – 013

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www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich Schiller University Jena, Germany. For editorial correspondence please contact markus.pasche@uni-jena.de.

Impressum:

Friedrich Schiller University Jena
Carl-Zeiss-Str. 3
D-07743 Jena
www.uni-jena.de

Human Capital, Social Capabilities and Economic Growth

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This version June 29, 2016

Abstract

In this paper we show that inconclusive results in previous empirical studies on human capital and growth might be due to omitted variable bias. Using data for about 130 countries, we show that after inclusion of variables related to the social capabilities concept of Abramovitz (1986) i.e. economic opportunities and quality of legal institutions, the human capital variable turns out to be significant. We also show that economic opportunities significantly moderate the relationship between human capital and growth. The results are robust to different variants of indices for economic opportunities and the quality of legal system.

Keywords: Human Capital, Economic Growth, Economic Opportunities, Social Capabilities

JEL classification: O15, O4

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1 Introduction

The relationship between human capital and growth has been repeatedly studied both empirically and theoretically since endogenous growth theory became popular (Arrow 1962; Romer 1986; Aghion and Howitt 1992; Benhabib and Spiegel 1994). While theoretical formulations of the relationship between human capital and growth clearly show the importance of knowledge embodied in humans for innovation, productivity and growth, empirical studies on the same relationship do not provide conclusive evidence. For instance, Benhabib and Spiegel (1994) shows that, in levels, human capital has positive relationship with per capita income while does not have significant impact on growth in changes. Similarly, Cohen and Soto (2007), show that levels of human capital have significant positive relationship with economic growth showing that specification of human capital variable matters for the analysis of human capital and growth. With the aim to find the reason behind the inconclusive results, some studies show that quality of education is important to consider (Hanushek and Kimko 2000), some show that specification of the model is the reason for inconclusiveness (Sunde and Vischer 2015) and some highlight the importance of factors such as inflation, health and opportunity costs of investments in the theoretical framework of human capital (Becker 1994). Becker's idea correspond to the "social capability" concept of Abramovitz (1986). Abramovitz emphasized the importance of social capabilities in the adoption and diffusion of technologies. He further argued that countries differ in social capabilities and the extent to which human capital contributes to economic growth will be at least partly dependent on that country's social capabilities. Social capabilities include factors like the quality of institutions, as reflected, for instance, in the quality of governance and factors that allow economic agents to utilize their potential. In other words, in order for technologically lagging countries to catch up with their leaders, they need not only human capital, but also well-functioning institutions (Olofsdotter 1998).

A related concept to social capabilities is the concept of human capabilities. In his seminal contribution, Sen (1983) argued that improvement in the quality of life of citizens should be the objective of economic policy, instead of focusing narrowly on increasing overall output. This approach suggests human and productive capabilities should be improved to facilitate human capital, and a higher level of human capital can only affect productivity if it is efficiently utilized by the economic system. It is therefore important to identify socio-economic and institutional indicators that can strengthen or weaken the relationship between human capital and growth.

From a methodological point of view, Sunde and Vischer (2015) show that traditional econometric models provide better results when initial level of human capital is included in the regressions. Sunde and Vischer (2015) interpret these findings as the need to include other channels through which human capital can affect economic growth in the specification. Despite being approached from dif-

ferent angles, a common point of the studies mentioned above is that traditional econometric models for human capital and growth relationship should include more channels through which human capital could affect economic growth.

Following the literature highlighted above, in this paper we re-examine the relationship between human capital and growth with the aim to shed some light on the reasons behind inconclusive findings in the literature. We use data for 132 countries for the period of 1996 to 2011, first to re-estimate the established results in the literature using cross-sectional methodology on our dataset; second, to test whether the results of cross-sectional studies hold when same econometric models are estimated using panel data method and finally to test the role of two variables related to social capabilities; "economic opportunities" and "legal systems and property rights" in the relationship between human capital and growth. Our results show that the significance of human capital variable, whether in change form or in levels, goes away when panel data methods are applied to the econometric models of human capital and growth. Results also show that when variables related to social capabilities are included in the growth models, the human capital variable in levels becomes highly significant, highlighting the importance of incorporating different channels through which human capital can affect economic growth. Finally, we show that economic opportunities significantly moderate the relationship between human capital and growth.

The structure of this paper is as follows. In the section 2 we present a short background on the relationship between human capital and growth. Section 3 presents conditionalities associated with the relationship between human capital and growth. Sections, 4, 5 and 6 present econometric model, description of data and methodology, respectively. Section 7 provides discussion on results and section 8 concludes the paper.

2 Human Capital and Economic Growth

In the field of economics, knowledge is considered as a set of skills and abilities that can be used to produce new goods. In the literature on endogenous growth, knowledge embodied in humans is termed as human capital. This literature highlights the importance of knowledge for economic growth at the country level, postulating that human capital explains most of the variation in growth across countries. As a result, knowledge - in the form of education and productive capabilities - is brought to the centre of discussions on drivers of growth. The general conclusion is that human capital is a very important, if not the most important, source of growth (Arrow 1962; Romer 1986; Romer 1990; Aghion and Howitt 1992; Mankiw, Romer, and Weil 1992). It is believed that the abilities of people shape the structure and evolution of the economy. Knowledge accumulation and recombination bring new ideas and improve both productivity and the quality of products. In a broader macroeconomic sense, higher human capital also encourages entrepreneurship and

innovation, which leads to higher growth rates (Dakhli and Clercq 2004).

Human capital was originally defined as '[...] knowledge, skills, attitudes, aptitudes, and other acquired traits contributing to production' (Goode 1959). This definition is broader than just educational attainment, as it includes any productive skills or capabilities of individuals, not just those that are formally taught. Human capital encompasses all forms of investments made to improve human skills, including schooling, informal education, on-the-job training, and learning by doing; it also includes other factors that facilitate the productive use of human skills, such as health. Other than formal education, nearly all of the components of human capital listed here are very difficult to measure. Therefore, most studies linking human capital to economic growth have been restricted to studying the impact of formal education on economic growth. This methodological choice has been bolstered by the common understanding that education is an important ingredient in sustainable economic growth, and that better education ensures smooth economic growth over time (Lucas 1988; Barro 1991). For simplicity, in the present paper we use the very generic conceptualization of human capital offered by Becker (1994), who referred to this as the 'resources found in people'. These resources would typically include knowledge, skills, competences, and other attributes embodied in humans that are relevant to economic activity.

Highlighting the role of knowledge in economic growth, endogenous growth theory shows that the abilities of people shape the structure and evolution of an economy. Knowledge accumulation and recombination bring new ideas and improve both productivity and the quality of products. In a broader macroeconomic sense, higher human capital also encourages entrepreneurship and innovation, which leads to higher growth rates. However, this literature assumes homogeneity of institutional and socio-economic settings across national boundaries, even though countries are heterogeneous in many ways, with different laws, institutes, types of government, and policies that can affect the relationship between human capital and growth. Logically, therefore, the strength of the relationship between human capital and growth will differ across countries due to the differences in their institutional and socio-economic characteristics, creating a need to identify the institutional and socio-economic factors that weaken or strengthen the relationship between human capital and growth.

The dynamics of knowledge and its relationship with macroeconomic indicators is important to understand, as endogenous growth theory posits that while the domestic stock of knowledge is essential for growth, the dynamics of knowledge accumulation and its relationship with growth are directly or indirectly modulated by many other factors (Robeyns 2006). First, high regulatory quality is expected to lead to the enforcement of labour laws related to fair wages and transparent hiring and firing procedures, creating a suitable working environment for the qualified labour force. Second, countries with high levels of corruption are generally characterized as lacking equitable rights, meaning that a high level of corruption

is expected to weaken the relationship between human capital and growth due to a sub-optimal utilization of human capital. Finally, a country with favourable entrepreneurial policies is more likely to attract and retain qualified individuals who seek to start their own businesses. A lack of opportunities in this sense makes it difficult for entrepreneurs to form start-ups, thereby under-utilizing the potential of the qualified labour force.

3 Conditionalities Associated with the Human Capital and Growth Nexus

In this section, we summarize the literature touching on the conditionalities associated with the relationship between human capital and growth. Sunde and Vischer (2015), for example, explored the reasons behind the weak empirical effect of human capital on growth in existing cross-country studies. They elaborated on the standard neoclassical growth model, which does not account for the important variables through which human capital affects growth. Using three different datasets for average years of schooling for more than 80 countries, their study identified two distinct channels through which human capital affects growth: changes in human capital, and initial levels of human capital. Their results suggested that the effect of human capital is likely to be underestimated and biased in empirical specifications that do not account for both channels. On the basis of these findings, they argued that the weak growth effects found in previous studies were due to heterogeneity in the cross-country data, as well as due to measurement issues.

Elias and Fernandez (2000) emphasized the role of human capital and income levels in sustained growth in Latin American countries. Education indicators - school enrolment ratios - were used as a proxy for human capital. Their results revealed that the countries that invested more in primary education in 1965 had a tendency to grow more; however, neither secondary nor high school spending had a significant relationship with growth until a variable representing life expectancy is included in the model. Elias and Fernandez conclude that when a country has high levels of skill, high life expectancy, and better work habits, increased educational spending improves growth performance.

The quality of the educational system has also been shown to be a facilitating characteristic for the effect of human capital on growth. For instance, Dessus (1999) used panel data on 83 countries to demonstrate that differences in the quality composition of human capital across nations must be taken into account when analysing the effect of human capital on growth. Ignoring such differences creates a significant estimation bias. The result of such bias is that human capital is presented as a negative contributors to growth models (e.g. Islam 1995). After correcting for such bias, Dessus found a positive effect of human capital on growth. Additionally, using a varying parameter method, Dessus traced the heterogeneity

among countries to the differences in the quality of their human capital; in particular, to difference of the education infrastructure and the initial endowment in human capital. He found that such differences affect the quality of human capital, as well as the capacity of the education system to equitably distribute educational services. Similarly, Banerjee (2012) used data for 55 countries for the period from 1980 to 2007 to show that the quality of human capital is important for growth. He argues that the stock of human capital affects economic growth through its effect on capital productivity, as well as through technological diffusion. He makes this assertion based on his finding that while the stock of persons with tertiary education is not a significant determinant of growth, the stock of persons with secondary and primary education is important. Consequently, although basic education may not be sufficient to ensure a high degree of research and development (R&D), it is necessary to allow the population to absorb existing technologies, and its quality therefore plays a key role in conditioning the effect of human capital on growth.

Concerning the role of quality of institutions on the human capital and growth nexus, Farida and Ahmadi-Esfahani (2008) provided empirical evidence regarding the impact of corruption on human capital productivity and growth in Lebanon. In this paper, the Solow growth model is extended by including corruption as an additional determinant, a variable that the authors found to have a significant coefficient. Moreover, this new model yielded considerably smaller coefficients for the other growth determinants, indicating that corruption leads to inefficiency in the economy. Their study concludes that corruption lowers investment, as well as the effectiveness of government expenditure and the productivity of human capital. In the absence of adequate demand for a qualified labour force, skilled individuals either settle for a much less productive job or they emigrate, as confirmed by findings of Fan and Stark (2007) that international migration from developing countries is largely due to the lack of adequate demand for qualified individuals, which creates unemployment among educated persons.

From a policy point of view, quality of institutions can be viewed as market enhancing or growth enhancing. Market-enhancing growth is a narrow concept, which only deals with the efficiency of markets. The primary argument is that efficient markets attract technology and capital, and eventually improve the economic development of the country. In contrast, growth-enhancing governance suggests that markets are inherently inefficient. Specific governance capacities are required for the efficient allocation of resources and to accelerate growth using both market and non-market mechanisms, allowing both productivity and absorptive capacity to be increased (Khan 2007). In short, growth-enhancing and market-enhancing governance capacities are substantially different from each other, but are not necessarily mutually exclusive.

Although cross-country analysis has generally assumed a common, balanced growth path for all countries, this assumption has met with widespread criticism.

In Owen, Videras, and Davis (2009) analyses of a sample of developed and developing countries, for example, it was shown that countries do not necessarily follow similar growth paths; rather, countries can be sorted into categories, each with its own unique growth processes. The largest source of heterogeneity in this respect is the quality of institutions, quality of institutions (proxied by the degree of law and order) which influences the growth environment and affects the growth process by determining the effects of the usual factors of production, including human capital accumulation. In Gemmell (1996), it was shown that a country's level of development significantly determines its human capital needs: Primary education is most important in least-developed countries (LDCs), secondary education for intermediate countries, and tertiary education for OECD countries. Similarly, the findings of a series of multi-country analyses by Sunde and Vischer (2015) offered strong evidence contradicting the assumption of a balanced growth path. However, once the balanced growth path assumption is removed, human capital as a production factor or an innovation input no longer directly influences growth. The effect of human capital on growth is conditioned by living conditions: When living conditions are favourable, the contribution of human capital to growth is amplified (Sunde and Vischer 2015).

In addition to the role of quality of institutions, literature also highlights the importance of economic opportunities in the relationship between human capital and growth. Main argument in these studies is that increasing human capital is not enough if productive capabilities are not also increased (Ranis, Stewart, and Ramirez 2000). In this context, facilitating new business formation is of prime importance, as new businesses create demand for both skilled and unskilled labour. Abramovitz's concept of social capabilities (Abramovitz 1986) highlights the importance of ability to absorb new technology, attract capital and participate in global markets in the catching up process. Concept of social capabilities goes beyond human capital and adds dimensions related to economic opportunities in the framework of determinants of catching-up process. On similar grounds, Sen (1983) introduced the concept of human capabilities in welfare economics. Human capabilities brings to the center of discussion the importance of human freedom to choose, factors that affect happiness of individuals and distribution of economic opportunities in the society. From the perspective of both social capabilities of Abramovitz and human capabilities of Sen, it becomes clear that analysis of growth goes beyond simple inputs to production function. It therefore follows that human capital should strongly contribute to economic growth in countries with high levels of economic opportunities. The efficient utilization of resources requires sound institutional policies that protect the basic rights of individuals and that provide fair and equal opportunities to all economic agents. In the presence of corruption and low regulatory quality, the legitimacy of institutions becomes questionable as they fail to perform their functions efficiently (IMF 2002). Under these conditions, the educated labour force will contribute less than its potential to economic growth;

some individuals will emigrate, while those who stay will not be able to perform as efficiently as they would have under a system with high quality of institutions.

Inspired from the discussion above, in this study we re-examine the relationship between human capital and growth. First, we replicate the traditional models of Benhabib and Spiegel (1994) and Cohen and Soto (2007) in the cross-sectional settings. Second, we extend these models using panel data approach in order to test for the robustness of these results to change in methodology. Third, we include factors related to economic opportunities and quality of legal institutions in the framework of human capital and growth. Finally, we test for the moderating role of economic opportunities and quality of legal institutions in the relationship between human capital and growth.

4 Econometric Model

Similar to the framework of Benhabib and Spiegel (1994) (henceforth BS), our econometric specification is based on Cobb-Douglas type production function which takes the following form:

$$y_{i,t} = A_{i,t} K_{i,t}^{\alpha} L_{i,t}^{\eta} H_{i,t}^{\gamma} \epsilon_{i,t} \tag{1}$$

Where y is per capita GDP at current purchasing power parity, K is the stock of physical capital at current PPP, L is the employed labor force, A is the technological progress, H is the human capital and ϵ is the residual. Taking log differences on both sides of equation (1) gives us our main econometric model for estimation as shown in equation (2).

$$\Delta ln y_{i,t} = \Delta log A_{i,t} + \alpha \Delta ln K_{i,t} + \eta \Delta ln L_{i,t} + \gamma \Delta ln H_{i,t} + \Delta \epsilon_{i,t} \tag{2}$$

Lagged endogenous independent variables are frequently used in the literature to account for potential simultaneity bias. Moreover, since qualifications and experience are only reflected in the output after a time lag, we also used one period lag of human capital variable as well as other covariates. Notice that here we arrive at the econometric model with human capital in changes which is also the first base model in BS. However, we know from later studies that the effect of change of human capital is generally found to be insignificant on economic growth and that the level form of human capital (or both differences and levels) better explains the relationship between human capital and economic growth. Following this tradition, we also use different formulations of equation 3 for estimations i.e. by replacing human capital variable in differences with level form of the same.

$$\begin{aligned} \Delta ln y_{i,t} = \beta_0 + \alpha \Delta ln K_{i,t} + \eta \Delta ln L_{i,t} + \gamma \Delta ln H_{i,t} + \beta_1 ln H_{i,t} + \beta_2 ln y_{i,t-1} \\ + \delta + \lambda + \epsilon_{i,t} \end{aligned} \tag{3}$$

Where δ represents time dummies and λ represents country dummies.

Moving on to the first extension of the model, we now introduce our variables of interest in the model, namely Economic Opportunities (EO) and quality of Legal Institutions and Property Rights (LP) in equation 4.

$$\begin{aligned}\Delta lny_{i,t} = \beta_0 + \alpha\Delta lnK_{i,t} + \eta\Delta lnL_{i,t} + \gamma\Delta lnH_{i,t} + \beta_1 lnH_{i,t-1} + \beta_2 lny_{i,t-1} \\ + \beta_3 lnEO_{i,t-1} + \beta_4 lnLP_{i,t-1} + \delta + \lambda + \epsilon_{i,t}\end{aligned} \tag{4}$$

As a second extension to the model, we test for the moderating role of EO and LP on the relationship between human capital and growth (equation 5).

$$\begin{aligned}\Delta lny_{i,t} =& \beta_0 + \alpha\Delta lnK_{i,t} + \eta\Delta lnL_{i,t} + \gamma\Delta lnH_{i,t} + \beta_1 lnH_{i,t-1} + \beta_2 lny_{i,t-1} \\ &+ \beta_3 lnEO_{i,t-1} + \beta_4 lnLP_{i,t-1} + \beta_5 lnH_{i,t-1} * lnEO_{i,t-1} \\ &+ \beta_6 lnH_{i,t-1} * lnLP_{i,t-1} + \delta + \lambda + \epsilon_{i,t}\end{aligned} \tag{5}$$

In all the specifications presented above, the EO and LP variables are in absolute form. In a cross-country analysis, relative standing of a country might be more important than the absolute one especially when the variables are not changing rapidly over time. Keeping this in view, we performed additional set of estimations replacing absolute EO and LP variables with their relative versions. This exercise serves as a robustness test for the results of equation 3 and 5 In particular, the relative versions of the variables are relative distance from the frontier in a given year, taking the value of 0 for the frontier itself. Formally:

$$X\_GAP_{i,t} = \frac{X_{leader,t} - X_{i,t}}{X_{leader,t}} \tag{6}$$

where X can take the variable EO or LP. Subscript i represents the value of variable X for country i at a given time t and *leader* represents the country with a maximum value of the variable X at time t.

5 Description of Data and Variables

Our sample comprised 132 countries from 1996 to 2011. Data used in this study were taken mostly from Penn World Tables v8.0, World Development Indicators (WDI) of the World Bank and Economic Freedom Dataset of the Fraser Institute (Gwartney, Lawson, and Hall 2014). Short description of data and their sources is provided below.

5.1 GDP per capita, physical capital and labor

Dependent variable in this study is growth of GDP per capita. Data for GDP per capita is taken at current purchasing power parity from World Development Indicators. The physical capital K is also taken at current purchasing power parity while L is the engaged population in a country in a given year. Both K and L are taken from Penn World Tables v8.0.

5.2 Human Capital

The human capital index is taken from Penn World Tables v8.0. This index is based on average years of schooling (according to Barro and Lee 2013) and the rate of return (according to Psacharopoulos 1994). Recent literature on quality of education argues that the human capital indicators based on average years of schooling does not provide accurate estimate of quality of education system in a country (Hanushek and Kimko 2000; Ali, Cantner, and Roy 2015). However, indicators proposed for quality adjustment of human capital variable are not available for long time periods. Moreover, using a human capital variable based on average years of schooling allows for the comparison of results with previous established studies. Therefore, we use human capital index based on average years of schooling for our analysis.

5.3 Economic Opportunities (EO) and Legal System and Property Rights (LP)

In order to add a component of social capabilities in our growth regressions, we used two proxies: economic opportunities and legal system and property rights. Both of these indices are components of Economic Freedom Index. The Economic Freedom Index has been developed by The Economic Freedom of the World project of The Fraser Institute (Gwartney, Lawson, and Hall 2014). The score on this index ranges from zero to ten, where zero represents the least amount of freedom and ten represents the highest level of freedom. This index has been used in previous studies for similar types of economic analysis, in which the authors aimed to test for the moderating role of economic freedom on the main variables of interest (see for example Alguacil, Cuadros, and Orts 2011). Legal system and property rights is component number 2 in the Economic Freedom Index which comprises of factors related to quality of legal institutions. Economic opportunities index in this study is the average of fourth and fifth component of the index, namely "Freedom to trade internationally" and "Regulation". Both of these indices cover the factors that affect the abilities, apart from the human capital, to engage effectively in the economic activities. The list of subcomponents of these indices is presented in Appendix table A5.

6 Methodology

A noticeable difference between our model and the previous ones in the literature is that it exploits the time dimension available in the dataset. Surprisingly, most studies in the literature suppress the time dimension and simply use a cross-sectional data for analysis, a strategy which can have serious demerits especially in the context of growth regressions. First, growth models, such as the one used here, have a strong component of convergence which is less likely to be captured in a cross-sectional setting (Islam 1995). Therefore, year-to-year variation in the data is more likely to capture the convergence among countries. Second, use of panel data allows for the control of country specific effects which are crucial in a setting with large number of countries with heterogeneous characteristics. Countries differ not only in terms of their stock of human capital or their level of income, they also differ with respect to their cultural settings, institutions and other socio-economic traits, most of which are unobserved and are likely to bias the results if countries are assumed to be homogenous. Even though some studies include country group dummies, either based on levels of per capita income or geographical locations, they still do not capture the country level heterogeneity present in cross country analysis. We, therefore, rely on panel data instead of cross sectional data for our analysis. Doing so not only allows us to test for the robustness of the previous findings in the literature when time dimension is introduced in the analysis but also enables us to use significantly larger number of observations due to the exploitation of time dimension in the data. Most common estimation methods for panel data analysis are fixed effects models (FE), random effects models (RE) and generalized method of moments (GMM). As compared to FE and RE models, GMM offers various attractive features such as unbiased dynamic panel data modelling and correction for endogeneity. However, GMM is most efficient when there is high persistence (Soto 2009), for our analysis, results show no persistence over time [1] which forces us to use simple fixed effects model.

7 Results and Discussion

Since we employ a different estimation methodology to a traditional model, we begin with a comparison of our results with previous results in the literature. Our main specification (model 1 in table 1) is similar to the one used by BS. For our dataset, we also employed the methodology similar to the one used by BS i.e we suppressed the time dimension and used one observation per country to estimate a simple cross sectional OLS regression. An alternative model provided by Cohen and Soto (2007) (henceforth CS) is also estimated to test for the robustness of the outcomes and to make sure that our data complies with the previous studies on the issue (models 4, 5 and 6 in table 1). First noticeable result is the negative

1. Results are available with the authors

and significant sign of labor variable in model 1 which is insignificant in BS study. The significance of labor variable disappears when human capital variable enters the specification in level form both in model 2 and 3. This result corresponds to the findings of Sunde and Vischer (2015) (henceforth SV) where they propose to include both channels of human capital in the regression. The negative sign could also be the result of the structural change in some economies moving from labor intensive technologies to the capital intensive technologies during the period of analysis. It could also be due to the misspecification of the model when country specific and time specific effects are missing from the model (we will see this later in this section).

Table 1: Pooled-OLS Estimation. Dependent variable: per capita GDP growth

	(1)	(2)	(3)	(4)	(5)	(6)
ΔlogK	0.164**	0.169**	0.160**	0.105	0.145**	0.136**
	(0.077)	(0.070)	(0.074)	(0.067)	(0.061)	(0.064)
ΔlogL	-0.402***	-0.197	-0.193			
	(0.141)	(0.156)	(0.159)			
ΔlogH	-0.453		0.590	-0.845		0.618
	(0.561)		(0.661)	(0.585)		(0.637)
$logy_0$	-0.055***	-0.113***	-0.116***	-0.051***	-0.122***	-0.125***
	(0.017)	(0.024)	(0.025)	(0.017)	(0.021)	(0.022)
$logH_0$		0.606***	0.697***		0.725***	0.818***
		(0.145)	(0.198)		(0.124)	(0.157)
Constant	0.853***	0.710***	0.602***	0.788***	0.644***	0.533***
	(0.171)	(0.154)	(0.164)	(0.179)	(0.163)	(0.160)
Observations	128	128	128	128	128	128
R^2	0.206	0.306	0.314	0.115	0.288	0.297
Adjusted R^2	0.181	0.284	0.286	0.093	0.271	0.274

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The human capital variable in change form however does not appear to be significant in any of these specifications and appears with a negative sign in model 1 corresponding to the results of BS. Due to the unexpected negative and significant sign of labor variable in model 1, we estimated additional set of regressions without the labor variable which is similar to the specification of CS. The results with respect to human capital variable in changes appear to be similar to the ones obtained with BS specification showing that the results are robust to the change in specification. A noticeable result here is that human capital in levels always ap-

pears to be significant while in changes it is always insignificant. The insignificance of the change variable contradicts with the findings of SV who showed that, when both channels of human capital are included in the regression, both forms have positive and significant sign. Nevertheless, results do show that human capital in levels should be considered in the analysis of human capital and growth.

After the estimation of cross-sectional regression for the sake of comparison with the existing influential empirical studies on human capital and growth relationship, we now turn to the panel data estimation of the same models. A noticeable difference here is that the variables appearing in change form are annual first differences and the lags represent one year lags. Results presented in table 2 model 7 show that human capital variable in changes is insignificant, which corresponds to the results of BS. Both labor and physical capital are significant and positive while lagged income variable is negative and significant showing significant role of convergence. A noticeable difference between model 1 in table 1 and model 7 in table 2 is the sign and significance of labor variable. As we will see later, the significance of labor variable remains and even increases in some models showing that when individual differences across countries and time periods are accounted for, the expected sign of the labor variable appears with relatively high significance. Apart from positive and significant coefficient of labor, results do show that despite the significant differences in econometric settings, results of BS are verified by our exercise.

Following SV, we estimated two more variations of the base model: one after replacing human capital variable in changes with human capital in levels (model 8) and second with both channels of human capital (model 9) in the same specification. Our results show that human capital variable, both in changes and in levels, has insignificant coefficients both in model 8 and 9. These results, especially the insignificance of human capital variables in model 9 in table 2, contradict with the findings of SV who show that human capital variables show significant and positive relationship with economic growth when both level and change variants are included in the model. The contradiction challenges the results of SV: we could only find partial support for their results in the cross-sectional analysis and we could not find support for their results in the panel data analysis.

In an attempt to search for the explanation of these findings, one could take the exercise of SV a little further. Their exercise is grounded in the argument that traditional human capital models do not account for all the major channels through which human capital could influence economic growth; this is precisely how they interpret significant coefficient of human capital when both changes and level variants of human capital are included in the model. Following the same line of argument, one could also think of channels other than existing level of human capital that could affect the relationship between human capital and growth e.g. institutional characteristics and economic opportunities. Underlying argument for the inclusion of additional variables is that the stock of knowledge in a given

country has to be utilized efficiently for it to be able to contribute to economic growth.

Table 2: Fixed Effects Estimation. Dependent variable: per capita GDP growth

	(7)	(8)	(9)	(10)	(11)
ΔlogK	0.041*	0.044*	0.045**	0.057**	0.057**
	(0.023)	(0.023)	(0.023)	(0.025)	(0.024)
ΔlogL	0.193**	0.188**	0.192**	0.285***	0.284***
	(0.087)	(0.087)	(0.087)	(0.095)	(0.095)
$logy_{t-1}$	-0.064***	-0.064***	-0.063***	-0.089***	-0.088***
	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)
ΔlogH	0.325		0.443	0.412	0.419
	(0.259)		(0.257)	(0.250)	(0.253)
$logH_{t-1}$		0.072	0.091	0.149**	0.156**
		(0.071)	(0.073)	(0.060)	(0.060)
$logEO_{t-1}$				0.069**	
				(0.032)	
$logLP_{t-1}$				0.045***	
				(0.011)	
EO_Gap_{t-1}					-0.135**
					(0.063)
LP_Gap_{t-1}					-0.078***
					(0.017)
Constant	0.536***	0.481***	0.452***	0.538***	0.754***
	(0.136)	(0.161)	(0.166)	(0.123)	(0.129)
Observations	1948	1948	1948	1659	1659
R^2	0.198	0.199	0.200	0.315	0.317
Adjusted R^2	0.191	0.191	0.192	0.307	0.308

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Human capital is expected to improve productivity, increase innovation and increase entrepreneurial activities. However, in absence of sound economic, social and institutional environment, human capital stock of a country is expected to be underutilized. Quality of legal system and property rights, for example, is likely to facilitate hiring of labor on merit and will also facilitate entrepreneurial process by providing sound business environment to the economic agents. Keeping this in view, we include "Economic opportunities" (EO) and "Legal system and property

rights" (LP) in our specifications (model 10 in table 2). Interestingly, human capital in level form becomes significant after the inclusion of these variables while human capital in changes is still found to be insignificant. This result holds when both variants of human capital enter our specification together or separately. The change of significance of human capital in level form shows that econometric specifications that aim to model the relationship between human capital and economic growth should account for country specific characteristics related to economic and business environment in addition to the past levels of human capital as proposed by SV. As far as the significance of the additional variables is concerned, both EO and LP had positive and significant signs atleast at 5% significance level. Inclusion of these variables also increases the model fit considerably, increasing adjusted-R^2 from 0.192 in model 9 to 0.307 in model 10 (table 2). In order to test for the robustness of these results, we converted EO and LP variables from absolute forms to the relative forms by calculating distance from the frontier in each year (for formula and explanation, see equation 6 in section 4). A noteworthy observation here is that after conversion of the variables from absolute to relative measures, the interpretation of these variables becomes opposite i.e. the larger the distance is from the frontier, worse it is for economic growth. Results of model 11 in table 2 show that findings of model 10 related to human capital variables are robust to the changes in formulation of EO and LP variables. Both EO and LP are significant with opposite sign for the same reason as explained above.

Following the arguments for EO and LP as facilitators of the human capital and growth relationship, we extend our analysis by including interactions between human capital and EO and LP. Results, as reported in table 3, show that interaction between human capital and EO is significant in model 13, showing that higher economic opportunities significantly increase the effect of human capital on growth. Since EO index includes two broader components of economic freedom i.e. freedom to trade internationally and regulation which capture the ease of doing business, significance of the interaction between EO and human capital can be interpreted in both contexts. From point of view of freedom to trade internationally, this result hints towards the importance of domestic stock of knowledge as an indicator of absorptive capacity to absorb knowledge spillovers from, for example, imports (Ali, Cantner, and Roy 2015). It also shows that increase in freedom to trade internationally increases the opportunities for the individuals in the home country to exploit the needs of foreign markets. If stock of human capital at home is good enough, individuals are expected to innovate in order to compete with the foreign producers in the international markets thereby improving growth.

Table 3: Fixed Effects Estimation. Dependent variable: per capita GDP growth

	(12)	(13)	(14)	(15)
ΔlogK	0.057**	0.059**	0.057**	0.059**
	(0.025)	(0.025)	(0.024)	(0.024)
ΔlogL	0.285***	0.277***	0.284***	0.274***
	(0.095)	(0.096)	(0.095)	(0.095)
$logy_{t-1}$	-0.089***	-0.098***	-0.088***	-0.100***
	(0.016)	(0.018)	(0.016)	(0.017)
ΔlogH	0.412	0.487*	0.419	0.513**
	(0.250)	(0.255)	(0.253)	(0.258)
$logH_{t-1}$	0.149**	-0.068	0.156**	0.240***
	(0.060)	(0.131)	(0.060)	(0.059)
$logEO_{t-1}$	0.069**	0.089**		
	(0.032)	(0.035)		
$logLP_{t-1}$	0.045***	0.047***		
	(0.011)	(0.013)		
$logH_{t-1} \times logEO_{t-1}$		0.143**		
		(0.063)		
$logH_{t-1} \times logLP_{t-1}$		0.006		
		(0.031)		
LP_Gap_{t-1}			-0.078***	-0.089***
			(0.017)	(0.022)
EO_Gap_{t-1}			-0.135**	-0.185***
			(0.063)	(0.069)
$logH_{t-1} \times EO\_Gap_{t-1}$				-0.362***
				(0.119)
$logH_{t-1} \times LP\_Gap_{t-1}$				-0.044
				(0.050)
Constant	0.538***	0.572***	0.754***	0.857***
	(0.123)	(0.131)	(0.129)	(0.144)
Observations	1659	1659	1659	1659
R^2	0.315	0.322	0.317	0.328
Adjusted R^2	0.307	0.312	0.308	0.318

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

From the perspective of ease of doing business at home, significant interaction between human capital and EO implies that with the sound economic environment, that facilitates economic agents to perform, human capital is expected to have stronger effect on growth. Another important result here is the significant sign of human capital variable in changes which shows that when variables related to social capabilities are included in the regression along with their interactions, the human capital variable in changes becomes significance, further highlighting the importance of including factor relating to facilitation of human capital in the growth regression. Sign of human capital at levels was found to be insignificant in the regression with interaction. However, in presence of interaction, the main effects should always be interpreted in combination with the interaction. Figure 1 shows the graphical representation of interaction between human capital and economic opportunities. One can see from the figure that the effect of each additional unit of human capital is stronger when economic opportunities are higher.

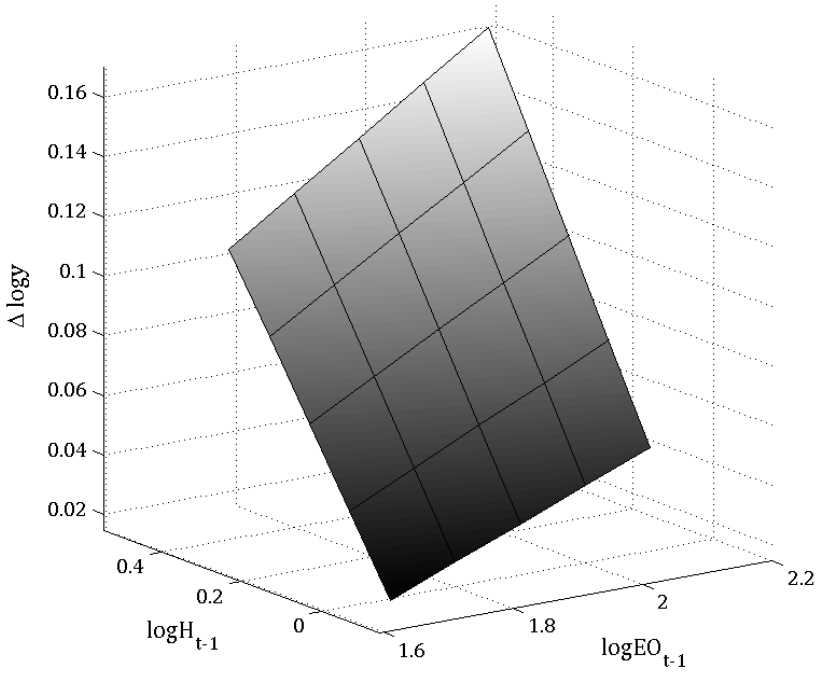

Figure 1: Interaction between human capital and economic opportunities

Surprisingly, the interaction between human capital and LP do not have significant coefficients showing no moderating role of legal system on the relationship between human capital and growth. The result is surprising because one would expect quality of legal system and property rights to strengthen the relationship between human capital and growth through provision of protection for the innovators and investors.

In order to test for the robustness of the moderating effects, we performed a similar exercise with relative measures for EO and LP i.e. EO_Gap and LP_Gap. Results, as reported in model 14 and 15 in table 3, show that gap versions of EO and LP have opposite signs as compared to their absolute counterparts and their significance also corresponds to the results reported in models 12 and 13. This result shows that, similar to the findings in table model 12 and 13, the interactions between human capital and gap versions of EO and LP have negative and significant coefficient showing that larger the gap is with the frontier with respect to EO and LP, weaker the effect of human capital is on growth. An important distinction between the results of model 15 compared to 13 is that both change and level forms of human capital are significant showing that relative versions of the EO and LP variables are more relevant for the significance of human capital variables in the growth regression. Overall, we conclude that our findings show support for the moderating role of economic opportunities in the relationship between human capital and growth while it does not show significant moderating role of legal systems and property rights in human capital and growth relationship.

8 Conclusion

The empirical relationship between human capital and economic growth has been explored repeatedly since the development of literature on endogenous growth theory. However, results from these studies are far from being conclusive. Recent study by Sunde and Vischer (2015) shows that results of the human capital and growth regressions depend on the specification and that additional channels related to human capital should be included in the empirical analysis. In the present study, we take this argument further and test for the role of economic freedom and quality of legal institutes in the relationship between human capital and growth. Moreover, most studies in this regard employ cross-sectional analysis to study the relationship between human capital and growth. We argue that the argumentation related to convergence is better captured by panel data when time dimension is considered in the model. Using data for 132 countries, we show that results of the previous studies on human capital and growth partially hold when we include time dimension in the model and control for country specific and time specific effects. We also show that economic opportunities and quality of legal institution have significant and positive relationship with growth. More importantly, inclusion of these variables changes the significance of human capital variable in the model, highlighting the importance of including channels through which human capital can affect growth in the regression. Test for the interaction effects reveal that economic opportunities significantly moderates the relationship between human capital and growth while quality of legal institutions do not seem to have a moderating relationship with human capital. We test robustness of our results by replacing EO and LP variables with their relative versions and found

that our results are robust to the absolute and relative versions of EO and LP.

This study contributes to the growth literature by identifying the factors that can strengthen the link between human capital and economic growth. It shows that results shown in some traditional models do not hold when time dimension is included in the results and that it is important to include socio-economic characteristics in the model to better explain the relationship between human capital and growth.

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9 Appendix

Table A1: Correlation Table: Panel Data

.	Δlogy	ΔlogK	ΔlogL	$logy_{t-1}$	ΔlogH	$logH_{t-1}$	$logEO_{t-1}$	$logLP_{t-1}$
Δlogy	1							
ΔlogK	0.1527	1						
ΔlogL	0.0955	0.1955	1					
$logy_{t-1}$	-0.0815	-0.0217	-0.103	1				
ΔlogH	0.022	0.1235	0.1039	-0.275	1			
$logH_{t-1}$	0.0313	-0.1379	-0.2568	0.7474	-0.4032	1		
$logEO_{t-1}$	0.1063	0.0811	-0.0796	0.6963	-0.243	0.6412	1	
$logLP_{t-1}$	0.086	-0.0158	-0.1521	0.7343	-0.2441	0.6098	0.6138	1

Table A2: Descriptive Statistics: Panel Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Δlogy	1951	.0249289	.0467287	-0.4301615	0.6506202
ΔlogK	1980	.0530881	.0679552	-0.4876966	0.9718685
ΔlogL	1980	.0199598	.0298383	-0.1491693	0.291219
$logy_{t-1}$	1954	8.173697	1.688926	3.97215	11.36358
ΔlogH	1980	.0068272	.0055718	-0.012367	0.0273357
$logH_{t-1}$	1980	-.0032263	.2535024	-0.7432166	0.4157762
$logEO_{t-1}$	1695	1.910732	.1685139	1.088507	2.231478
$logLP_{t-1}$	1712	1.712567	.3467041	0.1492792	2.264325

Table A3: Correlation Table: Cross Sectional Data

	Δlogy	ΔlogK	ΔlogL	ΔlogH	$logH_0$	$logy_0$
Δlogy	1					
ΔlogK	0.1854	1				
ΔlogL	-0.1782	0.3992	1			
ΔlogH	0.0146	0.2814	0.3614	1		
$logH_0$	0.0745	-0.2551	-0.4831	-0.6324	1	
$logy_0$	-0.2502	-0.0634	-0.1707	-0.3849	0.7298	1

Table A4: Descriptive Statistics: Cross Sectional Data

Variable	Obs	Mean	Std. Dev.	Min	Max
Δlogy	128	0.373616	0.2877525	-0.4768372	1.576412
ΔlogK	132	0.7963213	0.6311445	-1.656434	3.745654
ΔlogL	132	0.2993976	0.2464028	-0.3392376	1.592419
ΔlogH	132	0.1024086	0.0579185	-0.0160332	0.264487
$logH_0$	132	0.8163371	0.2658609	0.1271352	1.256124
$logy_0$	130	7.99791	1.700084	3.97215	10.96582

Table A5: Components of the EO and LP Indices

Legal System and Property Rights	**Economic Opportunity**	
Legal System and Property Rights	**Freedom to trade internationally**	**Regulation**
A Judicial independence	A Tariffs	A Credit market regulations
B Impartial courts	Ai Revenue from trade taxes (% of trade sector)	Ai Ownership of banks
C Protection of property rights	Aii Mean tariff rate	Aii Private sector credit
D Military interference in rule of law and politics	Aiii Standard deviation of tariff rates	Aiii Interest rate controls /negative real interest rates)
E Integrity of the legal system	B Regulatory trade barriers	B Labor market regulations
F Legal enforcement of contracts	Bi Non-tariff trade barriers	Bi Hiring regulations and minimum wage
G the sale of real property the sale of real property	Bii Compliance costs of importing and exporting	Bii Hiring and firing regulations
H Reliability of police	C Black market exchange rates	Biii Centralized collective bargaining
I Business costs of crime	D Controls of the movement of capital and people	Biv Hours Regulations
	Di Foreign ownership /investment restrictions	Bv Mandated cost of worker dismissal
	Dii Capital controls	Bvi Conscription
	Diii Freedom of foreigners to visit	C Business regulations
		Ci Administrative requirements
		Cii Bureaucracy costs
		Ciii Starting a business
		Civ Extra payments/bribes/favoritism
		Cv Licensing restrictions
		Cvi Tax compliance

Table A6: List of Countries

Developing Countries	Jordan	Thailand	Greece
Argentina	Kenya	Togo	Hungary
Bahrain	Korea, Republic of	Trinidad and Tobago	Ireland
Bangladesh	Kuwait	Tunisia	Iceland
Barbados	Laos	Turkey	Italy
Belize	Lesotho	Uganda	Japan
Benin	Liberia	Uruguay	Lithuania
Bolivia	Macao	Venezuela	Luxembourg
Botswana	Malawi	Vietnam	Latvia
Brazil	Malaysia	Yemen	Malta
Brunei	Maldives	Zambia	Netherlands
Burundi	Mali	Zimbabwe	Norway
Cambodia	Mauritania	**Transition Economies**	New Zealand
Cameroon	Mauritius	Albania	Poland
Central African Republic	Mexico	Armenia	Portugal
Chile	Mongolia	Croatia	Romania
China	Morocco	Kazakhstan	Slovak Republic
Colombia	Mozambique	Kyrgyzstan	Slovenia
Congo, Dem. Rep.	Namibia	Moldova	Sweden
Congo, Republic of	Nepal	Russia	United States
Costa Rica	Niger	Serbia	
Cote d'Ivoire	Pakistan	Tajikistan	
Dominican Republic	Panama	Ukraine	
Ecuador	Paraguay	**Developed Countries**	
Egypt	Peru	Australia	
El Salvador	Philippines	Austria	
Fiji	Qatar	Belgium	
Gabon	Rwanda	Bulgaria	
Gambia, The	Saudi Arabia	Canada	
Ghana	Senegal	Switzerland	
Guatemala	Sierra Leone	Cyprus	
Honduras	Singapore	Czech Republic	
Hong Kong	South Africa	Germany	
India	Sri Lanka	Denmark	
Indonesia	Sudan	Spain	
Iran	Swaziland	Estonia	
Iraq	Syria	Finland	
Israel	Taiwan	France	
Jamaica	Tanzania	United Kingdom	