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# EFFECT OF HUMAN CAPITAL INVESTMENT ON ECONOMIC GROWTH AND PRODUCTIVITY: A SIMULATION APPROACH

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## ABSTRACT

The study investigates the dynamiceffects of incomeon a new cohort oflabor force byusing real demography in order to increase investment on human capital. The study constructed three scenarios such as baseline, typical, and optimistic.In the baseline scenarios,the rate of human capital investment,which is observed in 2020 remains constant in 2060,whereas, typical and optimistic scenarios,the rate of human capital increased for each country to median and 75$^{th}$ percentile.The study computes result for each country separately for 40 years into the future, from 2020 to 2060, then average out the findings throughout the complete sample, which the study refers to as the world. Theglobal human capital per worker is computed in absolute terms. In base case scenario, where investment on human capital remain unchanged, the human capital per worker increases in the next four decades, primarily due to demographic changes. Human capital per worker grows somewhere under typical and optimistic scenarios, from around 1.13 to 1.62 and 1.20 to 1.729, respectively. While human capital expands under 50$^{th}$ and 75$^{th}$ percentile from 0.59 to 0.62 and 0.63 to 0.66 respectively.

**JEL Classification**: E24, J24

**Keywords:** Human Capital, Economic Growth, Productivity, Simulation

## 1. INTRODUCTION

The importance of human capital in economic growth has widely been examined from the era of Great Economists Adam Smith and Alfred Marshall. The area has always been spellbound for economists and economic historians. However, Becker (1964), Schultz (1961), and Mincer (1958) develop the complete theory of human capital. According to this theory, an individual's education level and his/ her experience determine the future income.

Notwithstanding, the definition of human capital is somehow clear, human capital measurement is still more elusive. Many researchers have measuredhuman capital through academic education such as enrolment rate or education attainment levels, while others considered human capital as literacy and numeracy. However, these measures do not explain human capital adequately, as they overlooked informal learning, vocational training, learning by doing, and on-the-job training and experiences. Furthermore, above-stated human capital measurements do not consider the

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economic worth of human capital, the possible variation in the rates of return amid different categories of education level, and the acquirement of human capital for consumption rather than production. It should be clear that the measurement of human capital is inclusive and consistent with theoretical foundations. Productive spending in education and health is considered an integral part of the development which brings significant economic benefits in the long run. However, Investment in human capital often not observable in the short run and takes time to give a benefit. Therefore, most of the countries especially developing countries have no priority to invest in human capital earnestly.

The income differences among the countries are the result of differences in human capital investment rates. These can be seen in the components to assess human capital, such as educational attainment among the working-age population. The economists extended human capital measurement to capture the impact of quality education as test scores and health as adult survival rates. The human capital components considered earlier have shown lesser differences as an extended measure to assess human capital. The low-income countries' children generally obtain fewer years of low-quality education and schooling andmove into the workforce with weaker health than their counterparts in high-income countries.

Kraay (2018) developed a new Human Capital Index (HCI) for the World Bank, based on human capital investment flow rate across countries. This is the futuristic approach in which human capital is determined to capture the productivity of future generations (forthcoming generations). It measures themagnitude of productivity of the workforce adult who initially got the poor health and poor education due to unfavorable economic conditions in the native country where they born. Also, it captures the effects of current spending on health and education on future productivity of upcoming generations. HCI integrates school as measured expected years of schooling and test scores and health assessed combining adult survival rate with child stunting and mortality. Based on empirical evidence, different weights have assigned for schooling and health on wages by using method developed by Weil (2007). In the HCI, learning adjusted year of school has measured combining expected years of secondary school and harmonized test scores. The value of HCI ranges from zero to one i.e. a value of one signifies a nation where all children achieved complete secondary schooling and got 625 test scores on the PISA (Program for International Students Assessment) scale.

## 2. LITERATURE REVIEW

Mankiw et al. (1992) verified Solow growth model by taking 121 countries' data by applying Ordinary Least Squares (OLS) methodfor the period of 1960 to 1985.They used Cobb-Douglas production functions with and without human capital along with labor and physical capital as factor inputs. They created a new proxy named "SCHOOL" for human capital. The variable school was created by taking percentage of working age population between 12 years to 17 years enrolled in secondary school and then multiply this percentage by working population that is of school age (15 to 19). The results showed that model without human capital explained around 50 per cent income variation in the sample countries while the model with the human capital explained around 80 per cent income variation in the same sample countries. On the basis of

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their findings,they recommended an Augmented Solow Growth Model for further studies on economic growth.
Benhabib and Spigel (1994) examined human capital impact on exogenous and endogenous growth theories by using the data-set of Summers and Heston (1991)'s study.They also used Cobb-Douglas production function and regressed it with growth accounting. They found that human capital is insignificant in growth regression and checked robustness through six different specification and found that their results was robust. They also examined the role of human capital in endogenous growth model with specification that the total factor productivity depends on the stock of human capital in the country. With this specification, they found that human capital has significant and positive role in determining economic growth.Gemmell (1996) examined the effects of human capital on economic growthby taking cross country data of high- and low-income countries by using the framework of Mankiw et al.(1992)'s studyon the data-set of Summer and Heston (1991)'s study. The study employed different proxies for human capital and divided human capital as primary, secondary and tertiary level on the basis of enrolment. The study concluded that human capital has significant positive effect on economic growth.Bernanke and Gurkaynak (2001) extended data set from 1960 to 1995 and rechecked Mankiw et al.(1992)'s framework with same variables and methods. They concluded that results of extended data set differ from Mankiw et al. (1992), and asserted that the long run growth is endogenous and correlated with behavioral variables such as saving rates.Midendorf (2005) examined the role of human capital on economic growth of 29 Organization of Economic Co-operation and Development (OECD) countries by taking panel data from 1965 to 2000. The study found that human capital has a positive significant effect on economic growth. To avoid endogeneity and heterogeneity, the study used instrumental variable approach and concluded that the impact of human capital on economic growthis significantly different when applied different proxies of human capital in the model.
The economic theory placed important role to determine economic growth. Tiruneh and Radvansky (2011), ul Mustafa, Abro, &Awan, (2021), and Wang and Liu (2016) investigated the association between human capital and economic growth by using different proxies of human capital for panel study of European countries for the period 1995 to 2001.The study employed random effect model and found that different proxies of education have positive and significant association with economic growth. Mankiw et al. (1992),Ul Mustafa, Nishat, &Abro, (2022),and Barro(2001) empirically tested and verified that human capital is one of the most important determinants of economic growth besides other determinants. Omotayo (2015) investigated the effect of human capital on growth for the period 1980 to 2012 by applying OLS technique. The found positive effects of human capital on Gross Domestic Product (GDP) growth.

# 3. METHODOLOGY

## 3.1 Data

The study uses the methodology of Weil and Matthew(2019) to trace the changes in the GDP per capita, resulting from the changes in HCI. The demographic structure of the population in each

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age group has been considered and taken into five years age groups. The data for this sutydis used from the United Nations Population Divisionfor demographic age structure projections, and integrates them into a model. Another data-set used in this study is taken from Barro and Lee (2013) for educational attainment of the populationwhich is categorized in five-year age groups. The study of Barro and Lee (2013) covers 146 countries; the study increased data size by using IHME (2015)and reconcile both the data by using the methodology of Weil and Colin (2020). The educational attainment data with exact age-group is essential because with time, older cohorts with lower educational attainment will be replaced in the workforce by younger cohorts with higher educational attainment.This progression will increase the average education attainment in the population. The study would be more dynamic when using similar age-specific quality education and health data, but this type of data is not available.

### 3.2 Variables Specifications

The input of production function is the average human capital per working-age population is computed by Coalescing data on the education attainment of various age groups and the population age structure. The presumption being that the rate of investment remains constant, the study also tracks the physical stock of capital that grows gradually over the period. By using human capital, physical capital, and GDP per worker, the study computes the total factor productivity of each country. At last, by using the ratio of the working-age population and total population, the study traces the transformation of GDP per worker into GDP per capita.

Combining all these Smithereens, the study builds the scenarios under different assumptions of the value of HCI that how the country's standard of living will change over time. To further analyze, the study develops a baseline scenario to show the economy's growth that how the current HCI level confirms in the future.The growth will happen due to four reasons in this baseline scenario. Firstly, most countries have increased their level of investment in HCI, which is why the young cohort received higher investment than the older cohort of workers. Therefore, the process of replacing the older cohort of workers with a young and more educated cohort of workers will increase the averagehuman capital. Secondly, the proportion ofthe working-age population declines in most countries due to variation in fertility. Thirdly, as historical trends show, productivity will grow in the future (Weil and Matthew, 2019). Lastly, as human capital per worker and productivity increase, physical capital will adjust in most countries.To determine the impact of enhanced HCI, the study compares the changes in income due to a specific policy options to the variations in those same metrics in the baseline scenario.

It equates to nations narrowing the disparity between their present HCI levels and the maximum of 1.0 at a pace of about 6.5% per 5 years. In this case, anaveragegrowing nation's HCI would grow from 0.5 in 2020 to about 0.82 in 2060. The second scenario awards each nation the 75th percentile rate of progress in each component, which translates to a nationnarrowing 7% of disparity between its present human capital index and the upper limit of 1.0 in next 5 years.

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The current study followed (Weil and Matthew 2019)'s methodology that shows the effects of change in HCI by using three alternative scenarios. Unavailability of previous data compels us to take 50th and 75th percentiles' initial data from Weil and Matthew (2019), the study takes two scenarios of how HCI levels have augmented between 2005 and 2015. First, it identifies a change in the gap between HCI and full benchmark 1.0 for the average nation in the dataset, which has witnessed improvement in each of the HCI's fundamental components. Then, the study applies the rate of change to every nation in the simulation.The study concludes that in the first scenario, global GDP per capita expected to rise five percent greater than the baseline case in the year 2060.

This study constructed country to country basis model; therefore, the social planner could use the results for planning and assessment:

What benefits gain from the rise in HCI and when it reaches maturity?

What pathway of changes in HCI is requisite to hit a particular target?

This study does not incorporate the impactsof parental human capital on fertility and children's human capital. Parents who are better educated have fewer children and spend more on their children's education and health and helpsto increase GDPper capita.

### 3.3 Model Specification

The study assumes that the physical and human capital is used as input in Cobb-Douglas production function togenerate output. The technological progress and institutional efficacyare assumed to be exogenous and constant. The study also considers anticipated demographic shifts to be exogenous and independent of human capital investment adjustments. The research discusses the simulation's novelties in the computation of quality-adjusted labor input, examining the influence of human capital investments on how much labor employees can offer. The study analyses information on years of education, quality education, and health outcomes to generate indicators of human capital for incoming employee cohorts. Observe the human capital of the whole labour force when fresh cohorts of employees replace older cohorts, using the technique and parameterization of Kraay (2018). As explained further below, the study also converts increases in GDP per worker into changes in GDP per-capita income.

#### 3.3.1 Fundamental Assumptions

Time, indicated by the symbol t, proceeds in five-year intervals. When t = 0, our model will be calibrated for 2020. When t = 1, it will predict 2025, and so on.

Labor force working ages vary depending on perspective; the study considers all persons aged 20-60 to be part of the labor force in the model. Fifteen would be a more acceptable age to begin labor force participation in many developing nations. However, the study uses education data, including education up to the 12th grade, which generally finishes at eighteen. To capture all

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benefits in secondary school achievement assessed in the Barro-Lee data, the study begins the study at the age of twenty. The study assumes that all persons, regardless of gender or age, actively engage in the labor force during these years. The study makes no adjustments for those out of the workforce while pursuing education beyond twenty or labor force before this age.

The study categorizes the population into 5 year age groups (20-24, 25-29). The age indicates the letter a, and it shows index age groups by the first age bin, i.e., a = 20; 25; and so on.

The World Population Prospects: 2017 Revision age-specific population by five-year age groups areutilized throughout the simulation (United Nations Department of Economic and Social Affairs, Population Division 2017). The study considers population projections to be exogenous and hence does not account for human capital (or income) feedback to fertility, mortality, and labour force participation.The study does not account for educational differences in mortality.

In the case of schooling, the study solely considers data from secondary school. Tertiary education is beyond the scope of the study.[3] Variations in higher education between nations reflects factor productivity and assumed to be constant throughout the simulation.

The study assumes that the amount of human capital seen in 20-24-year-olds in 2020 relatesso that created by the Human Capital Index-measured human capital investment flow.

The study examines nations separately to calculate variation in human capital, physical capital, productivity, and GDP per capita. Later, the study combines the whole data and takes averages to evaluate the implications for the world. The study will not use nation subscripts in computation as given below.

Calibration for the value t = 0
Where feasible, the study makes use of 2020 data to calibrate the model for the first period. When that year is not available, we use the next accessible year. The following sections explain how this data produce the model's beginning values.

### 3.3.2 Age-wise population and Working Age Population

Let $Pa,t$denotes total population (both sexes) in the age group "a" in year t. WARKAGE denotes the Working Age Population and calculated asas

$$WRKAGEt = \sum_{a=20}^{60} Pa,t$$

$WRKAGEFRACTt$denotes the labor force fraction and calculated as

$$WRKAGEFRACTt = \frac{WRKAGEt}{\sum_a Pa,t}$$

[3]The sole exception is the smaller collection of nations that depend on the Institute of Health Metrics and Evaluation (IHME) estimate of years of schooling, covering pre-primary and postsecondary education.

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### 3.3.3 Gross Domestic Product (GDP)

The study takes the GDP data from the World Bank's GDP in 2020, calculated in constant 2017 international dollars at purchasing power parity (PPP). The study calls this metric GDP0. The GDP per working age defines as

$$GDPPERWORKER_0 = \frac{GDP_0}{WRKAGE_0}$$

And GDP per capita can be calculated as

$$GDPPERCAPITA_{0=}GDPPERWORKER_{0\times}WRKAGEFRACT_0$$

### 3.3.4 Stock of Physical Capital

K0 denotes physical capital at zero time. The study uses the Penn World Tables 10.0 as our source and uses a country's 2019 stock of capital value at current PPPs in millions of 2017 $US. The capital per worker is therefore defined as follows:

$$KPERWORKER_0 = \frac{K_0}{WRKAGE_0}$$

### 3.3.5 Schooling

Data on educational achievement has been gathered from two sources for each five-year age group. The first is the Barro-Lees database on educational achievement, which covers 146 nations and is divided by gender and five-year age groups up to 2010. (Barro and Lee 2013).The institute of health metrics and evaluation is the second source of the education attainment (IHME 2015).The study assumes that each age group retains the value it would have had five years earlier for schooling assessment in 2020, and that no cohort receives any additional years of schooling beyond 2010. It is assumed, for example, that the 35-39 age group had the same educational achievement as the 30-34 age group in 2010. The exact value of educational attainment in 1980 is assigned to the age group 55-59 in the study. The study only considers the primary and secondary education attainment, and few countries have an educational attainment of more than 12; therefore, the study limits the value of 12 years of education.The data from IHME does not differentiate between different degrees of education. The study uses the approach used (Matthew, Weil 2019) to convert IHME years of schooling into Barro-Lee Primary and Secondary schooling equivalents. The study caps the average years of schooling at 12 years, as did with the Barro-Lee data.The average number of years of primary and secondary education completed by people in age group an in year t is EAaa;t. For the purposes of the calculations that follow, we'll assume that this measure's theoretical maximum is also 12.[4]

### 3.3.6 Standard of Education

Data on educational attainment is available for all age bins. However, the quality of education is very scarce for older cohorts, and most developing countries do not gather such data.As a result,

[4] It is worth noting that this approach to educational attainment differs from that of the Human Capital Index, which uses UNESCO methods to compute Expected Years of Schooling (EYS), based on a total possible 14 years of schooling from pre-primary through 12th grade. The study scales educational attainment proportionally to the EYS change in the following sections to address this mismatch.

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it assumes that all working-age populations at time zero have the same educational quality, even if their achievement differs, and therefore

$$EQ_{a0} = EQ_0 \ \forall_a$$

EQ0 is allocated to each country based on the most current available observation of harmonized test results from Altinok, Angrist, and Patrinos (2018). These are measured in PISA-equivalent units. " UsingAngrist, Filmer, Gatti, Rogers, and Sabarwal's (2018) technique, the study defines the most recent test score as Score0 and turn it into a quality measure".

$$EQ_0 = 1 - \Psi \times (\frac{625 - Score_0}{625})$$

Where $\Psi = 1$ which is consistent with the findings of Matt and Colin (2019)
Human capital as a result of health

As the study could not incorporate quality education for different age bins, we cannot assess the health condition of different age groups in our data. It requires locating childhood health inputs for now-middle-aged employees when they were younger. Instead, we apply the HCI's two concurrent health indicators, the proportion of stunted children and adult survival rates (ASR), to the total adult population. Our two health input metrics are ASRt and Stuntingt, which are not available in all countries.These measures directly contribute to the construction of human capital in the health sector. In a country with perfect health, it scales to a value of one. If both measurements are present, we develop.

$$HCI\ Health_{a,0} = e^{(\gamma_{ASR} \times (ASR_0 - 1) + \gamma_{Stunting}} \times {}^{Stunting_0}/_2$$

If only ASR data are available, we create health human capital based solely on ASR, so that

$$HCI\ Health_{a,0} = e^{(\gamma ASR \times (ASR_0 - 1)}$$

Based on Weil and Kraay (2007), we choose ASR = 0.6528 and Stunting = 0.3468. (2018).

### 3.3.7 Human Capital as a Whole

Total human capital for an age cohort is the sum of human capital derived from education and human capital derived from health.

$$HC_{a,0} = HCSchool_{a,0} \times HCHealth_{a,0}$$

We can calculate total human capital for the economy by summing all cohort-specific humanCapital multiplied by population. In practice, we only consider human capital per worker terms.

$$HCPERWORKER_0 = \frac{\sum_a^{60} Pa,t \times HC_{A,0}}{WRKAGE_0}$$

PRODUCTIVITY at TIME =0

$$A_0 = \frac{GDPPERWORKER_0}{Kperworker_0^{\alpha} \times HCperworker_0^{1-\alpha}}$$

The value of $\alpha = 1/3$, as Matt and Colin (2019) took in his paper.

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### 3.3.8 Rate of Investment

The study uses the World Bank's measure of gross capital formation as a percentage of GDP to determine the investment rate Inv0. The study assumes that the investment rate remains constant throughout the scenarios and takes on the average value for each nation from 2006 to 2020.

### 3.3.9 Simulation Scenarios

We will develop many possibilities for each nation for which we have data, each generated from the temporal courses taken by all endogenous variables. Each scenario will have a shared rate of productivity growth, which will be considered exogenous:

$$A_t = A_0\,(1+g)^{5t}$$

The study haschosen g = 0.013 from Weil and Matthew (2019).

**Scenario-1: Baseline Scenario (Constant HCI)**

The study begins by creating a route that would be followed if human capital investments per worker stayed constant at their time zero level (the current HCI). That is, the human capital of the youngest working generation (those aged 20-24) remains constant, while the entire population gradually acquires the same value when older generations retire.Other dynamics will emerge due to productivity growth, physical capital accumulation, changes in the working-age population size, and changes in the dependence ratio.

Cohort-specific human capital is created by aging all existing working-age cohorts and then assigning the amount of human capital from the youngest working-age cohort at time zero to the youngest working-age cohort.

$$HC_{20,t+1} = HC_{20,0}$$

$$HC_{a+5,t+1} = HC_{a,t} \qquad \text{For a = 25,……60}$$

$$HCPERWORKER_t = \frac{\left(\sum_{a=20}^{60} P_{a,t} \times HC_{a,t}\right)}{WORKINGAGE_t}$$

Capital evolves as

$$KPERWORKER_{t+1} = \frac{WORKINGAGE_t}{WORKINGAGE_0}\left[KPERWORKER_t + 5 \times \left(INV_0\, A_t\, KPERWORKER_t^{\alpha} HC_t^{1-\alpha} - \delta k_t\right)\right]$$

For capital depreciation, it assumes a base case value of $\delta$ =.05. The GDP per worker and GDP per capita are then calculated.

$$GDPPERWOKER_t = A_t \times KPERWORKER_t^{\alpha} \times HCPERWORKER_t^{1-\alpha}$$

$$GDPPERCAPITA_t = GDPPERWORKER_t \times WRKAGE\ FRACT_t$$

The baseline scenario is essential for understanding how, even if human capital investments were constant, GDP per capita would change when older cohorts with lower levels of educational attainment aged out of the labor market. Then, with varying degrees of optimism, we explore three possible scenarios in which the whole HCI increases at different rates over the subsequent 40 years.

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**Scenario 2: Typical HCI growth**

The study first analyzes how nations perceive gains in human capital components at the same bound as the median country over the last decade.To do so, the study looks to the HCI's data on projected years of schooling, harmonized learning outcomes, stunting rates, and adult survival rates. Due to unavailability of past data, the study takes the data from Weil (2019) for the rate of change at the 50th percentile and 75th percentile in each country's outcome for 2005 and 2015. This data can be seen in Table 1 below:

**Table 1:Typical & optimistic scenario (Changes in Human capital)**

| Outcomes | Change between 2005-2015 | Change between 2005-2015 | Median value in 2015 |
|---|---|---|---|
| | *50th Percentile* | 75th Percentile | |
| Expected years of schooling | 0.482 | 1.151 | 11.48 |
| Harmonized Learning outcome | 6 | 19 | 423.27 |
| (Non) Stunting rates | 0.051 | 0.1 | 0.77 |
| **Adult Survival Rates** | **0.022** | **.043** | **0.87** |

Source: Weil (2019)

We compare median levels of these outcomes in 2015 to the influence of these changes at the 50th percentile on the nation's HCI. That is, how much would the HCI change if a country with an EYS of 11.84 improved its harmonized learning outcomes of 423:57, non-stunted rates of 0.77, and adult survival rates of 0:87 by 0.482, 6, 0.051, and 0.022, respectively.We examine precisely the percentage change in the "HCI gap," which is the difference between the average human capital of the first age bin and the theoretical maximum of 1.0 that would result from this anticipated growth in the components. Closedt is the fraction of the time difference between the HCI's zero and maximum value in year t that has passed. A number of 0 indicates that the country's HCI has been stable since the beginning of time. A score of one indicates that the HCI has reached its maximum level.

If a nation with median values of the components in 2015 had the same growth in those components as the 50th percentile country (for each component) did between 2005 and 2015, the study would anticipate that country to close around 1.3 percent of the HCI gap every year, or nearly 6.5 percent in every five years.A score of one signifies that it has reached the maximum level of HCI.

Instead of reproducing advances in all components of human capital, we will mimic this scenario by applying a 6.5 percent (.0359) decline in the HCI deficit for each nation every five years.

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Consequently, the value of Closedt affects the human capital of the subsequent generation of workers.Therefore[5]

$$HC_{20,t} = 1 - Closed_t \times (1 - HC_{20,0})$$

**Scenario 2: Optimistic Growth in the HCI**
Inthis scenario, the study applies the same procedure as in scenario 1.However, the study examines the percentage change in the HCI gap that would result from a nation seeing the same increase in HCI components as 75th percentile countries. In this scenario, our fictitious nation would experience a 1.32 percent (.0132) annual decline in the HCI gap, equal to a 7 percent (.066) reduction every five years in our optimistic future.Thus, we apply a 7% decrease in the HCI gap for each nation in our simulation every five years.

**Scenario 3: the HCI moves to the frontier immediately**
In this scenario, we assess the change in GDP per capita that would occur if each country went to the border immediately (HCI = 1.0). In this scenario, each new age group between 20 and 24 has one unit of human capital per worker. As older cohorts pass away, the human capital per worker increasingly converges to this number. This is not a realistic scenario for the majority of nations, but it is a good exercise for estimating the maximum growth benefit of human capital upgrades. The growth effects of current investments are only realized at the rate at which the workforce ages and is replaced.

**Table 2: Human capital Per Worker**

| Year / Average HCI Per Worker | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|
| **Baseline** | 1.107 | 1.128 | 1.1901 | 1.2479 | 1.3024 | 1.3538 | 1.3988 | 1.4374 | 1.4738 |
| **50th Percentile** | 1.1338 | 1.2163 | 1.2959 | 1.361 | 1.4239 | 1.4833 | 1.5359 | 1.5818 | 1.6241 |
| **75th Percentile** | 1.2098 | 1.297 | 1.382 | 1.451 | 1.517 | 1.580 | 1.636 | 1.684 | 1.729 |
| **100th Percentile** | 1.21 | 1.38 | 1.59 | 1.799 | 2.019 | 2.251 | 2.490 | 2.743 | 2.840 |

Source: Author's own compilation

**Table3: Average Human Capital**

| Year / Average HCI | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 | 2055 | 2060 |
|---|---|---|---|---|---|---|---|---|---|
| **Baseline** | 0.5714 | 0.5801 | 0.5869 | 0.5919 | 0.5956 | 0.5987 | 0.6000 | 0.6000 | 0.6000 |
| **50th Percentile** | 0.5964 | 0.6052 | 0.6121 | 0.6173 | 0.6209 | 0.6240 | 0.6251 | 0.6251 | 0.6251 |

[5]It is worth noting that we anticipate that future increases in human capital investment will solely affect new generations of the workforce. This assumption is correct when the improvement is in the form of more excellent school quality and extra years of elementary and secondary education. It is in evident in the case of health due to a lack of data. Lower stunting certainly only impacts children, but to the degree that adult survival reflects improved health, it may signify higher human capital investment in present young people and better health of current adults. We may underestimate the impact of health improvements on production growth and poverty reduction if we exclude this latter route.

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|---|---|---|---|---|---|---|---|---|---|
| **75th Percentile** | 0.6372 | 0.6465 | 0.6536 | 0.6588 | 0.6624 | 0.6654 | 0.6667 | 0.6667 | 0.6667 |
| **100th Percentile** | 0.6237 | 0.6820 | 0.7385 | 0.7931 | 0.8465 | 0.8993 | 0.9503 | 1 | 1 |

Source: Author's own compilation

The study explains how the world HCI and HCI per worker changes over the period. Table 2 shows that HCI per worker grows gradually from 2020 to 2060 while in the scenario HCI moves in frontier immediately shows that HCI per worker twice as baseline scenario. Table 3 shows the average HCI of the world. It indicates that rise in investment on education improves human capital and productivity.

## 4. EMPIRICAL RESULTS

### 4.1 Human capital and Human capital per worker

The study computes resultfor each nation in the study for 40 years into the future, from 2020 to 2060, then average out the findings throughout the complete sample, which we refer to as "the globe."[6]The study computes human capital per worker for the globe in absolute terms. In our baseline scenario, where human capital investments stay constant, human capital per worker increases over the next 40 years primarily due to demographic changes. Human capital per worker grows somewhat under typical and optimistic scenarios, from around 1.13 to 1.62 and 1.20 to 1.729, respectively.While human capital expands under 50th and 75th percentile from 0.59 to 0.62 and 0.63 to 0.66 respectively.

### 4.2 Human Capital Investment versus Physical Capital Investments

Throughout this research, we have looked at how increasing investment in human capital might boost economic development as measured by the HCI. Naturally, before approving such a strategy, it would be prudent to evaluate its cost-benefit ratio to alternatives. The most obvious of them to evaluate is physical capital investment. A comprehensive comparison is outside the scope of this research because we have not specified the costs of enhancing HCI. To provide some light on the issue, we use a different approach, comparing the size of improvements in HCI and physical capital necessary to produce a specific rise in production in the steady state.While the steady-state effects of the two policy changes outlined above would be same, the transitions to steady-state would be distinct. To put it another way, investments in both human capital and physical capital require time to bear fruit, but their temporal profiles differ. Physical capital stock responds more quickly to changes in investment than human capital stock.

## 5. CONCLUSIONS

The significant disparities exist across the nations in terms of the ratesof Human Capital Investment on their populations. Taking a comprehensive measure that covers education quality and quantity and measurements of the effect of health on worker productivity, there is a factor of three differences in the human capital of new employees in high-investment nations relative to those that invest the least.Human capital investment rates are significantly connected with per

[6] Our findings encompass around 90-92 percent of the world population for the period considered in this research.

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capita income. Due to health and education deficiencies, employees' decreased labor input is a significant factor in poverty in many countries.These findings indicate that increasing investment in human capital is an attractive method for enhancing revenue. This study quantified the dynamic responses of income to such an increase in investment. In this instance, the time dimension is crucial, as the advantages of increased human capital investment have extremely lengthy gestation periods. It takes a long time to develop a new worker, and it takes much longer for workers who were subjected to inferior human capital investments during their adolescence to leave the labour force.Our primary experiment compared the paths of income under two distinct scenarios to a baseline in which the current rate of human capital investment in every nation stayed constant into the future. In one scenario (labelled "normal"), each nation's human capital investment increases at a rate similar to what was witnessed in the decade ending in 2020. In this scenario, the global GDP per capita in 2060 is five percent higher than the baseline. In the "optimistic" scenario, each nation is projected to expand the components of human capital investment at a pace equivalent to 75% of what was observed in the data. In 2060, the global GDP per capita is predicted to be 12% higher than the baseline.We also utilized our model to compare the dynamics of production growth in response to increased human capital investment to those in response to increased physical capital investment. The latter provides far greater growth benefits; that is, a country can construct more equipment and infrastructure faster than it can build better personnel.Our informal comparison of the prices of the two types of investments reveals that investing in people is significantly less expensive than investing in machines to offset the temporal advantage associated with investing in machines.

Finally, while we have emphasized the instrumental value of investing in human capital to create money (both for the country as a whole and for disadvantaged individuals), it is essential to recall that the kind of investments under consideration yields benefits in other dimensions.Individuals can lead fully realized lives and engage more actively in their communities due to long years and higher quality education. Better health, which we have only examined to make employees more productive, also permits individuals to live for longer periods of time. Taking these advantages into consideration, a significant investment in human capital is a necessary catalyst for a rapid economic growth.

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