A Study of the United States' Increasing Human Capital Throughout the 20th Century

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Abstract

Throughout the 1900's, the United States saw rapid human capital growth which led to significant changes to the overall economy. This analysis will use the average level of education as a proxy for human capital accumulation by the workforce. Human capital plays a pivotal role in economic growth. As the civilian and working population gain better skills, they can use these skills to create more value in a given timeframe, leading to economic growth year after year. At the start of the century, the United States was a heavily manufacturing country, with a workforce that had limited human capital shown by many individuals not even graduated high school. Shortly after WWI, nearly every teenager was given a chance to finish high school, and the teenagers' human capital and graduation rates increased. After WWII, a similar, albeit smaller increase occurred with higher education. The second-half of the 1900's showed a gradual and persistent trend of more college graduates and an ever-increasing human capital. This ever-increasing human capital allowed the United States to move away from manufacturing and move towards service-based industries that create more economic growth.

Introduction: An Overview of Economic Theory

Throughout the 1900's, the United States saw initially an increase in high school graduation rates, then an increase in higher education (like 4-year degrees or graduate degrees). This dramatic shift from the "uneducated" masses to the "educated" masses highlights greater human capital accumulation. **Human capital** is defined as skills, knowledge, and experience possessed by an individual(s).[1] Unfortunately, the basic economic growth theory, the Solow model, fails to capture the impact of human capital:

$$Y(t) = K(t)^{\alpha} \left(A(t)L(t)\right)^{1-\alpha}$$

The model estimates GDP (Y) at time *t* as a function of the total factor of productivity or "knowledge" level (A), the physical capital or investment[2] (K), and number of employed workers (L). This formula is primarily used in economic growth accounting by comparing 1-year differences in economic output to get a growth rate or change year over year. Growth accounting tries to map the economic growth and change in economic output to a set of underlying variables like technology and knowledge (A; the primary cause), physical capital investment by firms (K), and changes in the labor markets (L).

The Solow model does not estimate human capital directly but does capture technological and other efficiency gains through the productivity term (A). This 'A' term is called the "total factor of productivity" (TFP) and the TFP drives sustained growth. The Solow measures physical capital and labor directly, however, these values have upper limits. Physical capital is often constrained by the number of workers, and the labor market, by the amount of available people to work and physical capital. For example, If you have 100 workers with 100 tractors, getting another 100 tractors will not double the economic output; you need 100 tractors and 100 laborers. Therefore, the Solow model has an optimal steady state where there is an ideal K (amount of physical capital) and L (amount of labor), resulting in the optimal economic output where no more growth will occur.

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[1] Human capital will be synonymous with education from this point forward.
[2] Investment here typically is represented as to I = Y – G – C (from the standard equation for GDP, Y=I+G+C).

So, if there is a steady state, how do economies continue to grow. The TFP drives economic growth. This TFP highlights that as time passes, as new generations are born, experience and knowledge is passed down. The next generation is at better place than the previous. Therefore, the model keeps increasing that steady state of economic growth, leading to consistent year-over-year economic growth as the technology and knowledge improve. Unfortunately, the Solow model calculates the TFP (A-term) backwards. It plugs the estimates for physical capital and for the labor market and the economic growth recorded. Then, the growth that is not explained by physical capital or the labor market will be attributed to the TFP. For example, the growth accounting may only indicate that the economic growth driven by increased physical capital was only 0.5% and the economic growth from the labor markets was only 0.6%, but the total measured economic growth was a total of 2%. Thus the TFP was responsible for 0.9% of economic growth.

A newer and refined version of the Solow model was produced in 1991 by Mankiw, Romer, and Weil where human capital is explicitly defined as:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\alpha-\beta}$$

The variables represent the same values as in the Solow model with "H" representing a proxy variable for aggregate human capital accumulation for the country.[3] Comparing this augmented Solow model to the traditional model by doing a cross-country regression shows the augmented model captures 78 percent of unexplained variance of a cross-country analysis versus the traditional model capturing 59 percent of the unexplained variance. Both results show significant variation is explained, even when ignoring the human capital element. The amount of variance explained is very high for macroeconomics, indicating that there is good reason to believe these formulas are applicable to reality (1992).

Theoretically, if a country has high human capital levels, they should have high marginal productivity of labor because the workforce is more skilled than without high human capital accumulation. The short-run effects of human capital can also be shown through the TFP or

[3] The proxy variable used is share of population between ages 18 and 21 that forgo work and attend college. The goal of the proxy is to estimate the importance of human capital accumulation for a given country.

knowledge term in the basic Solow model and the “H” term in the augmented model. The marginal productivity of capital should increase because both workers have higher human capital and workers can develop superior physical capital over the long-term. This increased productivity from capital and labor results in increasing the returns for the firm.

However, not all the benefits are given to the firms, or the individuals would never even consider high school, college, or a post-graduate education. Naturally, the best way to entice individuals to increase their human capital levels is to pay better wages. However, these wage premiums need to be significant as people often forgo earning wages for 4-8 years by studying at university. These 4-8 years must be repaid with interest by these wage premiums, or else individuals would still choose to not bother with higher education.

In practice, these wage premiums are often given to individuals with higher levels of education because the demand for high levels of human capital is increasing. There is evidence over the past century that wage premiums for attending college have been increasing and was the primary factor when deciding whether to enter the workforce or to attend college. By studying the rise of the average human capital levels of the citizenry within the United States over the past century, it can shed light on the era of United States economic dominance.

Part I: The Rise of High School; the Path to University

Starting in the early 1900's, the United States started a new trend: universal publicly funded secondary education. Goldin and Katz study the implications of the "high school movement" by studying Iowa's census from 1915 to 1940. Iowa is used as a proxy for the United States because there is no Census data from before 1940, except for the Census of Iowa in 1915. They find high school graduation rates for youths increased from 10 percent in 1910 to 60 percent in 1935 (Goldin and Katz, 1998). This is the first significant increase to human capital accumulation in the twentieth century. This allowed anyone, initially utilized by the wealthier neighborhoods, to qualify for more skilled jobs. Though Iowa is considered and justified as a good proxy for the United States, bear in mind that it is just one state among 48 (Hawaii and Alaska were not states; Arizona and New Mexico recently joined the United States in 1912).

Additionally, a comprehensive overview of education in the United States by the U.S. Department of Education shows similar results across the country. They measured the enrollment of 14–17-year-olds in secondary schooling (high school). They found that between 1910 and 1940, the enrollment rates jumped from 10% to 70% (United States, page 27). That is a massive increase in high schooling. This jump helps to set the stage for university as teenagers across the country had a skillset that allowed them to consider enrolling in university to further their own human capital levels.

Goldin and Katz find that there are significant returns to this high school attendance. They find a 10 to 12 percent increase in wage for each additional year of high school compared to someone without any post-primary schooling (Goldin and Katz, 1998).[4] They find similar wage premiums[5] for each additional year of college compared to someone without any college experience. This implies that high school and college were roughly equal in importance, and

[4] This wage premium is comparing people with high school experience (years attended) versus a control group of only people who completed the default primary schooling and never had further education.

[5] "Wage premium" represents the additional wages a certain education level will give compared to a lower level. Often it is a median (or average) wage for someone with college degree divided by median (or average) wage for someone with only high school degree. The degrees can change depending if it is the high school movement (i.e. high school degree wage / primary school degree wage) or college movement (i.e. college degree wage / high school degree wage)

that college was an extended form of high school. There were hardly any returns from having additional years of primary schooling, meaning staying at primary school, when a high school did not exist nearby, was not an adequate replacement.

Part II: Post-War College Boom

Abramovitz states that in the years between 1900 and 1988 there was a labor force demographic change of only a select few with a high school diploma to 85 percent of the labor force had a high school diploma and 45 percent had some post-secondary schooling. Within the 45 percent who had some post-secondary schooling, 58 percent, or about 26 percent of the labor force, had 4 years of post-secondary schooling or more. Abramovitz also states that education was only attained because it was beneficial when looking at a cost-benefit analysis. The cost of higher education and money lost to attending school rather than joining the workforce, were outweighed by the wage premiums given for future work after having a college degree or even just had some college experience. The premium has increased between 1970 and 1990's, implying the benefits of college are greater than the costs to attend college in the long-run (Abramovitz, 1993).[6]

Many economists have studied the earning premiums from higher education after the 1960's, when significant number of workers had attended higher education, and many had actual degrees. Katz and Murphy found that the increased wage inequality in the 1980's was caused primarily by firms' increased demand for higher-educated and "more-skilled" employees. Though another explanation looks at the computer revolution in the 1970's and 1980's, which would decrease the demand for physical labor, hurting the poorly educated workers most. In both scenarios, the more educated an individual is would correlate to having a higher wage premium because the higher-level skills were in-demand, and the lower-level skills were being replaced by technology (1992).

The Katz and Murphy findings show wage premiums increasing between 1963 and 1987. These findings show a general trend illustrating the increasing demand for individuals with high human capital accumulation. They find that the industry employment shares[7] within the United

[6] Unfortunately, the data Abramovitz considers stops before 2000, and therefore does not consider the implications of the Dot-Com bubble and the Great Recession.Currently, there are many more questions being asked related to the costs of higher education and whether the costs are still outweighed by the future benefits. More on this question later.

[7] Employment shares represent the percent of the employed labor force that is within a given subset of the industry (like manufacturing or financial services).

States changed; meaning the United States economy was changing from production and service work towards professional and technology-oriented jobs (Katz, murphy). These employment shifts also caused higher demand for a more educated labor force resulting in these increased wage premiums. The production and service worker employment shares declined from 50.6 to 42.2 percent (net is -8.4), and professional (technology and managerial positions) increased from 28.1 to 35.4 percent (net is +7.3). These industrial sector shifts helped the more educated and women the most. Women, often ignored for the more physically intensive jobs, were now able to get good paying white-collar jobs, expanding the potential workforce available to employers (Katz and Murphy, 1992).

Additional studies have found similar increases in earning premiums for college graduates between the 1980's and 1990's compared to prior decades (Abramovitz, 1992; Pascarella and Terenzini, 2005). Pascarella and Terenzini find a 40% increase in wages on average for an individual with a bachelor's degree versus a high school graduate's average wage during the 1980's into the 1990's. This indicates a high premium placed on higher education to reach higher levels of aggregate human capital accumulation. These premiums clearly tried to attract people to attend college and then reap the rewards later in life. This shows the idea that supply of skilled workers was insufficient, so firms increased the wage to attract more workers to attend higher education.

Additionally, Pascarella and Terenzini find significant differences between area of degree seem to impact wage premiums significantly. The fields with the highest premiums typically have "functional linkages with specific jobs" such as computer science or engineering (2005). These differences based on majors is not a new concept, but it started showing a divergence in wage premiums in the 1980's and 1990's as more technical jobs (like software development) became in-demand.

Part III: The Economic Effects and Growth

Overall, the twentieth century shows a significant shift in the value of human capital; initially starting with the high school movement from 1910 to 1940's and then the post-secondary movement after World War II. The firms continuously demanded more and more human capital because the economy was shifting from the manufacturing and physical labor to a more technology-based economy that required more human capital than previously needed. The rise of the computer certainly helped increase the demand for higher education in the 1980's and 1990's shown by the increasing wage premiums for higher education. These wage premiums helped convince people to attend college to reach higher potential income levels.

Clearly the push for education was predominantly caused economic reasons by firms and potential workers. Firms wanted a skilled workforce that could compete, and ideally trump, all other countries; and potential workers would be given wage premiums for attending college. The individual's wage premiums would outweigh the cost of education and the forgone wages to attain said education. And the model posed by Mankiw et al. (the augmented Solow model), shows that the economy was boosted by this greater aggregate human capital accumulation. Their findings suggest that human capital accumulation is roughly equal in importance as physical capital. The augmented model's regression analysis shows that the basic Solow model may have been forgoing a significant part of economic growth theory: the effects of human capital on economic growth (1992).

The augmented model also shows greater return for human capital than physical capital in terms of magnitude for OECD countries (human capital coefficient of 0.76 versus physical capital coefficient 0.28) than intermediate countries[8] (0.73 versus 0.70) or non-oil countries[9] (0.66 versus 0.69). As the OECD countries have a higher standard of living and generally a

[8] The "intermediate" countries are countries with little information on income from 1960, meaning population surveys may show more errors than expected. Meanwhile, the OECD countries have very accurate and robust estimates.

[9] Non-oil countries refer to countries where oil production is not a significant percentage of the economy, meaning these economies are not based around added-value to goods. Mankiw et al. do not believe standard growth accounting is useful for forecasting and finding patterns in these oil-dominant economies.

stronger economy, this would imply that human capital is more valuable in developed economies.

A more comprehensive study by Abramovitz on whether there has been a shift away from physical capital to human (or intangible[10]) capital. Abramovitz studies the shares of physical capital and TFP (total factor productivity, or the "knowledge" level) on economic growth in America between 1800 and 1989. Though TFP is not directly human capital, it does contain some human capital in the calculation. Abramovitz shows evidence that the TFP, and by extension human capital, was a minor aspect of economic growth in the 1800's through early 1900's; while physical capital had a large share of the economic growth. This finding is hardly surprising as during the Indusrial Revolution, the driving force of economic growth was indeed physical capital. Better and better physical capital allowed for more output.

After the Industrial Revolution started to end, and the Information Age was born, the role of physical capital declined. Abramovitz looks at the shares of economic growth during the 1900's and finds that TFP became increasingly important; conversely, physical capital dropped significantly in importance to sustaining economic growth. His conclusion is there was a switch from physical capital demand to non-physical capital demand; most likely human capital.

Both history of wage premiums for higher education and the economic growth theory shows significant changes in the value of human capital. Since 1900, the United States has seen rapid evolution of schooling from the birth of secondary school to the modern era where everyone is expected to at least have some college. When the push for education got started, there was a demand for higher skilled workers to work more complex jobs that created more economic value resulting in higher wages. This basic economic theory of increasing wages to attract individuals worked, unsurprisingly. People saw a way to earn more money by attending high school and college, and correctly believed the benefit was greater than the cost.

[10] Intangible capital is broader than just human capital. Human capital relates to individual's knowledge, skill, and experience; but intangible relates to all capital not deemed physical.

Conclusion

The 1900's brought huge growth to high schooling and post-secondary schooling, resulting in an explosion of human capital. This increased human capital allowed the United States to shift the economy away from manufacturing and working with raw resources, towards a more advanced service-based economy. These services include the technology sector with computers and servers, to medicine, to the financial sector, to engineering. Many sectors saw increases in the number of suitable workers due to the increased human capital level. These new and growing sectors brought tremendous economic growth, especially towards the end of the 1900's.

Unfortunately, all booms must come to an end. The United States is now no longer the clear leader in human capital accumulation and level. Not because the United States have given up on education, but that other countries have pushed for their own education systems to properly train future workforces to have higher levels of human capital. However, a rising issue in the United States is that wage premiums for 4-year degrees are starting to stagnate while the cost of these degrees increase substantially. This stagnation, as well as rising income inequality, increasing college costs, increasing healthcare costs, and increasing housing prices create an environment of economic anxiety for the younger generations (Piketty and Saez, 2003). With rising anxiety among the younger generations, many people believe publicly funded college is the answer.

Many believe the solution to the anxiety over college's cost and allowing the economy to boom again with 5% growth, is to allow university to be free. However, I feel it is far from that simple. Free college may help, but the issue is not education, but human capital levels. Remember, education is only a **proxy**. As a country we need to increase the human capital to help drive the economic growth upwards as shown in the Solow model through TFP and the modified model by Mankiq, Romer and Weil. Some solutions may not be to increase the amount of schooling (like offering 4 years free of university), but to **improve** the schooling system. The role of human capital is more important than ever, and hopefully policies can be set to help facilitate better accumulation of human capital.

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