

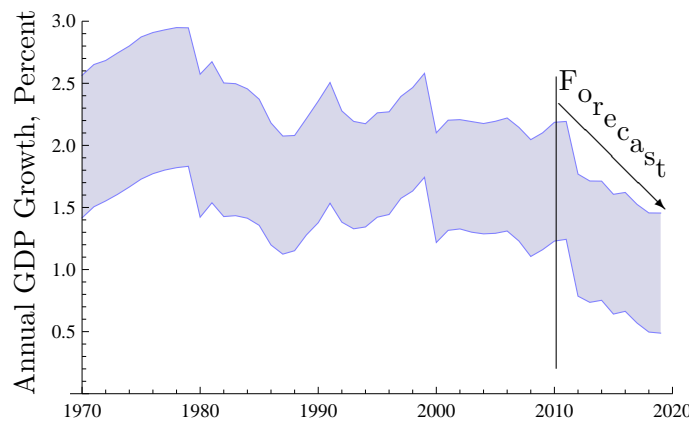
Decline of Economic Growth: Human Capital & Population Change

Henry Potrykus, Patrick Fagan*

September 8, 2011

Overall GDP growth in the United States has been lagging for more than 50 years, a phenomenon known as the ‘growth slowdown.’¹ Human capital considerations, when they are tied to the demographics of the working population, explain this growth slowdown (Chart 1).

Chart 1: Decreasing Human Contribution to GDP Growth



Expected economic growth rates were about 4 percent per year (or more) in the post-war period, with growth in human productivity—labor and skills, capacities, and know-how of the worker, that is, human capital—playing the major part.^{2,3}

*Henry Potrykus, Ph.D., Senior Fellow; Patrick Fagan, Ph.D., Director. Correspondence may be addressed to the first author at hgp@frc.org.

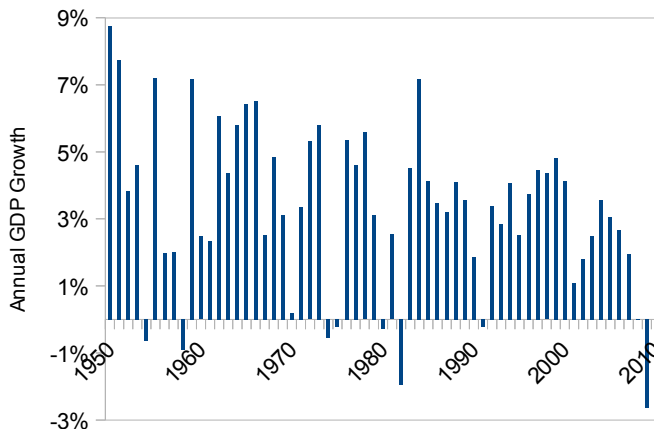
¹Robert Barro and Xavier Sala-i-Martin. *Economic Growth*. Second Edition. Cambridge: MIT Press, 2003.

²James Heckman and Dimitriy Masterov. *The Productivity Argument for Investing in Young Children*. Tech. rep. WP 07-03-22c. University of Chicago, 2007.

³J. Delong, L. Katz, and C. Goldin. “Sustaining American Economic Growth”. In: *Agenda for the Nation*. Ed. by H. Aaron, J. Lindsay, and P. Nivola. 2003.

Chart 2: Slowdown in Real GDP Growth (1950-2010)

Bureau of Economic Analysis NIPA



A slowdown in GDP growth from past levels, over the foregoing decades, has been driven by a human productivity slowdown, from nearly 3 percent per year in the 1970s to less than 2 percent in the 2000s (Chart 1).

General Overview

Chart 1 shows the ‘human’ contribution to GDP growth.^{4,5,6} This decreasing con-

⁴The quick upturns and downturns in the graph are due to (large) changes in cohorts (population concentrations; cf. Chart 5) entering or leaving the workforce, a demographic reality the model captures.

⁵Even though the baby boom contributes generally to growth throughout their careers, their greatest effect is *demographic*. Upon their entry into the job market around the 1970s they contribute massively to economic growth even though their human capital is still developing.

⁶The band graphed in Chart 1 parameterizes different levels of learning that generations receive before entering the workforce. See the “Model Overview” section for further discussion.

tribution has two driving characteristics:

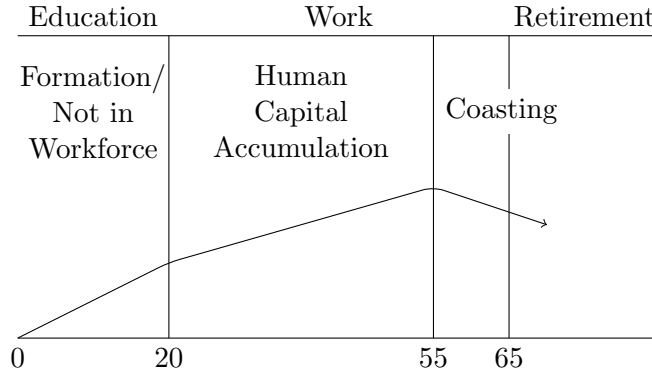
- The overall demographic make-up of the working U.S. population;
- The productivity contribution at various stages in life by that working population (see Chart 5).

This productivity contribution is quantified through the changes in the population’s human capital: the skills, capacities and know-how held by an individual.

Chart 2 depicts the reality of the slowdown in GDP growth, as given by Department of Commerce statistics.

Comparing Chart 1 to Chart 2 explains all of the growth slowdown of the last 40 years by tracking changes in the laboring population and its human capital ‘deposit.’ The contribution of physical capital (physical plant and machinery contributing to production) to GDP growth is slightly more than 1 percent

Chart 3: A Worker's Human Capital Development



per year over the period in question.⁷

We employ our method to project economic growth into the future. As seen in Chart 1, the growth slowdown is projected to continue and become more serious during years 2010-2020, with consequences for the overall economic picture of the United States.⁸

Populations' Effect On Growth

The slowdown of GDP growth is explained by the concentration of both population and human capital in the baby boom, which is now being replaced by lower human capital cohorts. This study looks

⁷Barro and Sala-i-Martin, op. cit., this can be seen from a modifications of standard 'growth accounting' estimates. The forthcoming technical expansion of this paper contains an elaboration on this point. See marri.frc.org/human-capital/2 .

⁸See H. Potrykus, P. Fagan, & R. Schwarzwald, "Our Fiscal Crisis: We Cannot Tax, Spend, and Borrow Enough to Substitute for Marriage." MARRI Research, June 2011. marri.frc.org/fiscal .

only at human capital, as quantified by standard wage curves, to predict that the U.S. economy will continue to sputter over the coming years. This slowdown is amplified by the retiring of a generation with significant human capital (the baby boom) and its replacement by a generation inadequate in population size to continue the expected and required growth of the macroeconomy.⁹

Human Capital

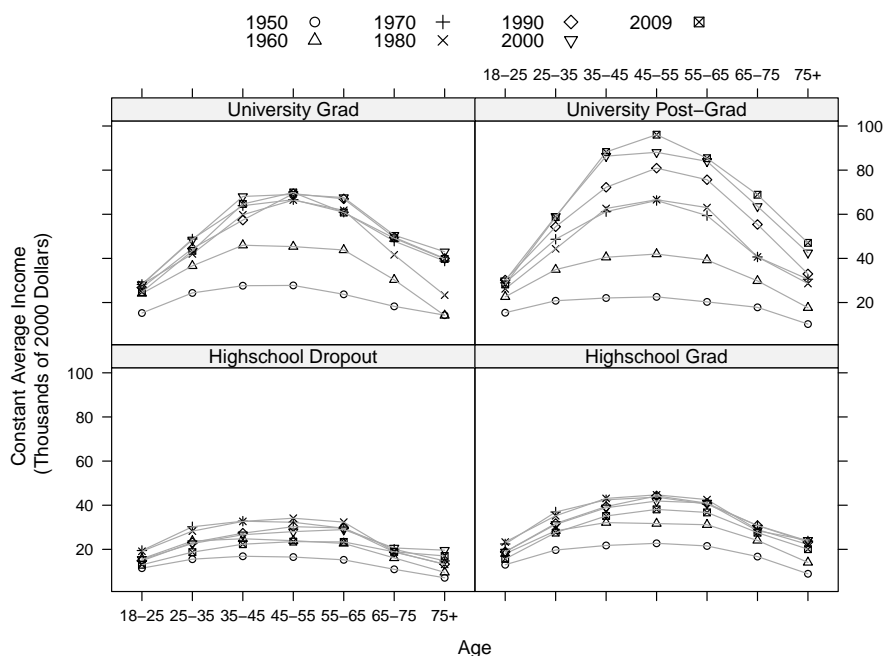
Chart 3 shows the course of development human capital typically takes over the life course of workers. There are four basic phases in workers' lives.¹⁰ Prior to entry into the workforce there is a training or formative period. Then, upon entry

⁹This includes future support of the welfare state.

¹⁰Gary Becker. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. Third Edition. Chicago: University of Chicago Press, 1994.

Chart 4: Income Scales

Derived from U.S. Census Long Forms and American Community Surveys



into the workforce there is a further accumulation of skills, competencies, and know-how (all human capital) as laborers gain in experience and income annually, up to their year of peak productivity (around 55 years of age). Thereafter, in the post-prime phase, workers tend to coast—with little or no further investment in human capital—until they retire. This phenomenon occurs during the coasting phase, and is followed by the last phase, retirement.

Human capital—marketable skills, capacities, and general or specific know-how—has a value that is quantified in the market exchange of work for wages.¹¹ Hence, the schedule of income rises and falls over the careers of a class of workers.

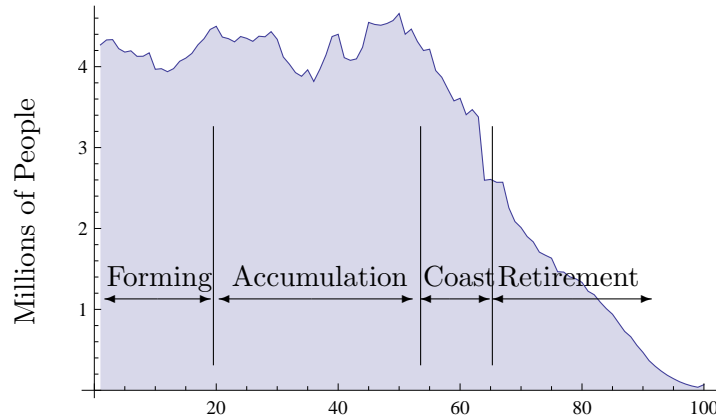
¹¹Ibid.

Chart 4 quantifies these levels of human capital for different levels of education.¹²

For purposes of illustration we might imagine an engineer who up to age 20 is being formed and so obtains skills, capacities and know-how that are valuable to his future profession. After 20 years of such formation he begins to work, at first through paid internships, then as a full-time employee, all the while accruing human capital. Until age 55 he continues to attend professional conferences, reads literature pertinent to the technology of his field and interacts with other engineers, all of which increases his deposit of human capital. Moreover, he obtains many

¹²The rate of increase of human capital while one the job is quantified by a roughly 1.2% increase in income for each year on the job, see Chart 4.

Chart 5: Labor Phases for the U.S. Population:
Population Totals for Each Age, 2010
U.S. Census Current Population Projections



habits that help him function well as a practicing engineer.¹³ Around the age of 55 he may realize that further investment of time and effort into his own human capital formation is not worthwhile and begin to coast, allowing his human capital to stagnate and depreciate until his retirement.

A similar trajectory applies to other jobs, professions, and categories of workers, Chart 4.

Population Phases of Human Capital

Chart 5 depicts the population totals for each age-year in 2010, showing what phase of human capital development each of

¹³Flavio Cunha and James Heckman. “Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation”. In: *Journal of Human Resources* 43 (2006), pp. 738–782, these capacities and habits are often called non-cognitive skills.

these population segments currently falls into. As the working population ages over time, their human capital evolves as they progress through the labor phases first illustrated in Chart 3.

The baby boom generation is moving through peak productivity now and is transitioning into the coasting phase with concomitant human capital depreciation. Moreover, as a cohort, it is beginning a rapid entry into the retirement phase of the life-cycle.

Our method quantifies the effects of these transitions in the model, illustrated in Chart 6.

Overview of the Model

In its most elementary form, for a given age-cohort—e.g. age 50 as singled out by the long horizontal line in Chart 6—the model multiplies the value of a cohort’s accumulated human capital by that work-

Chart 6: Calculation of Human Capital Contribution to GDP

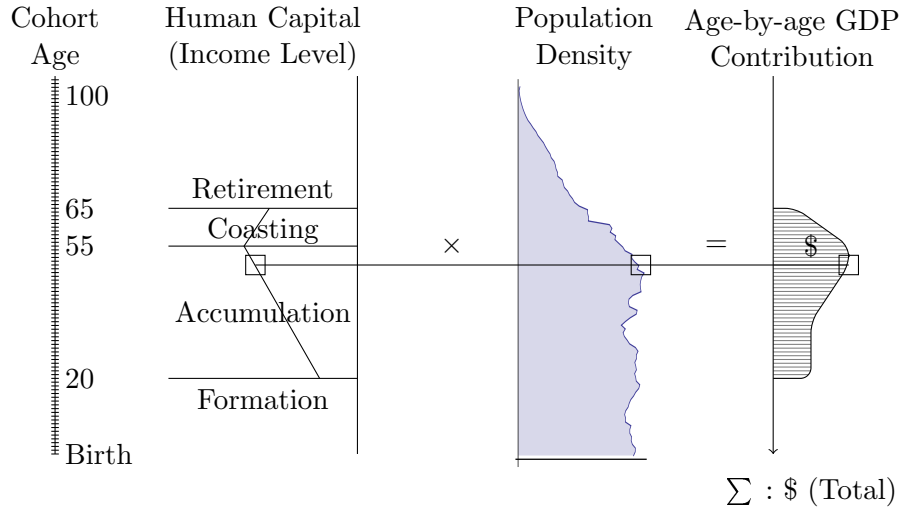
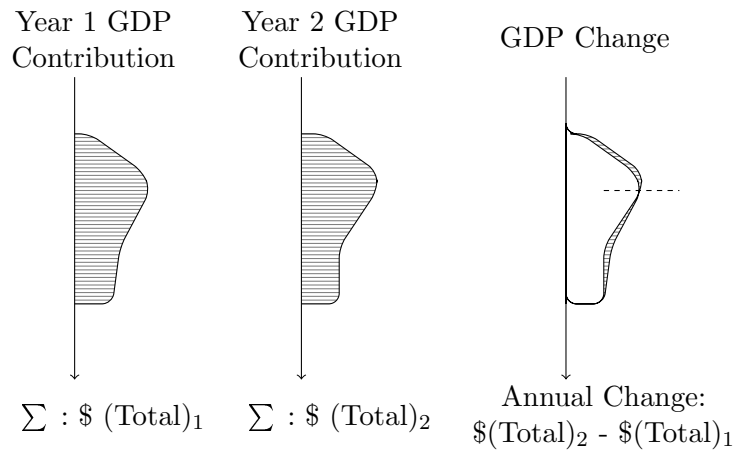


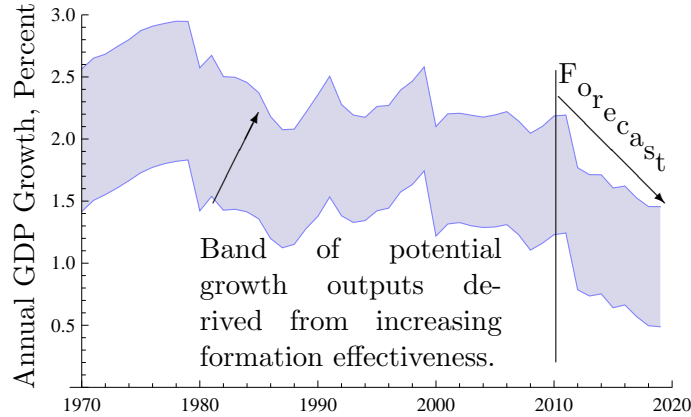
Chart 7: Annual Comparison of Human Capital Contribution to GDP



ing cohort's population count. The values across the age-cohorts are then totaled yielding the human contribution (labor plus human capital) to economic production.

From this calculation of the human contribution to economic production we then compute annual changes in economic production, i.e. economic growth, as shown in Chart 7.

Chart 8: Decreasing Human Contribution to GDP Growth



Completing the Model

Human capital is composed of two types: transferable and non-transferable. Transferable human capital is the effect of knowledge transfer, i.e. what one person teaches or passes on to another. We recognize some human capital is passed forward to the newer generations of workers during their formative years; it is taught or otherwise conveyed, e.g. through schooling, apprenticeships or less formal mentoring or training. Non-transferable human capital is gained and increased solely by the individual's efforts which yield experience particular to him alone.

For various levels of the transfer of human capital during the formation phase, the younger generation is better or worse able to leverage the older generation's know-how. In the model simulation, this allows the younger generation to transition out of the formational period into employment with the same or fraction-

ally less human capital currently found with their forefathers. The results of different transfer levels are plotted as a band of growth contribution levels in Chart 1, shown again here in Chart 8.

Conclusions

This paper developed a simple model of human capital and population evolution so that the component parts contributing to economic growth are clearer, and demonstrated the importance of human capital to the macroeconomy. Human capital and labor combined with physical capital each contribute roughly equal parts to growth.¹⁴ Increasingly it has been hoped by many that physical capital may substitute for any decline in population's and human capital's contribution to growth. However, this has not been attained his-

¹⁴Barro and Sala-i-Martin, *op. cit.*

torically.¹⁵ Also, for the output of the other major institutions of society—family, education, government [crime], and health [longevity, addictions]—it is the development of the human person—which re-

¹⁵DeLong, Katz, and Goldin, *op. cit.*, these authors describe policies for *physical capital investment* as brought up in H. Potrykus, P. Fagan, & R. Schwarzwald, *op. cit.* (household savings, fiscal prudence).

sults in higher human capital—that is much to be preferred. Thus, the historical balance of population growth, human capital development, and physical capital investment is the optimum national path to economic growth. Growing our human capital is critical to our future economic growth.