

HUMAN CAPITAL IN RESTORING EQUILIBRIUM*

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It is no secret that I am addicted to human capital. It makes me feel good to see so much of it at this conference. I confess, however, that growth models do not turn me on. I am especially fond of small entrepreneurs. It hurts me to see them left out, as if they were outcasts. Even Schumpeter, a real pioneer in economics, overlooked small entrepreneurs. I see disequilibria, as increases in income events occur, whereas growth model builders abhor disequilibria as Nature abhors a vacuum.

Economics thrives on metaphors. Growth is such a metaphor. The concept of growth is basically biological. "Grow wheat" is meaningful; "grow computers" makes no sense. Biological metaphors have some advantages over mechanical metaphors. Marshall's preference for biological metaphors has not gone unnoticed; their limitations have been stressed.

Growth economics connote an orderly, steady process of advances in the economy. Thus, the stage is set for the assumption that economic growth is a tidy, steady, and balanced process. This assumption is a serious flaw in growth models. We need a concept of increases in income that is not burdened by biological connotations.

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There are research endeavors to explain national increases in income. These endeavors may be trying to explain more than is possible in view of the limitations of economic knowledge about changes in economic conditions over time.

What has emerged, however, is a substantial consensus in economics on particular sources of increases in income. We may be well advised to concentrate our analytical work on the income increasing properties of each of these sources.

These overlapping sources include: (1) advances in technology, (2) increases in return events, (3) proliferation of human capital, and (4) additional specialization induced by the increases in income derived from (1), (2) and (3). As these increases in income are attained, dis-equilibria occur and some additional income is derived from restoring equilibrium.

Part one is a brief critique of the first four overlapping sources of increases in income; part two concentrates on human capital in restoring equilibrium.

PART ONE

Advances in Technology

At long last, we have new commitments to treat advances in technology as endogenous events. These advances are man-made. They originate from within the economy. Neither the sun, the earth, the wind, nor El Niño is in the business of developing new and better technology. The economic analytics of endogenizing technology awaits additional theory and evidence.

In retrospect, it seems odd that the early, popular growth models treated technology as being exogenous. What seems even

more peculiar is that now, in designing models to endogenize technology, there appears to be no awareness of the published contributions on theory with evidence pertaining to this issue. The analytics of endogenizing advances in technology, including robust estimates of costs, rates of returns, and gains in welfare, were first published thirty years ago by Zvi Griliches in the JPE, October 1958, "Research Costs and Social Returns: Hybrid Corn and Related Innovations." Griliches' classic study paved the way for a considerable number of comparable technological studies.

Treating agricultural research as an investment, the rates of return were and continue to be high compared to normal alternative investment opportunities.

We also have learned that it may take many years before returns from higher yielding crops are realized, as was the case in hybrid corn. A theory of hybridization dates back to 1905. Public research expenditure began in 1910. It took 23 years of research to create the first hybrid to be released. Griliches' study was based on data up through 1955. The accumulated past research expenditures on hybrid corn, as of 1955, came to 63 million dollars. By then the annual return had become very high. As a technological advance, hybrid corn is a great economic success story.

Ponder the economic meaning of the following U.S. evidence. The first application of hybrid corn began in the early thirties. For the purpose at hand, 1933 is pre-hybrid corn. In 1933, the acreage planted to corn was 109.8 million. By 1987 only 76.7 million acres were in corn, or 33 million acres less than in 1933. The 1987 production, however, was well over three times that of

1933, 8.25 and 2.40 billion bushels respectively.

The economic story of hybrid corn including all of the complementary inputs, the value of the output from the cropland released from corn, the reductions in the costs of feed to produce livestock products and the resulting consumer surpluses, all occur inside the economy. They are an important part of the basic economic stuff in explaining increases in income.

The high yielding wheat variety that India imported in the mid-sixties was created by highly competent specialized plant breeders at CIMMYT in Mexico. India's wheat production sky rocketed from 11 to 46 million tons by 1984. While we await a theory of economic productivity to rationalize this extraordinary event, we should try to explain why the rates of return to land, fertilizer, equipment, labor, and to the entrepreneurship of farmers in the wheat growing parts of India, especially so in the Punjab, all exceeded normal rates for a period of years.

The spark that ignited the Green Revolution in wheat in India had its origin in CIMMYT. It entailed years of costly research. CIMMYT's high-yielding wheat originated from inside of the international economy. It was man-made and so were each of the complementary inputs that were required to produce the high wheat yields in India.

We are now back on the right track in dealing with advances in technology. It is reassuring. We will discover, however, that it is a daunting analytical task. It entails both micro and macro entities. In the corn research example, large, long term investments were required. Experiment stations and research laboratories are costly. Corn is grown in many different

countries. Hybrid corn seed is decidedly location specific. Scale issues are complex. Within the United States, the corn producing areas are not homogeneous. Each of the many geographical locations requires a specific hybrid designed for the particular area. In terms of scale, parts of basic plant genetics are not location specific. But most organized research pertaining to hybrid corn is geographically specific and scale limitations dominate.

We must also reckon with the fact that when plant genetics reaches a certain level, the creation of higher yielding crop varieties becomes a highly skilled production process, tailored to the sunlight, temperature, and rainfall of an area and also to the texture and acidity of its soil. Furthermore, plant breeders also alter the required planting, cultivation, and harvesting so that the crop more readily mechanized.

Thus, a symbiotic relationship develops among many research groups: geneticists, chemists, plant breeders, soil scientists in research laboratories and in agricultural experiment stations, including engineers and technicians in factories producing farm machinery and other agricultural inputs. This research process entails a wide array of highly specialized human capital components to create technologies that prove to be superior to those that existed.

To get on with the analytical part, how much guidance can be had from existing models, designed to ascertain the increases in national income that originate from all advances in technology over a period of decades? To do this is as yet beyond the capacity of the state of our theory and evidence.

We must for the time being settle for less but even that is formidable, unless there is some way of aggregating all such advances in technology into a single "homogeneous" economic entity.

There are additional unsettled issues. The increases in income from advances in technology may be a consequence of augmenting supplies, including substitutes for land, or of the additional specialization made possible by these advances, or of both in some ascertainable proportion. We need a model to get at this issue. Meanwhile, evidence and reasons lend support for the view that specialization is the key to such increases in income. Another issue pertains to restoring equilibrium; namely, determining the economic properties of the disequilibria that are consequences of advances of technology.

Increasing Income Events

In my "On Investing in Specialized Human Capital to Attain Increasing Returns," Yale Symposium paper, April 1986, I presented a concept of such events. Since then, I have extended this concept.

The idea of increases in returns had considerable influence on the thinking of the early economists. The origins of such returns were perceived mainly as historical events, not as analytical implications derived from theory. Allyn Young in his "Increasing Returns and Economic Progress," made an important analytical contribution. But Young's achievement and the riches of some of the earlier ideas about economic progress were long neglected. They are now being rediscovered.

It is as if economics had been locked into a state of economics that excludes increases in income events. To break this lock does not imply going back "...to a state of innocence before diminishing returns."

Young's paper should have sprung this lock and have opened economics so that economists could pursue increases in returns. It should have made room for economic events that result in increases in output that exceed the increases in inputs. One wonders why economists have not pursued Young's approach. It could be that he turned economists off by asserting, "I suspect, indeed, that the apparatus which economists have built...may stand in the way of a clear view of the more general or elementary aspects of the phenomena of increasing returns...."

What is not elementary is that increases in income events do not exist in the axiomatic core of general equilibrium theory. But when such events occur, disequilibria occur as a consequence. The microeconomics of restoring equilibrium is driven by incentives to which individuals and families respond in reallocating the resources in their domain and in doing so, restore equilibrium in that domain.

Some of the pertinent ideas of economists, before growth models became popular, have a comprehensiveness that has been lost in today's economics. Above all there is the magnificent idea pertaining to the division of labor, its origin and its income producing capacity. The economic importance of the division of labor is presently underrated. It holds one of the keys to specialization, to investment in specialized human capital and to classes of increasing income events. The idea that there are such

increases is no longer a part of mainstream economics. There is too little room in today's growth models even for Adam Smith's division of labor, its origin, and its income-producing capacity. Marshall's laws of increasing returns no longer seem to be kosher. In the same vein, it is hard to explain the long standing silent treatment by economists of Young's classic paper.

Part of the explanation for this neglect of so fruitful a concept surely stems from the growing technical refinement of economics, which brings with it a desire for ever greater precision in the use of terms. As economics has become ever more rigorously and minutely exact, the richness of the idea of increases in returns has eroded. What was once a concept that evoked many different sources of additional income streams, the vaguely sensed secrets of economic progress, has ended up as a simple bit of arithmetic: namely, when all factors of production are doubled, more than twice as much is produced.

When early English economists observed increases in production by various manufacturing industries, they attributed a part of the additional income to increases in returns. The favorable changes in economic conditions in their day came to be known as the Industrial Revolution. As an economic process it had much in common with what is now referred to as the Green Revolution in agriculture.

Marshall argued that "the part which nature plays in production shows a tendency to diminishing returns, [while] the part which man plays shows a tendency to increasing returns..." Man's part in agriculture conforms to the law of increasing returns.

Advances in technology, innovations, discoveries, and other sources of increases in return episodes are economic events. Most of them are small, micro events, as in the case of a farmer's increase in corn yields made possible by hybrid seed. Such events can, as a rule, be identified and measured, and their economic effects are in general ascertainable. But when increases in returns are attributed to large, "macro events" - the Industrial Revolution, for example - the sources of the increases in incomes are exceedingly difficult to ascertain.

We are dealing here with transitory events. While the increases in income brought about by them are potentially lasting, the disequilibria they create are transitory. The life span of these disequilibria is clearly observable where such events are small and occur under open-market competition. When a new technique appears, people learn that it is worthwhile to reallocate resources. Entrepreneurs respond to the expected profits to be had, and their actions account for the transitory attribute of these events. Nature is a minor source of these events. For all practical and analytical purposes they are consequences of the activities of human beings. They may have their origin either within or outside of the economic system. Those that originate from within would be included in Schumpeter's theory of economic development.

These income events have become important sources of additional income streams in many countries. These events spawn related events. The economy of many countries has a built-in capacity to create them, notably by means of organized research, R&D in general, university-based science research, and investment

in education and in the distribution of knowledge.

The idea of such events conjures up the old ideological issue of a surplus from an unearned profit. This issue notwithstanding, such observable events account for measurable increases in income and welfare.

More Human Capital Matters Greatly

In a modern economy, most of the increases originate out of the based on the proliferation of human capital. The notable attribute of this conference is its concentration on human capital.

We must hold fast to specialized human capital. We must develop theory to analyze the interactions of physical and human capital accumulations that induces investment in specialized human capital. We must find ways to identify and test the external effects of human capital as seen by Lucas. He argues that these effects spill over from one person to another, people at each skill level are more productive in high human capital environments, and human capital enhances the productivity of both labor and physical capital. Lucas sees "human capital accumulation as a social activity, involving groups of people, in a way that has no counterpart in the accumulation of physical capital."

Specialization and Income Increases

The vast extent of modern economic specialization should give us pause. If we knew the economics of this vast specialization, we would know much of the economics that matters in achieving

increases in income. Growth models that do not deal with this development, of course, provide no explanations why it has occurred.

Specialization abounds in our agriculture and factories, in commerce, manufacturing, and in light and heavy industries. But what about the professions? I turn to the production and distribution of knowledge in the United States based on the studies by Machlup. He shows that much specialization prevails. The last book from Machlup's fertile mind is on the economics of information and human capital. It is evident that the extent and complexity of our knowledge producing professions bespeak human capital specialization and it accounts for much of the realized productivity.

I cannot resist arguing that agriculture is not immune to specialization, exemplified by corn belt farm families who no longer produce eggs, milk, vegetables and fruit for home consumption. Meat is also purchased. So is the electricity, gas for fuel, and telephone service. The farmer no longer produces his own seed corn. He buys hybrid seed appropriate to his area. His production expenses are large; they consist mainly of inputs produced by industry. Pig production is highly specialized into (1) producing breeding stock, (2) farrowing and through weaning, (3) producing feeder pigs, and lastly (4) finishing their growth into hogs to suit the market. Yet the myth persists that there is virtually no specialized physical and human capital within agriculture.

The gains from two-way trade in similar products between similar countries is a received part of international trade

studies. Becker compares his analysis of the division of labor within the household to that which occurs in international trade. Members of the household specialize their investments and time. "Moreover, with constant or increasing returns to scale, all members of efficient households must be completely specialized." Becker sees increasing returns from specialized human capital as a strong force creating a division of labor in the allocation of time and investments in human capital between married men and married women.

Rosen came to the issues at hand with the following telling argument.

"Incentives for specialization, trade, and the production of comparative advantage through investment are shown to arise from increasing returns to utilization. Hence, the rate of return is increasing in utilization and is maximized by utilizing specialized skills as intensively as possible. Identically endowed individuals have incentives to specialize their investments in skills and trade with each other for this reason, even if production technology exhibits constant returns to scale. The enormous productivity and complexity of modern economies are in good measure attributable to specialization."

PART TWO

Human Capital in Restoring Equilibrium

Human capital is now in good standing. Economists are no longer shy in talking about it. For me to tell stories about

economic disequilibria is in bad taste. But what is even worse is to associate disequilibria with human capital.

It has become an art to conceal economic disequilibria that occur as a consequence of modern increases in income. It is my contention that most of them cannot be prevented from occurring by any optimum modernization policy.

In dealing with this class of disequilibria at the micro level, individuals and families, who find themselves in an inefficient allocative state, endeavor to attain equilibrium. Their ability to restore their equilibrium and to do it efficiently, is enhanced by the quantity and quality of their human capital. This part of the economics of restoring equilibrium is in general neglected in economics. Schumpeter's approach to economic development is a notable exception.

When a disequilibrium occurs, it may be treated by means of special assumptions. The standard treatment is to rely on the tendency assumption, based on the proposition that there is such a tendency throughout the economy. That such a tendency of sorts exists is not at issue. If it is a strong tendency, there is merit in using this assumption to simplify the analytical task. If, however, it is not a strong tendency, the analyst is in trouble.

This tendency assumption is pervasive throughout economics. In Knight's view, "There can be no question of a real tendency toward equilibrium in detailed relationships, or even apparently in the system as a whole." Dependency on this assumption is neatly stated by Boulding, "The compass in all our travels has been the concept of equilibrium... The 'equilibrium' position of

any price, wage, firm, industry, or system is the position toward which it is tending." What is at issue are the economic properties of this tendency. Hicks' argument is telling. "Something has to be specified about reactions to disequilibrium before the existence of a tendency to equilibrium can be asserted... Even if the equilibrium exists, and the tendency to equilibrium exists, we may still have insufficient ground to justify the equilibrium assumption if the convergence to equilibrium is very slow."

We now have many studies that show the magnitude of the positive effects of experience, training, schooling, advanced education, and of the state of health on the allocative efficiency in restoring equilibrium.

Restoring equilibrium entails both macro and micro economics. It may also entail legal and other institutions, including public policy. The reason for concentrating on the micro part is that the implications of micro economics are stronger and much more readily testable than those derived from macro economics. It is so empirically because of the greater divisibility of the functional entities inherent in micro economics. What individuals and families do within firms, households, or who are self-employed, give rise to many sets of data. For example, the effects of schooling on the success of farmers in various parts of the world, as they take advantage of a new high yielding crop variety, tell a consistent story. Thus, a consensus emerges that schooling increases the rate of adoption of high yielding crop varieties by a rate that can be measured.

There are various types of micro disequilibria. They are not homogeneous. Most of this study deals with the particular micro

type that occurs, as a consequence of modern increases in income.

The economic domain of my human agent is small. There is ample hard evidence that shows that when this agent perceives that he is no longer allocatively efficient because of a change in conditions, he acts to bring his small domain into equilibrium. What he does is treated as entrepreneurship. The motive of this entrepreneur is not that of restoring a general economic equilibrium. He is concerned about the disequilibria in his own private domain.

With respect to the opportunities that are available to small entrepreneurs, much depends on the prevailing economic organization. There is strong evidence that choice of organization matters greatly.

Policy oriented economic inquiry understandably searches for ways of preventing disequilibria during the process of modern increases of income. Aside from the organizational choice between a centrally controlled and a market oriented economy, are there ways that a market oriented economy could prevent all micro disequilibria? As already noted, all indications are that it is impossible to have modern increases in income with no disequilibria occurring. A centrally controlling economy may try to conceal such disequilibria but it too cannot keep them from occurring.

The innate and acquired abilities of people, be they individuals or families in charge of firms or households or who are self employed, are exceedingly important in restoring equilibrium. Human capital inquiry to ascertain the economic value of work experience, schooling, more education, and of

health, has added substantially to our knowledge of economic value of these human capital components.

Despite this knowledge the mainstream of economics is still silent on the function of human capital in restoring equilibrium.

More on Entrepreneurial Ability

Entrepreneurs are not accorded the status of an occupation. Useful entrepreneurial statistics are rare. Reported wages, salaries and other earnings for work, do not give us entrepreneurial earnings. What entrepreneurs earn is not identified in national income accounting. Nor are their earnings identified in micro empirical studies, using standard production function techniques, which as a rule report a residual, and what part of the residual may be entrepreneurial earnings is left undetermined. Our primary concern is to understand the economic function of entrepreneurs in dealing with changes in economic conditions in a modernizing economy. We do not feature the coordination of the factors of production within the firm under a state of equilibrium as Coase has done. He begins by observing that, "Outside the firm, price movements direct production, which are coordinated through a series of exchange transactions on the market. Within the firm, these market transactions are eliminated and in place of a complicated market structure with exchange transactions is substituted the entrepreneur-coordinator, who directs production." Coase's entrepreneur exists in a market economy which is on his assumption in equilibrium.

Elements of the Supply

Like intelligence, entrepreneurial ability is one of the general attributes of the human population. Observable human behavior in response to changes in economic conditions indicates that most able-bodied adults do what is here deemed to be entrepreneurship. They break their routine and proceed to reallocate their own time and related resources when they perceive that it is worthwhile to do so. The implication is that not only individuals who are in charge of business firms, but also farmers, others who are in self-employed occupations, employed workers, students, and women who are in charge of households have the ability to be entrepreneurs. But they differ for reasons of differences in their genetic abilities and in their acquired abilities.

On changes in the production function, Becker is clear and concise, "As conditions improve - as knowledge expands - the function 'shifts' and a larger useful output is obtainable from the same inputs. Even at a moment of time, the functions vary...as 'entrepreneurial' knowledge and the nature of the product vary." Furthermore, "The level of technology varies...among firms in the same industry because of differences in entrepreneurial ability..." The entrepreneur's stock of knowledge in this context is a proxy for his ability.

Although the genetic abilities of entrepreneurs vary and the differences in abilities on this score may matter, we shall concentrate on acquired abilities because as far as we know, the distribution of genetic abilities within large populations are about the same. Thus, it is plausible that there is no

appreciable difference in the level and distribution of genetic abilities between the people of China and of the United States. But the per capita acquired abilities are decidedly less in China than in the United States. For individuals in a market regime, for any past or present date, it is useful to think in terms of a supply of entrepreneurial ability. Each individual has his own "private" supply curve which declines initially, as Becker has noted, "...because of the fixed cost of using the entrepreneur's own time and related resources. Eventually, it rises because the opportunity cost of a single owner's time increases as he is forced to draw more and more on leisure and sleeping time..." Full-time entrepreneurship, however, is exceedingly rare.

On the supply of acquired abilities, the best studies to date pertain to education as forms of human capital.

Education and Entrepreneurship

The productivity of U.S. agriculture provide strong evidence that education enhances the entrepreneurial ability of farmers. The empirical results are not restricted to difference in the effects between 8 and 12 years of schooling on the allocative ability of farmers. The evidence also resolves the puzzle why the proportion of U.S. farmers with a college education is increasing. Farmers are normally both self-employed workers and entrepreneurs. Thus, the productivity effects of education are of two parts; namely, on work-skills and on entrepreneurship in dealing with the disequilibria that occur as a consequence of changes in the economy. In Transforming Traditional Agriculture, I advanced the hypothesis that the schooling of farmers increases their

allocative ability. This hypothesis lead to many studies to determine the effects of schooling on the adoption of new superior agricultural inputs. Chandhri was among the vanguard in showing that changes made in the composition agricultural inputs is sensitive to the schooling of farmers. Research in this area owes much to Welch, Griliches, and Evenson. In Welch's approach, the demand for entrepreneurship is estimated by the level of agricultural research activity on the assumption that the higher the level, the more rapid the increases in production opportunities and the larger the advantages of the entrepreneurial ability acquired from education. Although the increases in productivity from the new technologies called for more work-skills, it was not plausible that such additional skills of college graduates could account for all of the very considerable increases in their earnings, which in Welch's study came to 62 percent more for the college graduates than for those who completed high school. He found that the advances in agricultural research explained roughly one-third of this difference between college and high school graduates.

Huffman's studies got at the heart of the allocation issue. He focused on the use of a single input, nitrogen fertilizer, in the production of corn. He reasoned that where a major economic change occurs with various lesser changes in its wake, the education of farmers should increase the rate of the adjustments. His major economic change was the 22 to 25 percent decline in the price of nitrogen relative to that of corn. Using a sample of county data drawn from five key corn belt states for the period 1950-54 to 1964, he found that one additional year of schooling

resulted in farmers earning \$52 more from this one dimension of improved allocative efficiency in one farm activity, i.e., in using nitrogen in corn production.

Petzel's study deals with the relationships between the education of farmers and the dynamics of acreage allocations to soybean production in the United States. His study focuses on a period of rapid growth in the acreage devoted to soybeans in nine states from 1943 to 1973. Petzel found that the adjustments made by farmers occurred more rapidly in the counties where average education levels are highest. He also found more rapid adjustments with respect to two dimensions of scale, namely the total crop area devoted to soybeans and the unit scale per farm.

There are few economic propositions that are as valid empirically as is the proposition that the entrepreneurial ability of farmers is enhanced by their education. The most complete and competent survey of the effects of farmers' education on their performance in modernizing of agriculture is that by Marlaine E. Lockheed, Dean T. Jamison and Lawrence J. Lau. Their empirical studies include many that pertain to low income countries. The data base for each of the twenty low income countries featured in the analysis is presented. It is hard to resist their findings! "We conclude that our results lend support to T.W. Schultz's hypothesis that the effectiveness of education is enhanced in a modernizing environment.

The methods of analysis, the data sets, the treatment of education and profitability, adoption of technical advances, and rate of return to rural education, is the substance of a comprehensive book by Jamison and Lau.

Property Rights in Human Capital

People who are bound by the institution of slavery, have no property rights in their human capital. Poor people who account for most of the world's population, in general have some property rights. Their individual human capital component, however, is very small. In high income countries where investments in human capital have been large, and where the rise in the value of human time has been pronounced, we observe that the property rights of people in their human capital is being enlarged.

In the United States and also in other countries where wages, salaries and earnings of entrepreneurs account for three-fourths and more of personal income, important institutional changes in favor of human capital property rights have occurred during recent decades. The political and legal origins of these changes appear to be fairly easy to document. Where the origin has been social, it may be difficult to establish the evidence. There is much to be said for undertaking research to analyze the various origins and the economic importance of each. Self-interest should motivate scholars, scientists including economists to determine ways and means of extending intellectual property rights going beyond existing patents and copyrights, beyond existing safety in the work place, beyond tenure rights, and beyond soft honors to additional financial rewards for various unprotected intellectual property rights.

As the economic value of human time rises, we are in the realm of new and better opportunities. The range of private and social choice is enlarged. It is, indeed, an optimistic set of circumstances that all too few people of the world enjoy. But

even so, our favorable circumstances are not free of institutional stresses and strains. Since we can specify and identify these institutional processes we can also analyze their results in terms of efficiency, income and welfare.

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Human capital has become an important economic concept. I have not impaired the good standing of human capital. On the contrary, I have argued that its role in restoring equilibrium, as modern increases in income are achieved, adds substantially to economic importance of human capital. I remain addicted.