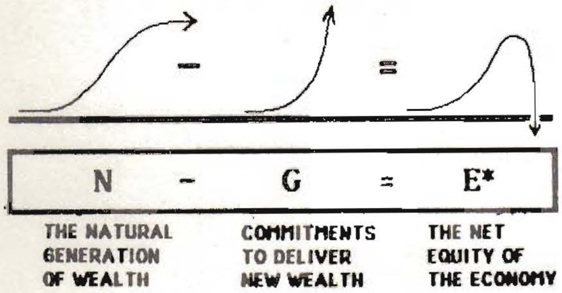
UNCONDITIONAL POSITIVE FEEDBACK IN THE ECONOMIC SYSTEM

Philip F. Henshaw

INFLECTION POINTS RESEARCH
420 6TH AVENUE
BROOKLYN, N.Y. 11215



ABSTRACT

The occasional periods of major social crisis and grand economic failure are unquestionably one of the most thoroughally confounding features of the human experience. This paper discusses various related issues and identifies a widely accepted financial practice which gives money a powerful natural dynamic of its own and, during periods of economic climax, is sufficient to bring about a general socio-economic crisis and failure.

The financial practice so identified is the use of earnings from investments to add to investments, the normal compounding of investment earnings that makes 'unattended' money in the bank continuously multiply. It establishes an unconditional positive feedback of financial investment. During periods of economic climax it progressively stimulates competitive struggle until a majority are unable to fulfill their financial commitments. **Barring presently unforseeable changes in financial practice the automatic compounding of investment returns will produce increasing investment risks sufficient to bring about a majority failure of investments.**

From an natural systems science point of view the problem and its implications can be clearly defined and found to be particularly fascinating. Genuine hope that people will eventually be able to overcome the awesome natural calamity presented is also offered. The paper begins with an overview of natural growth systems and types of system growth limits. A rigorous economic model is developed that fully incorporates, rather than dismisses, all economic system 'externalities'. It is used as the basis for making a definitive deductive proof of the above assertion.

1 INTRODUCTION

The discussion of limits to economic and population growth had its modern beginning in 1798, when Thomas Malthus published his prediction that human population growth would be brought to a climax with mass starvation, disease, or continuous warfare. He is thus credited with having made economics 'the dismal science' and provoked a long, unsettled and emotional debate (Heilbroner 1980). His prediction and argument offend those who might have wished to see our resources and abilities as unlimited, and also those who wanted to believe that mankind really does have the genius to build a finer destiny.

His argument is a powerful one, however. Barring unforseeable changes in human behavior, the continuing multiplication of population is conditioned only upon the human ability to continue multiplying the production of food, by the species losing its physical health, or by war and social chaos. Each of those is an absolute limit to population and in their absence human population would seem to have an absolute tendency to grow.

A similar argument is that the insatiable human appetite for increased productivity, doing 'more with less', will end in our trying to do 'too much with too little'. The climax of productivity growth could be the creation of a productive system that is unstable due to excessive complexity, or vulnerable to change due to over-specialization. A catastrophic disordering and 'memory loss' within the system could then result.

Surely the ultimate limit of population or prosperity could be by any one or combination of these catastrophies, as well as by various others, but saying that it will be denies much of the needed inquiry into what other possibilities there might be. There have, in fact, been great civilizations in the past, notably those of ancient Egypt and ancient China, that achieved population climax without catastrophy, and were also, in some real sense, quit civilized.

Any exponential growth[1] of population will indeed someday come to an end, as will the exponential growth of economic wealth and the related exponential growth of money in the bank. The question is when and by what means. Looking at the various ways that growth comes to a climax in natural processes suggests that "unforseeable changes", specifically ones other than resource exhaustion or systemic disorders, are perhaps as likely and far more interesting. "Unforseeable changes" in growth systems includes some of nature's more magnificent ways of developing and refining new forms of order, building new things and making them last. The 'dismal science' that Malthus and others made out of global economics can be put to rest by a little closer look into the creative facts of life.

Part of the task is still a matter of dealing squarely with the serious facts that our misunderstanding of growth and its limits have put squarely in our path. Various tools for doing that will be used here. One will be a fairly original kind of economic model, one not designed to show mathematical relationships between economic measures, but one designed for allowing a fully rigorous propositional logic to be applied to questions about economic process structures.

Before getting to the development of the model, it will be helpful to do some exploration of natural systems and the way various kinds of feedback are displayed in them. The review of feedback systems will develop ideas with which to understand some of the real meanings of 'unconditional' feedback and its effects on economies. It will also provide a way of introducing some carefully constructed ideas for use in the economic model to follow.

2. CONCERNING THE SCIENCE OF FEEDBACK

The scientific understanding of feedback in natural systems is still relatively underdeveloped. Natural feedback systems have causal relationships that are enormously complex and internalized. This gives them autonomous organization and behavior that is significantly invisible to outside observation. Partly because the traditional tools of science are specifically designed for using simple abstract measures in the study of remote causation, those tools have proved very inadequate for dealing with the subject.

The subject of feedback is recognized as important in every branch of science and each has contributed something to it, but none, including General Systems Theory, seems to have a very reliable idea of how to interpret natural instances of feedback or where they come from or lead to. Thus the following discussion of natural system feedbacks will be of a broadly descriptive kind, concerned only with general principles that can be largely supported by common sense and common direct observations.

Many of the more difficult, and more interesting, topics will not be touched on. For a related discussion of feedback issues and the investigation of autonomous systems in general, see elsewhere in these proceedings (Henshaw 1985). One advanced topic that should at least be mentioned is that of the separate but interrelated behaviors of 'contact' interaction feedbacks (including information) and 'throughput' (resource/product) interaction feedbacks.

An example of this dual pattern is found in the feedback exchanges of information that occur within economic markets (contact systems) in conjunction with resource & product feedbacks that are passed through economic markets (throughput systems). Each system is intimately associated with aspects of the other, but is also quite disconnected from the other and has a logic and organization of its own. Each also involves a very different type of content, one typically material/physical and the other typically of comparative value.

The reason for mentioning this is that the economic model to be developed here is of money (a numerical marker of comparative value) and, as such, concerns the contact interaction structure of the economic system. The feature of money to be modeled, however, is its simple exchange, the throughput passage of money from the holdings of one person to another. Arranging the model in this way constructs a valid means of applying natural science tools to macro-economic problems. Contact and throughput feedbacks have enough similarities that their differences need not be mentioned further.

§1. *The term 'exponential growth' has a complex variety of meanings. Unless otherwise indicated in context, it is used to refer to a measurable subject for which successive ratios of change are not tending to zero. An example would include subjects undergoing irregular positive feedback as first noted in changes by fluctuating percentages that remain greater than some positive constant.*

3. MEASURES OF FEEDBACK

The term 'positive feedback' refers to a pattern of effects involving a process and its environment. The effect that the process has on its environment, in turn, has an effect of positively increasing the process and its subsequent similar effects on its environment. It is thus a 'reflexive' process of self-effects through a local environment (figure 1.).

In regular cases there are periods when the effects of each successive cycle increase or decrease approximately in constant proportion to the effects of the preceding cycle. These are periods in which the process and its effects become a constant multiple or fraction of themselves over time.

Proportional positive feedback is occurring when a crack in a sea wall is opening wider in proportion to the amount of water leaking through it, or when acoustic feedback in a public address system is growing in proportion to the level of sound emitted by the speakers. It is also the case when increases in population are in constant proportion to the size of the population or when economic activity increases in constant proportion to the amount of economic activity. It is a very common characteristic of processes that are dynamically changing.

The mathematical description of constant proportional change is:

$$\Delta X = r \cdot X$$

(The change in X equals proportional constant 'r' times X.)

• A GENERIC PICTURE OF PROCESS FEEDBACK •

Figure 1. NATURAL PROCESS FEEDBACK IS ENORMOUSLY COMPLEX AND CAN NOT BE EFFECTIVELY DESCRIBED WITH MATHEMATICS. IT IS AS COMMON AND IMPORTANT IN THE WORKINGS OF THINGS AS HUMAN LABOR PRODUCING FOOD (FOR HUMAN LABOR) OR A FLAMES SPREADING COMBUSTION (TO PRODUCE FLAME). FEEDBACK IS ALWAYS PART OF A DYNAMIC SET OF EVENTS.

The mathematical description of constant proportional change over time is the summation (integral) of a continuous series of proportional changes, the common formula for exponential change:

$$X = X_0 \cdot e^{(r \cdot t)}$$

(The value of X equals its initial value times logarithmic constant 'e', raised to the power of rate constant 'r' times elapsed time 't')

In total there are four basic kinds of feedback, corresponding to the four basic developments of a new direction in a curve measuring change over time (figure 2.). These are: 1) positive feedback, (F^+), (turning up, increasing increase, 'growth'), 2) negative-positive feedback, (F^{-+}), (topping out, declining increase, 'climax'), 3) positive-negative feedback, (F^{+-}) (turning down, increasing decline, 'collapse') and 4) negative feedback, (F^-) (fading off, declining decline, 'decay').

The double term feedbacks refer to situations where the primary feedback process is itself subject to either positive or negative feedback. Sometimes a different +/- symmatry convention for these symbols is used. The line in the graph is drawn rough and wide to indicate that there are always local fluctuations in any activity or measure of change, even for the most systematically regular growth to decay process.

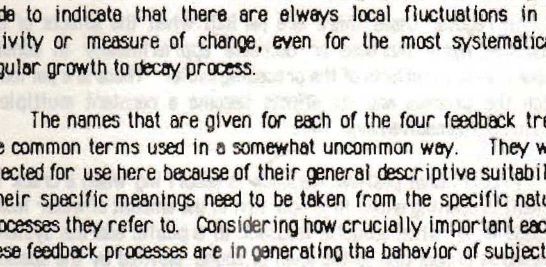
The names that are given for each of the four feedback trends are common terms used in a somewhat uncommon way. They were selected for use here because of their general descriptive suitability. Their specific meanings need to be taken from the specific natural processes they refer to. Considering how crucially important each of these feedback processes are in generating the behavior of subjects of both common and scientific interest, it is intriguing that well established individual terms for them do not yet seem to exist.

4. INTRODUCTION TO LIMITS

One of the natural principles which applies to positive feedback is that some part of the the process undergoing expansion or its environment will prevent a feedback multiplication of effects from being sustained. An axiomatic statement of the principle is:

$$F^+ \longrightarrow F^{-+}$$

(A process of positive feedback results in a negative feedback for itself)



• INDICATORS OF ORGANIZATIONAL CHANGE •

Figure 2. THE FOUR TRENDS THAT CORRESPOND TO THE FOUR BASIC TYPES OF FEEDBACK PROCESSES MAY NOT APPEAR IN ALL THE MEASURES OF FEEDBACK PROCESSES, OR NECESSARILY INDICATE WHERE INDIVIDUAL FEEDBACK PROCESSES ARE HAPPENING. THEIR MOST EFFECTIVE USE IS FOR REMOTE SENSING/TRACKING RATHER THAN FOR FIRM IDENTIFICATION OR DESCRIPTION.

The general meaning of the principle is that positive feedback is a particularly transient feature of any system in which it is present. The general reason is that positive feedback alters the conditions that made it possible, either by exhausting its opportunities or by creating opportunities for other things to take over. Each cycle of effects, instead of leading to larger increases of the same kind, leads to smaller increases of that kind.

This can be intuitively understood from the general fact of limits to all things. A multiplying leak in a dam eventually lowers the water pressure and the flow of water stops growing. Amplifier feedback quickly exceeds the response limits of the microphone, speakers, amplifier or power supply. The market for even the most universally popular new product is eventually saturated, even if the product is sold below cost.

The special transience of positive feedback in a system can also be partly appreciated from the character of positive exponential change as involving ever more rapidly increasing speed and acceleration. The fact that a positive feedback curve gets steeper and steeper, faster and faster has strong implications about what must be occurring within the process that produces it.

Feedback loops are generally composed of separate steps of physical activity, often in long chains or networks. There is always a limiting 'cycle rate' for the chain or network as a whole. That's because every kind of physical process or reaction, or action of any subcomponent or external enabling process, takes some minimum finite amount of time to complete.

In addition to simple limiting speeds there are also limiting accelerations, limiting rates at which processes can change their speed of operation. There are also limiting rates at which a process can change its acceleration, etc. If you try to accelerate a car engine too fast it will hesitate, and perhaps stall, rather than leap forward. If you develop subjects in a discussion too fast you lose people whether the logic is connected or not, rather push them ahead faster. In general, sufficiently radical change, no matter how coherent otherwise, interrupts the flow of change and inhibits rather than accelerates.

There is much more of interest that could be said on this subject. It is of note that proportional positive feedback (exponential) change involves underlying processes of changing all the underlying speed or accelerations of a process, at ever more rapidly accelerating rates. It thus also can therefore potentially confront physical speed limits on any level of the process or on all of them at once. Exponential change is truly radical change.

Some processes for which there has been positive feedback grow to a climax and then continue at steady rates for a period. A grass fire in a field may initially display a positive feedback growth from a spark to blaze and then continue to burn steadily as an expanding fiery ring around its central origin. It would be a rather unusual grass fire that grew so fast at first that it blew itself out or suffocated in its own combustion products, but that could conceivably happen. Other processes for which there has been a positive feedback growth will reach a natural speed limit accompanied by various distortions and disruptions in the process, as with acoustic feedback distortions in a public address system.

5. GROWTH LEVEL SHIFTS

Other kinds of processes respond to growth limits very differently. Some, in approaching limits, go through an organizational change, without disruption, become able to operate at still greater scales and speeds and continue or resume positive feedback growth toward the next limit, somewhat like shifting into a 'higher gears'. Others, also without disruption, go through organizational changes that effectively turn off the feedback sub-system well before other limits to growth are reached. In some cases of this kind, a stable rate of activity becomes established that can be maintained for a comparatively long period of time, apart from outside interferences.

One example of the first variety is apparent in the patterns of human learning, especially during childhood development. Childhood learning seems to step from one whole developmental stage to the next as new sets of conceptual tools are adopted. As the need arises we learn to understand more with less effort by substantially reordering our thought processes. That shifting of 'gears' to new and more powerful modes of thinking enables the positive feedback of learning and new interests in things to learn about to continue, toward the next limit.

A more common example is provided by the natural successions of plant and animal ecologies. The ecologies of an abandoned field may be succeeded by those of dense brushland, and then by those of fast growing trees, tall long-lived trees and, finally, multi-canopy climax forest. Whole integrated systems follow one upon another as part of a unified process of ecosystem growth and evolution. In developing from a sparce plant community to a teeming multi-habitat ecology the first stages in the succession are likely to expand the previous growth limits of the location exponentially.

Another example of that variety, particularly relevant to our primary subject, can be found in the historic growth pattern of our economic system. For over 300 years our economy has stepped successively from one whole system order of products and methods to another. Despite being distinguished by numerous significant breakdowns and slowdowns of various kinds, it has maintained generally continuous exponential growth.

The physical work limit of the hand plow, black smith and telegraph were far exceeded by those of the multi-purpose tractor, steel mill and teletype. Their potential work limits, in turn, were far exceeded by those of our present gigantic and highly specialized farm machines, computerized continuous casting, extrusion and stamping mills, and digital electronic communication systems. One might relevantly ask 'Where's the next leap to ?!?', and a lot of other questions.

6 CLIMAX LEVEL SHIFTS

An example of systems that change order and achieve a stable climax without seeming to confront the limits of their potentials or resources can be found in almost every kind of living organism. Most living organisms have a built in method of turning off the growth option and reaching a definite growth climax well within their potential growth limits. This usually seems to be achieved by a mechanism for deactivating the genetic growth machinery as the organism approaches its optimum size and vitality.

This sort of growth to a specific point of system maturation, well within the system's ultimate potential limits, can also be seen in human societies that achieved a long stability. The climax society of Egypt's Old Kingdom grew in both wealth and population but then its surplus resource exploitation capabilities were turned elsewhere, to building monuments, among perhaps other things, rather than to further population and empire expansion. Modern American population is climaxing in what may be somewhat the same way, as we devote more of our time and resources to work and play and less to raising families.

The same kind of pattern is evident in a growing university that declines the option of further expansion and diverts operating surpluses to raising the quality of education it offers instead of the quantity. In general, living and non-living systems that climax their growth in this way can be said to contain some kind of 'image' of their ultimate form before reaching it. Their quantitative expansion resources become used in qualitative refinement as their means of achieving climax.

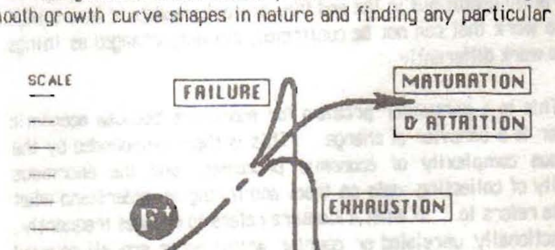
Part of the pattern is that initial growth creates conditions in which growth of another kind arises to bring it to an end. Most examples of adventitious growth bringing an initial growth process to climax would not, however, be considered evidence of a system's maturation. One example is animal population growth which is kept in check by the adventitious growth of predators, competitive-conflicts or disease. Stable climax may be achieved, and one might consider it as part of the ecosystem's maturation, but it is not, in the sense used here, a maturation of the population itself. Climax is achieved by a wasting of growth resources and not by a diversion of growth resources to alternate developmental uses.

Also in this group would be the examples of growth climax where subsequent adventitious growth causes some kind of system death or failure. One of this variety would be the appearance of a destructive parasite in an plant colony that has, say, grown to the point of niche over-crowding (seriously weakening its members) or has grown to the point of providing refuge to animals which introduce plant diseases from elsewhere. Social and economic processes that require war or economic failures to end their escalation would also be of this type.

7. FEEDBACK SUMMARY

The following graphic (figure 3.) characterizes three of the classic types of growth, climax and following collapse and decay. The 'maturation / attrition' curve represents the various different kinds of stable process climax. The latter two feedback periods (collapse and decay) are implied to be at some indeterminate time in the future. The 'exhaustion' curve shows the characteristic pattern of climax, collapse and decay immediately following growth, due to an exhaustive scavenging of resources begun during initial growth. The 'failure' curve represents the kind of process that climaxes and collapses suddenly, as perhaps due to an internal disordering of the process brought about by the growth changes themselves.

Though there is no necessary correlation between finding these smooth growth curve shapes in nature and finding any particular set



• THREE GENERAL TYPES OF GROWTH CLIMAX •

Figure 3. POSITIVE FEEDBACK RUNS ITS COURSE IN VARIOUS WAYS. IF NOT OTHERWISE LIMITED, IT PRECIPITATES ITS OWN SUDDEN DISRUPTION AND SYSTEM FAILURE. THE OTHER POSSIBILITIES ARE THAT IT PRECIPITATES THE DEVELOPMENT OF A SUSTAINABLE CLIMAX SYSTEM OR DRIVES THE EXHAUSTION OF ITS OWN RESOURCES. ASPECTS OF ALL THREE CAN OCCUR AT ONCE IN A COMPLEX CLIMAX OF A COMPLEX SYSTEM.

of structural events within the subject process, those discussed here are found more often than not. Because natural growth involves many systems within systems, there are abundant variations on these basic themes.

A fourth common category of growth curve changes, those created by the impact of unrelated events, would not display the natural history of an individual growth process and is not depicted. A fifth, and really the most common category of change over time patterns, those that are somewhat or largely erratic, are incorporated in the manner depicted in figure 7. and discussed in section 11.

We are now in a position to state some of what it would mean if there is 'unconditional' positive feedback in our economic system. If there is, climax could only come about as a result of single or multiple resource exhaustions, externally caused interruptions or internal system failures. Our economic system would be structured to be incapable of maturing toward any optimal state. No variety of human decision, or fortunate accident, that did not reorient the feedback system, could alter that. Various atypical local conditions could be achieved, but only as part of a system as a whole that becomes overwhelmed by adventitious disordering.

8. MEASURES, MODELS AND THE ECONOMY

The analytical model that will be used to help show some of the specific effects that unconditional positive feedback will have on our economy is a simple but unusual one. It is designed to overcome a number of the shortcomings of more conventional economic models. One of the principle differences is that it is not built from economic measures. It is built from a comprehensive set of and categorically distinct references to concrete financial transactions. It becomes an effective tool for proving economic theorems by referring only to the concrete markers of money, rather than expectations of money value or credit, and by applying a fully reliable set of presumptions about the natural context in which money transactions occur.

Built in this way the model forms a specific map of how things do actually work. Experience, observation and the study of empirical measures then become a great help for understanding the processes it identifies. The conclusions reached may be initially difficult to understand but at least one is left with something that is highly reliable to start from. Normal economic models are based on philosophical assumptions and extrapolations of measures that have only a historical probability of bearing any relationship to each other(see Seitz 1984, McClelland 1975). They may be temporarily useful but in the end they are only models of how things seem to work that can not be confirmed, but only changed as things seem to work differently.

This is a particular problem for economics because economic behavior is a behavior of change. This is then compounded by the enormous complexity of economic processes, and the enormous difficulty of collecting data on them and trying to understand what that data refers to. If what a measure refers to changes frequently, and functionally unrelated or counter acting parts are all counted together, what results can be rather missleading.

Even the most carefully developed and analyzed economic measures present serious problems. GNP, for example, is treated as a reliable measure of real economic development. However it includes both spending from earnings and spending from credit, recording the economic stimulus of either as being the same thing. It also includes spending to repay interest on past credit, whether received from earnings or from making further promises to turn over earnings in the future. The latter, of course, is not economic development and involves no purchase or production of anything but numbers on paper. These troublesome mixings of measures seems to have directly contributed to the missreading of massive economic failure as rising prosperity.

In the 70's when the GNP's of the 'developing' economies were growing rapidly, banks around the world kept pouring in investment funds based on the expectation of continued rapid growth. That rapid growth in GNP's reflected the stimulus of new spending on credit as much or more than a growth of sustainable development. As the hidden economic failure became exposed the lenders continued to show a growth in earnings from their bad debts, simply by lending the debtors more money for making their debt payments, effectively counting those loans as bank earnings. Those false earnings, in turn, were counted in U.S. GNP, and helped to generate illusions of growth in the U.S. economy.

Now the tables may have turned. The rapidly growing use of foreign credit by U.S. businesses and the federal government is strongly stimulating the circulation of money and growth of GNP. It inflates the economy's apparent earning power, and attracts further increases in financial investment to further inflate the economy's apparent earning power. It looks a lot like a boom of credit running after credit, rather than one of sustainable development. With a severe depression in U.S. exports, in a broadly stagnant world economy, the U.S. economy is vastly increasing its borrowings of foreign money to buy foreign goods.

Sorting out what is real and what is not in the measure of GNP may be possible, but is likely to be quite difficult. As found in circulation, credit derived dollars look the same as dollars derived from sustainable earning abilities, and so can not be counted differently. The model to be presented gets around that problem by effectively maintaining a continuous reference to where dollars originated from throughout their transaction history. It does not specifically show that the above suggested mode of economic failure would occur, though further work with it might. It does show that as sustainable economic development approaches climax, for any variety of natural causes, investment credit will continue to grow disproportionately. Some form of credit financed economic activity, far in excess of the sustainable level, is the result.

9. TWO MEANINGFUL MEASURES

The the graphs of the history of labor productivity in the U.S. economy (figure 4.) and the growth of insured tax-exempt securities (figure 5.) are offered to partially demonstrate the relevance of the model to our current economic experience.

The productivity curve shows a relatively steady trend of exponential growth up until the mid-sixties. Though it could not have been clearly seen until the mid-seventies, the trend rate of productivity growth then went through an inflection point and began increasing by regularly smaller and smaller steps, approaching a climax. Why that occurred and whether productivity will resume an exponential trend of growth are not that important. What is important is that it definitely did occur and for all appearances may be continuing.

The fact that the climaxing trend is of an unprecedented duration shows how unique in modern history the current experience is, and that the discussion of material economic climax is indeed relevant. Among other things the curve also shows the difference between the principle trends and local fluctuations. What is important in that regard is that the fluctuations are of similar scale

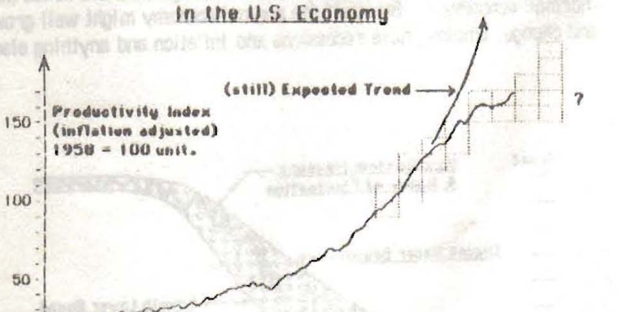
One limitation of the curve is that it only presents information about the U.S. economy, and not about the global economy as a whole. The experience of other economies has certainly been different in many ways, but essentially the same in one critical way. For all the developed economies and there was an inflection point in productivity growth during the sixties. Though some are climaxing slower and some faster, the world economy as a whole shifted from exponential productivity growth to productivity climax. The data on the U.S. economy is used for local relevance and because it is the longest and most reliable available.

The graph of insured tax-exempt securities is evidence of a breakdown in the trust that investors have in local governments and the regulated business ventures they sponsor. Government sponsored projects were once considered to be unquestionably sound and secure investments and were trusted havens for the most conservative investors (N.Y Times 8/30/84).

The confidence that once existed has been shattered by various utility company and other failures as their projected earnings failed to materialize. In the case of energy producing utilities, the problem seems to have come from a failure to predict the climaxing of energy demand, tightened environmental and safety requirements, and the inability of governments to continue bailing out troubled projects. Now security vendors increasingly need to offer an insurance guarantee of returns in addition to the promise that a project has been determined to be a public necessity worthy of public support.

The subject is raised here as an indication of the generally increasing risks involved in all financial investment. It displays only one localized breakdown in formerly unquestioned standards of trust. The model will be used to demonstrate that during periods of material economic climax, such breakdowns in standards of trust become systemic. Increases in investment risks, it should be noted, are generally associated with increasing interest rates, as well as with an increasing frequency of failures. Those are both notable symptoms of recent economic experience.

The History of Labor Productivity in the U.S. Economy



(U.S. Dept of Commerce & Business Conditions Digest statistics to 1984)

Figure 4. INCREASES IN THE AMOUNT OF CONSTANT DOLLAR G.N.P. PER HOUR OF LABOR IN FOR-PROFIT BUSINESS HAVE SUCCESSIVELY DECLINED SINCE ABOUT 1965, AFTER REGULARLY ACCELERATING THROUGHOUT THE LAST CENTURY. THIS HAS OCCURRED DESPITE ENORMOUS PRODUCTIVITY GROWTH IN SOME SECTORS, AND MAJOR PRODUCTIVITY IMPROVEMENT EFFORTS THROUGHOUT THE ECONOMY. THE CURRENT CLIMAX MAY BE TEMPORARY LIKE THE ONE THAT PRECEDED THE GREAT DEPRESSION, OR IT MAY BE LONGER LASTING.

9. THE BASIC MODEL

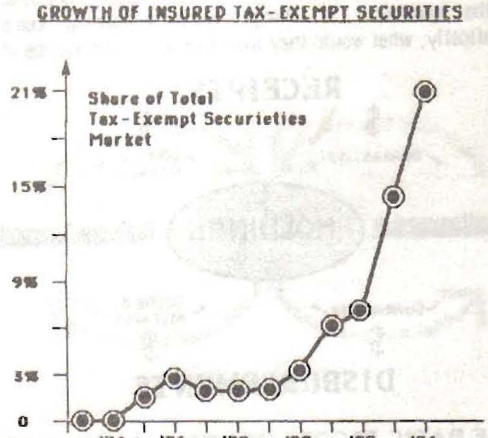
The principle subject of the model is money, specifically the numerical value of government issued certificates of money and any other tangible marker which can be fluidly used as money and has no other comparable value in exchange. Personal checks would not be considered as money since they have value in exchange only under certain conditions and lose value in the hands of a third party. Speculative business paper would also not be technically considered as money since its marker value is subject to wide fluctuation. As interpreted here, the 'money' which is associated with checks is the electronic or printed markers in banks that have federally regulated systems for ensuring their equivalence to all other money.

The subject of money is thus concrete and specific, in the sense that there is a definite rule for determining whether something is, or is not, included. It includes all of what we conventionally consider as money and is finite. There is a great deal more that could be said on this, say, concerning how the growth of concrete money markers is regulated and constrains free market credit formation and how credit and the velocity of money fluctuate, but no more that needs to be.

The basic references of the model are to money received, money held and money disbursed (either personally or in accounts according to personal instructions), essential parts of every money exchange. As shown in figure 6., receipts and disbursements are then divided according to two categorically distinct sets of conditions upon which holders disburse money, either for investment or divestment. These fairly smoothly correspond to flows through the two principle economic markets, the investment market and the purchases market.

The hard rule for distinguishing between investment and divestment is to include all exchange in expectation of an equal or greater money value in return as investment and all other exchange in divestment. There are several finer distinctions that could be made, but this one is adequate.

GROWTH OF INSURED TAX-EXEMPT SECURITIES



(adapted from New York Times/Aug. 30, 1984)

Figure 5. THE GROWTH IN INSURANCE FOR TAX-EXEMPT SECURITIES INDICATES A SIMILAR GROWTH IN THE PERCEIVED RISK OF THESE ONCE UNQUESTIONABLY RELIABLE INVESTMENTS. IT REPRESENTS A SINGLE INSTANCE OF A SYSTEMIC PHENOMENON OF INCREASING ECONOMIC UNCERTAINTY. EACH ECONOMIC SECTOR COMPENSATES FOR NEWLY DISCOVERED RISK IN ITS OWN FASHION.

that is a product of human competition, politics, cultural activity, and invention. The normal economy, however, is not by itself in the economic world.

It shares the economic world with what will be called the 'compound investment' economy. In the compound investment economy some fraction of the earnings from investments is used to indefinitely multiply the level of savings. The difference is that those savings are not for future spending, but simply to serve as a base for multiplying future investment, investment earnings and indirect services to the profit seeking of others. That conventional, but non-essential, activity is thoroughally intertwined with the normal economy, and has tremendous effects on it.

The compound investment economy includes the standard handling of savings indefinitely left in a bank. It also includes the customary handling of corporate assets, pension and endowment funds, the personal wealth of the rich and much more. These funds are managed to indefinitely multiply by the automatic application of some of their earnings to increase their principle.

The compounding of investment earnings is the commonplace object and purpose of all financial and business investment. The acceptance of it as the practice of choice is so universal that it has gone almost completely unnoticed as being a practice of choice at all. Holdings of wealth not managed that way grow relatively more slowly. Those that are come to dominate all decision making with their incessantly growing power in decision making. The compounded funds participate in the normal economy in much the same way as non-compounded funds, except that the competitive struggles they fund multiply unconditionally until stopped by investment failures or the choice of their owners to withdraw their earnings to be spent.

More exhaustive definitions and identifications could be made. The above, however, should sufficiently identify the primary asset accumulation technique of modern capitalism and establish the fact that relatively unconditional positive feedback of investment does exist. It remains unconditional as long as the practice continues and there are positive investment returns.

The defining characteristic of funds referred to as part of the compound investment economy is that the fraction of savings which are spent is accumulatively smaller than the total amount of returns. The defining characteristic of funds referred to as part of the normal economy is that the fraction of savings spent is accumulatively larger than the total amount of returns. Thus the normal economy is the sector in which the amount of savings tends to decline if not voluntarily added to from the earnings of non-investment activity.

It should be noted that as people spend their direct income, and their pension and insurance funds and other funds they support are managed for them, most people are participants in both of these economies. Hopefully the definitions have been made carefully enough so that all money transactions are referred to and no money transaction is included in both economies. The primary conclusions of the model would not change so long as there is some unconditional compounding activity in the compound investment economy and all other exchange activity is referred to by the normal economy.

12. ANALYTICAL ASSUMPTIONS

The normal and compound investment economies are diagrammed in figures 8. and 9. respectively, and their superimposition (representing the whole economy) in figure 10. The basic assumptions for the completed model are as follows:

1. N (**normal economy**)
- there is earning and spending from providing direct services, and savings that are not continuously multiplied.

2. Θ (**compound investment economy**)
- some funds are managed to continuously multiply.

3. $R_m > R' > 0$ (**positive expected rate of return**)
- the expected real rate of return on investments is greater than a constant which is greater than zero.

4. $P_r(1+R_m) > 1$ (**net probability of return**)
- the probability of expected return times the expected benefit of risk is greater than one.

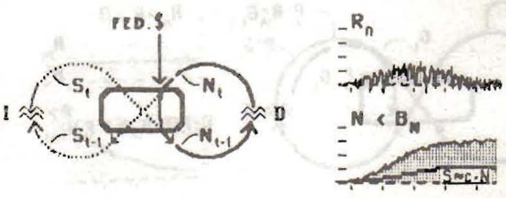
5. $F_s \cdot \Theta < \Delta\Theta$ (**net positive compounding**)
- the fraction of Θ that is spent is smaller than the gain in Θ from retained investment earnings.

The first two assumptions were supported above. The third assumption is just the statement that there is always some positive interest rate. It would take considerable discussion to firmly establish what additional assumptions that implies. The simplest argument is that as long as people try to make the most of their own competitive situations there will always be profit in having money to use for doing so.

Slowing economic growth, as has occurred globally for the past 15-20 years, has not been accompanied by a decline of real interest rates, as the decline in the general economic productivity of investment might seem to suggest. The climaxing of the economies, and the turbulence, inflation and failures that have accompanyed it, have in fact also been accompanyed by higher than normal real interest rates.

The 'expected' rate of return on investments is the combined rate promised or projected for all investments. Though it can not be precisely determined it can be firmly expected to be greater than the nominal interest rate. Investors that manage their money for maximum returns make investments without a guarantee of returns (such as in common stocks) only when the expected benefit of the risk is greater than that available from guaranteed investments, such as lending at the nominal rate of interest. The available guaranteed return on investment, other things equal, is necessarily the lowest rate of return available.

The issue of inflation is reflected here in making the assumption that there is always a positive *real* rate of return on investment. Inflation does effectively reduce the earned rate of



• THE NORMAL EARN/SPEND/SAVE ECONOMY •

Figure 8. THE NORMAL ECONOMY IS REFERED TO USING THE BASIC MODEL OF EXCHANGE. MARKERS ENTER BY GOVERNMENT REGULATED MEANS (FED.) AND CIRCULATE IN DIVESTMENT (N) AND IN INVESTMENT (S). THE NATURAL GROWTH RATE (R) RISES AND FALLS, N REMAINS SMALLER THAN SOME SMOOTH BOUND CURVE (B) AND S REMAINS IN CONSTANT FRACTION OF N IN GROWTH AND CLIMAX.

return on all investments and unexpected inflation can temporarily exceed the rate of interest on fixed rate investments. As long as there is a positive advantage to using money, however, the rates of return expected from all investments used to maximize returns will exceed the expected inflation rate, as if inflation did not axist. Thus, except when inflation is increasing faster than professional money managers can allow for (as briefly occurred in the 1970's), it will not diminish the real rate of investment returns below some R''. Since it therefore doesn't matter to this analysis it is omitted to make the mathematics and discussion easier to understand.

The fourth and fifth assumptions should be self explanatory. No one would invest money unless they thought it was a good risk, or it would no longer be called investment. No one who wants to accumulate wealth by investment spends more than their investments earn. The growth of Θ will be exponential as long as as long as those two conditions hold.

To be completely comprehensive there are two additional circuits of money flow that should be included. These are voluntary additions to Θ from N (transfers from the normal economy into the compound investment economy) and the direct reinvestment of invested funds (pure investment loop circulation in Θ or N). These flows do occur and are interesting but their omission does not alter the conclusion.

13. THE MATHEMATICAL ARGUMENT

The proposition is that:

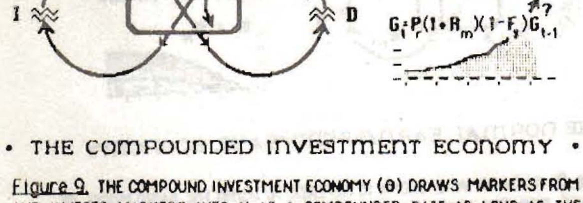
Barring presently unforseeable changes in financial practice the automatic compounding of investment returns will produce increasing investment risks sufficient to bring about a majority failure of investments.

As for any other process which is conditioned upon the performance of physical activities the circulation of money in the normal economy (N) is always smaller than some smooth upper bound curve (B_N).

1. $N < B_N$

Increases in the normal economy (ΔN) are equal to its natural rate of change (R_n) times its previous scale (N_{t-1}).

2. $\Delta N = R_n \cdot N_{t-1}$



• THE COMPOUNDED INVESTMENT ECONOMY •

Figure 9. THE COMPOUND INVESTMENT ECONOMY (Θ) DRAWS MARKERS FROM AND INJECTS MARKERS INTO N AT A COMPOUNDED RATE AS LONG AS THE EXPECTED RATE OF RETURN (Rm) IS GREATER THAN A POSITIVE CONSTANT (R'), THE PROBABILITY OF RETURNS (Pr) IS LARGE ENOUGH AND THE FRACTION OF Θ FREELY SPENT IN N (Fs) IS SMALL ENOUGH. AN UNLIMITED GROWTH OF RETURNS IN A CLIMAXING ECONOMY IS POSSIBLE ONLY IF MONEY IS BEING ALLOWED TO BECOME MEANINGLESS.

The earnings over an investment cycle in the compound investment economy (Θ_e) are equal to the probability of returns (P_r), times the rate of return on money (R_m), times the previous scale of investment (Θ_{t-1}). The amount of investment principle returned after an investment cycle (Θ_p) equals the probability of returns (P_r) times the previous scale (Θ_{t-1}).

3. $\Theta_e = P_r \cdot R_m \cdot \Theta_{t-1}$

4. $\Theta_p = P_r \cdot \Theta_{t-1}$

The total amount of savings at the end of a cycle of investment (Θ_t) equals the sum of the earnings and returning principle, reduced by the fraction of the total spent (line 5.). Substituting lines 3. & 4. and combining terms gives line 6. The amount of gain ($\Delta\Theta$) equals the total less the former amount (line 7). Substituting line 6. and combining terms results in line 8.

5. $\Theta_t = (\Theta_e + \Theta_p) \cdot (1 - F_s)$

6. $\Theta_t = P_r \cdot (1 + R_m) \cdot (1 - F_s) \cdot \Theta_{t-1}$

7. $\Delta\Theta = \Theta_t - \Theta_{t-1}$

8. $\Delta\Theta = (P_r(1 + R_m)(1 - F_s) - 1) \cdot \Theta_{t-1}$

Since the net probability of return, $P_r(1 + R_m)$, has been assumed to be positively greater than one and the fraction spent, F_s, has been assumed small enough not to reduce $\Delta\Theta$ to zero, there is a constant R'' greater than zero and smaller than the ratio of change in the compound investment economy, $((P_r(1 + R_m)(1 - F_s) - 1))$.

9. $(P_r(1 + R_m)(1 - F_s) - 1) > R'' > 0$

and

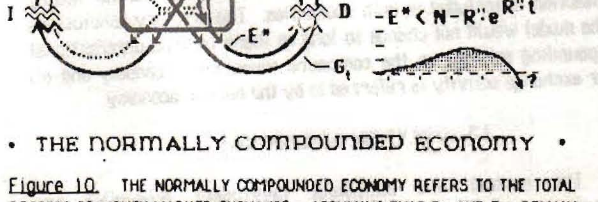
10. $\Delta\Theta > R'' \cdot \Theta_{t-1}$

By the differential equations for exponential functions:

11. $\Theta > e^{R'' \cdot t}$ for some constant $R'' > 0$

and

12. $\Delta\Theta > R'' \cdot e^{R'' \cdot t}$



• THE NORMALLY COMPOUNDED ECONOMY •

Figure 10. THE NORMALLY COMPOUNDED ECONOMY REFERS TO THE TOTAL PROCESS OF MONEY MARKER EXCHANGE. ASSUMING THAT Pr AND Rm REMAIN LARGE ENOUGH AND Fs SMALL ENOUGH AND THAT N APPROACHES A CLIMAX, THE REMAINDER OF N THAT CAN BECOME COMMITTED TO Θ, (E*), WILL DECLINE TOWARD NEGATIVE INFINITY.

Therefore the scale of the compound investment economy is always greater than some pure exponential and:

13. $O \dashrightarrow +\infty$

Total exchange is a combination of N and O. The measure of N as so modified by the stimulus and withdrawls of O is called E*, the net economic equity available for absorption into the flow of compounding investments. It represents the circulation of money in the economy that is not on its way to or on its way from the compounding of investments and so mortgaged and liable to provide it returns. It is thus the money which is available for providing those returns.

12. $E^* = O(N)$
$= N - \Delta O$ (see figure 10.)
$< N - R''_a{}^{R''\cdot t}$

13. Since: $N < B_N$
and: $\Delta O \dashrightarrow +\infty$

14. Therefore: $N - \Delta O \dashrightarrow -\infty$
and $E^* \dashrightarrow -\infty$

A net economic equity of zero, let alone one approaching $-\infty$, could no longer provide returns for investments and the assumptions of the model can not be sustained. Since all other assumptions are quit firm, there must occur a sufficient failure of investment expectations to no longer provide a net positive return. Q.E.D.

The feasible escape clauses from this conclusion are:

1. that the fraction spent, F_8, might rise sufficiently (at least to equal the net rate of return, $1-P_r(1+R_m)$) so that the compound investment economy would cease to exist by changing to operate like and relieve its burden on the normal economy,

2. that under the experiance of impending E* decline the economy as a whole might be prodded into the discovery of yet another growth level shift and forestall the otherwise eventual profound crisis one more time.

What seems to have been most common historically is a combination of the financial failure and growth level shift options in the form of general economic panics and creative reconstructions. Whether we liked going about change in that fashion or not, it is a trick that can not be repeated indefinitely.

To put it in graphic terms, if all dollars were colored, green for participating in the normal economy and red for participating in the compound investment economy, then maintaining economic stability would cause the green dollars to vanish completely. The entire value of the red ones would come to reside in empty promises that could be kept only by making still bigger empty promises, stripping money of all real meaning.

Luckily, that does not actually happen. Economies, and the irrational expectations they are built around, become unstable and create enough failure to prevent it. Following the events of system failure, and the release of former investment commitments, the number of green dollars is apparently able to grow more rapidly than the number of red ones for a while. The growth of the red dollars inevitably overtakes, however, and the cycle repeats. Thus the process depicted is of a periodic destructive annulment of the natural excesses of regularly compounded investments.

14. CONCLUSION

What has been described above is a strange state of affairs. It is a dilemma so complexly, pervasively and influentially entwined in all human affairs that attempting to state its social or political meaning seems nearly impossible. It is never the less a real dilemma. It can be talked about in meaningful terms, and is going to be dealt with, meaningfully or not, for quite some time to come. It might be dealt with in enormously rewarding and naturally creative ways.

The analytical approach developed here can be further developed, as can alternate approaches. In doing so, it is likely that more specific and more practically useable 'escape clauses' would be discovered. That there is no dilemma, however, would not be discovered, that is, unless we can discover how to not operate with money, or its equivalent, or how to not be operating in a real world.

REFERENCES

Heilbroner, Robert; 1980; The Worldly Philosophers ; Simon & Schuster

Henshaw, Philip F.; 1985; directed Opportunity, directed Impetus: New Tools for Investigating Autonomous Causation; (elsewhere herein) SGSR 1985 Conference Proceedings ; Intersystems Publications

N.Y.Times; 8/30/84; Michael Quint; "Insuring Tax Exempt Bonds: Default Fears Spur Increase"; The New York Times; page D1; New York

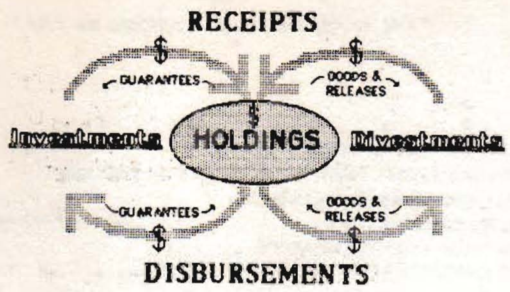
McClelland, Peter D.; 1975; Causal Explanation and Model Building in History, Economics and the New Economic History; Cornell Univ. Press

Seitz, Neil; 1984; Business Forecasting, Concepts and Micro-computer Applications; Reston Publishing Co., Reston

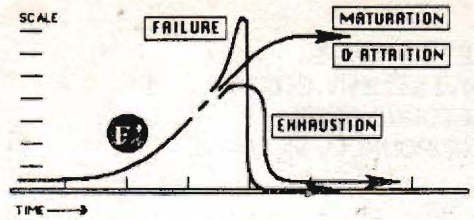
AUTHOR:

Philip F. Henshaw
INFLECTION POINTS RESEARCH
420 6th Avenue
Brooklyn, N.Y. 11215

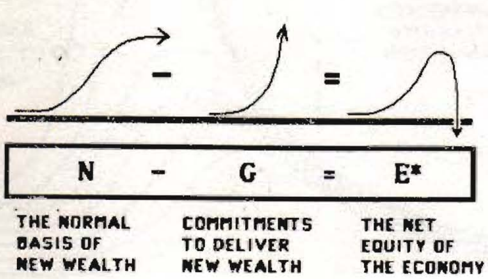
BIOGRAPHY: B.S. Physics 1968; M. Arch. 1974, design, theoretical structures, micro-climates; 76-79, original research in natural building climates, autonomous air current dynamics and systems science issues; construction contracting, building and product design, solar design consultant, research conference papers and alternative journal publication; practicing architect in N.Y.C.

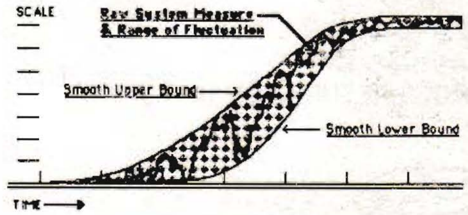


• BASIC MODEL OF TOTAL EXCHANGE •

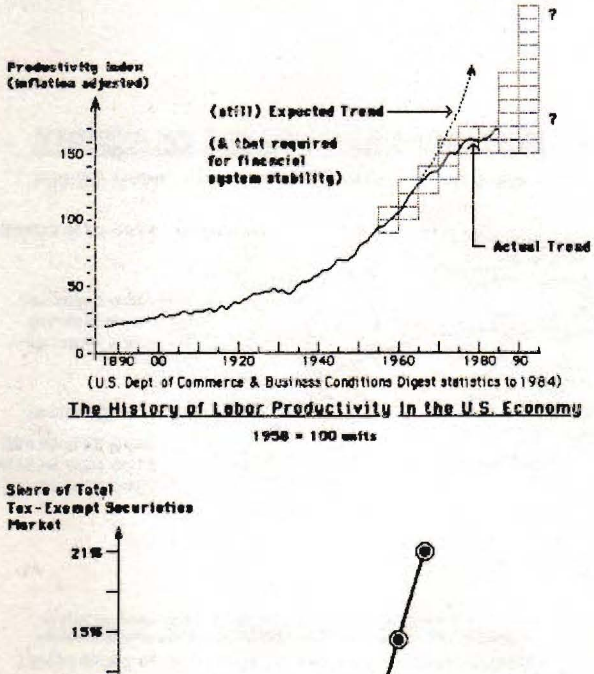


• THREE GENERAL TYPES OF GROWTH CLIMAX •





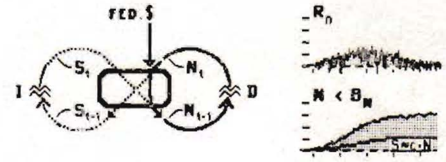
• IMPLIED SMOOTH GROWTH ENVELOPE •



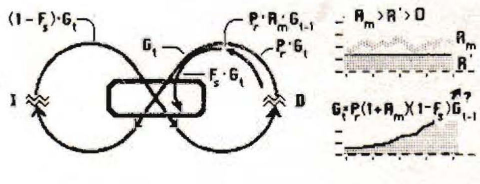
(U.S. Dept. of Commerce & Business Conditions Digest statistics to 1984)

The History of Labor Productivity in the U.S. Economy

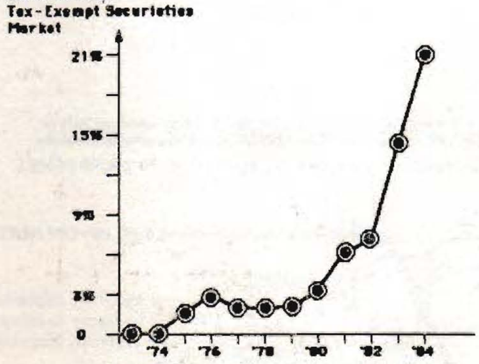
1958 = 100 units



• THE NORMAL EARN/SPEND/SAVE ECONOMY •

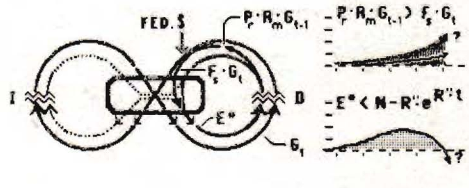


• THE COMPOUNDED INVESTMENT ECONOMY •



(adapted from New York Times/Aug. 30, 1984)

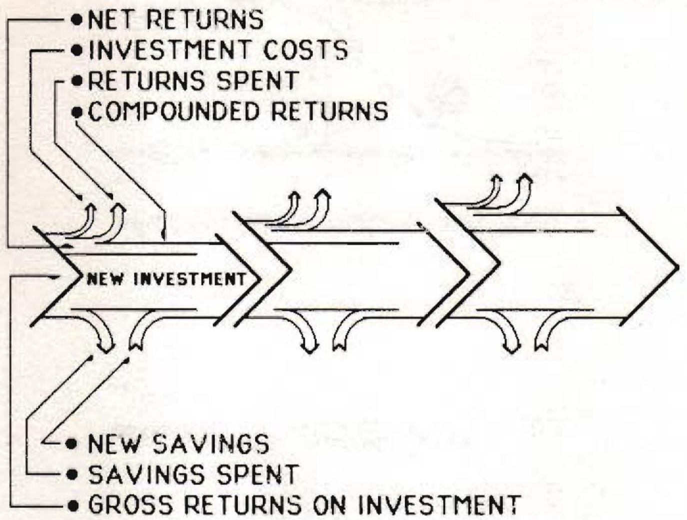
GROWTH OF INSURED TAX-EXEMPT SECURITIES

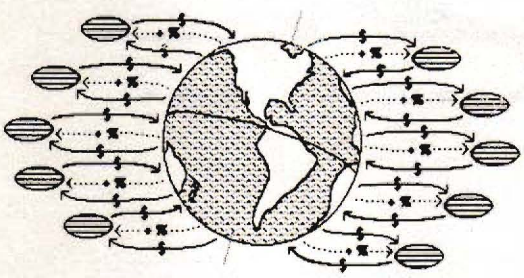


• THE NORMALLY COMPOUNDED ECONOMY •

Henshaw 85

THE COMPOUND ACCUMULATION OF INVESTMENT

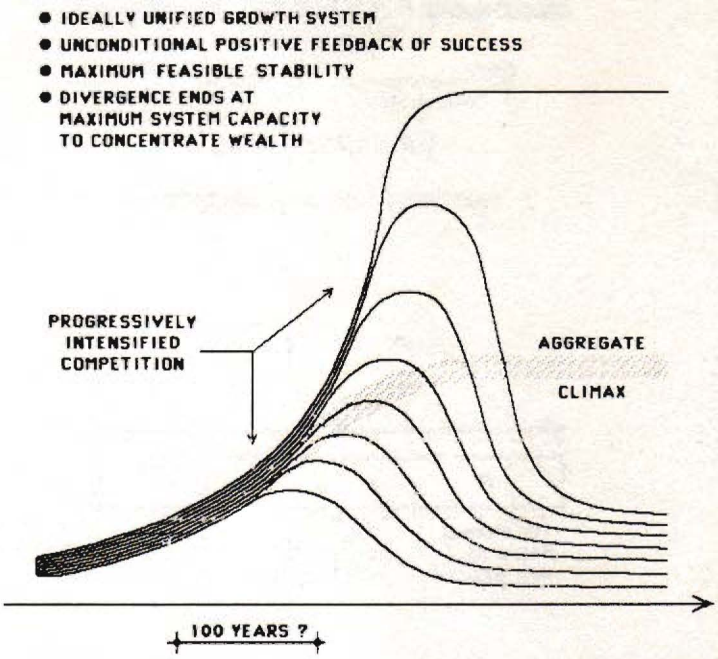




COMPETITIVE DIVERGENCE AT CLIMAX

-OR-

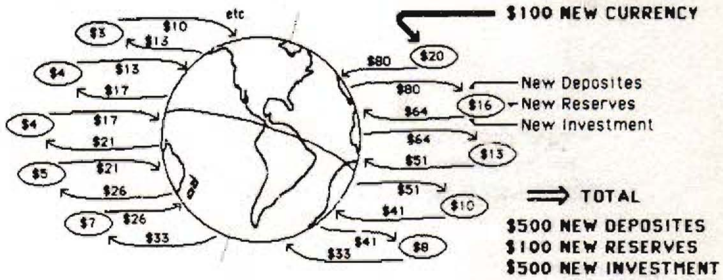
"THE IMPORTANCE OF STAYING ON TOP"



"Hence the stock of capital and the level of employment will have to shrink until the community becomes so impoverished that the aggregate of savings has become zero, the positive savings of some ...being offset by the negative savings of others." J. M. Keynes

IDEALIZED EXPANSION OF CREDIT

NEW CURRENCY NORMALLY SUPPLIED AS ECONOMY EXPANDS



IDEALIZED COLLAPSE OF CREDIT

NORMALLY PREVENTED BY PROFITS SUFFICIENT TO COVER LOSSES