Long Term Growth and the Wealth of a Nation:
Growth Miracles and Lost Decades

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June 1, 2009

Adam Smith's title notwithstanding, wealth has always remained minor partner to income in macroeconomic theory. We all recognize some influence of wealth on consumption spending and short term economic performance. Spending decisions are based partly on wealth, on permanent rather than current income. But we have not explored the link between wealth and long term economic growth.

This paper links economic growth to the price of capital. Where past work on endogenous growth concerns the expansion of the pool of ideas and knowledge, we focus instead on the decision process by which these ideas are adopted. The theory is based on two hypotheses: that economic growth is an important determinant of the price of capital and that the price of capital, in turn, explains the rate of economic growth.

A financial approach to the valuation of capital assets leads to the specification of the impact of economic growth on the price of stocks, land and other assets. The second hypothesis is based on the Schumpeterian process of creative destruction that pits new technologies and new patterns of specialization against the old. Equilibrium is achieved between the new and the old through adjustments in the price of capital. When the price of capital increases, the profitability of implementing new technology decreases. Entrepreneurial activity is directed away from innovation and toward the exploitation of more valuable existing wealth. Conversely, a fall in the price stimulates innovation. Therefore rational decisions of innovators determine the course of innovation in response to the price of existing wealth.

The model explains several puzzling empirical regularities in the succession of market upheavals that characterize modern economic history. It shows why asset prices are subject to the violent shifts so often attributed to investor irrationality. It explains why bubbles and panics are frequently similar in amplitude. It accounts for the apparently irreconcilable facts that while brutal changes in the fortunes of investors always precede upturns and downturns in the product markets, not all bubbles are followed by an expansion and not all panics precede a recession. The theory gives a simple reason for the long periods of rapid economic growth miracles and the equally long spells of stagnation (lost decades) that often follow these miracles. And it explains why modern economies never seem to settle on an average and sustainable long term growth path between these two extremes.

We begin in section 1 with a re-examination of the 13 asset crises that occurred in the United States since 1903. We explain the apparent disconnect between these crises

and economic fundamentals and the reason why economists fall back on irrationality and market failure to explain them. We show that the relationship between wealth and growth provides an alternative, simpler explanation of the severity of asset crises. In Section 2, we specify the relationship between wealth prices and economic growth. Both the static and the dynamic specifications of the model demonstrate that the economy tends to settle on one of two alternative stable equilibrium growth paths. Prolonged periods of low, sluggish growth, lost decades, follow years of growth miracles. A third equilibrium at the average long term growth rate is unstable. The theory of a wealth-growth connection opens numerous avenues for future research that we present in conclusion in Section 3.

I.   Economic Fundamentals and Asset Prices

Bubbles and Panics

Bubbles and crashes have always fascinated economists. Though it goes against their grain, they have frequently resorted to irrationality and market failures to explain them. In his recent review Stephen F. LeRoy notes: "Many contemporary writers are more sympathetic to the idea of irrationality than mainstream financial economists were a generation ago."[1]

The extreme volatility of asset prices–far greater than product prices- has led most observers to conclude that price movements were due to irrationality and market imperfections. Economic fundamentals do not seem to change enough to explain the erratic behavior of asset prices. The very names of these wild price movements - panics, crises, bubbles - suggest irrationality or market failure.

Consider the headline of the business section of the New York Times on October 8, 2008: " Forget Logic; Fear Appears to Have Edge." But, it is not only politicians and journalists who ascribe to panic the large drops in asset values that seem to happen so frequently. Economists also invoke irrationality and market failure. In the same New York Times article, Vikas Barjas quotes two analysts as follows:

"Fear is an immensely powerful force, perhaps more so than greed. Scientists who have studied the brain function have found that the amygdala, the part of the brain that controls fear, responds faster than the parts of the brain that handle cognitive functions. At this point, any spreadsheet analysis of underlying and intrinsic values of stocks becomes meaningless, and concern for preserving wealth overrides the desire to grow it — what some may call greed." (Andrew Lo, MIT)

"What's happening is people are crawling into a bunker and pulling an iron sheet over their heads because they think the sky is falling." (William Ackman, hedge fund manager).

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[1] It is not the purpose of this note to review the literature on crashes and bubbles. For an excellent review, see LeRoy, 2004.

Mishkin, certainly the top expert on financial crises, defines the phenomenon as "a nonlinear disruption to financial markets in which asymmetric information problems (adverse selection and moral Hazard) are getting worse so that financial markets are unable to efficiently channel funds to economic agents who have the most productive investment opportunities." (2008) A similar view is present in the work of many others, such as Bernanke when he explains the severity of the Great Deprecession (1983):

"The basic premise is that, because markets for financial claims are incomplete, intermediation between some classes of borrowers and lenders require nontrivial market-making and information-gathering services" that were disrupted by the 1930-1933 events.

In the panic of 2008, rationality has been abandoned completely in all explanations of the crisis. In Mishkin's words,

"The originate-to-distribute model of securitization, unfortunately, created some severe incentive problems--or agency problems-- …. problems resulted in lower underwriting standards, giving borrowers with weaker financial positions access to larger loans than they should have had. Investors in mortgage-backed securities apparently ignored the importance of these agency problems and did not adequately understand the risk characteristics of the securities they were holding." (Mishkin, 2008)

Should we accept these explanations? Should we join in and reject a link between investor behavior and economic fundamentals? Or is it possible that the erratic behavior of markets and participants has a rational explanation?

Fundamental Determinants of Asset Prices

The wealth of a nation is the value of its real assets, homes, equipment, labor, and land. Wealth is subject to large variations over time, not because of its volume, but because of its value. Wealth is owned directly by individual economic agents or indirectly through ownership of financial assets that provide an agent a claim on physical assets. Accordingly, prices of financial assets also vary. In fact, they seem to be even more volatile than the prices of physical wealth.

In studying asset prices, economists' supply and demand framework is useful to study the dynamics of price changes while a financial approach is needed to obtain an absolute value of the economy's assets. Adopting a financial approach and assuming certainty about the future stream of earnings and infinite lifetimes, we can express the value of assets as the sum of present and future net payoffs the latter discounted back to the present to reflect the time preference of investors.

$$P = (1 + \Pi) \{ (1+c) A + [\Sigma \{A (1+g)^n / (1+r)^n\}] \}$$

$$= (1 + \Pi) \{ (1+c) A + [A / (r - g)] \} \tag{1}$$

Economic fundamentals enter into this equation in three ways. Economic conditions, past and expected, influence the level of the returns (A), their expected long-term growth, g, and the costs (benefits) of an imminent recession (expansion) c. To simplify the formulation, we assume that all of the effects of the next phase of the short term business cycle are felt at once and need not be discounted. We further assume that the discount rate r is constant. Left unexplained by economic fundamentals is π, a premium or discount reflecting the undervaluation or overvaluation due to irrationality or market failure (bubbles or panics).

Because fundamental value is unobservable, the traditional approach to estimate π is to use a proxy for [A / (r - g)]. In stock market studies, for example, A is dividends and (1+ π) can be estimated by studying the historical course of the price-earnings ratio (Cochrane, 1991). In home price studies, the proxy is housing rents (Kramer and Wei, 2004).

Right away we see that speculation and irrationality are difficult to detect empirically because π has precisely the same effect on P as economic fundamentals such as g or c. Since the proxy for fundamental value is based on past rather than unknown future trends, the analysis tosses changes in long-term and short-term growth expectations into π. As a result, journalists and politicians (and also economists) all conclude that irrationality and market failure are to blame for swings in asset prices. We see bubbles and panics everywhere.

Price Movements in Asset Markets

That asset markets are subject to violent swings is beyond doubt. In U.S. stock markets, we have gone through as many as 13 "upheavals" or "crashes" since 1903. Table 1 summarizes the intensity and timing of these crises.

The performance of residential housing prices is equally remarkable. According to the Office of Federal Housing Enterprise Oversight (OFHEO), house prices have appreciated at an annual rate of 5.4% on average (68.9% over the seven years from 2001 to 2007). By January 2009, the average home price in America had fallen by 29% since the highs attained in mid 2007. .[2] A similar drop of 30% in home prices occurred from 1925 to 1933.[3]

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[2] There is no reason to doubt that similar large fluctuations do not also occur in other components of a nation's wealth. The value of human property, impossible to measure other than through its returns (wages and salaries), is probably also subject to large-scale swings.

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Table 1: Financial Crises and Economic Cycles

a	b	c	d
Financial Crises	Peak to trough change in the Dow-Jones index	Duration of crisis, months	Short term situation and prospects
1903	-34%		Recession
1907	-41%	22 months from 1/4/06 to 11/5/07	Recession: Production declined by 11%
1920	-35%		18-month recession
1929	-89%	34 months from 9/3/29 to 7/7/32	First phase of the Great Depression: Production fell by 30%
1937	-41%	12 months from 3/10/37 to 3/31/38	Recession of 3.4% within the Great Depression
1940	-20%	9 months from 9/12/39 to 6/10/40	Growth (+4.6%) and prosperity
1962	-23%	6 months from 12/31/61 to 6/26/62	Growth (+5%) and prosperity
1970	-31%	6 months from 11/16/69 to 5/26/70	Mild recession (-.3%)
1973	-46%	24 months from 1/8/73 to 12/6/74	Serious recession starting 10 months after the start of the crash (-2%)
1987	-27%	24 mo.	Growth (+3.4%) and prosperity
1990	-21%	3 months from 7/17/1990 to 10/11/1990.	Mild recession (-2%)
2000	-23%	29 months from 5/7/99 to 10/1/01	Mild recession (-0%)
2008	-50%	21 months from 7/18/07 to 3/5/09	Severe recession (at least -6%)
Average	-31.7%		
Range	15%-41%		

Source: Economagic.com and author's computations.
All declines in the Dow Jones average of more than 20% were included except the brief crisis of 1946. There is nothing left to explain in that "crisis" since the 25% fall in the stock market reflects almost exactly the 20% fall in output associated with the shift from wartime production.

Crises in asset markets cannot be explained solely by short term business cycles. This is shown by the relatively low correlation between movements in stock prices (column b) and economic conditions during and shortly after periods of crises (column d). Only ten of the thirteen crises were associated with recessions (We alter Paul Samuelson's quip: the stock market predicted 13 of the last 10 recessions), three occurred during expansions. Even more telling is the fact that 11 recessions, including the sharp downturns of 1957-58 and 1981-82, were not accompanied by stock market crashes. Even if all of the cyclical change in GDP were immediately reflected in an equal change in stock prices, there would remain a large unexplained residual.

With sudden price decreases of 32%, little of which can be explained by short term business cycle fundamentals, the fall back for an explanation is to allege panic behavior. It is not surprising that these wild price swings are interpreted as evidence of mispricing by imperfect markets, irrational investors, and "greedy", unregulated institutions. But the short business cycle is only one of the potential explanations for price movements in capital and other asset markets.

Impact of a short term shock

In this section, we show why an imminent recession, even the severest one, cannot explain stock and housing prices "bubbles" and "crashes". The 34% decline that rocks stock markets every 7 or 8 years cannot be attributed to short-term or cyclical economic fundamentals. Neither can the "bubbles" that precede these crashes. In fact, many of these violent price movements have occurred without a boom or recession in sight.

A simple calculation demonstrates that short-term economic fluctuations cannot explain more than about one-third of observed overvaluations and undervaluations in the asset markets. Let us assume, for example, that a recession is imminent and that all of its negative impact will be felt immediately. In this worse-case scenario, earnings fall to zero and do not recover until the end of the recession. At the end of the recession, earnings return to their long term growth path. The loss in the stream of earnings is shown by the shaded area in Figure 1. Clearly this is an overvaluation of the losses occasioned by a recession since the "real world" behavior of earnings probably follows a more realistic trend such as is shown by the broken line in the figure.
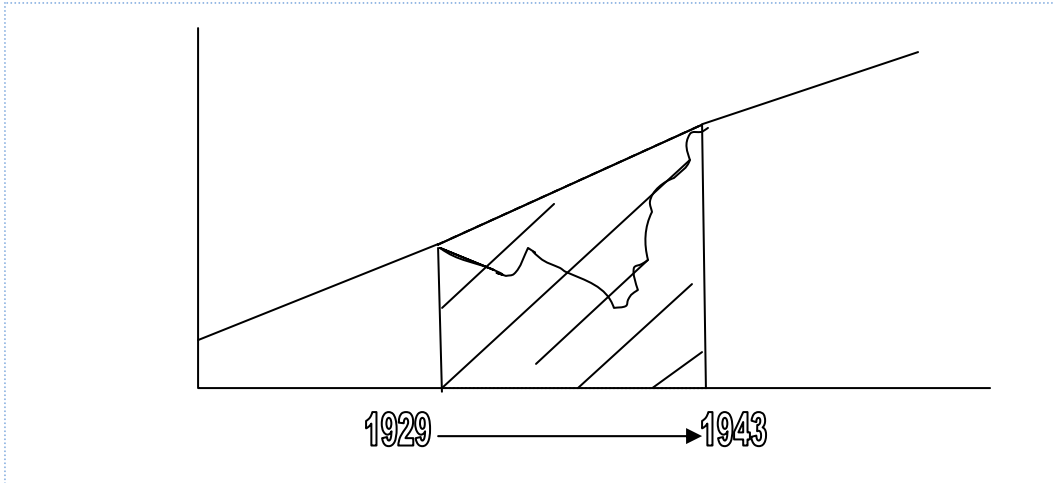
Figure 1: Impact on the stream of earnings of a cyclical downturn as serious as the Great Depression

If the recession lasts n years, the total loss of earnings in the extreme case will total n A. Estimating this loss as a percentage of the total stream of earnings yields

$$c = n A / A (1 + r - g) / (r - g)$$

$$\approx n (r-g)$$

Taking a discount rate r of 5% and a rate of growth of earnings of 2.1% (the average U.S. long term growth of per capita real GDP), Table 2 simulates the effect of the duration of severe recessions on the price of assets.

Years	1	2	3	5	8	10
dP/P	-2.9%	-5.8%	-8.7%	-11.5%	-23.2%	-29%

Table 2: Effect of the Duration of a Severe Recession on Asset Prices

As we said earlier, this is an overestimation of the impact of a recession! Do we expect something worse than the Great Depression every time the stock market crashes? If even the expectation of a certain and imminent Great Depression cannot knock off more than 29% to the fundamental value of stocks, houses and other assets, no wonder that the traditional fall back explanation for all of these crashes is "fear itself". But there is an alternative and far simpler explanation for the catastrophic decline in asset values. This explanation does not require that we abandon rationality, the most fundamental assumption of the science of economics.

Impact of changes in long-term trends on asset prices

While the long term average per capita growth rate stands at about 2.1%, the American economy is rarely on its 2.1% long term growth path. The historical record

shows a succession of periods of low-growth followed by periods of high growth. The periods differ greatly in length but not in amplitude. The high-growth rates are twice as high as the low-growth rates. For example, as shown in Table 3, the average growth rates for the last six decades oscillate between high growth (3.8% or 2.6%) and far lower growth (1.3% or 1.5%).

	Growth rates	Number of years
1951-1961	1.3%	10
1961-1969	3.8%	8
1969-1983	1.5%	14
1983-1999	2.6%	16
1999-2008	1.3%	9
	2.1%	11.4

Table 3: Alternation of Periods of High and Low Growth in the post-War United States

Changes of this magnitude in the near-term rates of GDP growth are common. The onset of the Great Depression probably brought the medium-term expected growth rate to 0%. The same thing happened in Russia in 1990 and Argentina in 2001). The 1970s and early 1980s brought about a break in the medium-term growth rate, bringing it down to about 1.4%. The Bush years have similarly cut the growth rate in half, and that for a period that has already lasted nine years. Similar breaks in the long term rate of growth occur in almost every country. Given the historical record, it is reasonable that the investing public expects occasional breaks in the long term growth rate.

As shown in Figure 2, the future stream of earnings will be profoundly altered if investors perceive a break of ten to twelve years in the normal growth path. For example, after a low-growth hiatus as short as 11 years, the economy returns to normal growth at a level of earning 20% lower than the high growth economy. Assuming a rate of time preference r of 5% in equation (1), an 11-year shift of the rate of growth in earnings g from 3.2% to 1.5% causes the asset price-earnings ratio to fall from 41 to 35, a 15% decline.
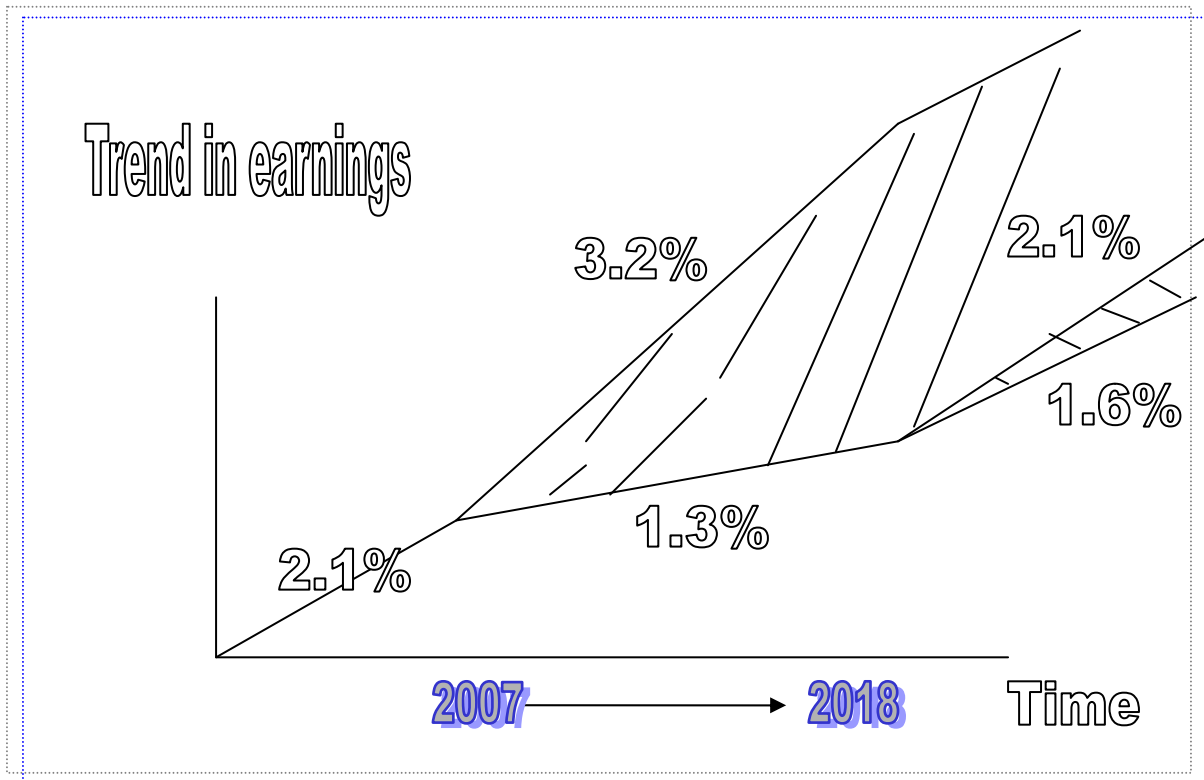
Figure 2: Impact on the stream of earnings of a break in the expected long term rate of growth

The figure also shows what happens if the secular rate of growth does not return to its normal 2.1% growth rate. Still using equation 1, a permanent decrease of 5 points (from 2.1% to 1.6%) in the secular growth rate reduces asset values by another 15%.

Now with only fifty years of reliable economic growth data for countries throughout the world, it is not possible to demonstrate conclusively the existence of long cycles in long term growth. All we can do is rely on observations of Kondratieff and others on the existence of 50 to 60 years cycles. We also note that the Kondratieff cycle is consistent with the steady drift in the long term average growth rate in most countries since the 1960s, when the ten-year moving average growth rate has fallen from about 3% to 2.1%.

Neither the business cycle nor the outlook for the long term rate of growth alone can explain the serious crises that rock the financial markets periodically. Each cause, acting singly cannot account for more than a 20% decline in asset prices. But the simultaneity of these shocks can account for even the most serious of the crises.

It is probably the combination of three expected events that caused the 80% decline in stock prices at the start of the great depression: a serious recession, a ten to fifteen years period of stagnation and the permanent slowdown in secular growth

predicted by many economists, Keynes among others. The 2008 financial crisis appears to be another situation in which the three factors are again at work simultaneously. Despite being denied for months during the election year of 2008, we knew that a serious recession was in the making (NBER finally recognized in October 2008 that the recession had started the previous December). It took several years of anemic recovery following the 2000 recession to finally convince investors that the New Economy was nothing like it had been described in the 1980s and 1990s and that it was time to revise downward growth estimates for the next decade and to discard the belief that the secular decline in long term growth had ended. A 50% decline in the stock market and a 29% decline in housing prices followed shortly after these changes in expectations.

Rationality is restored and so is the idea that markets are efficient. All it takes to produce a bubble or a crash is the coincidence of expectations of imminent upturns or downturns in three superimposed cycles. The cumulative effect of a serious recession followed by ten to twelve years of slow economic growth, and the continued slow and steady secular decrease in the long term growth rate could and probably did cause the crash of 2008. Although not synchronous, the three cycles are of different duration. Their peaks and troughs can easily coincide. The very conception of a medium or long term rate of growth creates a correspondence between the short business cycle and longer term trends. The long term rate of growth is an abstraction, the product of a moving average of short term rates. It is often a recession or a combination of recessions that leads the economy into a longer period of relative stagnation.

Because long term growth rates are not known with certainty, expectations play a role here. The "long term growth rate" (in earnings or GDP) is not well defined in investors' minds. The historical record plays a major role. Confronted with constant changes in the rates of growth and unable to determine how much of current growth is permanent, how much is temporary, we turn to simple thought processes. The current growth rate is probably important in our thinking, but it is important in its relationship with the historical high and low growth nodes. If the current growth rate is very low (below the low-growth equilibrium), we expect that it will probably rise in the near future. If, on the other hand, the current growth rate rises above the low-growth equilibrium, a large proportion of investors will judge that it will soon decline to its normal low-growth path. This will continue as long as the rate of growth is below its long term average of 2.1%. When current growth rates rise above their long term average, a large number of investors will believe that the economy is settling on its stable high-growth path. And since we have learned to expect that the economy rarely settles on its average long term trend, the 2.1% growth rate is rarely achieved and never expected: the economy oscillates between its high and low growth path. Asset prices follow.

When combined with the short term influence of business cycles, the breaks in economic growth can fully explain the wild gyrations in asset markets. If investors expect that a slowdown in economic growth will coincide with the onset of a recession, asset markets will be marked by panics of the order of 30% or more. If they expect the coincidence of a long term acceleration and short term expansion, asset prices will bubble

up by a similar percentage. Panics and bubbles are rational reactions to major changes in economic growth.[4]

II. Growth Miracles and Lost Decades

The Effect of Economic Growth on Asset Prices

As shown in equation (1), we have a hyperbolic relationship between the asset price-earnings ratio P/A and the long term rate of growth. Let us add the effect of expectations. A Gaussian curve summarizes how expectations enter into the valuation of capital assets. The larger the difference between the observed long term rate of growth and the average, the less likely this growth will continue. When combined, the two relationships define a logistic function. The declining probability of unusually high or low growth levels produces a well-defined inflection point at the average level of the growth-wealth relationship (2.1% growth and a price earnings ratio of 16)[5].
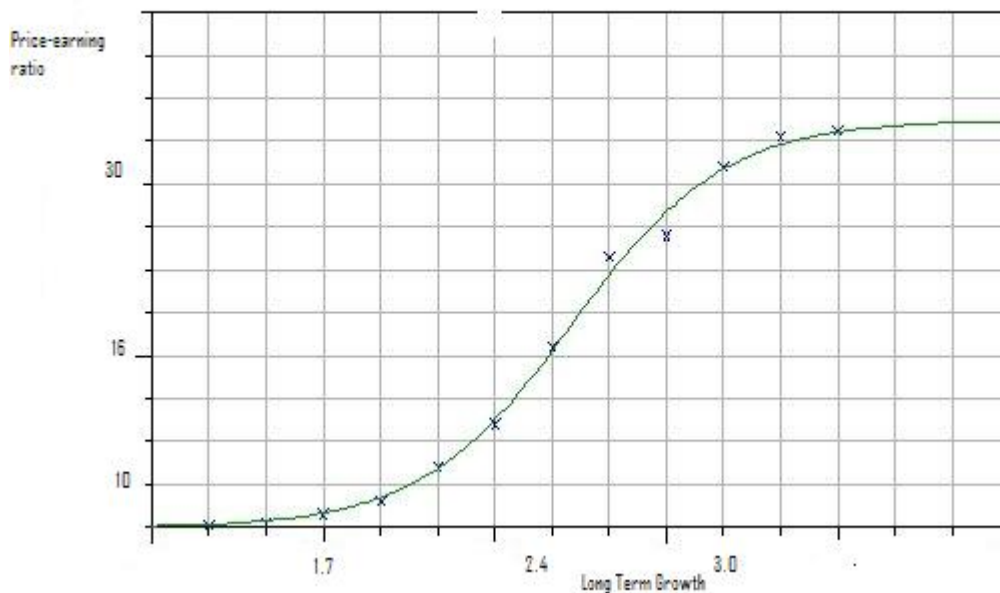

Figure 3: The Wealth-Growth Logistic Curve

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[4] That economists do not identify these events as "structural breaks" is not surprising. Only one (possibly two) structural breaks can be allowed in any time series by current statistical techniques. Hence, studies to date have only captured major events such as World War I in Europe and the Great Depression in the United States as significant changes in long-term growth rates.

   [5] We ignore the possibility that the higher the expected growth rate the higher the rate of discount (because of the diminishing marginal utility of consumption). This paper assumes that the rate of time preference is constant. Without any further discussion, we assume that sudden and major preference shifts are unlikely and should not be taken as determinants of fundamental value. On this point, see George J. Stigler and Gary S. Becker. De gustibus non est disputandum. American Economic Review, 67:76—90, 1977.

Whether the current long term rate is expected to continue depends on investors' mood. Realistically, a higher than normal growth rate cannot persist for very long. Nor can an abnormally low growth rate. However, governed by cycles of euphoria and fear, investors may easily become over-optimistic at times, over-pessimistic at others. In either case, the logistic function becomes steeper at either extremes and asset prices are more variable. But the function must always eventually turn flatter at both extremes. In the United States in the late 1990s, when expectations became totally unrealistic, the stock markets experienced price earnings ratios as high as 40, probably a record. Even then, however, there was a limit to euphoria and it was attained in the turbulent weeks of December 1999. At the other extreme, the year 1933 brought us to a climax of "fear itself". Yet even then, with a preponderance of investors suffering from utmost depression, the market itself did not and could not turn completely irrational: there continued to be some buyers and a floor was attained for the prices of assets.

Prices of assets increase with economic growth. At high growth rates, however, the objective effect of economic growth is partly offset by the subjective belief that growth may not be sustainable. Similarly, at low growth rate, more and more investors expect an acceleration in the near future. Accordingly, the shape of the logistic curve is governed by the nature of expectations. There are some countries and some environments where asset prices are more responsive to the current rate of long term growth. In others, the response is weaker and extreme of price earning ratios are rare.

So far this theory is purely one sided. Asset prices respond to economic fundamentals, both short and long term. Changes in economic fundamentals are sufficient to explain the severity of disturbances in asset markets. The more difficult questions remain: How, after a 10 to 12 years break in the normal growth rate, the economy returns to its former potential growth path? How long does it take for an investor to incorporate a new growth rate in the present value calculation? Are panics and bubbles symmetric in length? To answer these questions, we look at the reverse effect of asset prices on technical progress. .

Technology Adoption and the "cost of working": The Impact of Asset Prices on Economic Growth

Technological change is in part exogenous, in part endogenous. Exogenous is the stock of ideas and new techniques. It is large and increases constantly. In contrast, the process by which new technology is adopted is endogenous. At any one time, only part of the available stock of new technologies is adopted.

Schumpeter long ago cautioned us that inventions have little impact on economic growth until they are packaged into commercial innovations. New technology appears into production and consumption embodied into new products and new methods of production. The innovation process is difficult, risky. It is not simply a matter of a single entrepreneur with an idea and the resources and the gall to bring it to fruition. Each

innovation entails a measure of reorganization and the establishment of new relationships between people, products and institutions, new patterns of specialization and intermediation. The adoption of new products and techniques is accompanied by greater specialization. Each new product, each innovation is one more dimension in the organization of production and consumption. Consumers, workers, suppliers, creditors and even close competitors must collaborate in the process for innovations to be successful.

Surmounting the difficulties and the risks of new technology adoption requires powerful incentives. These incentives must be of a nature to benefit everyone. It is not just a question of rewarding entrepreneurs. All experimenters, all risk takers must stand to gain if the technology is successful. Incentives originate in the price difference between the old and the new.

We define as "cost of working" the relative price of capital. The cost of working is measured by the price of accumulated assets (that embody existing technologies and specialization patterns) relative to the price of new products. Since existing capital embodies existing technology, the cost of working is the price of the old relative to the new. It turns out to be one of the important parameters of an economy.

There are two ways to account for the negative relationship between innovation and the price of capital. First, innovations require the use of existing capital. Therefore innovation entails higher costs if capital is more expensive. As wealth increases in value, the profitability of new initiatives decreases. Second, there is an alternative use of entrepreneurial resources. Entrepreneurs can earn a profit from the exploitation of existing wealth. When the price of capital is high, entrepreneurial resources are more inclined to be redirected to imitation and other rent-seeking activities, to the detriment of innovation. Rent-seeking, the alternative to innovation, increases in a wealthier environment. A high price of capitals slows innovation and economic growth.

It should come as no surprise to those who have witnessed a serious depression that entrepreneurs become more numerous and active when the economy is doing very poorly. Though most of us are too young to have witnessed the Great Depression in the United States, we have had ample recent opportunities to observe situations just as serious in other countries. For example, in Russia and Eastern Europe during a transition to capitalism that ruined many, it seemed like everyone was forced to turn to entrepreneurial pursuits. Grandmothers used the sidewalks as the site for their tiny-scale retail ventures, people of all ages and all occupations became capitalists.

We find in environmental biology a parallel for the relationship between the boom-burst cycles of the economy and the technology cycle. Biology posits the existence of two types of environments. In environments where specie populations are large and safe, individuals enjoy stability and predictability. In low-population environments, insecurity is rampant as specie survival is at stake. Where populations are large and well established, resources are scarce and it is important to exploit them fully. Competition is high, each actor seeking to be well established and strong. Production units are larger,

live longer. Market entry is limited. Mobility is minimal. In such environments, behavior is more likely to be guided by K-type strategies. In contrast, there are environments where the ability to adapt quickly is more important. Consumers and producers are r-strategists. They are small, nimble, and foot loose. There is little need to compete with others because resources are plentiful and relatively unexploited. Because populations are small and vulnerable, short run survival is the primary goal. In the economic realm, the environment is determined by the price of capital. High prices lead to K-type environments in which we tend to focus on competing for the exploitation of high-value assets. The reverse is true of r-type environments where prices of assets are low, resources are plentiful, and the secret for success is to use these resources to create the new.

Although we thus surmise a negative relationship between the price of capital and the pace of technical progress, there is little or no information on the precise shape of the relationship. The level and elasticity of the innovation function probably depend on structural, institutional and historical conditions. There are countries and regions where the urge to innovate is strong and can be triggered by relatively small decreases in the price of capital. Others, lacking entrepreneurial spirit and initiative, may be more static and less prone to change.

Lacking more precise information, we hypothesize a straight line relationship between the price of capital and technical progress. The line has negative slope but its elasticity varies in different economic environments.

The Static Model

As shown in Figure 3, we have two hypotheses to explain the pace of technical progress and the price of capital. They are essentially demand and supply relationships. D is the demand for existing capital for use in developing the new products and techniques that will raise the rate of growth. S is the supply, the reservation price of existing assets, rising with the rate of growth.

Price-earning ratio
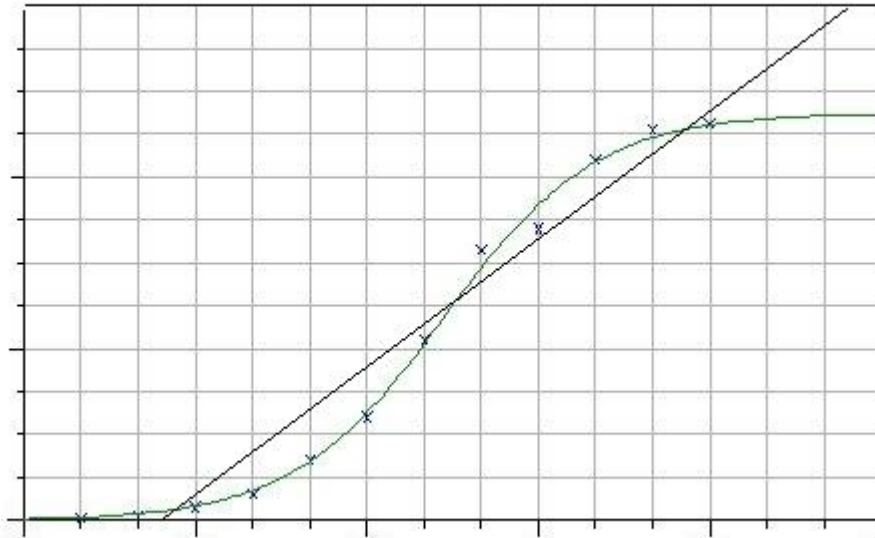
Long-term growth

Figure 3: The two stable long term growth equilibria

There is no originality in the model. All economic cycles are governed by similar laws. Some kind of inconsistency or limiting value causes upturns and downturns. In this case, a cyclical pattern originates in the inflection point of the supply curve.

We hypothesize that the process of creative destruction is triggered by the low price of existing capital embodied in land, labor and structures. The process begins at point A when the price of capital has fallen below normal. Since economic growth is also below normal, the cost of working will continue to fall for a while, making it cheaper and cheaper for entrepreneurs to undertake new projects. Economic growth progressively accelerates, reducing the rate of decrease in the price of old assets. The reversal in the decline in the value of wealth occurs at point B, the start of phase II. At point B, growth has reached its normal level and the period of abundant and cheap wealth ends. Prices of wealth begin to rise. But since wealth is still relatively cheap (below normal) growth continues to increase for a while. In Phase II, both economic growth and the price of wealth increase simultaneously. Phase II ends at point C when the price of capital has reached its normal level. Maximum economic growth has been attained. Since growth is higher than normal there, the scarcity of capital assets continues to be felt and the price of capital continues to rise for a while. In Phase III, existing assets have reached a higher than normal price and rent-seeking raises its ugly head. Entrepreneurs shift their effort to

competing for existing rents while wealth owners expend resources to defend their valuable wealth. Economic growth begins to decline but it remains higher than normal; hence the demand for capital continues to be high and asset prices continue to rise. Economies experience stagflation, a combination of rising wealth prices and declining growth. Asset prices reach their peak when growth falls to its normal level. The upward pressure on asset prices ceases at point D. In the final phase of the cycle, growth continues to fall because of higher than normal capital prices and the steady reduction in economic growth reduces the scarcity of existing wealth until prices fall back to a normal level and a new cycle can start.

The model behaves according to the standard Cobweb Theorem. The lag happens on the demand side in the slow response of new technological innovations to a change in the price of capital. The long term growth rate is rarely at its average level where the equilibrium is unstable. Any disturbance tends to push the economy into a cyclical pattern of periods of stable high growth and high asset prices followed by periods of low growth and low asset prices. There are "economic miracles" and "lost decades"

The path of equilibrium depends on conditions similar to those of the Cobweb model. If demand is inelastic, if the slope of the demand curve for existing capital is higher than the steepest portion of the supply curve (at its inflection point), the cycles will be dampened and the economy will progressively approach a stable equilibrium at the long term average rate of growth. If demand is more elastic, the system will tend toward a stable cycle in which the economy oscillates between a high and low rate of growth and a high and low price of capital. Any deviation will force the economy back toward these two attractors. If the gap between the two rates of growth is large, the cycles will dampen until they reach their normal course. If the high growth-low growth difference is very small, the cycles will explode for a while until normal oscillations are restored. Finally, the greater the elasticity of demand and the lower the elasticity of supply, the greater the difference between the high and the low long term growth rates, and the longer the periods of high and low growth.

Combined with the standard business cycles, the periodic shifts from growth miracles to relative stagnation are sufficient to explain the frequent bubbles and panics in property and financial markets. Rationality is restored and so is the idea that markets are efficient. All it takes to produce a crash in asset prices is for the expected growth rate to fall to its low level. If investors also foresee a serious recession ahead, the crash can take major proportions. All it takes to produce a bubble is for the economy to accelerate to its high level of long term growth while the economy is in the expansion phase of the business cycle.

The Simple Dynamics of Growth Miracles and Lost Decades

We follow the Walrasian-Schumpeterian tradition and assume that entrepreneurs seek temporary profits that are eventually whittled away by competition. The number of active entrepreneurs E (or the number of innovations) determines the rate of growth. The rate of growth is equal to the normal long term pace of innovation diminished by

the number of entrepreneurs diverted to rent seeking activities. That number depends on the availability of rents and rents are a positive function of the price of capital. The simplest linear formulation of these relationships yields the following equation:

$$dE/dt \ = \ E \ (g - \beta \ P) \ \text{ or, expressed in rates of growth:}$$

$$g_E = (dE/dt)/E \ = \ g^* - \beta \ P$$

A linear approximation of the rise in the price of capital assets yields a relationship between the change in price and the scarcity of existing assets as measured by the difference between the current and the "natural" number of active entrepreneurs.

$$dP/dt \ = P \ \ \delta(E \ - \ E^*), \text{ so}$$

$$g_P \ = (dP/dt)/P = \delta \ E \ - \ \delta \ E^*$$

Very similar to a linear Phillips curve, this function indicates that there is upward or downward pressure on the price of capital when the number of innovating entrepreneurs exceeds or falls short of a natural level E* at which the economy would grow at its long term average g*.

Recognizing that $\alpha = g^*$ and $\gamma = \delta \ E^*$, the two equations define a Lotka-Volterra model in which E is the prey and P the predator (a rise in P turns entrepreneurs into rent seekers or, alternatively, reduces the incentive to innovate). The four coefficients differ in every country: α is the normal long term growth rate, β a measure of the ease with which entrepreneurs become rent seekers, δ the response of the price of capital to abnormally high or low growth and E* is the number of innovating entrepreneurs when the economy grows at its natural rate.

The model closely resembles a theory of economic growth proposed by Goodwin in Goodwin showed that variations in the saving rate and capital accumulation could result from changes in the share of wages in total income. Wages in turn tended to be related the employment rate by a simple Phillips curve. But Goodwin's model sought to explain the accumulation of capital, we focus on the pace of technical progress. Much of the work on variations in the saving rate as the determinant of the rate of growth was dealt a serious blow by Solow's seminal article.

The Need for Empirical Work on Cyclical Patterns of Long Term Growth throughout the World

If the empirical evidence was limited to the observation that all financial crises follow a bubble, the theory would verge on the tautological. For all bubbles must burst. But the patterns of economic growth across the world reveal much more. Practically all countries experience prolonged periods of high economic growth followed by equally long periods of stagnation. And practically all countries have

experienced bubbles and crises of varying intensity that coincide with major breaks in economic growth.

It has not been our objective in this paper to report on the empirical validity of our theory. While there is strong evidence of the presence of cycles in medium term and long term rates of growth in all countries these cycles of varying duration and intensity are superimposed on each other.

Although much of the empirical work in prior studies of economic growth has focused on long term growth averages, there exists a wealth of literature on medium term breaks in the rate of growth. Our own preliminary findings confirm that moving averages over periods of 5,10, 15, 20 and 25 years behave cyclically. These cycles are not synchronized in different countries and are less apparent in the growth rate of the world as a whole, suggesting that internal causes are at work. The distribution of moving averages do not follow the normal distribution and are often bimodal, indicating the presence of high and low nodes.

Even a cursory examination of World Bank economic growth data from 1960 to 2007 confirms that economic growth in the Post War era has occurred in waves, with Europe leading the way immediately after the war, followed by Japan starting in the mid sixties, the New Industrial countries in the eighties and early nineties, and the emerging economies, particularly India and China, around the turn of the century. Other countries including those of Latin America and the United States have experienced shorter waves. But, in most cases, the movements in the growth rate have been large enough to produce bubbles and crises in asset markets. Most of the deviations from the mean growth rates occur in prolonged periods of 10 years or more and all of the movements in the growth rate have been large enough to produce bubbles and crises in asset markets. For example, using a 12-year moving average of annual growth rates, the high and the low growth rates appear to differ from the average by slightly more than one standard deviation. This would imply that the high growth node is 2 times higher than the average and 4 times higher than the low growth node.

III. Conclusion

Far more empirical work, and more sophisticated work, will be needed to sort out the patterns of economic growth throughout the world. This paper offers a new simple framework to explain these variations, one that restores the rightful place of rationality and economic fundamentals in understanding panics and crashes.

We are not all rational, of course. But, on the average and as a group, we are. Individual rationality and irrationality will determine who will gain and who will lose from panics and bubbles. But the system itself cannot be irrational. If it were, it would immediately perish.

Property markets do not bet on their own demise. For every panicky seller, there is a buyer who will benefit from others' panic. In the words of Warren Buffett, "Be fearful when others are greedy, and be greedy when others are fearful." And as long as there is at least one Warren Buffett, the system remains whole. If there were no buyers in a panic, the market would disintegrate. That's the only case in which a crisis becomes an upheaval, a cataclysm, a debacle, a deluge, a calamity…. and, while we have heard all of these words in every past panic, none of these things happen. Instead, markets get mired into long periods of low price-earning ratios and slow growth followed by long periods of high growth and asset markets booms.

One of the important conclusions of this analysis is that the 2008 financial crisis was not only associated with a serious recession; it also portends at least a decade of sluggish growth or near stagnation and perhaps the prolongation of the secular decline in the long term growth rate that has occurred since the glorious decades immediately after the war.

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