Notes: Bubbles, Equity Premia, and the East Asian Financial Crisis of 1997-1998

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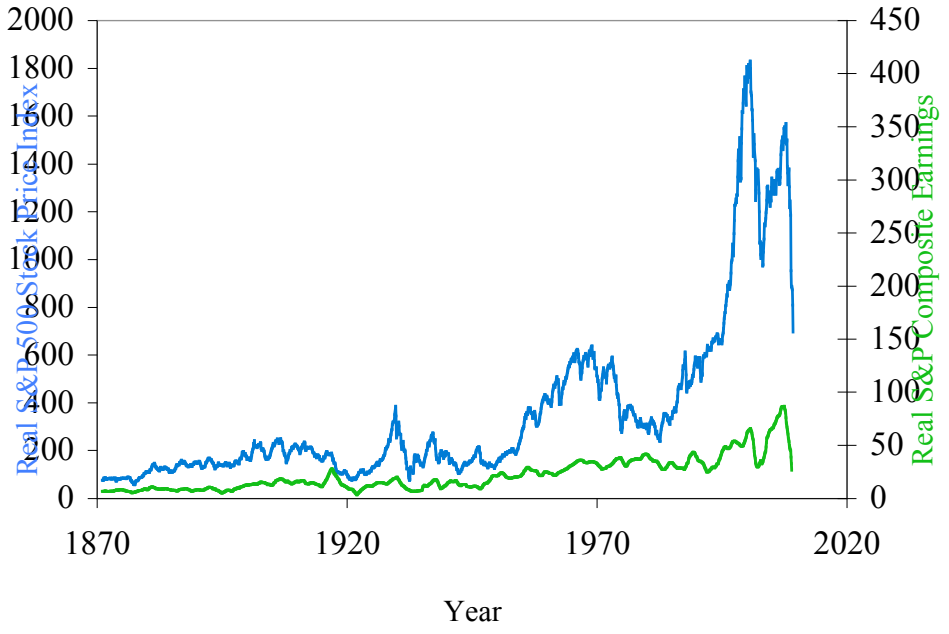


Recall our asset pricing equation:

$$(1) \qquad p_t = \lim_{n->\infty}\left\{E_t\left[\sum_{i=0}^{n} d_{t+i}\right]\right\} + \lim_{n->\infty}\left\{E_t \eta_{t+n} \frac{(1+g)^n}{(1+r)^n}\right\}$$

It is plain that if g is greater than or equal to r bubbles are not just "rational" and possible—they are required unless there are very powerful economic forces driving the limit of η to exactly zero. But if r > g than prices must be equal to fundamentals—if the rule by which we identify "expectation" with orthogonal projection and the law of iterated orthogonal projections holds. So we must find some way to drive r less than g—which could be done with a dynamically-inefficient economy, which requires something like an overlapping-generations framework to block the long-horizon investments and trades between the present and the far future that would eliminate dynamic inefficiency; or could be done by depriving "rational" investors of capital so that when asset prices become high (or low) relative to fundamentals, their attempts to profit from this by taking on leveraged positions very quickly drive their r to large and negative (or large and positive) values. Yet we do see things we pretty much have to call "bubbles"—both the most recent one in the real estate market, but also and more frequently in the bond and stock markets as well.

Suppose that we have done this, and no longer need to worry about long-horizon or well-capitalized and risk-averse agents in our economy—that we are in the world of DeLong et al. (1990) and of Shleifer and Vishny's "Limits to Arbitrage." And that we are not in the world of Friedman (1953) in which non-rational utility maximizing agents lose money fast enough to be driven out fo the marketplace. And so we can go behavioral. The simplest behavioral model is the "infection" model from public health: people get infected with irrational exuberance (or irrational pessimism) through (a) contact with the infected, and (b) transmission. The infection model produces both (a) bubbles, as the infection spreads, and (b) peaks, as the number of those to whom the infection can spread drops. (It does not produce (c) crashes.)

Start with a unit interval [0, 1] of investors. Investors can either be in the market and own stocks or out of the markets and own bonds. Bonds pay a fixed and certain net rate of return r each period. Stocks have a price p, and each period pay a serially-uncorrelated stochastic dividend d: δ with probability π and 0 with probability $1-\pi$. When investors want to buy stocks they are supplied by venture capitalists. When investors want to sell stocks they are bought up and destroyed by private equity firms. By coincidence the price at which venture capitalists and private equity firms create and destroy equities is such that the price of equities p is equal to the fraction p of agents who own stocks.

At the start of each period t a value for the dividend and a price p_t for stocks is cried out by a Walrasian auctioneer. A parameter λ governs the fraction of agents are paying attention: those who are paying attention frantically calculate the rate of return on stocks $(p_t - p_{t-1} + d)/p_{t-1}$. Based on whether that return was more or less than the rate of return on bonds some of the λ agents who are paying attention commit to buying stocks or

selling stocks, the fraction p of stockholders shifts, and at the start of the next period the auctioneer will cry out a new value for p:

$$(2) \qquad p_{t+1} = p_t + \lambda p_t (1 - p_t)\left(\frac{p_t - p_{t-1} + d_t}{p_{t-1}} - r\right)$$

The intuition is that (a) you have to encounter somebody following a different portfolio strategy than you to even think of switching, and (b) once you think of switching you do so depending on whether stocks or bonds did better recently.

Taking expectations:

$$(3) \qquad \mathrm{E}_t(p_{t+1}) = p_t + \lambda p_t (1 - p_t)\left(\frac{p_t - p_{t-1} + \pi\delta}{p_{t-1}} - r\right)$$

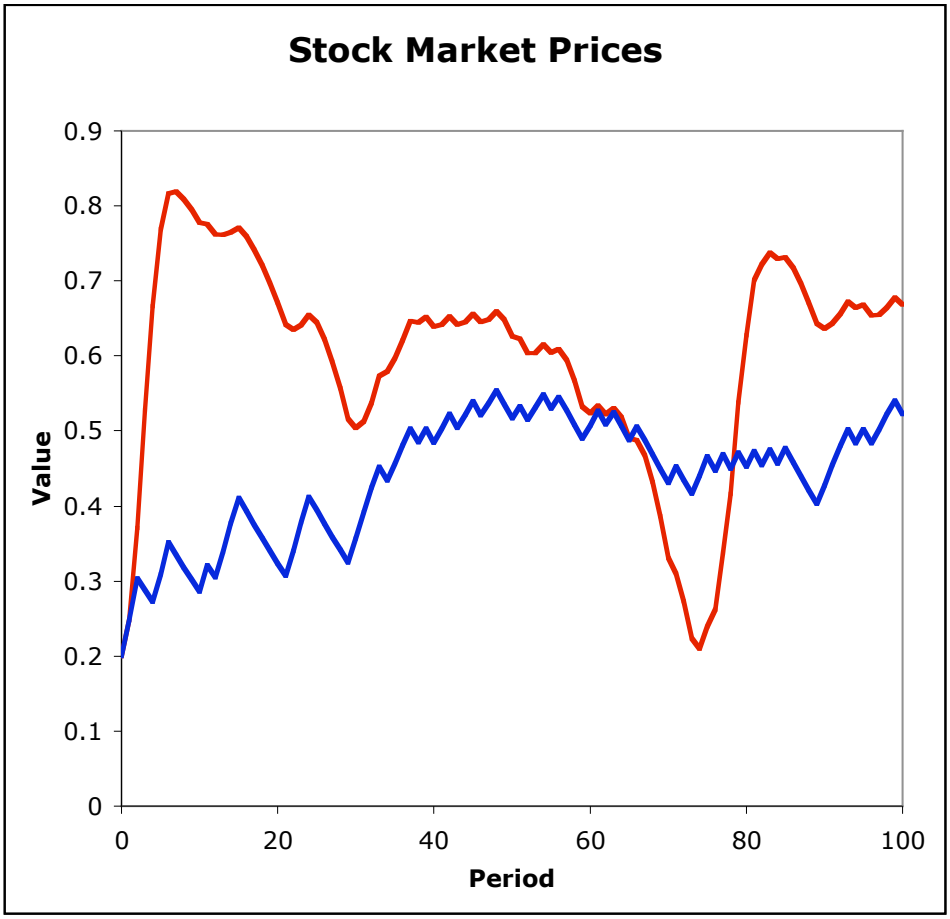
So:

$$(4) \qquad \mathrm{E}(\Delta p_{t+1}) = 0 \text{ if } p_{t-1} = \frac{\pi\delta}{r}$$

is the "fundamental" value of p: call it p*.

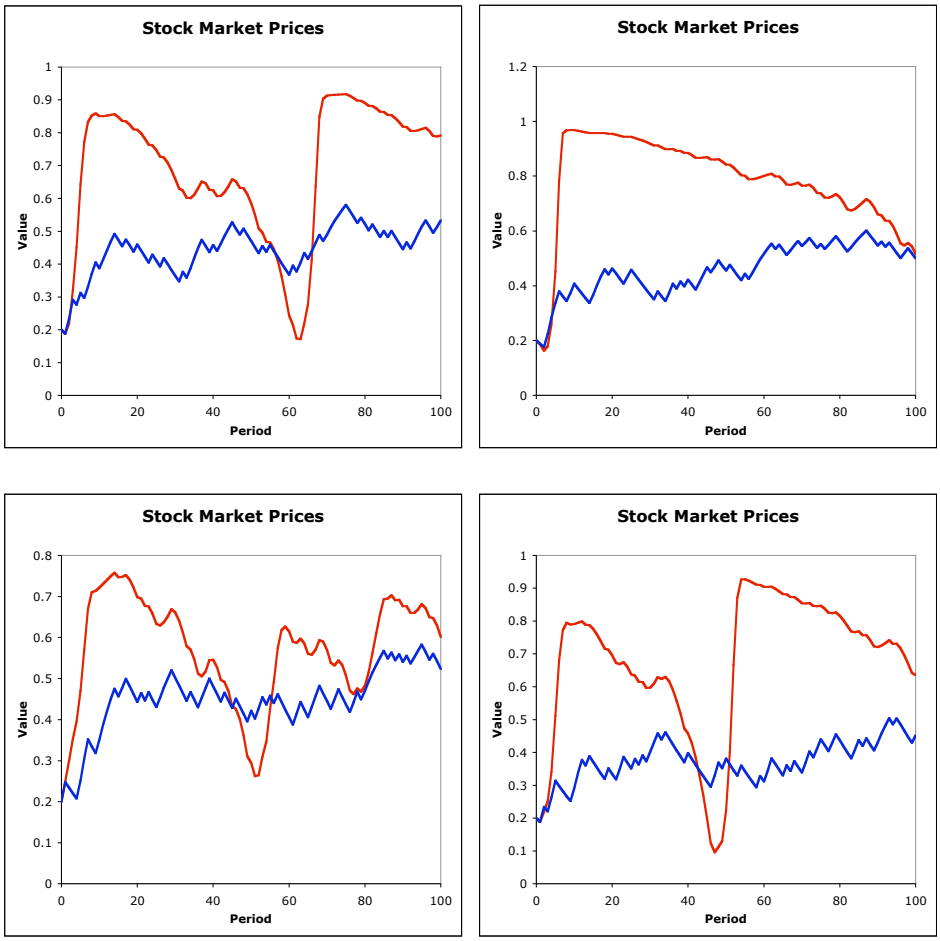
Note that we can eliminate the possibility of bubbles in this model by having investors ignore the capital gain when they assess returns, as in:

$$(5) \qquad p_{t+1} = p_t + \lambda p_t (1 - p_t)\left(\frac{d_t}{p_{t-1}} - r\right)$$



Suppose that something has just happened—a global savings glut, perhaps—to drop r from its initial level of 12.5% (corresponding to a p* of 0.2) to a level of 5% (corresponding to a p* of 0.5). The probability that the dividend is actually paid is 1/2 but the amount of the dividend to .05. This initial "displacement"—the fall in r from 12.5% to 5%--is a large impetus. And for a value of $\lambda = 1.5$, we get a mania—but not a panic or a crisis. We get a bubble—but it does not pop, instead it deflates. For these parameter values we find rapid convergence, substantial overreaction, and then once again deflation back toward fundamentals.

Note the behavior of this simulation after period 30, when the deterministic system has settled down to within a small neighborhood of its fundamental value p*. The fact that porfolio choice depends not just on fundamental returns but on capital gains—themselves driven by previous fundamental displacements and previous capital gains—amplifies the fluctuations in prices considerably.



The lesson is that if you have short look-back periods, poor knowledge of long-run fundamentals, a tendency to adopt recently-successful strategies,

moderately long-duration assets traded at some frequency, and an initial displacement—a true change in long-run fundamentals—it is easy to generate bubbles and manias and overshooting on the upside and on the downside. If we take a look at our equation (2) transformed into lag- and difference-operator form:

$$(6) \qquad D[p_{t+1}/p_t] = \lambda(1-p_t)L\big(D[p_{t+1}/p_t]\big) + \lambda(1-p_t)(d_t - r)$$

and transform it:

$$(7) \qquad D^2[p_{t+1}/p_t] = [\lambda(1-p_t)-1]L\big(D[p_{t+1}/p_t]\big) + \lambda(1-p_t)(d_t - r)$$

We see that, for very small fluctuations, when λ=0 we get smooth exponential convergence. We also see that when λ(1-p)=1, we have a harmonic oscillator: undamped oscillations that return the price to fundamentals relatively quickly, but then shoot on past and come back again for another try. In either case the market does not seem to be performing particularly well as a social capital allocation and forecasting mechanism.

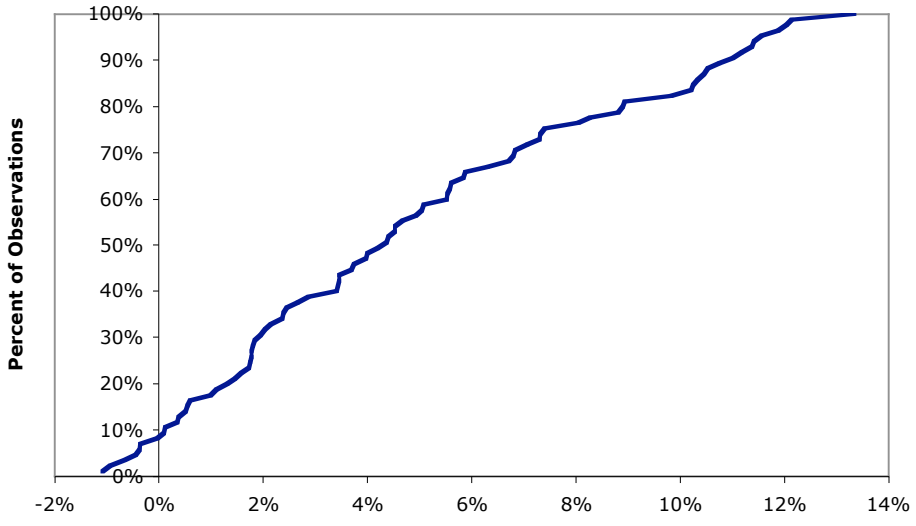
One last remark: we have manias, bubbles, and overshootings. But that is not what we really want out of a model. Our model is not sufficient to generate panics and crashes. Panics and crashes are asymmetrically strong downward movements. We cannot generate them out of a model that is, after all, a symmetric one.

The place to go, I think, to get panics and crashes—sharper and steeper and larger downward than upward movements—is to note the asymmetry between profits and losses. Profits make you feel exuberant—rationally or irrationally—and prone to expand your position. Losses leave you bankrupt and your position is then involuntarily sold out from under you. Portfolio insurance, stop-loss orders, margin calls, capital requirements, and many other contractual mechanisms work to make positive-feedback trading on the downside automatic and hence swift, while positive-feedback trading on the upside remains discretionary.

How to get a financial market to do better? Patient, long-run rational capital; or lots and lots of well-capitalized nearly risk-averse short-run rational capital. But patient, long-run capital is limited by (a) agency, (b) desire to reveal and exhibit skill, (c) limits to arbitrage, (d) leverage, and (e) noise trader risk.

How much patient, long-term or nearly risk-averse short-term capital is there? Here I think there is an important lesson to be learned from the equity premium literature.

Figure 1: Twenty-Year Stock Minus Bill Average Annual Returns Since 1901



More than 80 years ago, financial analyst Edgar L. Smith (1924) publicized the fact that long-horizon investors in diversified equities got a very good deal relative to investors in debt: consistently higher long-run average returns with no more risk. It was true, Smith wrote three generations ago, that each individual company's stock was very risky,

"subject to the temporary hazard of hard times, and [to the hazard of] a radical change in the arts or of poor corporate management." But these risks could be managed via diversification across stocks, or as Smith wrote, "effectively eliminated through the application of the same principles which make the writing of fire and life insurance policies profitable."

Edgar L. Smith was right. Common stocks have consistently been attractive as long-term investments. An index of American stock prices compiled by Robert Shiller and deflated by consumer prices shows an average real return on equities of 6.5 percent per year— compared to an average real long-term government bond return of 3.6 percent and an average real bill return of 4.5 percent. Since the start of the twentieth century, this index linked to the Standard and Poor's Composite shows an average real equity return of 6.0 percent per year, compared to a real bill return of 1.6 percent per year and a real long-term government bond return of 1.8 percent per year. Since World War II, equity returns have averaged 6.9 percent per year, bill returns 1.4 percent per year, and bond returns 1.1 percent per year. Similar gaps between stock and bond and bill returns have typically existed in other economies. Mehra (2003), citing Siegel (1998) and Campbell (2001), reports an annual equity return premium of 4.6 percent in post-World War II Britain, 3.3 percent in Japan since 1970, and 6.6 percent and 6.3 percent respectively in Germany and Britain since the mid-1970s.

The horizontal axis shows the returns of stocks minus the return of Treasury bills over these 20-year horizons, expressed as an annual rate. The vertical axis shows the cumulative probability in this data of receiving that or a lower outcome. Thus, there is a 100 percent chance of receiving an equity premium of 13.5% per year or less; there is about a 9 percent chance of receiving an equity premium of zero percent or less. The average geometric return differential since 1901 is some 4.5% per year. When the portfolios are cashed in after 20 years, investments in diversified stock portfolios are on average 2.67 times as large as an investment in short-term Treasury bills. Stock investors more than double their relative wealth 60 percent of the time, more than quadruple their relative wealth 30

percent of the time, and have a 17 percent chance of a more than seven-fold multiplication of relative wealth. The downside appears small: the empirical cumulative distribution function finds that stocks do worse than bills less than 9 percent of the time. The probability that the equity return premium is going to be more than 3 percent is large: 75 percent. The very worst case observed is the 20 years starting in 1989—and ending now.

This equity return premium is not a short-term asset liquidity effect driven by the special ease with which short-term Treasury bills can be turned into cash even in financial panic emergencies: it is an absence of rational risk-neutral or long-horizon capital effect. Compare investing in a diversified stock portfolio and investing in a long-term Treasury bond portfolio and find that the lower tail is even smaller.

If the actual twentieth-century pattern of returns is a good proxy for the true underlying set of returns that investors should expect, powerful implications follow for investors' beliefs about their relative marginal utility of wealth. Over the twentieth century, the chance of relative gain through the equity premium is ten times the chance of loss. The average amount of gain conditional on their being a gain—167 percent—is 17 times the average amount of loss. If the marginal investor's marginal dollar is no more advantageously employed in stocks than bonds, then it becomes necessary to explain why investors view these risks of gains and losses as balanced in utility terms. Under the unreasonable and indefensible assumption that marginal utility is a step function with one fixed value in the "loss" and another fixed value in the "gain" states of the world, the marginal utility of wealth in the "loss" states of the world would have to be 170 times the marginal utility of wealth in the "gain" states of the world: the average dollar lost relative to the risk-free return would have to be 170 times more painful than the average dollar gained relative to the risk-free return is pleasurable.

The equity premium puzzle appears softer if attention is focused on short-horizon investors who invest for one year only. Stocks *are* very risky in the short run. 1931 sees a return differential of –60 percent. And bonds have outperformed stocks in some 35 percent of the past century's years.

Yet even on a year-to-year scale, the equity premium return puzzle remains: the large year-to-year fluctuations in the consumption of marginal investors correlated with stock returns that would account for the premium by creating a high marginal utility of wealth in "stocks lose" states remain elusive. At the one-year horizon, a marginal investor would be indifferent between stocks and bills only if that investor had a marginal utility of wealth in the gain state 83 percent of the way up the return distribution (+20%) that was half that of marginal utility in the loss state 17 percent of the way up (-10%).

The inescapable lesson, I think, is that in financial markets:

- Rational, patient capital is very scarce.
- Rational, nearly risk-averse capital is very scarce.
- Financial markets are doing a really lousy job at mobilizing the collective risik-bearing capacity of global society and deploying it under the management of rational-forecaster (or perhaps properly—incentivized?) portfolio managers.

In the past, the corollary I would draw from this is that financial innovation to encourage greater risk-spreading should be encouraged. Now it is not so clear. Financial markets exist to (a) mobilize capital, (b) spread risk, and (c) provide good corporate governance. And how to structure them to do that is not at all clear.

Let us change gears now and look back at the last big financial crisis—the East Asian crisis of 1997-1998:

From Morris Goldstein:

Table 1 Exchange rates, 30 June 1997 to 8 May 1998

	US dollars per 100 local currency 6/30/97	US dollars per 100 local currency 12/31/97	Percentage change 6/30/97-12/31/97	US dollars per 100 local currency 5/8/98	Percentage change 1/1/98-5/8/98	Cumulative percentage change 6/30/97-5/8/98
Thailand	4.05	2.08	–48.7	2.59	24.7	–36.0
Malaysia	39.53	25.70	–35.0	26.25	2.1	–33.6
Indonesia	0.04	0.02	–44.4	0.01	–53.0	–73.8
Philippines	3.79	2.51	–33.9	2.54	1.3	–33.0
Hong Kong	12.90	12.90	0.0	12.90	0.0	0.0
Korea, South	0.11	0.06	–47.7	0.07	21.9	–36.2
Taiwan	3.60	3.06	–14.8	3.10	1.2	–13.8
Singapore	69.93	59.44	–15.0	61.80	4.0	–11.6

Sources: Bloomberg; *Financial Times* (various issues).

Table 2 Stock markets, 30 June 1997 to 8 May 1998

	6/30/97	12/31/97	Percentage change 6/30/97-12/31/97	5/8/98	Percentage change 1/1/98-5/8/98	Cumulative change 6/30/97-5/8/98
Thailand	527.3	372.7	–29.3	386.4	3.7	–26.7
Malaysia	1,077.3	594.4	–44.8	580.1	–2.4	–46.2
Indonesia	725.0	401.7[a]	–44.6	434.7	8.2	–40.0
Philippines	2,809.0	1,869.2[b]	–33.5	2,210.0	18.2	–21.3
Hong Kong	15,197.0	10,722.8	–29.4	10,060.4	–6.2	–33.8
Korea, South	745.4	376.3[b]	–49.5	373.0	–0.9	–50.0
Taiwan	9,030.0	8,187.3	–9.3	8,210.8	0.3	–9.1
Singapore	1,988.0	1,529.8	–23.0	1,420.8	–7.1	–28.5

Note: All stock market indices are local indices. The Hang Seng index is used for Hong Kong and the Straits Times for Singapore.

a. As of 12/30/97.
b. As of 12/29/97.

Sources: Bloomberg; *Financial Times* (various issues).

From Paul Krugman (1998). "What Happened to Asia?"

> It seems safe to say that nobody anticipated anything like the current crisis in Asia. True, there were some Asia skeptics - including myself - who regarded the claims of an

Asian economic miracle as overstated, and argued that Asia was bound to run into diminishing returns eventually. And some people - again including myself - raised warning flags a year or two before the Thai crisis…. But even pessimists expected something along the lines of a conventional currency crisis followed by at most a modest downturn, and we expected the longer-term slowdown in growth to emerge only gradually. What we have actually seen is something both more complex and more drastic: collapses in domestic asset markets, widespread bank failures, bankruptcies on the part of many firms, and what looks likely to be a much more severe real downturn than even the most negative-minded anticipated…. [W]e find ourselves playing theoretical catchup - trying, after the fact, to develop a framework for thinking about events that have already happened….

[…]

In the canonical "first-generation" crisis models (Krugman 1979; Flood and Garber 1984), a government with persistent money-financed budget deficits was assumed to use a limited stock of reserves to peg its exchange rate; this policy would, of course, ultimately be unsustainable - and the attempts of investors to anticipate the inevitable collapse would generate a speculative attack….

In "second-generation" models (Obstfeld 1994, 1995) policy is less mechanical: a government chooses whether or not to defend a pegged exchange rate by making a tradeoff between short-run macroeconomic flexibility and longer-term credibility. The logic of crisis then arises from the fact that defending a parity is more expensive (e.g., requires higher interest rates) if the market believes that defense will ultimately fail; as a result, a speculative attack on a currency can develop either as a result of a predicted future

deterioration in fundamentals, or purely through self-fulfilling prophecy….

[T]hese models… miss important aspects of the unfolding crisis in Asia…. [N]one of the fundamentals that drive "first-generation" crisis models seems to have been present in any of the afflicted Asian economies… all of the governments were more or less in fiscal balance; nor were they engaged in irresponsible credit creation or runaway monetary expansion…. Second… the Asian victims did not have substantial unemployment when the crisis began. There did not, in other words, seem to be the kind of incentive to abandon the fixed exchange rate to pursue a more expansionary monetary policy that is generally held to be the cause of the 1992 ERM crises in Europe…. Third, in all of the afflicted countries there was a boom-bust cycle in the asset markets…. Finally, in all of the countries financial intermediaries seem to have been central players…. Thailand… nonbank intermediaries that borrowed short-term money, often in dollars, then lent that money to speculative investors, largely but not only in real estate…. South Korea… conventional banks… borrowed extensively at short term and lent to finance… speculative investments by highly leveraged corporations…. [T]he Asian story is really about a bubble in and subsequent collapse of asset values in general….

The problem began with financial intermediaries - institutions whose liabilities were perceived as having an implicit government guarantee, but were essentially unregulated and therefore subject to severe moral hazard problems. The excessive risky lending of these institutions created inflation - not of goods but of asset prices…. And then the bubble burst. The mechanism of crisis, I suggest, involved that same circular process in reverse: falling asset prices made the insolvency of intermediaries visible,

> forcing them to cease operations, leading to further asset deflation. This circularity, in turn, can explain both the remarkable severity of the crisis and the apparent vulnerability of the Asian economies to self-fulfilling crisis - which in turn helps us understand the phenomenon of contagion between economies with few visible economic links….

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[O]ver-guaranteed and under-regulated intermediaries can lead to excessive investment by the economy as a whole (although this point has been emphasized by McKinnon and Pill (1996))… consider a simple two-period [small open] economy. In the first period firms purchase capital; in the second they produce using that capital… the production function…

$$Q = (A+u)K - BK^2$$

where u is a random variable…. [C]apital will earn its marginal product…

$$R = A+u - 2BK$$

In the absence of any distortion… we will have

$$K = (A+Eu)/2B$$

Now let us introduce guaranteed financial intermediaries…. How would such intermediaries behave? From their point of view, any rate of return on capital in excess of the world safe rate of interest - that is, any $R > 1$ - represents a pure profit…. But given our assumption of competition among potential intermediaries any such pure profit will be competed away. The only way this can happen is if:

- All capital ends up being purchased by guaranteed intermediaries… extremely leveraged….
- Investment is pushed up to the point where $R = 1$ in the most favorable possible circumstance…

[T]he owners of intermediaries will instead focus on what we might call Pangloss values: the values that variables would take on if it turns out that we live in what is (from their point of view) the best of all possible worlds…. [S]uppose A = 2, B = 0.5, and u has an equal probability of equalling 0 or 1. The undistorted level of investment would set K = 2.5… moral-hazard-prone financial intermediaries… will drive out equity investment and push up the capital stock to 3….

[L]us now go to the other extreme and consider a model in which the supply of assets is completely inelastic, and in which intermediaries therefore have their impact not on quantities but on prices… land… cannot be either created or destroyed…. In the first period investors bid for land, setting its price. In the second period they receive rents, which are uncertain at the time of bidding…. Suppose that the rent on a unit of land could be either 25, with a probability of 2/3, or 100, with a probability of 1/3. Risk-neutral investors would then be willing to spend (2/3)H25 + (1/3) H100 = 50 for the rights to that land.

But now suppose that there are financial intermediaries… able to borrow at the world interest rate… because they are perceived as being guaranteed…. [I]ntermediaries will be willing to bid on the land, based not on the expected value of future rent but on the Pangloss value - in this case 100. So all land will end up owned by intermediaries, and the price of land will be double what it would be in an undistorted economy….

[L]et us now introduce the possibility that this regime may not last - that liabilities carried over from period 2 to period 3 might not be guaranteed…. If liabilities of intermediaries are not guaranteed, then nobody will lend to them (the moral hazard will remain, but its burden would now fall on investors rather than on the government). So intermediation will collapse, and the price of land will reflect only its expected return of 50. On the other hand, if intermediaries are guaranteed, the price will still be 100.

What about the price of land in the first period? Investors now face two sources of uncertainty: they do not know whether the rent in the second

period will be high or low, and they do not know whether the price of land in the second period will reflected expected values or Pangloss values.

However, as long as there is competition among intermediaries in the first period, the price of land will once again be driven to a level that reflects the most favorable possible outcome: rents of 100 and a price of 100. So even though this is now a multi-period world in which everyone knows that disintermediation and a decline in asset prices is possible, [period 1] asset prices are still set as if that possibility does not exist!

Now let us get to the really interesting part: examining what happens when the change in regime is endogenous… implicit guarantees… are available only until they have had to be honored…. In the context of our three-period example, this criterion can be stated alternatively as the proposition that creditors of financial intermediaries will be bailed out precisely once.

To see what this means, first suppose that in period 2 rents are disappointing - 25, not 100. Given the structure of our model, in the absence of intermediaries this should have no effect on the price of land at the end of the second period, since it does not change the probability distribution of future rents. But a less-than-Panglossian rent in period 2 means that creditors of intermediaries need to be bailed out in that period, and therefore that future creditors can no longer expect the same. So the intermediaries collapse, and the price of land drops from 100 to the expected rent 50.

Notice that this means that there is a magnification effect on the losses of the intermediaries established in the first period. The "real" news about the economy is that rents in period 2 were 25, not the hoped-for 100. But land bought for 200 will now yield only 25 in rents plus 50 in resale value, a loss of 125 rather than merely 75. The magnification effect is caused, of course, by the circular logic of disintermediation: the prospective end to intermediation, driven by the losses of the existing institutions, reduces asset prices and therefore magnifies those losses.

And now we come to the possibility of multiple equilibria. Suppose that in fact intermediaries have been lucky, and that second-period rents do turn out to be 100. Now if everyone then expects that the government will continue to guarantee intermediaries in the future, the land price at the end of the second period will also be 100. In that case no bailout will be needed; and so the government guarantee for intermediation will in fact continue.

But on the other hand, suppose that despite the high rents in the second period potential creditors become convinced that there will be no guarantee on newly incurred liabilities of intermediaries. Then they will not be able to attract funds, and the price of land in the second period will be only 50. That means, however, that intermediaries that borrowed money in the first period based on Pangloss values, including the Pangloss value of 100 for land sales, will require a bailout - and since the government's willingness to provide for bailouts is now exhausted, investors' pessimism is justified.

In short, our stylized little model appears to generate a story about self-fulfilling financial crises, in which plunging asset prices undermine banks, and the collapse of the banks in turn ratifies the drop in asset prices.

We now have the necessary elements in hand to tell a story about the Asian crisis…

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