Explaining Global Market Turmoil: A Fresh Perspective on its Origins and Nature

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1. Today's Triple Vacuum – Today's Problem at the Broadest Level

At the broadest level, the global market pandemonium experienced during the summer of 1998 stems from a political, institutional and conceptual vacuum. On the political level, with the recent defeat of Chancellor Kohl in Germany, there has rarely been a period of such weak leadership virtually everywhere on earth. Indeed, it is hard to think of a single leader of any nation who is truly 'in charge' either ideologically or politically.

At the institutional level, so great is the void that there are increasing calls for a 'new global financial architecture'. And whatever one's ideology might be concerning 'bailouts' in general, and the role of the IMF in particular, one thing has become clear in the wake of the Russian and Brazilian crises: the funds available to help troubled nations are as inadequate as the theories that determine their use.

This leads us to the third and arguably most important vacuum – the conceptual vacuum. Virtually every orthodox theory of international economics and finance is in disarray. Nowhere is this situation more true than in the area of foreign exchange, where events in recent years have made a mockery of almost all theories of exchange rate determination. The same is true of the valuation of stocks and bonds in emerging markets. At a deeper level, confusion as to why this is true is now so widespread that virtually any explanation is taken seriously. One half-baked op-ed page diagnosis follows the next with daily regularity.

In the absence of any compelling logic, the issue of the world's financial architecture has become increasingly politicised. Central to such politicisation are disputes over the proper nature, scope and implementation of 'bailouts' – a noun whose usage pickles any serious discussion as effectively as formaldehyde pickles a mouse.

In my talk, I will offer my own diagnosis of what has gone awry in the behaviour of global markets. In addition, I will discuss what can and should be done to improve matters based on this diagnosis.

2. What's Not Responsible for Today's Turmoil – Conventional Explanations

It is all too tempting to seize upon the more obvious deficiencies of the status quo as the source of what is wrong. It is thus not surprising that we read daily of such bromides as:

- If only Asians did not suffer from crony capitalism, then…;

- If only markets in emerging nations possessed transparency, then…;
- If only the disincentives of moral hazards were eliminated, then…;
- If only societies enjoyed the discipline of a gold standard, then…;
- If only more nations adopted currency boards, then…;
- If only investors were rational and took the long view, then…;
- If only speculators were not so greedy, then…;
- If only hedge funds were outlawed, then…;
- If only life were fair, and rich nations did more for the poor, then…

Each of these 'if only' conditions possesses a certain validity, although some (e.g. the last three) amount to wishful thinking at best. The problem is that none of the stipulated conditions addresses the root problem of today's crises, namely asset market overshoot – particularly currency market overshoot. Thus, while increased transparency and reduced cronyism would improve the efficiency of capital and product markets, they would not reduce excess asset price volatility per se.

The empirical vindication of the new research from Mordecai Kurz at Stanford University puts this matter in a wholly new perspective. For we can now state the following result as a theorem:

> Even if there is no crony capitalism and full transparency, and even if all agents were perfectly rational (in the sense of maximizing expected risk-adjusted returns), then asset markets will still exhibit price volatility between 300% and 800% greater than that predicted by classical finance theory.

Historically, asset markets have always exhibited overshoot, and people accepted this as natural, if unfortunate. Absent the idealisations of modern efficient markets theory, they saw no need to invoke currently trendy theories of moral hazards or irrationality or non-transparency in order to explain episodes ranging from the Dutch tulip bubble to the Crash of 1929. Such episodes were simply manifestations of 'herd behaviour' or 'market psychology'.

As fate would have it, advanced economic theory itself now demonstrates that pathological behaviour by the market as a whole is not in fact a manifestation of moral turpitude or irrationality on the part of individuals. Rather, it is a manifestation of their ignorance. For in attempting to maximise expected risk-adjusted returns, investors make mistakes. And when they realise that they make mistakes, they then sell or buy, thus impacting on asset prices.

When lots of people make the same mistakes at the same time (so-called 'correlated mistakes'), bouts of price overshoot result, via mechanisms we have discussed in past reports. In the process, trend-following behaviour becomes rational, further exacerbating overshoot. This is part of what we have learned during the past five years from the new research program at Stanford.

The challenge – explaining the increase in volatility today: Our task in the next section is to demonstrate why overshoot behaviour has increased in recent years. Could it simply be that today's investors are more irrational, more greedy, more corrupt, or simply (as in Kurz's theory) more wrong? No. For human nature never

changes, and people have always exhibited these properties to one extent or another. Something else must be going on deeper down; a genuine structural change. And indeed it is: the arrival of the computer and related technological changes. Before turning to this, it will help to introduce a simple taxonomy of 'risks'. Then, we can better understand which component risks have been affected by which kinds of technological change.

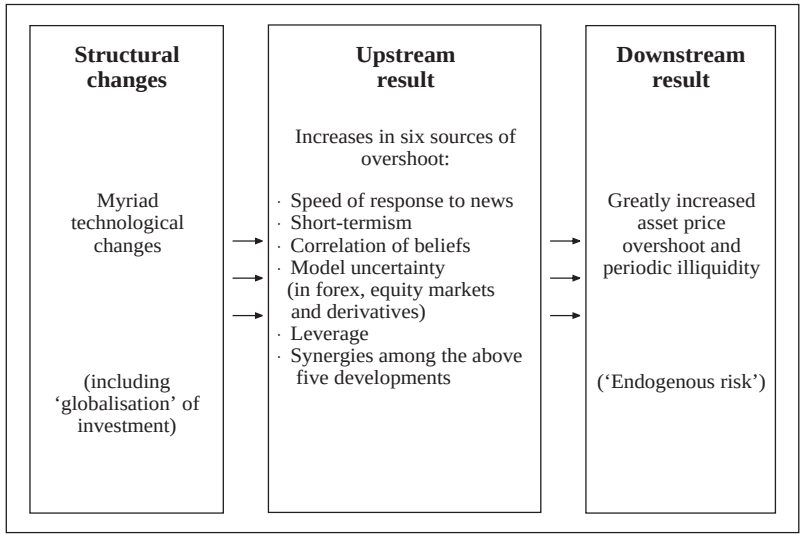
3. The True Source of Today's Increased Volatility – Technology

Figure 1 will serve as a guide to our discussion of how technological change is directly and indirectly the culprit responsible for increased market pandemonium. On the left is the 'driver' of the analysis: a host of technological changes ranging from the invention of the theory of derivatives and the computerisation of their pricing and trading on the one hand, to computer trading systems, Bloomberg, First Call, and other data delivery services on the other. It is easy to forget to what extent technology alone has made today's 'global investing' possible.

In the middle of Figure 1 appears a list of six sources of market overshoot. In each case, the impact of technology has been to increase the magnitude of the particular source of overshoot, e.g. the extent of belief correlation among investors. Then on the far right is the downstream impact of all this in which we are interested, namely

Figure 1: Today's Global Financial Crisis

The deeper origins: technology



Note: This causal chain does not presuppose any 'non-transparency', moral hazards, crony-capitalism, irrationality, or asymmetric information. This result can now be demonstrated from first principles in advanced microeconomic theory.

the increase in endogenous risk. Note here the appearance of the term 'periodic illiquidity'. This refers to the fact that markets such as US corporate bond markets, which by any conventional standard are 'deep' and thus 'liquid', may sometimes seem to be illiquid.[1]

A currency market subtext: If there is a subtext to the following remarks, it concerns the way in which global foreign exchange markets have become at once the most important, yet most misbehaved, of all financial markets. In our view, understanding currency overshoot must be the starting point of any thoughtful analysis of what has gone wrong.

The first two of the following five developments may seem trivial, yet they are very important because of the synergies they engender with the four that follow.

3.1 Technology-based increases in speed of response

In the past, news about fundamentals (e.g. a firm's earnings) reached different investors at different times. Moreover, both the ability and the incentive of these investors to sell (buy) on the news were hindered by factors ranging from geography to sky-high transaction costs. As is well known, technology changed all that. There are now no barriers in space or time to transacting on the spot. Moreover, transaction costs have been driven down to near zero.

Consider why this matters. Suppose that some adverse developments occurred in a given market in the distant past. Suppose also that people did not learn this at the same time, and/or did not wish to sell at the same point in time, and/or did not have the ability to do so. Then the impact of the news on price would have been much smaller than it would be in today's world where everyone learns and reacts at once.

3.2 Technology-based increases in short-termism

Consider our ability to measure managers' absolute and relative performance much more rapidly and frequently than before (even with 8 000 mutual funds), to disseminate this information to interested investors more rapidly and frequently than before, and to mark securities to market each day. These developments have contributed significantly to today's much-criticised 'short-termism' in asset management.

With these simpler points out of the way, we now turn to the three most important developments.

1. When there is a correlated mistake and a resulting panic, an accelerating number of investors will start revising downwards their expectations of returns. This creates a situation where markets seem to be illiquid, even though there is considerable depth in the underlying market as conventionally measured. Almost any trade will clear, even though the bid-ask spread is 'unacceptably' large in the very short run. In a genuinely illiquid market, e.g. that of a closely held company, many trades will not clear at all, and this is true even absent a panic. We make this distinction because the term 'illiquidity' is routinely abused to describe situations where people don't receive the price they think they 'should' receive, and would have received a day or even a minute earlier. Calling this illiquidity confuses two different issues.

3.3 Technology-based increases in 'belief correlation'

Suppose earnings growth of a stock you own drops unexpectedly by 10 per cent. As we have shown in previous reports, such a development will have a three-to-four times larger impact on price today than it would have had three decades ago. Why?

- First, our age-of-Oprah electronic media have created 'A-Team' analysts, hedge fund superstars, and economic commentators who achieve celebrity status and strongly influence expectations. As a result, there now exists a much more concrete expectation about which investors can be 'disappointed'. If, as in the past, prior expectations were diffuse – or in some cases, nonexistent – then the impact of any news on price would be much smaller: it would neither please nor displease investors as much.
- Second, technology has seen to it that investors of all stripes now know what top-rated analysts expect earnings to be. This is guaranteed by the proliferation of information delivery systems such as First Call.
- Third, the electronic ritualisation of earnings announcements implies that today's investors know exactly when all-important earnings announcements will occur and where (on the screens of news services). No such 'earnings ritual' existed before the 1980s.

Main result: Our main result follows from the synergies among the above three points about belief correlation on the one hand, and developments 3.1 and 3.2 above on the other hand: given managers' incentive to 'perform' better in the short run (and clients' expectation that they do so); given the fact that everyone will receive the news at the same time (and everyone knows this is true for everyone else too); given the fact that expectations are more correlated, so that if investor *i* is disappointed, it is more likely that investor *j* will be as well; and given that everyone is now able to sell simultaneously; then the result is a much greater impact on price than used to be the case, assuming that the news was somewhat unexpected. In such an environment, observed price volatility over time will clearly be significantly higher than it used to be, given the same quotient of news.

Relevance to broader asset classes: The simple example we have just presented using corporate earnings news can be extended to virtually all asset classes. In fixed income, consider the 'lurch' of global markets when the Greenspan Fed tightens/eases unexpectedly. (Dr Greenspan is a prime example of a celebrity whose announcements and actions serve to correlate expectations.) The Chairman's 25 basis point tightening in the winter of 1994 ended up precipitating not only pandemonium in global bond markets, but brought the housing industry to a standstill by year's end.

In the currency markets, there are countless examples of consensus expectations having been disappointed about matters ranging from external reserves and trade deficits on the one hand (recall Thailand and Indonesia in summer 1997) to budget deficits and IMF support on the other, and where currencies collapsed/soared as a consequence. In the case of emerging market nations, it is all too easy for A-Team analysts or hedge fund stars to act as belief correlators. Their putative expertise

substitutes for the ignorance most of us profess about such markets. We need to believe that someone understands the incomprehensible!

Caveat: To understand currency markets it is not enough to take increased belief correlation alone into account. For as we shall see, it is the synergy among correlation and the next two developments that causes currencies to go completely off the track.

3.4 Technology-based increases in 'model uncertainty' – currencies, emerging markets and derivative securities as case studies

If there is one principal culprit most responsible for today's turmoil, it is probably model uncertainty. This concept is both abstract and unfamiliar, and its implications for asset price behaviour are not widely understood. For this reason, let us start off with some simple analytical preliminaries. Contrast the following two asset pricing equations:

$$\Delta P = F(\Delta X_1, \Delta X_2, ..., \Delta X_n, e) \text{ with } F(\bullet) \text{ fixed and known} \quad (1)$$

Here, the change in an asset's price, ΔP, depends upon the vector of n 'driver variables' $\Delta X_1, \ldots, \Delta X_n$, and upon white noise e. Think of any such driver variable ΔX_i as denoting the change in consensus expectations about the ith fundamental variable X_i. In the 'efficient markets' world governed by this model, everyone is assumed to know perfectly the impact on price, ΔP, of changes in consensus expectations about the future values of X_i. That is, they know perfectly the function $F(\bullet)$.

$$\Delta P = F^*(\Delta X_1, \Delta X_2, ..., \Delta X_n, e) \text{ with } F^*(\bullet) \textit{ not} \text{ fixed and known} \quad (2)$$

In this second case, investors do not, and indeed cannot, know the map $F^*(\bullet)$. This is because the economic environment is time-varying (non-stationary) due to largely unpredictable structural changes. Hence, even if some clairvoyant revealed to investors the change in consensus expectations due to future news about fundamentals (i.e. the specific values of $\Delta X_1, \Delta X_2, \ldots, \Delta X_n$), they would still not know the impact on price.

Two-step argument: We now wish to make the following two-step argument. First, the greater the extent of model uncertainty, the greater the resulting market chaos. Second, different asset classes can be 'ranked' according to their amount of model uncertainty. When this is done, currencies, emerging markets and derivatives rank highest. This, in large measure, explains their problematic behaviour.

- **Step 1 – more model uncertainty implies more chaos:** In classical economics and finance, we learn the following points, each of which can be proved as a theorem: there is no overshoot; markets are 'efficient' in that prices move strictly in proportion to news about fundamentals, and in doing so signal an optimal ('efficient') allocation of resources throughout the economy; and there is no serial correlation of returns, implying that it would be irrational for any investor to act 'technically' because the expected return from doing so would be zero.

The axiom underlying all these celebrated results is nothing less than the assumption of model certainty on the part of all economic agents. In short, Equation 1 above is assumed to apply. In technical parlance, all agents are assumed to hold rational expectations of the weak form.[2] When the conditions for this assumption to hold are not met, as in Equation 2 and in reality, the implications for individual behaviour and hence for aggregate market behaviour are radical. Consider the behaviour of an individual attempting to make investment decisions. This investor knows he lacks full knowledge of $F(\bullet)$, and knows that others are in the same boat. Accordingly, he will be uncertain how to proceed even just after news about X_i is announced. He will wait and see what others do.

It turns out that confusion and 'hesitancy' of this kind can generate serial correlation ('trends'), which our investor will detect in the data. But if this is true, then it becomes rational to adopt technical behaviour. For if serial correlation exists, the expected returns from surfing the trend can be greater than zero. As more and more people detect this, and respond rationally, their actions make the case for technical behaviour even stronger, since the amount of serial correlation detectable in the data will increase. Still others in turn will be lured into this game. Note that there is no presumption or indeed hint of irrationality here. To sum up, model uncertainty is a crucially important source of endogenous risk in asset market behaviour.

- **Step 2 – how different asset classes rank:** Consider now in Figure 2 a ranking of the amount of model uncertainty corresponding to the different asset classes.[3] Bonds and bills enjoy a high level of model certainty for one very simple reason: the pricing theory underlying each is intelligible to investors, is appealing, is thus applied in practice, and thus becomes self-reinforcing.

  For instance, everyone knows that a government 10-year bond is a piece of paper whose only risk is inflation risk. Accordingly, even your labrador retriever can be trained to know that when inflation expectations are worse than expected, bond prices will drop. It may not know the magnitude of such price reactions, but it certainly knows the direction. Thank God for small blessings!

With equities, the underlying pricing logic gets more complex. Here you have to trade-off the impact of changes in expectations about multiple variables – e.g. earnings growth, interest rates and corporate share-repurchase policy. How can an investor be really sure about the 'weights' attached to the different sources of volatility? Thus there is more model uncertainty, and correspondingly more endogenous risk.

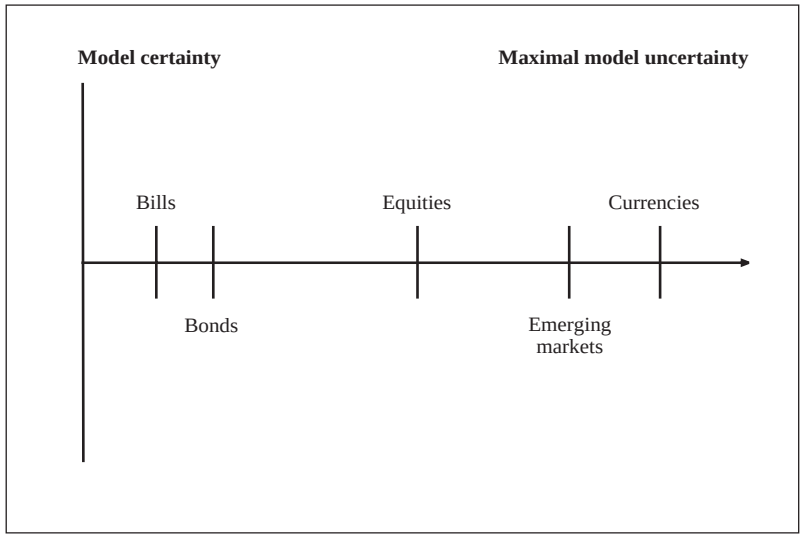
The special case of currency market chaos: Currencies are perched way out towards maximal model uncertainty in the figure. Why might this be the case?

- First, the number of variables driving currency markets is double that in any other market. These include trade deficits, cumulated current account deficits, inflation

2. For these results to hold true, a further assumption must hold true: the stochastic process governing the X_i variables must be fixed and known to all agents.

3. We treat currencies as an asset class below even though, strictly speaking, they are not. What matters is that currency values are relative prices, and our analysis therefore applies without any problems.

Figure 2: Asset Classes
Ranked by extent of pricing model uncertainty



differentials, interest rate differentials, safe-haven differentials, non-monetary policy differentials, etc. Matters are complicated even more by the ever-changing 'game' that gets played between speculators on the one hand and governments on the other. Knowing the map $F(\bullet)$ would imply knowledge of the rules of this game on top of everything else!

- Second, at a more theoretical level, textbooks present what seems to be a confusing array of conflicting valuation theories, and adds to practitioners' conceptual agnosticism. (In point of fact, a good 'synthesis' now exists as to how currencies ideally should be valued in today's world of complex trade and capital flows. These theories command respect by the few who understand them.)
- Third, at a purely empirical level, real-world data reject all such fundamentals-based pricing models, and favour 'technical' models above and beyond all others. These capture currencies' well-known propensity to 'trend'. According to the logic set forth above, this in turn implies that we should observe a large amount of technically driven trading strategies in forex markets.

To support this conclusion, we have only to turn to the well-known 1990 study by Jeffrey Frankel and Kenneth Froot that we have discussed in the past. They found that, whereas over 80 per cent of forex traders described themselves as 'fundamentalist' in 1978, only 15 per cent still described themselves that way in 1989. Too many had learned the hard way: even if you were right about the 'news', you still got fired. The result is a market in which trends dominate. Moreover, unlike any other market, the trend can be the reverse of what it 'should' be, and no-one cares. Such is the magnitude of conceptual agnosticism! Recall in this regard the rally of the

yen/US dollar in the period 1994–96. The yen soared from 143 to 79 during a period when the Japanese economy essentially collapsed.

Special cases of emerging markets and derivatives: Other than in the foreign exchange markets, the greatest meltdowns and surprises have occurred in the emerging markets and in the derivatives markets. Why? Once again, a principal reason lies in pricing model uncertainty. To see this, contrast the relative performance of the Japanese and US equity markets in recent years on the one hand, with that of the Russian and Brazilian markets in the period after the 1998 Russian meltdown.

In the latter case, investors revealed themselves completely confused by the nature of the Russian economy, and by the behaviour of the Russian Government. Their reaction? 'Well, Brazil may be next. Sell one, sell 'em all!' Ignorance leads to a herd-like reaction – precisely the opposite of the US-Japan example. Here, investors believe they understand the ways in which Japan isn't the US and vice versa. Just because you sell one doesn't mean you sell the other. Indeed, exactly the opposite was the case. Here investors revealed confidence in their knowledge of the distinctions between two economies, and they acted on it: they sold Japan and bought the US.

Finally, in the case of derivatives, matters are definitionally so complex that, when trouble comes, model uncertainty is maximised and pandemonium ensues. So complex is the underlying structure of counterparty contracts that no-one can know 'the extent' of exposure. Worse, everyone knows this is the case and that makes matters still more problematic!

Increases in model uncertainty: The contention in Figure 1 is not simply that the six factors in the middle box impact volatility (which they do), but rather that technology has increased their levels and thus increased asset market volatility downstream. How does this tenet apply in the case of model uncertainty?

In the case of stocks and bonds, it is not altogether clear that the model uncertainty quotient itself has risen. To the extent that volatility in these particular asset classes has increased, this is explained by developments in the other variables we are considering, in particular belief correlation and leverage (discussed below). There, the impact of technology is quite straightforward. In currencies, however, there is not the slightest doubt that model uncertainty has exploded. This is because life was very simple during the Bretton Woods era when exchange rates were largely fixed.

But why did Bretton Woods break up? Was this simply a reflection of a stumbling America that could no longer support gold-convertibility at US$35 an ounce? No. The closing of the gold window was merely a symptom of deeper developments. What happened was that technology was making it possible for the impact on currencies of global capital flows to outweigh that of trade financing. Today's world of fungible assets, 'global portfolio investment', and hot money was dawning. Ever since, we have been living in a free-for-all environment of fluctuating ideologies, fluctuating regimes, as well as overshoots and undershoots of a kind once unthinkable. In this environment, currency values have been the swing values.

3.5 Technology-based increases in leverage – a three-step paradox

Two very different kinds of technological change underlie the increase in leverage that in recent months has compelled a string of 'proprietary trading' institutions to contemplate liquidation. These were conceptual advances on the one hand, and engineering advances in computer science on the other. To appreciate both, it will be helpful to recall some important economic history.

Step 1 – lessons of the Great Crash: The Great Crash of 1929 and the onset of the Great Depression of the 1930s spawned three particularly notable legislative reforms in the US, which would be copied elsewhere in subsequent years: the Securities and Exchange Commission was established; the Deposit Insurance Act was enacted; and margin accounts for equity investors were reduced from 95 per cent to 50 per cent. In the third case, it was widely agreed that raising the cash required to 50 per cent 'helped investors save themselves from each other'.

Step 2 – advent of the theory of derivatives: Prior to 1953, the notion of multi-market 'supply/demand balance' had never been modelled in the presence of uncertainty about the future. Another significant gap in economic theory was the failure to understand the role of financial markets. But this second problem was intimately connected to the first problem: it was difficult to contemplate a need for securities markets if all future prices were known with certainty. Both these problems were solved simultaneously in Kenneth Arrow's landmark 1953 paper, 'The Role of Securities in the Optimal Allocation of Risk Bearing'.

This paper showed that Adam Smith's intuition about the existence of an 'invisible hand' which optimally allocated resources would hold true in the presence of uncertainty – but only if traditional commodity and labour markets were supplemented by securities markets. The kind of securities required were quite abstract ('state-dependent contracts'), and are now essentially known as derivatives. Investors were assumed to be risk averse, and individual investors would accumulate a bundle of these contracts, which made it possible for them to optimally hedge their risks. Arrow then proved that if everyone did this, overall risk itself was optimally allocated across all agents, and all resources would end up optimally allocated via the equilibrium prices of commodities and securities.

Step 3 – utilising derivatives to increase leverage and risk: Arrow has told the author that back in 1953, he never envisaged today's computer power, much less the derivatives pricing models that computers would render operational in everyday life. In other words, he never foresaw the ability of hedge funds and the like to utilise derivatives in creating leveraged positions even greater than those existing prior to 1931. In short, technological change made it de facto possible to veto the deleveraging legislation passed into law in the early 1930s. The irony is that this was done via the very instruments intended to permit a partitioning and spreading of risk by risk-averse individuals!

While people in the investment business have always had a suspicion of the staggering 'towers of leverage' to which derivatives-based trading positions could

give rise, the whole world learned just how far this could be taken in the aftermath of the Long-Term Capital Management debacle late this past summer.

4. Synergies Among Developments 3.1 – 3.5

In concluding this discussion of the sources and nature of excess volatility, it is essential to stress the synergy effects that amplify the increased endogenous risk attributed to the five technology-based developments discussed above. To make this point more forcefully, there is no better place to start than with leverage.

Suppose that there had been no increase in belief correlation. Indeed, suppose that there were no endogenous risk at all in the markets, and that markets were classically efficient as in the textbooks. Then 'more leverage' would in fact have no adverse consequences at all. For, absent mistakes, leverage is harmless. Of course, since it is impossible to reap any excess returns in such environments, leverage wouldn't help either. No pain, no gain!

All in all, it is its synergy with the other developments that makes a unit of leverage more risky today than it would otherwise be. By analogy, it is the collective synergy among all five of the developments we have reviewed that matters most in understanding recent market turmoil. They are mutually reinforcing in generating asset market overshoot.

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