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Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence

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Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence

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Abstract

This paper discusses a "pure" form of financial contagion, unrelated to economic fundamentals – investors' shifting appetite for risk. It provides an analytical framework for identifying changes in investors' risk appetite and discusses whether it is possible to directly measure them in a way that can enable policy makers to differentiate between financial contagion and domestic fundamentals as the immediate source of a crisis. Daily measures of risk appetite are computed and their usefulness in predicting financial crises is assessed.

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I. Introduction

It is now generally accepted that the contagion or spill-over of sovereign financial crises is not fully explained by domestic fundamentals alone. The debate on this subject has been conducted at least since the ERM crises of 1992/3 and intensified following the Tequila crisis centred on Mexico in 1994/95 and the Asian, Russian and the LTCM crises of 1997/8. A key issue has been the temporal and geographical clustering of financial crises: according to a widely accepted definition of currency crises, 48 out of the 58 crises that have occurred over the past 10 years have occurred in a cluster of two or more.[2] *Crises like company.*

Some have argued that there are "fundamental" reasons for this clustering relating to close trading links within regions or common external economic factors. For instance, when several countries come under speculative attack it may be because a major trading partner has just devalued its currency, or because several countries have been adversely affected by a slowdown in industrial country activity, or by a rise in global interest rates. Each of these channels of contagion has been amply investigated and each has been found to play some role in one crisis or another.[3]

The main message of this paper is that important as these channels are, there are factors related to investor behaviour in international capital markets which may exercise an important additional, or underlying, influence and provide a general channel for the transmission of contagion. According to this mechanism, the agent of contagion is not only, and perhaps not even mainly, local or international economic factors and risks, but a reduction in investors' *appetite for risk.* This view of contagion implies a different policy response to the threat of crisis. The idea that contagion follows a fundamental trail suggests attention needs to be paid to these fundamentals to reduce vulnerability. An improvement in domestic policies is necessary and sufficient to prevent contagion. Along with this idea is the notion that trying to stave off a crisis arising from fundamental factors, at worst, may be impossible and at best, is likely to lead to moral hazard. However, the view developed in this paper is that while sound policies and reforms are undoubtedly *necessary* for improving underlying economic performance, they may not be *sufficient* to limit contagion. We suggest that attention also needs to be paid to aspects of the global financial architecture which can make countries susceptible to crises even when they are pursuing sound policies.

If this is the case there is an added reason for increasing efforts to prevent crises happening in the first place, lest they beget others and in turn serve to discourage the pursuit of sound policies and reforms. Given that widespread financial crises have a negative social externality for the world economy, prevention assumes a critical role, as does an early response to prevent contagion.

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[2] See Eichengreen et al (1996) and Caramazza et al. (2000).

[3] There is a large literature in this area; see, for instance, Caramazza et al (op.cit).

A key element in the discussion below is the recognition that the global financial deregulation that began in earnest in the 1980s, and the ensuing increases in cross-border capital flows, while bringing significant benefits, may also have increased the channels through which contagion occurs. Policy-makers, as well as the IFIs recognize this and try to judge the relative import of different types of factors when responding to a crisis. But given deep uncertainties over the nature and determinants of investor and creditor behaviour, there is an understandable emphasis on the fundamental factors. This is despite the burgeoning literature on contagion. In particular, the "pure" form of contagion, unrelated to fundamentals, remains ill-defined, poorly measured and is often treated as a residual when all the familiar fundamentals have been accounted for.

The discussion below attempts to make some headway in understanding this form of contagion. It develops an analytical framework for defining investor risk appetite, building on the analyses by Persaud (1995, 1996). It uses this framework to obtain daily, quantitative measures of risk appetite, examines their evolution and assesses their usefulness in explaining global crises.

The rest of the paper is organized as follows: Section II discusses the concept of contagion and how it relates to changes in investors' appetite for risk. This is followed in Section III by an analysis of a number of issues related to risk, investors' aversion to risk or appetite for it. Section IV develops an empirical measure of investors' appetite for risk and describes and interprets changes in this measure over the past ten years. Section V describes a simulation exercise to predict systemic crises using the risk appetite measure and assesses its usefulness. Section V1 discusses the policy implications.

II. Contagion and Risk Appetite

In the context of assessing the determinants of a currency crisis, Eichengreen *et al* (1996) defined contagion as *"a systematic effect on the probability of a speculative attack which stems from attacks on other currencies, and is therefore an additional effect above and beyond those of domestic fundamentals..."* Extending their analysis, the following taxonomy of different types of contagion provides a useful framework for assessing the role of fundamental and non-fundamental factors (see also Kumar et al 1998, Masson 1998, and Ahluwalia 2000). One can identify three possible routes of contagion:

1. *Trade links:* a devaluation in one country may impact upon the relative international competitiveness of other countries, resulting in speculative attacks to re-establish equilibrium. The U.K.'s exit from the ERM in September 1992, and the subsequent depreciation of sterling, sharply reduced the trade competitiveness of Ireland, where 60% of trade was with the U.K. The subsequent attack on the punt in January 1993 is an illustration of contagion via trade linkages. Note that these two events, while linked, were still separated by four months. Contagion can take time: limiting it only to instantaneous afflictions, as some statistical studies appear to do, can lead to it being defined away. Trade links were also

important in the recent Asian crisis where countries had, to varying degrees, tied their exchange rates to the US dollar, but exported to Japan or competed against Japanese exports.

Many earlier studies including Eichengreen at al. (op.cit.) and Glick and Rose (1998) have found trade links as the most important form of contagion. However, the relatively recent and sharp rise in cross-border capital flows versus cross-border trade flows suggests that factors relating to financial flows may be assuming a greater importance than during the period these studies covered.

2. *Common external shock*: A second form of contagion, again linked to fundamental factors, is the effect on many countries of a single common external shock, termed "monsoonal effects" by Masson (1998). An important example is the Latin American debt crisis of the 1980s, which was triggered by higher US interest rates and a sharp increase in interest payments. It could also be argued that the plunge in commodity prices substantially contributed to the crises in 1998 in Chile, South Africa, Australia and other primary commodity exporters.

3. *Risk appetite*: A channel for contagion which has received relatively less attention in academic literature, although it is given significant attention in market and policy circles, relates to shifts in *investors' appetite for* or aversion to risk (Persaud, 1996). Under this form of contagion, investors share a common but *changing* appetite for risk. This may not be entirely inconsistent with the classical assumption that investors have different but fixed risk appetites. Investors may not have a single preference function or a continuously changing one, but it may be that at any point of time investors appetite for risk is in one of two states: risk loving and risk averse. When investors' appetite for risk falls, they immediately reduce their exposure to risky assets, which, consequently, fall in value together. When investors' appetite for risk rises, risky assets are in increased demand and rise in value together. This type of contagion has been called "pure" contagion because it runs along the lines of risk, not shared fundamentals, trade, or exchange rate arrangements. While the long-term direction is different, periods of strength and weakness have been similar for perceived risky assets such as Brazilian bonds, Thai baht, South African rand and U.S. junk bonds even though Brazil, Thailand, South Africa and the US share few macroeconomic trends.

One other fault line along which a reduction in risk appetite might lead to contagion is via the portfolios of international investors. A crisis in one country can lead investors to reduce their appetite for risk, which in turn leads them to reduce their exposure to other risky assets as they re-balance their portfolios in terms of risk or liquidity requirements. Accordingly, countries with a high degree of exposure to a major lender to a crisis country may face an increased chance of crisis themselves. This phenomenon, labelled the "common creditor", has found some support especially in the Asian and Russian crises (see, Goldfajn and Valdes, 1997; Calvo, 1999, and Allen and Gale 1999).

In a related fashion, a shock in one country could lead investors to change their perceptions of risk in countries facing similar macroeconomic fundamentals. For instance, a successful speculative attack on a country employing a currency peg may lead investors to question the resilience of currency pegs in general or in particular the ability of countries with similar macroeconomic conditions to maintain a currency peg. For fear of being caught twice, or being seen as not learning a prudent lesson, investors' become more sensitive to the risks in countries with similar characteristics falls. In such a situation, whether the common characteristics are real, or just apparent, may not matter much.

A. Some Market Implications of Shifting Risk Appetites

It is not always clear what functions as a "sunspot", co-ordinating shifts in investors' appetite for risk. It may be the demand for quarterly returns which keeps investors from straying too-far and for too long from the normal risk-return calculations. It may reflect the constraints of "bounded rationality": investors often have a simple paradigm that governs their view of a particular country, region or sector and an event, or a series of events in quick succession, may bring the validity of this paradigm into question, inducing investors out of risky assets (this is examined in detail in Appendix I on bounded rationality). A crisis often does the trick, but it would appear that a variety of events may serve as a 'wake-up call' for investors, causing them to revise down their risk appetite and to reassess the situation in countries, sectors etc. where they had previously been happy to take on the risk, leading to further crises (Goldstein, 1998).

If we accept that there may be changes in investors' appetite for, or willingness to, bear risk and that these changes can occur relatively quickly, it can be seen that this has the capacity to cause, or facilitate, shifts from one equilibrium to another. Examples abound:

1. Throughout most of 1999 investors appeared to have a high appetite for risk and were willing to buy equity stakes in small technology companies which had no track record, current revenues or any near-term expectations of breaking even. These companies were able to raise new capital readily and invest, which further raised hopes of future revenues and attracted yet more investors. When investors' appetite began to wane in late 1999 and turned sharply lower in the first quarter of 2000, the very same companies could not raise any new capital; and as they did not have sufficient revenues even to cover their operating costs, creditors began to pull the plug, leading to a collapse in equity prices and widespread bankruptcies.

2. In Southeast Asia, the early to mid-1990s' "paradigm" of the "tiger economies" was of a group of countries with outward oriented strategies, macroeconomic stability, hard working people, and almost unlimited potential. Bountiful capital chased this vision up to early 1997and helped to sustain investment, growth and consumption. However, following the devaluation of the Thai baht in July 1997, the perception of these economies changed overnight, and previously sanguine investors and bank loan officers were gripped with concern over countries' short-term external liabilities and a variety of structural weaknesses. Capital flowed out just as indiscriminately as it had flowed in.

These two examples illustrate the possibility that although different crises appear to have different proximate causes, they may each follow the underlying cycle of investors' appetite for risk. This is not inconsistent with the observation that the causes of crises, and therefore the nature and extent of any ensuing contagion, have not remained constant (Gregorio and Valdes 2000). While in the debt crisis of the 1980s many developing countries were affected by a common external shock, and faced similar macroeconomic problems as a result of that, contagion also spread because of a sudden reassessment by international banks of the credits on their books from developing countries (see Kumar and Panic, 1984). In the Asian crisis and its aftermath, contagion spread rapidly throughout East and Southeast Asia before extending beyond the region to Russia and Brazil; this suggests that, while fundamental, trade and financial linkages may initially have predominated, the behaviour of portfolio investors became increasingly more important. Whether all previous contagious crises can be shown to be related to the evolution of investors' appetite for risk, the enormous increase in the size and inter-linkages in global financial markets in the last two decades would suggest that investor behaviour may be *becoming* a more significant channel for contagion, highlighting the need for obtaining some measure of investor risk preference.

It is worth noting that the shift in the risk appetite measure could reflect either or both of the two following possibilities (i) a genuine shift in the degree of aversion to risk; (ii) a shift in the relative weight or proportion of different types of investors with different risk appetites. Both factors are likely to be at work. In the first category, shift in risk appetite may reflect investor overconfidence where investors attribute a string of positive returns to their superior skill and in response are willing to take on higher risk. Conversely a string of negative returns could trigger excessive pessimism and reduce the willingness to take risk. (The Appendix provides a detailed discussion of these phenomena)[4]. In practice, in a risk averse environment it may be that short-term traders respond to deteriorating environment by exiting riskier positions and widening bid-offer spreads. These actions are in turn amplified by investors' unwillingness to move on the other side of the trades.

In other words, a fall in risk appetite can be accompanied by greater price movements than might be suggested by the flows. In the second category, the rise and fall of hedge funds, or the popularity of emerging market mutual funds or the use of leveraged derivative instruments could be an important element in the observed change in risk appetite.

III. Risk and Risk Appetite: Conceptual Issues

Given the increasing recognition that investor risk appetite plays an important role in financial markets, a variety of indicators have been used to assess it and changes in it over time. However, most if not all of these indicators *appear to proxy for the level of risk, general or specific, and changes in it and not necessarily or even primarily, reflect the level or changes in risk appetite per se.* One commonly used measure is the average yield spread between AAA corporate bonds and BBB or lower rated bonds. But this spread may simply

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[4] See Shiller (1998) on fads and irrationalities in financial markets.

reflect the level of risk rather than provide any indication of the change in risk appetite. For instance, the sharp increase in telecom credit spreads since late 1999 has, given the size of this sector, impacted credit spreads more generally. Does this reflect an increase in industry specific risk only, an increase in default risk in general, a decrease in risk appetite per se, or some combination of the three? Similarly, to what extent did the decline in emerging market spreads, particularly in Asia, in late 1996 and early 1997 reflect a specific re-rating of risks for these economies, a general increase in risk appetite or a combination of the two? The answer is not obvious from individual market prices in either case.

Would weighting, in some appropriate manner, different measures of risk premia yield a measure of investor risk appetite? For instance, could a weighted measure of spreads across a wide range of assets, including technology, emerging market currencies and junk bonds provide a measure of risk appetite in global financial markets? If the weights were selected in some optimizing framework to reflect underlying investor preferences, such an approach could certainly help. This is the route taken by many financial market participants themselves, who take a weighted average (often equi-weighted) of a large number of spreads for liquid markets, and regard this as a measure of investor "risk preferences" (see Riskmetics 2001). However, quite apart from the problem of the appropriate weighting, it is not unlikely that common fundamental factors might be driving the general movement in spreads. This would then not be capturing risk appetite per se but rather changes in the underlying risk. For instance, a decline in overall GDP growth might harm credit quality and lead to a rise in credit risk spreads generally. Of course, risk appetite may also decline but the observed increase in spreads would be a combination of the two rather than predominantly a measure of risk appetite.[5] Similarly a fall in global oil prices may lower spreads, in part by reducing inflationary expectations but this need not necessarily reflect an increase in risk appetite.

Another measure of investor risk preference has been based on the information embodied in derivatives prices, particularly in options price. In particular, investor risk aversion is deduced from the changes in implied volatility versus actual (historic) volatility with a rise in implied volatility taken to be a proxy for a fall in risk appetite. However, even assuming that options markets have adequate liquidity, and that options exist for a wide range of assets, there is still a problem of how to weight these volatilities. More fundamentally, if investors are prepared to pay more for market insurance this may indeed reflect their reduced appetite for risk, but it may also reflect their view that there is more risk around to be insured against. The prospect of a central bank acquiescing to its currency trading outside a long-held trading range against another could lead to a significant increase in implied volatilities of currency options without signalling a fall in investor risk appetite.

[5] A decline in growth would likely be accompanied by a fall in interest rates and have two effects with ambiguous implications for risk appetite: a desire to attain better returns by moving into riskier assets—an increase in risk appetite, or a signal that economic developments are likely to be worse than anticipated—leading to a decrease in risk appetite.

The above examples illustrate the often-subtle distinction between shifts in risk and risk appetite. In the case of fixed income spreads, this distinction can be highlighted heuristically as follows:

Spread $=K$ (risk), $K(.)$ reflects *risk appetite*, and risk=g(fundamentals,u) (1)

This then gives rise to the issue of how to model K and *assess its role in the contagion* of financial crises. One way of doing so is the following:

$$K = \text{h(structural component; time-varying element)} \quad (2)$$

where the structural component is relatively constant and reflects parameters of the investor utility function as well as structural elements of the financial markets including the degree of competition and incentive system; the time varying element reflects short-term factors, such as the incidence of a "wake-up call" which leads to a shift in risk appetite from risk-loving to risk-averse.

More formally, define K as above to be a measure of risk appetite. Assume that the investor is risk-averse, and risk is proxied by σ^2, the variance of the asset. Then equation (3) provides an illustrative representation of expected return:

$$E(R) = \alpha + K\log(\sigma^2) \quad (3)$$

where $E(R)$ is the expected return; α is a measure of "global" risk; K can be positive, negative or zero depending on the type of investor. An increase in the value of K represents an increase in the level of risk aversion. The expected return can be viewed as the long run price $LR(P)$ minus the current price of the asset:

$$LR(P) - P = \alpha + K\log(\sigma^2) \quad (4a)$$

or

$$P = LR(P) - \alpha - K\log\sigma^2 \quad (4b)$$

For a given level of "specific" risk, we have two possibilities:

1. A change in "global" risk with K constant.

K is not affected, but the shift in general level of risk is represented by a shift in the intercept. Therefore, the effect will be the equivalent increase in expected return and decrease in price across all levels of risk. The bigger the change in general risk, the bigger the change in price:

$$\frac{\partial P}{\partial \alpha} = -1 \quad (5)$$

Note that the change in price is invariant to the level of specific-risk.

2. A change in risk appetite, given by a change in K implies:

$\frac{\partial P}{\partial K} = -\log\sigma^2$ That is, a fall in risk appetite also warrants an increase in asset price for all levels of specific risk. But the magnitude of this would be in general different from the case above and depends on the riskiness of the asset itself. To see this, consider a second asset which has twice the risk of the first:

$$
\begin{aligned}
&E(R) = \alpha + K\log(2\sigma^2) \\
&LR(P) - P = \alpha + K\log(2\sigma^2) \\
&P = LR(P) - \alpha - K\log(2\sigma^2) \\
&\frac{\partial P}{\partial K} = -\log(2\sigma^2)
\end{aligned} \tag{6}
$$

In this case, an increase in general risk will again warrant a fall in price. But now a decline in K will have a greater negative impact on the asset's price, than the increase in general risk. This implies that the more volatile (riskier) is the asset, the greater the required rise in expected returns; therefore the greater the negative impact on the asset's price of a decline in risk appetite relative to an increase in the general level of risk.

The above illustrates how there can often be confusion between shifts in general risk and shifts in risk appetite, not least because both can occur at the same time. However, these shifts would likely have a different impact on the *order* of returns for any given asset. *When risk changes at period t, the order of price movements is the order of the impact of the contemporary change in risk.* So the rank correlation between price movements at t and a measure of riskiness at t-k should be weak. However, *when appetite for risk changes, the order of price changes follows the order of inherent (or past) riskiness.* Therefore the rank correlation between current price movements and past riskiness should be strong.

We try to exploit this difference to examine empirically whether we have a shift in risk or a shift in investors' appetite for risk. If we assume that the riskiness of assets can be measured by some long-run measure of the volatility of excess returns, the correlation between the *order* of current excess returns and the order of past measures of riskiness will be high in a world of shifting risk appetite. *But it will be low in the case where excess returns are being driven by news.* If we take the null hypothesis as excess returns being independently distributed and having a zero correlation with past information, including past volatility, we can test to see whether the degree of rank correlation seen between current returns and past risk is statistically significant, when it is and how frequently this is the case.

IV. Empirical Measure of Risk Appetite

A. Operational Issues

The analysis above suggests that inter-temporal changes in risk appetite will likely lead to a specific pattern in returns across assets, namely that the rank of returns will be the same as the rank of risk. Using high frequency data, this is a pattern that we are less likely to see if risks change but not risk appetite. If we consider excess returns, and proxy risk as past volatility of excess returns (and if we use non-overlapping periods in calculating these returns and volatilities), then, with given risk appetite, there should be no statistically significant correlation between the rank of current excess returns and the rank of past risk. Relatedly, we have little reason to expect a direct correlation between past volatility of excess returns and the impact on returns of changes in local or international fundamentals.

If we use the zero correlation as the null hypothesis, we can not only measure the degree of correlation between the rank of current returns and the rank of past risks, but we can also measure its statistical significance. Note that although the risk-appetite measure is a continuous variable, it may be more appropriate to view it as indicating the probability that investors as a whole are in one of two states: low risk aversion and high risk aversion. The significance tests can then be used to assess the likelihood that there is indeed a shift from one state to another.

In order to make the above assessment we need to use as many asset returns as we can with as much history as possible to minimize the risk that we misinterpret a chance correlation between risks and returns. We have chosen to focus on currency markets for three reasons. First, we will then be able to compare our index's ability to predict currency crises with the extensive literature and empirical work in this area. Second, there are a relatively large number of liquid currency instruments outside G7 for which high frequency data is available going back a long time. Third, given the liquidity in these markets, international contagion may be expected to impact currency markets more quickly than other markets.

We use ten years of daily spot and forward exchange rate data on the following seventeen currencies which are relatively liquid and where the forward exchange rate is not encumbered by capital controls: Argentinean peso, Australian dollar, Canadian dollar, Czech koruna, Euro Area's euro (synthetic), Hong Kong dollar, Japanese yen, Mexican peso, New Zealand dollar, Norwegian crown, Polish zloty, Singaporean dollar, South African rand, Swedish crown, Swiss franc, Taiwanese dollar and British pound.[6]

Operationally, we calculate excess returns by taking the log difference of the spot rate and the one or three-month forward rate determined one or three months (a quarter) ago.

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[6] Prior to October 1994, due to lack of data we replace spot and forward exchange rate data from Argentina, Czech Republic, Euro Area, Mexico and Poland with data from the Netherlands, Belgium, Germany, Italy and France.

(There is an excess return if the spot rate has outperformed its forward rate over the preceding month or quarter). In calculating risk, we calculate the average volatility of monthly or quarterly excess returns, over a period of a year or more precisely 250 business days. To apply the null hypothesis we need to ensure that the period over which we measure returns and over which we measure the volatility of returns do not overlap: so in calculating volatility we use the 250 days up to the beginning of the last month or three months. We then find the correlation of the rank of (current) excess returns and the rank of past volatility

One measurement problem is that while it does not matter which currency one uses as the numerate in calculating returns—whether you take dollar or yen returns, the rank of returns is always the same—the rank of volatility is sensitive to the exchange rate. The Canadian dollar is volatile versus the yen, but relatively stable versus the dollar. This sensitivity is reduced by focusing on excess returns rather than spot returns and can be reduced further by using average excess returns across the majors: yen, euro and dollar. This is the route we have taken. However, it should be noted that while a great deal of sophistication can be used in calculating volatilities, the rank of volatility is not very sensitive to different methodologies; most suggest the Swiss franc is safe and the Polish zloty is not.

We use Spearman's rank correlation because this places greater weight on the relative returns of the most and least risky currencies where there is the biggest contrast in risk, and not on the returns of those in the middle where differences in risk are less stark and where the ranks are more susceptible to measurement error. In terms of risk, one may regard the US dollar and the South African rand at different ends of the spectrum, but the differences between sterling and the Swedish crown are less sharp and more sensitive to measurement parameters such as time periods and the volatility calculation.

B. Description and Interpretation

Figures 1 and 2 show the evolution of the Spearman's rank correlation of current returns and past risks, with 1 and 5% significance levels drawn in for the risk-appetite index for monthly and quarterly returns. While the measure of risk appetite appears volatile, one way of interpreting this volatility is that it is a measure of the likelihood that we are in one of two very distinct regimes that may be defined by periods when the index level is beyond its statistically significant levels (for monthly returns +/- 0.34 and +/-0.49 at 5% and 1% level respectively).

What if we focus only on the statistically significant correlations? This is illustrated in Figure 3 below, which shows the values of the monthly index only when they were significant at the 1 percent level. There are two main observations which can be made: first, compared to Figure 1, as might be expected there are fewer periods when the index is significantly different from zero. This increases the confidence we can place in the index as a measure of risk appetite, rather than arising simply as a series of chance events. Second, and equally importantly, over the last decade, periods of significantly "high" risk appetite appear to be more frequent and longer lasting than periods of significantly "low" risk appetite. This may to some extent reflect the optimistic bias of investors.

Another test of whether there are indeed distinct periods of aversion or attraction to risk among investors and whether our index captures these, is to test whether the currency returns sampled from each environment—as indicated by the index—are statistically separate, and more precisely whether we could reject the null hypothesis that the returns in fact could come from the same distribution with a given preference function. Note that a rejection of the null hypothesis is consistent with the notion of two distinct states of investor preferences. We summarize this test below and provide the full test statistics in the appendix.

The histogram below plots the distribution of returns during risk-averse periods and risk-loving periods separately. Examination of the figure and the descriptive statistics indicate that the mean and median returns of the risk-loving periods are higher than in the risk averse environments. The Mann-Whitney U test statistic confirms that the two distributions have significantly different medians. Furthermore, the Brown-Forsythe test indicates that the two distributions have significantly different variances. Further evidence supporting the notion of two distinct regimes is provided by testing the normality assumptions. Beginning with the risk-loving returns, the distribution has a kurtosis of 3.2, very close to that of a normal distribution. The Jarque-Bera test reinforces this result and fails to reject the null hypothesis of normality. A skewness of 0.26 indicates a near-symmetric series similar to that of a normal distribution. Conducting the same tests for the risk-averse returns reveals a very different regime; a more peaked (leptokurtic) and negatively skewed distribution. The Jarque-Bera test fails to reject normality, however the magnitude of the statistic is far smaller than for the risk averse environment. These standard statistical tests clearly support the notion of two separate regimes, and show that the risk-appetite index is able to distinguish between them.

C. Comparing the Index over Past Crises

It is now worth taking a closer look at the risk-appetite index and its evolution over time, and comparing it with a variety of interest rate spreads. As Figures 1 and 2 above, and 5 illustrate clearly, there appear to be rather marked quarterly and annual cycles in the index. Troughs in the index appear correlated with major market discontinuities. In the last three years, our risk appetite index hit extreme lows (or "riot points") on four occasions and reached extreme highs on five. Consider for illustration purposes, the highs and lows at the end of the third quarter of 2000 summer, tension surrounding the run up to Y2K in the second half of 1999 and the subsequent easing of market concerns, and the crisis period and eventual recovery in the third quarter of 1998.

(i) The risk appetite index was significantly negative from the September 5 to November 1 last year, reaching a low of –0.69 on October 2. This may have reflected investors' uncertainties and concerns in the face of rising oil prices and possible stagflation, uncertainties in the currency markets with the euro reaching a record low versus the dollar, widespread profit warnings by U.S. firms in part reflecting their exposure to a strong dollar

(40% of the earnings of the S&P 500 come from overseas), and continuing concerns about the general weakness in global equity markets. September 22 noted the first round of G3 intervention to prop up the euro. Also on this day, the US Department of Energy announced that it would release thirty million barrels of oil from the Strategic Petroleum Reserve.

To illustrate how the low in the index on October 2 is derived, Table 1 below notes the rank order of the risk and returns for the 17 currencies on that day. Note that the returns are computed for the preceding month, (September 3 to October 2) while the risk is computed for the period of a year preceding this month (September 3, 1999 to September 2, 2000). As the Table shows, for this particular day, the New Zealand dollar had the highest risk and the lowest return, followed by the Mexico peso which had the second highest risk and was eighth in terms of return. The Hong Kong dollar had the lowest risk and the third highest return. The Spearman's correlation of these ranks gives the value of -0.69.

Table 1. Risk and Returns

October 2, 2000	Rank of Risk	Rank of Return
New Zealand	1	17
Mexico	2	8
Poland	3	14
Australia	4	16
Czech Republic	5	11
Euro	6	9
Switzerland	7	4
Japan	8	13
South Africa	9	12
United Kingdom	10	1
Sweden	11	15
Norway	12	7
Canada	13	10
Singapore	14	6
Taiwan, PoC	15	5
Argentina	16	2
Hong Kong	17	3

Correlation: -0.69

(ii) Following the intervention in the oil and currency markets, and some speculation that the US Federal Reserve may begin policy easing in the near-term, the risk appetite index began to improve from early November onwards. The index was significantly positive between November 9 and January 19, reaching a peak of 0.78 on December 6. Table 2 notes the new rank order of the risk and returns. (As before, returns are for the month ending December 6th, 2000, while risk is computed for the year ending November 6, 2000). Now, while the New Zealand dollar still had the highest risk, it now also had the highest returns; it was again followed by the Mexican peso in terms of risk, but this now had the third highest return. The Hong Kong dollar now had the second lowest risk, but its return was almost the lowest. The Spearman's correlation of these ranks gives the value of 0.78.

Table 2. Risk and Returns

December 6, 2000	Rank of Risk	Rank of Return
New Zealand	1	1
Mexico	2	3
Australia	3	7
Poland	4	14
Euro	5	9
Czech Republic	6	11
United Kingdom	7	1
Switzerland	8	4
Sweden	9	15
South Africa	10	12
Japan	11	13
Norway	12	7
Canada	13	10
Taiwan, PoC	14	5
Singapore	15	6
Hong Kong	16	3
Argentina	17	2

Correlation: +0.78

Based on this example, we can illustrate the intuition behind our claim that the index represents a measure of risk appetite and change in it, rather than simply a change in underlying risk. Between October and December the relative ranking of the measured risk across currencies actually remains virtually unchanged and this is generally the case even when shorter periods are chosen to calculate the volatility of excess returns used in the rank of underlying risk.[7] However, there is almost a complete reversal in the returns across the full set of currencies. While it is possible for underlying fundamental risks to have changed within countries between October and December in a manner that our measure does not capture, it is extremely unlikely that those risks would have changed in direct proportion to past volatility of excess currency returns. That is, the country with the biggest fall in these fundamental risks would have had to be the country with the highest level of long-term volatility of returns, and the country with the second biggest fall in these fundamental risks would have had to be the one with the second highest level of long-term volatility of returns, and so on. While this cannot be completely ruled out, the probability of it happening across seventeen currencies repeatedly overtime is minute.

[7] Note that as it is important to obtain a measure of underlying risk, return volatility is computed over the preceding year. Computing the measure with risk measured over a shorter period, say the preceding six months does not materially change the results.

(iii) The third time our index showed severe risk aversion was October 1999, a period of uncertainty ahead of Y2K. A sharp increase in precautionary demand for money began to starve global markets of liquidity. This prompted policymakers to take action, offering assurances that liquidity will be plentiful—Greenspan made a speech on this topic on October 15. Averaging 9.4% year-on-year growth in 1999 Q3, US monetary base accelerated to a peak of 15.5% in December 1999 the fastest pace in forty years.

(iv) There was a period of severe risk retrenchment from August 10 to September 23, 1998, which witnessed the Russian debt default on August 17 followed by mounting concerns about LTCM in late August and early September and the rescue facilitated by the US authorities announced on September 23. This was followed by an interest rate cut by the Federal Reserve on September 29. According to the index, the lows of risk appetite were reached in the second half of August, following the Russian crisis and as early news of LTCM difficulties began to seep into the market.[8] The index began to recover after September 23, although the rate cut at end September was initially followed by a drop in risk appetite. This may have reflected concerns that the Fed was privy to more bad news. In the event, no further bad news emerged, and by the second week of October risk appetite was rebounding. By the time of the Federal Reserve's second rate cut on October 15, the risk-appetite index was continuing to rise reaching its highest level since mid-July.

The following three figures provide a comparison of the evolution of the index and EMBI+, corporate credit spreads, and junk bond spreads since June 1998. Given that these spreads are widely used as a measure of specific risk, it is useful to examine the extent to which they are correlated with the risk appetite index. A comparison with the EMBI+ shows that a fall in the risk appetite measure is generally associated with an increase in emerging market spreads (both are on a monthly basis) (see Figure 6). The correlation is quite close at times, as during the second half of 1998 and early 1999, and often the index leads the turning points in the spreads. Late last year, however, there was some difference in the magnitude of the movement in these two, with the risk appetite rising more than the fall in spreads.

The relationship between the risk appetite index and change in corporate credit spreads in the U.S. is also quite close (Figure 7). The latter are defined as the difference in spread between BBB and AAA rated bonds; an increase in the spread indicates investor perception of increasing risk and possibly of risk appetite. In general the correlation between credit spreads and risk appetite measure is even closer, with some evidence that oftentimes the appetite measure leads the change in spreads. This is particularly so over the period September to December 2000, and in the most recent period. Finally, Figure 8 shows the relationship between junk bond spreads and the index. While these spreads are more volatile,

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[8] LTCM formally informed investors in a letter on September 2 that the value of the fund was down 44 percent in August and 52 percent for the year, but markets had begun to anticipate large losses at LTCM several days before the formal notification.

the relationship with the risk appetite measure is again fairly close and the measure often leads the change in spreads.

V. Risk Appetite and Systemic Crises: Empirical Evidence

A global, quantitative, daily measure that differentiates between shifts in risk and shifts in investor risk appetite should help policy makers when they come to consider how best, or if, to respond to market dislocation. The above illustration, for example, suggests that the Federal Reserve's third rate cut and possibly even the second, in 1998, may not have been necessary or at least not at the time, as financial contagion was already dissipating by the second week of October. But while a better understanding of current conditions is always helpful, a key interest is whether the index can give us visibility into the future. This section undertakes an evaluation of the power of the risk appetite measure to predict systemic crises.

Systemic crises are defined when there is severe market pressure in the currencies of *two or more* industrial and emerging market economies in any given quarter. This type of analysis complements models which have proliferated in recent years which try to forecast crises in individual countries (see for instance, Kaminsky et al 1999). They invariably utilize a binary measure of currency crisis: we have adopted the same approach but extend it to a multilateral case so that a value of 1 indicates that more than one country experiences a currency crisis and value of 0 represents a tranquil period (which may include an isolated crisis).

The dependent variable in our analysis is an aggregate measure of market pressure across countries, based on the formulation by Eichengreen et al (1996) for individual countries. The market pressure variable is calculated as follows:

$$EMP_{it} = (\alpha\,\%\Delta e_{i,t}) + (\Delta\beta\,(i_{i,t} - i_{G,t})) - (\gamma\,(\%\Delta r_{i,t} - \%\Delta r_{G,t})) \qquad (7)$$

Where e_{it} is the cross exchange-rate of country i to the base country G, $i_{i,t}$ is the short term interest rate differential of country i relative to country G. $r_{i,t}$ is the ratio of international reserves to narrow money of country i, thus $(\%\Delta r_{i,t} - \%\Delta r_{G,t})$ is the reserve ratio differential between country i and the base country. Crisis is defined as extreme values of this measure such that:

$$\begin{array}{l} Crisis_{i,t} = 1 \text{ if } EMP_{i,t} > 1.5\sigma_{EMP} + \mu_{EMP} \\ Crisis_{i,t} = 0 \text{ Otherwise} \end{array} \quad \textit{in more than one currency}; \qquad (8)$$

where σ_{EMP} and μ_{EMP} are the standard deviation and mean of the exchange market pressure indicator respectively.

The econometric model used in our estimations is a probit model. One of the commonly experienced limitations of using the probit to predict the occurrence of crisis across daily data is that there are many more periods of non-crisis than crisis in the sample data. Consequently, we are unable to effectively capture the variation in the data during the crisis periods. To overcome this problem we have constructed a special data set where the number of crisis periods is equal to the number of non-crisis periods.[9]

Variables during crisis quarters are unchanged. But in between crisis periods (tranquil periods) each variable is given three values spread over the same number of datapoints with the number of datapoints determined so that in the dataset as a whole there are the same number of datapoints during crisis periods as during non-crisis periods. The first value of a variable during a tranquil period is equal to the average of that variable during that period. The second value is equal to the average plus the standard deviation of that variable and the third value is the average minus one standard deviation. Once the regression is estimated on the constructed data, the estimated parameters are then used to predict the probability of systemic crisis on the original data. Because a constructed dataset is used, the probit cannot be interpreted as a probability, but simply as a measure of the likelihood of a crisis and the diagnostic tests of the regression model are less relevant than long-run tests of the model's ability to predict a crash out-of-sample.

The explanatory variables include a number of different specifications of the risk appetite index, including its average level and change over time. The following Table 3 provides a brief summary of the expected results for the different specifications, with the dependent variable being the binary crisis indicator. The model attempts to specify the dynamics of the risk appetite index: the first and the second elements are the one month change and average level of the index: these would be capturing the current environment and would be expected to be inversely correlated with the likelihood of the systemic crisis. Since crises tend to follow periods of high and rising risk appetite, the third element, the three month change lagged four months, would be expected to be positively correlated with the crises. The final element is the six month average level of the index, lagged five months: this is included to test the hypothesis that the longer the period of high risk appetite, the greater the likelihood of a subsequent reversal, leading to a crisis. These expectations are illustrated in Figure 9 which shows the evolution of risk appetite in the run-up to a crisis. Note also that given the non-overlapping construction for these variables, there is limited collinearity amongst them. The G-7 yield curve (defined as the yield spread between the 10 year swap rate less the 2 year swap rate, across G7 countries, weighted by GDP) lagged was included to provide a proxy for the global fundamentals.

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[9] For detailed rationale of this, and the methodology, see Persaud (1998).

Table 3. Hypotheses Regarding Risk Appetite and Currency Crises

Variable	Expected Sign of Coefficient	Hypothesis
1 month change in the risk appetite index lagged (10 days)	-	Expect fall in risk appetite one month prior to crisis
1 month average of risk appetite index lagged (20 days)	-	Expect average of risk appetite to be low immediately prior to crisis
3 month change in risk appetite index lagged (80 days)	+	Expect risk appetite to be rising 4 months prior to crisis
6 month average in risk appetite lagged (100 days)	+	Expect average of risk appetite to be high several months prior to crisis
G-7 yield curve lagged (80 days)	+	Expect G-7 yield curve to be positive several months prior to crisis

A. Empirical Results

A number of alternative models utilizing the above elements of risk appetite and fundamentals were estimated. Table 4 below reports results for the specification which yielded the most significant results. In this specification, parameter estimates were strongly supportive of the hypotheses discussed above: in particular, the results support the notion that crises are preceded in the immediate run-up by a fall in risk appetite, but from earlier higher levels. The accompanying Figure 10 compares the predicted probability of systemic crises with their actual incidence. As the figure illustrates clearly, the model performs quite well in predicting crises over different time periods.[10]

Table 4. Empirical Results for Risk Appetite

Variable	Coefficient	Std. Error	z-Statistic
1 month change in the risk appetite index lagged (10 days)	-1.60	0.18	-9.08
1 month average of risk appetite index lagged (20 days)	-1.77	0.19	-9.54
3 month change in risk appetite index lagged (80 days)	0.96	0.12	8.33
6 month average in risk appetite lagged (100 days)	4.48	0.35	12.86
G-7 yield curve lagged (80 days)	2.13	0.25	8.41

[10] We have to be careful when interpreting the estimated coefficient provided by the probit. In an OLS regression the slope coefficient provides the marginal effect of a unit change in the regressors on the dependent variable. However, in the probit model, the coefficient is the change in the probability of an event given a unit change in the value of the regressor.

Table 5. Diagnostics of Regression Results

Mean dependent var	0.53	S.D. dependent var	0.50
S.E. of regression	0.42	Akaike info criterion	1.03
Sum squared resid	241.46	Schwarz criterion	1.06
Log likelihood	-706.64	Hannan-Quinn criterion	1.04
Restr. Log likelihood	-962.45	Avg. log likelihood	-0.51
LR statistic (7df)	511.62	McFadden R-squared	0.27
Probability (LR stat.)	0.00		

Tables 5 and 6 indicate the model's performance. Table 6 formally tests how well it predicts crises. The first column counts the number of crises (out of 11) that have been identified by the model at different trigger levels ranging from 0.1 to 0.9. The second column notes the proportion of crises that are correctly predicted by the model at different trigger levels, which is an indication of Type I error—failure to predict crises which occur. Clearly, the lower the trigger threshold, the lower would be the Type I error. For instance, with trigger level of 0.3 or less, all crises are predicted and the Type I error is zero. Of course, the lower the trigger point, the higher the Type II error—prediction of crises which do not materialize. This is noted in the third column.

Table 6. Prediction of Crises

	(1)	(2)	(3)
Probability	No. of crises Identified	Proportion of Crises Correctly Predicted	Proportion of Time Crises are Falsely Predicted
0.1	11	1.00	0.62
0.2	11	1.00	0.57
0.3	11	1.00	0.51
0.4	10	0.91	0.46
0.5	9	0.82	0.41
0.6	9	0.82	0.35
0.7	9	0.82	0.27
0.8	7	0.64	0.18
0.9	3	0.27	0.08

VI. Concluding Remarks

This paper takes as its starting point the proposition that investor appetite for risk plays a role in explaining developments in global financial markets, including financial crises. While fundamentals undoubtedly remain of significant importance, they may not by themselves adequately explain or predict developments in financial markets and in real economies. We have argued that investors' appetite for risk changes over time and can be measured. Models based on fundamentals alone would have less predictive power than those which embody some measure of risk appetite.

The analysis and empirical results have a number of implications: First, multiple equilibria may arise where the sustainable level of a currency depends on whether or not a speculative attack occurs, which may in part reflect a measure of investors' appetite for risk. Hence, while current fundamentals are important, so too are future fundamentals, and investors' willingness to take risk. However, the state of future fundamentals is partly determined by whether or not a successful speculative attack occurs. Therefore, it may be that a currency peg is compatible with current and future fundamentals in the absence of a speculative attack, but incompatible with current and future fundamentals after an attack has taken place. Work on this subject has suggested that a "grey area" may exist where the sustainability of a currency peg is determined by the attitude of market participants. Thus fundamentals that surpass this "grey-area" ensure that the country is safe from speculative attack, whilst those countries with fundamentals that are worse than this - and therefore outside the grey area—are likely to suffer a speculative attack.

Second, from a policy perspective, it is surely useful to distinguish between crises arising primarily from bad fundamentals and those arising mainly from abrupt shifts in investors' preferences. If crises are due to risk appetite turning negative, the contagion effects arising from them have to be treated differently than from those arising from the weakness in fundamentals. For instance, the role of conditionality in financial programs may well be different if the cause of crisis is essentially unrelated to shifts in risk appetite, and reflects mainly weak policies. In this case, it may well be appropriate for there to be a detailed assessment of the weaknesses and conditionality to be relatively strong, entailing significant adjustment. On the other hand, if the crisis reflects mainly weaker risk appetite, it may be appropriate to provide funding expeditiously to stabilize sentiment and have lighter conditionality.

More specifically, in circumstances where a crisis occurs in the wake of a declining risk appetite after a long period of high risk appetite, the market will have a high propensity to react adversely to events that might not otherwise warrant major reaction. In these instances, responding quickly to a crisis could substantially reduce its magnitude and potential spill-overs. This would suggest that there could be an important trade-off between negotiation of policies to improve the country's fundamentals, and the speed of disbursement of funds. A delay in disbursement to agree on the right level of conditionality, even in the case of a crisis developing in a country previously pursuing unsustainable policies, could have broader adverse spill-over effects.

Third, if a general risk aversion is contributing to financial crisis, countries which have been pursuing the right policies may have disincentives. The good and the bad are both caught. Even though the "good" may possibly rebound more quickly, in the short run there can be significant discouragement for those pursuing sound policies. What to do? If the good can be pre-screened or pre-selected, there may be a seal of approval from IFIs and if the country is still hit by the crisis because of the generalized worsening in investor risk appetite, it would be able to weather the storm better. But there are can be considerable problems in pre-selecting or pre-screening (see for instance Bergsten 1999 and Kumar et al 2000). Nevertheless, in implementing variants of this approach which can ameliorate its shortcomings, it might be appropriate to consider whether a crisis is likely to be caused by poor fundamentals or changes in risk appetite, and if the latter to provide significant assistance.

Figure 1. Quarterly Risk Appetite Index

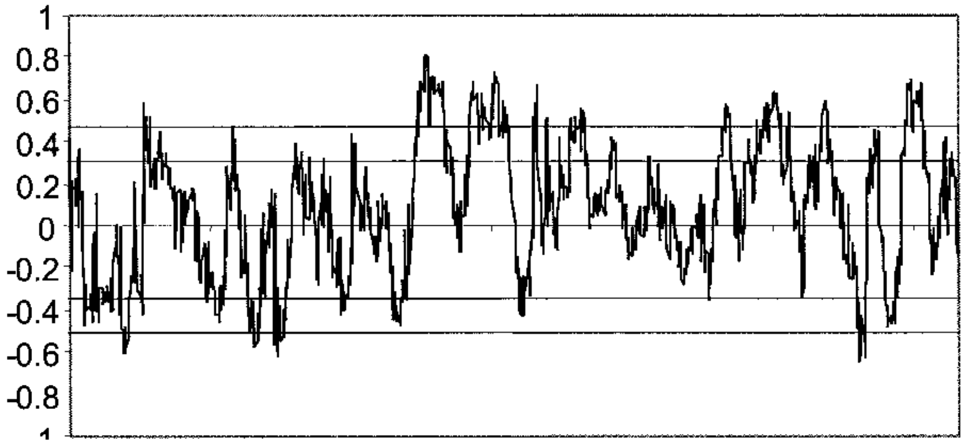
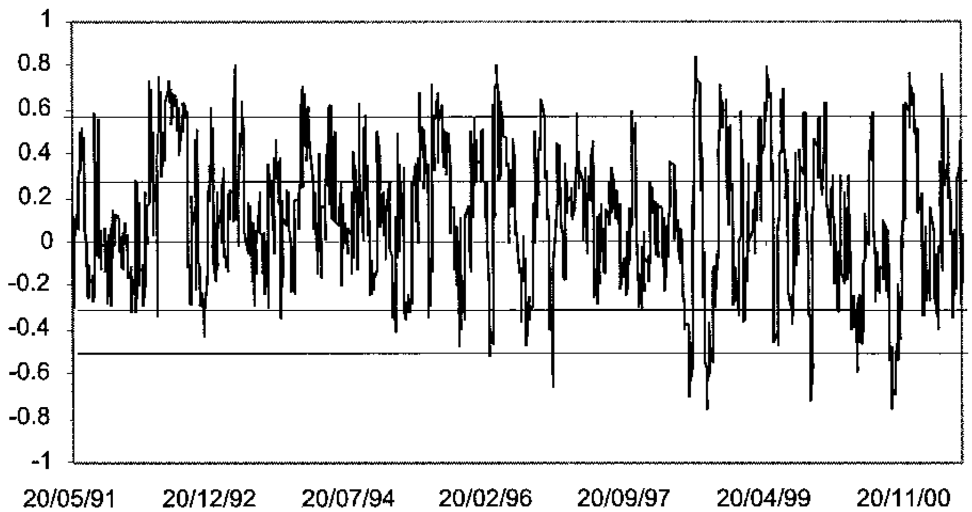


Figure 2. Monthly Risk Appetite Index



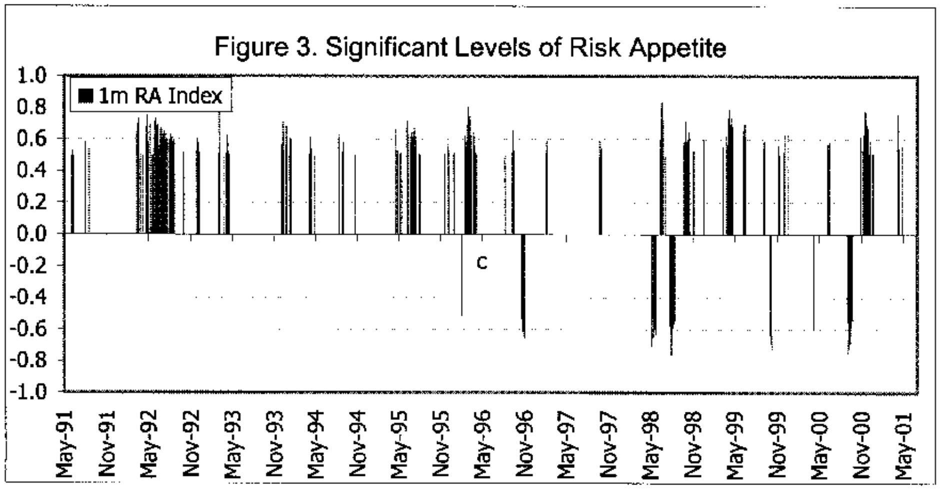


Figure 4. Low and High Risk Appetite

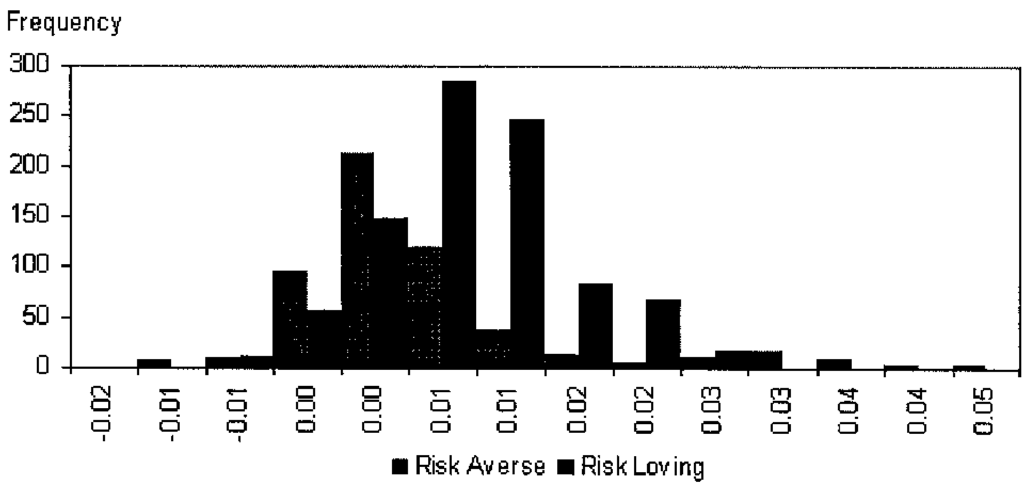


Figure 5. Recent Movements in Risk Appetite

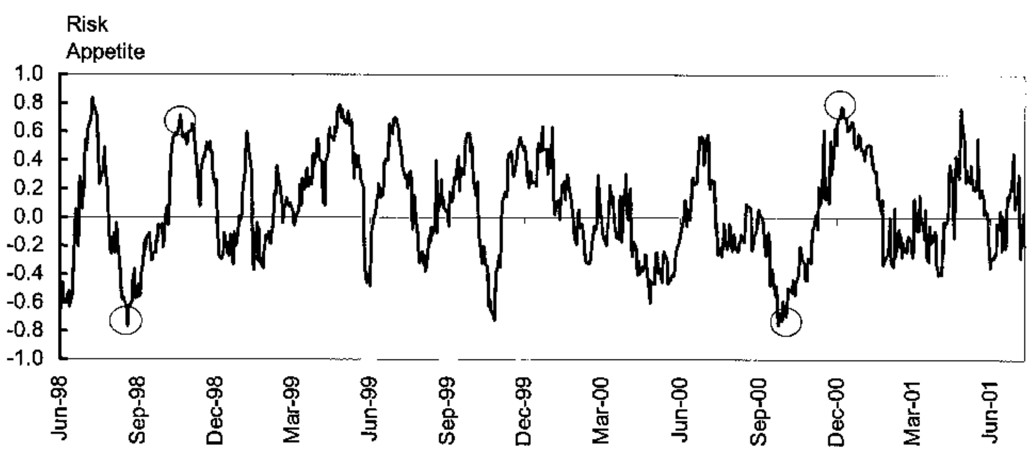


Figure 6. Correlation Between EMBI and Risk Appetite

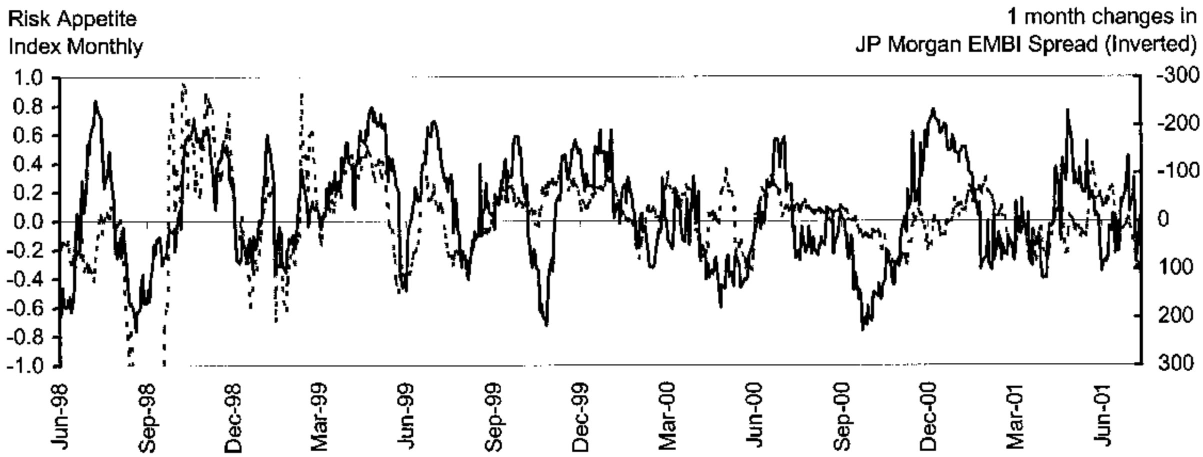


Figure 7. Correlation Between Credit Spread and Risk Appetite

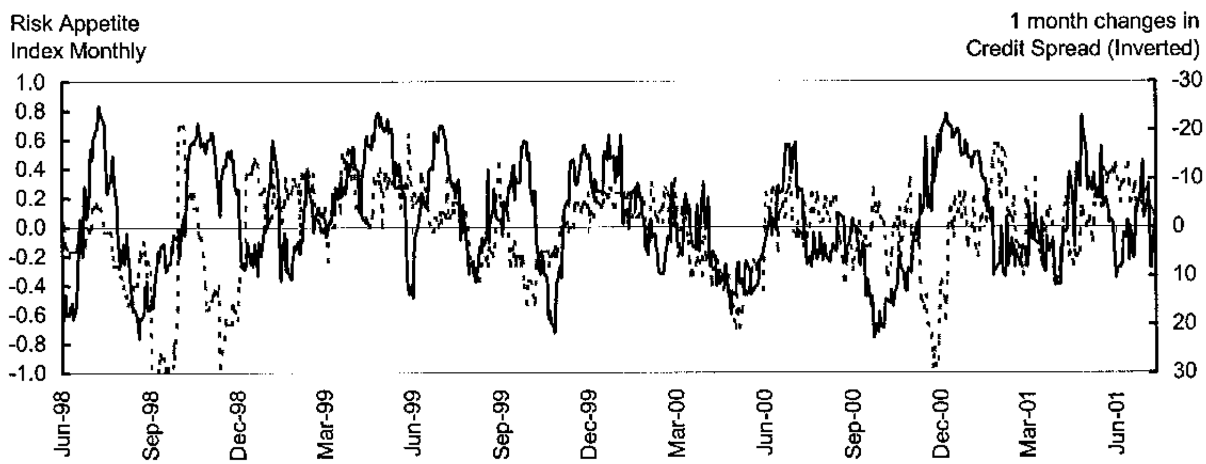


Figure 8. Correlation between Junk Bond Spreads and Risk Appetite

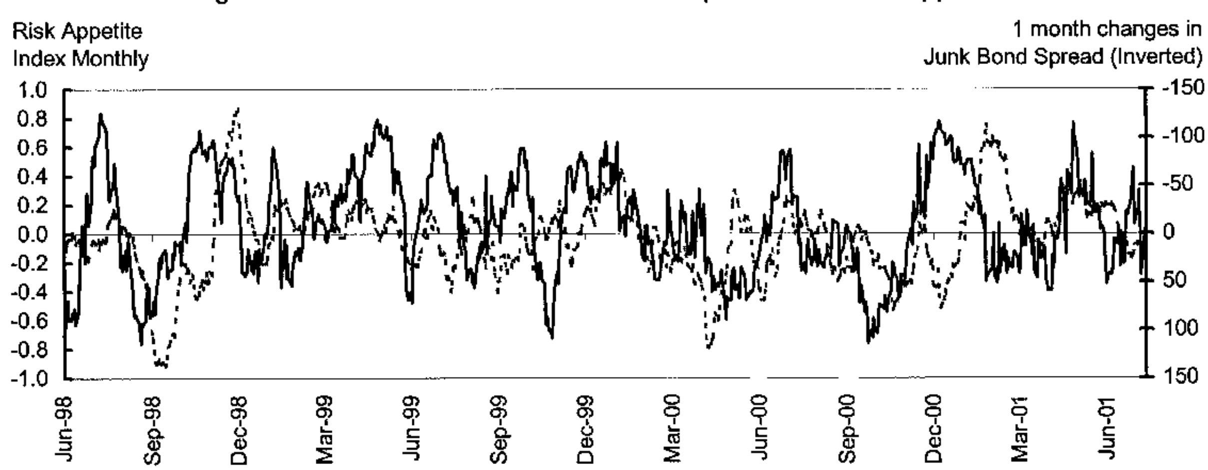


Figure 9. Stylized Risk Appetite Cycle and Currency Crashes

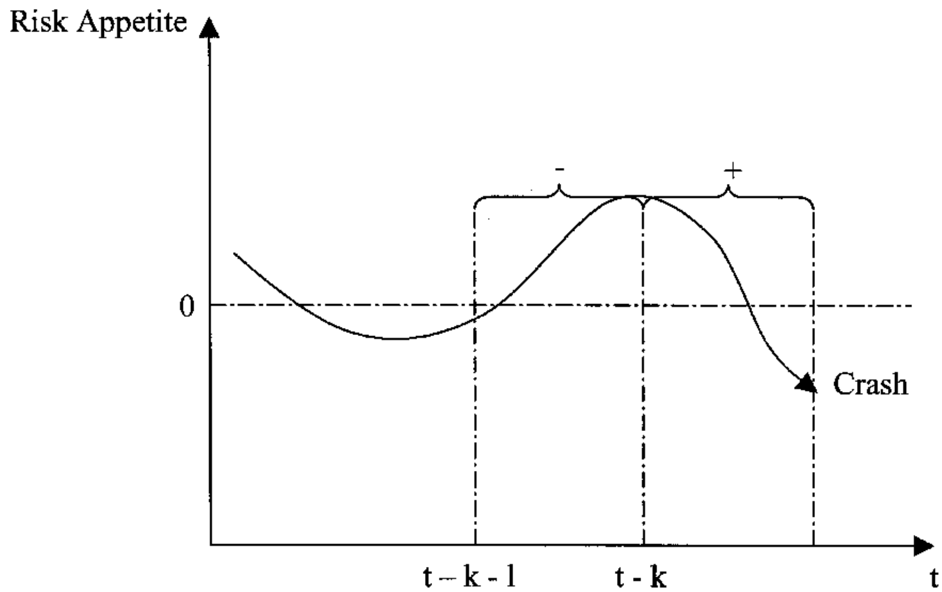
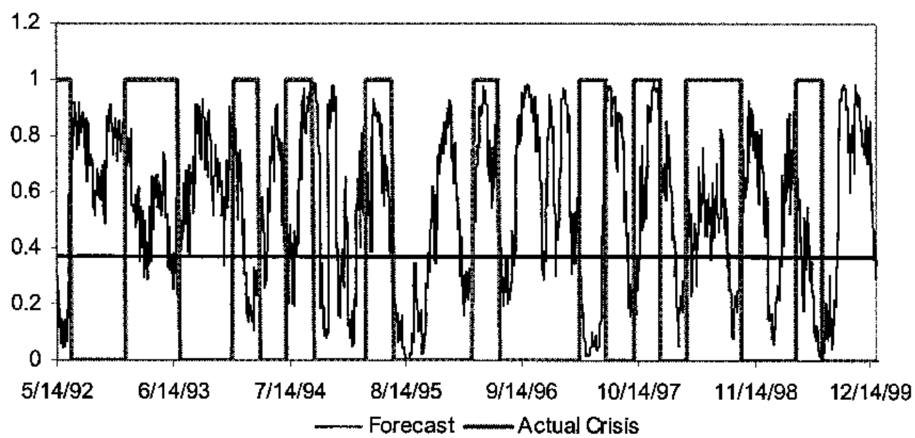


Figure 10. Actual and Forecast Global Crises



Factors Behind Shifts in Investor Risk Appetite

A shift in risk appetite may reflect the *level* of risk appetite in the preceding period: optimism or pessimism feeds upon itself, propelled by belief that there has been a "fundamental" change for the better, or for worse. Tversky and Kahneman (1974, 1979) and more recently Shiller (1998) suggest that that the precepts of rational, optimizing behavior are frequently violated in real life. They also showed that these "anomalies" could be predicted. In their 1974 paper Tversky and Kahneman argued that individuals rely on a limited number of heuristic principles that serve to simplify complex probability judgments. Usually these "short-cut" decision-making tools work fairly well—that is, approximate to rational economic behavior but under certain circumstances they result in systematic errors of judgment. For instance, under the Availability Heuristic, individuals assess the probability of an event by the ease with which instances can be called to mind, rather than by its actual probability distribution. Thus, people will generally assume that their chances of being involved in an airline disaster are higher if there has recently been a high profile instance of a crash.

The cyclical nature of risk appetite noted above may reflect, in part, the influence of this model of decision-making. The self-reinforcing nature of upswings and downturns, driven to a degree by investors' expectations, could reflect the fact that during an upswing (a period of high and/or rising risk appetite) high levels of return are easily called to mind and the possibility of a crisis is more distant in the memory. In short, the probability of continuation of the high yields obtained through investment in risky assets is seen as disproportionately probable since this is what recent experience indicates. Conversely, during a downturn the probability of continued economic woes continuing is accorded a disproportionately high weight in the investors' minds; and so risk appetite falls, safe havens seem all the safer and the downside risk associated with high-yielding assets looms large in the minds of investors.

This process continues until extremes appear to be reached over the risk-appetite "cycle". The extremes are invariably followed by events that call these beliefs into question, and engender uncertainty. This period was described by Kindleberger (1978) as one of "distress" and represents, for him, the uneasy period between "mania" and "panic". That is, there appears to be a sharp turning point triggered by events which in a more neutral environment would not warrant a large response. An abrupt and sharp reappraisal set in train by this "trigger" then reverses the cycle.

Two examples: consider first the sharp compression in emerging market spreads that occurred in 1996. Investor flows into emerging market debt were buoyed by a general belief that the fundamentals for these economies were significantly better and improving. In the event, most economies, regardless of the fundamentals and policies, benefited. The spreads were driven down to levels which were inadequate for the risks in many of these markets, underlining the increase in investors' appetite for risk. This increased the probability that there could be a sharp reappraisal of the risk/return nexus on any disappointment, and as a consequence of the new uncertainty, a general decline in the willingness to take risk. This is what happened following concerns about current accounts and the short-term debt situation of a number of these countries. *A reappraisal of a specific risk led to a general reassessment of the willingness to take risk.*

It is possible that the extent of this impact is not constant in every situation and is likely to reflect the degree to which investors believe that a fundamental change has occurred. Thus, the sharp compression in emerging market spreads in 1996 could be connected to the "new paradigm" that was perceived to have occurred. The Tiger economies of the Southeast Asian region had experienced rapid and sustained economic growth over a long period. The East Asian Miracle had been widely hailed as a new paradigm for the developing world, with other less developed countries urged to follow suit. Consequently, and despite the large differences in their individual economic and political structures, the countries of Southeast Asia benefited, as a perceived homogeneous group, from rising investors' risk appetite in the region. This phenomenon may be related to the 'Representative Heuristic' (Tversky and Kahneman, 1974). Under this heuristic, probabilities are evaluated by the degree to which an event is representative of (or similar to) a class of events or objects, rather than by its actual probability distribution. If probabilities are evaluated, at least to some extent, by the degree to which an asset is perceived as being similar to another—or representative of a particular class - then we would expect assets viewed as similar to move together. Thus, for example, currencies viewed as similarly risky (perhaps due to similarities in political, cultural or geographical factors) would show high degrees of correlation independently of differences in economic fundamentals.

However, it is also possible that the favorable shift in investor sentiment *vis-à-vis* Southeast Asia had a more general impact, in that the prospects for *all emerging markets and developing countries* seemed to be enhanced. If very high levels of productivity growth over many years were possible in Southeast Asia, then perhaps the same was also possible elsewhere. Consequently, high levels of risk appetite for the Southeast Asian region resulted in "positive contagion" as levels of risk appetite for all emerging markets rose.

The flip-side of this coin is that when the Asian crisis hit, not only was the level of risk appetite for that region affected, as investors realized that the "new paradigm" was flawed after all, but appetite for risk in all emerging markets was sharply reduced. If as has been argued, the success of Southeast Asia offered the chance, in the minds of investors, for other emerging markets and developing countries to follow suit, the realization that this was not the case dealt a blow to their prospects and hence the level of risk appetite *vis-à-vis* all emerging markets declined. This may, in part, explain the relatively higher level of contagion in the Asian crisis than in the Mexican crisis. Prior to the onset of the latter there was no talk of a new paradigm and, it may be that investors were not shocked by another crisis in that region and therefore did not alter their appetite for risk with regard to other developing countries.

A second example relates to the sharp deterioration in market conditions following the collapse of LTCM in September 1998. Market sentiment was already adversely affected following the Russian debt default and devaluation in August. It led to a substantial reappraisal of not only emerging market prospects, but also of risks more generally, with investors' appetite for risk appetite being adversely affected. This led to, but was magnified significantly by the LTCM collapse. However, in that extreme event, prompt and aggressive response by the US

Federal Reserve to provide unlimited liquidity, and lower the Fed funds rate, had a salutary positive impact on investors' appraisal of risks. Risk appetite appears to have rebounded sharply, and continued to increase subsequently in the run up to the millennium

The sharp decline in risk appetite following the collapse of LTCM may represent another example of a "new paradigm" proving to be illusory. The sophisticated quantitative models used by LTCM, and designed by Nobel-prize-winning economists, offered the prospect of guaranteed high returns with minimum risk. Thus it can be assumed that their success offered the industry the prospect of enjoying similar rewards through the employment of similar methods. Consequently, with the collapse came the question: if LTCM with all their skill and high-technology techniques are not safe, what chance do the rest of us have? Thus general levels of risk appetite fell precipitously. However, the fact the Fed's intervention was able to rescue this situation perhaps reflects the fact that another paradigm was seen to be more powerful: that paradigm can be summarized as 'don't fight the Fed', a reflection of the perceived omniscience, not to say omnipotence, of Federal Reserve Chairman, Alan Greenspan. So, if we assume that investors' appetite for risk is ultimately supported, at least to some extent, by faith in the ability of Greenspan *et al* to rescue any situation, then the consequences on levels of risk appetite, were this paradigm to prove illusory as well could be profound.

If hedge funds have a markedly higher appetite for risk than, say, institutional investors, then a decline in the proportion of market positions being held by hedge funds could reduce the market's overall appetite for risk. In the wake of the LTCM crisis, the underperformance of "value investing" and new disclosure requirements from their creditors, a number of the large macro-bet hedge funds (including the Tiger and Quantum funds) decided to downsize or even shut up shop completely during 2000 when investors' appetite for risk also began to fall. As risk appetite recovered in late 2000 and early 2001, there was evidence of a renaissance of hedge funds. An increased role of hedge funds can in turn amplify general increase in risk appetite.

An example from the literature of this process is Kindleberger's (1978) distinction between "insiders" and "outsiders". Kindleberger argued that, at some point in the generation of a bubble, "insiders", who are aware of the situation, sell out at the top of the market to "outsiders" eager to get on the bandwagon. It would seem probable that the risk appetite of such gambling-inclined "outsiders" will be higher than the insiders they replace; thus the overall level of risk appetite is increased and the bubble continues to grow. A possible recent example of this phenomenon is the internet bubble, during the later stages of which many small private investors, seeing the gains to be made, entered the market, replacing professional insiders who were able to take their gains before the bubble burst. Also, the insider/outsider distinction may be applicable to the domestic/foreign investor divide. Thus insiders (domestic investors) may have greater knowledge of their own economy and, seeing a crisis looming before the outsiders (foreign investors), sell their positions at the top of the market.

Testing the Risk Appetite Index Distribution

The following table provides the results of statistical analysis which test whether currency returns in a risk averse environment are from a different distribution to the returns of a risk loving period. The skewness provides a measure of the distributions asymmetry. Kurtosis indicates how peaked or flat the distribution is. A normal distribution has a skew of 3, values greater than three reveal a relatively peaked (leptokurtic) distribution, while values below 3 are platykurtic or flatter than a normal distribution. The Jarque-Bera tests whether each distribution is normal. It is distributed as χ^2 with 2 degrees of freedom. A low Jarque-Bera probability indicates a rejection of the null hypothesis of normality.

The lower panel of the table tests whether the two distributions are equal, for each statistic a probability value is provided to show whether the null hypothesis of equality is rejected. The first row is a mean equality test which is t-test statistic, which rejects equality. In the second row the equality of the medians is rejected by the Mann-Whitney U test statistic. In the final row the Brown-Forsythe test statistic indicates that the variances of the two distributions are significantly different.

Table 7. Low and High Risk Appetite States

	Low Risk Appetite	High Risk Appetite
Mean	0.005	0.009
Median	0.003	0.008
Std. Deviation	0.001	0.007
Skewness	1.967	0.255
Kurtosis	7.706	3.212
Jarque-Bera	846.560	11.612
Probability of Jarque-Bera	0.000	0.003

	Tests for Equality	Probability
t-test (Mean)	8.13	0.00
Mann-Whitney U test (Median)	13.01	0.00
Brown-Forsythe test (Variance)	7.97	0.00

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