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Kuo Chuen David LEE

Singapore Management University, davidlee@smu.edu.sg

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Long Memory and Asian Crisis: Implications for Capital Controls and Management

David K.C. Lee¹

Ferrell Asset Management Pte Ltd

20 Cecil Street

#25-05 The Exchange

Singapore 049705

and

Department of Finance and Accounting

National University of Singapore

Email: Dlee@Ferrell.com.sg

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Abstract: “Financial markets are given to excesses and if a boom/bust sequence progresses beyond a certain point, it will never revert to where it came from. Instead of acting like a pendulum, financial markets have recently acted more like a wrecking ball, knocking over one economy after another.”

- A testimony before the US House Banking Committee, Sep, 1998.

There are three parts to this paper. The first part examines the time series behaviour of the equity indices of ten countries. Using Robinson (1995a)'s modified GPH estimator and Robinson (1994a)'s average periodogram estimator for the differencing parameter, we have detected that not all the financial series exhibit long range dependence. Non-detection of long memory lends support to imposition of policies to block free capital flows. The results suggest that Indonesia has a stronger case to restrict capital flows than Malaysia.

In the second part, we attempt to determine the degree of the contagion effects. This has important implications for diversification of portfolio risks as the increased co-dependence of asset prices increases risk in the short-term. Using correlations of equity indices across markets, we can get an indication of the severity of the contagion. The evidence suggests that these effects increased significantly and systematically as the Asian crisis worsen shortly after it started on 2 July 1997.

The third part discusses the implications of the results for fund management. We argue that new regulations and hedge fund techniques have contributed to large capital flows that cause severe damage to economies. In the interim period of under-regulation of “leverage” and before the establishment of a new international financial architecture, adopting hedge fund's market neutral or zero investment techniques may be a way to preserve Asian capital.

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1. Introduction

“In the normal course of events, a speculative price rise provokes countervailing forces: supply is increased and demand reduced, and the temporary excess is corrected with the passage of time. But there are exceptions. In foreign exchange, for example, a sustained price movement can be self-validating, because of its impact on domestic price levels. The same is true in the stock market where the performance of a stock may affect the performance of the company in question in a number of ways. And in examining the recent history of international lending we shall find that the excessive lending first increased the borrowing capacity of debtor countries, as measured by their debt ratios, and then, when the banks wanted to be repaid, the debtor countries’ ability to do so evaporated. Generally speaking, we shall find that the expansion and contraction of credit can affect the debtors’ ability and willingness to pay.

Are these exceptions that confirm the rule, or do they necessitate a revision of accepted theory? The answer depends on the frequency and severity of their occurrence. If we are dealing with an isolated instance, we can treat it as a paradox; but if one incident follows another, we must question the theory.”

■ George Soros (1998)

The Asian currency crisis started when Thailand was no longer able to maintain, and decided to abandon its fixed exchange rate regime on 2 July 1997. The effect caused by the massive capital flight and the duration and magnitude of the decline in asset prices have surprised most economists and practitioners. With stock prices decreased to the level of 15 years ago and exchange rates depreciated as much as 60% in some Asian economies, few prescriptions of economic policies, including IMF and World Bank’s, have helped to restore confidence in Asia.

A few recent publications and speeches have mooted the idea of a new financial architecture because of the failure of countries to control large short-term capital flows. Policy makers (Mahathir (1998)), academics and advisors (Krugman (1998)), financiers and practitioners (Soros (1998)) have all contributed to the debate in this area.

Soros’s view about the international financial system has not been well received initially but the hedge funds’ view cannot be ignored. The macro hedge funds

community believes there is a global capital system with a centre and periphery (Soros (1998)), and that the system is inherently unstable and the effect of capital flow is asymmetric. With the centre as the provider of capital and the periphery as the user of capital, the rules of the game are skewed in favour of the centre, both in terms of information flow and the attraction of capital. This “centre” is where the most active and mobile part of the world’s financial capital is domiciled. It includes not only the international financial markets like New York, London, Frankfurt or Tokyo, but more important, the offshore tax havens which are not adequately regulated.

This capitalist system, as they believed, is inherently flawed and excesses may be self-correcting at huge economic and political cost to the periphery. Using their belief in disequilibrium and their expertise in influencing the fundamental factors of investment, they have been highly successful in their transfer of wealth from the periphery to the centre. The inadequacy of international regulations is not purely attributed to the failure to understand the so-called “reflexive” (a concept introduced by Soros) nature of credit and anti-regulatory mood, but mainly to the lack of appropriate international institutions.

During the boom time, the centre provides the capital for economic expansion in the form of credit. An abrupt change in the willingness of the centre to provide capital in the form of debt instruments, bank loans, stock investment or direct investment, to the periphery can cause great disruption in the recipient countries. In times of uncertainty, capital tends to return to its base, which is the centre. This causes disproportionate disturbances to the periphery and the bust follows. Therefore, not only the global system is unstable; its effect on the centre and the periphery is asymmetric.

The paper is organised in the following way. In Section 2, we provide an account of the Asian crisis and the motivation for the empirical work. In Section 3, we outline some basics about long memory or long range dependence. In Section 4, we describe the models and introduce two methods of estimation of the differencing parameter. In Section 5, we discuss the choice of bandwidth and other smoothing numbers for practical implementation. Readers not interested in the technical details can skip Sections 3-5. In Sections 6 and 7, we provide information on the sources of data and discuss the results. In Section 8, we examine the links between capital controls and long memory. In Section 9, we look at the issue of hedge funds and leverage. In Section 10, we examine the correlation coefficients over a period of two years as indications of the degree of contagion. In Section 11, we further discuss the implications for Asia fund management. Finally, in Section 12, we conclude.

2. The Asian Crisis

The scope and severity of the Asian crisis that originated in Thailand in July 1997 surprised the most pessimistic. The Pacific Century, has suddenly ended before the end of the century. The Asia Miracle has given way to the Asian crisis. The currency crisis escalated into a financial crisis, and later economic crisis. Kwok (1999) has mentioned that as the months went by, the crisis is also, at bottom, a political and social crisis. He has suggested that it is also a moral crisis, with the suggestion rooted in the workings of global capitalism. Both Malaysian Prime Minister Dato Seri Dr. Mahathir Bin Mohamad and American financier George Soros have seen the need for some kind of international regulation. Capitalism is amoral, and not necessarily always rational, as the workings of the

market lead to morally questionable effects, which the periphery will be more vulnerable to.

Soros (1998) in his book noted the followings. The Association of Southeast Asian Nations (ASEAN) admitted Myanmar, a regime politically and humanely unacceptable to Western democracies, as a member in June 1997. Not long after, a number of seemingly unrelated inefficiencies and latent imbalances and their interaction sparked off a series of shocks, whose results were entirely out of proportion with the ingredients that contributed to the crisis.

Some have argued that the deficiencies in the Asian development model were the culprits. “Asian values” were precisely the values that legitimised the “corruption, cronyism, and nepotism” now identified as the scourge of Asian capitalism. These include the structural weakness of the banking system, which led to over-lending; the lack of transparency in ownership of business and politics, which led to crony capitalism; and the challenge of the UN Universal Declaration of Human Rights and the proclaimed superiority of Confucian capitalism, which led to less liberal economic model. However, countries in Asia that do not have the obvious characteristics described above also suffered along with their neighbours on a scale far beyond what anyone has predicted.

The fact remains that the Asian crisis was not confined to Asia alone and it soon engulfed Russia, South Africa, Brazil and then Latin America. It has become clear that the Asian crisis cannot be explained by the reasons given above, as they have always been in existence. The main source of instability and the asymmetry can possibly be found in the inherent deficiencies in the international financial system itself.

This led to the search for a new global financial architecture. The real problem lies in the excessive leverage of hedge funds and proprietary traders of large financial institutions. The best and now well known, Long Term Capital Management, was known to have leveraged 40-50 times. Proponents for the regulation and supervision of hedge funds and improved bankers' codes believe that some of the damage to Asian economies had been caused by disruption from large and sudden capital flows. As Hong Kong Financial Secretary Donald Tsang noted, "To the extent that hedge funds had been the main players directing such private-sector fund flows, effected through their financial size and leverage, they were able to lead markets." He added, "The priority now is to increase the transparency and disclosure of the exposure of hedge funds, information sharing... and international cooperation on monitoring hedge-fund activities are essential." He has been pushing the international community to take a serious look at their activities and evolve mechanisms to check their excesses, without resorting to controls.

When the Thai peg broke, borrowers who had assumed that the peg would hold, scrambled to cover their currency exposures, which was deemed too expensive to hedge (much higher than 20% premium) previously. As Soros (1988) had predicted, the hedge funds, financial institution's proprietary traders, mutual funds, long-term pension funds, and sophisticated high net worth investors, realised that there were profits to be made, further aggravated the situation by withdrawing the capital from all the asset markets. Suddenly, there was a credit risk as well as currency risk, as asset values depreciated and margin calls and redemption set in. The credit rating agencies, bank risk management and credit committees, took actions that reduced the willingness of the lenders to extend

existing credit. As interest rates increase and as asset prices depreciated, the fundamentals of companies as measured by price earnings to growth ratio and net asset values deteriorated sparking further sell-off of equities. As the market capitalisation of each country shrank, further withdrawals of funds from the region were seen from asset re-allocation and this self-reinforcing process resulted in a 53% decline in the Thai stock market, expressed in local currency, between June 1997 and the end of Jun 1998. In USD terms, this is -70%, which compares with an 86% loss in Wall Street between 1929 and 1933.

The panic spread across Asia. It started as an attack on the peso, then the rupiah and the ringgit. As the individual governments of these countries managed to a certain extent to limit the damage done to the currency, the other North Asia currencies came under siege. Any speeches by policy makers that were viewed as being in denial were perceived as signals to the traders to short sell the country's currencies associated with the particular policy maker and the flows were intense and concentrated. No government, including Hong Kong and Singapore, whose currencies were previously seen to be safe havens, could withstand the intensity of the attacks. In particular, the Singapore currency depreciated together with the rest of the regional currencies against USD, rather than appreciated as in previous crises. This immediately aggravated the situation, as it was then obvious that no country can withstand the panic as competitive devaluations were seen to be in process. Rotational plays in the region were then taking place and attacks in financial markets were seen going to Northeast Asia, then south and back round again. Japan's effort in starting an Asian Fund was not widely supported outside Asia and that was another clear signal that Asian currencies would continue to depreciate without coordinated

and concerted efforts to support. An uncomfortable market movement offering one-way bet in the form of indefensible currencies had occurred.

Soros used the wrecking ball example to describe the panic and competing depreciation, while others have referred this modern version of bubonic plague as the Asian Financial Contagion. The crisis was complex as it involved both currencies and credits. The credit component was further complicated with local and foreign debts. The debts are complicated as they involved many private companies, some of which are politically linked. IMF was ill equipped to deal with the Asian crisis, as its methodology was more geared towards a contained currency component and public sector debts. IMF was simply not ready to deal with rapid flow of information through wired information agencies such as Bloomberg and Reuters, and swift flow of capital.

IMF's job was to prevent a liquidity crisis and the "structural reform" was supposedly designed to address the underlying fragilities, along with the macroeconomic policies to help stabilise the immediate crisis. Besides limited attempts to rehabilitate weak banking and corporate sectors, most structural problems were left to the country concerned. The hedge funds, which held the opposite view, believed that the only solution was to convert debt into equity. Without foreign direct investment, relying just on lending from IMF, the structural imbalances would lead to further deterioration of confidence, competitive currency devaluation, higher interest rates, and asset deflation. This belief has its merits as indeed, the initial collapse in demand led to a steep drop in domestic investment, which plummeted by more than 25% in South Korea and Thailand, and more than 50% in Indonesia in a matter of few months. The sharp depreciation of currencies devastated the balance sheets of companies,

many of which had high-unhedged foreign exchange exposures. The big drop in investment was followed by huge withdrawal of foreign capital, rising country risk premiums and region-wide collapse of asset prices. The slump was worsened by increased precautionary savings that led private consumption to fall by more than income, as consumers were anticipating a prolonged recession.

While export volume went up, export values declined as USD strengthened. Major markets for Asian exports were depressed as regional trade collapsed. Following civil unrest and collapse in the banking system, production was disrupted and bankruptcies set in. There was no stopping the speculators and traders as their confidence grew with the size of their winnings.

China, unlike its neighbours, was not affected as much by the crisis. Similar problems existed in the Chinese economy, evidenced in the collapse of the International Trust and Investment Corporations (ITICs). There had been tremendous boom in asset prices, highly leveraged financial institutions with foreign currency loans, and deteriorating balance sheets of state-owned enterprises. The main difference between China and the rest of its neighbours was that its currency was not convertible. The saving grace for China was that the capital control had bought some time for the Government to act.

This has very interesting implications, as Soros believes that the main task for policy makers in times like this is to slow capital flows back from the periphery to the centre. The most timely, direct and effective way to stop the flow in the short-term was to impose capital controls, thus slowing down capital flight.

In this respect, Malaysia has imposed capital controls to prevent flow from the periphery to the centre. Malaysia Prime Minister Dato Seri Dr Mahathir Bin Mohamad shares the same view in that free market is not working and

intervention is needed to restore some stability. There are different ways of imposing a financial architecture incorporating the valves, which control the speed and volume of the capital flow to and from the periphery to the centre. Malaysia has adopted one of the most direct methods: capital controls. Contrary to expectations of analysts, the controls have not sent the Malaysia economy into a tailspin. Instead, there were numerous improvements since the imposition of capital control on 1 Oct 1998. With the local currency pegged at RM3.80 to USD1.00, interest rates have plunged, exports in USD terms have improved boosting foreign reserves, ailing banks are being re-capitalised, debts are being restructured, stockmarket has surged, car and home sales have stopped falling. There has not been a development of a large black market for the currency as predicted. In fact, with the regional currencies strengthening, some believe that the ringgit is under-valued vis-à-vis the regional currencies. There are expectations that the ringgit may strengthen, because Malaysia needs more foreign investment goods to replace depleted goods.

The controls have worked relatively well in the short-term but the longer-term cost of instituting draconian measures will likely be paid in the form of slower foreign investment and capital injection. The verdict is not out yet as a change in investment rules could be enough to attract a critical mass of the typically fickle investment community. The fact is, financial variables have stabilised and are beginning to improve. We believe financial markets can be classified into two groups: the first group behaves like a pendulum, where the market can swing from one end to the other, but eventually it will return to its long-term trend; the second group, once disturbed, would not return to its long-term growth trend.

Currency and stock markets in the first group requires no intervention from the relevant authority as markets have a tendency to return to its long-term growth trend. In the second group, intervention is required to bring the markets back to the long-term growth trend as there is no tendency to return to its trend.

In the first case of series with long memory, the shocks have not altered the statistical process, and the market will likely return to its original growth trend.

In the second case, shocks may have altered the underlying statistical process of the financial series, and the damage may not be contained. An intervention in the market to prevent the capital flows to the centre from the periphery is justified, as damage is limited by such actions. In the first case, intervention in a market that will eventually return to its original growth path is undesirable as the short-term benefits would not compensate for the long-term costs of possible reduced investments.

Two issues need to be researched. The first relates to whether a block is required to stop the flows from the periphery back to the centre and whether such a block is required for all countries or for some. This paper will likely raise more questions than answers but it is an attempt to show the weakness of some markets in terms of their defence against short-term large capital flows. Having established that a valve is required to block the flow of capital back to the centre and a new financial architecture needs to be in place, what are the implications for investing in Asia? The new financial architecture may still be in its infancy, but for fund managers and policy makers alike, capital preservation is the most crucial in the next few years until the structure is finally in place. As far as the countries in question, one solution is to impose some form of a block in the interim period. Obviously, capital controls is one form. For fund managers

having substantial portion of their portfolios in Asia, some form of capital preservation strategy has to be pursued. This brings us to the second issue.

The second relates to implications for Asia portfolio management. While diversification is the key word to portfolio management, one has to be concerned about the increase in the correlation of all markets, especially Asian markets. Indeed, it may be unwise to hold on to the belief that diversification is always good, especially if it leads to “di-worsification” as a result of the contagion effect. We investigate the seriousness of the contagion effect and whether it makes sense to invest in different countries in Asia for diversification. We suggest using the single period linear correlation coefficients as a form of measure of the intensity of the contagion effect.

The series may possess long memory and the shock may not persist indefinitely, but in the short-term, having high correlations for all Asian markets is no comfort to a fund manager seeking to diversify his portfolio. Using and monitoring this measure of the intensity of the contagion effect may help to alleviate the problems of overexposure to systematic risks. The implications of contagion effect for portfolio management are discussed. Readers not interested in the technical details may skip the next three sections and go directly to Section 6.

3. The Basics

Let X_t , $t = 1, 2, \dots$ be a covariance stationary time series having a spectral density

$$f_x(\lambda) = \frac{1}{2\pi} \sum_{j=-\infty}^{\infty} \gamma_x(j) \cos j\lambda, \quad -\pi < \lambda \leq \pi \quad (1)$$

where

$$\gamma_x(j) = E[(X_1 - E(X_1))(X_{1+j} - E(X_1))] = \int_{-\pi}^{\pi} \cos(j\lambda) f(\lambda) d\lambda. \quad (2)$$

X_t is therefore covariance stationary so that the mean and the autocovariances do not depend on t . While $f(\lambda)$ is non-negative real valued for all $\lambda \in (\pi, -\pi]$, we restrict our attention to the value of f at the neighbourhood of $\lambda = 0$ without worrying about f elsewhere. Consider two cases:

$$(i) \ 0 < f_x(0) < \infty, \quad (3)$$

$$(ii) \ f(0) = \infty \text{ or } f(0) = 0 \quad (4)$$

A series having the property (i) is an I(0) series. The simplest example of an I(0) series is a series of uncorrelated, homoscedastic, random variables. But empirical observation is sometimes consistent with models satisfying (ii), rather than (i).

Now consider a series $y_t, t = 1, 2, \dots$ such that

$$(1-L)^d y_t = X_t, \quad t = 1, 2, \dots \quad (5)$$

where L is the lag operator, so $Ly_t = y_{t-1}$, and d is a real number. The fractional differencing operator d is defined by

$$(1-L)^d = \sum_{k=0}^{\infty} \frac{\Gamma(k-d)L^k}{\Gamma(-d)\Gamma(k+1)}$$

with $\Gamma(\cdot)$ denoting the gamma function. We require $f_y(\lambda)$ to satisfy the well known basic long range dependence semiparametric specification

$$f_y(\lambda) \sim C\lambda^{-2d}, \text{ as } \lambda \rightarrow 0+, \quad (6)$$

where C is a finite positive constant and d is the differencing parameter. The unknown parameter d is related to the self-similarity parameter H such that $H = d + 1/2$. We have the following observations:

Characteristics)	Difference Parameter	Self-Similarity Parameter	$f_y(\lambda)$ as $\lambda \rightarrow 0+$
Antipersistent: undefined Pink Noise	$-1/2 < d < 0$	or $0 < H < 1/2;$	

Short Range Dependence: $d = 0$ or $H = 1/2$; equal to C
White Noise

Long Range Dependence: $0 < d < 1/2$ or $1/2 < H < 1$; $\rightarrow \infty$
Black Noise

Nonstationary: $1/2 \leq d < 1$ or $1 \leq H < 1 1/2$;
undefined

Unit Root: $d = 1$ or $H = 1 1/2$; **undefined**

H is usually required to lie within the interval (0,1), bounded away from its limit values for meaningful inferences. This is equivalent to $d \in (-1/2, 1/2)$. For $d \geq 1/2$, $f_y(\lambda)$ is not well-defined, but a suitable amount of integer differencing produces a covariance stationary time series in $I(d)$ for $d < 1/2$. It is simple to induce stationarity for a series y_t that is $I(d)$ for $1/2 \leq d < 1$ by taking the first difference $(1-L)y_t = z_t$. The resulting series z_t is $I(d)$ satisfying

$$f_z(\lambda) \sim C\lambda^{-2d}, \text{ as } \lambda \rightarrow 0+, \quad -1/2 \leq d < 0, \quad (7)$$

and so $f_z(0) = 0$. Two semiparametric estimators, outlined in the next section, are used for our empirical application. By semiparametric, we mean using the parametric relation (5), involving unknown parameter d and known functional form $(1-L)^d$, and then combining with the nonparametric component $f_y(\lambda)$. In terms of statistical assumptions, we need only to impose some mild regularity assumptions in a neighbourhood of zero frequency and condition (3).

Delgado and Robinson (1994) have discussed various methods of estimating the differencing parameter d . They consider models for long memory time series in which the autocovariance sequence is parameterised at very long lags or the spectral density is parameterised at only very low frequencies. In particular, instead of looking at time series as either purely stationary or non-stationary, one may view the series consisting of two memory components. Indeed, a series may

be decomposed into a long and a short/medium memory component. For a more formal discussion on long and short memory processes, consider the followings conditions and restrictions:

$$\text{Summability:} \quad \sum_{j=-\infty}^{\infty} |\gamma_j| < \infty \quad (8)$$

$$\text{Boundedness:} \quad f(0) < \infty \quad (9)$$

$$\text{Covariance:} \quad \gamma_j \approx c j^{2d-1}, \text{ as } j \rightarrow \infty \quad (10)$$

$$\text{Spectral Density:} \quad f_z(\lambda) \sim C\lambda^{-2d}, \text{ as } \lambda \rightarrow 0+. \quad (11)$$

Most Gaussian models used in empirical studies imposed stronger conditions than (8) and (9). In particular, ARMA(p,q) models requires autocovariances to decay exponentially as j approaches infinity and spectral density that is analytic at all frequencies. An ARMA specification can be used to model short/medium memory processes.

Mathematically, series that violate the (8) and (9) are termed long memory. The ARFIMA(p,d,q) models, is a weaker class of models that violates (8) and (9), and yet can be shown to satisfy (10) and (11). Typically, long memory implies that autocorrelations decay hyperbolically with exponent exceeding -1 , or that the spectral density increases as a power law in the neighbourhood of a singularity, usually at zero frequency. Strictly speaking, most financial time series exhibits characteristics of nonlinear models and non-Gaussianity. Unfortunately, for non-Gaussian processes there are no such “global” concepts of short and long memory.

In any case, if Gaussianity is forcefully imposed and assumed correct, incorrect specification of the autoregressive order p and moving average order q may affect the consistency of d estimates. If p or q is misspecified, d may not be

consistent. If we are interested in the long memory estimates d , and not the short or medium range estimates p and q , it makes sense to estimate d semiparametrically. In some models, the Gaussian assumption is not necessary for consistency but is usually required in establishing the limiting distribution.

While there are several models proposed in the literature, we select the methods used based on robustness, computational advantages and ease of use. Given a correct, fully parametric model for $f_y(\lambda)$ at all frequencies, root- N -consistent estimates of d and other parameters are available. In particular, Gaussian maximum likelihood estimates are not only root- N -consistent but also asymptotically efficient in case y_t is Gaussian.

We are aware that there are many asymptotically more efficient techniques such as Fox and Taqqu (1986), Dalhaus (1989), Giraitis and Surgailis (1990), Sowell (1992) and Robinson (1995b). Indeed, in the case of Robinson (1995b), much weaker assumptions than Gaussianity are imposed and it is semiparametric in the sense (6) is used with an approximate form of frequency domain Gaussian likelihood. The estimator is theoretically appealing but the main disadvantage is that, unlike the estimates of Geweke and Porter-Hudak (1983) and Robinson (1995a), the semiparametric “Gaussian” estimate of d is not defined in closed form. Though one Newton-type step (based on the ‘Gaussian’ objective function) from a log periodogram type estimate gives the same asymptotic efficiency as the ‘Gaussian’ estimate. However, our proposed pooled log periodogram estimate probably would not improve efficiency much. Empirical applications of the techniques on Singapore indices and Spanish inflation can be found in Lee and Robinson (1996), and Delgado and Robinson (1994) with discussions of estimator in Robinson (1993).

The results from a paper by US Deputy Treasurer Lawrence Summers while he was at Harvard University more than a decade ago were interesting. Porteba and Summers (1988) have found that U.S. stock returns exhibit mean reversion behaviour, that is the tendency for the returns to move away from the trend, then reverse direction, overshooting the trend before returning to it again. Lo (1991), however, has found no evidence against random walk hypothesis for the US stock indices. We are not aware of any work done for Asian markets.

4. The Estimators

We exploit the large number of observations available to employ semiparametric procedures which are not necessary root-N-consistent, but can be justified as consistent in the absence of parametric model assumptions. More importantly, it has practical computational advantage over other estimators that require optimisation with the estimators not given in closed form.

Our estimates are functions of the periodogram

$$I(\lambda) = (2\pi n)^{-1} \left| \sum y_t e^{it\lambda} \right|^2 \quad (12)$$

We estimate $I(\lambda)$ only at frequencies for $\lambda = \lambda_k = 2\pi k/n$, for $k = 1, \dots, m$, where $m < n$. There are three numbers that need to be chosen by the practitioners, m , τ and J . The integer m is a user-chosen bandwidth number and in asymptotic theory, m is regarded as increasing as n tends to infinity, but at a slower rate. A “trimming number” $\tau \geq 0$ in asymptotic theory, is regarded as tending to infinity slower than m . The “pooling number” J , is a small integer that stays fixed in asymptotic theory.

4.1 Log-Periodogram Least Squares Estimate

Now introduce

$$W_k^{(J)} = \log \left\{ \sum_{j=0}^{J-1} I(\lambda_{k+j}) \right\}, \quad k = \tau+J, \tau+2J, \dots, m, \quad (13)$$

$j=1$

Where we have implicitly assumed that $(m-\tau)/J$ is an integer. Now write

$$W = c^{(j)} - d (2\log\lambda_k) + U_k^{(j)}, \quad k = \tau+J, \tau+2J, \dots, m, \quad (14)$$

Where $c^{(j)} = \log C + \psi(J)$ and ψ is a digamma function, $\psi(z) = (d/dz)\log\Gamma(z)$, where Γ is the gamma function and C being the scalar in (7).

Define \hat{d}_1 to be the least squares estimate of d based on the semiparametric regression model (14), where the U_k are the unobserved error term.

If $\tau = 0, J = 1$, and we replace $2\log\lambda_k$ by $4\sin^2\lambda_k/2$

$$W = c^{(1)} - d (\log(4\sin^2\lambda_k/2)) + U_k^{(1)}, \quad k = \tau+1, \tau+2, \dots, m, \quad (15)$$

We define the least square estimate of d as \hat{d}_0 . Then, the \hat{d}_0 becomes the estimate of Geweke and Porter-Hudak (1983). Using the trimming to omit low frequencies from the regression, Robinson (1995a) showed that

$$2m^{1/2} (\hat{d}_i - d) \rightarrow N(0, J\psi'(J)) \quad i = 0, 1. \quad (16)$$

In the case $J = 1, J\psi'(J) = \pi^2/6 = 1.645$. The recurrence relation $\psi'(J+1) = \psi'(J) - J^{-2}$, indicates that the function $J\psi'(J)$ decreases in J , taking values 1.289 at $J = 2$ and 1.185 at $J = 3$ and tending to 1 as $J \rightarrow \infty$. Furthermore, it can be deduced that the usual large-sample interpretation of regression t-ratios applies in this case, which means that one can use the standard regression t-test for d .

The major drawback of \hat{d} is that y_t has to be Gaussian. Thus, in the event that y_t is not Gaussian, statistical inferences based on (16) may well be invalid. The following estimate, proposed separately by Robinson (1994a), is consistent even

in the absence of Gaussianity. While it may be more robust, the limiting distribution is nonstandard for $d > 1/4$ and normal with a complicated variance for $d < 1/4$.

4.2 Averaged Periodogram Estimate

The averaged periodogram estimate has been shown to be consistent for d under mild conditions in Robinson (1994a). This estimate is based on the limiting relationship in (11) for $f(\lambda)$. The advantage of using (11) instead of (10) is that not all autocovariances are eventually positive. Consider an average of the periodogram near zero frequency

$$\hat{F}(\lambda_m) = 2\pi n^{-1} \sum_{j=1}^m I(\lambda_j) \quad (17)$$

Where m is a positive integer less than n . Under some regularity conditions (Robinson (1994a)) and as $m \rightarrow \infty$ and $m/n \rightarrow 0$ as $n \rightarrow \infty$, that

$$(1-2d) \hat{F}(\lambda_m) / C \lambda_m^{1-2d} \rightarrow 1, \text{ as } \lambda \rightarrow 0+ \quad (18)$$

indicating convergence in probability to the right hand side. For a q (0,1) chosen by the practitioner, we have

$$(1-2d) \hat{F}(q\lambda_m) / C (q\lambda_m)^{1-2d} \rightarrow 1, \text{ as } \lambda \rightarrow 0+ \quad (19)$$

Differencing the logs of the left hand sides of (18) and (19) eliminates the scale factor C . Robinson (1994a) suggests the estimate

$$\hat{d}_2 = 1/2 - \log(\hat{F}(q\lambda_m)/\hat{F}(\lambda_m))/(2\log q) \quad (20)$$

Robinson (1994a) showed that d_2 is consistent for d under the same conditions as those underlying equation (18) and including only a second moment condition on y .

5. The Choice of Bandwidth

In choosing m , we adopt simple methods although we are aware of the results of Delgado and Robinson (1994) and Robinson (1994b). Robinson (1994b) has shown that for $0 < d < 1/4$, a bandwidth that asymptotically minimizes a mean squared error criterion is

$$m = \left[\frac{A_0}{A_1} \right]^{1/(2\alpha + 1)} n^{2\alpha/(2\alpha + 1)} \quad (21)$$

where

$$A_0 = (1 - 2d + \alpha)^2$$

$$A_1 = E_{\alpha} (2\pi)^{-2\alpha} (1 - 4d)$$

With

$$f(\lambda) / C\lambda^{-2d} = 1 + E_{\alpha}\lambda^{\alpha} + o(\lambda^{\alpha}), \quad \text{as } \lambda \rightarrow 0^+,$$

for the largest possible α in $(0, 2]$. We have chosen the smoothing parameter $\alpha = 2$, and $E_{\alpha} = 2$. We also employ the “rule-of-thumb” bandwidth $m = n^{1/2}$, usually about three or four times smaller than (21). We also report the t test statistics for $d = 0$, which corresponds to the null that there is no long memory in the first difference of the logged stocks. The null is rejected when absolute value of t is significantly larger relative to the normal distribution.

For d , estimate, we reported results for $J = 1, 2, \dots, 10$, and $\tau = 1, 2, \dots, 10$ with the optimal bandwidth and the rule-of-thumb bandwidth. However, rather than focussing confining our discussions to results using these “optimal” bandwidths

and selected J 's and τ 's only, we decided to be broader and cover the results using a range of bandwidth for d_2 estimate.

6. Data

All the daily data are obtained from the Bloomberg unadjusted. These are the data watched by investors of large institutions on a real time basis and most of the allocation and buy/sell recommendations are based on reports that rely on these data. We collected the data as far back as possible for each series (see Table 1). Define P_t the stock index at time t . We shall apply the methods of previous section to the returns $y_t = \log(P_t/P_{t-1})$. We have stock indices for 10 countries starting from beginning of Jan 75 to June 1998, depending on the availability of the data from source. The number of observations ranges from 2491 for Taiwan to 5962 for US.

We have also split the sample into two sub-periods, with period 1 from 2 Oct 1989 to 2 Jul 1997 and period 2 from 3 Jul 1997 to 30 Jun 1998. The motivation for splitting the sample into Period 1 and Period 2 is to capture the Asia Growth period in the 1990's for Asia and the Asian Contagion period from Jul 1997. The results for the sub-periods are not reported in this paper as the main conclusions are not changed and they add little value in our following discussions. Lo (1991)'s augmented rescaled range test was also applied to the data but the conclusion is not changed and results are not reported here. The markets we covered in the study included Singapore (STI), Hong Kong (HSI), USA (INDU), Indonesia (JCI), Korea (KOSPI), Malaysia (KLCI), Japan (NKY), Philippines (PCOMP), Thailand (SET), and Taiwan (TWSE).

7. Results

We have reported the results for stock market indices for 10 countries covering 25 years from 1975 to 1998 in the first version of the paper. We have results for the d_1 estimates with the corresponding $J = 1, \dots, 10$ and $\tau = 1, \dots, 10$ (a total of a 100 estimates). We also use $m = n^{1/2}$ and the optimum bandwidth of (21). These results are not reported but available from the author. We particularly look at the cases where the $|d_1| > 0.1$ and two-sided test statistics (null hypothesis is no long memory) significant at the 10% level. Non rejection of the null does not imply that the null is true and it simply means that we have not detected any presence of long memory. The proportion of rejections out of the 100 estimates would give us an indication of the likelihood of the presence of long memory. The proportions corresponding to two different bandwidths are reported in Table 2.1.

Having long memory ($d > 0$) in the series implies that the market would return to its long-term trend sometime in the future, but it may not get all the way back there. Having no long memory ($d = 0$) in the series implies that the market would not return to its long-term trend ever and if it did, it is by chance. This would provide some justifications, though not conclusively, for the policy makers to act. Most of the significant estimates are positive indicating that if a one-sided test is conducted and the null is rejected, the series are likely to have long range dependence.

We can also look at how much long memory we have in the series. By looking at the proportion of the coefficients lying outside $[-0.1, 0.1]$ with test statistics greater than the critical value at 10% level of significance, we can have an idea of how “White” the noise is. We can see that for the two developed markets, US and

Japan, the results seem to suggest that these two markets are fairly efficient and the random walk hypothesis may not be rejected. However, not all the Asian markets are efficient and exhibit random walk behaviour. For some Asian markets, namely, Hong Kong, Indonesia, and Malaysia, the null seems generally not rejected most of the time implying market prices (not returns) exhibit random walk behaviour.

Would trading volume make any difference to the results? In terms of trading volume or liquidity of the three markets, Indonesia is the least liquid, followed by Malaysia and Hong Kong. While some have argued that liquidity may be a source that would bias the results for individual stocks, the index itself is not subject to such criticism. There are therefore some justifications for the policy makers in these countries to act against the flow of capital back to the centre.

Rather than reporting the results in a table, we plot the results for d_2 estimate for 500 different bandwidth starting from $m = n^{1/2}$. Here, the summary statistics of the bandwidth are reported below the Figures 1(a) to 1(j) for comparison. In particular, we seek to answer the question of when the long memory effect is the strongest corresponding to m . The summary statistics are reported in Table 2.2.

We concentrate on markets that exhibit long memory behaviour. The maximum estimates for series exhibiting long memory lie in the range [.1525, .1823]. The corresponding m 's lie in the range [15, 287]. Taiwan market has the shortest cycle of "long memory" with $m=15$ and Thailand has the longest cycle of "long memory" with $m = 287$.

8. Capital Controls and Long Memory

It would be difficult to draw firm conclusions from the results. However, it is clear that emerging markets such as Indonesia, Malaysia and Hong Kong do not

have strong trend-reinforcing characteristics as other neighbours. In other words, if there are shocks to the system, it is unlikely that the markets would return to their long-term trend. If the market were any indication of the real economy, then any shock would push the original growth projection away from the potential long-term path, to which it is unlikely to return.

Since the imposition of capital controls in Malaysia in 1998, a number of dissident voices noted the openness of the capital account. But orthodox policy views concerning the openness of the capital account generally prevailed. Since the Asian financial crisis, the consensus in the economics profession regarding the wisdom of controls began to fray. Bhagwati (1998) and Krugman (1998) made the case for capital controls as a way of managing small open developing economies. Shortly after the publication of some of these views, Malaysia reversed its orthodox stabilisation and structural reform policy that was initiated by the former Deputy Prime Minister and Finance Minister Datuk Seri Anwar Ibrahim. Malaysia started deviating from policies thought to be IMF's prescriptions. Clearly, in terms of the practical implementation, political issues and events have taken over economic debates.

A detailed discussion of the political economy of capital controls is beyond the scope of this paper. For the case of Malaysia and its neighbours, Haggard and Low (1999) have covered some of the more important issues. The success and failure of controls in Malaysia will influence the debates on costs and benefits for small economies of the domestic market's close integration with the international financial system.

Mahathir's efforts in severing an informal and extensive financial integration between Singapore and Malaysia has been successful, shutting the Ringgit

offshore market and the CLOB International, a Singapore second board that traded in over 100 Malaysian shares.

We do not attempt to answer the question of whether the Malaysia's capital controls will constitute an interim strategy that other countries should emulate. This will depend on the preliminary evidence Malaysia's controls have produced. But the results so far have been encouraging. The list of supporters has grown over time. Supporters of the impositions have included the United Nations Development Programme, the United Nations Conference on Trade and Development, the Japanese Deputy Vice Minister Eisuke Sakaribara, and Japan's Federation of Economics and Business Association, Keidanren.

On 27 Feb 1999, in a foreign policy speech to three public affairs groups in San Francisco, US President Bill Clinton noted that a solution is needed to facilitate the movement of money that could avoid these dramatic economic cycles of boom and then bust. According to him, the need for change was acute because huge capital flows that surged in and out of emerging economies have bankrupted developing countries. An earlier held view that countries should stick to restructuring first as fundamentals would eventually determine asset prices and currency values, have now taken a backseat and given way to reforming the global financial systems.

While top industrial nations have joined efforts to revamp world financial rules after the global crisis, the Clinton administration have rejected proposals that would place more stringent controls on the movement of investor capital across borders.

Our results suggest that if Malaysia is successful in its effort to revive and restructure its economy, Indonesia should follow the actions of Malaysia.

Indonesian President B.J. Habibie has moved to distinguish himself from the Malaysia Prime Minister since the imposition of the controls. Indonesia's central bank has argued that it will be too complex for Indonesia to implement the same controls as in Malaysia, contending that the floating exchange rate system is more practical and efficient. Clearly, one needs to address the constraints of the IMF programmes, the political muscles and a competent administrative service to carry out similar policy course. Notwithstanding this, our results are biased towards the implementation of a system that blocks or slows large reverse short-term capital flows.

In Aug 1998, US Federal Reserve Chairman Alan Greenspan orchestrated a private bailout of Long Term Capital Management after the crisis in Russia. The main reason cited was the supposedly USD1 trillion market positions that potentially posed severe risks to the global financial system. There were some signs that the centre was also vulnerable to events in the periphery.

9. Hedge Funds and Leverage

LTCM was an absolute anomaly among hedge funds due to the extent of its leverage, which was apparently more representative of some institutional trading desks than of hedge funds. While new regulations governing lending to hedge funds seems likely, it probably will have little impact on the world of hedge funds.

Several testimonies to the House Committee on Banking and Finance recently have perhaps thrown some lights on the hedge funds activities. The announcement of the Hong Kong Government identifying four hedge funds as "speculators" on the Hong Kong exchange and HK dollar in Aug 1998 has also indicated that the larger and highly-leveraged hedge funds, together with the

proprietary desks of major institutions contributed to the volatility of the market.

Towards the end of 1998, redemptions from hedge funds were unusually high at 10%. At the end of Nov 1998, emerging US hedge funds and emerging offshore hedge funds were recording negative returns of -40.7% and -23.6% respectively compared to the overall total return of different hedge fund styles of 7.4% and -3.2% for US and offshore funds. In particular, short selling hedge funds returned a negative 12.4%. However, offshore aggressive growth and market timing returned 20.1% and 16.5% respectively. Macro hedge funds and market neutral – securities hedging returned 6.8% and 7.4% respectively. This is contrary to what most believe that hedge funds are the main culprit as a group. Although we cannot be sure how many funds have been hurt by the reversal in markets in Asia, there are others that possibly have good returns.

It is unknown how many hedge funds are there in the world but Van Hedge Fund Advisors International, Inc., covers 4100 (13 different styles) hedge funds with USD140 billion in assets. It is unclear if the hedge funds and/or the proprietary desks are the main forces in initiating large capital flows but highly leveraged funds and derivatives can cause wide fluctuation in asset prices. On 29 Jan 1999, the 10-country Basle Committee on Banking Supervision asked banks to tighten their lending standards to hedge funds. The Committee also suggested that banks better tailor their demands for collateral and margin to the risk profile of hedge funds, indicating “leverage” and the use of derivatives may be the main culprit. The US President’s Working Group on Financial Markets is examining the activities of hedge funds in the wake of LTCM.

In the context of portfolio management, and in the interim period, guarding against large reverse capital flows is a major and crucial task. This is especially important as implied by the results, that some markets are not likely to return to its long-term trend. The assumption of continuous growth can no longer be assumed. No matter what the investment horizon is, changes in short-term correlations in non-trend reversal markets have important implications even for long-term funds.

10. Correlations and The Contagion Effect

Tables 3.1, 3.2, 4.1 and 4.2 reported the correlation coefficients of the 10 markets for the period Jul 1996 to Jun 1998. We split the samples into Jul 96-Jun97 and Jul 97-Jun 98. The selected results for the first period are reported in Tables 3.1 and 4.1 and the second period in Tables 3.2 and 4.2. Using Tables 3.1 and 3.2, we can examine the selected monthly correlation coefficients. For Tables 4.1 and 4.2, we have the rolling three-month correlation coefficients. Splitting the data into two periods allows us to examine the changes in the correlations before and after July 1997, the start of the Asian crisis (full results are available from the author). It is particular interesting to note the changes in the correlation coefficients for markets such as Indonesia, Malaysia and Hong Kong. In Oct 1996, most of the markets were not moving in tandem but in opposite directions. Indonesia was negatively correlated with 4 out of the 9 markets, Malaysia was negatively correlated with 7 out of the 9 markets, and Hong Kong was negatively correlated with 6 out of the 9 markets. As the crisis broke out in Jul 1997, the correlations change abruptly.

By Oct 1997, there were no correlation coefficients recording less than +0.699 with any of these three markets. For Hong Kong, the minimum coefficient was

0.818, indicating that all markets were moving in tandem with Hong Kong. Similarly, Malaysia and Indonesia markets were also moving closely with the rest.

One may argue that single month correlations were too volatile to draw any conclusions. Indeed, investment committees usually meet every quarter, after which the re-balancing of portfolios is being done. It is therefore more appropriate to examine the three months correlations. The results give similar picture. By Oct 1997, there were no negative coefficients, indicating that the herd-like behaviour was contagious.

Large reverse capital flows had caused all the markets moving in the same direction making it a one-way bet for speculators and investors alike. Initially, the correlations were not strong. But as the crisis deepens, the profits of market timers were accumulating and bigger bets were placed. On the one hand, there was a group of investors whose feeling of “fear” got stronger as the negative events unfolded. On the other hand, there was another group of market-timers that grew in confidence and felt “superior”. These “feelings” were contagious and it would quickly spread across Asia, inflicting damages to the markets and economies. The herd behaviour accelerated the sell-off with increased outflows of capital from the Asian markets.

As seen in the changes in the correlation coefficients, once the contagion effect had reached its “peak”, it subsided temporarily. Some genuine investors would have been sidelined by then and market-timers continued with the activities until the next wave of “fear” and “superior” feelings resurfaced again. This is demonstrated by the coefficients that drop substantially before picking up again.

There would be a point where “saturation” was reached and almost all the market participants were from a small group of highly leveraged market-timers. Trading of equities were among a few large institutions with very little participation from others. The feeling of “control” was there and the markets were “cornered” and had overshot their fundamental values on the downside. As their confidence grew, the springs were coiled and the markets were depressed with artificial strength through more leverage. The bets got larger and when this group stopped trading, the depressed springs would uncoil and the markets would spring up with tremendous upward force. However, not all markets can behave this way as those that had their springs damaged could not shoot up as much. Markets with spring mechanism working would finally have their glitters back but markets with failed mechanisms will have to live with them until the springs are fixed and functioning again.

Recently, the highly leveraged funds were hurt badly from the Russian crisis. The banks had to enforce margin calls and Asian markets moved up with “de-leverage” activities. As the Russian crisis erupted with attention focused elsewhere rather than Asia, and when Hong Kong Government started to buy Hong Kong shares, together with Malaysia imposing capital controls, most markets returned to normal as leveraged funds were hurt.

There are implications here for short-term and long-term investment strategies. While it is too early to infer any permanent change in the correlations, there are concerns regarding diversification across markets and instruments. It could be shown that the currencies and bond markets behaved the same way as most funds seek refuge in the US treasury bills, thus causing the yields to drop and USD to appreciate even further. One can successfully implement investment

strategies using trade-timing models that have superior performance based on correlation data. However, any discussions of Quant models here are beyond the scope of this paper and pursued elsewhere.

11. Discussions

With the markets moving in tandem with correlations as high as 0.9, it is difficult to diversify as there are few instruments that move in opposite directions. Meantime, fund managers may have to resort to techniques to hedge their position or risk losing more capital or redemptions. The long-term funds have now got to focus on capital protection, rather than to seek positive returns. The following discussions attempt to shed some light on the development of hedge funds techniques that have wide implications.

(i) Hedge Funds Investment Styles and Regulations

To understand the rationale and importance of correlations in the present context, it is essential to understand the workings of the different style of hedge funds. Discussions of different styles can be found in Lederman and Klein (1995). One particular style, market-neutral investing, has been responsible for most of the significant innovations in portfolio management for the 1990's. The market-neutral strategy has been introduced as early as 1949 by A.W. Jones investment partnership, sometimes referred to as the first hedge fund (Lederman and Klein (1996)). This 50 years old "new" money management approach, also known as zero investment approach, is used to produce returns independent of capital markets systematic risk.

The basic market-neutral strategy starts with one dollar of capital, purchases a long position on an asset, and sells another short. The cash proceeds from the short sale are invested to produce a return that approximates the risk-free rate.

In effect, the return to the strategy is the sum of two alphas, one each from the long and short portfolio. With leverage, alpha multiples of 40 to 50 can be achieved.

Within the framework the capital asset pricing model, market-neutral portfolios have a zero beta. In fixed-income strategies, market-neutral investing can be described as zero-duration investing. Market neutral encompasses a whole range of so-called relative value techniques and arbitrage within and across assets that owes its returns largely to a fund manager's skill in hedging and spotting inefficiencies.

In practice, leverage is limited by credit providers for all classes of securities, except equities in US. In US equities, Regulation "T" defines the maximum leverage and applies to customer accounts. In the case of 50% or 2:1 maximum leverage, one can have a long and a short for one-dollar of capital. In the unregulated fixed income market, leverage is negotiated between the broker-dealers credit or margin department. In US equities, Securities and Exchange Commission (SEC) regulations allow broker-dealers' long/short equity accounts to attain leverage ratios of 6.29 to 1.

According to White (1996), "Leverage of 20:1 in convertible bonds can be achieved. In foreign equity markets, "contracts for differences" with local investment banks allow the attainment of equity long/short leverage ratios of up to 10:1, depending on the strategy and the overall creditworthiness of the borrower."

One way to leverage further within US is for an institutional investor to set up passive broker-dealers, partly to avoid taxation, partly to take advantage of the more advantageous net capital rules applied to exchange members and broker-

dealers. In 1995, the US Internal Revenue Service (IRS) issued IRB1995-4 #29 revenue ruling that long/short investing does not create unrelated business taxable income (UBTI), clearing the path for long-term and pension funds such as Universities, Pension Plans and Charitable Remainder Trusts to enter into market-neutral management mandates.

We have argued that it is the degree of leverage that has to be regulated and this involved not only hedge funds, but also unregulated derivatives trading. With this in mind, we now have an idea how large capital flows have evolved.

What are the implications for investment in Asia? In Asia, it is now easier for fund managers to initiate a short position by borrowing scrips from offshore. It may sound ironic, but it is crucial that fund managers managing investment in Asia be allowed to have facilities to do short-selling in order to protect against falling assets values. Many Asian shareholders cannot sell shares due to moratorium or to retain control. Short selling should be allowed and regulated, provided leverage is regulated tightly. Regulations that promote, rather than prohibit short selling as in the case of Malaysia, should be adopted. Otherwise, investors in these countries risk losing more of their capital as the facilities are not available to them in their own countries.

The other concern about regulations involves rating agencies. As most funds cannot hold on to the assets or currencies as their ratings fall below designated level, such as investment grade for bonds, they have to sell with no regards to the price level at the next re-balancing exercise. This suggests that the role of a rating agency is important too and it raises the issue of whether there should be international regulations for rating agencies. Any downgrade of assets is a signal to short sell an asset and that causes huge reverse flows of capital.

(ii) Capital Flows and Leverage

Large capital flows would return after each short period of recess, as perhaps the most significant in the hedge fund industry is the recovery of arbitrage styles a few months after the collapse of LTCM. The performance fees for LTCM in the last quarter was USD 50m, just a couple of months after the 16-institutions bailout. Many arbitrage strategies use corporate bonds, treasury bonds, or both, with corporate typically representing long positions and Treasury bonds being held as short positions. During the period of “flight to quality”, hedge funds and proprietary desks were hurt as money flowed into Treasury bonds, bidding up prices. On the other hand, corporate bonds were sold, depressing prices. It was a double blow to the hedge funds. Their long position in corporate bonds was hurt, together with their short position in the safer treasury bonds. Banks started reducing their exposures and that worsened the positions of hedge funds, prompting US Federal Reserve Board (Fed) to act so that further de-leverages would not occur.

Since the beginning of Nov 1998, increased confidence and demand for corporate bonds pushed up prices while treasury bonds prices moved in the opposite direction. The “flight to quality” disparity in values between corporate and Treasuries was generally viewed as a historical anomaly that had not occurred for decades. The implication will likely be that “market neutral” strategies are again safe havens, and that spells trouble for economies. It has been said that the storm has passed and new hedge funds continue to spring up like mushrooms after a hard rain. Investment into hedge funds, both institutional and private, continues to grow. More research on the curb of leverage, and international capital flows, need to be done.

It is clear now that it is not the hedge funds that caused the storm, it is the leverage of the hedge funds and large unregulated institutions that aggravated the Asian crisis. Financial firms and investors will move their money offshore if the US or another country goes forward with new rules on its own for derivatives or hedge funds. International coordination is crucial to regulate the leverage aspects of hedge funds and unregulated over-the-counter derivatives. Clearly, once regulation is in place in a single country, it may threaten the legality of many investments and chase the market offshore. It is arguable whether a single financial regulator for the world is feasible, but at least some international regulatory coordination is possible.

The financial flu had spread beyond Asia to Russia and Latin America. Some argue that imposing some kind of involuntary debt rescheduling and capital controls in the affected countries can contain the crisis. Others argue that hastily designed and heavy handed attempt to keep private creditors in one country could send more capital fleeing from other countries, and might well have further reduced the pool of financing for emerging markets. Whatever it is, the enormous volume of capital flows in relation to the limited resources made available to international institutions is an important issue to address.

On 4 Feb 1999, Malaysia's Finance Minister Tun Daim Zainuddin announced Malaysia's new graduated exit tax on the repatriation of portfolio capital and profits. The original capital bought in before 15 Feb 1999 can be repatriated subject to a graduated levy between 30% and 10% based on the duration of investment. For Malaysia, life seemed to have returned to normal.

For hedge funds too, at least, life is back to normal. But for others, "Nightmare at the Periphery: Part II", could just have begun and the world is not ready for

it. Furthermore, we are not sure how long the deflation of the rest of the world can continue to subsidize the phenomenon of asset inflation in the U.S.. If Soros's prediction is right, then the centre would eventually be affected very badly when the bubble bursts. Our results clearly suggest that it would also be wise for US to impose policy to slow down the outflows of capital to the periphery. It is not so much whether the capital should flow from the centre back to the periphery, but the speed that matters. In the long-term, US capital outflows are good for both the centre and the periphery, but not when all capital outflows happen all at once. The consequence of that is disastrous and has prompted the call for the establishment of an International Credit Insurance Corporation by Soros (1998) due to the failures of Bretton Woods Institutions, namely IMF and World Bank, in instilling confidence in the emerging markets.

The continued outflow of capital from U.S. to Japan forces many fund managers to re-balance their portfolios in favour of Japan and that is good. In terms of market capitalisation in March 1999, US accounts for over half (USD12.23 billion) of the world market (USD24.02 billion). Japan is now the third largest with only 7.3% (USD1.8Billion), behind UK with 9.28% (USD2.35 billion) of global capitalisation. As long as the Japanese equity market continues to be on an uptrend with gradual re-distribution of capital from the U.S., the probability of a rapid exit of capital is reduced.

12. Conclusion

Time series can be viewed to have two components, a long memory component and a short memory component. Using the tools from long range dependence literature, we have inferred that there is a case for some control measures for reverse capital flows from the periphery to the centre. The use of semiparametric

techniques can identify series with long memory. These series have memories and what happened previously, though seen to have no effects visually, do have some influence in the future. To put it simply, with long memory, the pendulum may not have been broken and become a wrecking ball causing damages to economies. Market mechanism is still working, with market swinging to one end, and then swinging back in due course.

Our results suggest that there is a case for interventions in Indonesia, Malaysia and Hong Kong. In particular, Indonesia has a stronger case than Malaysia to impose some controls to slow reverse capital flows. This is because these markets do behave like a wrecking ball, causing enormous damage to the economies when shocks hit. The flows have to be blocked, as there is no guarantee that the markets would return to its trend.

It is perhaps too early to conclude that capital controls have worked for Malaysia, but preliminary evidence has been encouraging. Of course, any short-term benefits would have its long-term costs but so far the costs seemed to be minimal. It takes time to build the new financial architecture, which requires consensus and concerted efforts.

We have also shown that the financial flu is contagious and an Asian portfolio is not diversified unless one is allowed to invest in instruments that move against the markets and have negative correlations. There are few such instruments and one may have to resort to hedge fund techniques such as market neutral to protect the capital and hopefully enhance investment yields. In an era where large capital flows are caused by highly leveraged funds and herd-behaviour with the rapid flow of information through the information highway, “new” and “innovative” investment techniques that protect capital and promise superior

performance would evolve. Finally, to prevent a “Nightmare on Wall Street”, US may have to control the outflows of capital and the Fed has acted quite successfully through influencing the expectations of interest rates. Inherently unstable financial markets need supervision and regulation, especially in the area of leverage by hedge funds and trading desks of large institutions. Whether a new international financial authority would eventually emerge and in what form is a future area of research. Meantime, we leave it to individual countries to fend for themselves. To prevent a global meltdown, the world would have to act fast.

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