Dynamic Adjustment of Corporate Leverage: Is there a lesson to learn from the Recent Asian Crisis?[1]

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Abstract: While the aggregate macroeconomic analysis of the recent Asian Crisis highlights the moral hazard problem of bad loans in poorly supervised and regulated East Asian economies, there is very little firm-level analysis to characterize it. The present paper attempts to fill in this gap of the literature and focuses on the process of dynamic adjustment of the actual leverage towards the optimum. Our results based on the Worldscope firm-level panel data indicate a close correspondence between excess leverage and excess capital stock and also reveal signs of corporate inertia. This inertia has been evident not only among firms with excess capital stock, but also among those with larger share of short-term debt in the worst affected countries, especially during the pre-crisis and crisis periods; the adjustment process was however speeded up in the post-crisis period. One possible way out of this problem of bad loans would be to develop the equity market and induce the firms to rely more on equity finance.

Key words: Moral hazard, Over-lending and over-investment, Speed of adjustment, Inertia, Generalised Methods of Moments

JEL classification: G32, O16

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1. INTRODUCTION

The existing literature on the recent Asian crisis highlights the problem of bad loans and moral hazard in capital markets. Much of this analysis is carried out at the aggregate level, and highlights the problem of excessive borrowing and over-investment (see for example Krugman, 1998; Corsetti, Pesenti and Roubini, 1999a,b). The well-understood moral hazard problems were exacerbated by the bail-out policies of the governments of the crisis countries, and the lack of supervision of the financial sector. The result was financing of unprofitable projects and cash shortfalls with external borrowing causing overinvestment and lower returns, paving the way for the crisis. However, there is very little firm level analysis seeking to determine the nature and scale of the moral hazard problem. This paper is an attempt to fill this gap, with particular focus on the levels of leverage in these economies, and the process of corporate adjustment. This is an important exercise, because this analysis directly addresses the question of how firms choose and adjust their capital structure towards the optimal level. In the context of the Asian Crisis, this provides a hitherto unavailable analysis of the extent of the moral hazard problem of bad loans, discussed but seldom analysed in the existing literature.

This paper then draws together two strands of the literature. Firstly, a key feature in the macroeconomic analysis of the crisis is the importance of moral hazard in the loan market. We integrate this crisis literature with a second strand of more established literature, concerned with the choice of optimum capital structure in corporate finance.[2] Much of the literature concerning the determination of a firm's optimum capital structure is based on the seminal analysis of Modigliani and Miller (1958, 1963) who argued that leverage is independent of firm value. More recent trade-off models assume that firms determine their optimal leverage by comparing the costs and benefits of an additional unit of debt. Considerations of bankruptcy and agency costs will therefore modify the central hypothesis of Modigliani and Miller (1958), as will different tax treatments of debt or interest

[2] Though there is a sizeable literature on the theory and evidence on optimal capital structure, most analyses are done in static framework and that too primarily for the US corporations (e.g., see Titman and Wessels, 1988) and other industrialised countries (Rajan and Zingales, 1995) with the single exception of Welch (2004) who examined the debt ratio dynamics for US corporations (see further discussion in section 3).

repayments. Further, the existence of information asymmetries will lead to retained earnings and debt being viewed as preferable methods of finance rather than new equity, especially when that equity is under priced. Secondly, in the presence of bankruptcy costs, there is a limit to how much risky debt can be issued before new equity is preferred. Thus, leverage will be dependent on the net present value (NPV) so that firms with higher NPV are more likely to issue debt. This argument is expounded in a theoretical literature that can be traced back to Ross (1977), Leland and Pyle (1977) who predict a positive correlation between firm quality and leverage. Similar arguments are found in Brennan and Kraus (1987), Kale and Noe (1991).

Perhaps for our purpose it is more pertinent to consider the literature that seeks to move away from static models of leverage and focuses in stead on dynamic adjustment process. A common theme in this strand of the literature is that the actual and the desired (or optimal) leverage may not be equal at any time because of market disturbances or desired leverage may change over time. Market frictions such as transaction costs and capital market imperfections may prevent an instantaneous adjustment of the actual leverage to the desired level. As a result the rate at which a firm decreases the gap between the actual and desired leverage provides an approximate measure of the relative adjustment costs faced by the firm.

There is a relatively limited literature on dynamic modelling of capital structure, and the focus of such work has generally been on the transaction costs associated with the adjustment process. For example, Fischer, Heinkel and Zechner (1989) argue that even small recapitalization costs could lead to wide swings in a firm's debt ratio over time. Conversely, Leland (1998) emphasises the role of agency costs of debt in determining optimal leverage. Much of the US literature is couched in terms of firms facing a crisis in the form of a devaluation of its equity, and therefore tending to exhibit sub-optimal levels of leverage and thus seek to increase them. As such, the possibility of asymmetric adjustment costs or non-linearity in the adjustment process is seldom discussed within the existing partial adjustment literature. This is particularly pertinent when one considers the different costs involved in the directions of adjustment in general and also the reverse scenario as in the case of SE Asian firms.

The moral hazard problems of corporate borrowing among the East Asian firms resulted in excessive levels of financing, with the observed capital stock often exceeding the optimal (for further discussion of this see Corsetti et al., 1999a,b, Demetriades et al. 2001). An important question is therefore the extent to which firms have deviated from their optimal levels of capital and what, if any, determines their inclination/ability to adjust their capital structure towards the desired level. While small adjustments in leverage may be seen as not cost effective, previous evidence suggests that average adjustment rates are slow for US firms, see for example Fama and French (2002), Baker and Wurgler (2002) and Welch (2004). This however may in part be due to the methodologies employed, and the fact that they obtain only average adjustment rates across the various samples employed. In the context of East Asian firms, the persistent failure to adjust to the optimal leverage could, among other things, be taken to be a measure of moral hazard in poorly supervised and regulated East Asian economies. Though the importance of the moral hazard argument is emphasized in the literature, there is rarely any attempt to quantify it at the firm level as we propose to do.

We investigate the determinants of the speed of the adjustment process, and model the extent to which these changed before, during or after the crisis. Our analysis is based on leverage rates for firms taken from the Worldscope firm-level data from the four worst affected countries, Indonesia, Korea, Malaysia and Thailand. We then compare the capital structure, and adjustment behaviour of firms in these countries with those in Hong Kong, Singapore and Taiwan, countries relatively unaffected by the Crisis. The results presented here suggest that optimal leverage was lower for more profitable firms and also for firms with higher market valuation. Dynamic estimates of speed of adjustment however suggest a close correspondence between excess capital stock and excess leverage. A significant degree of corporate inertia is also evident among firms with excess capital stock or high share of short-term loans in the worst affected countries. These results seem to strengthen the moral hazard argument of bad loans in the poorly regulated and relatively unsupervised East Asian economies of Indonesia, Korea, Malaysia and Thailand.

The paper is developed as follows. Section 2 describes the data and section 3 explains the analytical framework. Section 4 presents and analyses the empirical results while section 5 concludes.

2. THE DATA AND INITIAL ANALYSIS

The analysis is based on the Worldscope firm-level data. Here we extend the Worldscope firm-level data used in Driffield and Pal (2001, 2004) in two ways: Firstly, in addition to countries badly affected by the crisis, namely, Indonesia, Korea, Malaysia and Thailand, for comparison we include Hong Kong, Singapore and Taiwan, which were relatively unaffected by the crisis. Secondly, we extend the data beyond the crisis period. This enables us to trace the patterns of recovery, if any, in these countries.

The number of firms in each country with and without outliers is summarised in Table 1 for each year. However, there is a problem of missing observations for many firms, especially during the early years, e.g., 1989-93. In order however to carry out the dynamic analysis discussed above, we construct sub-sample of firms with at least four consecutive years of data, which resulted in smaller sample for each country for the period 1993-2002 (see Appendix Table A1).

2.1 Analysis of capital Structures.

This paper focuses on the behaviour of corporate leverage and its dynamics in the sample countries. Here corporate leverage is defined as total debt divided by common equity (book value); this ratio is alternatively labelled as the debt-equity ratio. Firms choose their optimal capital structure based on the relative costs and benefits of internal and external finance. Further, agency costs, bankruptcy costs and taxes play an important role, as do institutional factors, ranging from stock market development, legal protection of shareholders/creditors, and government control of the financial sector influencing the corporate capital structure in a given country. It is clear that many of these are country level phenomena, with differences therein suggesting different determinants of leverage across countries. By focussing our analysis on each country separately, we are able to highlight import inter-country differences, while focusing within countries on firm-specific factors (both real and financial) affecting the determination of optimum capital structure and its adjustment in a dynamic framework.

The analysis commences by considering the distribution of internal and external funds before (1989-96), during (1997-98) and after (1999-2002) the crisis as summarised in Table 2. In general there was a greater dependence on external finance in all countries in the pre-crisis period. External finance accounted for about 65% of total finance in Korea followed by Thailand (37%), Indonesia (35%) and Malaysia (30%). After the crisis, the average ratio of external finance in total finance declined in all the worst affected countries: it decreased by some 26% in Thailand, 23% in Indonesia, 10% in Korea and 7% in Malaysia. In contrast, the average share of external finance in total finance in the least affected countries was modest (ranging between 25%-32%) and did not change perceptibly after the crisis.

Subsequently, we consider the composition of debt and equity in external finance. Compared with the least affected countries there seems to be a greater reliance on debt in the worst affected countries throughout this period though the highest in each case was observed during the crisis period. Following the crisis, however, the share of debt generally decreased in all these countries though the decrease was more perceptible in Korea where the average share of debt was even lower than that in the pre-crisis period average. The latter has been accompanied by a gradual increase in the share of new equity finance in external finance in the post-crisis period though clearly the reliance on equity has been much higher in Hong Kong and Singapore.

One possible problem is that the debt-equity ratio defined this way could be negative if the book value of common equity is negative. However a negative debt-equity ratio does not necessarily mean low leverage; in fact in most cases negative debt-equity ratio is associated with very high external debt. A simple way to address this problem for our purpose is to make use of the absolute debt-equity ratio instead - this is what we would be doing in much of our analysis.

Table 3 summarises the annual descriptive statistics for leverage rates for each of these countries. Interestingly, the average for absolute leverage (|DE|) was less than 1 in the least affected countries in contrast to the worst affected countries, notably Korea. While the average |DE| remained around 2 during 1989-90, it suddenly shoot up in 1991 from 2.41 to 3.19. The latter was followed by some downward adjustment during 1992-93, which again spiralled up as the crisis approached. Thus there seems to be a bimodal distribution of leverage in the Korean case, one observed in 1991-92 while the second one in 1997-98 though the latter was more pronounced. In comparison, there seems to be a relatively steady average |DE| in Indonesia, Malaysia and Thailand during 1989-1993 that gradually increased as the crisis approached.

It is well documented that many East Asian corporations in the worst affected countries were heavily reliant on debt during this period. A rapid rise in the value of debt was due to the revaluation of dollar-dominated debt (attributable to the collapse of exchange rates), which was not hedged. Equally, anecdotal evidence identifies a number of other explanations for high levels of debt, including large shareholders' desire to keep control of the management by increasing leverage rather than equity (thus preventing dilution of their ownership), low real interest rates on bank loans and poor financial and corporate governance indulging over- lending by banks, decline in equity value.

Table 4 shows the period-specific averages of leverage, and some other indicators of firm performance across these sub-periods. It indicates several potential problems across firms in these countries in the run up to the crisis period. The average value of cash flow to current liabilities in all countries, especially the worst affected ones, was declining. This was accompanied further by decreases in both interest coverage (interest payments as a share of EBIT[3]) and debt coverage (interest payments plus principal as a share of EBIT) ratios in all the worst affected countries. Many firms in the worst affected countries also exhibit negative equity values[4] in the build-up to the crisis period, generally after 1994. The proportion of firms with negative equity during the pre-crisis period is the highest in Korea (18.9%), while there were no firms in Singapore or Taiwan that had negative equity during this period. With a rapid depreciation of currencies exchange rate, some firms became technically insolvent which could partly be reflected in negative equity valuations.

It is also possible to detect some signs of recovery in all of the worst affected countries in the post-crisis period. For example, the average debt-equity ratio was gradually adjusted downwards (especially visible from around 2000) while shares of tangible assets slowly increased in all these countries. This was accompanied not only by a gradual increase in interest and debt coverage ratios, but also by an increase in cash flow in relation to current liability in all the worst affected countries in the post-crisis period. The proportion of observations with negative equity was almost halved in Korea while the adjustment in this respect was not so pronounced elsewhere. In fact, the proportion firms with negative equity increased in Indonesia and Malaysia in the post-crisis period.

Figure 1 shows the trend in average annual debt-equity ratios (absolute) while Figure 2 shows the trend in share of tangible assets to total assets over the 14-years period 1989-2002. These figures clearly demonstrate that compared with firms in other countries Korean firms maintained a much higher debt-equity ratio throughout the pre-crisis period.[5] Also, while average debt-equity ratios increased dramatically from 1993 onwards, there were only modest increases in the share of tangible assets in all the worst affected countries. In contrast, average shares of tangible assets were much higher in Hong Kong and Taiwan over this period, with much smaller fluctuations in both average debt equity ratios and share of tangible assets. After the crisis, the average debt-equity was reduced in all countries, but most markedly in Korea and Indonesia, generally stabilising around 2000.

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[3] Earnings before interest and Taxes.
[4] Number of observations in each sample with negative equity is as follows: 5.3% in Korea and Thailand, 7.5% in Indonesia and 4.7% in Malaysia. In comparison, number of observations in the countries least affected by the Crisis was much smaller: only 0.2% in Taiwan, 0.6% in Singapore and 1.2% in Hong Kong.
[5] Among other things, this could be the result of lower stock market development in Korea compared with say Malaysia (see Demirguc-Künt and Maksimovic, 1995).

3. A DYNAMIC ANALYSIS OF LEVERAGE

Existing empirical research on the dynamics of firms' capital structure is often limited by the absence of panel data with an adequate time series, as well as unavailability of certain key variables. Most existing analysis is based on the hypothesis of a target leverage level for the firm, tested on cross sectional data within a country, usually the US (e.g., Welch, 2004)[6] or the UK. This cross sectional analysis omits a good deal of necessary information. More recently, in order to increase the degrees of freedom in such studies, data have been pooled, but then these models ignore the possibility of serial correlation, or structural breaks between years. More importantly, because of the latent variable problem, many studies tend to use observed debt level as a proxy for optimal debt level (e.g., Titman and Wessels, 1988; Rajan and Zingales, 1995, Hovakimian *et al*, 2001) and then seek to explain how firms periodically adjust their capital structures towards a target ratio. This is the framework within a static reduced form trade-off model, determined by the relative costs and benefits of adjustment. Although we generally follow this tradition, our analysis is distinctive in a number of ways.

Firstly, we allow for three distinct sub-periods in our data. The average |DE| for each country tends to vary between three distinct sub-periods, the pre-crisis, crisis and the post-crisis periods (see Table 4). This is likely to generate instability in any model of leverage over time.

The second issue relates to the treatment of the process of dynamic adjustment of leverage when the actual leverage deviates from the optimum. Firms may not find it easy to adjust their debt ratios frequently or fully, even if they are aware of the implied inefficiency. Much of the literature views adjustment in leverage as a uni-directional process. Heshmati (2002) for example attempts to differentiate between the observed and the estimated optimal debt ratio levels, where observed leverage is less than the corresponding optimum. However, we allow adjustment in leverage to be in opposite direction, an issue that is particularly relevant in the context of the SE Asian crisis. Over-lending and over-investment were common in the pre-crisis period (commonly attributable to the moral hazard problems of bad loans and weak corporate governance) so that actual leverage is likely to exceed the optimal leverage. We highlight this case in our econometric modelling and attempt to relate evidence of inertia in the speed of adjustment to the moral hazard problem. In doing so, we deviate from the standard practice in two ways: (i) we include two sets of adjustment parameters

[6] In examining the debt ratio dynamics for the US corporations, Welch focuses on the role of stock returns and argues that firms do not immediately readjust. Firms whose debt ratio increase (decrease) because of poor (good) stock returns performances seem to use their issuing activities not to readjust, but to amplify the stock return changes.

capturing different effects within the partial adjustment model. (ii) We allow the speed of adjustment parameter β_{it} to vary between firms and over time. The modelling process is explained in detail below.

3.1. A Model of Dynamic Adjustment

Our central focus is on the moral hazard problem as the common source of excessive external borrowing in a poorly supervised economy. If private agents act under the presumption that there exist public guarantees on corporate and financial investment, the return on domestic assets is perceived as being implicitly insured against adverse circumstances. Where lenders are willing to lend against future bail out revenue, unprofitable projects and cash shortfalls would be refinanced through external borrowing. In the absence of any significant growth in tangible assets, this generates excessive corporate leverage. It is in this context that we examine the process of adjustment of actual leverage towards the long run optimum.

Let the optimal leverage of a firm i at time t be DE_{it}^{*}, which varies across firms as well as over time. In the absence of any market imperfection, and with instantaneous adjustment, the observed leverage of firm i at time t DE_{it} would be equal to its optimal, i.e. $DE_{it} = DE_{it}^{*}$. If, however, adjustments are costly, for example due to agency and/or transaction costs) $DE_{it} < DE_{it}^{*}$ or if loans are not well regulated (e.g., due to weak governance and moral hazards problems), $DE_{it} > DE_{it}^{*}$. In either case, firms may fail to adjust completely to the optimal level.

In these circumstances, the movement of leverage over time becomes a partial adjustment process, of the form:

$$\Delta DE_{it} = \alpha + \beta_{it}(DE_{it-1} - DE_{it-1}^{*}) + \gamma \Delta DE_{it}^{*} + \varepsilon_{it} \qquad (1)$$

where DE_{it}^{*} is the equilibrium level of leverage while DE_{it} is the observed level for firm i in the current period t. Thus changes in leverage are determined by two components, namely, (a) its and adjustment towards the optimum for the previous period (DE_{it-1}^{*}) and (b) the annual change in the optimal leverage over the current period (ΔDE_{it}^{*}).

Much of the previous literature in this area, discussed in detail in Roberts (2002) essentially specifies a simple dynamic linear modelling approach to the adjustment in leverage. As such, an implied speed of adjustment is generated from the coefficient on the lagged dependent variable. This is problematic, as strictly this measures the rate at which a series converges on its long run level, rather than capturing annual adjustments in the face of changes in other explanatory variables. In response to this, more recent literature employs a partial adjustment model of the form:

$$\Delta DE_{it} = \alpha + \beta(DE_{it-1} - DE^{*}_{it-1}) + \varepsilon_{it} \qquad (1')$$

It is clear therefore that there is a crucial difference between specification (1), and the more common specification (1') criticised by Leary and Roberts (2005). The standard model (1') ignores the effects of changes in the optimal level of leverage, and merely focuses on the move towards the previous optimal level. Also, unlike the standard model of partial adjustment we allow β to vary among firms and over time as captured by the firm and year-specific adjustment parameter β_{it}'s. In turn, we seek to explain differences in the speed of adjustment across firms, and identify significant heterogeneity in the speed, even within countries.

As such, the two parameters in our model (1), β_{it}'s and γ can be thought of as capturing different effects within the partial adjustment model. On the one hand, β_{it} is the speed of adjustment of a firm i in period t as it measures the degree of adjustment per period. For example, if $\beta_{it} = 1$, i-th firm will adjust its leverage fully to its optimum from period t-1 to period t (i.e., within one period). If, however, $\beta_{it} < 1$, then the adjustment from year t-1 to t falls short of the adjustment required to attain the target. In contrast, β_{it} could also exceed unity suggesting that from period t-1 to period t, the firm fully adjusts within a given year. Fama and French (2002) found the estimate of speed to be much smaller than would be suggested by market efficiency. Several reasons for β being significantly less than 0.5 have been put forward in the literature, based on inefficiency of capital markets for example. If, however, the moral hazard problem is particularly significant, firms do not come under pressure to make adjustments even in the face of external shocks. As such, in the economies we are discussing here, where agency problems are found to generate significant frictions in capital markets, one would hypothesize that β will be small. It is argued that the speed of adjustment β_{it} would vary with the factors affecting the externality of adjustment in poorly supervised and regulated economies and could thus be taken to be a measure of the moral hazard in corporate financing in these east Asian countries (see further discussion in section 3.1.2). The second adjustment term, γ, reflects a firms ability to respond internally to disequilibrium, i.e., move towards a more efficient level of leverage in response to change in the optimal (ΔDE_{it}^{*}) during the year. γ then reflects the ability of firms to respond to changes in an attempt to become more efficient.

3.1.1. Determination of optimum leverage

Determination of optimum leverage is central to an analysis of the dynamics of the debt/equity ratios. There is a well-developed literature (see for example Hovakimian et al (2001), Hovakimian (2003) and Leary and Roberts (2005)) that seeks to explain variations in leverage, and uses observed leverage to generate predictions or estimates of the optimum leverage. This approach also provides an insight into the process of adjustment of the actual leverage toward the firm specific optimum.

Suppose a standard random effects model of leverage for a firm i, i = 1,2,…,I , in period t, t = 1,2,….,T is described as:

$$\begin{aligned} DE_{it} &= \alpha' X_{it} + \phi_i + \mu_t + e_{it} \\ &= \alpha' X_{it} + u_{it} \end{aligned} \qquad (2)$$

where $u_{it} = \phi_i + \mu_t + e_{it}$.[7]

The list of variables generally used in much of this literature includes; investment (or growth) opportunities, firm size, industry level effects, tax rate differentials, and the probability of failure. It is immediately apparent that such effects can seldom be captured directly, but rely on proxies. A literature has developed discussing the suitability of these proxies, and availability of instruments where problems of endogeneity arise, see for example Friend and Lang (1988), Titman and Wessels (1988), Berger et al (1997) Baker and Wurgler (2002), Hovaikimian et al (2001), and Ozkan (2001) among others. The literature in this area is largely based on Myers (1977) and is discussed in some detail in Ozkan (2001), while Ozkan (2001), Welch (2004). Gaud et al (2005) provide a review of this literature, focusing on firm size, performance, growth opportunities and risk. Hovaikimian et al (2004) among others extend this analysis to discuss and explain movements in capital structure and observed variations in the levels.

Many models seeking to determine optimal leverage are based on trade-off theory. This suggests that in the presence of significant capital market imperfections and information

[7] Recent work in this area (see for example Roberts (2002) highlights the problems in estimating a dynamic version of (2) in order to investigate movements in optimal leverage. Most importantly, firms may not find it cost effective to adjust their debt ratios from year to year even if they are aware of the sub-optimality of the existing levels.

asymmetry, the performance of the firm is an important determinant of optimum leverage. Thus better performing firms tend to have higher leverage. In our analysis, we include two possible indicators of firm performance, Tobin's Q as an indicator of market valuation, and profitability as an indicator of firm efficiency. In order to reduce the possible simultaneity bias, we use one-period lagged values of market valuation and profitability.[8]

An issue that authors in this area refer to, but seldom address in applied work is the importance of capturing the relationship between leverage and "available opportunities" for the firm to carry out investment projects. Theoretically, the prospects of the firm identifying major potential investment opportunities is linked to the leverage of the firm, an argument that is based on the work on Myers (1977) (for a review of this theoretical literature see Baker and Wurgler, 2002). The "available opportunities" variable is generally captured using growth (contemporaneous or lagged) at either the industry of firm level, or simply firm size. Alternatively, past R&D (often in dummy form) is employed to capture future growth opportunities. It is clear however that these are imperfect proxies. We adopt an alternative strategy, which is to employ a model from the factor demand literature (see for example Nickell (1979), Pfann (1996), or Thomsen (2000)) and estimate a model determining the optimal capital stock of the firm. Thus we are able to identify the extent to which a firm is operating above or below its optimal capital stock at a given point in time. This becomes important, not only for capturing future investment opportunities, but also for the asymmetric adjustment process towards a firm's optimal level of leverage. The deviation of actual capital (K) from the corresponding optimal (K*), i.e., (K-K*)[9] is taken to be a measure of over-(or under) investment.[10] This variable becomes important when one considers the central explanations for the depth of the recent Asian crisis, that over-lending has led to over-investment. Thus we would expect a direct relationship between excess capital stock and leverage in our sample.

Finally, we control for firm size and use natural logarithm of total sales as the relevant size variable. In particular, the firm size variable would account for the much-publicised hypothesis that larger firms in the worst affected East Asian countries found it easier to

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[8] Profitability here refers to earnings before interest and taxes as a share of total assets.
[9] The econometric approach to modelling the optimal capital stock of the firm is discussed in the Appendix. Also note that we include both the nominal and the absolute deviation of actual capital stock from its optimal. The latter allows us to account for the possibility of non-linearity in this respect.
[10] We have also experimented with other possible variables like some measure of bankruptcy and interest coverage (as a measure of loan default of firms), but none of these variables turned out to be significant in our samples.

obtain higher levels of debt finance because of their close links with the financing institutions..

Causal analysis of our data (Table 4) suggests that there are three distinct sub-periods (1993-96, 1997-98 and 1999-2002). We therefore allow the coefficient estimates of α to vary across the sub-periods and estimate three models corresponding to the three sub-periods:

$$DE_{it} = \alpha_1' X_{it} + u_{1it} \quad ,t = 1993-96$$

$$DE_{it} = \alpha_2' X_{it} + u_{2it} \quad ,t = 1997-98 \qquad (3)$$

$$DE_{it} = \alpha 3' X_{it} + u_{3it} \quad ,t = 1999-02$$

We also perform Chow statistics to test for the instability of the coefficients over the sub-periods. Results of this analysis are discussed in section 4.1.

3.1.2. Dynamics of capital adjustment

The ability of individual firms to adjust to equilibrium will vary across time. We use the fixed effects estimates of leverage (as explained in section 3.1.1) to generate the predicted values of optimum leverage (DE^*_{it}) and also its lagged value (DE^*_{it-1}) to be used in the second stage dynamic estimates based on the estimation of (1).[11]

It is likely that the potential speed of adjustment will differ between firms, depending on the situation of the firm, the level of leverage it has (and whether it has more or less than its equilibrium level) and a range of other variables including the distress it is operating under. Thus the speed of adjustment is assumed to vary among firms, and is determined by a vector of variables, both real (e.g., PROFIT) and financial (e.g., SR). The approach then allows us to generate firm-specific estimates of speeds of adjustment. Among the possible determinants of the speed of adjustment, we first include firm size (SALES) and profitability (PROFIT) of sample firms. Larger and more profitable firms are more likely to have more flexibility in adjusting the actual leverage towards the optimal leverage and therefore may have a higher speed of adjustment.

Secondly, we include the deviation of actual capital stock from the corresponding optimum, i.e., (K-K*). Most existing literature tends to presume a uni-directional adjustment mechanism, rather than a two-way process (with potentially asymmetric speeds) that we

[11] Within a panel framework, one still has the issue of stability of coefficients over time, though with differenced data (used for the dynamic adjustment) this is potentially less of a problem.

hypothesise here. If K > K* the firm has excess capacity in capital and may find it easier to adjust capital downwards towards the optimum than increasing the stock of capital; this asymmetry in the adjustment process is captured by including $|K-K^*|$ as well. While the firm may be able to adjust capital quickly if $K>K^*$, it may take more time to adjust the debt, e.g., by selling capital. If corporate governance is weak, firms may find it easier to adjust leverage towards the optimum if DE*>DE (upward adjustment) than if DE*<DE (downward adjustment). In this case too, we include |DE-DE*| to test for asymmetry in the adjustment process, if any.

It is expected that firms with higher stock returns may find it easier to adjust DE towards the optimum because they could substitute equity finance for debt finance. In order to control for this financial effect, we include annual stock returns (SR).[12] It has often been alleged that faster growth of short-term debt (often coming from the foreign commercial banks)[13] in the East Asian economies in the 1990s contributed to the financial crisis, as short term creditors withdrew their capital in the face of the crisis. Although we cannot observe the share of foreign loans in total debt in our data set, we use share of short-term loan in total loan (SDTD). Inclusion of this variable would then allow us to test its effect on the speed of adjustment. In particular, a negative coefficient estimate of this variable would be suggestive of a lower speed of adjustment among firms with higher share of short-term loan, thus lending support to the problem of weak corporate governance and moral hazard. In a similar vein, an insignificant coefficient would indicate that firms with excess short-term leverage might not adjust faster, again confirming the moral hazard problem of bad loans in these countries.

We also experimented with a number of variables that are used elsewhere to capture the distress under which a firm is operating. Compared with the better-off firms, behaviour of these distressed firms could affect the speed of adjustment. First, we tried to distinguish firms with negative equity (DE<0) from others (most of whom had very large debt). It is important to identify these firms with high debt and negative equity from others as they were typically relying on short-term loan. In fact the ratio of long-term debt to total debt remained very low for these firms, between 19% and 36% for all countries except those in Korea (where it was as high as 53%). Not surprisingly, these firms report significant losses. For almost all of these

[12] The stock return index represents the theoretical aggregate growth in value of a share over a given period (1 year in our case), assuming that dividends are re-invested to purchase additional shares at the closing price applicable on the ex-dividend date.
[13] A number of factors including faster economic growth and open trade policies pursued in these economies have been identified as causing the faster growth of short-term foreign loan in these economies.

firms, cash flow and earnings before interest and taxes (EBIT) are negative. It is however difficult to include a binary variable for DE<0 into a regression on change in DE since this is likely to introduce a simultaneity bias. But we believe that the profitability measure included in the analysis will to some extent control for the variation among this group of distressed firms. In addition, we experiment with two conventional measure of distress, e.g., cash flow as a share of current liability (CASHCL) and interest coverage INTCOV (interest payments as a share of cash flow) in the speed equation. It is difficult to retain both these variables in the final equation since they are highly correlated. Hence in the final set of estimates (shown in Table 6), we keep CASHCL as this yields the best set of estimates. Insignificance or a negative coefficient estimate of the distress variable in the speed equation could be taken as an indirect confirmation of the moral hazard problems in these poorly supervised economies.

Finally a crisis dummy (CRISIS) is included to account for the externality effect of the crisis years (1997-98) on the speed of adjustment, if any.[14]

Taken together, one can specify an equation capturing the speed of adjustment:

$$\beta_{it} = \beta_0 + \beta_1 * (K\text{-}K^*)_{it-1} + \beta_2 * |K\text{-}K^*|_{it-1} + \beta_3 * (DE\text{-}DE^*)_{it-1} + \beta_4 * |DE\text{-}DE^*|_{it-1} +$$
$$\beta_5 * (SALES)_{it-1} + \beta_6 * CRISIS_{it-1} + \beta_7 * (PROFIT)_{it-1} + \beta_8 * (SR)_{it-1} +$$
$$\beta_9 * INTCOV_{it-1} + \beta_{10} * CASHCL_{it-1} + \beta_{11} * SDTD_{it-1}$$
$$\beta_{it} = 0 \text{ if } DEit = DEit\text{-}1 = 0 \qquad (4)$$

Substituting the values of β_{it} from equation (4) into equation (1), one could obtain the final equation as:

$$\Delta DE_{it} = \alpha + (DE_{it-1} - DE^*_{it-1})\{\beta_0 + \beta_1 * (K - K^*)_{it-1} + \beta_2 * | K - K^* |_{it-1}$$
$$+ \beta_3 * (DE - DE^*)_{it-1} + \beta_4 * | DE - DE^* |_{it-1} + \beta_5 * (SALES)_{it-1}$$
$$+ \beta_6 * CRISIS_{it-1} + \beta_7 * PROFIT_{it-1} + \beta_8 * SR_{it-1} + \beta_9 * CASHCL_{it-1}$$
$$+ \beta_{10} * INTCOV_{it-1} + \beta_{11} * SDTD_{it-1}\} + \gamma(DE_{it}^* - DE_{it-1}^*) + \varepsilon_{it} \qquad (5)$$

where the dependent variable is $\Delta DE_{it} = (DE_{it} - DE_{it-1})$.

In general our data covers a period of 1989-2002 for each firm, which in turn provides a panel of thirteen annual differences. However, given the missing observations and also allowing for the use of lags and instruments, we finally use a complete panel data of ten

[14]The CRISIS variable is defined as follows: CRISIS =1 if year =97-98 and 0 otherwise.

years, namely, 1993-2002 in differences for each of the sample countries on which the partial adjustment equation (5) is estimated.

Estimation method

1. Due to the inclusion of lagged change in DE ratios on the right hand side of equation (5), and given that the model is estimated within a panel framework, ordinary least squares cannot be applied. Rather, one has to use the generalised method of moments (GMM) estimator similar to that suggested Arellano and Bond (1988, 1991) employing instrumental variables. This is because, within a panel framework, the "lagged levels" variables are treated as being pre-determined. Here we employ the estimation procedure outlined in some detail by Sevestre and Trognon (1996). This approach is common for example in labour demand modelling, where a non-linear adjustment process is assumed. For further discussion of this, see Hamermesh (1995).

Goodness of Fit Measure

The multiple correlation coefficient squared R^2 and its adjusted value are routinely used in most models as a measure of goodness of fit. There are, however, problems of using R^2 in a regression model estimated by instrumental variable (IV) methods, as outlined by Pesaran and Smith (1994). As an alternative, we use two possible indicators of goodness of fit: (a) Pesaran and Smith (1994) generalised R^2 commonly abbreviated as GR^2. (b) We also calculate a second measure, which is the correlation between predicted values of the change in leverage from GMM estimation and the actual values of the change.

Diagnostic tests

The estimation procedure generates heteroscedasticy consistent estimates by employing White's correction. In addition, we perform the following tests:

Exogeneity of instruments (Sargan's test): In a regression model estimated by IV method, it is important to test for the exogeneity of instruments to ensure the consistency of estimates. Sargan (1976) proposed a general procedure in this respect that involves the examination of the covariance between IV residuals and the set of instruments used. Sargan derived a chi-square test criterion by obtaining the asymptotic null distribution of the scaled covariance vector. This chi-square test is used here to test for exogeneity of instruments used.

Serial Correlation: When estimating panel data models by GMM, the consistency of the estimator relies on the assumption of no serial correlation. We therefore test for 1st and 2nd order serial correlation, and with differenced data, to quote Doornik et al (2002) "there should be evidence of significant negative first order serial correlation in the differences residuals, and no evidence of second order correlation". The appropriate AR1 and AR2 tests are then based on average residual autovariances, which are asymptotically distributed N(0,1).

4. EMPIRICAL RESULTS

In this subsection, we present and analyse the two sets of estimates, namely, the first stage long-run fixed-effects estimates of optimal leverage (section 4.1) and second stage dynamic estimates (section 4.2).

4.1. Long-Run Fixed-effects Estimates

Estimating the static (levels) models (3) generates estimates for each of the three sub-periods, with the choice between fixed effects models over the random effects determined by standard F test in each case. The estimates of the determinants of optimal leverage are summarised in Table 5.

While there are many similarities, the pattern is not uniform across the countries. The strongest result is that firms with higher market valuation have a lower dependence on external debt, holding true for all the countries in our sample. The significance of firm values in explaining leverage reflects the importance of information asymmetry and agency costs. It is possible that firm valuation is correlated with growth opportunities so that the negative correlation between firm valuation and leverage is a proxy for the difficulty in borrowing against intangible growth opportunities. Secondly, for a given level of market valuation, higher profitability significantly lowers leverage in all the worst affected countries in all the sub-periods. Among the worst affected countries, significant size effect is however observed only among Thai firms where larger firms systematically have higher leverage. This could be due to the fact that larger firms have lower costs of external debt. It could also be attributable to weak governance especially for larger firms who could secure larger debt despite being inefficient. The effect is however opposite in Singapore and Hong Kong. Finally, deviation of actual capital stock from the corresponding optimum is important in some cases. Most notably, it is systematically significant in Korea for all the sub-periods and in all cases a larger deviation is associated with higher leverage in the country; the latter presumably indicates a correspondence between over lending and over investment among Korean firms.

It is also interesting to closely examine the aspect of instability of some coefficients over the three sub-periods. It is clear that the effects of market valuation and profit margin on leverage do not change much across the sub-periods while effects of some other variables, e.g., firm size or $K\text{-}K^*$, do. Notably, the size effect of Indonesian and Thai firms or effects of excess capital among Malaysian seems to disappear during the crisis period. This is further confirmed by the Chow tests (see Table 5).

Finally, we use the fixed/ random effects estimates to generate the estimates of optimal leverage. This allows us to examine (a) to what extent the actual leverage deviates from the optimal ($DE_{it} - DE_{it}^*$) and (b) if there is any association between excess capital stock and excess leverage. To this end, we derive the correlation between the two for every year and compare the trend in correlations for each country. This is summarised in Figure 3. Clearly, the strength of the association is consistently low among firms in the least affected countries. In contrast, the correlation is positive and more pronounced among firms in the worst affected countries. The Korean case is particularly notable, where the correlation by far exceeds that for firms in other countries, especially in the pre-crisis period. In the post crisis period however there is a distinct change in the pattern (often a lower positive or even negative correlation) of the relationship among firms in many of these worst affected countries.

4.2. Estimates of the Speed of Adjustment

Table 6 displays the estimates of β_{it}'s and γ for the selected countries in our sample for the period 1993-2002. These estimates are heteroscedastic consistent in that the covariance matrix is adjusted for White's correction. Two measures of goodness of fit are presented for each case. The first is the generalised r-squared (GR^2) for instrumental variable estimation (Pesaran and Smith, 1994), while the second is the more common square of the correlation between the actual and fitted values of the dependent variable. In general, there is evidence of good fit for differences data in each case. Secondly, P-values from the Sargan test are shown in the Table, fails to reject the null hypothesis of instrument validity in all cases. The tests for serial correlation (negative first order, positive second order) are also presented for each case, which confirm the absence of any serial correlation problem here.

The results vary between the sample countries, though some similarities are noted. Deviation of the actual capital stock from the optimal played a significant role in all cases. Specifically, the larger the nominal deviation of actual capital stock from the optimal one, the lower is the speed of adjustment. There is also evidence of significant asymmetry in the adjustment of leverage with respect to K-K*, as the absolute term is also significant and positive, suggesting that firms with only a small absolute deviation from K* do not find it worthwhile to attempt to adjust their leverage. A similar pattern is also observed with respect to nominal and absolute deviation of $DE_{it} - DE_{it}^{*}$ over the previous period. These estimates suggest a significant correspondence between K-K* and $DE_{it} - DE_{it}^{*}$ and the speed of adjustment, which in turn is indicative of some degree of inertia/inability among sample firms to adjust the actual leverage to the optimal level, thus exhibiting some degree of moral hazard.

We also note some significant differences in results pertaining to the worst affected countries. Most notably, the crisis dummy is significant for the worst affected countries while it remains insignificant for Singapore and Taiwan, both of which were least affected by the crisis. The coefficient is negative for Malaysia and Thailand, indicating that compared with other years, the speed of adjustment was slower for these firms during 1997-98 while the effect was just opposite in Korea and Indonesia.

Firm performance, as measured by profit margin, plays a significant role for firms in the worst affected countries. More profitable firms in Korea and Thailand had higher speeds of adjustment, while those in Thailand seem to show signs of inertia. Our estimates also suggest that the speed of adjustment is lower among larger firms in Thailand. Among the worst affected countries, the coefficient of annual stock returns is significant only in Malaysia, such that higher annual stock returns enhance the speed of adjustment. The latter may be indicative of some degree of substitutability between debt and equity finance in the country.

More interestingly, a higher share of short-term debt is associated with significantly lower speed of adjustment in the worst affected countries while a higher share of cash flow (in relation to current liability) is associated with higher speed among firms in most countries except Korea. Clearly, firms with more short-term debt need to adjust leverage faster, though this does not seem to be the case in our sample, suggesting evidence of weak corporate governance. However for given share of short-term loan access to more cash flow is associated with faster speed of adjustment in the worst affected countries except Korea. For given share of short-term debt, Korean firms with more cash flow however seem to be reluctant to adjust their leverage to the optimal and yet continue to be in business as usual.

In addition to market frictions, annual changes in the optimal level of leverage are significant in explaining changes in actual leverage (captured by the estimate of γ) in all the worst affected countries. The elasticity of changes in leverage with respect to the changes in the optimal leverage indicates the extent to which the firm is able to respond to external changes. In general, the estimate of γ is positive and significant in most cases while the highest value of the estimate is observed among Korean firms, thus demonstrating the greatest ability of these firms to respond internally to changes in optimal leverage levels, for given values of other variables.

Finally, we use the coefficient estimates to calculate the firm-specific speeds of adjustment for the selected countries. The overall distribution of the speeds of adjustment are summarised in Table 7A. The average is below 0.5 in all cases though the maximum is often considerably higher than 1 and varies across the sample countries. Among the worst affected countries, the lowest average speed is observed among Thai firms while the Malaysian firms had the highest average closely followed by Korean firms. With annual data, the inverse of the speed of adjustment is clearly the number of years a firm would take to fully adjust to its optimum level of leverage. This in turn means that the average Malaysian firms would take 3 years to fully adjust, closely followed by Korean firms (just under 4 years). While Indonesian firms would take nearly 7 years, Thai firms would take more than double that time (nearly 16 years) to reach their respective optimal levels. On an average, dependence on external finance is lower among Malaysian firms (Table 2) in our sample. The latter is further reflected in low average leverage (and at levels similar to the average leverage rates in the least affected countries) and greater reliance on equity finance (Table 3) among Malaysian firms. In addition, share of tangible assets in total assets has been the highest among the sample countries for most of the sample period. Perhaps all these factors have resulted in a faster speed of adjustment among Malaysian firms.[15]

Table 7B in addition shows the distribution of speeds of adjustment before, during and after the crisis in the selected countries. This further reveals that compared with the pre-crisis period, the speed of adjustment was often significantly lower during the crisis years and then significantly increased during the post-crisis restructuring period in all the worst affected

[15] Although average leverage has been higher among the Korean firms in our sample, share of their current liability has been the lowest among all the sample countries (see Table 4); the latter may explain the relatively higher speed of adjustment among these firms.

countries. In contrast, speed of adjustment remained more stable (but low) in Singapore throughout the sample period.

5. CONCLUDING COMMENTS

While the aggregate macroeconomic analysis of the recent Asian Crisis highlights the problem of moral hazard of bad loans in poorly supervised and regulated East Asian economies, there is very little firm-level analysis to characterize it. The present paper attempts to fill in this gap in the literature and focuses on the process of dynamic adjustment of the actual leverage towards the optimum.

We use Worldscope firm-level panel data from four worst affected countries and present comparisons with three of the less affected countries. Our analysis for the period 1993-2002 suggests that contrary to the general hypothesis, higher quality firms (with higher market valuation and profit margin) tend to have lower leverage in most sample countries while larger firms in Indonesia and Thailand tend to have larger leverage. These results are also suggestive of a close correspondence between excess capital stock and excess leverage in the pre-crisis period, especially in the worst affected countries.

We examined the effects of a number of real and financial variables in the dynamic adjustment process. These results indicate a significant degree of corporate inertia in adjusting actual leverage towards the optimal. This is particularly prevalent among firms with excess capital stock and higher share of short-term loans. Equally, these problems seem to beset the largest firms in Thailand, perhaps explaining the severity of the crisis there. These findings are indicative of the moral hazard problems of bad loans in poorly supervised and regulated economies where even relatively better off firms can continue to borrow and over-invest without adjusting their capital structure towards the optimum. This inertia is particularly evident during the pre-crisis and crisis periods though our estimates tend to suggest that the adjustment process was significantly speeded up in the post-crisis period.

Clearly the least affected countries had relied less on debt finance and Malaysia, among the worst affected countries, had relatively low share of debt finance in total external finance (more in line with the least affected countries). This is further reflected in the significant and positive coefficient of the annual stock return variable in the speed equation for Malaysian firms, who also had the highest speed of adjustment among the worst affected countries. Thus without much loss of generality one could argue that greater reliance on equity markets could be one possible way out of the problem of weak corporate governance and the associated moral hazard of bad loans in these economies.

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TABLE. 1. NUMBER OF FIRMS IN SAMPLE COUNTRIES, 1989-2002

	Korea	Malaysia	Singapore	Thailand	Indonesia	Taiwan	Hong Kong
1989	75 (75)	55 (55)	29 (29)	11 (11)	1 (1)	5 (5)	44 (41)
1990	73 (73)	63 (63)	33 (33)	22 (22)	31 (31)	5 (5)	49 (46)
1991	74 (73)	108 (108)	56 (56)	70 (70)	33 (33)	22 (22)	61 (59)
1992	83 (81)	136 (136)	64 (64)	119 (119)	64 (64)	25 (25)	75 (74)
1993	122 (118)	134 (134)	64 (64)	159 (157)	65 (65)	40 (40)	76 (76)
1994	146 (144)	146 (146)	80 (80)	165 (164)	70 (70)	93 (93)	94 (94)
1995	161 (158)	203 (203)	110 (110)	174 (173)	91 (91)	170 (170)	161 (160)
1996	179 (175)	249 (249)	129 (129)	188 (188)	104 (104)	181 (181)	226 (215)
1997	190 (177)	265 (260)	141 (141)	186 (168)	103 (86)	192 (192)	257 (245)
1998	182 (175)	266 (263)	148 (147)	182 (165)	102 (68)	194 (191)	259 (247)
1999	175 (173)	266 (257)	170 (164)	174 (154)	100 (81)	313 (304)	283 (271)
2000	169 (165)	263 (251)	267 (262)	170 (158)	100 (80)	372 (365)	409 (393)
2001	160 (158)	264 (257)	316 (308)	166 (152)	100 (85)	411 (404)	544 (528)
2002	160 (158)	262 (258)	332 (326)	161 (159)	98 (90)	405 (396)	572 (562)

Note: Number in the parentheses give the corresponding number excluding the outliers in each sample.

TABLE 2. USE & COMPOSITION OF EXTERNAL FINANCE

		External Finance/total Finance (%)	Composition of external finance	
			new debt	new equity
Korea				
Pre-crisis	1989-1996	64.69	87.05	12.95
Crisis	1997-1998	26.79	91.24	8.76
Post-crisis	1999-2002	54.80	76.10	23.90
Thailand				
Pre-crisis	1989-1996	37.47	56.87	43.13
Crisis	1997-1998	17.97	76.63	23.37
Post-crisis	1999-2002	11.00	74.93	25.07
Indonesia				
Pre-crisis	1989-1996	34.60	72.52	27.48
Crisis	1997-1998	31.48	90.73	9.27
Post-crisis	1999-2002	11.86	84.88	15.12
Malaysia				
Pre-crisis	1989-1996	30.10	63.86	36.14
Crisis	1997-1998	21.85	75.80	24.20
Post-crisis	1999-2002	22.73	68.57	31.43
Hong Kong				
Pre-crisis	1989-1996	32.12	66.79	33.21
Crisis	1997-1998	40.55	60.45	39.55
Post-crisis	1999-2002	32.97	58.83	41.17
Singapore				
Pre-crisis	1989-1996	29.28	59.70	40.30
Crisis	1997-1998	46.87	62.44	37.56
Post-crisis	1999-2002	20.67	56.95	43.05
Taiwan				
Pre-crisis	1989-1996	25.96	81.04	18.96
Crisis	1997-1998	-6.68	70.89	29.11
Post-crisis	1999-2002	35.33	84.79	15.21

TABLE 3. DISTRIBUTION OF OBSERVED LEVERAGES, 1989-2002

	Mean leverage				Mean leverage				Mean leverage				Mean leverage			
Year	**|D/E|**	**D/E**	**Max**	**Min**	**|DE|**	**D/E**	**Max**	**Min**	**|DE|**	**D/E**	**Max**	**Min**	**|DE|**	**|DE|**	**Max**	**Min**
	Korea				**Indonesia**				**Hong Kong**				**Malaysia**			
1989	1.88	1.37	6.6	0.70	NA	NA	NA	NA	0.42	0.52	2.9	0.0	0.70	0.79	12.3	-2.6
1990	2.41	1.78	12.1	0.41	3.7	0.77	2.17	0.0	0.42	0.49	2.8	0.0	0.41	0.50	3.7	0.0
1991	3.19	3.10	24.2	0.36	2.5	0.52	3.89	0.0	0.55	0.61	3.1	0.0	0.36	0.42	2.5	0.0
1992	3.04	2.74	20.5	0.36	5.0	0.63	1.82	0.0	0.49	0.55	3.1	0.0	0.36	0.41	5.0	0.0
1993	2.61	2.63	17.8	0.49	13.6	0.65	1.65	0.0	0.42	0.47	2.2	0.0	0.49	0.55	13.6	0.0
1994	2.66	2.65	23.3	0.49	3.1	0.71	2.29	0.0	0.48	0.50	2.4	0.0	0.49	0.48	3.1	-2.6
1995	2.64	2.63	23.4	0.63	5.1	0.88	2.87	0.0	0.61	0.62	2.7	0.0	0.63	0.67	5.1	-1.8
1996	2.86	2.87	26.1	0.80	5.5	0.99	3.08	0.0	0.60	0.59	3.1	-2.2	0.80	0.87	5.5	0.0
1997	3.81	2.72	21.9	0.99	12.0	1.22	11.93	-28.7	0.52	0.50	2.3	-2.9	0.99	1.06	12.0	-1.2
1998	2.51	2.13	22.0	1.16	9.1	1.62	33.05	-25.0	0.56	0.47	2.8	-2.8	1.16	0.97	9.1	-6.0
1999	1.56	0.90	14.6	1.18	11.9	0.57	28.05	-15.7	0.56	0.43	3.2	-2.9	1.18	0.90	11.9	-6.2
2000	1.82	1.00	26.5	1.02	13.0	-1.41	18.46	-143.8	0.43	0.40	3.2	-1.7	1.02	0.64	13.0	-6.7
2001	1.59	1.13	10.1	0.95	8.8	0.83	30.95	-14.6	0.43	0.39	3.1	-2.7	0.95	0.49	8.8	-5.2
2002	1.80	1.38	30.2	0.99	14.9	-0.88	35.53	-149.0	0.43	0.39	3.2	-3.3	0.99	0.55	14.9	-7.1

year	**|D/E|**	**D/E**	**max**	**Min**	**|DE|**	**D/E**	**max**	**min**	**|DE|**	**D/E**	**max**	**min**
	Taiwan				**Thailand**				**Singapore**			
1989	0.39	0.38	1.0	0.1	0.74	0.74	2.14	0.07	0.31	029	1.1	0.0
1990	0.34	0.34	0.9	0.0	0.87	0.87	2.92	0.01	0.38	0.37	2.4	0.0
1991	0.52	0.52	1.5	0.0	0.89	0.89	4.28	0.00	0.39	0.38	2.4	0.0
1992	0.51	0.51	1.1	0.0	0.93	0.96	6.05	0.00	0.44	0.41	2.9	0.0
1993	0.45	0.45	1.7	0.0	0.94	0.95	4.14	0.00	0.51	0.48	2.9	0.0
1994	0.44	0.43	1.5	0.0	0.99	1.00	6.17	0.00	0.45	0.42	2.4	0.0
1995	0.47	0.46	2.1	0.0	1.17	1.09	3.80	-7.16	0.51	0.48	2.7	0.0
1996	0.51	0.49	2.4	0.0	1.33	1.20	6.08	-7.13	0.62	0.59	4.5	0.0
1997	0.53	0.52	2.6	0.0	2.44	0.91	7.77	-14.51	0.69	0.67	5.1	0.0
1998	0.65	0.63	5.9	0.0	1.95	1.10	9.17	-11.54	0.84	0.82	8.2	0.0
1999	0.64	0.62	5.0	0.0	1.75	0.78	8.67	-12.85	0.62	0.57	4.1	0.0
2000	0.69	0.67	5.8	0.0	1.59	0.80	7.68	-9.67	0.59	0.56	7.5	-1.1
2001	0.69	0.65	5.3	0.0	1.36	0.76	8.72	-12.74	0.61	0.57	5.7	-1.5
2002	0.67	0.64	5.9	0.0	1.58	0.60	9.20	-14.63	0.59	0.60	8.5	-1.6

Table 4. Selected characteristics of sample firms

	Absolute leverage	Current liabilities/ total liabilities	Tangible assets/ total assets	Cash flow/ current liabilities	Interest payments/ EBIT	(Interest +debt) /EBIT	% of firms with -ve equity
Korea							
1989-96	2.66	0.59	0.35	0.15	0.88	9.29	18.9
1997-98	3.16	0.61	0.40	-0.06	-2.88	-22.23	9.9
1999-2002	1.69	0.61	0.45	0.22	0.27	2.82	9.9
Indonesia							
1989-96	0.70	0.75	0.39	0.53	0.27	2.33	
1997-98	3.54	0.70	0.41	0.11	-0.25	-11.66	13.1
1999-2002	3.57	0.67	0.43	0.28	-0.03	-1.31	20.6
Malaysia							
1989-96	0.53	0.77	0.61	0.44	0.14	2.78	0.30
1997-98	1.08	0.72	0.76	0.26	0.16	4.15	3.63
1999-2002	1.03	0.73	0.90	0.32	-0.56	-6.38	12.00
Thailand							
1989-96	0.98	0.75	0.43	0.44	0.21	2.66	0.3
1997-98	2.19	0.73	0.47	0.27	-0.53	-7.52	12.1
1999-2002	1.57	0.68	0.46	0.40	0.11	1.23	11.8
Hong Kong							
1989-96	0.50	0.75	0.65	0.48	0.54	6.57	
1997-98	0.54	0.77	0.57	0.27	0.00	1.99	1.8
1999-2002	0.48	0.81	0.58	0.16	0.10	1.94	3.4
Singapore							
1989-96	0.43	0.78	0.35	0.36	0.20	4.13	
1997-98	0.74	0.74	0.41	0.24	0.40	6.70	
1999-2002	0.58	0.79	0.39	0.29	0.12	3.66	1.1
Taiwan							
1989-96	0.45	0.72	0.68	0.53	0.84	13.00	
1997-98	0.57	0.68	0.55	0.37	0.14	2.01	
1999-2002	0.64	0.70	0.55	0.38	0.23	3.32	

Table 5. Fixed-effects estimates of optimal leverage

	Indonesia	Korea	Malaysia	Thailand	Hong Kong	Singapore	Taiwan
1992-96	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coeff (T-stat)
Market valuation	-.567** (2.31)	-3.674** (2.97)	-1.190 (7.93)	-1.569** (7.16)	-1.963** (5.39)	-.798** (5.98)	-.798** (3.75)
Size	.006 (3.07)**	-.0001 (.69)	.0006 (6.66)	.004** (2.05)	-.0003** (4.62)	-.0001** (2.52)	.0004 (1.25)
Profit	-3.321 (5.43)**	-2.156** (2.40)	-.005 (.55)	-.070** (2.06)	-.240* (1.69)	-.045 (.53)	-1.503 (3.30)
K-K*	.0578 (.79)	7.441* (1.94)	-.071** (2.27)	.196** (3.64)	.040 (1.17)	.183** (6.60)	.135 (1.56)
F-stat ★	41.61 (0.000)	1.792 (0.79)	38.91 (0.000)	66.30 (0.000)	22.72 (0.000)	32.06 (0.000)	8.06 (0.089)
R-squared	.845	.567	.777	.762	0.648	.892	.900
1997-98	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coeff (T-stat)
Market valuation	-.619** (5.08)	-.744** (5.36)	-.573 (5.89)	-5.249** (2.20)	-.073** (1.97)	-.091** (3.22)	-.628** (3.15)
Size	.002 (1.06)	-.0008 (.68)	-.0001 (.38)	.004 (.64)	-.0073** (2.248)	-.00002 (.64)	.0007 (.88)
Profit	-4.904** (2.84)	-6.492** (2.54)	-.177** (2.14)	-25.52** (7.36)	-.281** (.4.13)	-1.019** (2.61)	-1.611** (3.21)
K-K*	1.055** (2.06)	3.268** (6.27)	.263 (3.13)	3.961 (1.14)	.050 (.87)	-.149 (1.16)	.175* (1.77)
R-squared	.905	.567	.899	.526	0.910	.862	.943
F-stat★	19.57 (0.006)	1.159 (0.082)	1.198 (0.73)	3.536 (0.47)	38.261 (0.000)	41.64 (0.000)	108.07 (0.000)
1999-2002	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coeff (T-stat)
Market valuation	-3.777** (2.66)	-7.171** (3.34)	-3.386** (3.49)	-8.977** (2.41)	-.588** (2.66)	-5.365** (3.86)	-.280** (1.99)
Size	.002 (.73)	-.0002 (.97)	-.0001 (.22)	.008* (.47)	-.0002** (2.24)	-.0041 (.68)	.00001 (.29)
Profit	.520 (.58)	-1.841** (2.00)	-1.05** (2.03)	-5.539** (7.93)	-.117** (2.82)	-3.408** (3.66)	-.991** (3.21)
K-K*	.788** (2.22)	.999* (1.22)	.888 (1.53)	1.485 (.51)	.139** (1.71)	4.18* (1.88)	.038 (1.71)
R-squared	.809	.502	.431	.392	0.756	.366	.845
F-stat ★	5.343 (0.25)	6.011 (0.19)	9.700 (0.046)	0.943 (0.918)	3.743 (0.44)	15.94 (0.003)	124.25 (0.000)
Structural Break (F stat)	12.374 (p=.000)	45.274 (p=.000)	25.247 (p=.000)	24.132 (p=.000)	24.108 (p=.000)	15.453 (p=.000)	12.268 (p=.000)

★ F-stat refers to the rejection of fixed effects tested against the alternative of random effects.

Table 6. Dynamic estimates of leverage

	Indonesia	Korea	Malaysia	Thailand	Hong Kong	Singapore	Taiwan
Variables Speed parameters	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coef. (T-stat)	Coeff (T-stat)
β_0	-4.407 (-1.291)	-0.177 (-0.914)	0.117 (0.124)	-0.250 (-2.278)	0.657 (5.753)	-0.329 (-0.567)	-0.449 (-1.12)
$(K\text{-}K^*)_{it-1}$	-4.729 (-1.959)	-0.253 (-2.849)	-0.303 (-2.035)	-0.294 (-3.209)	-0.232 (-7.429)	0.140 (2.813)	-0.446 (2.677)
$(DE\text{-}DE^*)_{it-1}$	0.443 (2.053)	-0.920 (-1.097)	-0.035 (-6.392)	-0.040 (-13.853)	0.0437 (16.782)	-0.065 (-0.458)	0.769 (5.477)
$(SALES)_{it-1}$	0.501 (0.754)	-0.744 (-0.381)	-0.225 (-2.777)	-0.228 (-6.975)	-0.599 (-6.468)	-0.136 (-0.176)	0.506 (0.666)
$CRISIS_{it-1}$	2.106 (1.606)	0.454 (2.745)	-0.055 (-2.937)	-0.232 (-5.208)	0.124 (3.391)	0.344 (1.224)	-0.090 (-0.907)
$\lvert DE\text{-}DE^*\rvert_{it-1}$	-0.193 (-0.372)	0.017 (1.966)	0.032 (11.530)	0.041 (14.314)	-0.046 (-5.303)	0.114 (2.764)	1.149 (2.731)
$\lvert K\text{-}K^*\rvert_{it-1}$	10.718 (2.317)	1.118 (3.159)	0.409 (2.851)	0.224 (2.012)	0.405 (6.524)	0.333 (0.781)	0.749 (3.918)
SR_{it-1}	-8.864 (-0.634)	0.102 (0.275)	0.268 (4.846)	0.144 (0.626)	0.214 (1.358)	-0.116 (-0.333)	-0.227 (-0.922)
$PROFIT_{it-1}$	31.946 (1.747)	2.174 (1.156)	0.769 (2.128)	-0.205 (-4.679)	0.019 (0.154)	-3.028 (-0.832)	0.879 (1.134)
$CASHCL_{it-1}$	-3.069 (1.2109)	-0.496 (2.278)	0.0089 (4.0450)	0.009 (2.365)	0.123 (2.8572)	1.237 (3.15)	0.256 (2.449)
$SDTD_{it-1}$	1.846 (0.566)	0.107 (3.604)	-0.002 (1.581)	-0.93 (6.937)	-1.19 (5.597)	0.257 (0.537)	0.792 (2.189)
Γ Adjustment parameter (ΔDE_{it}^*)	0.567 (0.844)	0.735 (9.145)	0.284 (3.847)	0.146 (9.539)	0.066 (7.105)	0.020 (0.511)	0.567 11.357
Sargan's test	0.314	0.274	0.259	0.178	0.192	0.201	0.324
GR^2	0.444	0.514	0.482	0.431	0.553	0.531	0.647
Corr(y, $\hat{y}$)	0.32513	0.698723	0.437053	0.49043	0.697997	0.643073	0.48362
*AR1~ $\chi^2(1)$ (pvalue)	4.314 (0.037)	5.219 (0.022)	6.214 (0.012)	4.891 (0.027)	3.899 (0.048)	4.955 (0.025)	5.73 (0.016)
AR2~ $\chi^2(1)$ (pvalue)	1.352 (0.244)	1.547 (0.213)	1.681 (0.195)	2.001 (0.157)	1.08 (0.299)	1.11 (0.292)	2.368 (0.123)

Note: * denotes significance at 10% or lower level and '**' denotes the same at 1% or lower level. All estimates use White's correction for heteroscedasticity.

* The AR1 tests presented here and in table A2 are for negative serial correlation, following Doornik *et al* (2002)

Table 7A. Distribution of speeds of adjustment in the sample countries

	Hong Kong	Indonesia	Korea	Malaysia	Singapore	Taiwan	Thailand
mean	0.18894	0.15082	0.26357	0.215413	0.098283	0.303059	0.0932169
St. dev	17.8125	15.32562	3.98187	0.737965	0.987565	0.263933	0.2755990
median	0.1081	0.38200	1.51E-06	0.266812	0.150788	0.342359	0.149065
max	631.9036	5.90888	6.48204	28.62558	26.45863	6.470119	3.291618
min	0.00022	2.127E-05	0.000463	0.000534	5.6222E-05	0.00031	0.000249
skew	34.0291	-12.0089	-8.134784	1.783668	-7.354186	-3.05219	3.327086

Table 7B. Distribution of speeds of adjustment before, during and after the crisis

	1993-96	1997-98	1999-02	1993-96	1997-98	1999-02
	Indonesia			Hong Kong		
mean	0.1014	0.05524	0.34642	0.12508	0.20123	0.15465
st dev	2.55976	0.56037	0.45778	6.52292	5.12393	9.21823
median	0.07263	0.09099	0.57779	0.10778	0.29692	0.28329
max	1.83413	3.77037	5.90888	52.7208	631.904	28.5176
min	0.00029	2.1E-05	0.00011	0.00025	0.00023	0.00035
skew	16.4524	8.78116	11.4564	3.68706	-7.007	-1.872
	Korea			Malaysia		
Mean	0.22163	0.12489	0.37108	0.20114	0.08899	0.28558
st dev	0.28901	4.4266	6.67862	0.2748	0.39925	0.30004
median	0.15757	0.01482	0.19	0.2004	0.12504	0.17425
max	0.52786	0.61833	6.48205	4.46951	3.65053	28.6256
min	0.00044	0.00055	0.00086	0.0003	0.00016	0.00095
skew	0.63263	0.71422	1.42144	-0.147	-2.1183	27.4537
	Singapore			Taiwan		
mean	0.08062	0.08316	0.12688	0.31506	0.20209	0.34839
st dev	0.04466	0.03918	1.14118	0.3287	0.41112	7.85847
median	0.08003	0.07609	0.06521	0.26558	0.15119	0.05161
max	0.22235	0.28039	26.4586	1.19087	2.15476	6.47012
min	5.6E-05	0.00037	0.00032	0.00061	0.00032	0.00082
skew	2.46353	1.35567	19.2874	0.35438	0.98356	23.3264
	Thailand					
mean	0.03848	0.03362	0.17558			
st dev	0.18311	0.17001	0.14349			
median	0.03904	0.04163	0.29449			
max	0.33352	0.71406	3.29162			
min	0.00025	0.00044	0.00091			

Figure 1. Trend in absolute debt-equity ratio, 1989-2002

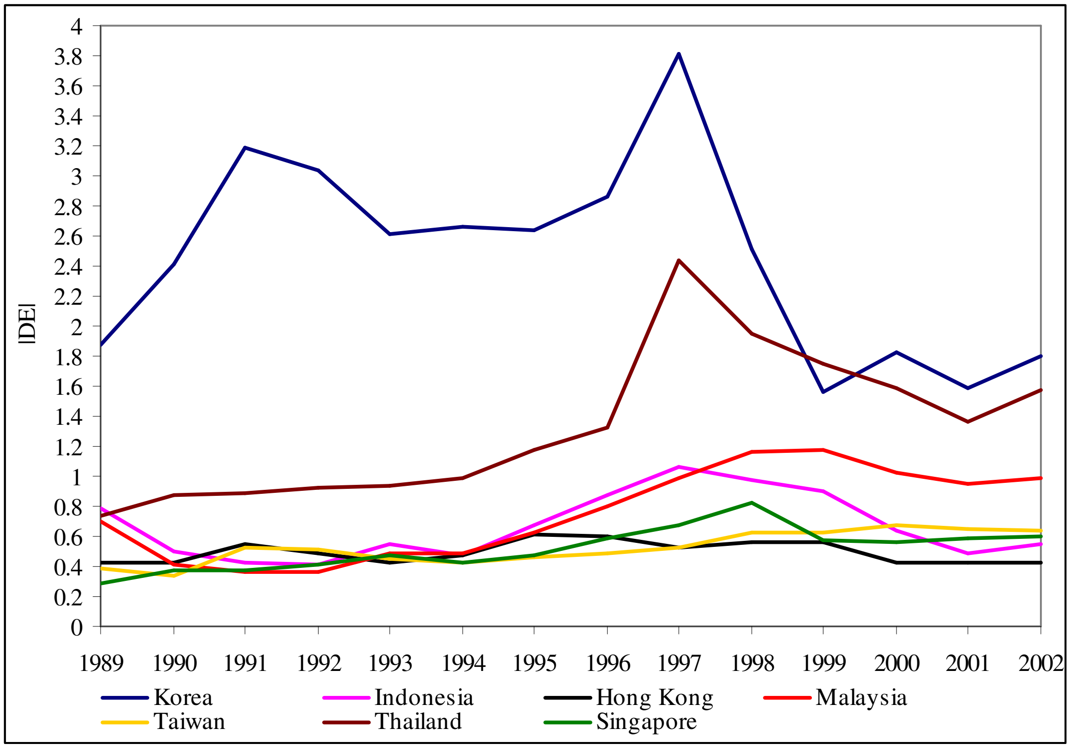


Figure 2. Trend in tangible assets, 1989-200

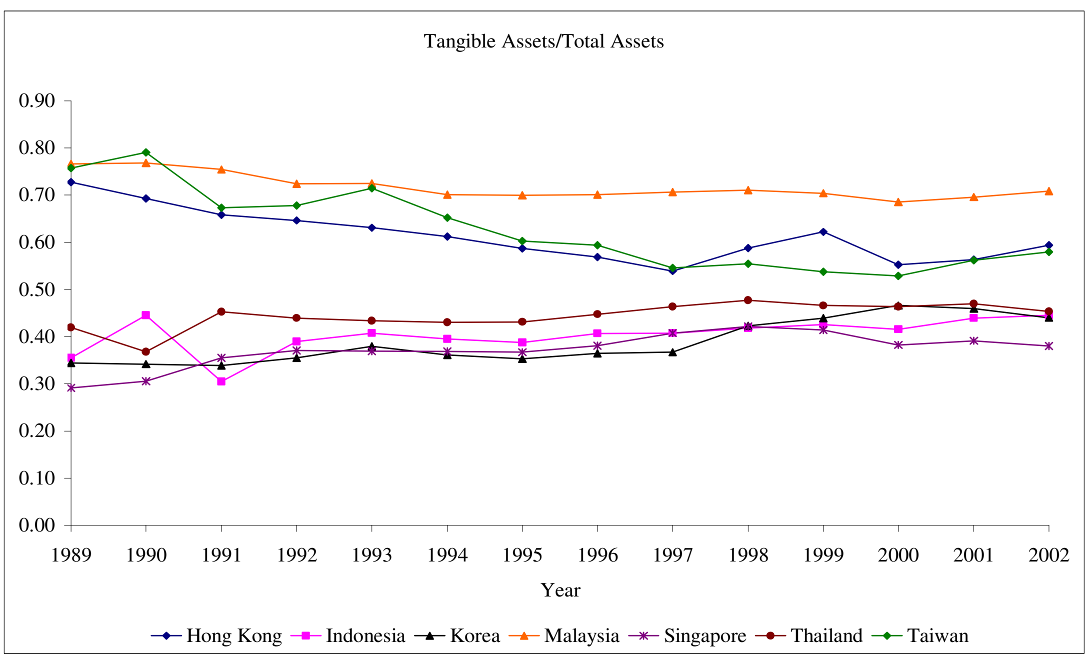
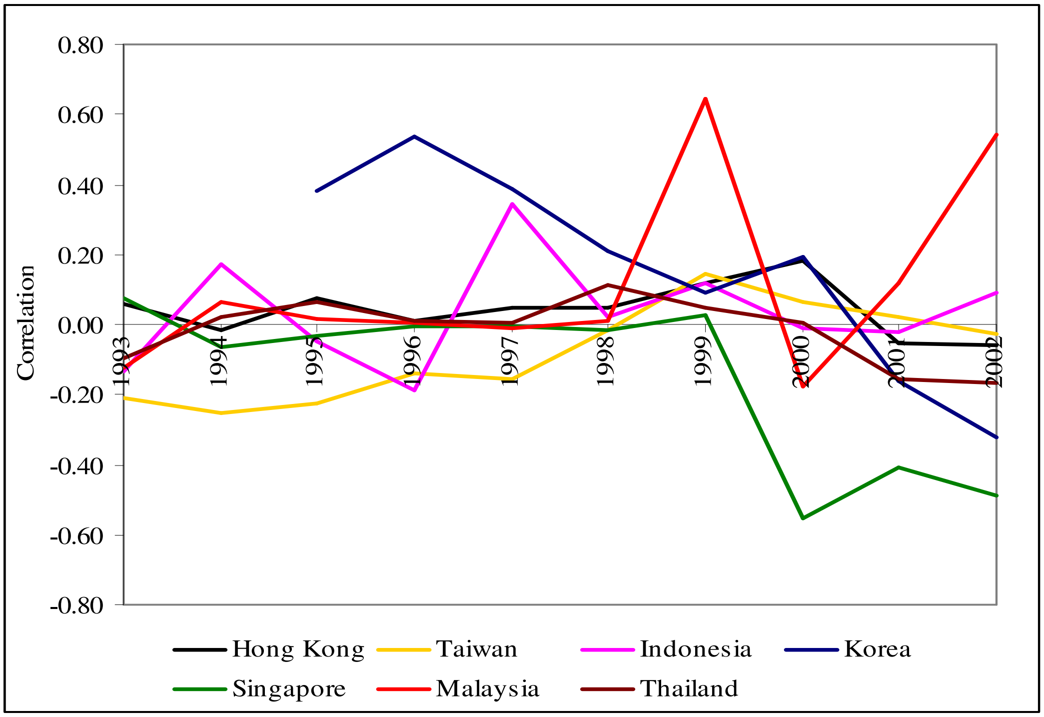


Figure 3: Correlation between DE-DE* and K-K* over time



APPENDIX

Determination of optimal capital stock

Before embarking on the determination of optimal leverage and the dynamic adjustment of actual leverage to the optimum, we first determine the optimal capital stock and its deviation from the actual since it plays an important role in our analysis.

We only observe actual capital stock K, but not the optimal capital stock K*. So as a first step, we need to determine K*. Standard models of the optimal level of capital services are based on the work of Nickell (1979), Pfann (1996), or Thomsen (2000) which makes use of a simple structural model of the capital market. Output (Q) allows for any exogenous change in local output, either due to change in demand in the product market, or the relocation decision of the firm for example. However, the development of a firm's capital stock is generally assumed to follow a partial adjustment process, as the firm moves to wards optimal capital levels. Partial adjustment arises because firms are presumed to operate in imperfect capital markets that prevents them from fully adjusting when financial structure deviates from its target and also prevent optimal funding of new investment spending. The primary hypothesis in this case is that the speed of adjustment coefficients is positive but less than unity, see for example Hall (1992), Nickell (1979). For empirical treatments of this type of model, see Barrell and Pain (1996) or Bajo-Rubio and Sosvilla-Rivero (1994) for example.

We estimate the optimal capital stock using a standard fixed effects estimator, though this was tested against group means estimator and the dynamic fixed effects model following Arrellano and Bond (1989). compared with the estimates from the various procedures were very similar, and the (within) fixed effects estimates were employed to generate the optimal capital stock K* in our sample. A further consideration here is the larger number of observations that it generates compared with the dynamic model, requiring lags and instruments.

Table A1. Number of firms, total observations in the dynamic estimates

	Total	Pre crisis	Crisis (97-98)	Post crisis	Period
Indonesia					1994-2000
Firms	114	105	114	67	
No of obs	474	105	302	67	
Korea					1994-2001
Firms	40	40	38	39	
No of obs	298	115	113	78	
Malaysia					1994-2001
Firms	200	200	200	176	
No of obs	1067	200	532	335	
Thailand					1994-2001
Firms	147	147	128	102	
No of obs	674	147	353	174	
Hong Kong					1994-2001
Firms	186	165	186	175	
No of obs	1002	165	499	337	
Singapore					1994-2001
Firms	112	85	106	112	
No of obs	571	85	289	197	
Taiwan					1994-2002
Firms	277	80	165	277	
No of obs	1003	80	475	448	