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An empirical survey of Indonesian equities 1985–1992 [☆]

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Abstract

Using a new data base of equities listed on the Jakarta Exchange, historical returns were documented for the 1985–92 period. Jakarta stocks had high volatility relative to other countries, and startling short-term price movements, such as several hundred percent during December 1988. A new model of microstructure suitable for markets with infrequent trading was developed and applied to Jakarta. It disclosed substantial non-random price fluctuations. Indonesian equity returns were weakly but significantly related to returns in other countries. Jakarta's value stocks (those with low market/book value ratios) performed much better than growth stocks.

Keywords: International markets; Market microstructure; Stock returns

JEL classification: G14, G15

Although Indonesia has had an active equity market for a number of years, no empirical studies of this market have appeared in western scholarly journals. The lack of conveniently accessible data has recently been alleviated through a joint

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effort by the University of Rhode Island's PACAP Research Center and the Jakarta Stock Exchange. The resulting PACAP/Jakarta data set covers the calendar years 1985–1992. The present paper provides an introductory survey of these data.

The purposes of the paper are (a) to document historical characteristics of Indonesian equities (b) to compare Indonesian equities with those from other countries, and (c) to point out curious and puzzling phenomena worthy of further investigation. The main objective is merely to survey the empirical terrain, not to conduct in-depth analyses of particular issues. Hopefully, scholarly appetites will be whetted for further investigation.

The paper consists of four sections on the following topics:

1. The historical behavior of Jakarta Exchange listed stocks.
2. Phenomena related to the market micro-structure of the Jakarta Stock Exchange.
3. The relation of Indonesian equities to equities traded in other countries.
4. Accounting-based style investing and its historical performance.

1. The historical behavior of Jakarta exchange listed stocks

Fig. 1 shows the month-end price index levels of the Composite Index of the Jakarta Stock Exchange (JSXCI), with January 1985 normalized to 1.0. The

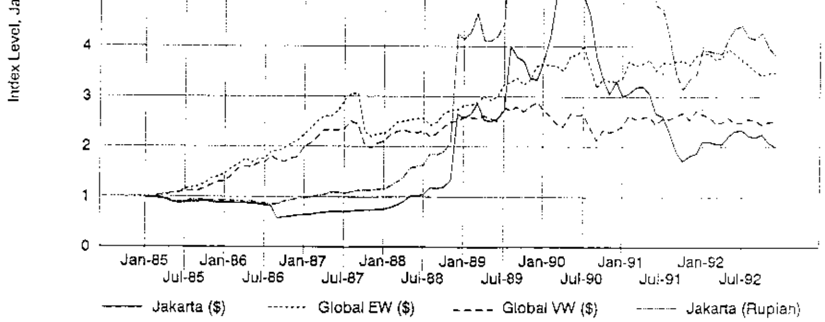

Fig. 1. Jakarta Stock Exchange composite index and global indices of 24 countries (monthly, 1985–92).

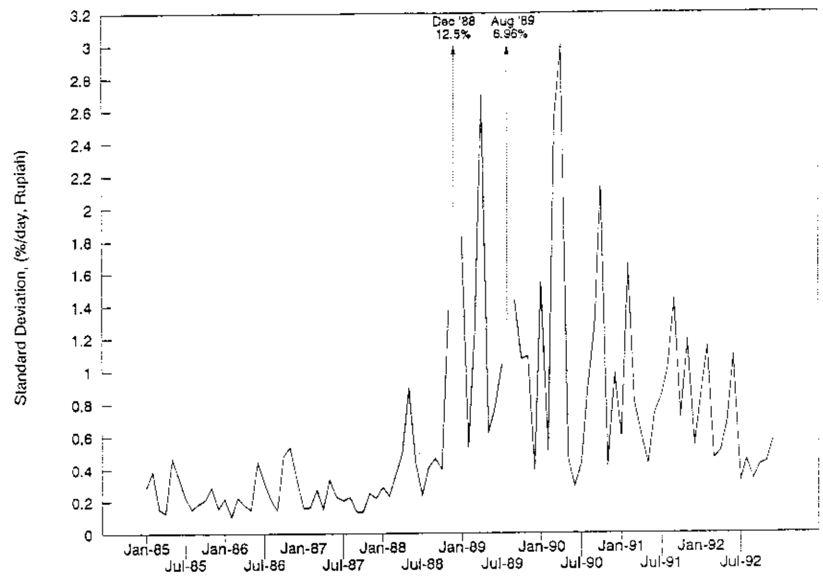

Fig. 2. Volatility of Jakarta Exchange composite index returns (intra-month, 1985–92).

JSXCI is a value-weighted index of all listed companies adjusted for splits, stock dividends, and rights offerings. It does not contain reinvested cash dividends. The index level is given in local currency (the Rupiah) and also converted to U.S. dollars at the current Rupiah/$ spot exchange rate.

Also plotted in Fig. 1 for the same time period are price indices for stocks in the major developed countries, expressed in U.S. dollars. The Global EW index is constructed from an equal-weighted average of the returns from the 24 individual countries [1] that comprise the Goldman Sachs/FT-Actuaries global market indicators. [2] The Global VW index weights these 24 country returns by their respective aggregate stock market capitalizations.

As the figure makes obvious, the available history for Indonesian equities can be divided into two distinct periods. From January 1985 through November 1988, there was only moderate movement in the JSXCI. The standard deviation of

[1] The 24 countries represented are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Singapore, South Africa, Spain, Sweden, Switzerland, United Kingdom, and United States.

[2] The FT-Actuaries World Index is owned and jointly compiled by Goldman, Sachs and Co., NatWest Securities Limited and The Financial Times Limited in conjunction with the Institute of Actuaries and the Faculty of Actuaries. "FT-Actuaries World Indices", "FT-Actuaries World Index", and "FTAWI" are trade and service marks of FT and are used under license by Goldman, Sachs and Co. and NatWest Securities Limited.

monthly (daily) returns was 3.86% (0.417%). In December 1988, Jakarta stock prices rose 100.1% in Rupiah and 99.2% in dollars. Subsequent to that extraordinary month, i.e., from January 1989 through the end of the dataset, December 1992, the standard deviation of monthly (daily) returns has been 10.6% (1.60%), three to four times larger than before December 1988, depending on the return interval. Fig. 2 plots the intra-month volatility (standard deviation of returns) for the JSXCI over the entire sample period. The second sub-period (since January 1989), has systematically larger volatitility; i.e., the larger volatility over the entire post-1988 period is not just due to a few outliers.

Clearly, the Indonesian stock market experienced a dramatic structural change around the end of 1988. What happened that December to cause first a doubling of prices and then an order-of-magnitude increase in volatility? The answer seems to be that December 1988 marks the point when foreign investors were given greater access to the Indonesian market and limits on foreign ownership were relaxed for most companies.

There is empirical evidence from other countries that restrictions on foreign ownership cause significant price discounts. Bailey and Jagtiani (1994) document price premia in Thai stocks that have reached foreign ownership limits. (In this case, there are two separate market prices, one for locals and one for foreigners.) They also find a similar phenomenon for several issues traded in other Asian markets. An implication of such premia is that local prices will rise when restrictions on foreign ownership are eased. Why there should be such premia in

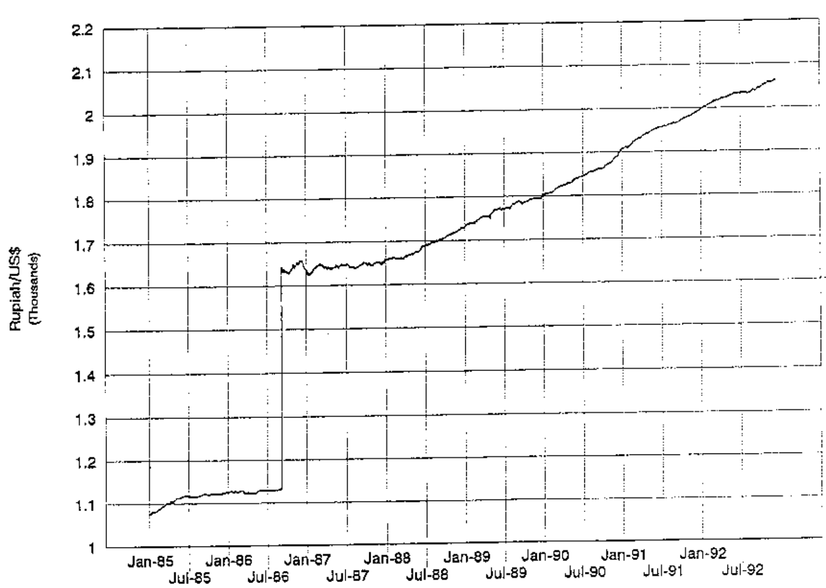

Fig. 3. Exchange rate, Rupiah/U.S.$ (daily, 1985–92).

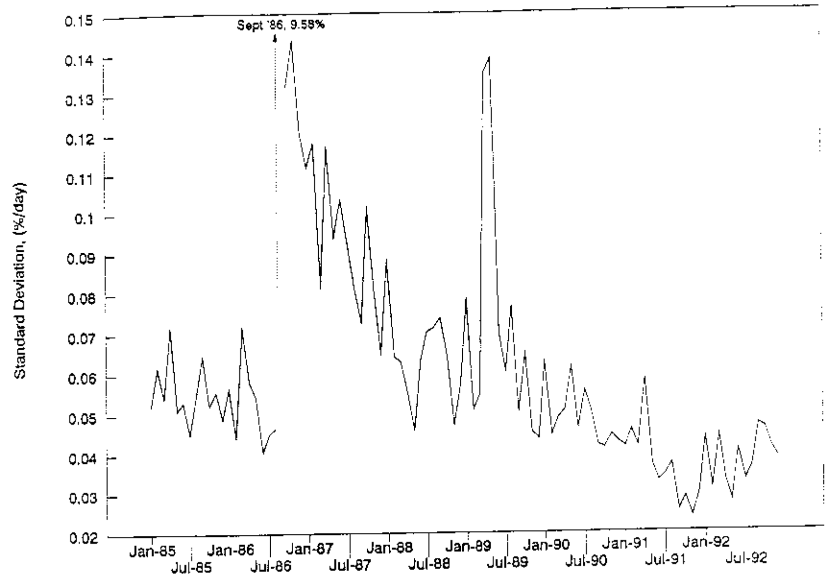

Fig. 4. Volatility of exchange rate changes (intra-month, 1985–92).

the first place is a puzzle. Perhaps foreigners view local stocks as less risky. Perhaps foreign real interest rates are lower, which implies that locals would discount cash flows at higher rates. [3] However, it remains for future research to verify that these possible causes were of adequate materiality to result in a doubling of prices and in a subsequent longer-term increase in volatility.

Returns from the Jakarta Stock Exchange converted to another currency display very similar patterns to the pattern observed in local currency because the Rupiah has not fluctuated very much. The few large observed changes in exchange rates were not related to events in the equity market.

Fig. 3 plots the Rupiah/U.S. Dollar exchange rate over the period and Fig. 4 plots intra-month volatilities of its daily percentage changes. The biggest exchange rate event was a devaluation of the Rupiah from 1134/$ to 1644/$ over the weekend September 12–15, 1986. Other than for this single date, the Rupiah has declined slowly but steadily against the dollar. In comparison to equities, its volatility has been very low. For example, during the post-1988 period, the standard deviation of daily changes was 0.0554 percent; the standard deviation of equity returns was almost 29 *times* larger. The history of the Rupiah/$ exchange

[3] This may have been particularly the case for Indonesia around the end of 1988. At that time, U.S. dollar yields were 1000 basis points less than Indonesian Rupiah yields, though inflation rates were not very different. I am endebted to Warren Bailey for this observation.

rate bears evidence of central bank interventions designed to smooth out its natural volatility.

Looking more closely at the period around the end of 1988, Fig. 5 shows the JSXCI before and after the year end, and, on a finer scale, the months of December 1988 and January 1989. The exchange rate clearly played no major role in this period; there is little difference in the patterns of equity prices expressed in Rupiah and in dollars. The within-month volatility of equity returns during December is startling; the return standard deviation during the month was 12.5 percent *per day*. Although the overall monthly return for December 1988 was impressive, the intra-month fluctuations were even more so. The JSXCI shot up from 153 on December 1 to 442 on December 20, a movement of +289 percent in Rupiah, but then it declined to 305 by December 30, losing 31 percent of its highest level. At the end of the month, the index was roughly twice its beginning-of-month level, but this must have been small comfort to investors who bought stock during the third week of December!

Prior to December 1988, there were only 18 stocks in the data base with at least twenty daily return observations. Subsequently, the number of listed stocks has grown rapidly; a total of 131 issues had at least 20 return observations in the period from January 1989 through December 1992. [4] Fig. 6 shows the number of stocks with available price quotations daily over the entire sample period. [5] The end of 1988 marks the beginning of substantial growth in the number of issues as well as an increase in index volatility.

The prices of individual stocks conform to the same general pattern as the JSXCI. Table 1 shows that the standard deviation of returns averaged over all available stocks prior to December 1988 was 1.84% per day while it was 4.81% subsequent to that date. This is not simply attributable to new listings being more volatile; the 18 stocks with available data prior to December 1988 had even a higher subsequent volatility, 6.69% per day. During the month of December 1988, there were 13 stocks with at least five daily returns and their average volatility that month was 19.07% per day!

Table 1 reveals some other relevant information about these data. Notice that the average number of time series return observations available for individual stocks in the nearly four years prior to December 1988 was only 85.6, while the average number in the four years after December 1988 was 251.5. In contrast, the composite index (the JSXCI) had a total of 1973 reported observations over these eight years. The difference is due to contrasting assumptions when computing a valid individual stock return as opposed to an index value.

For an individual stock to have an observed daily return, it must have had an actual transaction *on two adjacent trading days*. If the stock did not trade on either

[4] There were 151 different stocks listed at some time during 1985–92.

[5] Stocks with available data were usually the same stocks in each period; i.e., there was not much time variation in the liquid issues.

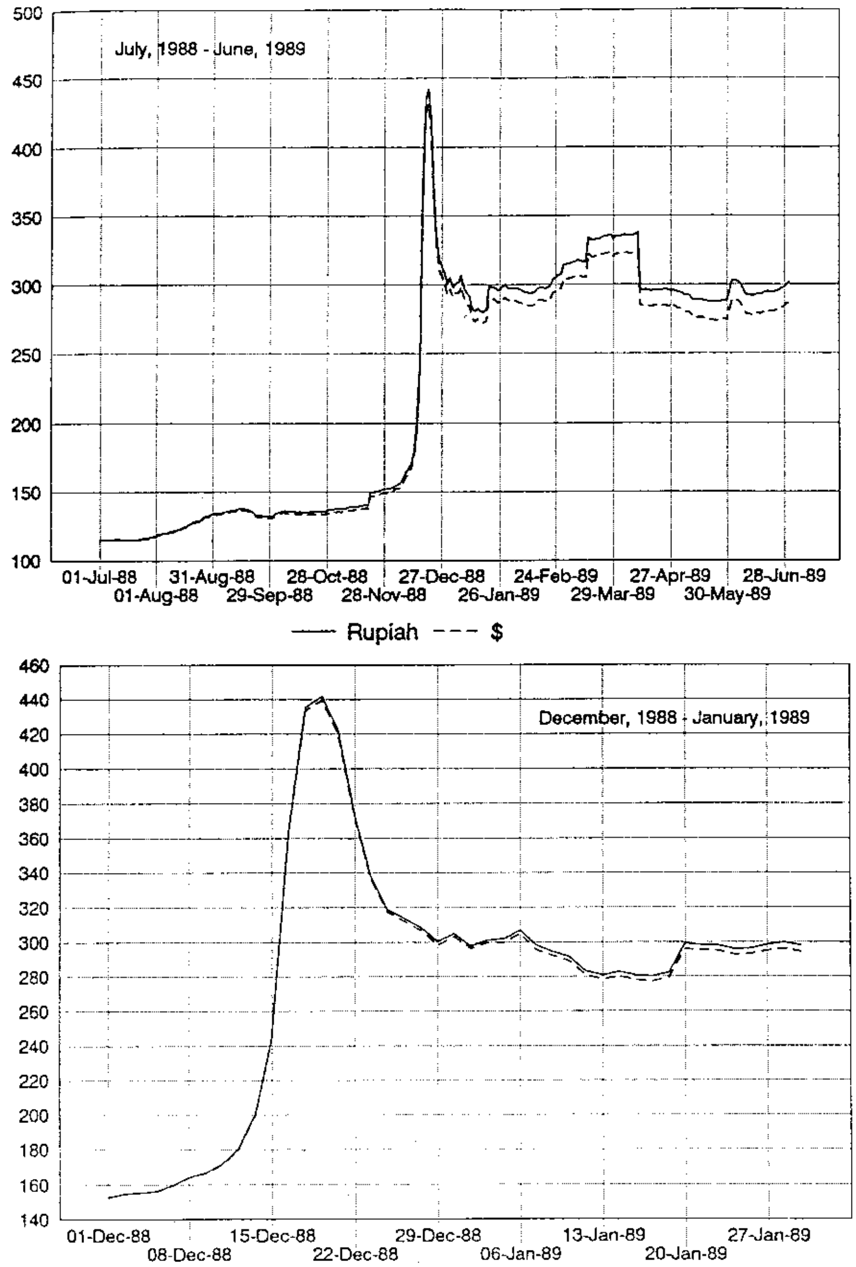

Fig. 5. Jakarta Stock Exchange composite price index around the end of 1988.

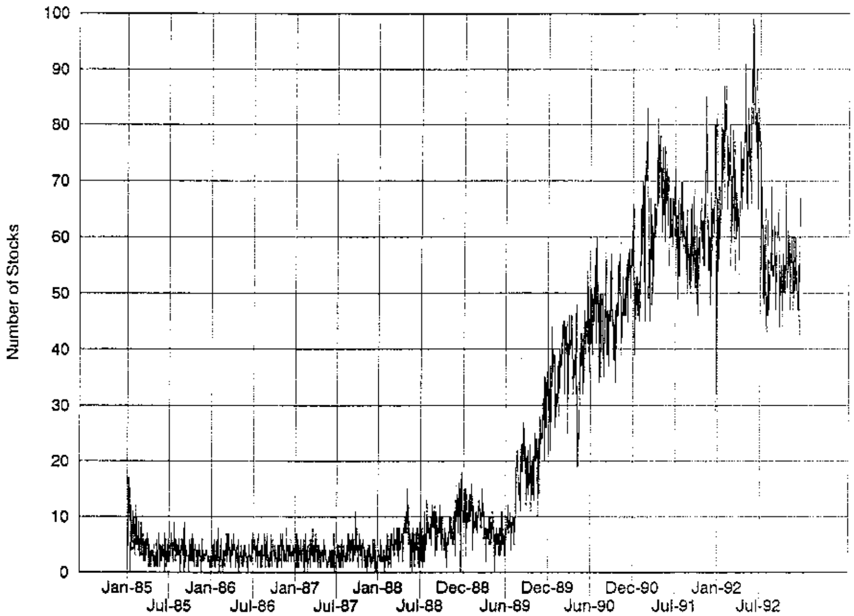

Fig. 6. Stocks with transaction prices, daily (Jakarta Stock Exchange data base).

day t or day $t-1$, the return for day t is missing. The index, however, is calculated using the last reported transaction price of each listed stock. As a consequence, its daily observations often contain many ''stale'' individual prices; this induces a pattern of spurious autocorrelations. The first- and second-order autocorrelation coefficients for index returns over the entire eight years are 0.476 and 0.241, respectively. Over the post-1988 period, the autocorrelations are smaller, 0.171 and 0.103, though still statistically significant; their smaller values undoubtedly reflect the more active trading during 1989–92. Autocorrelations of order higher than two days were negligible in both periods, so most of the stale pricing effect seems to be expunged after two trading days.

2. Evidence about market micro-structure [6]

The rates of return of *individual* Jakarta listed equities do not display unusual daily autocorrelations, at least on average. Table 2 presents average serial correla-

[6] A new paper by Chang et al. (1994) also examines the market microstructure of the Jakarta Exchange. However, their paper focuses on *intra*-day behavior using transactions data from September, 1992 through February, 1994. Among other findings, they conclude that price reversals are more common than price continuations in Jakarta equities.

Table 1
Characteristics of individual Indonesian equities. Cross-sectional means and standard deviations for several sample periods

	Cross-sectional	
	Mean	Standard deviation
January 2, 1985 – November 30, 1988		
Number of stocks with at least 20 daily returns: 18		
Time series standard deviation of returns	1.84 [a]	0.74
Beta on composite index	0.989	0.742
R-square from market model	0.101	0.124
Number of time series observations	85.6	72.0
January 3, 1989 – December 30, 1992		
Number of stocks with at least 20 daily returns: 131		
Time series standard deviation of returns	4.81	2.88
Beta on composite index	0.811	0.988
R-square from market model	0.091	0.111
Number of time series observations	251.5	186.5
January 3, 1989 – December 30, 1992 (for stocks present before December, 1988)		
Number of stocks with at least 20 daily returns: 18		
Time series standard deviation of returns	6.69	4.19
Beta on composite index	1.20	0.813
R-square from market model	0.173	0.147
Number of time series observations	228.8	220.0
December 1, 1988 – December 30, 1988		
Number of stocks with at least 5 daily returns: 13		
Time series standard deviation of returns	19.1	11.7
Beta on composite index	1.44	1.20
R-square from market model	0.569	0.319
Number of time series observations	11.7	4.2

[a] In percent per day.

tion coefficients, for lags from one through ten trading days, and their cross-sectional standard deviations for the 126 individual stocks with at least 30 observations.

The mean coefficients are negative at every lag out to ten days but none can be judged more than just marginally significant even if the 126 coefficients are assumed to be cross-sectionally independent. For instance, the largest mean coefficient (at lag 4 days) would have a t-statistic of only 1.56. Naturally, the cross-sectional *average* autocorrelation might conceal some significant positive or negative coefficients for individual stocks.

To examine this possibility, we can exploit a more refined method of assessing serial dependence in returns, based on the partial adjustment model of Amihud and Mendelsohn (1987). In their model, the observed market price is assumed to adjust to the unobserved true value according to the expression

$$P_t - P_{t-1} = g(V_t - P_{t-1}) + u_t, \tag{1}$$

Table 2
Autocorrelation coefficients for individual Jakarta equities. Lags up to ten days, 126 stocks with at least 30 observations, 1985–1992

Lag (days)	Cross-sectional	
	Mean coefficient	Standard deviation
1	−0.00969	0.175
2	−0.01123	0.171
3	−0.01732	0.166
4	−0.02194	0.158
5	−0.01433	0.156
6	−0.00781	0.154
7	−0.00731	0.151
8	−0.01505	0.131
9	−0.01834	0.125
10	−0.01717	0.118

where P_t is the natural logarithm of the observed price, V_t is the natural logarithm of the unobserved value, both measured on date t, g is a speed-of-adjustment coefficient and u_t is essentially white noise induced by fluctuations within the bid/ask spread and by other time-independent sources of non-systematic and non-informational pricing error. The true value V is assumed to change only in response to new information. Thus V follows a random walk with a drift that reflects the stock's expected return. For the price process to be stationary, the speed-of-adjustment coefficient is restricted to the interval, $0 < g < 2$.

The advantage of this framework is its flexibility. The speed-of-adjustment coefficient, g, can be less than one, thereby indicating that information is slowly incorporated into price; greater than one, thereby indicating that the stock over-reacts to new information; or equal to one, indicating that the market is informationally efficiency. Thus, the nature and extent of market inefficiency, if any, becomes an empirical question about the value of g. We merely require a satisfactory empirical estimator for g.

Such an estimator was suggested by Damodaran (1993), who noted that volatilities calculated from single- and multi-period returns should depend on g itself, and also depend on the true information volatility $v^2 \equiv \text{Var}(V_t - V_{t-1})$ plus the volatility of noise, $\sigma^2 \equiv \text{Var}(u)$; (this is Damodaran's notation.) At least in principle, even though true value (V) is unobservable, estimates of the three parameters $(g, v^2$, and $\sigma^2)$ can be obtained with sample variances computed from returns of three different intervals.

To see how this is possible, first note that the Amihud and Mendelsohn setup can be expressed in return form simply by subtracting the lagged value of Eq. (1) from its current value (since P and V are log price and value, respectively),

$$R_{1,t} = g(V_t - V_{t-1}) + (1-g)R_{1,t-1} + u_t - u_{t-1}, \tag{2}$$

where $R_{1,t}$ is the single-period return terminating on date t. As Amihud/Mendelsohn and Damodaran noted, this recursive equation can be expanded in an infinite series, and provided that $0 < g < 2$, the variance of a single-period observed return is,

$$\sigma_1^2 = (gv^2 + 2\sigma^2)/(2-g). \tag{3}$$

Since the returns in (2) are log price relatives, a multi-period return is simply the sum of single period returns. Thus, a K-period return would be $R_{K,t} \equiv R_{1,t} + \ldots + R_{1,t-K+1}$. Although it requires several tedious pages of recursive algebra, it can be shown that the variance of a K-period return (for non-overlapping periods of length K), is given by

$$\sigma_K^2 = v^2[K - (1-g)M_K] + M_K\sigma^2, \tag{4}$$

where $M_K \equiv 2[1\text{-}(1\text{-}g)^K]/g(2\text{-}g)$.

Given (4), estimates of g, σ^2, and v^2, can be obtained by computing variances for three different sets of return intervals and solving the resulting system of three simultaneous non-linear equations. For example, we could use non-overlapping one-, two-, and three-period returns. Although this procedure is straightforward, it does encounter a significant econometric difficulty for some ranges of parameter values: the resulting solutions are non-linear functions of the sample statistics and the sampling distributions of the estimators are not familiar and may even have non-existent moments.

To see why this can occur, consider solving for g using one- and two-period variances. The two-period return variance has a particularly simple form,

$$\sigma_2^2 = 2gv^2 + 2\sigma^2, \tag{5}$$

Eliminating σ^2 from (3) and (5), g can be expressed as

$$g = (\sigma_2^2 - 2\sigma_1^2)/(v^2 - \sigma_1^2). \tag{6}$$

This provides an estimator for g based on the one- and two-period observed variances and a sample estimate of v^2 (which would be obtained by solving other expressions). From (3) the *true* value of the denominator of (6) is zero if $g = 1 - \sigma^2/v^2$; thus, the sample value of the denominator in (6) would fluctuate around zero if g happened to have this value. In such a situation, the sampling distribution of g's estimate would certainly have very thick tails and possibly have an infinite mean and variance! Of course, this most problematic value of g is strictly less than unity, so the sampling distribution might be satisfactory for stocks that inefficiently over-react to information ($g > 1$). But for efficient stocks that happened to have relatively small noise variance and for inefficient stocks which react slowly to news, there could be a serious problem.

The problem is endemic. Using one-, two-, and three-period returns, the exact solution for g is

$$g = 1 + (2\sigma_2^2 - \sigma_1^2 - \sigma_3^2)/(\sigma_2^2 - 2\sigma_1^2). \tag{7}$$

The denominator of the quotient on the right side of (7) is zero when $g = 1 - \sigma^2/v^2$.

Another strategy might derive an estimator based on some combination of autocorrelations and multiple-period variances. For the Amihud/Mendelsohn process, the auto-covariance function of single-period returns is

$$\mathrm{Cov}(R_{1,t},R_{1,t-j}) = W(1-g)^{j-1}\,\{j>0\}, \tag{8}$$

where $W \equiv g[(1-g)v^2 - \sigma^2]/(2-g)$. As a stock approaches informational efficiency, ($g \to 1$), this covariance for $j=1$ approaches $-\sigma^2$, which is the familiar result from Roll (1984) and others that first-order negative serial covariance is induced by bouncing back and forth within the effective bid/ask spread. Unfortunately, using auto-covariances is subject to a similar sampling distribution problem. No matter which combination of variances and serial covariances is used, the sampling distribution of the estimator can "blow up" for certain values of the true parameters. [7]

This problem led me to wonder if some other method might be preferable, a method which exploits the linearity of (2). Note that (2) is not a well-specified regression equation because it contains an unobservable (V) and because the disturbances are both serially dependent and related to the observable random explanatory variable, R_{t-1}. Amihud and Mendelsohn argue that the unobservable change in log true value, $V_t - V_{t-1}$ should be just equal to a mean expected rate of return, ("m" in their notation), plus a time-independent, zero mean disturbance, e_t. Given this assumption, (2) can be written

$$R_t = m + bR_{t-1} + \xi_t, \tag{9}$$

where $b \equiv 1-g$ and $\xi_t \equiv ge_t + u_t - u_{t-1}$. Although ξ_t is not a spherical disturbance, because it is related to both ξ_{t-1} and R_{t-1}, the serial dependence in ξ can be eliminated simply by using every other observation. Note that ξ_t is independent of ξ_{t-2}. Thus, if we run a regression in the form of (9) but using observations of R_t only for $t = 2,4,\ldots$, (and correspondingly, every other observation for the explanatory variable R_{t-1}), the OLS estimator of the slope should have standard distributional properties.

However, the estimated slope is biased because the disturbance is still related to the explanatory variable. The OLS slope coefficient estimate from (9), will have expected value $(1-g) - \sigma^2/\sigma_1^2$. Thus, if we just estimate g by using $1-\hat{b}$, where $\hat{b}$ is the OLS sample estimate of the slope in (9), g will be biased upward;

[7] Also, due to the structure of the model, the serial covariances are not independent of the variances of multi-period returns. For instance, it is straightforward to show that the first serial covariance, $\mathrm{Cov}(R_{1,t},R_{1,t-1})$ is exactly $\sigma_2^2/2 - \sigma_1^2$. Since this covariance is a linear function of the variances for returns of intervals one and two periods, it is not possible to exploit the sample covariance and these two variances to derive a sensible estimator of the underlying parameters.

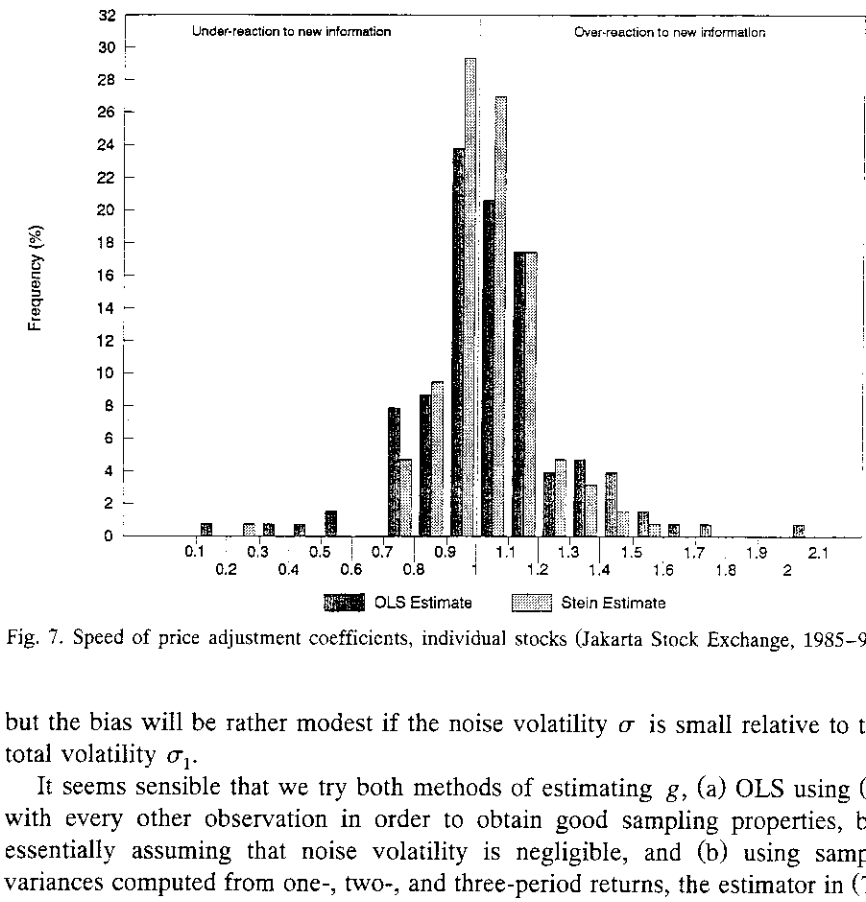

Fig. 7. Speed of price adjustment coefficients, individual stocks (Jakarta Stock Exchange, 1985–92).

but the bias will be rather modest if the noise volatility σ is small relative to the total volatility σ_1.

It seems sensible that we try both methods of estimating g, (a) OLS using (9) with every other observation in order to obtain good sampling properties, but essentially assuming that noise volatility is negligible, and (b) using sample variances computed from one-, two-, and three-period returns, the estimator in (7), while being wary of parameters in ranges that cause nonsensical sample estimates.

Results from the first method are reported in Fig. 7, which shows the cross-sectional distribution of speed-of-adjustment coefficients based on an OLS fit of (9) to individual Jakarta-listed stocks with at least 30 daily return observations. There were 126 stocks which met this criterion. The average value of g is 1.045, slightly greater than 1.0. This may be evidence of the bias induced by ignoring noise volatility. However, if this is the only reason for the average being slightly larger than unity, the bias is modest. The cross-sectional standard deviation of these estimates is 0.0651, so if they are independent, the average value of g is significantly above 1.0, with a t-statistic of 7.76.

Anytime more than three parameters are being estimated, it is well-known that ordinary individual maximum-likelihood estimates, such as those derived from a series of individual OLS regressions, represent an inadmissible collection of estimates taken as an entire set. In other words, if the investigator's criterion is to minimize some loss function taken over all the estimation errors (one error for each parameter of interest), an unambiguous improvement can be gained by shrinking the cross-section of estimates toward some common central value. This is known as a Stein (1955) method and is usually implemented using a variant known as an "empirical Bayes" estimator; cf. Efron and Morris (1973).

We have a collection of 126 speed-of-adjustment coefficients for Indonesian equities. Assuming cross-sectional independence in the estimation errors, admittedly a rather serious assumption that eventually should be investigated, an empirical Bayes estimate for each coefficient can be obtained as follows. Let $\hat{g}_j$ denote the sample estimate of g_j for stock j. Then the cross-sectional variance of the observed estimates, $\mathrm{Var}_j(\hat{g})$ is approximately the cross-sectional variance of the true values, $\mathrm{Var}_j(g)$, plus the cross-sectional average value of the error variance, $\mathrm{Var}(\hat{g}_j - g_j)$. From each OLS regression, we already have an estimate of the error variance, it is the square of the coefficient's standard error. Let $\bar{s}^2$ denote the cross-sectional average of this squared standard error while s_j^2 is the corresponding squared standard error for stock j. The empirical Bayes shrinkage factor is then

$$\gamma_j \equiv s_j^2 / \left[s_j^2 + \mathrm{Var}_j(\hat{g}) - \bar{s}^2 \right]$$

and the empirical Bayes estimate of the speed-of-adjustment coefficient is

$$g_j^* = \gamma_j + (1 - \gamma_j)\hat{g}_j,$$

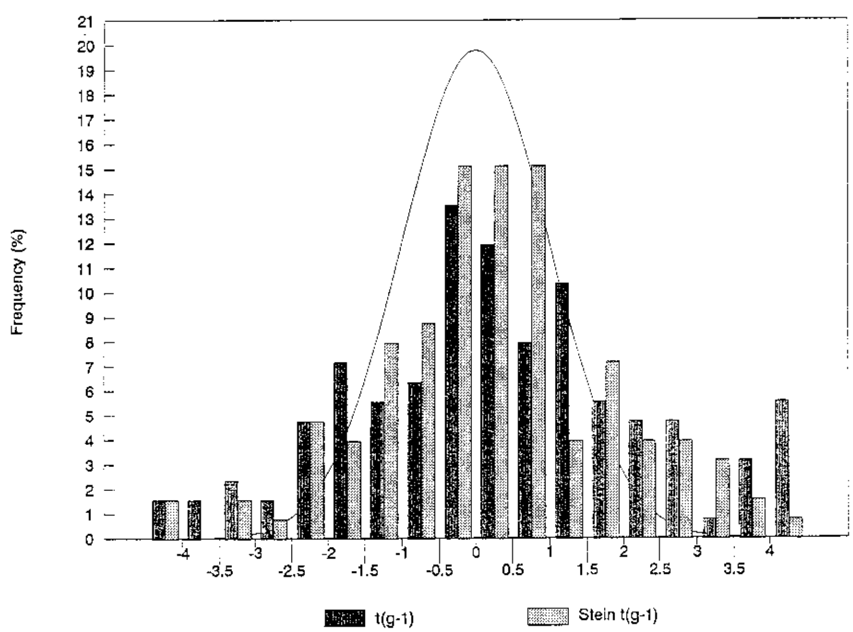

Fig. 8. Observed t-statistics for speeds of price adjustment of individual stocks compared to frequency distribution assuming *immediate* adjustment.

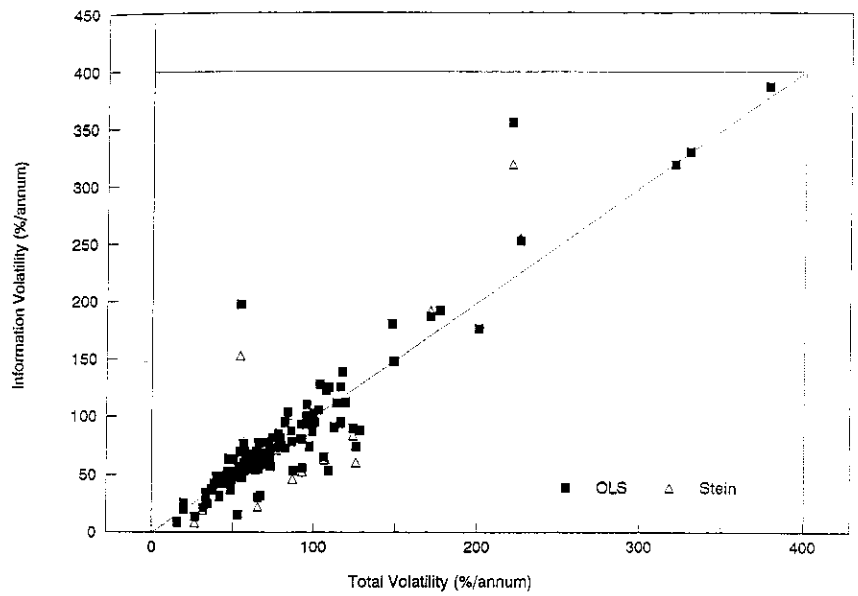

Fig. 9. Sample total volatility and estimated information volatility. Annualized standard deviations of individual stocks (Jakarta Stock Exchange, 1985–92).

where the central value toward which estimates are shrunk is the null value under market efficiency, 1.0. These revised estimates, g_j^*, are also plotted in Fig. 7 as "Stein estimates". Note that they are necessarily somewhat closer to 1.0.

Fig. 8 shows the t-statistics of these estimates of g against the null value of 1.0. If stocks adjust immediately to new information, these t-statistics should be approximately normally distributed. The normal curve plotted on the graph (the single line curve) shows that the coefficients are actually too dispersed. There are too many large values *and* too many small values. This tendency is grossly evident for the unadjusted OLS coefficients but it remains the case for the Stein estimates. Evidently, some stocks on the Jakarta exchange respond slowly to new information while others over-react. Notice, however, that these tendencies are limited to a rather small number of stocks; only ten (out of 125) have t-statistics less than -2, indicating statistically significant slow adjustment, while 19 (14) of the OLS (Stein) coefficients have t-statistics greater than $+2$, thereby indicating a tendency to overreact. Again, keep in mind that the disproportionate number of overreacting to underreacting stocks might have been caused by the bias in estimating g.

Fig. 9 plots estimates of the information volatility, v^2, against the observed total one-period volatility of returns. Even though the noise volatility, σ^2, has been assumed negligible, there can still be a difference between observed returns

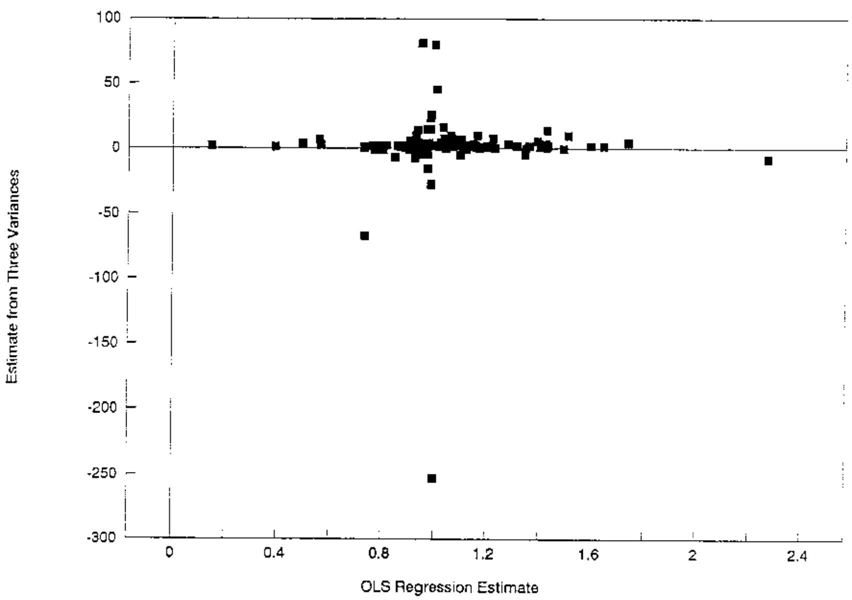

Fig. 10. Comparison of two estimates of speed-of-adjustment coefficient.

and true values, and thus between observed volatility and information volatility, because the speed-of-adjustment of prices is either too slow or too fast. As the figure illustrates, the observations cluster about a 45° line, as one would expect given that the speed-of-adjustment coefficients cluster around unity. There are, however, a couple of stocks with dramatically larger information volatility than observed return volatility (which implies a very slow speed of adjustment).

Estimates of the speed-of-adjustment coefficient using returns for one-, two- and three-day intervals and Eq. (7) turn out to justify our apprehensions. Estimates of g were found as negative as -253 and as large as 81. (Remember that the true value of g must lie between zero and two in the Amihud/Mendelsohn model.) Over the 126 stocks with at least 30 trading days of observations, the estimated cross-sectional mean for g from (7) was 1.36 and the cross-sectional standard deviation was 26.4! This contrasts with a mean of 1.045 and standard deviation of 0.0646 for regression-based estimate of g. The cross-sectional correlation between the two estimates was 0.019! The two estimates are plotted against each other in Fig. 10. Note that only one of the regression-based estimates of g exceeded 2 and none was negative, while the variance-based estimate (7) had an order-of-magnitude greater sampling dispersion with many observations outside the acceptable range, $0 < g < 2$.

Even if we discard all estimates outside the range zero to two, there is still virtually no cross-sectional relation between the two sets of estimates. Though

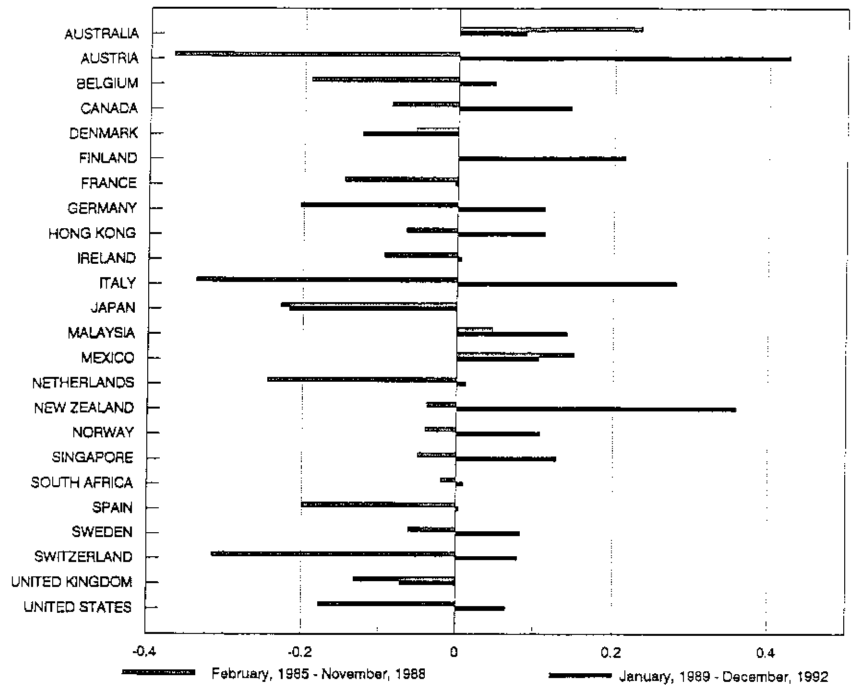

Fig. 11. Correlations of Jakarta monthly equity returns with returns of 24 developed countries.

perhaps containing a small positive bias, the regression-based estimates are clearly much more reliable.

3. The relation of Jakarta to other markets

When looking at the relation between the Jakarta Stock Exchange and equity markets in other countries, it seems sensible to break the available record into two sub-periods before and after the unique month of December 1988. This month demarcated what seems to have been a structural change in the Jakarta market.

For international comparisons, local currency market returns must be converted to some common currency and large exchange rate changes such as devaluations should be removed on the grounds that they represent anomalous events which tend to mask the underlying international relations among equities. Accordingly, in the results to follow, equity returns of all countries will be expressed in U.S. Dollars. September 1986 will be deleted from the monthly data sample, and September 15, 1986, will be deleted from the daily data sample, because of the Rupiah devaluation on that date.

Table 3
The Jakarta composite index and developed country indices

Country	Mean (%/month)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 1: Regression period: February, 1985 through November, 1988, Monthly, U.S. Dollars (excluding September, 1986)					
Australia	2.2248	10.2510	0.2345	0.2291	1.7748
Austria	2.9978	6.6208	−0.3689	−0.1602	−1.2110
Belgium	3.4337	7.6757	−0.1926	0.1391	0.7829
Canada	0.8988	5.4761	−0.0863	−0.0322	−0.1104
Denmark	2.2832	6.4262	−0.0537	0.0277	0.1973
France	3.2102	8.2799	−0.1482	0.2261	1.5790
Germany	2.4236	7.5496	−0.2044	−0.0371	−0.1692
Hong Kong	1.9144	8.9265	−0.0659	−0.0135	−0.0917
Ireland	3.3960	9.0505	−0.0950	−0.0168	−0.1432
Italy	3.6296	8.7429	−0.3375	−0.0574	−0.5867
Japan	3.9740	6.8734	−0.2283	−0.1866	−1.4096
Malaysia	0.9720	10.1780	0.0459	0.0698	0.3106
Mexico	4.0674	15.7950	0.1499	0.0555	0.9308
Netherlands	1.9319	5.2798	−0.2449	0.2560	0.8042
New Zealand	2.0769	9.5236	−0.0380	0.0543	0.3981
Norway	1.4385	8.2767	−0.0404	0.0743	0.5248
Singapore	1.5841	9.8163	−0.0497	−0.1681	−0.7993
South Africa	0.8725	13.9450	−0.0193	−0.0470	−0.7676
Spain	3.5546	8.4278	−0.2003	−0.0400	−0.3169
Sweden	2.6821	6.7576	−0.0616	−0.1032	−0.6413
Switzerland	1.9353	6.4702	−0.3150	−0.4817	−1.6273
United Kingdom	2.4513	6.8662	−0.1319	−0.0366	−0.1676
United States	1.2335	5.2762	−0.1782	−0.1917	−0.7958
Jakarta (dependent variable)	1.5326	3.8776			
Intercept				2.3645	2.8878
Adjusted R-square		0.90647E-01			
Std. error of estimate		3.7395			
F-stat (23/21)		1.1907			
Sample size		45			
Durbin-Watson		2.0141			

The two sub-periods are almost equal in length. The first sub-period, January 1985 through November 1988, contains 45 calendar months; one outlier month (September 1986) and January 1985 are deleted, the latter because its index level is the base of the first available return. [8] The second sub-period, January 1989 through December 1992, covers 48 calendar months. As mentioned in Section 1, the first sub-period has much lower volatility and fewer individual stocks listed on the exchange.

[8] For daily data, only the first trading day of January, 1985 is lost.

Table 3 (continued)

Country	Mean (%/month)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 2: Regression period: February, 1985 through November, 1988, Monthly, U.S. Dollars, Indonesia's regional neighbors (excluding September, 1986)					
Australia	2.2248	10.2510	0.2345	0.2284	2.7210
Hong Kong	1.9144	8.9265	−0.0659	−0.1044	−1.0927
Japan	3.9740	6.8734	−0.2283	−0.1356	−1.6801
Malaysia	0.9720	10.1780	0.0459	0.1006	0.7632
New Zealand	2.0769	9.5236	−0.0380	−0.1035	−1.1089
Singapore	1.5841	9.8163	−0.0497	−0.1188	−0.8656
Intercept				2.0684	3.2146
Adjusted R-square	0.13047				
Std. error of estimate	3.6567				
F-stat (6/38)	2.1003				
Sample size	45				
Durbin-Watson	1.4849				

Correlation coefficients of independent variables

	Australia	Hong Kong	Japan	Malaysia	New Zealand
Hong Kong	0.6125				
Japan	0.0899	0.0105			
Malaysia	0.4881	0.5940	0.0746		
New Zealand	0.7165	0.6370	0.0970	0.3197	
Singapore	0.4904	0.6249	0.1153	0.9014	0.4144

Fig. 11 shows correlations between Jakarta and major trading countries [9] using monthly index returns denominated in U.S. Dollars. Monthly returns were utilized in an effort to alleviate the stale pricing problem. We have seen that stale prices induce substantial first- and second-order autocorrelation in JSXCI *daily* returns and a similar phenomenon probably exists in the indices from some other countries. The month-end index levels will, of course, still contain some stale prices, so correlations will be biased at least somewhat toward zero; nonetheless, monthly return intervals should be long enough to discern most of the true correlation.

As Fig. 11 shows, correlations between Jakarta and other markets were mostly negative during the first sub-period, only three out of 23 were positive. In the second sub-period, the correlations were mostly positive, only four out of 24 were negative. [10] But were the individual correlations statistically significant?

To examine this question, Table 3 presents monthly regressions with JSXCI returns (dollar-denominated) as the dependent variable. For the first sub-period,

[9] The returns on the 24 countries shown are from the FT Actuaries/Goldman Sachs indices for each country.

[10] Data for Finland were not available during the first sub-period.

Table 3 (continued)

Country	Mean (%/month)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 3: Regression period: January, 1989 through December, 1992, Monthly, U.S. Dollars					
Australia	−0.1582	5.2870	0.0864	−0.6474	−1.4138
Austria	1.2657	9.7322	0.4270	0.9517	3.5723
Belgium	0.0954	4.9919	0.0476	1.1534	1.6393
Canada	−0.1091	3.5158	0.1448	0.6019	0.8866
Denmark	0.3574	5.9322	−0.1254	−0.4583	−1.0703
Finland	−1.0680	6.9983	0.2142	−0.0218	−0.0786
France	0.6662	5.4941	−0.0036	−0.5731	−0.8657
Germany	0.5760	6.6763	0.1119	−1.0473	−1.8001
Hong Kong	1.6874	7.0724	0.1123	0.2446	0.9719
Ireland	0.3086	7.0813	0.0061	−0.1513	−0.4096
Italy	−0.6687	6.8768	0.2805	0.4332	1.4866
Japan	−0.8816	8.5881	−0.2176	−0.3077	−1.0634
Malaysia	1.4812	6.6503	0.1409	−0.7365	−1.8837
Mexico	5.3985	9.8014	0.1055	0.2655	1.3364
Netherlands	0.7074	4.1182	0.0118	0.7762	0.8083
New Zealand	−0.7115	6.9844	0.3593	0.6786	2.4965
Norway	0.2251	6.9941	0.1078	−0.1289	−0.3967
Singapore	1.3255	6.4176	0.1283	0.1854	0.4033
South Africa	0.7801	7.5697	0.0094	−0.1437	−0.5728
Spain	−0.2849	6.5048	0.0039	−0.7878	−1.5906
Sweden	0.5257	6.8922	0.0835	0.7686	1.7764
Switzerland	0.9210	5.4597	0.0795	0.3426	0.7235
United Kingdom	0.6880	6.1064	−0.0719	−0.3050	−0.5221
United States	1.0290	4.0200	0.0648	−0.2188	−0.2942
Jakarta (dependent variable)	−0.087	10.4850			
Intercept				−1.6828	−0.8860
Adjusted R-square		0.39742			
Std. error of estimate		8.2249			
F-stat (24/23)		2.2916			
Sample size		48			
Durbin-Watson		1.8812			

Panel 1 employs all 23 FT Actuaries indices and Panel 2 employs indices from Indonesia's regional neighbors. During this 1985–88 period, Jakarta returns were very weakly related to those from other countries; the adjusted R-squares were only 0.09 and 0.13 in Panels 1 and 2, respectively.

In the regression with 23 country index returns as explanatory variables, Australia's coefficient is the only one that even approaches marginal significance. In the regression with the six neighboring countries, Australia's coefficient is statistically significant but none of the others are close. Indonesia's return volatility (standard deviation), was 3.88%/month, smaller than the volatility of every one of the other countries.

Table 3 (continued)

Country	Mean (%/month)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 4: Regression period: January, 1989 through December, 1992, Monthly, U.S. Dollars, Indonesia's Regional Neighbors					
Australia	−0.1582	5.2870	0.0864	−0.5917	−1.7309
Hong Kong	1.6874	7.0724	0.1123	0.1879	0.8251
Japan	−0.8816	8.5881	−0.2176	−0.5763	−3.0647
Malaysia	1.4812	6.6503	0.1409	0.3137	1.0213
New Zealand	−0.7115	6.9844	0.3593	0.8387	3.3562
Singapore	1.3255	6.4176	0.1283	0.1601	0.4507
Intercept				−1.0859	−0.7479
Adjusted R-square	0.23482				
Std. error of estimate	9.2684				
F-stat (6/41)	3.4039				
Sample size	48				
Durbin-Watson	1.8373				

Correlation coefficients of independent variables

	Australia	Hong Kong	Japan	Malaysia	New Zealand
Hong Kong	0.2378				
Japan	0.1316	0.3218			
Malaysia	0.1599	0.5030	0.4683		
New Zealand	0.6180	0.1070	0.1921	0.1373	
Singapore	0.4050	0.4951	0.5344	0.7161	0.3547

During the second sub-period, 1989–92, Panel 3 of Table 3 shows that about 40 percent of Jakarta's dollar-denominated monthly returns can be explained by correlations with other countries; the adjusted R-Square was 0.397. However, the particular countries which contribute most of the explained variance are rather surprising. Austria has the highest t-statistic and New Zealand is next. Also, thirteen of the 24 regression coefficients are actually negative and one of these, Malaysia's, is marginally significant. These oddities may be partly statistical aberrations induced by multi-collinearity, a small sample size, or a few outliers. Although the explanatory variables are not all that correlated (the vast bulk of their correlations fall in the 0.3 to 0.6 range), there are only 48 observations and 24 explanatory variables; thus, the degrees of freedom are rather limited and the standard errors are correspondingly large.

Recall that twenty of the simple correlation coefficients are positive. Thus, in conclusion, the JSXCI was positively correlated with most other countries during 1989–92, but the level of correlation was modest and of marginal statistical significance. Jakarta's total volatility (return standard deviation) during this period was 10.5% per month, higher than the volatility of every one of the 24 developed countries.

The six developed countries in Indonesia's geographic region explain about 23 percent of the JSXCI during the 1989–92 period; see Table 3, Panel 4. Curiously, Japan has a negative and statisically significant relation with Indonesia after taking into account the other five country returns. Only New Zealand has a significant positive t-statistic. One might have thought that Australia, Hong Kong, Malaysia, and Singapore would display significant correlation with Indonesian returns, but this was not the case from 1989 through 1992. The correlation coefficients between Jakarta returns and returns from its neighboring countries are relatively small and one (with Japan), is negative. This contrasts with the mutual correlations among these neighboring countries (reported in the Table); all are positive and most are larger in magnitude than the correlations with Jakarta.

Daily returns from Jakarta (Table 4) display a weak pattern of correlation with other countries in the region, even after inserting up to two daily lagged returns as

Table 4
The Jakarta composite index and Indonesia's regional neighbors

Country	Mean (%/day)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 1: January 2, 1987 through November 30, 1988, Daily, U.S. Dollars (Excluding September 15, 1986)					
Australia	0.1866	1.4980	−0.0577	−0.0053	−0.2522
Lag 1	0.1546	1.5354	0.0389	0.0183	0.8782
Lag 2	0.1229	1.5589	−0.0223	−0.0052	−0.2538
Hong Kong	0.1084	1.4527	−0.0745	−0.0108	−0.5219
Lag 1	0.1331	1.3972	−0.0183	−0.0063	−0.3042
Lag 2	0.0439	2.1070	0.0142	0.0097	0.6225
Japan	0.1830	1.3054	−0.0339	−0.0099	−0.4911
Lag 1	0.2028	1.3187	0.1169	0.0477	2.3662
Lag 2	0.1395	1.3229	0.0296	0.0021	0.1053
Malaysia	0.1305	1.3851	−0.0744	−0.0351	−0.9379
Lag 1	0.1462	1.2997	−0.0142	0.0204	0.5333
Lag 2	0.1324	1.3229	−0.0405	−0.0328	−0.9013
New Zealand	0.0143	1.5044	−0.0618	−0.0162	−0.8531
Lag 1	0.0059	1.6436	−0.0043	−0.0078	−0.4336
Lag 2	−0.0101	1.6413	−0.0241	−0.0033	−0.1866
Singapore	0.1099	1.5040	−0.0659	0.0204	0.5703
Lag 1	0.1328	1.4098	−0.0198	−0.0266	−0.7328
Lag 2	0.1084	1.4125	−0.0231	0.0166	0.4716
Jakarta (dependent variable)	0.1629	0.5101			
Intercept				0.1608	6.3000
Adjusted R-square		−0.99417E-02			
Std. error of estimate		0.51325			
F-stat (18/420)		0.76047			
Sample size		439			
Durbin-Watson		1.5645			

Table 4 (continued)

Country	Mean (%/day)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 2: January 3, 1989 through December 30, 1992, Daily, U.S. Dollars					
Australia	−0.0338	1.0710	0.0456	0.0453	0.7804
Lag 1	−0.0301	1.0793	0.0552	0.0635	1.0965
Lag 2	−0.0150	1.0810	0.0149	0.0118	0.2018
Hong Kong	0.0755	1.6287	0.0790	0.0507	1.4144
Lag 1	0.0524	1.6284	0.0446	0.0054	0.1491
Lag 2	0.0713	1.6195	0.0210	−0.0128	−0.3558
Japan	−0.0308	1.6008	0.0235	−0.0245	−0.6729
Lag 1	−0.0345	1.6129	0.0386	0.0154	0.4147
Lag 2	−0.0416	1.6147	−0.0550	−0.1009	−2.7698
Malaysia	0.0660	1.1854	0.0994	0.0804	1.1725
Lag 1	0.0531	1.1822	0.0981	0.0491	0.7098
Lag 2	0.0484	1.1730	0.0777	0.0702	1.0288
New Zealand	−0.0682	1.3262	0.0136	−0.0329	−0.7160
Lag 1	−0.0687	1.3292	0.0097	−0.0172	−0.3757
Lag 2	−0.0595	1.3432	0.0043	−0.0044	−0.0976
Singapore	0.0449	1.2454	0.0731	−0.0010	−0.0149
Lag 1	0.0414	1.2362	0.0876	0.0329	0.4987
Lag 2	0.0522	1.2332	0.0820	0.0875	1.3419
Jakarta (dependent variable)	−0.0204	1.5509			
Intercept				−0.0453	−0.8806
Adjusted R-square		0.15894E-01			
Std. error of estimate		1.5394			
F-stat(18/896)		1.8201			
Sample size		915			
Durbin-Watson		1.6564			

additional regressors in an effort to offset the stale pricing effect in the JSXCI. [11] For daily data, the first sub-period was truncated to begin only in January 1987 because the FT Actuaries/Goldman Sachs indices are not available on a daily basis prior to that time. During the 1987–88 sub-period, the six regional neighboring countries' equity returns had an insignificant adjusted R-square of -0.00994 in explaining Jakarta's return. Only one coefficient (for Japan, lagged one day), was significant; at least one such coefficient could be expected to be spuriously significant just by chance when a total of 18 are estimated. The Durbin-Watson statistic of 1.56 is marginally significant and probably implies that the impact of

[11] Since regressions with all 24 countries, each with a contemporaneous term and two daily lagged terms, had a total of 72 coefficients, they were too voluminous to report. They are, however, qualitatively similar: the correlations are very weak.

Table 5
Jakarta and global industry factors (January 1989 through December 1992, monthly, U.S. dollars)

Industry	Mean (%/month)	Standard deviation	Correlation	Regression coefficient	T-value
Finance	−1.8764	9.4657	0.2253	0.4009	2.1899
Energy	−1.6778	8.0137	−0.0082	−0.1340	−0.6007
Utilities	5.8950	13.4490	−0.0073	0.1444	1.0261
Transport	3.1681	18.7410	−0.1050	−0.2107	−2.1067
Consumer	3.2848	8.4628	−0.1721	−0.2868	−1.5804
Capital	−2.1602	13.0240	0.0357	−0.1160	−0.8358
Basic	0.2113	8.4922	0.2394	0.5971	2.9637
Jakarta (dependent variable)	−0.0869	10.4850			
Intercept				0.8219	0.4822
Adjusted R-square	0.14347				
Std. error of estimate	9.8060				
F-stat(7/40)	2.1246				
Sample size	48				
Durbin-Watson	1.5143				

stale prices has not been completely eliminated by the inclusion of lagged regressors. [12]

During the 1989–92 period, the six regional developed countries' equities had an adjusted R-square of 0.0159 in explaining JSXCI daily returns and the only significant coefficient is negative (the two-day lagged coefficient for Japan).

The overall impression of these results is that Indonesian equities are not very related to equities from other (developed) countries and the pattern of significant correlations is suspicious. The low correlation is reminiscent of the pattern that has long been observed in international comparisons and has become a prime motivation for international diversification. Indonesia seems quite typical in this regard.

Recently (Roll, 1992), I conjectured that the puzzling low level of inter-country correlations might be attributable to differing industrial structures across countries; if two countries are concentrated in disparate industries, their equity indices may be weakly correlated, even when individual stocks in the same industry are highly correlated across the same two countries. To examine this possibility for Indonesia, its index returns were regressed on seven global industry index returns constructed from stocks in the 24 developed countries, using the method described

[12] There are many missing observations for the JSXCI and some missing observations for the other countries. Missing data explain one puzzling result in the table. Notice that the standard deviation of Hong Kong's return is much larger at the two-day lag than at either the one-day lag or contemporaneously. This is explained by a single return, −32 percent, on the first day Hong Kong resumed trading after the October 1987 crash. Since the Hong Kong market was closed on the crash day and for a week thereafter, this date could not serve as a contemporaneous nor a one-day lag regressor value.

in Roll (1992). The industry indices are essentially global portfolios of stocks within particular broad industry groups. [13]

Table 5 presents a regression of monthly returns from the JSXCI on monthly returns for these industry groups, dollar-denominated, over the 1989–1992 period. [14] The adjusted R-square is 0.143. The Finance and Basic industry groups have positive and statistically significant coefficients while the Transportation group has a negative and significant coefficient. [15] The Durbin-Watson still indicates some residual stale pricing effect.

Results using daily observations are reported in Panels 1 and 2 of Table 6. In these regressions, two daily lags of each industry group return were added in an effort to accommodate the stale pricing problem in the JSXCI. Also, the daily change in the Rupiah/U.S. Dollar exchange rate, including two daily lags, and a Monday dummy variable, were included as additional regressors. [16]

Because of data availability (cf. fn. 12), the first sub-period has been further truncated; it begins on April 1, 1988 and has a total of only 165 trading days. The adjusted R-square is an abysmal -0.00066 and just a few regression coefficients are marginally significant. Clearly, global markets had little influence on Jakarta equities during this period.

During the second sub-period, however, global influences appear to matter more. The adjusted R-square is now 0.0332, which is slightly higher than the explanatory power of Indonesia's regional neighbors using daily data (cf. Table 4). All three finance industry coefficients (contemporaneous plus two lags) are significant or marginally significant, the first daily lag of the Capital Goods industry is significant, and all three exchange rate coefficients are either significant or marginally significant. Also, F-statistics (not reported) for the sums of the contemporaneous and two daily lag coefficients reveal significance for the Basics industry. The Monday dummy variable is marginally significant and negative.

Although the exchange rate coefficients are significant, they have bizarre values. If the Rupiah had been freely floating against the U.S. Dollar, the exchange rate coefficient should be -1.0; [17] yet the measured coefficients are all

[13] The seven industry groups are: (1) Financial, Insurance, and Real Estate, (2) Energy, (3) Utilities, (4) Transportation and Storage, (5) Consumer Goods and Services, (6) Capital Goods, and (7) Basic Industries such as mining and construction. A list of the specific industries that belong to each broad group is given in the appendix of Roll (1992).

[14] Monthly data for the first Indonesian sub-period, 1985–88, could not be used because the global industry indices can be constructed only after April, 1988. Industry identifications for the FT Actuaries/Goldman Sachs universe are unavailable prior to that month. This would have left only eight monthly observations. (Results using daily observations from this period are reported in Panel 1 of Table 6.)

[15] A negative correlation with transportation would make intuitive sense for a large oil exporting country such as Indonesia.

[16] This matches the daily return model in Roll (1992).

[17] See Roll (1992, pp. 26–30) for an explanation.

positive! This probably reveals that the Indonesian central bank was intervening vigorously to peg the Rupiah against the dollar, permitting only small fluctuations around some desired trajectory. An examination of interest rate data, particularly the rupiah-dollar yield spread, would probably help in understanding these exchange rate results.

Overall, the data reveal that Jakarta equities have become more attuned to global events. The period from 1989–92 was characterized not only by higher

Table 6
Jakarta and global industry factors

Country	Mean (%/day)	Standard deviation	Correlation	Regression coefficient	*T*-value
Panel 1: April 1, 1988 through November 30, 1988, daily, U.S. dollars					
Finance	−0.0079	1.1080	−0.0272	−0.0464	−0.6947
Lag 1	−0.0040	1.1110	−0.0472	0.0002	0.0023
Lag 2	0.0084	1.0845	−0.0602	−0.0035	−0.0538
Energy	−0.1021	1.6956	−0.0849	−0.0609	−1.3518
Lag 1	−0.0929	1.6250	−0.1324	−0.0027	−0.0589
Lag 2	−0.0957	1.6720	−0.0482	0.0055	0.1238
Utilities	0.1385	2.7227	0.0375	−0.0056	−0.1886
Lag 1	0.0940	2.7138	0.1315	0.0402	1.3741
Lag 2	0.1142	2.7206	0.0710	0.0194	0.6617
Transport	0.3149	3.8685	−0.0443	−0.0052	−0.2640
Lag 1	0.3148	3.8381	0.1032	0.0117	0.5637
Lag 2	0.3586	3.9174	0.0033	−0.0024	−0.1263
Consumer	0.1185	1.4921	0.0227	−0.0171	−0.3502
Lag 1	0.1007	1.4791	−0.1852	−0.0996	−1.9497
Lag 2	0.1087	1.4756	−0.1355	−0.0799	−1.6084
Capital	0.1408	2.1854	−0.0872	−0.0369	−1.0656
Lag 1	0.1720	2.1537	0.0459	−0.0300	−0.8427
Lag 2	0.1696	2.2288	−0.0173	−0.0272	−0.8283
Basic	0.0288	1.8094	−0.0718	−0.0792	−1.9153
Lag 1	0.0045	1.8053	0.0618	−0.0121	−0.2812
Lag 2	0.0064	1.7923	0.0141	−0.0026	−0.0668
Exchange rate	0.0215	0.0634	0.0016	−0.2747	−0.2696
Lag 1	0.0219	0.0635	−0.0201	−1.0076	−0.9172
Lag 2	0.0219	0.0635	−0.1397	−1.9956	−1.8225
Monday dummy	0.2000	0.4000	−0.0405	−0.1588	−0.9709
Jakarta (dependent variable)	0.2778	0.7360			
Intercept				0.4066	4.7228
Adjusted *R*-square	−0.66001E-03				
Std. error of estimate	0.73844				
F-stat (25/139)	0.99567				
Sample size	165				
Durbin-Watson	1.6087				

Table 6 (continued)

Country	Mean (%/day)	Standard deviation	Correlation	Regression coefficient	T-value
Panel 2: January 3, 1989 through December 30, 1992, daily, U.S. dollars					
Finance	−0.0800	1.8639	0.0336	0.0750	2.3419
Lag 1	−0.0949	1.8653	0.1071	0.0797	2.4220
Lag 2	−0.0898	1.8722	0.0886	0.0611	1.9234
Energy	−0.0734	1.9148	−0.0269	−0.0419	−1.3628
Lag 1	−0.0860	1.9052	0.0774	0.0358	1.1390
Lag 2	−0.0650	1.9149	0.0285	0.0323	1.0509
Utilities	0.2177	2.5130	0.0052	0.0079	0.3277
Lag 1	0.2216	2.5093	−0.0225	−0.0067	−0.2690
Lag 2	0.2317	2.4883	−0.0060	−0.0027	−0.1095
Transport	0.1110	3.4204	−0.0029	−0.0042	−0.2490
Lag 1	0.0916	3.4299	−0.0145	0.0002	0.0109
Lag 2	0.1354	3.3800	−0.0273	−0.0215	−1.2480
Consumer	0.1371	1.5632	−0.0149	−0.0131	−0.3359
Lag 1	0.1581	1.5694	−0.0044	0.0300	0.7693
Lag 2	0.1721	1.5520	−0.0273	−0.0138	−0.3711
Capital	−0.1274	2.8345	0.0058	0.0016	0.0749
Lag 1	−0.1061	2.8055	0.1021	0.0599	2.7087
Lag 2	−0.1020	2.7486	0.0401	−0.0061	−0.2791
Basic	0.0138	1.7857	0.0219	0.0597	1.8536
Lag 1	0.0050	1.7738	0.0050	0.0415	1.2411
Lag 2	0.0017	1.7845	0.0019	−0.0042	−0.1277
Exchange rate	0.0177	0.0555	0.1079	3.7125	3.9222
Lag 1	0.0173	0.0554	0.0283	2.4189	2.4270
Lag 2	0.0171	0.0551	−0.0032	1.9285	1.9475
Monday dummy	0.1996	0.3997	−0.0541	−0.2463	−1.8932
Jakarta (dependent variable)	−0.0146	1.6049			
Intercept				−0.0771	−1.1613
Adjusted R-square	0.33158E-01				
Std. error of estimate	1.5789				
F-stat (25/941)	2.3252				
Sample size	967				
Durbin-Watson	1.6876				

volatility, but also by greater correlation between Jakarta equities and equities in other countries, as measured either by national market indices or by global industry factors. However, the correlations remain quite modest in magnitude, though perhaps no more modest than is typical for other emerging markets. With regional neighbors, correlations are, if anything, even smaller.

4. Accounting data based style investment returns

The PACAP data base contains extensive accounting information about Jakarta equities. However, there are many missing observations, particularly during the earlier sub-period, before 1989. Nonetheless, it has proved possible to undertake a preliminary excursion into the accounting/finance territory, and to measure the relative performance of ''style'' investing.

By ''style'', I am referring to a practical adoption of a trading strategy suggested by scholarly empirical results, most recently those of Fama and French (1992), who found that stocks grouped by particular accounting ratios have very different returns in periods subsequent to the classification date. These findings actually lend credence to traditional investment selection methods based on price/earnings ratios or market value/book value ratios but there remains a controversy about whether differences in performance are attributable to risk premia or simply to market inefficiency. My purpose here is simply to present results of such a strategy applied to Indonesian equities, without commenting on the implications for the risk premium versus inefficiency argument.

Fig. 12 shows the monthly cross-sectional averages of the P/E (price/earnings) ratio and the M/B (market value/book value) ratio for Jakarta stocks with available data from January 1990 through December 1992. For a stock to be included in the P/E average, it had to have an available annual earnings number

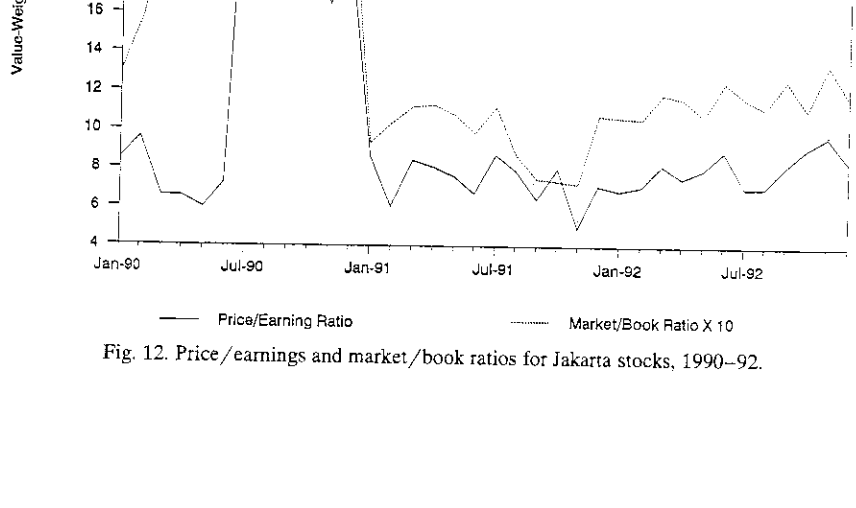

Fig. 12. Price/earnings and market/book ratios for Jakarta stocks, 1990–92.

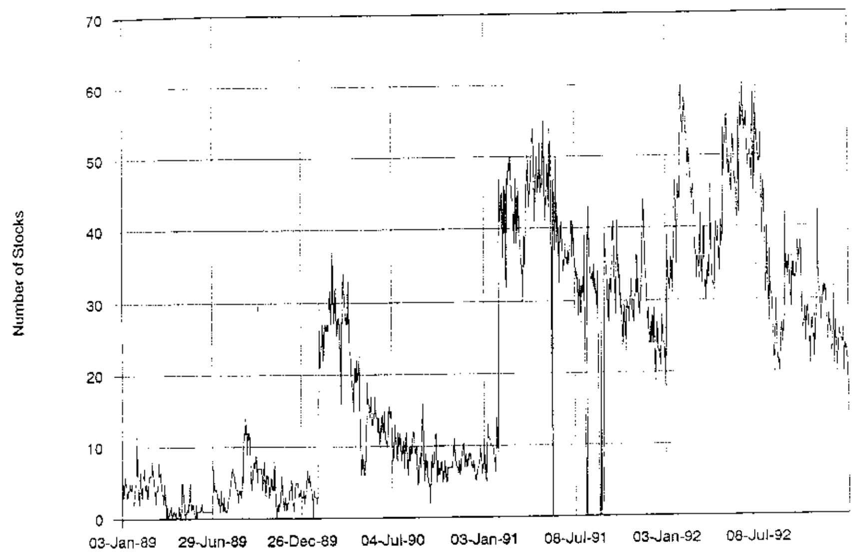

Fig. 13. Number of stocks with available book/market values, daily, used to form growth and value portfolios.

for the calendar year preceding the year in which the price was observed. (Of course, it also had to have an available month-end price.) For a stock to be included in the M/B average, it had to have an available book value at month end, an available price, and also an available number of outstanding shares (which is required to compute total market capitalization).

Only a minority of listed stocks had available data on most dates; Fig. 13 presents the number of stocks for which M/B ratios could be computed daily [18] over the 1989–92 sub-period. During 1989, this number was usually only four to six and it rarely exceeded ten. This explains why Fig. 12 begins in 1990; earlier averages would have little reliability. After January 1991, the number of stocks with available data was in the more reasonable range of 30–60, but even in this period, there were a few days with no available observations at all.

The P/E and M/B average ratios in Fig. 12 generally reflect the price movement of the JSXCI over the same period; cf. Fig. 1. There is a significant upswing during the first six months of 1990 and a significant decline during the second six months. However, the P/E and M/B ratios do not decline further after the beginning of 1991 although the market index falls roughly 25 percent during 1991–92. Apparently, the price decline in the 1991–92 period is matched by reductions in earnings and book values.

[18] Daily book/market values were computed with the closing transaction price on the date combined with the previous month-end number of outstanding shares and book value of equity.

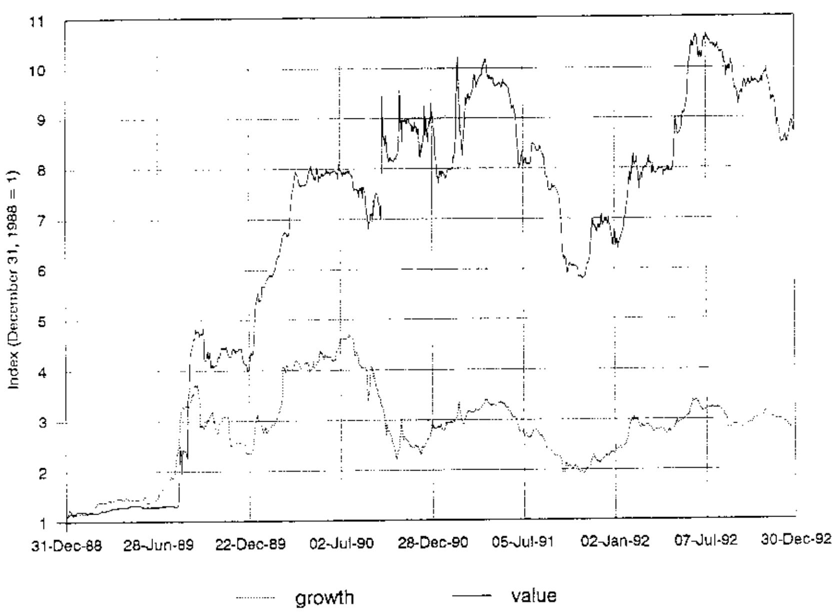

Fig. 14. Jakarta growth and value portfolio levels (Rupiah, 1989–92).

Style investment performance was based on the book/market ratio, the accounting variable found by Fama and French (1992) to have the greatest explanatory power for U.S. equity returns. At the end of each calendar month, stocks with available data were sorted by their observed book/market ratios into two groups. Using investment practitioner nomenclature, the low B/M group consists of "growth" stocks while the high B/M group consists of "value" stocks. Within each group, portfolios were formed by weighting individual stocks by their market capitalization the end of each calendar day; i.e., there was daily rebalancing based on changes in the market price, though the book values were only updated monthly. Returns for the growth and value portfolios were then computed for the subsequent trading day.

The results are shown in Fig. 14, which normalizes each portfolio to one Rupiah on December 31, 1988, and follows its performance daily over the entire four years of the second sub-period, ending on December 30, 1992. The performance difference between value and growth conforms to the same pattern as has been observed in other countries: value portfolios (low market/book) consistently outperform growth portfolios. For Indonesia, the performance differential is large: while the growth portfolio went from one to three Rupiah over the four years, the value portfolio increased from one to *nine* Rupiah. The mean return difference, Value-Growth, was 0.1218 percent per day. However, the standard deviation of the return difference was 2.99 (%/day) so if these observations can be assumed

Table 7
Growth and value portfolio returns. January 3, 1989 through December 30, 1992, daily, Rupiah, sample size: 884

	Mean	Standard deviation	Correlation	Regression coefficient	T-value
Panel 1: Growth portfolio on JSXCI index					
JSXCI	0.79952E-05	0.15230E-01	0.58779	0.83279	21.577
Growth	0.11552E-02	0.21579E-01			
Intercept				0.11485E-02	1.9538
Adjusted R-square	0.34475				
Durbin-Watson	1.6757				
Panel 2: Value portfolio on JSXCI index					
JSXCI	0.79952E-05	0.15230E-01	0.47944	0.88505	16.225
Value	0.23730E-02	0.28116E-01			
Intercept				0.23659E-02	2.8477
Adjusted R-square	0.22899				
Durbin-Watson	1.8611				
Panel 3: Growth portfolio on value portfolio					
Value	0.23730E-02	0.28116E-01	0.29853	0.22912	9.2893
Growth	0.11552E-02	0.21579E-01			
Intercept				0.61147E-03	0.87864
Adjusted R-square	0.88085E-01				
Durbin-Watson	1.5408				
Auto-correlations					

Lag (days)	Growth	Value
1	0.30581	0.23094
2	0.15348	−0.04786
3	0.05708	−0.10070
4	0.06313	0.10617
5	0.05584	0.03889
6	−0.00273	−0.00160
7	−0.01631	0.00774
8	−0.01162	0.05651
9	0.03248	−0.01448
10	0.00653	−0.03738

intertemporally independent, the t-statistic of the mean return difference based on 884 observations was only 1.21. Although the average return difference appears to be remarkable, the extensive noise in the data implies that the difference cannot be called statistically significant.

Table 7 provides some further statistics about the growth and value portfolios. Market model returns show that their simple betas against the JSXCI index are 0.833 and 0.885, respectively. Thus, the value portfolio has a slightly higher beta but, again similarly to results from other countries, the beta difference is not even close to being enough to explain the return difference.

The market model regressions (Panels 1 and 2) do not display all that much evidence of autocorrelated residuals; the Durbin-Watson statistics are at most marginally significant. However, the regression of growth returns on value returns (Panel 3), does have a significant Durbin-Watson and the autocorrelations of the two portfolios' returns show sizeable first-order effects. This is somewhat surprising because stale prices were not used in forming the growth and value portfolios; only stocks with valid transaction prices were included. By comparison, the JSXCI itself, which does contain stale prices, had a comparable first-order autocorrelation of 0.171 during this period. This may arouse some suspicion about the quality of transaction prices.

One puzzling aspect of these results is that the JSXCI had a significantly lower average return than *either* the value or the growth portfolios. To annualize the returns, multiply the mean daily return by 884, the number of daily observations in the mean, and divide by four, the total number of calendar years. This procedure gives an annual mean return (in Rupiah) of 0.177%/annum for the JSXCI, 25.5%/annum for the growth portfolio, and 52.4%/annum for the value portfolio.

A minor part of the JSXCI shortfall is explained by the absence of dividends; they are included in the individual stock returns comprising the growth and value portfolios. But the return differences are much too large to be attributable to dividends alone. The growth and value portfolio formation method should not be intrinsically biased; portfolios were formed on the basis of available information. Perhaps the differences are somehow related to stocks with missing observations. On average, it would appear that missing observations are associated with lower returns. Why this should be the case remains a subject for further research, but we conjecture that missing observations are mainly for information-deficient companies which investors, especially foreigners, do not regard with great confidence.

5. Conclusion

Stock price behavior on the Jakarta Stock Exchange presents an interesting case study of a market in rapid development. Over the 1985–1992 period, the number of listed issues grew dramatically and the volatility of returns increased by an order of magnitude. The reason for the increased volatility is not obvious; stocks present in the earlier, low-volatility sub-period were even more volatile in the later sub-period than new listings.

During December 1988, stock prices fluctuated impressively on the Jakarta Exchange. They ended the month approximately 100% higher than they began the month, but during the month, they trebled in value, only to fall substantially during the last ten days of the month. Again, the reason for this extraordinary behavior is not clear.

The price behavior of individual stocks listed in Jakarta contains evidence of imperfect adjustment to new information. Although most stocks seem to adjust efficiently to news, a significant minority of issues reveals over-reaction while a significant minority reveals slow reaction to the initial appearance of news. This cannot be attributed to illiquidity or stale pricing because only transaction prices were used in the estimation of speed-of-adjustment characteristics.

Jakarta equities are not very correlated with equities in other countries. Prior to December 1988, in fact, twenty of 23 measured correlation coefficients (based on monthly returns with developed countries) were negative. In contrast, during the period from 1989–92, most of the correlations were positive (20 out of 24) and approximately 40 percent of Jakarta's monthly return was explained by co-movements with other country returns. However, even in this later period, the particular countries which displayed the greatest relation to Jakarta were surprising; Austria and New Zealand topped the list for significance. Daily returns were, not surprisingly, virtually uncorrelated with other countries, even with countries in Indonesia's geographic region and even after searching for relations over various daily lags.

Using monthly data during the 1989–92 period, global industry indices were found to explain about 14 percent of Jakarta's return. On a daily basis, the explanatory power was only three percent, but it was statistically significant. The financial, capital goods, and basics (mining, etc.), global industry factors were the most important. There was also a significant daily impact of the Rupiah/US Dollar exchange rate on dollar-denominated equity returns. The empirical estimates provide strong evidence of central bank intervention in the foreign exchange market.

A brief foray was made into Indonesian accounting data. Price/Earnings ratios and Market/Book Value ratios were computed for stocks with available data; until January 1990, there were fewer than ten stocks with available data, but the last three years of the sample contained adequate numbers. Following recent methods employed in the U.S. and other countries, market/book ratios were used to classify stocks into "growth" and "value" portfolios and subsequent investment performance was observed. In agreement with other results, the value portfolio of Indonesian equities performed much better than the growth portfolio, though the large degree of noise in returns precluded an inference that the performance difference was statistically significant. Strangely, both the growth and the value portfolios outperformed the value-weighted Jakarta Composite Index; this seems to imply that stocks that are missing accounting data performed poorly compared to stocks with publicly available accounting data.

This empirical survey of Indonesian equities has raised many questions and answered none. The Jakarta market is now large, volatile, and fascinating. Along with markets from other large developing countries, it offers fertile ground for further empirical study. Unlike data from the more developed countries, which have been "snooped" for many years, Jakarta's data are virtually untouched and in that sense provide the opportunity for more reliable inferences about market behavior.

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