IMF Working Paper

© 1997 International Monetary Fund

WP/97/117   INTERNATIONAL MONETARY FUND

Policy Development and Review Department

Determinants of Stock Prices: The Case of Zimbabwe

Prepared by Tsuyoshi Oyama[1]

Authorized for distribution by Roger Nord

September 1997

Abstract

This paper examines the general relationship between stock prices and macroeconomic variables in Zimbabwe, using the revised dividend discount model, error-correction model, and multi-factor return-generating model. Despite the large fluctuation in stock prices since 1991, this analysis indicates that the Zimbabwe Stock Exchange has been functioning quite consistently during this period. Whereas sharp increases in stock prices during 1993-94 were mainly due to the shift of risk premium that was caused by the partial capital account liberalization, the recent rapid increase in stock prices can be explained by the movements of monetary aggregates and market interest rates.

---

[1] The author was an economist in the Policy Development and Review Department and has just returned to the Bank of Japan. The author would like to thank Bruno de Schaetzen, Ilan Goldfajn, Shogo Ishii, Piyabha Kongsamut, Roger Nord, Hideaki Shimizu, and Krishna Srinivasan for helpful comments. The opinions expressed in this paper are those of the author and do not necessarily reflect the views of the IMF.

Determinants of Stock Prices: The Case of Zimbabwe

<table>
<tr><td>Contents</td><td>Page</td></tr>
</table>

Appendices

SUMMARY

This paper analyzes the general relationship between stock prices and macroeconomic variables in Zimbabwe and examines how well macroeconomic variables explain recent movements of stock prices.

The relationship between the ratio of earnings per share and share price (E/P ratio) of the Zimbabwe Stock Exchange and market interest rates in Zimbabwe has undergone profound changes since the early 1990s, mainly reflecting market liberalization policies implemented since then. In particular, the sharp deviation between the E/P ratio and market interest rates since late 1993 is likely to have been triggered by the partial liberalization of the external capital account, which resulted in a convergence of the risk premium prevailing in Zimbabwe to the average level of emerging markets.

Application of an error-correction model to stock returns shows that the relationship between stock returns and the growth rate of money and treasury bill rates has been quite stable since 1991, except during the period of partial capital account liberalization.

An analysis of individual stock returns based on a multi-factor return-generating model indicates that the Zimbabwe Stock Exchange assimilates changes in some important macro variables quite consistently. Still, the contributions of these macro variables cannot explain the volatile movements of stock returns during the period from late 1993 to 1994.

The analysis indicates that sharp increases in stock prices during 1993-94 were mainly due to the shift of risk premium, while the recent rapid increase in stock prices can be explained by the movements of monetary aggregates and market interest rates. However, given that the recent moderation of inflation is likely to be the result of supply shocks, it is difficult to judge whether current macroeconomic conditions, which support high stock returns, are sustainable. Thus, it may be wise for policymakers to take some precautions against the risk of a downside shift in stock prices.

I. INTRODUCTION

This paper analyzes the general relationship between stock prices and macroeconomic variables in Zimbabwe, and examines how well macroeconomic variables explain recent movements in stock prices. Two consecutive excellent harvests and large inflows of foreign capital have boosted the Zimbabwe Stock Exchange (ZSE) since 1995, which now has become the second biggest market in Africa after the Johannesburg Stock Exchange. However, market liberalization policies seem to have changed the arbitrage relationship between stock returns and returns on other assets and goods, and sharp increases in stock prices in 1996 have caused some concern among foreign investors.

Asset prices such as stock prices are influenced strongly by market expectations, which often tend to dismiss economic fundamentals in the short run. Still, assets prices should be formed in the long run in a way that reflect economically justifiable rates of return. Therefore, being able to assess the deviation of stock prices from fundamental values, or what would be economically sustainable stock prices, is important to avoid disruptions in the financial market. In the case of developing countries, while the stock market still tends to be relatively marginal in the whole process of financial intermediation, the devastating effects of a market crash on an economy should not be underestimated given its increasingly important role for attracting foreign capital. Furthermore, a better understanding as to why stock prices deviate from their long-run fundamental value could also be helpful in identifying structural rigidities that discourage smooth arbitrage between different financial markets.

Several financial theories help explain the relationship between stock prices and economic fundamentals. For example, the basic dividend discount model (DDM) offers a very simple but useful framework to analyze the relationship between market interest rates and the level of stock prices. Focusing on the movements of a stock market index, the construction of a regression model which relates the stock market with other macrovariables is also a helpful way to identify such relationships. Finally, some factor models such as the Capital Asset Pricing Model (CAPM) or the Arbitrage Pricing Theory (APT) model could provide more micro-based information on macrovariables.[2] This paper examines the results of applying a number of these methods to the relationship between stock prices and macrovariables in Zimbabwe.

The paper is organized as follows. Chapter II provides a brief overview of Zimbabwe's stock market. Chapter III develops the basic assumptions regarding the general relationship that exists between stock prices and macroeconomic variables, on the basis of the DDM. It also discusses the arbitrage relationship between the ratio of earnings per share and share prices (E/P ratio) and market interest rates in Zimbabwe. Chapter IV constructs an error

---

[2] Factor models explain the difference of individual stock returns using their sensitivities (or return's elasticity) to one (CAPM—the market index) or several factors (APT model). The detail of these models is discussed later in the paper.

correction model to explain the movements of stock returns using two macrovariables—broad money and three-month Treasury Bill rates. Chapter V constructs a multi-factor return generating model based on the method by Chen, Roll and Ross (1986), in order to identify more macrovariables which may affect stock prices. Chapter VI presents a summary of the principal findings.

II. STOCK MARKET IN ZIMBABWE

Although the first exchange in Zimbabwe was opened in 1896 in Bulawayo and some other exchanges were opened subsequently elsewhere in the country, it was only in 1974 that the current Zimbabwe Stock Exchange (ZSE) was first established in Harare. The economy of Zimbabwe, the backbone of the ZSE, is well diversified in comparison with other African economies. This is partly owing to its economic as well as political isolation until its independence in 1980. The economy currently runs the gamut from a large agricultural sector and increasingly important mining sector to export-oriented chrome and textile, and various types of consumer product industries. This diversity is reflected in the composition of the companies listed on the ZSE (Table 1). Given the strong influence of agriculture in the overall economy, droughts periodically subject the economy to large shocks. Stock prices tend to be strongly affected by these droughts, which already have hit Zimbabwe twice (1992 and 1995) in the 1990s (Chart 1). The importance of the agricultural and mining sectors makes the economy also heavily dependent on international commodity prices. Besides staple products, the agricultural sector produces many commercial crops such as tobacco, sugar and horticulture, which now accounts for roughly 40 percent of total exports. In addition, the mining sector produces precious metals such as gold, platinum and nickel, which account for about 35 percent of total exports. The recent political change in South Africa has led to sharply increased bilateral trade, with a sizable impact on the Zimbabwean economy.

Table 1. Listed Companies on the Zimbabwe Stock Exchange: Classification by Industries

(In percent)

Food	Paper	Tobacco	Textile	Other Manu-facturing	Mining	Retail	Construc-tion	Finance	Other Services	Conglom-erate
14.5	6.6	3.3	3.3	21.3	11.5	8.2	9.8	8.2	4.9	8.2

Source: SAGIT (1996).

Chart 1. Zimbabwe: Stock Market Index and Return Rate

IFC Global Return Index
(In log scale)
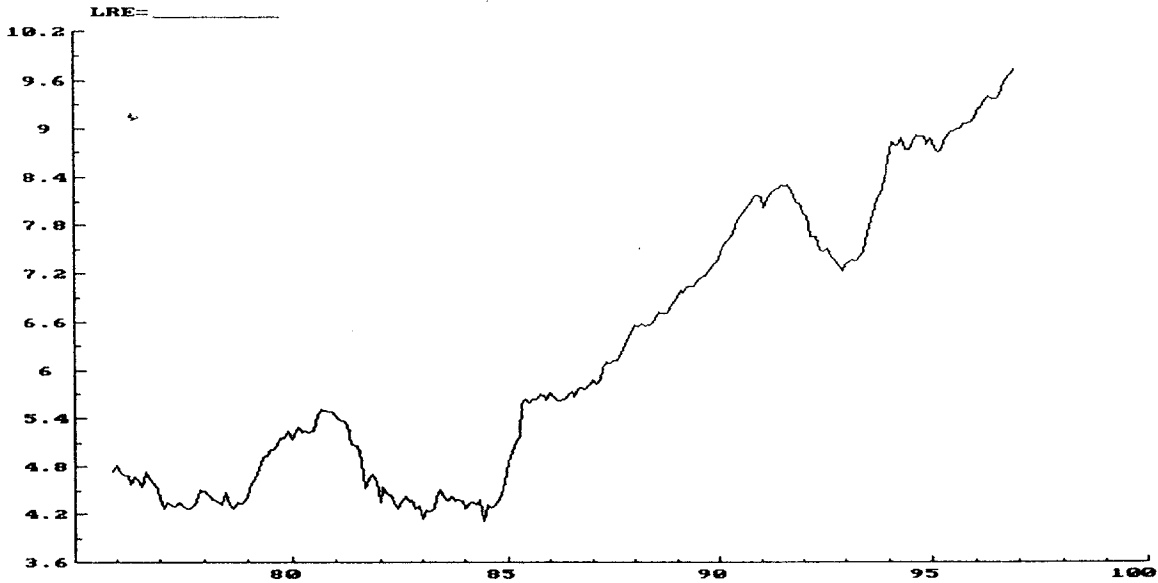
Annual Return Rate Based on the IFC Global Return Index

(In percent)
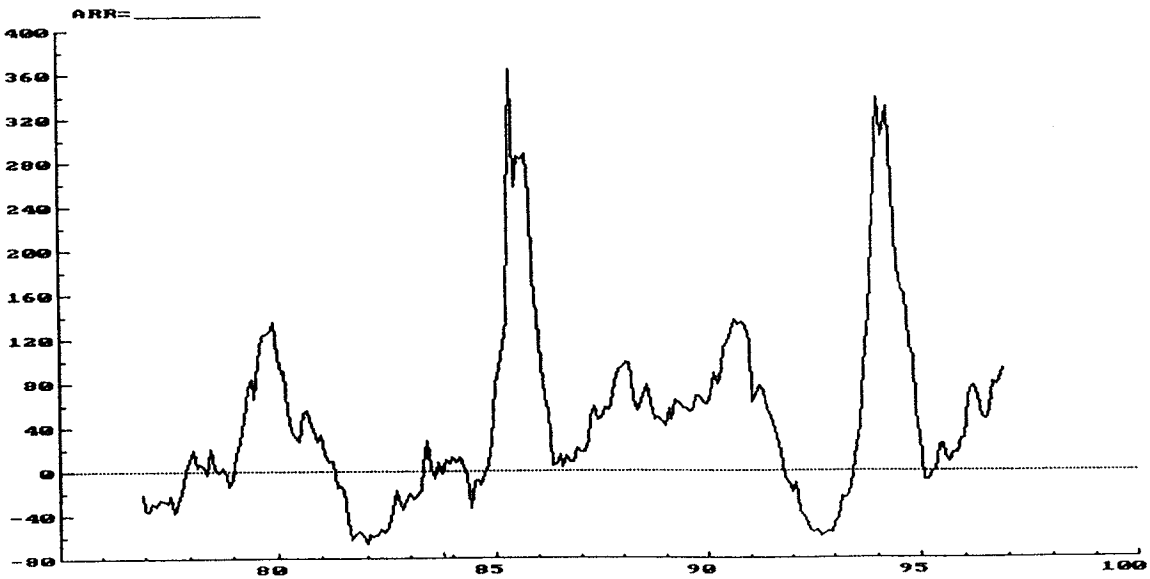
Since the beginning of the 1990s, the Zimbabwe Government has been implementing a broad stabilization and reform program, which has ranged from the liberalization of the foreign exchange market with respect the reform of financial markets. These policies have provided a strong stimulus for trading volume on the ZSE (Chart 2). In particular, the significant relaxation of foreign investment controls with respect to the ZSE[3] increased stock purchases significantly from nil in 1992 to US$84 million in 1996, or equivalent to about 40-60 percent of the annual turnover of the ZSE in recent years. The combination of these policy factors, as well as weather-related factors, has led to sharp swing in stock prices since 1990. The serious slump in stock prices between 1991 and 1992 is partly explained by a rapid increase in nominal interest rates, which was triggered by the liberalization of interest rates. More recently the liberalization of restrictions on foreign participation has provided an additional favorable effect on stock prices.

Owing mostly to the excellent rains in the past two years, the ZSE has seen "an historic year" (Quincor James Capel (1997)) in 1996 with the local industrial index rising by 121 percent (90 percent in US dollar terms), making Zimbabwe one of the top performers among emerging markets. As of December, 1996, there were 64 company listed on the ZSE with a total market capitalization of US$3.6 billion. Total market capitalization has recently been further boosted by the listing of "Ashanti"—a Ghana-based international gold mining company[4] (Chart 2). Consequently, the ZSE has now become the second largest stock market in Africa, second only to the Johannesburg Stock Exchange (Table 2).

**Table 2. Summary Statistics of Stock Markets in Zimbabwe,
Nigeria, and South Africa**

Country and Year	Market (millions of U.S. dollars)	Capitalization (percent of GDP) (1995) 1/	No. of Listed Companies	Annual Trade (millions of U.S. dollars)
Zimbabwe				
Dec. 1989	1,067	16.3	54	35.4
Dec. 1996	3,635	33.5	64	248.7
Nigeria				
Dec. 1989	1,005	3.3	111	3.8
Dec. 1996	3,560	5.2	183	72.9
South Africa				
Dec. 1989	131,059	120	748	7,337.0
Dec. 1996	241,571	206	626	27,048.0

Sources: IFC; and EIU.
1/ 1994 for Nigeria.

---

[3] After the initial relaxation to allow foreign ownership of shares up to 25 percent in June 1993, this ceiling has been raised several times, standing at 40 percent as of December, 1996.

[4] Since its capitalization alone accounts for about US$830 million, its listing raised the total capitalization of the ZSE to US$4.4 billion as of February 1997.

Chart 2. Zimbabwe: Value Traded and Market Capitalization of the Zimbabwe Stock Exchange

Value Traded
(Millions of U.S. dollars)
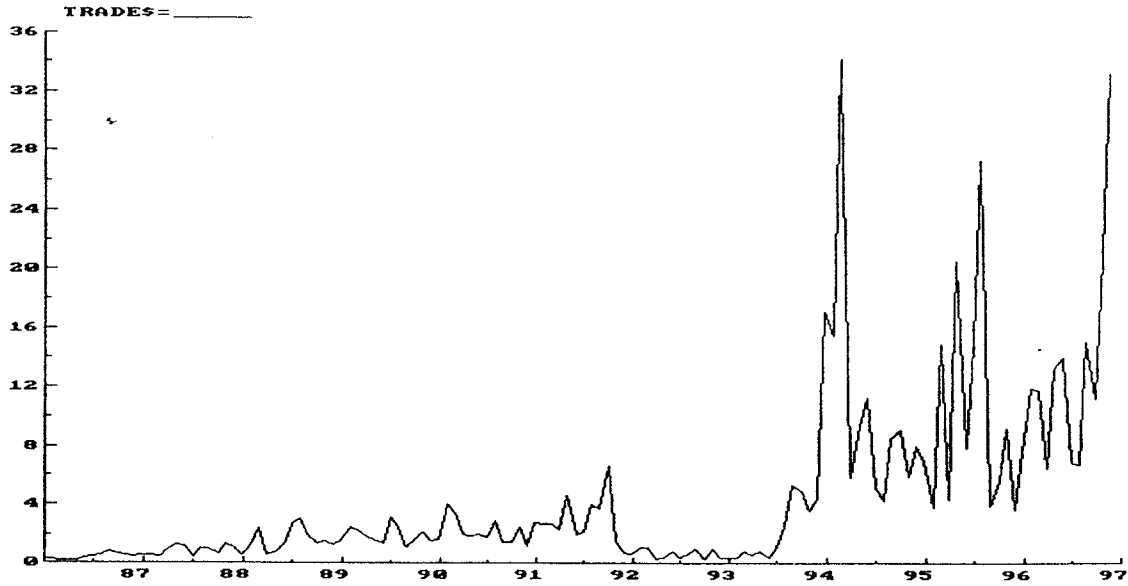
Market Capitalization
(Millions of U.S. dollars)
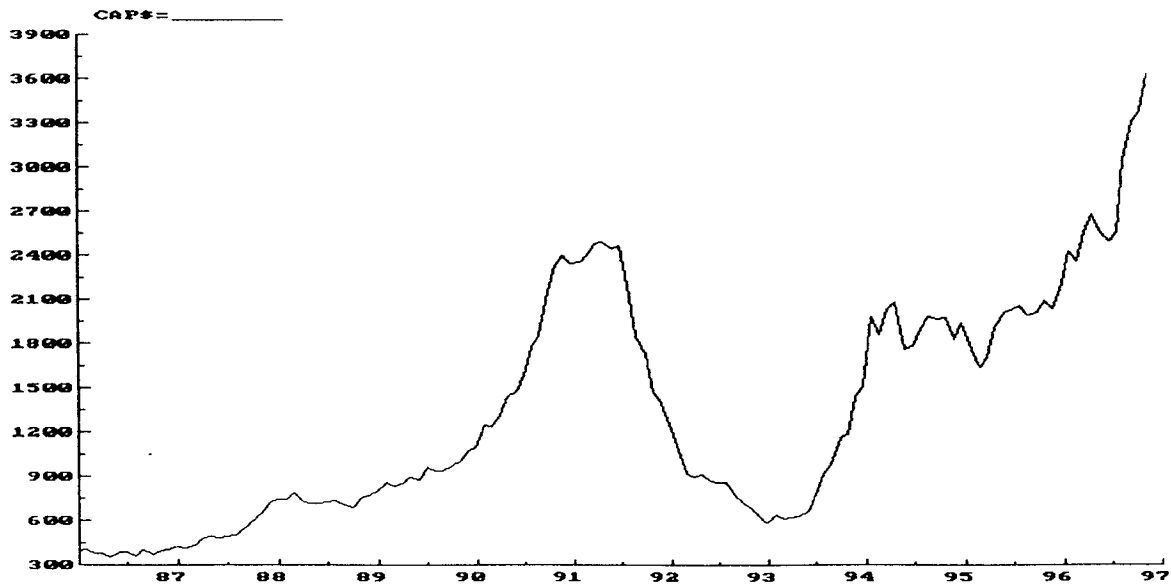
III. RELATIONSHIP BETWEEN STOCK PRICES AND MACROECONOMIC VARIABLES: IMPLICATIONS FROM THE DIVIDEND DISCOUNT MODEL

Asset prices are basically determined by the future cash flow stream arising from the underlying assets and discount rate. As these two factors are quite sensitive to changes in macroeconomic conditions, it is reasonable to assume a fairly close relationship between changes in asset prices and changes in macroeconomic variables. This relationship should be especially close for stock prices since the future cash flow of listed companies is strongly influenced by general economic activity, and discount rates critically depend on the current prevailing interest rates and investors' concerns about the volatility of future cash streams (risk premium).

Miller and Modigliani (1961) developed the Dividend Discount Model (DDM) to provide a simple but useful framework for understanding the relationship between stock prices, the stream of future cash flows from the stock, and the discount rate. Assuming the required rate of return and the expected growth rate of dividends per share are kept constant over the future period, the DDM presents the following relationship between stock prices and other variables:

$$P = D*(1+G)/(1+K) + D*(1+G)^2/(1+K)^2 + D*(1+G)^3/(1+K)^3 + \ldots \qquad (1)$$

or

$$P = D/(K-G) \qquad (2)$$

where
P: stock price;
D: dividend per share;
G: expected growth rate of dividend per share; and
K: required rate of return for investors.

Equation (2) can be transformed to:

$$K = D/P + G \qquad (3)$$

or

$$D/P = K - G \qquad (4)$$

Again, (3) can be rewritten as:

$$K = a*E / P + G \qquad (5)$$

where
a: dividend payout ratio, and
E: earning per share.

Since

$$K = I + R \tag{6}$$

where
I: risk-free interest rate, and
R: risk premium for stock investment,

Equation (5) can also be rewritten as:

$$a*E / P = I + R - G. \tag{7}$$

Assuming that the dividend payout ratio is kept constant and that earnings growth *solely* depends on the new investment initiated by retained profits,[5] G can be expressed as:

$$G = (1 - a) * G' \tag{8}$$

where
G': rate of return on the new investment.

Using equation (8), equation (7) can be transformed to:

$$a*E / P = I + R - (1 - a) * G'$$

or

$$E / P = I + R - (1 - a) * (G' - E / P). \tag{9}$$

Equation (9) indicates that the E/P ratio should be equal to a risk-free interest rate plus the risk premium in the long run since the ROE of new investments could not deviate from the E/P ratio for a long time period. Moreover, given that the dividend payout ratio is a policy variable which is determined by corporate management, the relationship in equation (9) can be assumed to be more stable than the relationship in equation (4).

In the case of stock markets in developing countries with relatively high and variable inflation rates, however, it may be better to consider the level of inflation explicitly in the

---

[5] As discussed later, since earnings growth is also subject to inflation, this assumption might be unrealistic particularly in high inflation countries.

above formula. In this case, if we assume that the inflation rate automatically pushes up corporate earnings by the same rate, equation (8) can be rewritten as follows:

$$G = (1 - a) * G' + IF \tag{10}$$

where
IF: expected inflation rate.

Therefore,

$$E / P = RI + R - (1 - a)(G' - E/P) \tag{11}$$

where
RI: risk-free real interest rate,

or, in the long term,

$$E / P = RI + R. \tag{12}$$

The meaning of the above formulae can easily be understood in a hypothetical comparison of a share in country A with a relatively low inflation rate (e.g., 20 percent) and a share in country B with a hyperinflation rate (e.g., 100 percent). For simplicity, we now assume that dividend payout ratios are 100 percent for both shares. Therefore, $P = E / (K - G)$ from equation (2). This means that 'G' solely depends on inflation rates. In this case, even if the risk-free interest rate in country A is 30 percent while the rate in country B is 110 percent, the 'E / P' ratio must be the same for both shares (= 10 percent).[6]

Although the DDM is basically the model for evaluating the *individual stock price*, it has also been used frequently for the analysis of overall stock market performance, such as the international comparison of the cost of equity or the P/E ratio. (For example, see Ando and Auerbach (1987), Frankel (1991), French (1991)). The popularity of the DDM is partly due to the fact that a fairly stable relationship between the E/P ratio and market interest rates is observed in many industrial countries.[7] This, however, does not mean that different countries share the same relationship between the E/P ratio and market interest rates. For example, the difference in the type of interest rates (i.e., short-term or long-term) arbitraged by the E/P

---

[6] The validity of this formula is partly evidenced by the fact that a more stable relationship can be observed on the spread between real interest rates and the E/P ratio than between nominal interest rates and the E/P ratio in many Latin American countries which have recently experienced a sharp reduction in inflation rates. In addition, many high-inflation countries (such as Argentina and Turkey in the late 1980s, and Brazil in the early 1990s) have recorded much higher nominal interest rates than the E/P ratio, nullifying an effort to measure risk premiums associated with stock investment based on equation (9).

[7] This indicates that in those countries, the sum of inflation and risk premium has been relatively stable.

ratio might be explained by local investors' average time horizon for investment. Similarly, the difference in the spread between the E/P ratio and market interest rates might be attributable not only to the different degree of risk averseness of local investors and the level of inflation, but also to the difference in the accounting system (e.g., accounting method of depreciation), tax system (e.g., the difference between tax rates on interest income and capital gain), the existence of cross-share holding between listed companies and so on.[8]

In Zimbabwe, an examination of the relationship between the E/P ratio and other rates of return on assets and goods suggest that major changes have taken place. As discussed below, most of these changes appear to have been in response to the introduction of several market liberalization policies since 1991 (Charts 3, 4, 5, and 6).

Before 1991: This is a period during which market interest rates (three-month TB rate) were regulated and kept constant. During this period, the E/P ratio would move with the CPI rate (Charts 3 and 4). This co-movement would appear to violate the relationship which we have seen in the previous section (equation (11)). This may be partly because the CPI was the only return rate (nominal return on goods) which could be arbitraged by stock return at that time. On average, the estimated risk premium (E/P ratio - TB rate + CPI from equation (12))[9] moved around 30 percent during this period (Chart 6). This stable relationship, however, seems to have collapsed in late 1989 when the E/P ratio began to gradually approach the level of nominal interest rates.

1991 to the latter half of 1993: The liberalization of market interest rates in early 1991 led to a close link between the E/P ratio and market interest rates (Charts 3 and 4). This relationship is well evidenced by major fluctuations in the E/P ratio from late 1991 until the middle of 1993 which closely follow the sharp tightening and subsequent loosening of monetary policy. During this period, however, the estimated risk premium also fluctuated due to the movements of inflation (Chart 6).

From the latter half of 1993: The E/P ratio became suddenly delinked from the interest rate in late 1993, and for the first time since the middle of 1980s, the E/P ratio fell to around the level of 15 percent *below* market interest rates (Charts 3 and 4). The timing of this sharp shift corresponds to the liberalization of portfolio investment by foreigners which began in June 1993, and thus it is likely that foreign capital inflows did provide some impact on the arbitrage relationship between the E/P ratio and market interest rates. It is noteworthy, too, that during this recent period, the estimated risk premium had gone down dramatically to the historically low level of around 0-5 percent (Chart 6).

---

[8] Although these are interesting topics to be examined, doing so is beyond the scope of this paper.

[9] Although the TB rate is not necessarily equal to the risk-free rate, particularly in developing countries, this rate is very likely to represent one of the least risky rates in terms of maturity as well as the issuer's credit standing. At the same time, even though other factors beside risk premium could also affect the difference between the E/P ratio and real interest rates, the paper calls this difference the 'risk premium' from now on for convenience.

Chart 3. E/P Ratio, TB Rate, and CPI Rate

(In percent)

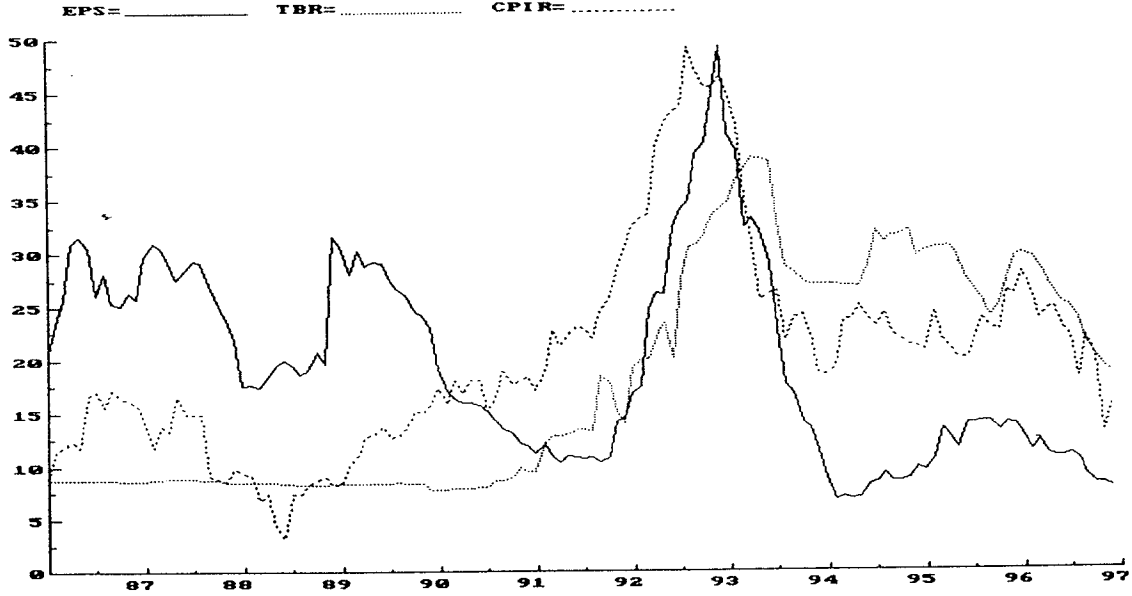EPS=_____   TBR=.............   CPIR= ....

Chart 4. Spreads Between E/P Ratio and TB Rate, and E/P Ratio and CPI Rate

(In percent)

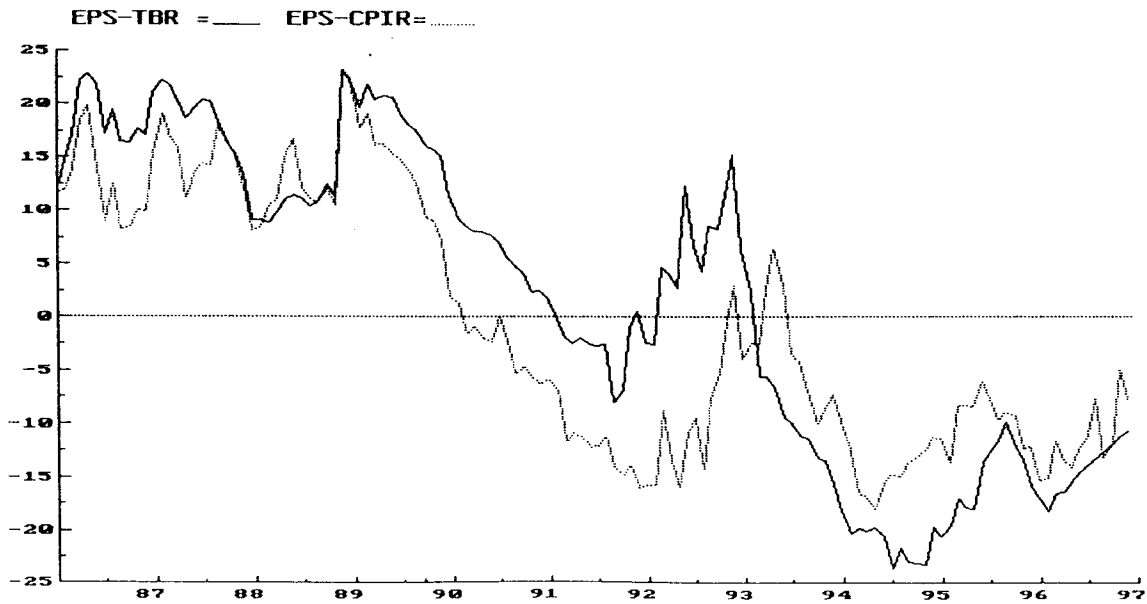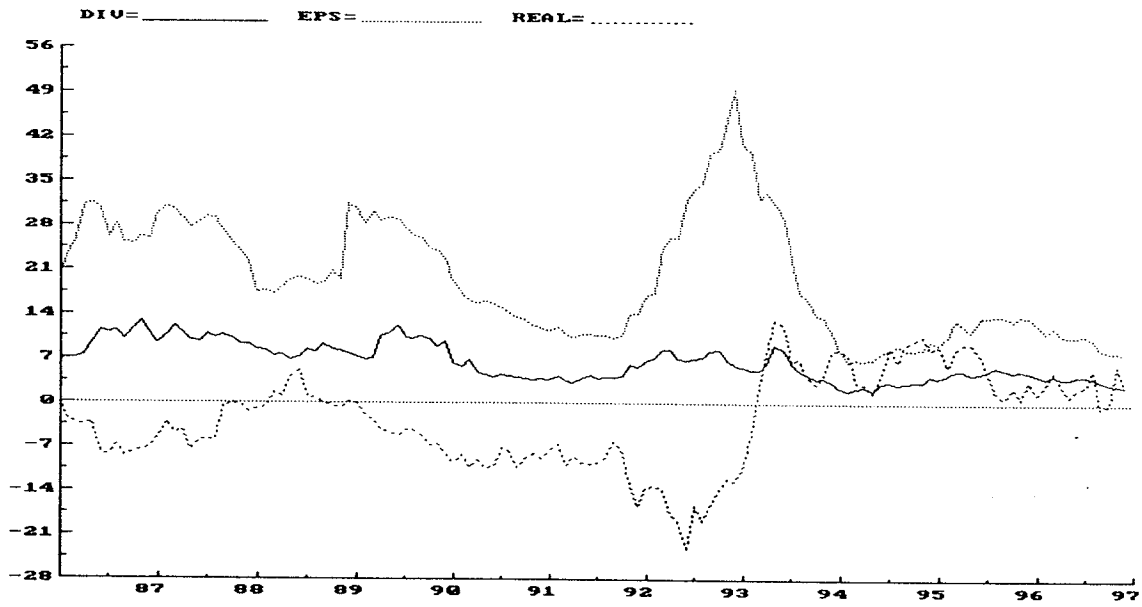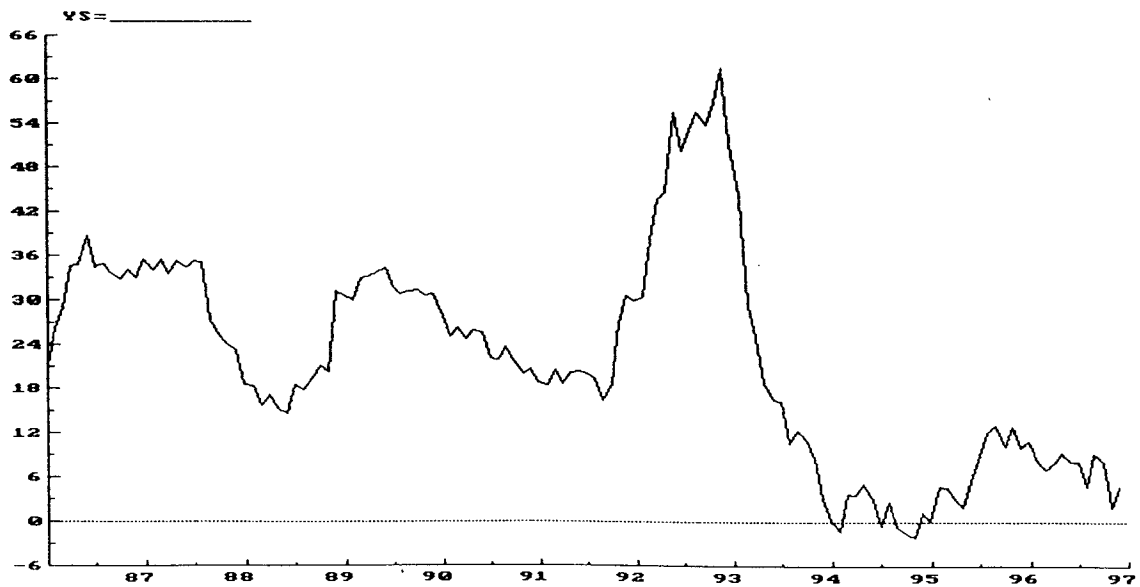EPS-TBR =____   EPS-CPIR=........

Chart 5. E/P Ratio, Dividend Yield, and Real Interest Rate

(In percent)

Chart 6. Estimated Risk Premium
(Yield Spread Between E/P Ratio and Real Interest Rate)

(In percent)

When compared to the level of estimated risk premium in other emerging stock markets, the recent level in Zimbabwe has moved much closer to the average (Chart 7). As previously mentioned, the level of risk premium (or the spread between the E/P ratio and the real interest rate) could be affected by many factors and thus cannot easily be compared on a cross-country basis. Still, it is interesting to note that the spread in most emerging markets has been moving in a very narrow range of 0-10 percent recently. This could be interpreted that the institutional investors' active international asset allocation is working in a way that converges risk premiums of different stock markets. It also indicates that the significant shift of the risk premium in Zimbabwe might have been triggered by the liberalization of portfolio investment and the subsequent sizable inflows. The above argument might be strengthened by the fact that similar changes in risk premium associated with the liberalization of foreign stock investment are also observed in other emerging markets.

Venezuela: The risk premium declined sharply from around 90 percent to less than 10 percent after the liberalization of stock investment by foreigners in 1990. This level was maintained until the middle of 1994 when the authorities reintroduced restrictions on the repatriation of capital and income which raised the risk premium again to more than 40 percent.

Jordan: The risk premium declined from more than 15 percent to around 5 percent in 1992 when the authorities increased significantly the amount of Jordanian currency and foreign exchange that could be taken abroad by residents and nonresidents.

Pakistan: Since February, 1991 when the stock market was opened to foreign investors, the risk premium has dropped from 10-20 percent to around 5 percent.

Poland: The risk premium has dropped dramatically since 1991 when a new foreign investment law came into effect and, subsequently, most limits on the transfer of profits for investments in shares were lifted. The premium dropped again from around 50 percent to 10–15 percent in 1993 when the authorities removed the remaining restrictions on the repatriation of profits and capital in certain portfolio investments and also proceeded with an aggressive privatization program which led to increased foreign investment.

South Africa: Responding to the end of apartheid in the early 1990s, many international institutional investors started to invest in South Africa. This movement is particularly remarkable in 1992 when net portfolio investments by foreigners jumped to US$1,500 million from less than US$100 million in the previous year. As a result, the risk premium has dropped from 15 percent to less than 5 percent since late 1992.

Chart 7. Spreads Between E/P Ratio and Real Interest Rate of Major Emerging Stock Markets

(In percent)

Chile, Colombia, Mexico, and Zimbabwe
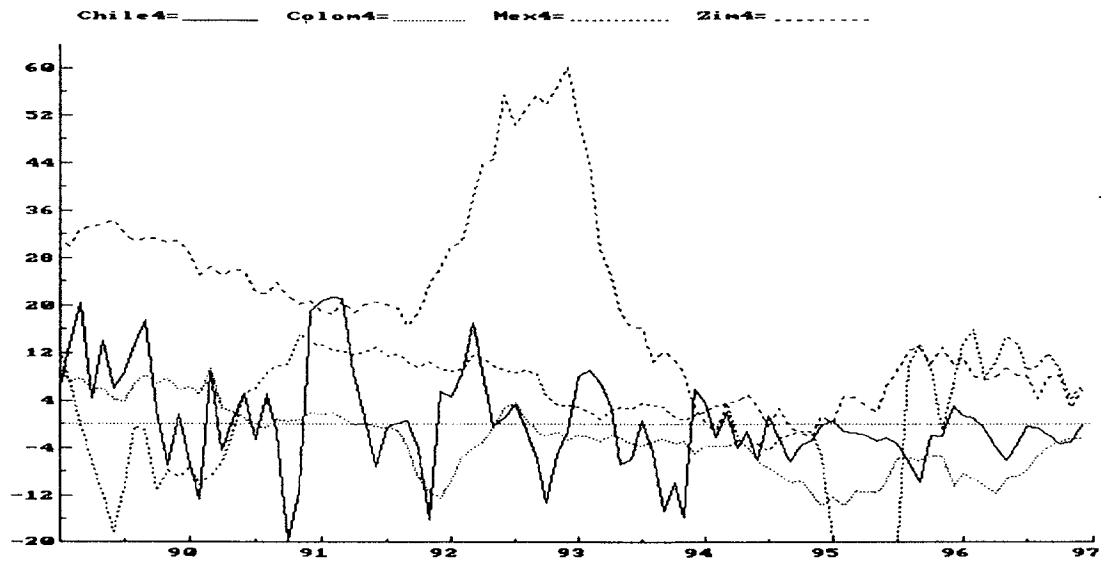
Korea, the Philippines, Thailand, and Zimbabwe
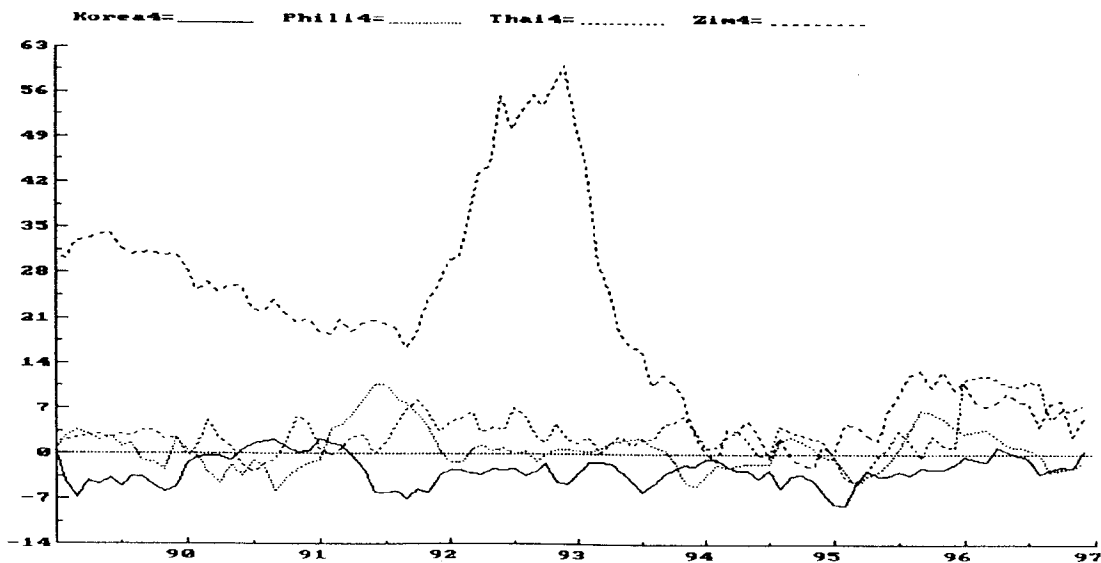
Chart 7 continued

Greece, Jordan, Portugal, and Zimbabwe
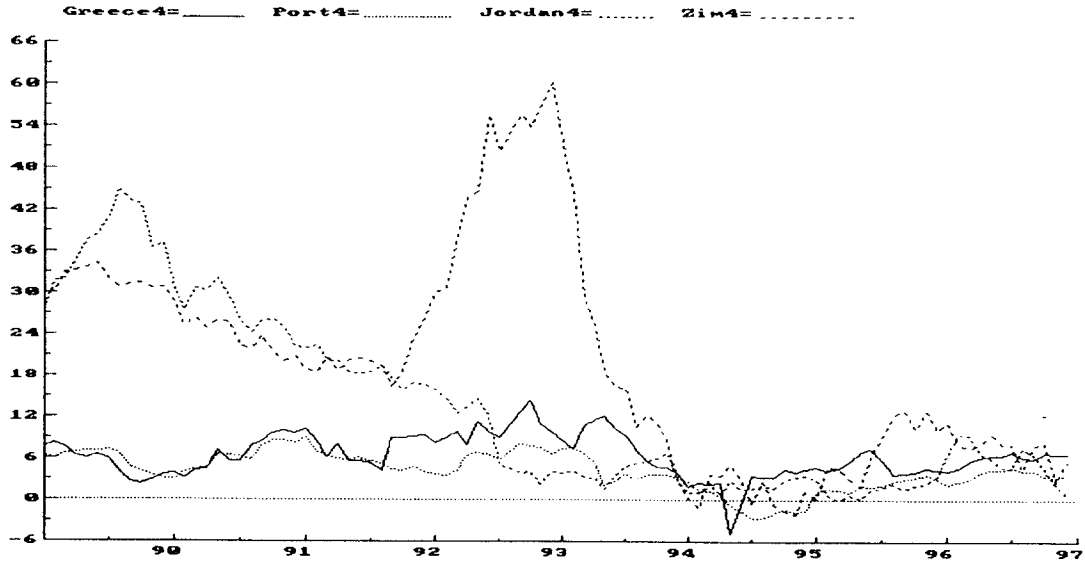
India, Pakistan, South Africa, and Zimbabwe
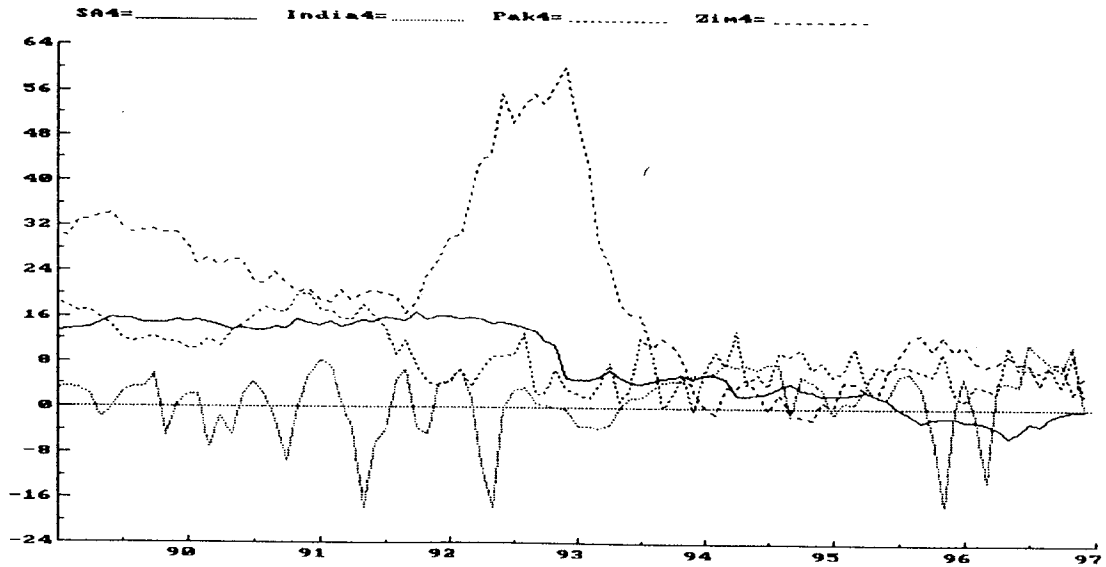
Chart 7 concluded

Hungary, Poland, Venezuela, and Zimbabwe
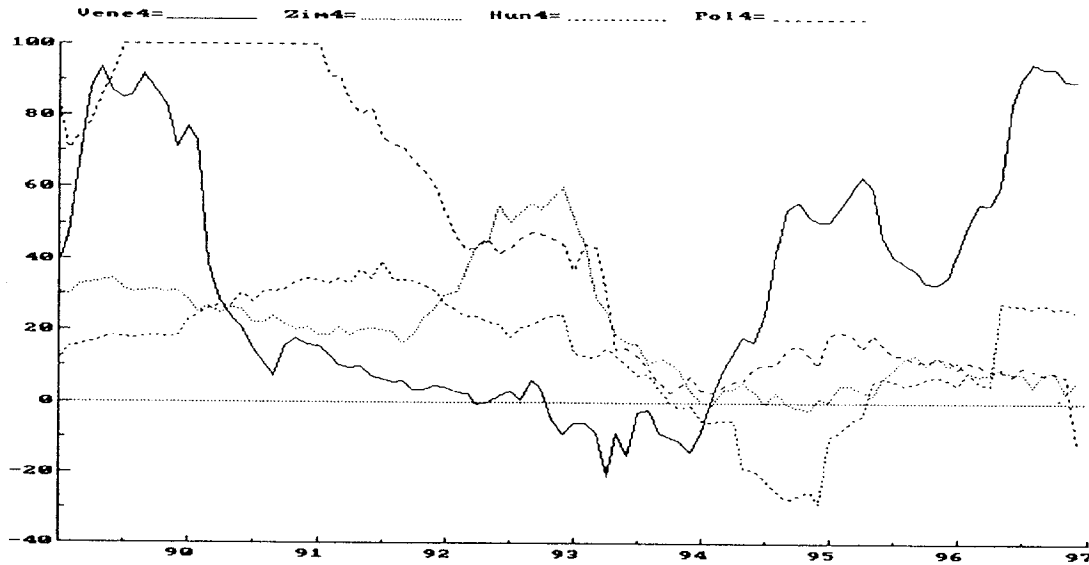
Indonesia, Malaysia, Sri Lanka, and Zimbabwe
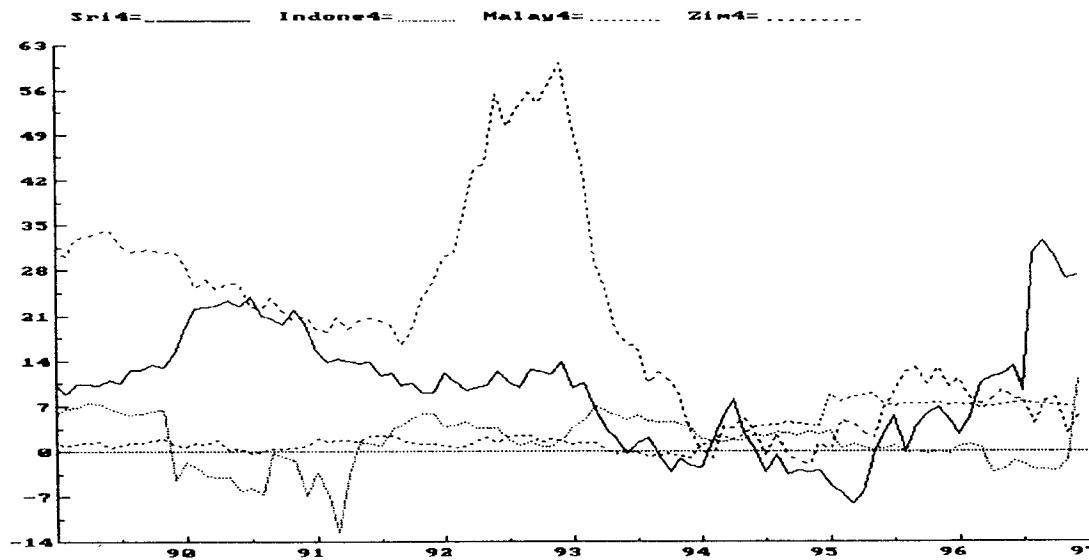
Sources: IFC; and IMF.

Note

The following short-term interest-rates in the IFS database are used for calculating real interest rates: **TB rate**—Greece, Hungary, Mexico, the Philippines, Poland, Portugal, South Africa, Sri Lanka,and Zimbabwe; **money market rate**—Indonesia and Korea; **call market rate**—India, Pakistan, and Thailand; **average of bank lending and deposit rates**—Chile, Colombia, and Jordan; **discount rate**—Malaysia and Venezuela.

IV. RELATIONSHIP BETWEEN STOCK PRICES AND MACROECONOMIC VARIABLES: IMPLICATIONS FROM THE REGRESSION MODEL

This section presents several ways to model the return of the overall stock market using some macroeconomic variables. The objective of this section is to identify the *simple relationship* between stock returns and macroeconomic variables and examine its stability over the sample period. If the relationship indicated by the DDM between stock returns, corporate profits and the discount rate holds in the long run, the stock price index might be explained by some proxies for these two variables. The limited number of macrovariables that are reliable as well as available with high frequency for a long period of time often causes a problem in building this type of model in developing countries. This section principally uses quarterly series of broad money (M2) and three-month Treasury Bill rates, two series which are relatively easily obtainable and satisfy the above conditions in many countries, for proxies for corporate income streams and the discount rate. (More variables will be introduced in the next section.) Instead of using the simple quarterly change of these variables, however, the paper examines the *quarterly change in the annual growth rate of these variables* as investors are likely to have a longer time horizon than one quarter for their investments and therefore pay more attention to changes in these variables over the past year rather than one quarter. Regarding the stock return index, the paper uses the IFC stock return index which takes account of both capital gains and dividend payments.[10] The sample period is set from the first quarter of 1991 to the fourth quarter of 1996 so as to cover the full period of interest rate liberalization.

In Zimbabwe, velocity has been relatively stable during the 1990s, making monetary aggregates (in particular M2) a good proxy for nominal GDP and consequently corporate earnings. Chart 8 shows quarterly M2, M, and the stock price index. This chart indicates that the stock index increased much faster than M2 during the eighties but that the growth of both series converged thereafter. This seems to be an intuitively correct movement given the relatively stable relationship between nominal GDP and total corporate value is often observed in other countries. A unit root test shows that M2 and the stock market return index are integrated of order two, and the Treasury Bill rate (TB) is integrated of order one (Table 3)[11]. Chart 9 plots the quarterly change in M2 (M2Q), the stock market index (SMIQ), and the TB rate (TBRQ), while Chart 10 shows the annual growth rate of the same variables.

---

[10] This index covers 72 percent of total market capitalization and therefore closely traces the local market index. See Appendix I for more detail.

[11] Given the small sample size, these results should be viewed with some caution.

Chart 8. M2, M1, and Stock Market Index

(In log scale)

LRE= _____   LM2= ....   LM1= ....
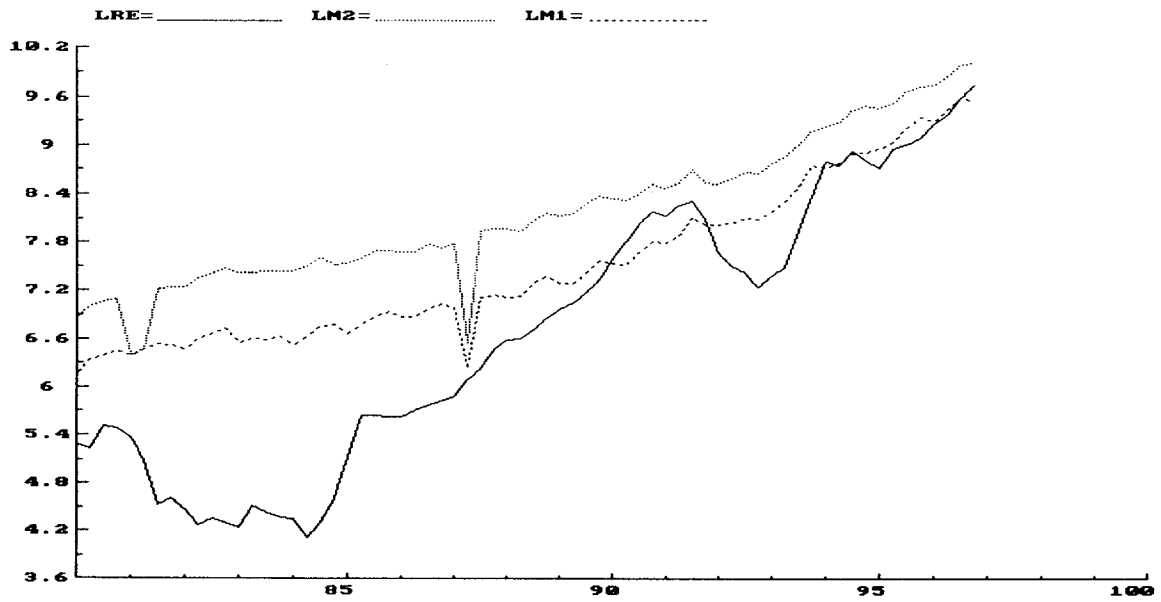
Chart 9. Quarterly Change in M2, Stock Market Index, and TB Rate

(In percent)

SMIQ= _____   M2Q= ....   TBRQ= ....
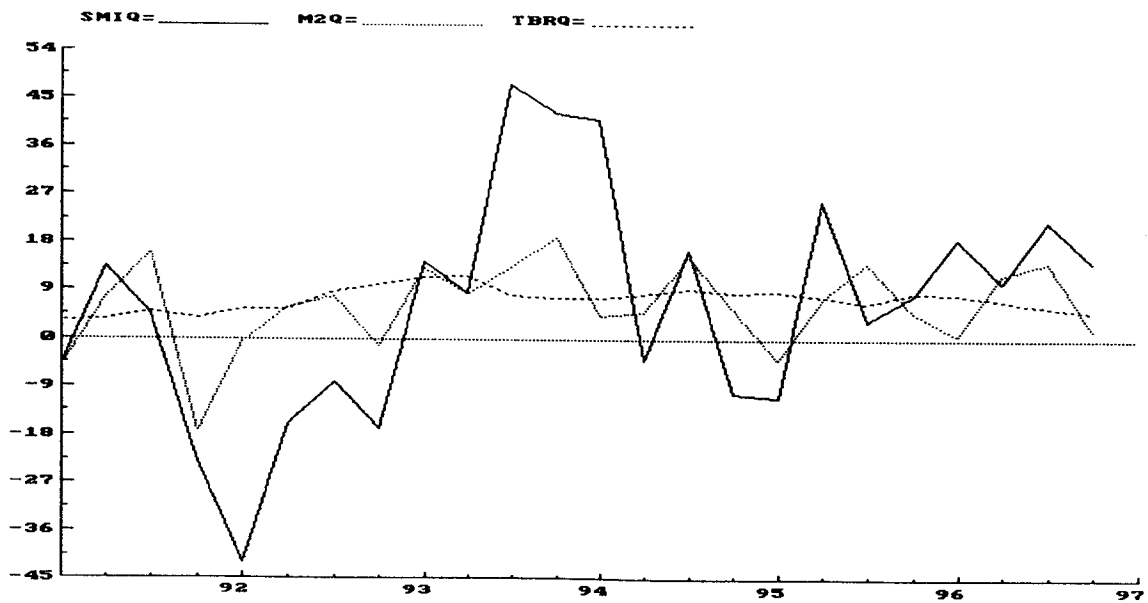
Chart 10. Annual Growth Rate of M2, Stock Market Index, and TB Rate

(In percent)
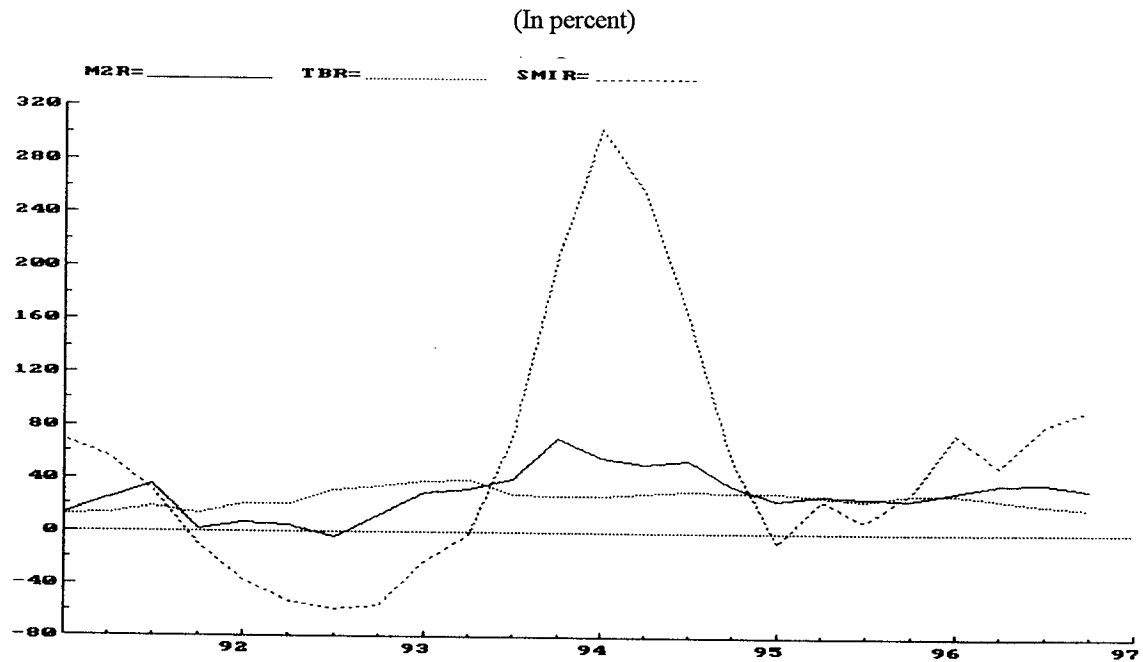
Annual Growth Rate of M2, Stock Market Index, and TB Rate
(After Adjusting the Means and Ranges to be Matched)

(In percent)
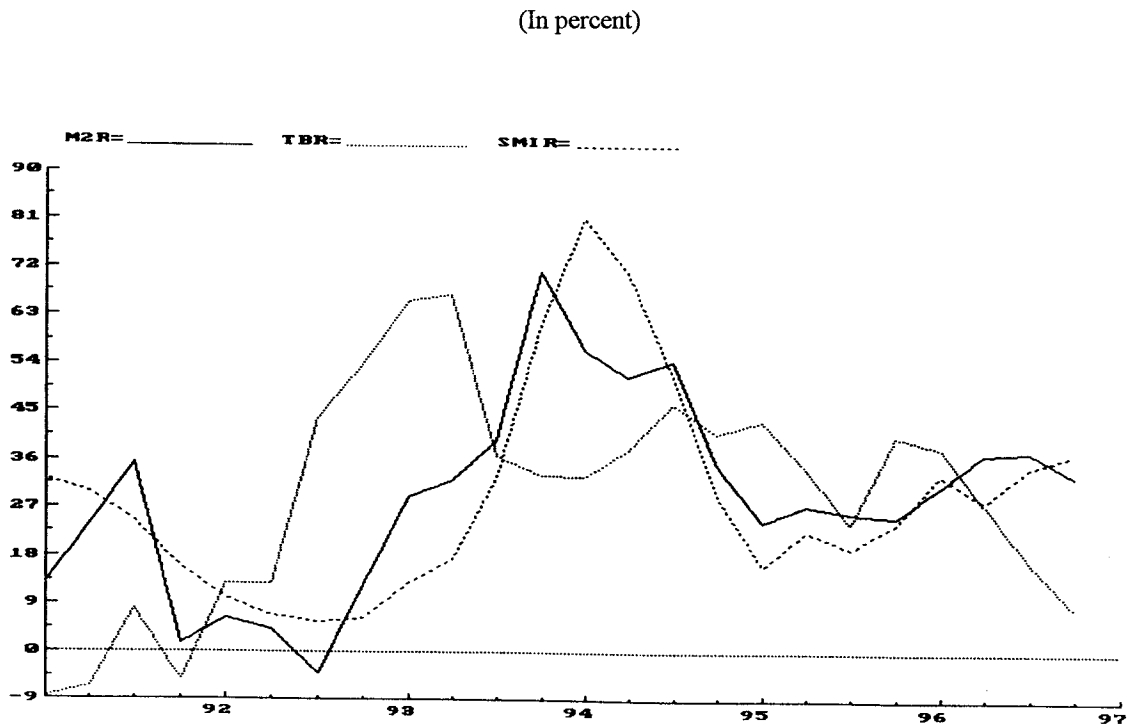
**Table 3. Augmented Dickey-Fuller Tests for the Presence of a
Unit Root, 1991:I–1996:IV**

Variable	I(0) ADF(3)	I(0) ADF(4)	I(1) ADF(3)	I(1) ADF(4)	I(2) ADF(3)	I(2) ADF(4)
Quarterly change						
M2	4.035	4.053	-0.488	-0.605	-3.245**	-2.525*
Stock market index	1.582	2.260	-2.312*	-2.336*	-2.557*	-2.562*
TB rate	-0.221	0.027	-2.945**	-1.823	-7.756**	-6.775**
Annual change						
M2	4.035	4.053	-0.879	-0.604	-2.452*	-3.282**
Stock market index	1.582	2.260	-1.904	-1.442	-3.393**	-2.139*
TB rate	-0.164	0.073	-2.809**	-1.744	-7.631**	-6.808**

Notes

1. Variables with I(0) indicate M2 in logs, stock market index in logs, and three-month Treasury Bill rate at the end of each quarter.
2. Variables of annual change, I(1) for M2 and stock market index indicate seasonal first difference, or I(1)$_4$.
3. ADF(k) is the Augmented Dickey-Fuller statistics with lag k.
4. Asterisks * and ** denote rejection at the 5 percent and 1 percent critical value, respectively.

A simple regression model is built for the above set of three variables. While recognizing the risk of a spurious regression, it may be helpful to see the long-run relationship among them.

Annual Return Model

$$DREA_t = 3.21*DM2A_t - 2.31*TB_{t-1} + 1.08*DUMMY_t \qquad (13)$$
$$\quad (4.51) \qquad (-3.11) \qquad (3.46)$$

$$R^2 = 0.89 \quad D.W. = 2.37$$

where
DREA: Rate of annual change in the IFC stock return index at the end of each quarter;
DM2A: Rate of annual change in M2 at the end of each quarter;
TB: Treasury Bill rate at the end of each quarter;
DUMMY: 1993 Q4–1994 Q3.

The estimated equation is statistically stable (except for a slightly high D.W.) and explains well the movements of stock returns. A dummy variable was added since the Chow statistic shows a structural break around late 1993/early 1994, indicating the effect of the liberalization of portfolio investment by foreigners.

In addition to the above model, the single equation error correction model (ECM) was examined. Starting from the fourth-order autoregressive distributed lag (ADL) model, and then truncating insignificant variables while checking the F statistics for testing the null hypothesis against the variable-maintained hypothesis, the following ECM was obtained, which is statistically fairy stable and explains well the movements of Δ DREA:[12]

Annual Return Model—ECM

$$\Delta DREAt = 1.67*\Delta DM2A_t - 0.48(DREA_{t-1} - 5.38*DM2A_t + 4.83*TB_t)$$
$$(3.55)(-6.48)(4.24)(-3.82)$$
$$+0.99*DUMMY_t (14)$$
$$(4.09)$$

$$R^2 = 0.85 D.W. = 2.11$$

where
DUMMY: 1994 Q1–1994 Q2.

Relatively large coefficients on the ECM term in the equation indicate a quick correction of the disequilibrium from their long-run relationship. The above equation uses dummy variables for 1994 (Q1 and Q2) since the Chow statistic shows structural breaks during this period. Chart 11-1 plots the actual and fitted values of DREA and the model's scaled residuals. In addition, Chart 11-2 shows recursive estimates of the coefficients on independent variables and the step-wise Chow test. They all indicate the very stable feature of this model, implying that the stock price formation process in relation with the movements of M2 and TB rate has not changed since 1991 except during the period of partial capital liberalization.

---

[12] Even though the sample size may be too small to draw a correct conclusion from the cointegration analysis based on Johansen's procedure, it indicates there is one cointegrating vector between $DREA_t$, TB_t and $DM2A_{t+1}$. The lagged variable for DM2A rather than a concurrent one was used because Granger causality as well as weak exogeniety tests indicate the stock market index is very likely to be affected by concurrent or future changes in M2 rather than past changes. In other words, stock investors might predict correctly the concurrent or future movements of monetary aggregates and incorporate this information in their stock price formation process. The obtained cointegrating vector, which can be interpreted as a long-run relationship between variables, is "$DREA_t = 6.76*DM2A_{t+1} - 5.64*TB_t$". The coefficients of $DM2A_{t+1}$ and TB_t are very close to their coefficients in the ECM term in equation (14), indicating the robustness of the model. Moreover, the assumptions of weak exogenity of DM2A and TB are accepted, supporting the ECM model using them as independent variables. See Ericsson, Campos, and Hong-Anh (1990) for details about the procedure of modeling.

Chart 11-1. Actual and Fitted Values of the Change in Annual Stock Market Return
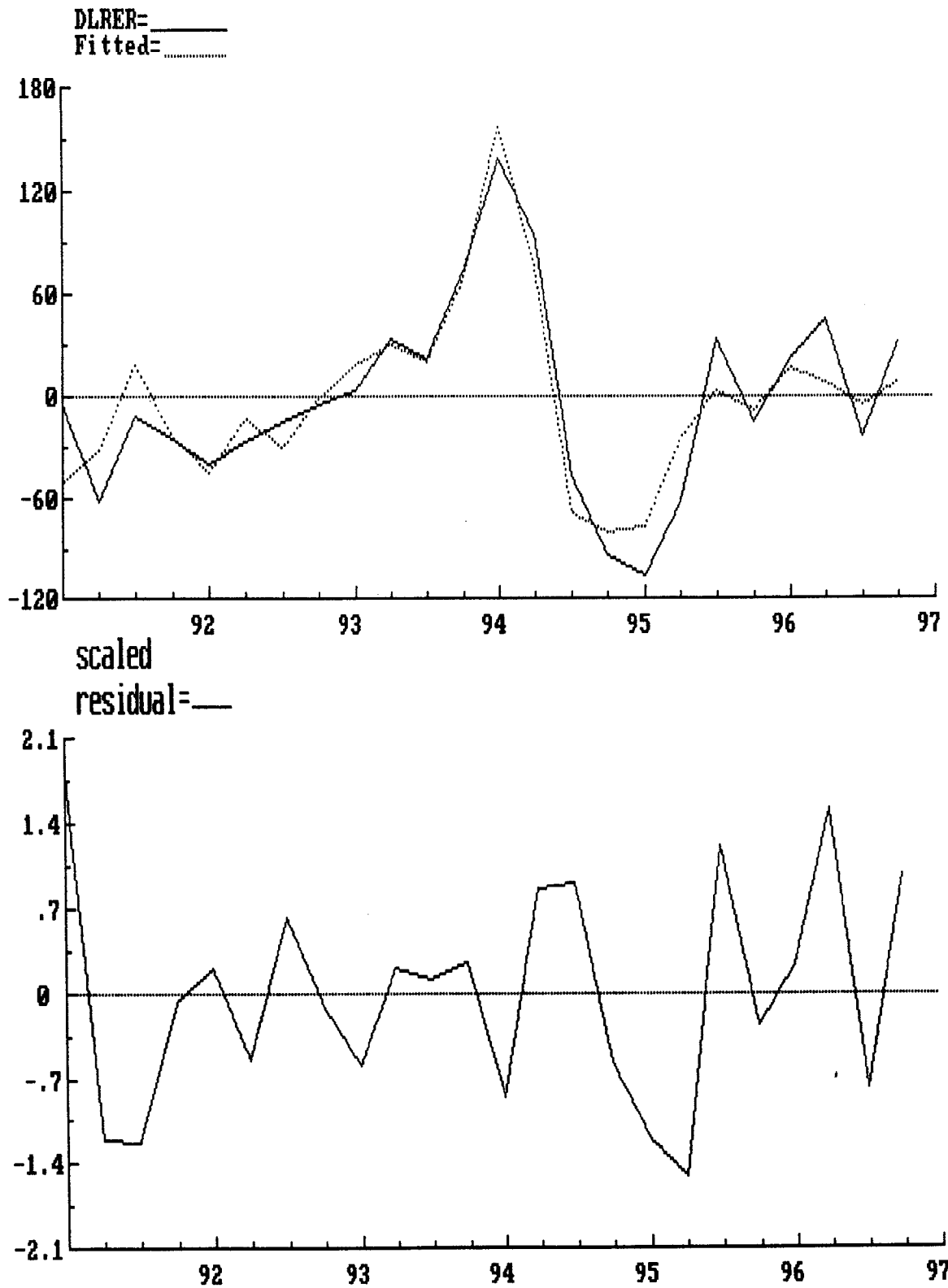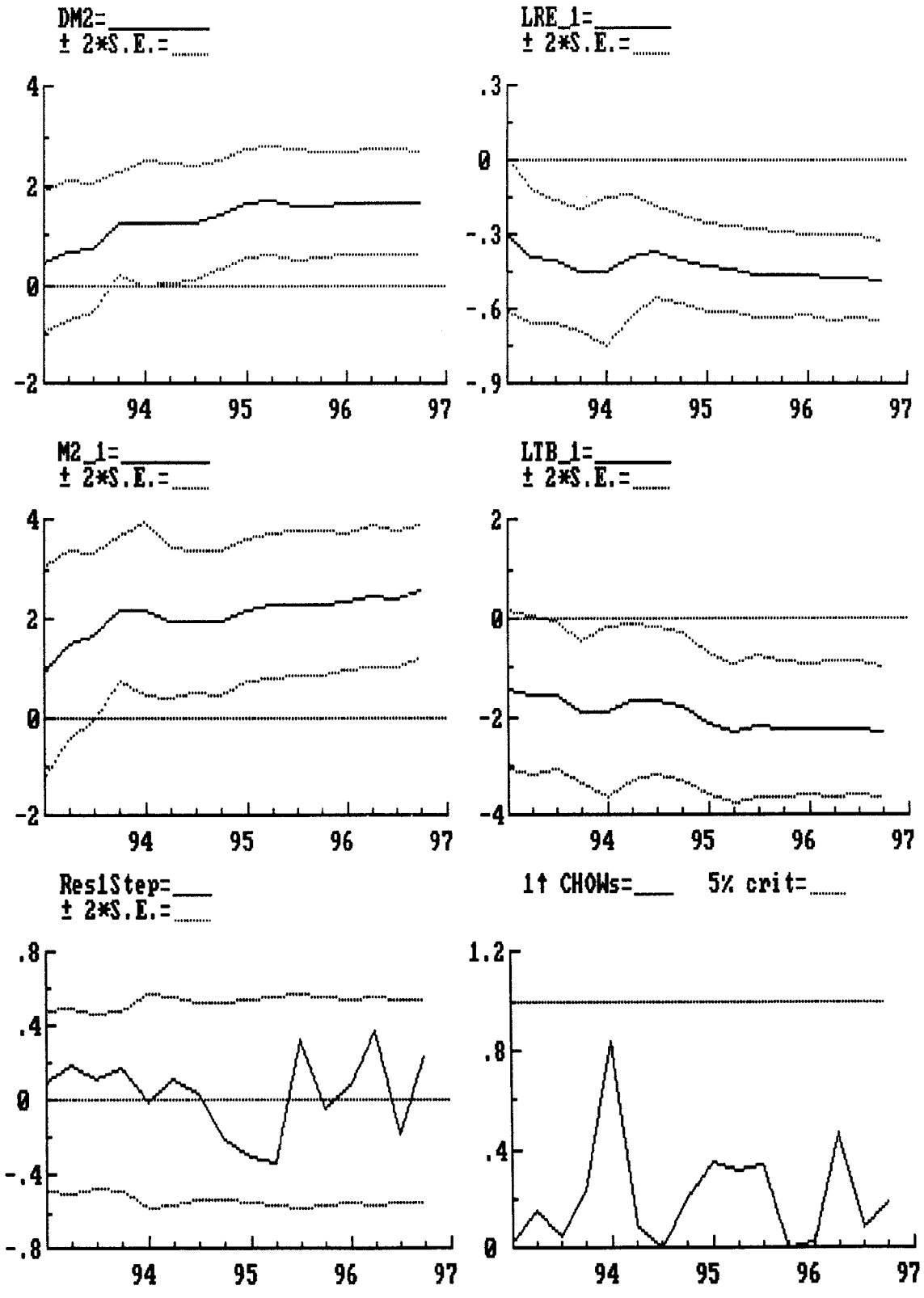
(In percent)

Chart 11-2. Recursive Estimates of the Coefficients and One-Step Residual

V. RELATIONSHIP BETWEEN STOCK PRICES AND MACROECONOMIC VARIABLES: IMPLICATIONS FROM THE MULTI-FACTOR RETURN GENERATING MODEL

Unlike a single-factor model such as CAPM, which assumes that the variance-covariance matrix of all individual stocks depends on a single factor (the market index), the multi-factor model takes the view that several primary sources of risk consistently impact the stock returns. Therefore, every stock and portfolio has exposures (or betas) to each of these systematic risks, which form the pattern of economic betas for a stock or portfolio (risk exposure profile). With a trade-off relationship between return and risk in the market, risk exposures are rewarded in the market with excess expected return over the risk-free rate, and thus the risk exposure profile determines the volatility and performance of a well-diversified portfolio[13].

Compared with other stock price analyses which focus only on the relationship between the market index and several macroeconomic variables, the multi-factor return generating model has several advantages. First, since it allows us to obtain the risk exposures of each stock, we can examine the rationality of the relationship between stock prices and macrovariables by comparing the sign of exposures (direction of change in returns corresponding to the change in factors) with the nature of underlying companies' business. Second, by explicitly incorporating the stock market's autonomous factor into the model, it becomes easier to distinguish it from the influences of other macrovariables. Third, the investigation of the individual stock's risk exposures enables us to discover the macroeconomic factors which have an influence on only a limited number of stocks and therefore tend to be dismissed in other analyses.

From a practical point of view, there are three alternative ways to select risk factors for constructing the multi-factor return generating model (Burmeister, Roll and Ross (1994), and Elton and Gruber (1995)). The first is to compute risk factors by using factor analysis or principal component analysis, which statistically extract the components accounting for the variance-covariance structure in a set of variables. The second alternative is to specify a set of portfolios which *a priori* are supposed to have general influence on security returns. Thus, the selection of these portfolios depends on the market's belief that certain types of stocks perform quite differently from the others (e.g., small capitalization stock vs. large capitalization stock) due to unknown economic or structural reasons. A third approach is to use economic or financial theory to specify these factors. Since our main interest is to identify the relationship between stock prices and macroeconomic variables, this paper basically follows the third approach.[14]

---

[13] For details about the theoretical and practical aspects of APT, see Elton and Gruber (1994), (1995).

[14] There are several empirical studies of the United States stock market based on the multi-factor return generating model. For example, Chen, Roll, and Ross (1986) find a strong relationship between macroeconomic variables (unanticipated change in individual stock returns, growth of industrial production, expected inflation, inflation, risk

In order to construct the multi-index model based on macroeconomic variables, we first have to carefully select those macroeconomic variables which have a *general* influence on stock prices among relatively few candidates available in developing countries. Appendix I lists major macroeconomic variables for which monthly data are available and which look influential as candidates for risk factors in the Zimbabwean economy. The *monthly change in the annual growth rate of these variables* is used for the following analysis. As Chen, Roll and Ross (1986) indicated, stock prices are more responsive to long-term changes in macroeconomic variables than short-term ones. However, the monthly series of annual growth rates are usually highly autocorrelated and this feature works against the assumption that changes in variables in the multi-index model should be *unexpected* (otherwise, stock prices have already incorporated the information). Thus, the first difference of the monthly series of annual growth rates, or monthly changes in the annual growth rate are used. The first differences of these variables are stationary and thus can be judged as unpredictable. The sample period is set from January 1990 to December 1996. Although many of the data indicated above are available beginning in the mid-1970s, it is very likely that there has been significant structural changes in the financial market corresponding to several structural reforms starting in 1990.

The multi-factor return generating model for the Zimbabwe stock market is constructed based on the following procedures which were first developed by Fama and MacBeth (1973):

▸ Individual stocks which are actively traded in the market (the criteria for stocks selected for the IFC Global index), and which are listed for a long enough period (in this paper, since January 1992), are selected.

▸ Principal component analysis is used to extract the common factors on monthly changes in the annual returns of the stocks.

▸ Among available data on macroeconomic variables (see Appendix I), several variables which are likely to explain the common factors for stock price changes are selected and then regressed against the common factors extracted in equation (14). Only macroeconomic variables which can be explained by one of these factors (with a 5 percent confidence level) remain as risk factors.[15]

---

[14](...continued)
premium, and term structure) and the set of indices extracted by factor analysis. Based on the above work, Burmeiser and McElroy (1988) constructed another model using the S&P composite index, risk-free interest rate, default risk, time premium, deflation, change in expected sales, and the market return not captured by the first four variables. Their results indicate that the first four factors account for about 25 percent of the variation in the return on the S&P composite index and each of the four coefficients is significant.

[15] In order to avoid the problem of multicollinerity, I select only one variable for each index based on the statistical significance.

▶ Each stock's exposure to macroeconomic variables is estimated by regressing its returns on the series of monthly changes in annual growth rates of macroeconomic variables over some estimation period.

▶ Each stock's risk exposures multiplied by the change in risk factors are summed up with their weights of market capitalization to compute the total contribution of the underlying risk factors to changes in the market index. Similarly, the summation of all these risk factors' contributions produces the total contribution of macroeconomic factors to changes in the market index.

The following are the details of the computations and outcomes of the procedures described above:

Selection of individual stock

Based on the criteria indicated above, 17 stocks were selected (see Appendix II). Among them, five companies belong to mining-related industries, three are conglomerates engaged in retail, hotel and some manufacturing, three are manufacturing of which performance depends on imports, five are manufacturing of which performance depends on exports (or imports substitution), and three are manufacturing and banking which are relatively neutral to external factors. Although the number 17 is about one fourth of the total number of listed companies (63 as of June, 1996), their total capitalization is Z$3,465 million, or 54 percent of total market capitalization.

Extraction of common factors underlying changes in individual stock prices

Risk factors are selected by using the principal component analysis on the above selected 17 individual stocks. Given the returns on a set of stocks, principal components analysis first computes an index that explains the maximum amount of variation in the variance-covariance matrix of security returns. Then it searches for the index, constrained to be orthogonal (uncorrelated with the first index), that explains as much of the unexplained portion of the variance-covariance matrix as possible.

The principal components analysis of 17 stocks indicates that there are 9 indices, which explain about 82 percent. Normally, the number of indices which "best separate out common influences from unique influences" (Elton and Gruber (1994)) should be based on some statistical criteria.[16] Otherwise, "as more factors were added to the solution, the probability increased that the added factors are idiosyncratic to the stocks in that sample or a subset of those stocks rather than factors that explain the covariance structure of returns among large groups of securities" (Elton and Gruber (1994)). In the case of Zimbabwe,

---

[16] In the case of the principal component analysis, the eigenvalue-one criterion (or, Kaiser criterion) and the scree test (Hatcher and Stepanski, 1994) are often used.

however, it seems unreasonable to assume that all these idiosyncratic factors are diversified away in the market, considering the very limited number of listed companies. Thus, if we try to identify only macrovariables which have influence on all individual stocks, we might have more risk to dismissing some macrovariables which have strong influences on some, but not all, stocks. For this reason, a relatively large number of factors were first used, which explain about 80 percent of total variance-covariance matrix. Some were eventually truncated after being acknowledged as weak in influencing stock returns in the following regression analysis.

Selection of risk factors

The results of the risk factor selection are shown in Table 4. At this stage, five macrovariables were selected (the stock market index ("R"); non-fuel commodity prices ("COMMO"); real interest rates (three-month Treasury Bill rates minus CPI rates or "TBCPI"); and real money (M2 growth rate minus CPI rates or "M2CPI")),[17] and one market index as the variables which have general influence on individual stock prices. In the following analysis, however, I use the residual ("RES") of the regression of R by the other five macrovariables as an index representing information captured by the market but not by other variables, instead of using the stock market index itself. This follows the method adopted by Burmeister and McElroy (1988), and would be better to capture the "pure" market factor influencing individual stock returns. RES still retains a strong relationship with the first index.

Estimate of risk exposures of individual stocks

Now that six risk factors (M2CPI; TBCPI; COMMO; SANOEX; NOMEX; and RES) have been selected, the next step is to estimate the individual stock's risk exposures to these risk factors. They can be derived by regressing individual stock's returns on the risk factors, of which the formula is shown as follows:

$$DR(t) = b_1*DM2CPI(t) + b_2*DTBCPI(t) + b_3*DCOMMO(t) \qquad (15)$$
$$+b_4*DSANOEX(t) + b_5*DNOMEX(t) + b_6*DRES(t) + e(t)$$

(First letter "D" represents first difference of each variable.)

---

[17] Using real money and real interest rates— but not the CPI— in the model do not appear to be appropriate in explaining stock returns as they are real variables while stock returns are nominal. One possible justification for this is that the movements of CPI might be replaced by the stock market index, which is the first and foremost risk factor.

Table 4. Relationship Between Macrovariables and Principal Components 1/

T-Statistic for Coefficient of each Principal Component
(p-value)

Dep. Variables	1	2	3	4	5	6	7	8	9
M1	-3.68	0.69	-1.72	1.77	-2.91	-0.90	0.23	0.84	-1.35
	(0.001)	(0.495)	(0.092)	(0.084)	(0.006)	(0.372)	(0.816)	(0.404)	(0.184)
M2	-2.37	1.02	-0.58	3.29	-2.73	0.21	1.17	1.34	-0.63
	(0.022)	(0.314)	(0.567)	(0.002)	(0.009)	(0.835)	(0.25)	(0.189)	(0.531)
M1CPI	-3.88	0.77	-1.92	1.78	-2.86	-0.82	0.41	1.26	-1.16
	(0)	(0.445)	(0.061)	(0.082)	(0.006)	(0.418)	(0.682)	(0.213)	(0.25)
M2CPI	-2.59	1.07	-0.84	**3.14**	-2.59	0.26	1.31	1.78	-0.42
	(0.013)	(0.29)	(0.403)	**(0.003)**	(0.013)	(0.795)	(0.198)	(0.082)	(0.68)
CPI	1.42	-0.46	1.13	-0.31	0.22	-0.25	-0.82	-1.99	-0.62
	(0.162)	(0.646)	(0.265)	(0.761)	(0.83)	(0.807)	(0.416)	(0.053)	(0.538)
TBCPI	-0.70	1.01	**-2.13**	1.07	-0.11	-0.59	1.46	2.18	0.53
	(0.489)	(0.319)	**(0.039)**	(0.29)	(0.912)	(0.561)	(0.151)	(0.035)	(0.597)
REALEX	0.87	-1.30	0.64	0.42	0.37	0.08	0.18	-0.22	-1.80
	(0.387)	(0.199)	(0.525)	(0.678)	(0.71)	(0.939)	(0.857)	(0.83)	(0.079)
COMMO	0.28	**3.55**	-0.24	-0.33	1.06	0.56	-2.55	-1.48	-0.06
	(0.778)	**(0.001)**	(0.808)	(0.74)	(0.294)	(0.577)	(0.014)	(0.146)	(0.949)
AGR	1.82	0.45	0.10	-0.40	1.06	0.71	-1.64	0.08	0.79
	(0.075)	(0.654)	(0.92)	(0.689)	(0.295)	(0.481)	(0.108)	(0.94)	(0.436)
METAL	0.25	1.66	-0.47	1.45	1.52	-0.16	0.60	-1.67	-1.46
	(0.803)	(0.104)	(0.64)	(0.153)	(0.135)	(0.876)	(0.551)	(0.101)	(0.152)
SAREEX	1.25	0.50	1.53	0.92	0.94	-0.58	0.75	2.56	-0.89
	(0.217)	(0.621)	(0.132)	(0.364)	(0.352)	(0.564)	(0.456)	(0.014)	(0.38)
USSTOCK	-0.51	0.68	0.46	0.96	-0.05	-0.70	0.03	1.20	1.40
	(0.612)	(0.501)	(0.647)	(0.344)	(0.964)	(0.485)	(0.972)	(0.237)	(0.17)
RE0	**23.82**	0.99	0.07	0.08	0.20	0.19	0.21	1.36	0.27
	(0)	(0.005)	(0.004)	(0.934)	(0.033)	(0.241)	(0.835)	(0.181)	(0.212)
NOMEX	0.55	-1.40	0.45	0.60	0.32	0.13	0.49	0.42	**-1.98**
	(0.588)	(0.168)	(0.655)	(0.549)	(0.751)	(0.896)	(0.629)	(0.677)	**(0.054)**
SANOEX	1.41	0.25	1.72	0.95	0.75	-0.55	0.70	**2.53**	-0.95
	(0.164)	(0.806)	(0.092)	(0.347)	(0.455)	(0.587)	(0.486)	**-0.014**	(0.35)

1/ Selected macrovariables are in bold print. Although there are several monetary aggregates which have a close relationship with the fifth index, they are eliminated due to their multicollinearities with M2CPI (already selected for the fourth index). There is no macrovarialbe which has a close relationship with the sixth index and only COMMO (already selected for the second index) is related to the seventh index.

Regression results are shown in Table 5. Among the 17 stocks, M2CPI is significant at the 5 percent level for 5 (for 8 at the 10 percent level of confidence); TBCPI is significant for zero (for 1 at the 10 percent level); COMMO is for 6 (7); NOEX is for 1 (2); SANOEX is for 3 (5); and RES is for 15 (15). These results indicate that the real interest rate and the nominal exchange rate against the U.S. dollar are not particularly influential in the individual stock return formation process.

More interesting results can be observed with respect to the consistency of the signs and size of the risk exposures in comparison with the nature of each company's business (Chart 12—in this chart, risk exposures which are not statistically significant with 10 percent confidence level are zero). For example, most of the commodity-related companies' ("Bindura," "Hippo," "Rio Tinto," "Zimbabwe Alloys") exposures to the commodity price index (DCOMMO) are significantly positive.[18] Among commodity-related companies, the only exception is "Wankie Colliery" (coal mining) of which exposures is not statistically significant. This seems to be because its sales are directed mainly to domestic public enterprises (not exports) and its selling prices are determined by the government in a way that does not necessarily reflect international market prices. Stock returns of all three paper companies ("Art," "Hunyani," and "Kadoma") also respond to changes in commodity prices but with different directions (while stocks of Art and Kadoma respond negatively to changes in commodity prices, Hunyani's response is positive) . This difference seems to depend on whether the business is export- or import-oriented. This is partly evidenced by the fact that only the stock of Hunyani responds significantly and negatively to changes in the exchange rate against the South African rand (DSANOEX)[19], indicating its exporting to South Africa. Meanwhile, there are some stocks ("Dunlop" and "National Foods") which respond positively to changes in the exchange rate against the South African rand, and their business actually depends on imports from South Africa. It is also observed that domestic market oriented companies such as "Portland" (construction), "Zimbabwe Financial Holdings" (banking) and "Tedco" (retail) have significant positive exposures to changes in real money (M2CPI).[20] Finally, conglomerates ("Delta," "Mashonaland," and "TA Holding") do not show any clear character of risk exposures. This may be due to the highly internal diversification of risk and partly due to high linkage with the market index. Overall, the signs of these risk exposures of individual stocks are very consistent with the nature of their businesses, and this fact provides an indication that the stock market in Zimbabwe incorporates some macroeconomic information into the process of individual stock prices fairly consistently.

---

[18] Positive sign means that an increase in commodity price tends to push up stock prices of those companies.

[19] Negative sign means that an appreciation of local currency against the rand tends to push down the stock prices.

[20] Positive sign means that an increase in M2 growth rate minus CPI rate tends to push up the stock prices.

Table 5. Estimates of Risk Exposures of Individual Stocks

	DM2CPI	DTBCPI	DCOMMO	DNOMEX	DSANOEX	RES	R²	D.W.
Commodity related								
Bindura	1.06	0.98	10.02	-4.1	-0.53	1.09	0.2	2.06
	(1.1)	(0.29)	(2.1)	(-1.99)	(-0.15)	(2.85)		
	(0.28)	(0.78)	(0.04)**	(0.05)**	(0.88)	(0.01)**		
	1.41	-3.69	8.43	-1.6	0.86	1.32	0.26	1.83
Hippo	(1.81)	(-1.34)	(2.19)	(-0.96)	(0.3)	(4.25)		
	(0.07)*	(0.19)	(0.03)**	(0.34)	(0.77)	(0.00)**		
Rio Tinto	-0.28	-0.12	4.44	-0.35	-1.74	0.89	0.53	1.85
	(-1.04)	(-0.13)	(3.35)	(-0.62)	(-1.75)	(8.35)		
	(0.3)	(0.9)	(0.00)**	(0.54)	(0.08)*	(0.00)**		
Wankie	-6.16		-4.67	1.96	4.98	1.66	0.08	2.51
	(1.07)	(-0.88)	(-0.48)	(0.46)	(0.68)	(2.11)		
	(0.29)	(0.38)	(0.63)	(0.64)	(0.50)	(0.04)**		
Zim Alloys	2.07	-0.06	8.75	-0.66	0.39	1.1	0.26	1.19
	(2.8)	(-0.02)	(2.4)	(-0.42)	(0.14)	(3.75)		
	(0.01)**	(0.98)	(0.02)**	(0.68)	(0.89)	(0.00)**		
Conglomerate								
Delta	0.39	-1.72	-0.86	1.56	-3.3	2.04	0.71	2.01
	(1.01)	(-1.28)	(-0.46)	(1.92)	(-2.35)	(13.46)		
	(0.31)	(0.21)	(0.65)	(0.06)*	(0.02)**	(0.00)**		
Mashonaland	0.91	1.17	-2.09	0.91	-0.16	0.28	0.24	1.71
	(2.99)	(1.09)	(-1.39)	(1.41)	(-0.14)	(2.3)		
	(0.00)**	(0.28)	(0.17)	(0.16)	(0.89)	(0.02)**		
TA	-0.12	0.57	-1.06	-0.43	-0.63	0.61	0.19	1.83
	(-0.32)	(0.44)	(-0.58)	(-0.54)	(-0.46)	(4.15)		
	(0.75)	(0.66)	(0.56)	(0.59)	(0.65)	(0.00)**		
Import related								
Dunlop	0.48	-1.68	-1.24	-0.11	2.36	0.53	0.23	1.58
	(1.43)	(-1.42)	(-0.75)	(-0.16)	(1.91)	(3.98)		
	(0.16)	(0.16)	(0.46)	(0.88)	(0.06)*	(0.00)**		
National Foods	0.4	0.28	-1.69	-0.23	5.53	0.59	0.14	1.77
	(0.67)	(0.13)	(-0.57)	(-0.18)	(2.5)	(2.48)		
	(0.51)	(0.89)	(0.57)	(0.86)	(0.01)**	(0.02)**		

Table 5. Estimates of Risk Exposures of Individual Stocks

|	DM2CPI	DTBCPI	DCOMMO	DNOMEX	DSANOEX	RES	R²	D.W.
Export related & import substitute								
Art	-0.97	2.42	-5.02	0.3	-2.13	0.15	0.11	2.29
	(-1.82)	(1.27)	(-1.82)	(0.26)	(-0.93)	(0.71)		
	(0.07)*	(0.21)	(0.07)*	(0.79)	(0.35)	(0.48)		
Hunyani	1.35	-6.28	15.44	-1.89	-12.38	0.4	0.15	1.85
	(1.02)	(-1.32)	(2.25)	(-0.67)	(-2.18)	(0.74)		
	(0.31)	(0.19)	(0.03)**	(0.51)	(0.03)**	(0.46)		
Kadoma	-0.06	-2.84	-5.92	-0.04	-2.27	0.7	0.38	1.89
	(-0.14)	(-1.93)	(-2.69)	(-0.05)	(-1.29)	(4.19)		
	(0.89)	(0.06)*	(0.01)**	(0.96)	(0.20)	(0.00)**		
Tabex	0.63	0.22	-2.25	-0.85	1.13	0.39	0.23	2.56
	(1.91)	(0.19)	(-1.26)	(-1.14)	(0.79)	(2.9)		
	(0.06)*	(0.85)	(0.21)	(0.26)	(0.43)	(0.01)**		
Tedco	1.49	1.39	1.5	-0.02	-1.62	1.08	0.35	1.34
	(2.95)	(0.78)	(0.6)	(-0.02)	(-0.87)	(5.39)		
	(0.00)**	(0.44)	(0.55)	(0.98)	(0.39)	(0.00)**		
External factor neutral								
Portland	2.23	-3.95	-2.7	0.44	0.02	2.19	0.55	1.55
	(3.28)	(-1.62)	(-0.77)	(0.3)	(0.01)	(8.02)		
	(0.00)**	(0.11)	(0.44)	(0.76)	(1.00)	(0.00)**		
Zim Financial	1.24	1.06	0.05	-0.37	-0.25	0.99	0.53	2.56
	(3.63)	(0.87)	(0.03)	(-0.51)	(-0.17)	(7.17)		
	(0.00)**	(0.39)	(0.98)	(0.61)	(0.86)	(0.00)**		

Note:

1. First row shows coefficients of each variables; second row shows t-statistic for these coefficients; and third row shows p-value of these coefficients.
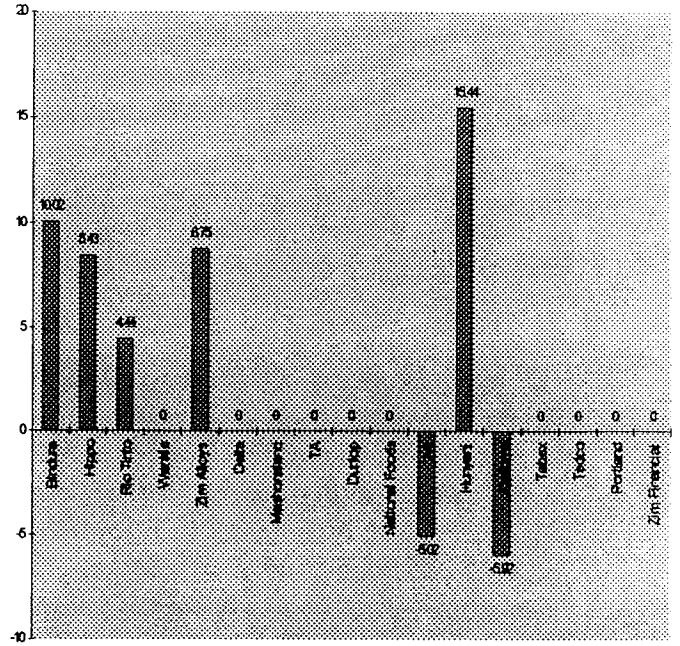
2. "**" indicates that the underlying coefficient is significant with 5 percent level of confidence, and "*" indicates with 10 percent level of confidence.

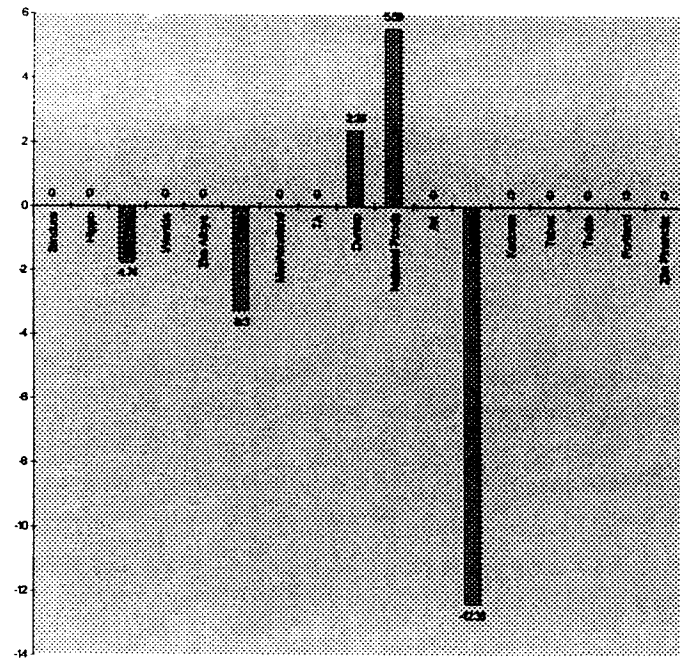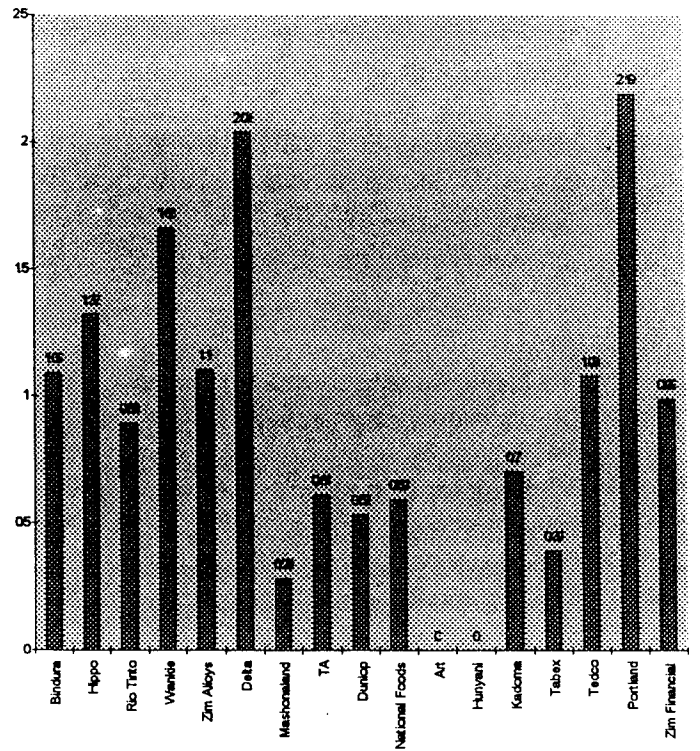**Chart 12. Risk Exposures of Individual Stocks**

DM2CPI
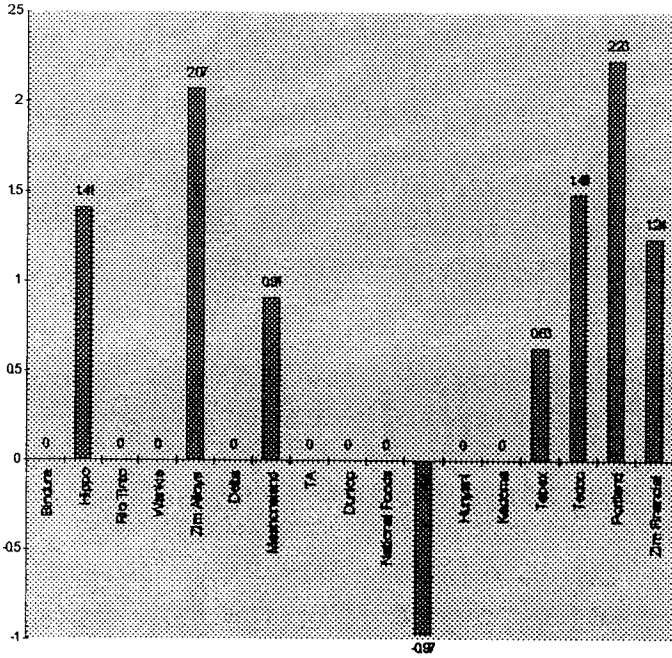
DCOMMO

DSANOEX

RES

Estimates of macroeconomic contributions to changes in the market index

Now that we have obtained individual stock's exposures to macroeconomic risk, we can calculate the total impacts of the macroeconomic variables on the stock market index by weighting them based on each stock's share of total market capitalization. In this process, two risk factors were dropped from the calculation (changes in TBCPI and NOMEX) as they are not significant for most of the individual stocks. Moreover, as shown in Chart 12, zero is used for the risk exposures which are not statistically significant at the 10 percent confidence level. A little surprisingly, despite this truncation and also the fact that capitalization of the underlying 17 stocks represents only 54 percent of total capitalization, total movements of factor contribution trace very precisely the monthly changes in annual stock market return (Chart 13). At the same time, if we look at the breakdown of this factor contribution (Chart 14), it is clear that a very big part of the total change is explained by the stock market's autonomous movement (RES) rather than other macrovariables. The swing of RES is particularly volatile from late 1993 through the beginning of 1995 when the E/P ratio started to deviate from market interest rates. Regarding macrovariables, their influence tends to be marginal compared to stock market factors though commodity prices and real money sometimes swing the stock return movements. All these facts suggest that the change in the arbitrage relationship during late 1993–1994 is likely to be initiated by some market factors rather than by the change in macroeconomic factors.

Chart 13. Monthly Change in Annual Stock Return (REO) and Total Factor Contribution
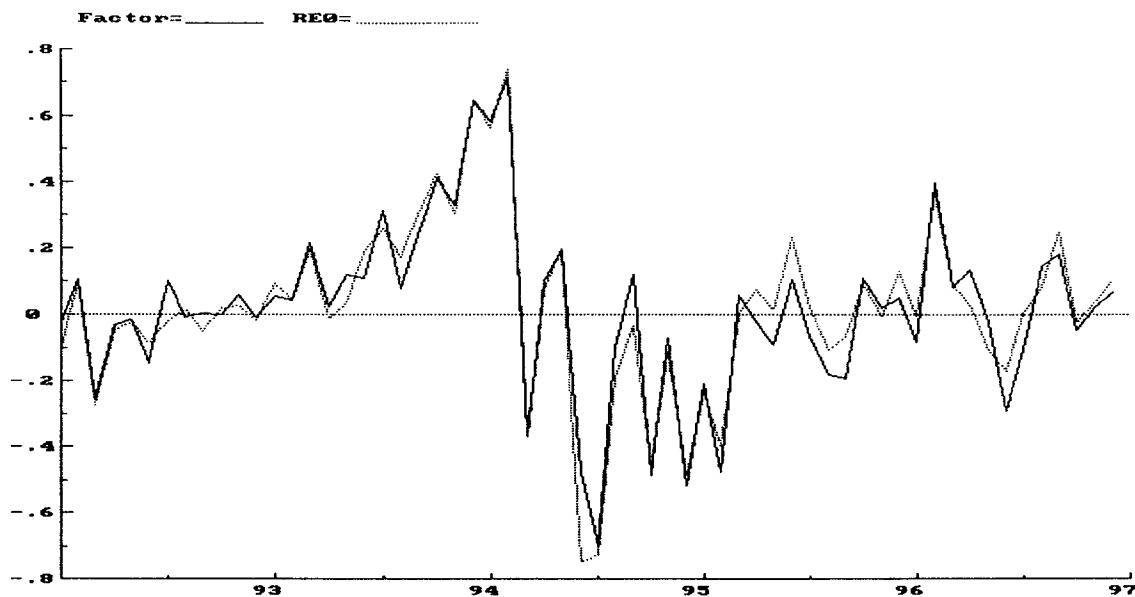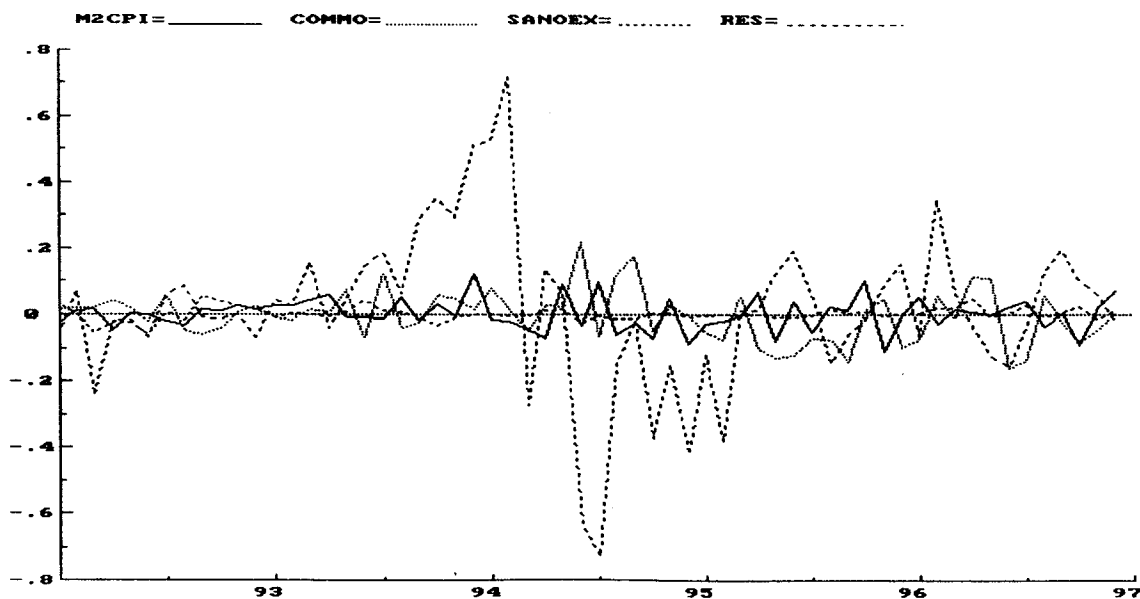
(In percent)

Chart 14. Factor Contribution to Monthly Change in Annual Stock Return

(In percent)

VI. CONCLUSION AND POLICY IMPLICATIONS

This paper has examined the general relationship between stock prices and macroeconomic variables in Zimbabwe. Several interesting findings are obtained. First, the relationship between the E/P ratio of the ZSE and other return rates in the Zimbabwe economy has experienced several changes since the beginning of the 1990s, which appear to result from market liberalization policies during this period. In particular, the convergence of risk premium (or the spread between the E/P ratio and real interest rates) to the average level of emerging markets since late 1993, which seems to have been triggered by the partial capital market liberalization, resulted in a significant increase in stock prices in 1993 and 1994. Second, the ECM model indicates that the relationship between stock returns, money growth and the Treasury Bill rate has been quite stable since 1991 except during the period of partial capital market liberalization. Lastly, the analysis on individual stock returns indicates that the ZSE assimilates changes in some important macrovariables quite consistently. Still, the contributions of these macrovariables could not explain the volatile up and down movements of stock returns during the late 1993–94 period.

As such, despite a large fluctuation of stock prices since 1991, the ZSE has been functioning quite consistently during this period. The sharp increase in stock prices during 1993–94 were mainly due to the shift of risk premium, which seems to have been initiated by international investors. The recent rapid increase in stock prices is consistent with the historical relationship between stock returns, the growth rate of money and the TB rate, indicating this rise has been due to domestic macroeconomic factors. While the recent moderation of the CPI despite an acceleration of the M2 growth rate is mainly the result of a supply shock, it is difficult to judge whether current macroeconomic conditions supporting high stock returns are sustainable. Thus, it may be wise to take some precautions against the downside risk of stock prices. It is advisable that the government consolidate the current trend of declining inflation, which so far has owed as much to weather factors as to policy factors. In the case that the government continues to accommodate a large fiscal deficit, the shock on stock prices is likely to come from the change in investors' expectations on the long-term price trend.

DATA ON MACROECONOMIC VARIABLES

Major macroeconomic variables for which monthly data are available and which look influential as candidates for risk factors in the Zimbabwean economy are listed below.

• **Stock market index.** IFC Global Index (the sign in the formula is "R"), which is a market capitalization weighted index of 23 listed companies or 72 percent of total market capitalization. The return index is used, which includes total cash dividends received by constituents during the period as well as share prices. Eligible stocks for the index are selected after considering whether (i) underlying stocks are actively traded or not; (ii) target market capitalization coverage reaches 60 percent to 75 percent; and (iii) selected stocks are well diversified in terms of industry (IFC (1996)).

• **Monetary aggregate.** Narrow and broad money growth rates (referred to as "M1" and "M2," respectively, in the paper), as well as those rates after being subtracted by the CPI growth rate ("M1CPI" and "M2CPI," respectively) are used. Real money growth rates (the latter two variables) are used here as proxies for either real GDP growth or industrial and agricultural production indices, of which monthly data are not available. In general, the income velocity of money has tended to be stable over the past couple of years, indicating the monetary aggregates reflect general economic activities in Zimbabwe well.

• **Inflation rate.** Change in CPI ("CPI")

• **Interest rate.** Three-month Treasury Bill rate ("TB") and the same rate after being subtracted by the CPI rate ("TBCPI"). The latter is used as a proxy for the term-structure of interest rates since they are both supposed to provide an indication of future nominal interest rates or inflationary pressure vis–à–vis the current ones.

• **Exchange rate.** Change in real and nominal exchange rates against the U.S. dollar ("REMEX" and "NOMEX," respectively) and the South African rand ("SAREEX" and "SANOEX," respectively). Unlike the case of the United States, many listed companies of the Zimbabwe Stock Exchange depend heavily on external trade, with the result that their stock prices are very likely to be sensitive to change in exchange rates.

• **Commodity price index.** Change in the indices of metals ("METAL"), agricultural raw products ("AGRC"), and non-fuel commodity prices ("COMMO") in the international markets, which are prepared by the IMF. As many large listed companies in Zimbabwe are closely related to mining (gold, nickel, platinum, etc.) and agriculture, changes in commodity prices in the world market are likely to have a significant impact on share prices of many listed companies.

•   **U.S. stock market index**.   Changes in the index of the Standard and Poors Corporation 400 industrials on the New York Stock Exchange ("USSTOCK"). This variable is added to reveal how the progress of financial globalization might synchronize the movements of stock prices between the U.S. and Zimbabwe.

There are some variables which seem to be important in the process of forming share prices but are not available in Zimbabwe. For instance, there is no active long-term bond market in Zimbabwe and thus we cannot observe the change in the term structure of interest rates. Moreover, a bankruptcy ratio is not available and there is no commercial bond market for which the rate differential from public bonds could be a good indicator of default risk.

Selected Companies Listed on the Zimbabwe Stock Exchange (June 1996)

Name of Company	Main Business	Market Capitalization (in millions of Zimbabwe dollars)	P/E Ratio
Mining related			
Bindura Nickel Corporation Ltd.	Mining of nickel	1,576.8 (1995)	6.2 (1995)
Hippo Valley Estates Ltd.	Sugar production	1,315.9	5.8
Rio Tinto Zimbabwe Ltd.	Mining of gold and nickel	585.0	2.6
Wankie Colliery Co. Ltd.	Mining of coal	388.5	4.0
Zimbabwe Alloys Ltd.	Carbon ferrochrome production	399.6	8.3
Conglomerate			
Delta Corporation Ltd.	Beverages, retail, hotel, transport	5,562.1	14.3
Mashonaland Holdings Ltd.	Construction, real estate, trading	137.1	4.3
TA Holdings Ltd.	Leisure, retail, electrical, foods, insurance	202.9	2.8 (1995)
Import related			
Dunlop Zimbabwe Ltd.	Manufacturing and distribution of tires	204.0 (1995)	6.1 (1995)
National Foods Holdings Ltd.	General foods production	503.1	6.6

Selected Companies Listed on the Zimbabwe Stock Exchange (June 1996)

Name of Company	Main Business	Market Capitalization (in millions of Zimbabwe dollars)	P/E Ratio
Export related			
Art Corporation Ltd.	Paper production, packaging	50.3 (1995)	0.5 (1995)
Hunyani Holdings Ltd.	Paper production, packaging	446.7	n.a.
TABEX	Tobacco production and retailing	n.a.	n.a.
External factor neutral			
Portland Holdings Ltd.	Cement and concrete production	743.9	4.7
Zimbabwe Financial Holdings Ltd.	Banking and retail	156.9	4.4 (1995)
TEDCO Ltd.	Manufacturing and retailing of clothing	156.5 (1995)	4.9 (1995)

References

Ando, Albert, and Alan J. Auerbach, "The Cost of Capital in the U.S. and Japan: A Comparison," *NBER Working Paper*, No. 2286 (June 1987).

Bernstein, Peter L.(1983), "Capital Market Expectations: The Macro Factors," *Managing Investment Portfolios: A Dynamic Process* (Warren, Gorham & Lamont).

Berry, Michael A., Burmeister Edwin and McElroy, Marjorie B. (1988), "Sorting Out Risks Using Known APT Factors," *Financial Analysts Journal* (March/April 1988), pp. 29–42.

Burmeister, Edwin, Roll, Richard and Ross, Stephen A. (1994), "A Practitioner's Guide to Arbitrage Pricing Theory," in *A Practitioner's Guide to Factor Models* (The Research Foundation of the Institute of Chartered Financial Analysts, Charlottesville, Va.), pp.1–30.

Chen, Nai-Fu, Roll, Richard and Ross, Stephen A. (1986), "Economic Forces and the Stock Market," *Journal of Business*, 59, pp.386-403.

Copeland, Thomas E., and Weston, J. Fred (1992), *Financial Theory and Corporate Policy* (Addison Wesley).

Elton, Edwin J. and Gruber, Martin J. (1994) "Multi-Index Models Using Simultaneous Estimation of all Parameters," in *A Practitioner's Guide to Factor Models,* (The Research Foundation of the Institute of Chartered Financial Analysts, Charlottesville, Va.), pp. 31-58.

——————————————————————— (1995), *Modern Portfolio Theory and Investment Analysis* (John Wiley & Sons).

Ericsson, Neil R., Campos, Julia, and Hong-Anh Tran (1990), "PC-Give and David Hendry's Econometric Methodology," *R. De Econometria* (April 1990).

Fama, Eugene F. and MacBeth, James (1973) "Risk, Return, and Equilibrium: Empirical Tests," *Journal of Political Economy*, 38, pp.607-636.

Fama, Eugene F., "Stock Returns, Real Activity, Inflation, and Money," *The American Economic Review*, Vol.71, No.4. (Sept 1981).

Frankel, Jeffrey A. (1991) "The Japanese Cost of Finance: A Survey," *NBER Working Paper* (Reprint No. 1616, Sept 1991.)

French, Kenneth R. and James M. Poterba (1991) "Were Japanese Stock Prices too High?" *Journal of Financial Economics*, 29, (North-Holland, 1991).

Harry H. Harman (1976), *Modern Factor Analysis* (The University of Chicago Press).

Hatcher, Larry and Stepanski, Edward J. (1994) "Principal Component Analysis," in *A Step-by-Step Approach to Using the SAS System for Univariate and Multivariate Statistics* (SAS Institute), Chapter 14.

International Financial Corporation (1996), *The IFC Indexes*.

Miller, Merton and Franco, Modigliani (1961), "Dividend Policy, Growth, and the Valuation of Shares," *Journal of Business*, 34, pp. 411-433

Kobayashi, Takao (1990), "Kabushiki no Fundamental Value (Fundamental Values of Shares)," in *Nihon no Chika, Kabuka Kakaku Keisei no Mechanism (Mechanism of Stock and Real Estate Price Formation in Japan)*, (Tokyo University Press 1990).

Peavy, John W. and Goodman, David A. (1985), "How Inflation, Risk and Corporate Profitability Affect Common Stock Returns," *Financial Analysts Journal* (September-October 1985).

Quincor James Capel (1997), *Zimbabwe: An Historic 1996 and our Forecast for 1997*.

Roll and Ross (1980), "An Empirical Investigation of the Arbitrage Pricing Theory," *The Journal of Finance*, 35, No. 5, pp. 1073-1103.

Roll, Richard and Ross, Stephen A. (1984), "The Arbitrage Pricing Theory Approach to Strategic Portfolio Planning," *Financial Analysts Journal* (May/June 1984), pp.14-26.

SAGIT Stockbrokers (PVT) LTD (1996), *Statistical Information on Companies Listed on the Zimbabwe Stock Exchange*.

Segal, Simon (1996), "Interest in Stock Exchange Revives," *International Herald Tribune* (October 22, 1996).

Sorensen, Eric H. and Williamson, David A. (1985), "Some Evidence on the Value of Dividend Discount Models," *Financial Analysts Journal* (November-December 1985).

Zimbabwe Stock Exchange (1996), *The New Investor Guide to Investing in Shares Through the Zimbabwe Stock Exchange*.