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INTERNATIONAL STOCK MARKETS AND FLUCTUATIONS IN EXCHANGE RATES AND OTHER MACROECONOMIC VARIABLES

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I Introduction

There are a number of issues related to the effects of exchange rate changes, interest rate changes and other macroeconomic disturbances on stock-prices. First, such effects may be used as measures of "economic exposure" and as a basis for risk-management in firms. Second, they help identify changes in the firm's fortunes or misfortunes that depend on long-term strategic factors as opposed to temporary macroeconomic phenomena. Third, they may be of obvious interest for the stock market speculator. Fourth, one may ask whether the effects are related to exchange rate regime, and macro-policy behavioral rules in order to analyze whether such regimes and rules influence industry. Fifth, from an economic theory point of view and for testing market efficiency, it is interesting to note whether anticipated and unanticipated changes in variables influence stock-prices differently. Sixth, using an APT framework one may analyze how different risks are priced in markets. Finally, from the point of view of ownership structure, one could ask whether stock-prices in a particular country are highly sensitive to relatively short-term macroeconomic shocks due to, for example, a short time horizon of most market participants in this country. If so, the country's industry may be a good "bargain" in particular macroeconomic situations for potential owners with a longer time perspective.

There are a number of studies on the relationship between stock prices and macroeconomic fluctuations. Until recently most have been partial in the sense that they investigate the influence of one particular variable. For example, Campbell (1987) and Solnik (1984) emphasize the presumed negative relation between interest rates and the stock market. Others, such as Fama (1981), Fama and Schwert (1977), Geske and Roll (1983) and Solnik (1983) take into account the links among interest rates, inflation, and stock market returns.

Within the framework of CAPM Adler (1985) investigates whether national bond and stock indices are exposed to exchange rate changes and inflation. He finds that exposure to inflation increases after 1979 but discovers no exposure to exchange rate changes. Under these

cirumstances real exchange rate uncertainty implies that internationally diversified portfolios are exposed to both inflation and exchange rate changes.

On the international side, there are also studies of the correlation across countries among stock markets as in Schollhammar (1987). Bhandari and Genberg (1989) analyze how relative stock market developments depend on real exchange rate changes. They find substantial instability in the relationship over time. Goodwin, Farsio and Willett (1989) argue that the sign of the exchange rate's effect on stock prices could be different depending on the nominal or real origin of a shock. Using the relation between exchange rates and interest rates, they identify disturbances as either nominal or real and allow the coefficient for the exchange rate to differ between the two cases. With this procedure they are able to improve the explanatory value of the exchange rate substantially.

Recently Asprem (1989) estimated the impact of macroeconomic variables on national stock-indices focusing on domestic macro-economic variables while capturing foreign influences through the US stockmarket index. We choose to capture the influence of foreign macro-shocks directly by using a symmetric set of domestic and foreign variables. Another study of macroeconomic shocks and stock-markets is Wasserfallen (1989). Innovations in domestic macro-variables are found to have small or no effect on stockmarkets. Asprem (1989) on the other hand discovers significant influences over a longer time-period. He also discovers significant systematic effects of lagged macroeconomic news. Thus, results are contradictory and sometimes inconsistent with efficient markets.

In Oxelheim and Wihlborg (1987) it was argued that one cannot expect a stable relation between any one macro-variable and firm's performance, since the variables typically change simultaneously within a general equilibrium framework. Thus, discovering exchange rate sensitivity of a firm's cash flows does not necessarily imply that there exists an independent exposure to exchange rate changes.

It is necessary to take a wide range of domestic and foreign variables into account simultaneously in order to draw such a conclusion. Even when a more complete set of macroeconomic variables are included the stability of coefficients can be doutbted, for example, if these factors are not truly exogenous. The reason is that if the factors are not exogenous, then their coefficients would depend on the frequency with which the "true fundamentals" have changed. Furthermore, the exogeneity of variables and the influence on expectations of shocks will depend on exchange rate and policy-regime. The 1970s and the 1980s have been characterized by several regime shifts. Therefore, stability of coefficients in stockmarket regressions on macro-shocks may be quite unstable.

It is our objective in this paper to analyze the stability of coefficients in regressions of stock market rates of return on macro variables in Japan, Sweden and the USA, under alternative specifications of the macro-shocks. We use different combinations of macro-price variables, such as the exchange rate, and possible fundamentals, such as the money supply, for the period 1970-1987. This period includes a number of policy and exchange rate regime shifts which may have the consequence that coefficients even for true fundamentals become unstable over the whole period.

As noted, stability is important for firms' risk management in which "sensitivity coefficients" are important inputs. From an asset pricing point of view it is of interest to understand which factors affect the stock market systematically. Policy makers would also be concerned with stability, if they perceive that economic activities are influenced by stock markets.

Although we do not test a complete asset pricing model our tests have bearing on the efficiency of stock markets and rational expectations models as well. By common definitions of efficiency only unanticipated disturbances influence rates of return. Any expected changes should be incorporated in the price at the time expectations are formed. Similarly, macroeconomic rational

expectations models predict that expected monetary shocks do not affect real variables such as the real rate of return. We attempt to distinguish between expected and unexpected changes in all variables, since the coefficients for expected and unexpected changes need not be the same even if the strong assumptions of rational expectations do not hold.

We will not analyze the pricing of macro-risk within a complete Arbitrage Pricing Theory (APT)-framework. Macroeconomic factors and the pricing of risk associated with uncertainty about such factors have been analyzed, for example, by Chen, Roll and Ross (1986). They include only domestic factors, however. The value of APT tests declines if foreign factors or important factors are not included. Our results have been bearing on the choice of variables in an APT framework, however.

The paper proceeds as follows. In Section II the complexity of the relation between stockmarkets and macro-shocks is discussed. Section III contains hypotheses followed by descriptions of data and testing procedures in Section IV. Results are discussed in Section V.

II Macroeconomic Shocks and Stock Markets

Theoretically macroeconomic shocks influence a firm's or a set of firms' value in two broad ways. They influence through expected cash flows creating "operating exposure effects". Second, they affect the opportunity cost of capital (the discount rate) and create "portfolio effects".

The value of a firm (PV_0) can be described in the following way:

$$PV_0 = \frac{CF_0}{r-g^*}$$

where CF_0 is the cash-flow at time 0, r is the discount rate in the market (the "riskfree-rate plus a risk-premium) and g* is the

expected growth rate of cash flows. Exchange rate changes, interest rate changes etc. may influence future cash flows and their growth rate (g), as well as the discount rate r, since the opportunity cost of funds for investors depends on the interest rate on bonds, and possibly on inflation, as well as exchange rate changes.

The exact channels through which cash flow effects operate are quite complex. Furthermore, the value effect of a shock through expected cash flow effects over different time horizons depends strongly on the expected persistance of shocks. For these reasons it is difficult to derive exposures analytically. It has therefore been suggested by Adler and Dumas (1980) and Oxelheim and Wihlborg (1987) that regressions analysis be used to determine exposure. Regression coefficients, if stable over time, may then be used as exposure coefficients for different kinds of disturbances.

The simple present value expression indicates that stock markets in different countries need not be highly correlated even in a highly integrated world, since the industrial structure differs among countries and, therefore, the sensitivity of cash flows even to similar disturbances may differ. In addition, real exchange rate changes create a "wedge" between goods markets as Bhandari and Genberg (1989) note.

A primary source of correlation between stock markets would be a highly integrated financial market for relatively risk-free government bonds. Uncovered interest rate parity among such security returns imply that interest rates adjusted for exchange rate expectations are perfectly correlated. Even in this case the "operating exposure" to interest rate changes would vary among countries reducing correlation. Furthermore, interest rate changes do not usually occur in isolation from changes in other macro-price variables with their own operating exposure implications.

Pålsson (1989) argues that the risk-premium associated with each security should be considered endogenous relative to interest rate

changes and, therefore, to macroeconomic shocks in general. This endogenous "beta-coefficient" represents another source of lack of correlation among national stockmarket indices.

These reasons for substantial independence in the movements of national stock markets make it possible to run regressions on individual countries' stock market returns on domestic and foreign macroeconomic variables rather than taking relative stock market returns as independent variables. In addition, this formulation of the tests allow us to distinguish between the independent effects of foreign shocks relative to domestic shocks.

An additional problem in defining and estimating sensitivity to macroeconomic shocks arises due to the dependence of the expected growth rate, g, on expectations about future macroeonomic shocks. Any current shock would normally lead to a revision of expectations about future values of macroeconomic variables. Exchange rate and policy regimes may influence the expectation formation of economic agents. Thus, regime shifts should be a major source of instability in the relationship between current stock market returns and current shocks. We argue in Oxelheim and Wihlborg (1987) that from a firm's point of view it may be advantageous to measure exposure of cash flows rather than of stockmarket values, even when the objective is to evaluate the sensitivity of the firm's economic value to macro-disturbances. Lacking internationally comparable cash flow data we limit the analysis to stockmarket indices for Japan, Sweden and the USA.

III Testable Equations and Hypotheses

The following equations are tested for Sweden, the USA and Japan on monthly data for the period 1970-87, and the sub-periods 1970-73, 1974-79, and 1980-87:

I Nominal stock market return ($\hat{R}^N$) on nominal exchange rate change ($\hat{s}_t$),

$$\hat{R}^N_t = a_o + a_1\hat{s}_t + \epsilon_1.$$

This formulation corresponds to estimation of a common concept of exposure to exchange rate changes with no consideration of 'related' macroeconomic variables (see for example, Garner and Shapiro, 1984).

II Real stock market return ($\hat{R}$) on real exchange rate change ($\hat{u}$),

$$\hat{R}_t = b_o + b_1\hat{u}_t + \epsilon_2.$$

With this formulation we allow for interaction between the exchange rate and inflation rates assuming that firms and shareholders are concerned about real returns.

III Real stock market return ($\hat{R}$) on anticipated and unanticipated exchange rate changes,

$$\hat{R}_t = c_o + c_1 E_{t-1}\hat{s}_t + c_2(\hat{s}_t - E_{t-1}\hat{s}_t) + \epsilon_3.$$

Here another refinement is made relative to I in which the coefficient a_1 would be unstable if the proportion of anticipated exchange rate changes varies over time.

IV Real stock market return, $\hat{R}$, on anticipated and unanticipated macroeconomic price variables (exchange rate changes, long-term interest rate changes and inflation),

$$\hat{R}_t = d_o + d_1 E_{t-1}[\hat{s}_t] + d_2(\hat{s}_t - E_{t-1}[\hat{s}_t]$$
$$+ d_3 E_{t-1}[\Delta i^{LC}_t] + d_4(\Delta i^{LC}_t - E_{t-1}[\Delta i^{LC}_t])$$
$$+ d_5 E_{t-1}[\Delta i^{FC}_t] + d_6(\Delta i^{FC}_t - E_{t-1}[\Delta i^{FC}_t])$$

$$+ d_7 E_{t-1}[\hat{p}_t^{LC}] + d_8(\hat{p}_t^{LC} - E_{t-1}[\hat{p}_t^{LC}])$$

$$+ d_9 E_{t-1}[\hat{p}_t^{FC}] + d_{10}(\hat{p}_t^{FC} - E_{t-1}[\hat{p}_t^{FC}])$$

$$+ \epsilon_4$$

where superscripts LC refer to local currency and FC to foreign currency. A Δ refers to change while $\hat{p}$ refers to percent rate of change.

This formation allows us to identify changes in value due to, for example, those exchange rate changes that occur independently of inflation and interest rate changes. The reason for including only market price variables is that firms seem to emphasize exposure to such variables. Many tests of APT such as Chen, Roll and Ross (1986) include a mixture of price and quantity variables, however. One would expect most macroshocks to produce some combination of effects on the price variables here.

Exchange rates for Sweden and Japan are SEK/$ and Yen/$ respectively. For the USA a trade-weighted average of 8 currencies was calculated and defined as FC/$. All FC variables for Sweden and Japan are US variables while for the USA weighted averages are used as for the exchange rate. Real exchange rates are deviations from relative purchasing power parity in terms of producer prices while inflation rates are in consumer prices.

Reasons why some variables are defined as percent rate of change and others as change are given in the section on data and estimation procedures.

Va Real stock market return $\hat{R}$ on anticipated and unanticipated fundamentals (monetary and fiscal disturbances).

If different shocks produce different combinations of effects on price variables and they occur with varying frequences, then expression IV would not produce stable coefficients. Formulation Va identifies sensitivity of returns to fundmentals in macroeconomic models.

For stock-market returns in Sweden monthly budget deficit changes domestically and abroad (the USA) were decomposed into anticipated and unanticipated changes and used as independent variables along with domestic and foreign money supply changes. For Japan monthly budget deficit or surplus data were missing.

It can already here be stated that the results for this formulation were poor within each subperiod, indicating one of three possibilities. First, money supplies and deficits may not be true fundamentals. Second, even if they are fundamentals the relation between current shocks and exported future shocks is unstable even within each subperiod. This cannot be ruled out, though major regime shifts in 1973 and 1979 are captured. Third, foreign exchange and financial market price-determination may be characterized by substantial deviations from assumptions associated with efficient markets and rational expectations in macroeconomics. For example, if "destabilizing speculation", "bubbles" and "bandwagon effects" characterize these markets we would expect that exchange rates and interest rates, as well as stock market prices move and fluctuate substantially without substantial changes in fundamentals.

Vb Real stock market return, $\hat{R}$, on anticipated and unanticipated monetary and price variables (exchange rate changes, money supply changes), and short term interest rate changes.

$$\hat{R} = h_o + h_1 E_{t-1}[\hat{s}_t] + h_2(\hat{s}_t - E_{t-1}[\hat{s}_t]) + h_3 \cdot E_{t-1}[\hat{m}_t^{LC}] + h_4(\hat{m}_t^{LC} - E_{t-1}[\hat{m}_t^{LC}]) + h_5 E_{t-1}[\hat{m}_t^{FC}] + h_6(\hat{m}_t^{FC} - E_{t-1}[\hat{m}_t^{FC}])$$

$$+ h_7 E[\Delta i^{LC}_{s,t}] + h_8 (\Delta i^{LC}_{s,t} - E_{t-1}[\Delta i^{LC}_{s,t}])$$

$$+ h_9 E[\Delta i^{FC}_{s,t}] + h_{10}(\Delta i^{FC}_{s,t} - E_{t-1}[\Delta i^{FC}_{s,t}])$$

$$+ \epsilon_5$$

where $\hat{m}$ is the percent rate of change of the money supply (M1) and i_s is the short-term interest rate.

In this formulation both fundamentals (money supply changes) and market price variables (exchange rate and interest rate changes) are present as independent variables. We neglect budget deficits and other potentials due to lack of data and poor results for formulation Va. If adjustment of exchange rates and interest rates to fundamentals is characterized by inefficiencies and bubbles are commonplace, then we expect relatively higher explanatory value of market price variables rather than of fundamentals under flexible exchange rates and interest rates. In this case we also expect market price variables to move independently of each other and, therefore, the coefficient for the exchange rate should not be influenced by the addition of other variables. In other words, the coefficient for the unanticipated exchange rate should be equal across formulations III and IV.

The following specific hypotheses can be stated:

1. Under flexible rates, the explanatory value of the exchange rate should be reduced as the interest rate and inflation variables are added in formulations IV and Vb indicating that destabilizing speculation and similar "inefficiencies" in foreign exchange markets are not major determinants of stock price effects of exchange rate changes.

2. The coefficient for each variable should vary across exchange rate and monetary policy regime, for reasons discussed in more

detail below.

3. Exchange rate expectations based on historical information should not influence real rates of return under the assumption that risk-premia are uncorrelated with the same expectations.[1]

4. Even in the absence of efficiency in the sense implied by hypotheses 3 above rational expectations models imply that expected monetary disturbances and inflation should not influence real stock market returns.

5. Under a fixed exchange rate system domestic and foreign monetary shocks should influence real variables such as stock market returns in the same direction while under flexible exchange rates domestic and foreign monetary shocks would have opposite effects.[2]

What can be said about signs of coefficients under different regimes? Hypotheses must be based on macroeconomic theory and on expectations formation in stockmarkets. We will take a rather conventional macroeconomic view of the links between macro-variables and firm-profitability and assume that shocks that tend to increase profitability affect stock-prices postively even if profit-effects are short-term. Many of the hypothesized sign can be disputed on theoretical grounds but they provide a starting point for discussion.

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[1] It could be argued that, if interest rates are risk-free rates, then expected interest rate changes should influence expected and actual rates of returns. It seems unacceptable to denote as risk-free an interest rate that is fluctuating over time and is subject to inflation risk. Thus, we imagine that there is a risk-free zero-beta portfolio and that government bonds is one of many risky assets. In this case expected interest rate changes should be uncorrelated with stock market returns.

[2] This hypothesis is developed in Glick, Kretzmer and Wihlborg (1989).

The conventional wisdom regarding exchange rates is that a depreciation of the domestic currency increases the profitability of domestic corporations. Under a pegged regime like the Bretton Woods we expect this "wisdom" to be valid, since devaluations are implemented in order to restore a country's competitiveness after a period of inflation. If, in addition, interest rates are pegged, then changes in different market price variables do not typically occur simultaneously. Exchange rate and interest rate changes may actually be seen as substitutes. We expect that during the sub-period 1970-73 in the tests below an unanticipated depreciation influences real stock returns positively in formulation IV while unanticipated interest rate changes and inflation influence the same returns negatively.

During the sub-period 1974-1979 in the tests the dollar and the yen became flexible while interest rates remained pegged. The interest rate variation between 1974 and 1979 occurred primarily when policy authorities adjusted their interest rate targets rather than in association with shifts in fundamentals. For this reason we expect that both domestic and foreign unanticipated interest rate changes influence stockmarkets negatively. Exchange rate changes and inflation in formulation IV would vary as a result of shocks in fundamentals and expectations. Thus the correlation between these variables and stockmarket returns would depend on the source of the shock. We expect that domestic and foreign unanticipated inflation increases in response to expansionary profitability-increasing shocks in the two countries. Such shocks should have a positive effect on real returns on stocks.

Under the same regime exchange rate changes may obtain either sign in response to expansionary shocks depending on whether they occur in goods markets or money markets. We can therefore not hypothesize a sign for exchange rate changes in formulation IV during flexible rates. For example, an unanticipated increase in aggregate demand may cause an appreciation while an unanticipated increase in the money growth rate could cause a depreciation.

The sub-period 1980-1987 is characterized by flexibility in both interest rates and exchange rates. Therefore, in formulation IV expansionary shocks presumably influencing stock markets positively may be associated with any sign for interest rates as well as exchange rates. As for the period 1974-1979, unanticipated inflation is expected to be the result of expansionary shocks with positive influences on the stock market.

Table 1 summarizes our hypotheses regarding coefficients during different periods for formulation IV including market price variables alone, and for formulation Vb including money supply changes instead of inflation.

In hypothesis 5 above we referred to theoretical results showing that money supply growth at home and abroad have opposite effects on domestic economic activity while under fixed rates the origin of a money supply change is irrelevant. This hypothesis is reflected in the signs in Table 1.

We expect the same signs of coefficients in formulations IV and Vb for pegged exchange rates and interest rates during the period 1970-1973. The reasons are the same as for formulation IV. The main advantage of formulation Vb is that it allows us to formulate hypotheses for coefficients for exchange rates and interest rates when one or both of these variables are not targeted by policy authorities. The reason is that when money supply changes are incorporated explicitly, the coefficient for the other variables can be associated with aggregate demand and expectations.

Although a monetary expansion should have the same effect under flexible rates whether interest rates are pegged or not the magnitude of the effect is likely to be different. If interest rates are pegged and a monetary expansion influences exchange rate expectations for the future, then this change in expectations is reflected in relative real interest rates. On the other hand, during 1980-87 when interest rates were largely flexible, then expectations

would influence relative nominal interest rates. Therefore, during the latter period the coefficient for money supply changes evaluated at a constant interest rate, indicates the effects of an unanticipated change in the money growth rate holding expectations about future exchange rate changes constant.

Similarly, during the same period changes in aggregate demand conditions would affect interest rates. Therefore, the coefficient for the interest rate captures the stock price effect of changes in aggregate demand conditions as well as exchange rate expectations at a constant money supply growth rate during the sub-period 1980-87. Assuming that expectations change primarily in association with money supply and exchange rate changes the coefficient for the interest rate depends on a aggregate demand shifts to a dominant extent. As noted above, foreign or domestic expansions in aggregate demand are expected to influence stock-prices as well as interest rates positively. Thus, both domestic and foreign interest rate coefficients are expected to be positive.

The exchange rate coefficient in formulation Vb is expected to be insignificant for the period 1980-87. The reason is that it is expected to capture effects of exchange rate changes at given money growth rates and aggregate demand conditions. Stock-price effects of exchange rate changes due to bubbles and other "coefficiencies" would be captured by the coefficient, however. Our hypothesis 1 above implies that no correlation between exchange rate changes and stock prices is expected during this period.

During the period 1974-79 when interest rates are pegged, stock-price effects due to aggregate demand conditions are captured by the coefficient for the exchange rate, as well. At given money growth rates, the exchange rate would respond to shifts in aggregate demand in goods markets in both countries. Since the stock-price effect would be independent of the origin of the shock but the exchange rate response would not, we cannot determine a sign for the exchange rate during this period.

IV Data and Econometric Procedures

The estimation procedure that we follow has two stages, and is similar to the procedures of Kormendi and Meguire (1984) and Glick, Kretzmer, and Wihlborg (1989). The first stage is the estimation of unanticipated components of market price variables, exchange rates, prices, and interest rates, and policy variables, short-term interest rates, money supply, and deficits for each of the three countries. The second stage employs the anticipated and unanticipated components of the variables from the second stage in an explanation of the real return for each country.

The data series represent Sweden, Japan and the USA. The data used in this study are monthly from December 1969 through September 1987. The period covers various economic cycles and major international events, including the end of the Vietnam War, the rise and decline of OPEC, different exchange rate regimes, and distinct economic policy rules e.g., monetary versus interest rate rules, and fiscal policies adopted by governments.

The stock price data in this study were gathered from monthly issues of Capital International Perspective (CIP) and Morgan Stanley Capital International Perspective, which have become the standard sources of international stock market data. The stock market indices are value-weighted and unadjusted for dividends.

Since the (CIP) publication only recently started presenting indices with dividend reinvested, we obtained the dividend yield separately and adjusted the stock returns with gross dividend reinvested (dividend yield was obtained from monthly issues of (CIP)). We then adjusted nominal returns for inflation in order to obtain the real return.

The data set on the remaining variables consists of seasonally unadjusted monthly observations for the period December 1969 to September 1987. They were obtained from the monthly issues and the

database tapes of the International Monetary Funds' International Financial Statistics. The series used were:

s_t Spot exchange rate. End-of-month exchange rates in terms of foreign currency units per dollar

p_t Consumer and wholesale price indices

$i_{s,t}$ Short-term interest rates. The three month rates for either domestic interbank deposits or government treasury bills (called federal funds rate and the treasury bill rate)

i_t Long-term interest rates. Yield on government bonds with maturity of four years or longer.

m_t Money supply. End-of-month, M1-equivalent, expressed in billions of currency units.

D_t Budget deficit. End-of-month, expressed in billions of currency units.

Due to nonstationarity in the levels, all variables except the interest rates and deficits were transformed into growth rates.

The strong first-order autocorrelation observed in the exchange rate process is confirmed by the results of Dickey-Fuller test for unit roots. Therefore, the first step is to take change in log of the exchange rate, prices, and money supply.

We also test for and take into account the possibility of heteroscadasticity, which may be related to causes such as the changing structural volatility of the foreign exchange markets, or exogenous variables. We therefore use the White procedure, which compares a consistent covariance matrix of the parameters with the one obtained from ordinary least squares, to test the hypothesis of

varying conditional variance of the residuals. The chi-square statistic essentially tests the joint hypohtesis that the model's specification of the first and second moments of the dependent variable is correct. White (1980) shows that the heteroscadasticity-consistent covariance matrix estimator used for this test is also appropriate for constructing usual asymptotic tests. All tests are based on the heteroscadasticity-consistent covariance matrix estimator, regardless of the presence of heteroscadasticity.

We turn next to the estimation of anticipated and unanticipated changes in independent variables. For exchange rates, it is assumed that the short term interest rate differentials equals the expected rate of change of the exchange rate.

There are several ways that one can decompose inflation into unexpected and expected components. One way is to use ARIMA models as developed by Box and Jenkins. Inflation forecasts from ARIMA models are used as estimates of expected inflation, and forecast errors are used as the unexpected component of inflation rates. The ARIMA models for a certain series can be selected on the basis of minimum sum of squared residuals which are serially uncorrelated. ARIMA models of [0,1,1] seem to fit most of the countries. There appears to have been a structural shift in the inflationary process in many countrie, whch may account for the lack of robustness of results when the ARIMA models are fitted for longer periods.

Another way to obatin estimates of expected inflation is to use Treasury Bills or equivalent money market returns as a predictor of inflation. This method is inappropriate if real interest rates vary with expected inflation rates.

We decided to adopt a somewhat crude procedure. We regressed the inflation rate on six lags of inflation, six lags of money supply changes, seasonal dummies and the trend. The residuals of each country's inflation equation serve as a measure of unanticipated inflation rates. The marginal significance levels by country for the

test (based on the Q statistics for residuals) showed that the residual autocorrelations from the inflation equations are insignificantly different from zero.

A similar procedure is used to derive anticipated and unanticipated changes in interest rates. We regress interest rates on six lags of the interest rate, six lags of the change in money supply, six lags of industrial production and an intercept term. The residuals of each country's interest rate equations serve as measures of unanticipated interest rates for use in the second stage regressions. Once again the residual autocorrelations from the interest rate equations appeared to be zero.

To separate anticipated from unanticipated money supply changes, we regress money supply growth in percent on six lags of domestic money supply growth, six lags of growth of industrial production, monthly seasonal dummies and a time trend.

To find the unanticipated deficit, we regressed an equation similar to that for money supply, using twelve lags of deficits. The overall pattern showed that residual autocorrelations from money supply and the budget deficit are insignificantly different from zero for most countries across different periods.

V Results and Interpretations

Results are presented in Tables 2-4 for Japan, Sweden and the USA. For each country results for formulation I, II, III, IV and Vb are presented separately. For the sake of clarity we emphasize results with respect to exchange rate changes. The results of statistical tests for neutrality, stability and heteroskedasticity are presented in the tables. It is noteworthy that heteroskedasticity is commonplace. As noted, procedures to correct for it are employed.

Note that the foreign country for Japan and Sweden is the USA, while

for the USA the foreign "country" is a weighted average of 10 major industrialized countries. All exchange rates are in currency units per US dollar.

The hypotheses presented in Section II can now be evaluated based on results presented in the tables.

1. The adjusted R^2 is very low in formulations I and II for all countries but the exchange rate change enters significantly in regressions for Japan and the USA. Its significance increases further when a distinction is made between anticipated and unanticipated changes in formulation III. When other variables are added, unanticipated eschange rate changes are insignificant in most periods except in formulation Vb for Sweden 1970-73 and for Japan 1980-87. For the fixed rate period the significance of the exchange rate accords with hypotheses. Thus, the inly indication of stock-price effects caused by independent exchange rate changes under a flexible regime is the result for Japan, 1980-87. However, when inflation is introduced in formulation IV there is no significant coefficient for unanticipated exchange rate changes. These results are consistent with those of Adler (1985), who shows that national stock-price indices are influenced by domestic inflation but not by exchange rate changes.

2. The tests presented in the tables reject stability of coefficients across regimes as hypothesized in all regressions. Even when signs are the same across regimes, magnitudes of coefficients vary widely. Only the effect of interest rate variables seems somewhat consistent across regimes in formulation IV. For Japan and the USA it is the unanticipated domestic interest rate, for Sweden it is the unanticipated foreign interest rate.

Coefficient estimates for formulations IV and Vb that appear consistent in sign with those hypothesized for unanticipated shocks in Table 1 are underlined whether coefficients are statistically significant or not. It is noteworthy that the sometimes positive and

sometimes negative signs for unanticipated exchange rate changes are consistent with hypotheses in all cases but Sweden 1970-73, although coefficients are rarely significant. The more significant coefficients for interest rate variables are consistent with our sign hypotheses in a majority of cases while the money supply variables perform poorly in terms of both significance and sign.

3. It is somewhat disturbing that proxies for expectations enter significantly as often as unanticipated changes and often with the opposite sign. The neutrality test presented in the tables indicate rejection of the joint hypothesis of market efficiency and constant returns in about half the regressions. Efficiency must be interpreted with care, however. For all variables except the exchange rate the expectations variable is formed from historical values of macro-variables. Thus, the significance of an expectatons variable implies that historical changes in macro-variables can be used to forecast stock returns. Asprem (1989) obtains similar results. Such predictability is contrary to market efficiency but it is noteworthy that the coefficients for proxies of expectations are quite unstable. Efficiency is contradicted only if agents are able to learn coefficients before regime changes occur. It is also possible that risk-premia are correlated with expectations in which case market efficiency cannot be rejected.

4. For money supply changes and inflation, as for other variables, proxies for expectations are significant as often as proxies for unanticipated changes. Thus, the results do not confirm the hypothesis that anticipations of monetary variables are neutral with respect to real stock returns.

5. This last hypothesis is not supported. For Sweden, the signs for money supply changes are consistent with a fixed exchange rate post 1973, while for Japan the results are consistent with a fixed rate after 1980.

VI Conclusions

We return now to some of the issues discussed in the Introduction. The implications of our analysis for measuring exposure to exchange rate changes and other macroeconomic shocks as well as for applying the APT model are strong. The instability of coefficients under any formulation of tests implies that great care must be taken when specifying risk-factors. Depending on domestic policy and exchange rate regime different combinations of market price variables or fundamentals like money growth rates are truly exogenous risk-factors and the expected sign and magnitude of the coefficient for any one variable varies. It is primarily when policy authorities peg exchange rates and interest rates for substantial periods that one appropriately can talk about exposure to these variables.

If markets are characterized by substantial variability of these prices as a result of destabilizing speculation and bubbles, then these price variables may be considered independent risk-factors under more flexible regimes as well. The empirical evidence presented here indicates that such exchange rate and interest rate changes are not important risk-factors on the aggregate level. This result could be explained either by the absence of such fluctuations in the variables or by the ability of market participants to diversify risks caused by these factors.

The empirical results for proxies for expected changes in different variables are somewhat disconcerting. The significance of these variables can be interpreted in many ways. Either it indicates market inefficiency in the sense that profits can be made by using historical macro-data for forecasting of stock-returns or assumptions of traditional asset pricing models are false. One possibility is that it takes time to learn coefficients for the impact of expected changes in macro-variables under any one policy regime. Since each regime does not last for very many years market participants may never learn true structural relationships. Another possibility is that the market risk-premium is correlated with

expected changes in macro-variables. We cannot draw the conclusion that there are ample profit-opportunities.

The discussion indicates to us that there is a substantial need for empirical work on the relationship between asset pricing and macroeconomic variables. This work should be based on well-specified macroeconomic relations and not on ad hoc macroeconomic risk-factors. The information assumptions of most models underlying empirical work can also be questioned on the grounds that policy regimes shift frequently with the consequence that agents continuously must face the challenge of learning new structural parameters.

Table 1 **Hypothesis for signs** (unanticipated shocks)

Formulation IV

	$\hat{s}(d_2)$*	$i^{LC}(d_4)$	$i^{FC}(d_6)$	$\hat{p}^{LC}(d_8)$	$\hat{p}^{FC}(d_{10})$
1970-73	+	-	-	-	+
1974	?	-	-	+	+
1980-87	?	?	?	+	+

Formulation Vb

	$\hat{s}(h_2)$	$\hat{m}^{LC}(h_4)$	$\hat{m}^{FC}(h_6)$	$i^{LC}(h_8)$	$i^{FC}(h_{10})$
1970-73	+	+	+	-	+
1974-79	?	+	-	-	-
1980-87	0	+	-	+	+

* in yen/$ and SEK/$: The signs for the exchange rate are the opposite to those noted in table in USA regression

Table 2 JAPAN

Real Stock Market Return ($\hat{R}$) and Macroeconomic Change

Exchange rate change ($\hat{s}$) in %; Yen/$; Heteroscedasticity consistent estimates

2.I Nom R/nom $\hat{s}$

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.011	-.01	-.005	.06
Observations	211	46	70	91
D.W.	1.85	1.42	2.10	2.04
Coefficient $\hat{s}$	-.19*	.276	-.124	-.336*
[T stat]	[1.82]	[.62]	[-.80]	[2.60]
Stability (F-test)	(3.72)***			

2.II Real R/real $\hat{s}$

$\bar{R}^2$	.006	.050	.014	.05
D.W.	1.68	1.37	2.06	1.95
Coefficient $\hat{s}$	-.168	.775*	-.223	-.326*
[T-stat]	[1.52]	[1.84]	[1.41]	[2.37]
Stability (F-test)	(7.52)***			

* T-stat > 1.64

*** The hypothesis of stability can be rejected at 5 % (1%) confidence level of F-stat > 3.00 (4.61)

2.III Real R/nom expected (E) and unexpected (U) $\hat{s}$

$\bar{R}^2$	.03	.093	.002	.08
D.W.	1.8	1.65	2.01	1.99
White-test **	33.12%	99.00%	97.50%	62.40%
Coefficient E[$\hat{s}$]	.27	17.26*	.64	1.78
[T-stat]	[.24]	[2.58]	[.39]	[.91]
Coefficient U [$\hat{s}$]	-.269*	.217	-.186	-.366*
[T-stat]	[2.44]	[.49]	[1.20]	[2.65]
Stability (F-test)	(6.78)***			
Neutrality test ****	78%	0.2%	64.50%	36%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at 5% confidence level when White test statistic in table < 5%

*** The hypothesis of stability can be rejected at 5% (1%) if F-statistic in table > 2.60 (3.78)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test-statistic in table < 5%.

2.IV Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange rate Change in %
Domestic and Foreign Interest Rates in Change
Domestic and Foreign Inflation in %

(Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during subperiods)

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.14	.298	.085	.23
Obs.	205	40	64	85
D.W.	1.92	2.20	2.08	2.10
White-test **	35.20%	19.50%	46.70%	58.90%
E[ŝ]	.575	10.22	-.586	1.168
[T-stat]	[.53]	[1.16]	[-.26]	[.52]
U[ŝ]	-.044	.417	-.038	-.077
[T-stat]	[-.37]	[.87]	[.19]	[-.48]
E [Domestic long-term interest rate]	-5.32	24.27*	-.67	-3.08
	[-1.08]	[1.80]	[-.11]	[-.75]
U [Domestic long-term interest rate]	-3.99*	-10.28	.103	-5.28*
	[-2.66]	[-1.04]	[.03]	[-2.63]
E [Foreign long-term interest rate	1.24	5.69	.27	3.18*
	[.64]	[.96]	[.08]	[2.63]
U [Foreign long-term interest rate]	.29	-7.63*	-7.55*	-.158
	[.27]	[1.04]	[2.21]	[.12]
E [Domestic inflation]	-1.28*	.158	-.777	-.158
	[-2.57]	[.09]	[-.75]	[-1.34]
U [Domestic inflation]	-1.09	3.39	-.321	-2.66
	[-1.59]	[1.06]	[.17]	[1.90]
E [Foreign inflation]	-.562	.229	-1.13	-1.55
	[-.63]	[.23]	[-1.12]	[1.04]
U [Foreign inflation]	-.223	.34	-3.79*	3.74*
	[.45]	[.17]	[-1.99]	[2.23]
Stability (F-test)	(5.48)***			
Neutrality-test ****	2.07%	.50%	78.00%	18.30%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.71 (resp. 2.25)

**** The joint hypothesis of market efficiency and constant returns can be rejected of test-statistic in table < 5%

JAPAN

Vb **Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange Rate Change in %**

Domestic and Foreign Money Supply Change in %

Domestic and Foreign Short Term Interest Rate in Change

Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during sub-periods.

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.070	.098	.020	.146
Observations	199	34	58	79
D.W.	1.89	1.7	2.1	2.2
White-test **	23.40%	49.00%	73.30%	88.00%
E[ŝ]	-.71	10.53	-3.67	2.36
[T-stat]	[-.59]	[.88]	[-1.40]	[.89]
U[ŝ]	-.241*	.180	-.155	-.328*
[T-stat]	[2.17]	[.30]	[1.02]	[-2.02]
E [Domestic money growth]	.145	.148	.018	.254*
	[1.60]	[.35]	[.12]	[1.92]
U [Domestic money supply]	.069	-1.51	-.581	.502*
	[.35]	[-.84]	[-1.60]	[1.68]
E [Foreign money supply]	.122	.171	.03	.26
	[.52]	[.18]	[.09]	[.79]
U [Foreign money supply]	1.55 *	1.407	1.01	1.58
	[2.44]	[.22]	[.83]	[1.50]
E [Domestic short-term interest rate]	-11.73*	-36.85*	-4.54	-10.91
	[2.15]	[-1.92]	[-.50]	[-.90]
U [Domestic short-term interest rate]	6.77*	5.37	5.03	1.9
	[1.73]	[.17]	[.83]	[.22]
E [Foreign short-term interest rate]	.946	17.33	-24.99*	-.504
	[.33]	[1.18]	[-2.50]	[-.12]
U [Foreign short-term interest rate]	-.582	-4.75	-6.212	2.384
	[.29]	[.25]	[-1.14]	[.67]
Stability (F-test)	(6.43)***			
Neutrality test ****	19.20%	5.00%	2.00%	40.80%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.89 (resp. 2.26)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test statistic in table < 5%

Table 3 SWEDEN

Real Stock Market Return ($\hat{R}$) and Macroeconomic Change

Exchange rate change ($\hat{s}$) in %; Yen/$; Heteroscedasticity consistent estimates

I Nom R/nom $\hat{s}$

	70-87	70-73	74-79	80-87
$\bar{R}^2$	-.002	.009	-.002	.005
Observations	211	46	70	91
D.W.	1.89	2.2	2.12	1.75
Coefficient $\hat{s}$	.101	-.443	-.187	.259
[T stat]	[.73]	[-1.19]	[-.90]	[1.23]
Stability (F-test)	(7.57)***			

II Real R/real $\hat{s}$

$\bar{R}^2$	-.003	-.020	-.013	-.005
D.W.	1.83	2.2	2.11	1.75
Coefficient $\hat{s}$	.078	-.021	-.062	.168
[T-stat]	[.56]	[-.06]	[-.34]	[.74]
Stability (F-test)	(6.14)***			

* T-stat > 1.64

*** The hypothesis of stability can be rejected at 5 % (1%) confidence level of F-stat > 3.00 (4.61)

III Real R/nom expected (E) and unexpected (U) $\hat{s}$

$\bar{R}^2$	.021	.022	-.020	.004
D.W.	1.9	2.2	2.1	1.8
White-test **	.3%	38.90%	44.70%	74.00%
Coefficient E[$\hat{s}$]	3.65*	2.576	.928	3.68
[T-stat]	[2.72]	[.77]	[.38]	[1.60]
Coefficient U [$\hat{s}$]	-.031	-.558	-.137	.191
[T-stat]	[-.21]	[-2.09]	[-.64]	[.88]
Stability (F-test)	(3.68)***			
Neutrality test ****	78%	0.2%	64.50%	36%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at 5% confidence level when White test statistic in table < 5%

*** The hypothesis of stability can be rejected at 5% (1%) if F-statistic in table > 2.60 (3.78)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test-statistic in table < 5%.

2.IV Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange rate Change in %

Domestic and Foreign Interest Rates in Change

Domestic and Foreign Inflation in %

(Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during subperiods)

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.120	.26	.012	.10
Obs.	199	40	64	79
D.W.	.194	2.06	1.97	2.1
White-test **	5.01%	14.00%	43.80%	57.00%
E[ŝ]	3.24*	.698	-.493	4.99
[T-stat]	[1.92]	[.21]	[-.16]	[1.60]
U[ŝ]	.107	.203	-.044	.402
[T-stat]	[.79]	[.61]	[-.18]	[1.50]
E [Domestic long-term interest rate]	-7.9* [-2.19]	[-0.72]	[-1.41]	[-0.97]
U [Domestic long-term interest rate]	-3.393* [-1.93]	4.08 [0.19]	0.513 [0.07]	-3.607 [-1.50]
E [Foreign long-term interest rate	-2.787 [-1.24]	4.492 [0.92]	5.73 [1.07]	-5.59* [-1.80]
U [Foreign long-term interest rate]	-1.92* [-1.64]	-8.71 [-1.62]	-6.77 [-1.57]	-2.402 [-1.24]
E [Domestic inflation]	1.84* [2.29]	-1.487 [-1.08]	-0.245 [-0.26]	1.139 [0.76]
U [Domestic inflation]	-1.35* [-2.94]	-3.268* [-2.37]	-2.58* [-1.99]	-3.27* [-2.24]
E [Foreign inflation]	-0.722 [-0.75]	-0.188 [-0.29]	0.239 [0.19]	1.95 [0.76]
U [Foreign inflation]	0.562 [0.97]	2.047 [1.39]	0.362 [0.16]	1.344 [0.50]
Stability (F-test)	2.61***			
Neutrality-test ****	0.40%	0.90%	62.00%	15.40%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.71 (resp. 2.25)

**** The joint hypothesis of market efficiency and constant returns can be rejected of test-statistic in table < 5%

SWEDEN

Vb **Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange Rate Change in %**

Domestic and Foreign Money Supply Change in %

Domestic and Foreign Short Term Interest Rate in Change

Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during sub-periods.

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.04	.39	-.02	-.004
Observations	199	34	58	79
D.W.	1.95	1.98	2.2	1.9
White-test **	3.15%	41.00%	76.00%	9.00%
E[$\hat{s}$]	2.49	4.19*	.76	2.5
[T-stat]	[1.60]	[1.70]	[.24]	[.63]
U[$\hat{s}$]	.013	-.57*	.10	.21
[T-stat]	[.09]	[-2.30]	[.39]	[.87]
E [Domestic money growth]	-.12*	-.32*	.07	-.16
	[-1.75]	[-2.69]	[.44]	[1.30]
U [Domestic money supply]	-.19	.46	.49	-.54*
	[-1.09]	[1.04]	[1.40]	[2.00]
E [Foreign money supply]	.37	.94*	.39	.02
	[1.02]	[1.86]	[.71]	[.04]
U [Foreign money supply]	-.23	-.68	-2.55	1.34
	[.35]	[-.26]	[1.60]	[.80]
E [Domestic short-term interest rate]	-10.0*	29.46*	-12.14	-6.71
	[-1.80]	[1.86]	[-1.50]	[-1.10]
U [Domestic short-term interest rate]	-.97	-16.97*	2.74	-1.61
	[-.39]	[-2.36]	[.44]	[-.52]
E [Foreign short-term interest rate]	-5.26	-10.80	7.46	-6.94
	[-1.41]	[-1.40]	[.61]	[-.78]
U [Foreign short-term interest rate]	-2.05	-16.58*	-15.70	-.101
	[-.88]	[-2.95]	[-1.55]	[-.02]
Stability (F-test)	4.40***			
Neutrality test ****	0.35%	0.01%	60.00%	24.00%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.89 (resp. 2.26)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test statistic in table < 5%

Table 4 USA

Real Stock Market Return ($\hat{R}$) and Macroeconomic Change

Exchange rate change ($\hat{s}$) in %; Yen/$; Heteroscedasticity consistent estimates

	70-87	70-73	74-79	80-87
II Real R/real $\hat{s}$				
$\bar{R}^2$	.033	.052	.030	.020
Observations	211	46	70	91
D.W.	1.91	1.5	2	2.1
White test (homosc.)**	88.68%	.01%	90.50%	78.80%
Coefficient $\hat{s}$	-.43*	-.72*	-.53*	-.31*
[T-stat]	[-2.88]	[-1.87]	[-1.71]	[1.68]
Stability test (F-test)	(2.77)***			
III Real $\hat{R}$/nom expected (E) and unexpected (U) $\hat{s}$				
$\bar{R}^2$	.03	.02	-.01	.09
Observations	199	64	70	91
D.W.	1.99	2.20	1.94	2.10
White-test (homosc.)**	80.00%	96.00%	93%	29.60%
Coefficient E[$\hat{s}$]	5.01*	9.42	2.76	9.58*
[T-stat]	[2.01]	[1.22]	[.63]	[2.61]
Coeff. U[$\hat{s}$]	-.28*	-.35	-.35	-.20
[T-stat]	[-1.83]	[-.88]	[-1.03]	[-1.09]
Stability test (F-test)	(4.08)***			
Neutrality test ****	2.80%	26.00%	41.00%	.30%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at 5% confidence level when White test statistic in table < 5%

*** The hypothesis of stability can be rejected at 5% (1%) if F-statistic in table > 2.60 (3.78)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test-statistic in table < 5%.

IV Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange rate Change in %
Domestic and Foreign Interest Rates in Change
Domestic and Foreign Inflation in %

(Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during subperiods)

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.24	.13	.18	.15
Obs.	193	34	64	79
D.W.	2.20	1.89	2.20	2.40
White-test **	51.60%	74.30%	54.00%	46.00%
E[ŝ]	1.39	4.71	-7.97	10.50*
[T-stat]	[.56]	[.47]	[-1.30]	[2.15]
U[ŝ]	-.11	-.56	.24	.25
[T-stat]	[-.67]	[-1.33]	[.65]	[1.08]
E [Domestic long-term interest rate]	-3.94*	-2.34	-2.73	-2.77
	[-2.07]	[-.51]	[-.54]	[-1.30]
U [Domestic long-term interest rate]	-.93	-4.78	-5.31	-1.25
	[.77]	[-.82]	[-1.30]	[.81]
E [Foreign long-term interest rate	-13.63*	3.24	-18.93	-4.27
	[-2.59]	[.29]	[-1.47]	[-.83]
U [Foreign long-term interest rate]	-4.69*	.14	-19.16*	-6.65*
	[-1.78]	[.01]	[-2.55]	[-1.88]
E [Domestic inflation]	.56	-.187*	-2.24*	1.61
	[.61]	[-2.65]	[-1.70]	[.97]
U [Domestic inflation]	-1.61*	-.58	-1.42	.41
	[-3.36]	[-.39]	[-.60]	[.25]
E [Foreign inflation]	-1.07	.05	2.08	-.29
	[-1.24]	[-.03]	[98]	[-.13]
U [Foreign inflation]	2.28*	3.04	.71	-1.00
	[1.89]	[.48]	[.15]	[-.32]
Stability (F-test)	2.71***			
Neutrality-test ****	0.01%	0.02%	27.00%	0.40%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.71 (resp. 2.25)

**** The joint hypothesis of market efficiency and constant returns can be rejected of test-statistic in table < 5%

USA

Vb — **Real $\hat{R}$/Expected (E) and Unexpected (U) Exchange Rate Change in %**

Domestic and Foreign Money Supply Change in %

Domestic and Foreign Short Term Interest Rate in Change

Underlined coefficients have signs in accordance with or not inconsistent with hypothesis in Table 1 for unanticipated changes during sub-periods.

	70-87	70-73	74-79	80-87
$\bar{R}^2$	.08	-.06	.27	.07
Observations	193	28	58	79
D.W.	2.05	1.83	2.1	2.2
White-test **	1.65%	32.00%	26.20%	17.58%
E[ŝ]	3.75	11.21	-6.55	14.02*
[T-stat]	[1.51]	[.79]	[-1.50]	[2.31]
U[ŝ]	-.22	-.68	.23	.01
[T-stat]	[-1.30]	[-1.40]	[.84]	[.06]
E [Domestic money growth]	.36*	.15	.46	-.03
	[1.88]	[.18]	[1.36]	[.11]
U [Domestic money supply]	-.15	2.73	-.69	-1.12
	[-.28]	[.57]	[.56]	[-1.18]
E [Foreign money supply]	-.14	-.03	.14	-.04
	[-.97]	[-.06]	[.50]	[.19]
U [Foreign money supply]	.86*	.45	-1.72	.55
	[1.90]	[.16]	[-1.54]	[.83]
E [Domestic short-term interest rate]	-5.04	-8.99	-23.28*	-5.95
	[-1.49]	[-.80]	[-2.26]	[-1.04]
U [Domestic short-term interest rate]	-5.99*	-10.41	-23.14*	-8.67*
	[-2.62]	[-.65]	[-3.34]	[-2.20]
E [Foreign short-term interest rate]	-4.97	13.21	-10.07	-7.19
	[.82]	[1.51]	[-.81]	[-.54]
U [Foreign short-term interest rate]	.603	10.78	-11.22	9.28
	[.11]	[.80]	[-1.17]	[.96]
Stability (F-test)	11.66***			
Neutrality test ****	2.90%	14.90%	0.10%	2.70%

* T-stat > 1.64

** Rejection of the hypothesis of homoscedasticity occurs at a 5% confidence level when the confidence level indicated in the table is less than 5%

*** The hypothesis of stability can be rejected at a 5% (resp. 1%) confidence level if the F-test > 1.89 (resp. 2.26)

**** The joint hypothesis of market efficiency and constant returns can be rejected if test statistic in table < 5%

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