## Раздел 3. ЗА РУБЕЖОМ

# Влияние размеров американских компаний и их положения на мировом рынке на взаимосвязь между стоимостью акций и обменным курсом

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Работа посвящена исследованиям причинной связи по Гранджеру между стоимостью акций и обменным курсом крупных и небольших американских компаний за период 1985 – 1998 гг.

Учитывая размеры и значение американской экономики, доллара и валютной политики США и их влияние на мировую экономику, данная работа сконцентрирована на изучении американских рынков.

Размеры американской экономики и роль доллара как главной резервной валюты и средства обмена для международных сделок создают предпосылки для сильного влияния американской валютной политики на остальной мир и, в частности, на обменный курс доллара.

Вопрос о природе взаимосвязи между стоимостью акций и обменным курсом остается открытым в академических исследованиях. Данные по рынку ценных бумаг и обменному курсу указывают на то, что ситуация меняется от положительной к отрицательной. Периоды поворота соответствуют основным изменениям в политике Федеральной резервной системы США и показывают сильное влияние экономики США на мировые рынки.

Результаты работы свидетельствуют о наличии причинной связи по Гранджеру в отношении изменений стоимости акций крупных фирм в зависимости от обменного курса, но не отражают причинной зависимости обменного курса от стоимости акций. Кроме того, результаты говорят в пользу ориентированной на «акции» модели, по которой изменения в экономической деятельности американских компаний ведут к колебаниям местной валюты и, следовательно, к изменению обменного курса. Подтверждаются также выводы о том, что глобальная интеграция могла бы быть ограничена крупными многонациональными корпорациями.

Предварительные выводы показывают, что природа соотношений между стоимостью акций и обменным курсом постоянно меняется. Кроме того, установлена зависимость стоимости акций и обменного курса от одних и тех же макроэкономических изменяемых величин, включая процентные ставки, уровень инфляции, валютную политику Федеральной резервной системы, и сделан вывод о сильном влиянии изменения в политике Федеральной резервной системы США на природу соотношения *стоимость акций – обменный курс*, и что следует продолжить исследования в данном направлении. Связь между изменениями в стоимости акций и обменного курса в США играет большую роль не только для американских компаний, но и в глобальном масштабе, так как США имеют огромное влияние на экономическую деятельность за пределами своей страны. Дается анализ влияния глобализации на рынок ценных бумаг.

Данная работа рассматривает положительный период (с 1995 по 1998 г.) соотношения между обменным курсом и стоимостью акций, которые регулируются размерами компаний и их выходом на международный рынок. В то же время статистически не отражено значительное влияние изменений в стоимости акций небольших фирм на обменный курс. Эти выводы (наличие причинной связи по Гринджеру между изменениями индекса Доу Джонса и обменным курсом и наличие сильной причинной связи только для крупных компаний) поддерживают модель, ориентированную на «акции», по которой изменения в экономической деятельности США, подтвержденной доходами по акциям, ведут к спросу на местную валюту и, следовательно, к изменениям обменного курса.

Результаты интересны также тем, что они указывают на тот факт, что глобальная интеграция могла бы быть ограничена главным образом крупными мультинациональными компаниями. Поскольку большинство предыдущих исследований рассматривало индексы по акциям, которые привлекают самых крупных американских и мировых игроков на рынках ценных бумаг, уровень глобальной интеграции таких рынков и последствия ее могли бы быть продиктованы финансовым здоровьем крупных компаний. Предварительные результаты указывают также на важность политики Федеральной резервной системы США в мировой интеграции.

В работе представлены более современные данные, чем в предыдущих исследованиях (Ajayi, Friedman, and Mehdian, 1998).

# Effects of Size and International Exposure of the US Firms on the Relationship between Stock Prices and Exchange Rates

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The question of the nature of the relationship between stock prices and exchange rates remains unsettled in the academic research. The data for the US stock market and exchange rate suggest that the sing of the relation changes over time from positive to negative. Periods of turning points correspond to the major changes in the US Federal Reserve Policy indicating a strong influence of US economy on the world markets. The causality relation in Granger sense between exchange rate and stock prices controlling for the firms' size for the US over a period 1985 – 1998 size is investigated in this paper. The results indicate the existence of Granger causality from large-cap firms' stock price changes to the exchange rate, but no Granger causality relation for the small-cap firms. The results support the "stock" oriented models, where changes in domestic economic activities lead to changes in demand for local currency, and hence, changes in exchange rates. The results also support previous findings that global integration might be confined to the large multinational corporations.

#### Introduction

Theory points to an existence of the relationship between stock prices and exchange rates, a number of researches have been published on this topic, and the same variables, such as interest rates, inflation and monetary policy, have been identified that influence both stock prices and exchange rates. Nevertheless, the empirical studies of the relationship are inconclusive. On one hand, theory suggests and research has found a positive relationship between exchange rates and stock prices, on the other hand some empirical research reports existence of negative relationship.

There is a wide spectrum of variations in studies of the exchange rate – stock prices relation that try to capture possible explanations for the contradicting evidence. Ajayi and Mougoue (1996), for example, report that an increase in aggregate domestic stock price has a negative short-run effect on domestic currency value and positive long run effect and currency depreciation has a negative both short-and long-run effect on the stock market. Study by Ma and Kao (1990) have found that relation between exchange rates and stock prices differs for export vs. import dominated countries: for export dominated countries currency appreciation will have a negative impact on stock markets and for import dominated countries (such as US) currency appreciation will have positive impact on stock prices.

Solnik (1987), on the other hand, has found a negative relation between real stock-return differentials and changes in real exchange rates over a period 1973-1983 and only weak positive relation over the sub-period 1979-1983. His conclusions support the idea that it is anticipated real growth that has a positive influence of the exchange rate. Malliaropulos

(1998) also reports a negative relation between international stock return differentials and changes in real exchange rate between US and other countries (France, Japan, and UK were examined). Boldin (1999) has concluded from his study that exchange rate has little effect on the general economy of the US (as measured by the domestic firm activity) and exchange rate rather demonstrates confidence in the US financial and monetary systems.

It is suggested in this paper that relationship between stock prices and exchange rate depends on the level of international exposure. Hodder (1982) has theorized that purely domestic firms as well as multinational firms are exposed to the exchange rate movements. A study by Jorion (1990) has looked at the effect of the exchange rate on the value of US multinationals and the author has reported that this relation is positively correlated with degree of foreign involvement for multinational corporations, but it did not matter for domestic firms.

The critiques of the previous studies attribute the apparent contradictions of the outcomes to the deficiencies in the proposed models. Solnik (1987) points to a poor quality of macroeconomic data, and Lucas (1982) critiques the absence of business cycle effects and assumed absence of production.

The view of the data suggests that the relation between exchange rates and stock prices is changing over time, with strong either positive or negative relation over sub-periods of time with distinct reversion points. Looking at Figure 1, that graphs Dow Jones Industrial Average Index as a proxy for stock prices against Exchange Rate over a time period 1973-1998, 3 periods of are easily identifiable: 1973-1985 period with very strong positive relation, followed by 1985-1995 period with negative relation and reversing back to positive



relation in 1995-1998 period. 1973 was chosen as a starting point of this research since this is a first year of flexible exchange rates.

The contradictions of the previous studies might be explained by the different time periods examined, given a strong affect that a chosen time period has on the relation for the US data. A study of the underlying factors that cause the relation between stock prices and exchange rates to reverse might be interesting and appropriate for future research in this area. Such an attempt has been done by Obstfeld (1985) where the author suggests that Federal Reserve policy of monetary growth can have strong positive effect on US currency but at the same time ambiguous effect on stock prices.

The significance of monetary policy for both exchange rate and level of stock prices has been theorized previously by Dornbusch (1976), where he suggests that monetary expansion will result in depreciation in the exchange rate and increase in domestic prices. Short run depreciation in the exchange rate will exceed the depreciation in the long run due to the fact that anticipation of the currency depreciation after monetary increase will have an immediate effect on the exchange rate, while adjustment to local prices will be a slower process. Eventually an increase in domestic prices will pull the exchange rate to the new equilibrium.

Later Patelis (1997) has also pointed to the significance of monetary policy, proposing that changes in monetary policy change the risk structure of the economy, and, therefore, the risk characteristics of the stocks. Patelis (1997) concludes that monetary policy indicators can also act as stock return indicators. Papers by Fama (1981), Ewing, Payne, and Forbes (1998), and Domian, Gilster, and Louton (1996) also point to the strong effect of monetary policy on the stocks. Fama (1981) has found that in a post 1953 period stock returns were negatively related to the inflation and inflation was negatively related to the real activity in the economy. Ewing, Payne, and Forbes (1998) reports that increase in the lending rate and decrease in the deposit rate (rates being a proxy for the monetary policy indicator) tend to raise the value of the stocks. Domian, Gilster, and Louton (1996) demonstrated that increase in stock returns can be observed over a year following a drop in interest rates.

It is plausible then for the future research to look at the monetary policy as a triggering mechanism for the changing relation between stock prices and exchange rate. Size of the US economy and dollar's role as a major reserve currency and medium of exchange for international transactions lead US monetary policy to have strong influence on the rest of the world and particularly on dollar exchange rate.

Looking at the Federal Reserve policy other the years, it should be noted that there were some significant changes made around the years of changing relation between exchange rate and stock prices. There were major regulatory and legislative changes in the early '80s that affected the climate for Federal Reserve policy (1980 Depository Institutions Deregulation and Monetary Control Act, 1982 Garn-St Germain Depository Institutions Act, MCA provision for interest rate ceiling to be gradually phased out). The changes lead to the fact that relatively close link between M1 and economic activity had been broken down, FOMC (Federal Open Market Committee) suspended its M1 target in late 1982 and in 1983 modified its procedures for guiding reserve provisions to be focused on measures of inflation and economic activity. In a mid '90s there was another major shift in the way Federal Reserve policy is conducted - in 1994 FOMC began as an experiment issuing press releases on policy decisions the day they were made and the procedure was formalized in 1995. As Federal Reserve policy became readily apparent to the market participants, Fed watchers no longer needed to provide analysis of daily Desk activity to interpret current FOMC policy. This period, again corresponds to another major turn in the relation between exchange rate and stock prices.

As noted by Ajayi, Friedman, and Mehdian (1998), the issue of causality between the exchange rates and stock returns remains largely unexplored and the direction of causality has not been rigorously established, and the direction of dependency remains implicitly assumed. The "flow" oriented models propose that changes in exchange rates dictate changes in demand, therefore, changes in output/income of domestic producers, and hence, the stock prices. The "stock" oriented models, on the other hand, dictate that changes in domestic economic activities, proxied by stock returns, lead to changes in demand for local currency, and hence, changes in exchange rates. Using Granger causality test, Ajayi, Friedman, and Mehdian (1998) have found uni-directional causality from stock return differentials to changes in exchange rates for the advanced markets, but no statistically significant relation was detected in the case of emerging economies.

The issue of globalization in pricing of stock markets complicates an issue of determining the causality relation between stock prices and exchange rates. A study by Eun and Huang (2003) shows that large-cap stock indices are cointegrated across countries, and large-cap stocks are priced globally, where as mid-cap and small-cap are not. Hameed (2003) points to the distinction between small-cap and large-cap stocks as well, stating that returns on small firms adjust slowly to the information already incorporated in large firms following the periods of market decline based on the study of Japan.

Given the size and importance of US economy, US dollar and US monetary policy in the world economy, this paper will concentrate on the study of the US markets. The objective of this paper is to investigate the causality relation between US stock prices and US dollar exchange rate controlling for the size and international exposure of the sample firms. Granger (1969) causality test is employed. The present paper extends the data set used in the previous study of causality presented in Ajayi, Friedman, and Mehdian (1998). The contribution of the paper is that it looks at the data over 1995-1998, a period of positive relation between stock prices and exchange rates, where as the above mentioned study used a sample over 1985-1991, a period of negative relation between stock prices and exchange rate. It is important to note that the results of this study show the same causality relation over a period of positive relation as over a period of negative relation. In addition, this study contributes to the existing literature in that it controls for the effect of size and international exposure of sample firms.

The rest of the paper is organized as follows. Section II presents data and methodology, Section III presents and discusses the results of the study and Section IV concludes.

### **Data and Methodology**

Daily data for the period 1995-1998 were collected for the following series. Daily nominal exchange rate index that is a "weighted average of the foreign exchange values of the US dollar against a subset of 10 currencies in the broad index that circulates widely outside the country of issue" was obtained from the Federal Reserve Board data base. Daily Dow Jones Industrial Average Index values were obtained from Dow Jones Indexes data base. Dow Jones Industrial Average is composed of 30 companies, which represent about one fifths of the market value of all US stocks, and about one forth of the value of stocks listed on the New York Stock Exchange. Each company of the Dow Jones Industrial Average Index is a major player in its industry. Dow Jones Industrial Average Index is used as a proxy for large-cap stocks. Daily Russell 2000 Index values were obtained from the Russell Company data base. Russell 2000 Index tracks the stock values of the 2,000 smallest companies in the Russell 3000 Index and represents approximately 98% of the total US equity market. Russell 2000 Index includes only stock of the US domestic corporations and, therefore, is used as a proxy for the small-cap domestic stock market.

Wednesday closing to Wednesday closing weekly averages were computed and used in the data analysis in order to avoid problems of the weekend effect and non-synchronous trading. As noted by Hameed (2003), most of the previous literature that looks at short-horizon stock returns uses weekly data and it is a standard convention in the literature to compute weekly averages from Wednesday close to the following Wednesday close.

It is proposed here that (1) changes in stock prices precede changes in exchange rate; (2) the causality relation with exchange rate, if present, is stronger for large-cap stocks than for small-cap stocks; and (3) speed of adjustment (determined as a best lag between the two variables) between large-cap stock and exchange rate is faster than the rate of adjustment between small-cap stock and exchange rate.

Granger causality test was identified as the appropriate methodology for the study. The procedure employed in this study follows that described in Granger (1969) and Hamilton (1983). Granger causality procedure is utilized in testing whether changes in one variable are a "cause" of changes in another. Even though we can not talk about either changes in stock prices or in exchange rate "causing' the changes in the other variable, the Granger causality test is appropriate here because it helps to determine the predictability relation between the two variables. It is hypothesized that changes in stock prices help to predict changes in exchange rate or in other words, domestic macro economic changes are first reflected at the domestic market and then through financial contagion are picked up at the international markets and the exchange rate. The causality relation between exchange rate and stock prices would be more pronounced and intimate for large-cap stocks than for small-cap stocks.

In order to establish causality in Granger sense, two tests would have to be performed: first, Stock Index changes help to predict Exchange Rate and, second, Exchange Rate changes do not help to predict Stock Index changes. Lag time has to be chosen in order to perform the test.

Data Set was tested for heteroscedasticity using Goldonfeld Quandt test and for serial correlation using Durban Watson test. The Dow Jones Industrial Average series was determined to have both heteroscedasticity and serial correlation and was adjusted accordingly. The Russell 2000 series was determined to have no heteroscedasticity problem but serial correlation only and was adjusted using auto-reg procedure. The two data series were also tested for the outliers measures of regression diagnostics, such as RSTUDENT, DFFIT, and DFBETAS were used, that allow us to determine whether there are "outliers" present in a data set that have unusually large influence on the regression model<sup>1</sup>.

For the Dow Jones Industrial Average Index data series 4 observations were identified as outliers, but, as the tests indicate, none of those observations, if omitted from the data set, will result in significant changes of parameter and model estimates. For the Russell 2000 Index data series 11 observations were identified as outliers, but, again, none of those observations, if omitted from the data set, will result in significant changes of parameter and model estimates of parameter and model estimates.

In his research, Hameed (2003) notes that there is no theoretical guide for determining the lag, and uses lags of 4, 12 and 26 weeks, following the previous literature. The best lag between the Exchange Rate and the two Stock Indexes for this study, therefore, was determined by the best adjusted Rsquared estimate of the lagged linear regressions run for the lag periods between zero and seventeen weeks. The best lag period for the Dow Jones Industrial Average Index and Exchange Rate was determined to be at 7 weeks and for the Russell 2000 Index and Exchange Rate at 13 weeks, which is consistent with the lags used in the previous literature.

In order to perform the Granger causality test, the two sets of regressions were estimated:

First test is for Ho: changes in Stock Index do not help to predict changes in Exchange Rate. The following regressions have to be estimated:

Unrestricted Model:

$$\Delta ER_{t} = \sum_{i=1}^{L} \alpha_{1i} \Delta ER_{t-i} + \sum_{i=1}^{L} \beta_{1i} \Delta SI_{t-i} + \varepsilon_{1t}; \qquad (1)$$

Restricted Model:

$$\Delta ER_{t} = \sum_{i=1}^{L} \alpha_{2i} \Delta ER_{t-i} + \varepsilon_{2t} .$$
<sup>(2)</sup>

Second test is for Ho: changes in Exchange Rate do not help to predict changes in Stock Index. The following regressions have to be estimated:

Unrestricted Model:

$$\Delta SI_{i} = \sum_{i=1}^{L} \alpha_{3i} \Delta SI_{i-i} + \sum_{i=1}^{L} \beta_{3i} \Delta ER_{i-i} + \varepsilon_{3i} ; \qquad (3)$$

DFBETAS measured the difference between coefficient estimate for a particular parameter and the same coefficient estimate with particular observation omitted. It is normalized by dividing the difference by the standard error of the regression. The DFBETA absolute value greater than 1.96 for two-tailed test at 5% significance level indicates that the observation has a strong influence on the value of the measured coefficient. We can set a cut off point for the value of DFBETAS to be concerned about the data point, for example, at 2 / N^{0.5}.

DFBETAS =  $(\beta - \beta(i)) / S(i)$ .

DFFITS measures the difference between the predicted value of the dependent value and the predicted value when a particular observation is omitted. It is as well standardized by dividing the difference by the standard error of the regression. DFFITS = (Y - Y(i)) / S(i).

Restricted Model:

$$\Delta SI_{t} = \sum_{i=1}^{L} \alpha_{4i} \Delta SI_{t-i} + \varepsilon_{4i} .$$
<sup>(4)</sup>

Where

 $\Delta ER_t$  – change in Exchange Rate

- $\Delta SI_{t-i}$  logged change in the Stock Index lagged i weeks
- length of the best determined lag (7 weeks for Dow Jones Industrial Average Index and 13 weeks for Russell 2000 Index)

 $\varepsilon_{jt}$  - random error, j = 1,2,3,4 such that  $\varepsilon_{jt} \sim N (0, \sigma^2) \alpha_{ji}$ ,  $\beta_{ji}$ - coefficients to be estimated,

$$i = 1, 2, ... 13$$
 (for Russell 2000 model) and

i = 1, 2, ...7 (for Dow Jones Model)

The test statistic is

$$F = \frac{(N-k)(ESS restricted - ESS unrestricted)}{L(ESS unrestricted)} \sim F_{L,N-k}$$

## **Empirical Results**

Based on the estimated results for equations (1) through (4) the F-statistics were calculated to estimate the Granger causality test. The results are reported in Table 1.

Table	1
Results of Granger Causality Tests for DJIA - Exchange	!
Rate and Russell 2000 – Exchange Rate Models	

	Dow Jones Model Lag $L = 7$ F Value (7,159)	Russell 2000 Model Lag $L = 13$ F - Value (13, 145)
Ho: $\Delta Sl \rightarrow \Delta ER$	4,099*	1,777
Ho: $\Delta ER \not\rightarrow \Delta SL$	1,139	1,215

Note: \* significant at 5% level

 $\rightarrow$  Direction of Causality

The results point toward uni-directional Granger causality for the model based on Dow Jones Industrial Average Index. Test results are statistically significant for Granger causality from changes in Dow Jones Index to changes in Exchange Rate, but not for the other direction. The results for the Russell 2000 Granger causality test are not statistically significant for both directions.

Changes in Stock Indexed and changes in Exchange Rate were also tested for the statistical significance of the relation. F-statistics for both tests, changes in DJIA Index as independent variable and changes in Exchange rate as dependent variable, and changes in Russell 2000 as independent variable and changes in Exchange Rate as dependent variable, are statistically significant. This indicates that statistically significant relation is present between changes in both Stock Indexes and changes in Exchange Rate.

As a result of the Granger causality test, uni-directional causation can be suggested for DJIA Index: changes in Dow Jones Industrial Average Index help to predict changes in Exchange Rates, but the same can not be concluded for the Russell 2000 Index. Even though based on Granger causality test we can not conclude that changes in Stock Prices "cause" changes in Exchange rate, but the results of this

 $<sup>^1</sup>$  RSTUDENT produces residuals for each observation when the regression line is estimated when that particular observation is omitted. It is normalized by dividing the residual for the particular observation by the standard error of the regression. RSTUDENT value greater than 1.96 in absolute value for two-tailed test at 5% significance indicates that the observation might be an outlier. RSTUDENT =  $\epsilon(i)$  / S(i).

tests suggest that there is s strong relation present between Stock Prices and Exchange Rate. The relation is much stronger for the DJIA Index than for the Russell 2000 Index.

Stock prices of large multinational companies have stronger relation to the exchange rate as indicated by both unidirectional causality in Granger sense and shorter lag period between changes in two variables. This is intuitively appealing since large companies have presence abroad and therefore their earnings will be more sensitive to the exchange rate fluctuations and large companies would have heavier foreign investment into them, hence their value would partially be determined by foreign investors, who are also sensitive to the changes in the exchange rate. The result is consistent with previous research that points toward integration of stock and currency markets in advanced economies (see, for example, Ajayi, Friedman, and Mehdian (1998)). Domestic firms, on the other hand, even though also affected by the same underlying variables (i.e. interest rates, inflation, federal monetary policy), display much weaker relation with changes in exchange rate and no causality relation in Granger sense. Again, this is intuitive since domestic firms would have much less international exposure for their production output and foreign capital investment.

#### Summary and Conclusions

This paper looks at causality relations in Granger sense between stock price changes and exchange rate changes for large-cap and small-cap stocks. The preliminary findings suggest that the nature of the relationship between stock prices and exchange rate is changing over time. Since both stock prices and exchange rate have been identified to depend on the same set of macroeconomic variables, including interest rates, inflation level, federal monetary policy, it is plausible to suggest that shifts in federal monetary policy in the US have a strong affect on the nature of the stock prices - exchange rate relation and it would be worth while to investigate further. It is important to recognize the shifts in the stock prices and exchange rate relation for the US, since US has tremendous impact on economic activity not only domestically but also globally.

This paper looks at the data over 1995-1998, a period of positive relation between exchange rates and stock prices, controlling for the size and international exposure of the stocks. The results indicate that large companies' market is well integrated with exchange rate market and has uni-directional causality from stock price changes to changes in exchange rates. At the same time there is no statistically significant causality relation exists between changes in prices of small-cap stocks and exchange rates. These findings (Granger causality from DJIA Index changes to exchange rate changes and presence of strong causality relation only for largecap firms) supports the "stock" oriented models, where changes in domestic economic activities, proxied by stock returns, lead to changes in demand for local currency, and hence, changes in exchange rates.

The results are interesting in that they point to the fact that global integration might be confined primarily to the large multi-national corporations. Since most of the previous re-

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