

An Empirical Study of the ‘Mystery of Currency Exposure’ with the Case of A-Share Listed Companies

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Given companies’ dynamic responses to expected exchange rate changes, this article improves on current methods of measuring exposure to foreign exchange rate changes by breaking down the spot exchange rate changes into expected changes and unexpected changes. The currency risk exposure coefficients resulting from an empirical analysis of 71 Shanghai Stock Exchange A-share listed companies on whose reported performance foreign exchange changes have a direct impact over a period from April 2006 to July 2009 have a high significance level, thus demonstrating a strong correlation between the value changes of A share listed companies and RMB exchange rate fluctuations. Unexpected changes to exchange rates measure the positive impact of RMB real appreciation on company value, whereas expected changes to exchange rates measure the negative impact of RMB real appreciation on that value. Because the influence of the RMB exchange rate on the value of A-share companies is asymmetric and complex, China should further accelerate the development of an optimal exchange rate management system, particularly at the micro-economic level, given the currency risk exposure of listed companies.

1. Introduction

With the increasing openness of the national Chinese economy, the impact of exchange rate changes on economic performance is becoming more obvious and increasingly important. At the micro-level of analysis, if all other conditions are the same, then the higher the proportion of a company’s international operations, the greater the effect of exchange rate movements on the company’s value. Similarly, the greater the magnitude of exchange rate changes, the more obvious it is when companies are operating under this influence. According to theoretical analysis, exchange rate movements not only affect a company’s current cash flow and profit margin through changes in the prices of raw materials and products, but also change the investment and financing structures and asset prices of listed companies because of investor anticipation of the company’s future

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cash flow and profit margin, and changes in the liquidity of the capital market. However, there is considerable domestic and foreign empirical analysis (Amihud 1994; Bodnar and Gentry 1993; Doidge 2006; Luo Hang and Jiang Chun 2007) that indicates that the impact of exchange rate changes on the asset prices of listed companies (exposure coefficient) is not significant. This issue is called “the mystery of currency exposure” (Bartram and Bodnar, 2005; 2008). Whether currency exposure is really important or whether it is the research methods used to study it that are responsible for the mystery is still a matter of debate. This paper attempts to improve on current empirical methods to clarify the issue.

Given companies’ dynamic responses to expected exchange rate changes, in this paper we improve on current methods of measuring exposure to foreign exchange rate changes by breaking down the spot exchange rate changes into expected changes and unexpected changes. The currency risk exposure coefficients resulting from an empirical analysis of Shanghai Stock Exchange A share listed companies on whose reported performance foreign exchange changes have a direct impact have a high significance level, thus demonstrating a strong correlation between the value changes of A share listed companies and RMB exchange rate fluctuations.

The remainder of this paper is arranged as follows. The second part is a literature review. The third part proposes an improved method of calculating currency risk exposure coefficients and describes reasonable business decision-making behavior and the quest to effectively measure enterprises that face a real risk of currency exposure based on the classification of exchange rate changes. The fourth part samples A-share listed companies, which are obviously affected by changes in foreign exchange rates, compares the measurement of currency risk exposure using different methods, and analyzes the currency risk exposure in terms of the expected and unexpected components of foreign exchange rate changes. The last part gives a summary of the paper.

2. Literature Review

Foreign exchange exposure studies can be traced back to the 1970s. The impact of exchange rate changes on firm value is defined by Shapiro (1974) and Dumas (1978) as a company’s “foreign exchange exposure.” In theory, this means that exchange rate changes directly affect a company’s cash flow and profitability by changing the prices of raw materials and the products of multinational enterprises in local currency, thus affecting the company’s market value. Adler and Dumas (1984) further distinguish between currency risk and currency risk exposure, positing that currency risk refers to changes in monetary value, whereas currency risk exposure is the volatility caused by exchange rate fluctuations in the value of a company. The identification of the concept of currency risk exposure strengthened concerns over the impact of exchange rate changes, but also generated the basic ideas on the issue of currency exposure.

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Jorion (1990) proposed that the present value of future cash flows as a measure of the variable value of a company could be represented by the stock price, which laid a good foundation for subsequent empirical econometric research on currency risk exposure and gradually led to the emergence of a body of literature. Bartov and Bodnar (1994)

added the market return R_m to the analysis of the mutual relations between exchange rate movements and the rate of return on stocks, and obtained a specific numerical model that measured the currency risk exposure coefficients. The basic equation was

$R_j = \alpha_j + \delta_j \times R_x + \beta \times R_m + \varepsilon_j$, where R_j is the return on capital of company j, R_x is the

percentage change in the exchange rate, R_x is a constant, R_m represents the stock

market return, and ε_j is the error. The degree of currency risk exposure is then

measured by the exchange rate volatility coefficient δ_j , which reflects the changes in company profitability that can be explained by spot exchange rate fluctuations, after adjustment for the market rate of return.

However, most empirical research thus far has found that currency risk exposure coefficients are not statistically significant, which contradicts the theoretical analysis. For example, Jorion (1990) chose 287 U.S. multinational companies as the target and used data for the 1971-87 period to conduct a regression analysis, and found only a 5.2% currency risk exposure among the sample companies at the 5% significance level. In a similar study of U.S. companies, Amihud (1994) chose 32 companies identified as the "top 50 exporters" by Fortune magazine in the 1982-1988 period as a sample, and found that the companies' currency risk exposure could not be identified at a suitable level of statistical significance. In a study of companies' currency risk exposure across several countries, Bodnar and Gentry (1993) found that only 23% of companies had significant currency risk exposure (at the 10% significance level) across sub-sectors in the United States. In Canada and Japan, which are more open and export-oriented, only 21% and 25% of industry currency risk exposure was found to be significant, respectively. Doidge (2006) and Griffin and Stulz (2001) similarly found only a weak relationship between the spot exchange rate changes and price changes.

Bartram and Bodnar (2005) posited the currency risk exposure mystery as the reason for the insignificance of such exposure, rather than problems with the methods used in empirical studies, such as the selection of samples or periods, because a company can hedge this risk by means of operational and financial methods, thus leading to endogenous results. The currency risk exposure in empirical analysis is the net value after hedging, which ignores the fact that companies can reduce their currency risk exposure during operations by anticipating this risk. Companies with high levels of risk exposure in particular will usually show even multiple sets of hedging means. Christopher (2006) found that company managers expect a few instances of exchange

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rate changes, and make the appropriate response in capital allocation to achieve profit maximization. The financial market itself can also hedge the currency risk caused by unexpected exchange rate movements. However, these interpretations do not specify what methods could be used to improve the empirical testing of currency risk exposure.

In recent years, Chinese research on currency risk exposure has followed the aforementioned popular empirical methods. Wei and Qiang (2007) analyzed companies' currency risk exposure during the exchange rate reform in 2005 by selecting 67 companies listed on the Shenzhen Stock Exchange that already had export revenue as their sample and examining the size of the currency risk exposure coefficient and sign. They found at a 10% significance level that seven companies had a coefficient with a positive sign (negative effect) and 12 had a coefficient with a negative sign (positive effect), which cumulatively means that 28% of the risk exposure was significant. Hang and Chun (2007) conducted an empirical analysis of the currency risk exposure of companies in the Shanghai A-share market after the exchange rate reform in 2005, and concluded that 12.6% of the listed companies benefited from the appreciation of the RMB and 4.3% were negatively affected. However, only 17.1% of all companies had significant exposure risk (10%). The conclusions of the two studies are similar to those of foreign empirical analyses.

Whether the issues surrounding currency risk exposure are due to errors in the theoretical logic or the failure of the existing methods of empirical analysis is the subject of debate. Observations of real economic operation indicate that the latter answer is undoubtedly the correct one: the current international financial crisis has been an impressive wake-up call. It is difficult to explain why in an open economy the presence of currency risk exposure is denied. The authors believe that the mystery of currency risk exposure, which has been extensively discussed, exists simply because existing tests of such exposure have serious flaws. For example, most studies simply take spot exchange rate changes into account when examining changes in the value of a company, which underestimates the degree of currency risk exposure in real economies. Based on this reasoning, we hypothesize:

H1: The currency exposure exists when better methodology is used to test it, and the key point is how to measure the change of exchange rates in real life.

Given the premise that management and allocation functions in the market are rational, currency risk exposure should rather be measured based on the classification of exchange rate changes, and the real exchange risk exposure coefficient should be measured from the perspective of unexpected exchange rate changes to generate more reasonable policy conclusions. Formally:

H2: Unexpected exchange rate changes are more suitable than expected ones for measuring real exchange risk

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exposure coefficients.

The opening up of China's economy is continually expanding and deepening, and the relationship between the operating conditions of companies and the RMB exchange rate is clearly becoming closer. Since the initial opening up of its economy, China has conducted several significant exchange rate system reforms. Now, the basic formation is a manageable floating exchange rate system, and the effects of market supply and demand changes on the RMB exchange rate are becoming evident. It is foreseeable that the importance of the accidental or unpredictable aspects of the RMB exchange rate will gradually increase. On the one hand, there will inevitably be fluctuations in national economic development, which may cause changes in the RMB exchange rate. On the other hand, other countries in the world economy are also changing, and there are many uncertain factors that will inevitably lead to exchange rate fluctuations. Considering the complexity of the international financial markets, future changes in the RMB exchange rate are likely to be much more uncertain. The risk of exchange rate movements and currency risk exposure thus merit study.

3. The Conceptual Framework and Empirical Model

Direct observation of exchange rate changes is usually achieved through spot exchange rate movements, which are very complex in substance. According to the efficient market theory, changes in price tend to reflect a range of integrated market information, and spot exchange rate changes can and should be regarded as the result of a combination of different market information, which has complex effects on the market. Here, spot exchange rate changes that can be directly observed are defined as the nominal exchange rate, which is then split into expected and unexpected exchange rate movements. According to theory, different types of exchange rate changes have different effects on corporate behavior, and thus bring different forms of currency exposure risk. We believe that the nominal exchange rate movement is insufficient as a standard measure of the nominal currency risk exposure, and that it is irrational to only use this indicator. It is more reasonable to measure the true comprehensive currency risk exposure with a combination of different methods.

3.1 Classification of Exchange Rate Changes Based on Expectation

Spot exchange rate changes are similar to changes in commodity prices, and to a certain extent are regarded as expected results. This is because an expected spot exchange rate itself can cause changes in the exchange rate, which means that changes in the spot exchange rate are, to some extent, predictable. Of course, some spot exchange rate changes are unpredictable. Based on this assumption, we take the logarithm of the spot exchange rate (local currency/foreign currency) and decompose it into expected and unexpected changes, as expressed by the formula

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$$\ln x_t = \ln e_t + u_t, \quad (1)$$

$$\ln e_t = \ln e_{t-1} + \varepsilon_t, \quad (2)$$

where $\ln x_t$ is the logarithm of the observable spot exchange rate changes (or the nominal exchange rate) and $\ln e_t$ is the logarithm of the expected exchange rate movements. It is assumed that equation (2) follows a stochastic trend and a random walk process without drift. Unexpected changes u_t and the impact of changes ε_t are unrelated, and are subject to $N(0, \tau_t^2)$ and $N(0, \sigma_t^2)$. The assumption of normal distribution means that there is a high probability of observing small changes and a low probability of observing a high variance resulting from long-term value changes.

In a real economy, companies often make the appropriate decomposition of changes in the spot exchange rate objectively, and adjust their corporate decision-making accordingly. For example, when making decisions, enterprise managers, at least in part, have their own expectations of changes in the exchange rate, and act accordingly to maximize profits, rather than simply and negatively accepting an overall change in the nominal exchange rate. Nominal exchange rate movements and expected exchange rate changes can be easily observed in business management decision-making. This is because spot exchange rate movements reflect both fundamental changes and temporary deviations from the fundamental value. When managers think that changes are fundamental, they will adjust their decisions on capital structure. However, for unexpected exchange rate changes caused by installments and temporary delays in delivery, a company may prefer to use financial products rather than adjusting decisions about capital structure.

3.2 Expected Exchange Rate Changes and Company Value

With reference to Bartram and Bandar's explanation for the mystery of currency risk exposure, we consider companies that participate extensively in international trade. Management goals for these companies are based on known information and current conditions, and seek to maximize the present value of profits. Assuming that a company's technology is in line with the Cobb-Douglas function, where K_t is capital stock, I_t is physical investment, E_t is the expected exchange rate change based on information during period t , β is the discount factor, e_t is the expected exchange rate change, P_t is the price of output, and P_I is the price of new investment, the company's greatest value is

$$V_t = E_t \left\{ \sum_{i=0}^{\infty} \beta^i \left[e_{t+i}^r P_{t+i}^r A_{t+i} K_{t+i}^\psi - P_{t+i}^I I_{t+i} \right] \right\}. \quad (3)$$

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Assuming the profit function $\pi_t = e_t P_t T K_t^\alpha L_t^\zeta - w_t L_t$, short-term profit maximization maximizes the output of the labor input, where T and w are the technology and wage rate, respectively, relative to L. Going back to the profit function, we obtain

$\pi_t = e_t^r P_t^r A_t K_t^\psi$, where $\gamma = \frac{1}{1-\zeta}, \psi = \frac{\alpha}{1-\zeta}$, $A_t = (\zeta T / \omega_t)^{\zeta\gamma} - w_t (\zeta / w_t)^\gamma > 0$ for integrated technology, and can prove that the value of A is positive and non-random.

All other conditions being constant, to maximize the value of the company is to maximize the use of capital. The usage scale of capital is thus

$$K_t = (1 - \delta)K_{t-1} + I_{t-1}, \quad (4)$$

where δ is the capital depreciation rate, assuming that investment costs are incurred in the current period but will turn to output in the next period. This time lag means that the company cannot immediately adjust the capital structure to respond to changes in supply and demand and problems of delivery delay, and the current investment decision-making determines the capital structure of the next phase. However, management can make appropriate forecasts of changes in the future exchange rate and adjust current investment to influence the size and structure of capital. By substituting (4) into (3) and including the unit output prices, we can derive the largest investment.

According to equations (1) and (2), ε_t is defined as a noise signal effect on long-term exchange rate changes:

$$S_t = \log x_t - \log x_{t-1} = \varepsilon_t + \Delta u_t, \quad (5)$$

where Δu_t is the unexpected change in the nominal exchange rate movement.

Assuming signal S_t and other relevant information $E_t(\log e_t | S_t) - \log e_{t-1} = E(\varepsilon_t | S_t)$, and

using a signal extraction formula for the variance, we can obtain $E(\varepsilon_t | S_t) = \lambda_t S_t$, where the signal to noise ratio is

$$\lambda_t = \frac{\sigma_t^2}{\sigma_t^2 + \tau_t^2 + \tau_{t-1}^2}$$

Let

$$n_t = \frac{\gamma^2}{2} [\sigma_{t+1}^2 + (1 - \lambda_t) \sigma_t^2] + m_{t+1}$$

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Finally, the profit growth ratio can be expressed as

$$\log \frac{\pi_{t+1}}{\pi_t} = \gamma \varepsilon_{t+1} + \frac{\gamma \psi}{1-\psi} [\varepsilon_{t-1} + \lambda_t S_t - \lambda_{t-1} S_{t-1}] + \frac{\psi}{1-\psi} \Delta n_t + \log \frac{A_{t+1}}{A_t}. \quad (6)$$

The conclusion from equation (6) is that changes in corporate profits can be divided into four parts. The first part comprises the company revenue directly affected by expected exchange rate changes, and the second part is the company revenue that is directly affected by unexpected exchange rate changes. The third and fourth parts are the effects resulting from changes in costs and technology. To simplify the analysis, it is assumed that the impact of changes in cost and technology is constant, and that the effects of expected and unexpected exchange rate movements on firm value are concentrated. This gives a new measurement for the indicators of currency risk exposure.

3.3 Currency Risk Exposure Measure Based on Expected Changes in Exchange Rate Movements

Current empirical research on currency risk exposure regards spot exchange rate change as a direct indicator for the calculation of the relevant parameters. Obviously, this gives a nominal value for currency risk exposure. However, it may be that defects in the logic of this approach have caused the failure to generate statistically significant results. The analysis in the previous section indicates that spot rate changes result from a complex signal. After a company has made a forecast of future exchange rate movements, it will take appropriate measures to reduce its currency risk exposure. Thus, the empirical measurement of currency risk exposure factors must take exchange rate expectations into account, but focus also on observations of the unexpected coefficient of currency risk exposure. Here, the measures of currency risk exposure proposed by Bartov and Bodnar (1994) and others are transformed, which allows us to construct the following empirical model.

$$R_{it} = \alpha_{1i} + \beta_{1i} Rmkt_t + \beta_{2i} EX_t + \beta_{3i} UN_t + e_{it} \quad t=1, \dots, T. \quad (7)$$

Here, R_{it} is the rate of return on company i in period t , α_{1i} is the constant term, $Rmkt_t$ is the rate of return on the current market portfolio, EX_t is the expected exchange rate movement, and UN_t is the unexpected exchange rate movement. The exchange rates used are direct quotations, that is, they are the RMB per dollar price. e_{it} is a random error for part of the period t . The parameter β_{2i} obtained from the regression analysis is the expected currency risk exposure coefficient of company i , and β_{3i} is the unexpected currency risk exposure coefficient, both of which reflect the sensitivity of the company's stock return to different types of exchange rate changes. By making these changes to the model, we believe that the conclusions drawn from the analysis will be more consistent with theoretical studies. At the same time, the model should better measure

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companies' real currency risk exposure, which will lead to more reasonable policy recommendations.

4. Data Sources and Empirical Results

4.1 Main Sources of Data

Rate of return on company R_{it} . The sample of listed companies is obtained through three steps. First, we select non-financial companies from the Shanghai and Shenzhen 300 Index whose "exchange rate changes on cash" in their cash flow statement is non-zero. This includes positive or negative effects of exchange rate changes on cash flow, and means that we include only sample companies on which it is clear that exchange rate changes have had an impact. From the Wind database, we select the closing price P_{it} (where i denotes firm i and t represents the month t) on the last trading day of each month from April 2006 to June 2009, which gives 38 months of data. We then use a differential equation with a logarithmic P_{it} , $R_{it} = \ln(P_{it}) - \ln(P_{it-1})$, to obtain the companies' rates of return. Finally, we examine the time series R_{it} with the ADF unit root stationery test to identify 71 companies with a t value of less than the 5% critical value, and generate a steady sequence for the empirical analysis. These 71 companies are involved in a range of industries, including transport, engineering construction, railway infrastructure, wine and food, computers, aerospace, finance, building materials, transport and logistics, pharmaceuticals, machinery, steel, real estate, coal, education, media, and other areas.

Market portfolio return, $Rmkt_t$. From the Wind financial information terminals, we obtain the closing price $Pmkt_t$ of the monthly market index (Shanghai and Shenzhen 300 Index) from April 2006 to June 2009, a total of 38 months. We then use the Log function on $Pmkt$ and the differential equation $Rmkt_t = \ln(Pmkt_t) - \ln(Pmkt_{t-1})$ to calculate the corresponding market rate of return. After examining the market rate of return for the time-series data with the ADF unit root test, we find that t equals -27.32, or less than -3.44 at the 1% significance level, which means the series is stable.

Spot exchange rate change, $Spot_t$. The spot exchange rate SX_t is regarded as the closing price of the middle quotation of the RMB against the US dollar, as directly quoted in the Exchange Database of the Bank of China. t represents t months. The period also runs from April 2006 to June 2009. Taking the log function of $\ln SX_t$, the percentage change in the spot exchange rate is $Spot_t = \ln(SX_t) - \ln(SX_{t-1})$. We also examine $spot_t$ with the ADF unit root test, and find a t value of -11.1, less than the value at the 1% significance level, which means that the series is stable.

Expected exchange rate changes, Ex_t . Part of the expected exchange rate changes can be reflected by the previously used measure of forward premium/discount (Harris, Marr

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and Spivey 1991; Choi and Prasad 1995), where expected exchange rate changes in period t can be reflected by the premium/discount $(FX_{t-1} - SX_{t-1})/SX_{t-1}$ in period $t-1$.

The Bartov and Bodnar (1994) currency risk exposure equation is $R_{it} = \alpha_{ii} + \beta_{1i}Rmkt_t + \beta_{2i}spot_t + e$, $t=1, \dots, T$. From this, we obtain $Ex_t = (FX_{t-1} - SX_{t-1})/SX_{t-1}$, where

the forward rate FX_t is the closing price of the six-month forward rate directly quoted for the RMB against the US dollar as obtained from the Foreign Exchange Database of the Bank of China for the September 2005 to March 2009 period (corresponding to the spot exchange rate from April 2006 to June 2009 after six months). After examining Ex_t with the ADF unit root test, we obtain a t value of -31.74, which is less than -3.44 at the 1% significance level, indicating that the series is stable.

Unexpected exchange rate movements, Un_t . It is important for the signal extracted from white noise in the ARIMA process (Fang and Loo 1994) to be representative, which involves extracting residuals in the changes in the spot exchange rate from April 2006 to June 2009. To do this, we first examine the data with the ADF (Dickey-Fuller 1979) unit root test as a stationary test. The basic test equation includes the intercept, and takes the first order difference of S_t ($d = 1$). The selected lag term follows the AIC and SC criteria. We then make judgments according to the graphics of the autocorrelation and partial autocorrelation function. Taking the first order difference on S_t , the selected lag coefficient of 16, and the results of the correlation function (ACF) and partial autocorrelation function (PACF), we estimate the value with the ARIMA process. The resulting data, including the constant term and all of the coefficients, are no greater than the value at the 5% significance level. Finally, for the residual test, we follow the "Correlogram-Q-statistics" method and select the lag order 36. The Q statistic is then 1.8 and the P value is 0.18, and thus we cannot reject the null hypothesis, which indicates that there is no significant autocorrelation in the residuals (the test process is lengthy and is omitted for the sake of brevity, but is available upon request from the authors).

4.2 Analysis of Empirical Results

We use the improved model, which decomposes the exchange rate changes into expected and unexpected parts (Equation 7), to measure the currency risk exposure of A-share listed companies, our results are consistent with hypotheses 1 and 2 and the results show a good level of statistical significance. If the spot rate were regarded as an independent variable, then the results would not pass the statistical tests with the same data. For comparison, Table 1 shows the currency risk exposure coefficients of the A share listed companies with the two methods, from which it can be seen that among the 71 sample companies, only 13 (18.3%) of the companies have a nominal currency risk exposure coefficient less than the value at a significance of 5% level ($p < 0.05$), and only 19 (26.76%) companies' nominal currency risk exposure coefficient is less than the

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value at the 10% significance level ($p < 0.1$). The results are similar to those of previous empirical research in which the currency risk exposure was not significant. However the expected and unexpected currency risk exposure coefficients of 31 (18.3%) companies are less than the value at the 5% significance level. The coefficient for 41 (57.7%) of the companies is below the 10% level. These results pass the test according to the majority principle. The empirical results not only explain that the “mystery of currency risk exposure” is due to defects in the measurement, but also make some sense of the real situation.

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Table 1: Empirical results for the currency risk exposure of A share listed companies using different measurements

Model 1: Currency risk exposure coefficients calculated with spot exchange rates							
	Adjusted R ²	Currency risk exposure coefficients	T Value	P Value			
Mean	0.381	-2.369	-1.799	0.021			
Median	0.411	-2.317	-2.406	0.016			
Standard deviation	0.144	2.695	1.803	0.016			
Variance	0.020	7.266	3.250	0.00024			
Max	0.043	-9.202	-3.538	0.00042			
Min	0.589	2.090	3.529	0.047			
Number of companies significant at 5% level		13					
Number of companies significant at 10% level		19					
Model 2: Currency risk exposure coefficients calculated with expected and unexpected exchange rates							
	Adjusted R ²	Expected exchange rate changes			Unexpected exchange rate changes		
		Currency risk exposure coefficient β_{2i}	T Value	P Value	Currency risk exposure coefficient β_{3i}	T Value	P Value
Mean	0.390	0.711	-0.178	0.048	-2.396	0.089	-0.597
Median	0.392	0.728	-0.234	0.044	-0.597	1.842	0.022
Standard deviation	0.109	0.241	1.0288	0.028	1.9665	2.476	0.024
Variance	0.012	0.450	1.059	0.001	2.7448	6.132	0.00056
Max	0.049	-0.201	-3.542	0.009	-7.534	-3.675	0.00039
Min	0.540	1.715	3.615	0.049	3.368	3.629	0.047
Number of companies significant at 5% level			31				
Number of companies significant at 10% level			41				

Note: the significance level for the risk coefficient is 5%

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First, we find that there is a generally observed risk of currency exposure among A-share listed companies. The empirical results show that the majority of companies' currency risk exposure coefficients pass the significance test, and that the value of the correlation is relatively large. Regardless of whether expected or unexpected changes are used as the dependent variable, the changes in the value of A-share listed companies are very sensitive to exchange rate changes. For example, the average expected currency risk exposure coefficient β_{2i} is 0.711, the maximum is 1.715, and the minimum is -0.201. The average unexpected coefficient β_{3i} is -2.396, the maximum is 3.368, and the minimum is -7.534. The currency risk exposure coefficients pass the significance test with both dependent variables. To some extent, the data indicate that exposure to foreign exchange risk has become an unavoidable problem for A-share listed companies. However, generally speaking, the exposure to unexpected currency risk factors is greater than the expected risk, and the analysis indicates that the unexpected currency risk exposure better reflects the true coefficient of currency risk exposure, which means that the actual currency risk exposure faced by A stocks is not low.

Second, real RMB appreciation has a positive impact on A-share listed companies when unexpected exchange rate movements are used as the measurement. The empirical results show that the unexpected risk exposure coefficient β_{3i} is negative, and two thirds of the company coefficients are negative, which shows that the real appreciation of the RMB can increase the value of a company in general. Note that the quotation used in the empirical analysis is a direct quotation, where a negative number means that appreciation has a positive relationship with the return on assets. A large number of foreign (Booth and Rotenberg 1990) and domestic (Hang and Chun 2007) studies have found a similar result that currency appreciation helps to improve a company's value. The theory suggests that this is because the appreciation of the RMB helps to reduce the costs of imported machinery, equipment, and raw materials, which has a positive impact on the development of the real economy. The benefits are particularly obvious when a company focuses on the domestic market. However, the appreciation of the RMB may also enhance the market price of assets. Given China's promising economic prospects, RMB appreciation is likely to boost stock prices, and indeed this is easily observed in real life. Thus, most A-share listed companies will benefit from the real appreciation of the RMB.

Third, real RMB appreciation has a negative impact on A-share listed companies when the expected exchange rate movement is used as the measurement. The empirical results show that there is a positive relationship between expected currency movements and firm value (the mean β_{2i} is positive and most of the company coefficients are positive), and again due to the use of direct quotation, we can infer that the expected appreciation of the RMB has a negative impact on the growth value of A share listed companies. This is not difficult to explain in theory, and export orders constitute an example of this. At present, China's export products are primarily labor intensive. There is a considerable amount of processing trade, and the profits are quite modest. When there is a clear expectation of RMB appreciation, companies are more hesitant to accept

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orders, which impedes the future expansion of the production scale. Similar effects may also be observed with foreign investment and overseas project contracting. There is a great difference between the impact of the real appreciation and expected appreciation of the RMB. Put simply, the former has an impact on future business decisions, whereas the latter affects the changes in value in the process of operation.

To sum up, empirical studies suggest that there are two important characteristics of the impact of RMB exchange rate movements on company value. The first is complexity. In reality, changes in the spot exchange rate of the RMB affect the value of A-share listed companies through two mechanisms. In the process of appreciation, the magnitude and timing is to some extent unpredictable, but objectively the appreciation of the RMB can still enhance the market value of a company. Expected appreciation of the RMB will cast a company's future business decisions, such as export orders and overseas project contracting, into confusion. Thus, we should not simply regard the impact of RMB appreciation as negative or positive. A second consideration is its asymmetry. The parameters obtained from the empirical study show that the impact of unexpected exchange rate changes on firm value is significantly greater than expected (they are derived from the same equation and the same unit of measurement). That is, exchange rate changes have more effect on actual business processes, including greater uncertainty. Hence, the currency risk exposure arising from unexpected exchange rate changes better reflects the true risks that enterprises face.

5. Conclusions

An improved model, which decomposes the exchange rate changes into expected and unexpected parts, is used to measure the currency risk exposure of A-share listed companies, our results are consistent with hypotheses 1 and 2 and the results indicate the influence of RMB exchange rate movements on company value is quite important and complex, which to a large extent eliminates the "the mystery of currency risk exposure" identified in previous domestic and international research.

We empirically study A-share listed companies identified in their reports as being affected by foreign exchange changes. The results pass the significance test, and indicate that most listed companies face a high currency risk exposure, which in turn means that there is a close relationship between changes in company value and the RMB exchange rate. RMB appreciation has a positive impact on the value of a company when the unexpected exchange rate is used as the measurement. However, RMB appreciation has a negative impact on the value of the company when the expected exchange rate is used as the measurement.

The impact of spot exchange rate changes cannot and should not simply be judged as positive or negative, because economic operations have complex and asymmetric characteristics. The currency risk exposure of A-share listed companies offers a special

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perspective on RMB exchange rate mechanism reform and China's foreign exchange management policy at the micro-economic level. Policy formulation should thus take into account the expectation of RMB appreciation to avoid serious speculation resulting from a huge gap between expected appreciation and real appreciation, and to try to make the RMB exchange rate a reasonable market signal. To keep the RMB exchange rate relatively stable over a long period, policy-makers should strongly resist the pressure to allow the RMB to appreciate in a single step. At the same time, it is necessary to make the necessary preparations for RMB devaluation, such as accelerating the development of the Chinese foreign exchange market and providing financial instruments to allow enterprises to hedge currency risk exposure.

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