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The Impact of Capital Structure Adjustment in Cross-Border Mergers and Acquisitions on the Operating Performance of Chinese Listed Companies: Empirical Study Based on Ridge Regression

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Abstract: This research uses a sample of 44 Chinese listed companies that announced and completed cross-border mergers and acquisitions (M&A) in 2017 and builds a ridge regression model using indicators such as return on equity, asset-liability ratio and equity multiplier from 2016 to 2022 to explore the sustained impact of capital structure adjustments on their operating performance. We found that the adjustment of capital structure after cross-border M&A presents an *"N"* shaped relationship with operating performance. This indicates that debt financing in cross-border M&A activities can enhance financial leverage and profitability in the short term but may lead to a decline in performance in the medium term due to financial pressure and integration issues. In the long term, as integration completes and debt is gradually repaid, performance is expected to recover and improve. Additionally, we offer suggestions for companies planning to undertake cross-border M&A, advising careful management of liquidity and economies of scale, optimization of debt financing strategies and ensuring the stability of performance from a long-term perspective. This research not only fills the gap in the existing literature on the impact of capital structure adjustments on operating performance in cross-border M&A but also provides empirical evidence for companies to formulate scientifically reasonable cross-border merger and acquisition strategies.

Keywords: cross-border mergers and acquisitions, corporate finance, operating performance, ridge regression

1. Introduction

Cross-border mergers and acquisitions (M&A) refer to the purchase of some or all of the assets of a company of another country by a multinational corporation of that country through specific channels and payment methods for specific objectives. With the increase of international trade and the development of communication technology, the global economy has become more closely connected, and the cross-border M&A activities of Chinese companies have become increasingly active [1]. Cross-border M&A can not only help companies better participate in the global market and reduce their dependence on a single market to withstand regional economic fluctuations and political risks,

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but also enable companies to rapidly expand their scale, increase market share, reduce costs and realize economies of scale, which can help them gain a competitive advantage [2].

Cross-border M&A are often accompanied by adjustments in capital structure, including changes in debt levels and equity structure. It usually involves a large amount of debt financing, and if the company can effectively utilize these funds to increase earnings, financial leverage will improve the company's operating performance. Conversely, if the company is overburdened with debt, the increase in financial leverage can create financial risks for the company.

Due to the high transparency of information and stable operation status of listed companies, the conclusions drawn from the selection of listed companies as research cases are more general and reliable. Based on this background, this paper selects Chinese listed companies involved in cross-border M&A as the research object, and analyzes the impact of the adjustment of company capital structure on the company's operating performance after cross-border M&A through empirical research, so as to provide certain reference for companies intending to carry out cross-border M&A.

2. Literature Review

The impact of corporate M&A and capital structure on corporate operating performance has always been of great concern to academics, but the results of existing studies on the impact of corporate M&A on operating performance are not the same. Through empirical research, Anwei X. found that cross-border M&A can improve the operating performance of listed companies in China, but the impact gradually decreases over time [3]. However, Qianqiang L. et al. found that cross-border M&A could not improve operating performance, but rather lead to a decrease [4]. Interestingly, Liuhui C. and Tiancai X. found that within two years of M&A activities, most listed companies did not significantly improve their operational performance, and even showed that shareholders' interests were compromised, but from the third year onwards, the operating performance of the majority of companies began to rise [5]. A different perspective is provided by the study of Congcong G., he analyzed the M&A of listed companies in the retail industry as well as the operating performance of companies, and concluded that after the M&A of listed companies in the retail industry, their operating performance will be improved to different degrees, and the promotion effect of horizontal M&A on the operating performance of companies is more significant than that of vertical and mixed M&A [6], this finding contrasts with the findings of Liuhui C. and Tiancai X. Additionally, Lei L. et al. argued that the performance of China's listed companies in the year of M&A is better compared to the year before M&A, but in the following year, the operating performance has declined, it shows an inverted "V" shaped [7].

Regarding the research on the relationship between capital structure and company operating performance, scholars mainly focus on the two perspectives of equity structure and debt structure, and the results are still different. As early as in 2014, Taoufik B. and Ting L. through examining the impact of the adjustment of the capital structure of 850 U.S. companies on their operating performance five years after the M&A, found that leverage ratio moving towards the target leverage ratio of the acquirers exhibit increased performance after M&A activities, but the correlation is not significant in the long run [8]. Similarly, Jiamei J. found that there is no significant correlation between the debt structure of small and medium-sized listed companies and the return on net assets as well as the growth rate of the main business of the companies [9]. Meanwhile, some research has also concluded that there is a relationship between capital structure and operating performance. Ruimin Z. explores this question further from a different perspective, she suggested that in terms of debt structure, there is a significant negative correlation between the asset-liability ratio variable and company operating performance, but in terms of equity structure, there are differences in the impact of different shareholder shareholding ratios on company operating performance [10].

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It can be seen through the above literature combing that corporate M&A has a certain impact on its operating performance, and there is also an interactive relationship between corporate capital structure and operating performance. However, the current research on the impact of capital structure adjustment on the operating performance of company in cross-border M&A is still imperfect, so this paper will be based on the empirical method to study this impact, to make up for the gaps in the existing literature.

3. Research Design

In this section, we will elaborate on how to explore the impact of cross-border M&A on the capital structure and operating performance of Chinese listed companies through empirical research methods.

3.1. Sample Selection and Data Sources

We use the Zephyr database to collect company cross-border M&A information, including the companies of both parties involved in cross-border M&A, the dates of announcing and completing the M&A, as well as the type of M&A and the value of the business. Since the impact of minority share M&A business on the capital structure of companies is small and negligible, this study chooses Chinese listed companies whose transaction value in M&A transaction business is more than 1 million dollars and does not involve the business of acquiring a very small number of shares as the object of the study.

We obtain the financial data of listed companies through Choice Financial Terminal database, such as the company's asset-liability ratio, operating income, and return on assets. In view of this, we select 44 Chinese listed companies such as China Shipbuilding Industry Company Limited, Hundsun Technologies Inc., and China Meheco Group Co., Ltd., which announced and completed cross-border M&A activities in 2017, as the research objects, we analyzes the sustained changes of their capital structure and operating performance in the five years after completing the cross-border M&A in order to explore the impact of the adjustments of the capital structure of cross-border M&A on the company's operating performance.

3.2. Variable Selection

In this study, we select the return on equity (ROE) as an explanatory variable to measure the performance of a company after a cross-border M&A. ROE reflects the ratio of a company's net profit to its shareholders' equity, which provides a direct measure of a company's profitability. High ROE is often regarded as a sign of high operating efficiency and maximization of shareholder value. By selecting the asset-liability ratio and equity multiplier as explanatory variables, the capital structure of the company can be reflected from different perspectives. Asset-liability ratio is the ratio of corporate liabilities to total corporate assets, reflecting the level of corporate indebtedness. Equity multiplier is the inverse of the ratio of shareholders' equity, which can reflect the share of shareholders' equity in total assets. In order to prevent the influence of other variables that may affect the dependent variable on the results of the study, we choose the company's current ratio and company size as the control variables to ensure the reliability of the study. And to quantify the company size, we choose the business income indicator.

3.3. Research Hypothesis

Based on the previous analysis of the existing literature, we propose the following hypotheses on the relationship between capital structure adjustment and operating performance in cross-border M&A.

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Hypothesis H1: There is an "N" shaped relationship between capital structure adjustment in cross-border M&A and operating performance.

Hypothesis H2: There is no significant relationship between capital structure adjustment in cross-border M&A and operating performance.

Hypothesis H1 is based on the analysis of existing literature, that the adjustment of capital structure in cross-border M&A can bring positive financial impact for companies in the short term, but this impact may not be able to exist in the long term, and the adjustment of capital structure may lead to the trend of the company's operating performance to first increase, then decrease and then increase.

Hypothesis H2 is based on the MM theory proposed by Modigliani and Miller, which argues that under certain ideal conditions, the value of a company is not affected by its capital structure. The value of a company depends only on the cash flow of its operating activities and not on the way it is financed.

3.4. Model Design

In order to reflect the changes in company operating performance before and after the cross-border M&A business, this paper takes T_0 (2016), the year prior to the completion of the M&A, as the baseline time for the study, and the year in which the cross-border M&A is completed (2017) is denoted as T_1, 2018 is denoted as T_2, and so forth, the year 2022 is denoted as T_6.

The changes in the capital structure of the companies are first measured by using the values of the changes in the asset-liability ratio (ALR) and equity multiplier (EM) in the first year of the completion of the cross-border M&A operations (T_1) in comparison with the year T_0, before the M&A took place. Then use the difference between each year's return on equity (ROE_T) and the ROE value in year T0 as a measure of the change in the company's operating performance. The variables defined as follows.

$$\Delta ALR = ALR_{T1} - ALR_{T0} \tag{1}$$

$$\Delta EM = EM_{T1} - EM_{T0} \tag{2}$$

$$\Delta ROE_T = ROE_T - ROE_{T0} \tag{3}$$

To verify the short-term and long-term effects of capital structure adjustment on the operating performance of companies after cross-border M&A business, the model is established as follows, in which return on equity (ROE) is the explanatory variable, asset-liability ratio (ALR) and equity multiplier (EM) are the explanatory variables, current ratio (CR) and company size (CS) are the control variables. α is the constant term, and β1, β2, β3 and β4 denote the coefficients corresponding to the variables, and ε denotes the error term.

$$\Delta ROE_T = \alpha + \beta_1 \Delta ALR + \beta_2 \Delta EM + \beta_3 CR_T + \beta_4 CS_T + \varepsilon \tag{4}$$

In this study, we mainly analyze the impact of capital structure changes on company's operating performance in the year in which a cross-border M&A is completed (T_1) compared to the year prior to the completion of the M&A (T_0). It is mainly categorized into the short-term impact in the year of completing the M&A (T_1) and the first year (T_2), the medium-term impact in the second year (T_3) and the third year (T_4), as well as the long-term impact in the fourth year (T_5) and the fifth year (T_6) after completing the cross-border M&A. We will regress the cross-sectional data of each year separately and determine the impact of capital structure adjustment on post-merger operating performance through the coefficients.

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4. Empirical Analysis

In this section, we evaluate the immediate and long-term effects of cross-border M&A on companies' operating performance based on the above model. And we employ ridge regression to deal with the problem of multicollinearity, by providing a robust analytical framework to reveal insights into the relationship between cross-border M&A on companies' adjustment of capital structure and their operating performance.

4.1. Descriptive Statistic

The core financial indicators of return on equity (ROE), asset-liability ratio (ALR) and equity multiplier (EM) of 44 listed companies have changed significantly compared to 2016 after they completed cross-border M&A operations in 2017. The average values of the core indicators over the years during the study period are shown in Table 1, and the trend graph of ROE is shown in Figure 1.

Table 1: Average of core indicators between 2016-2022.

	2016	2017	2018	2019	2020	2021	2022
ROE	0.0010	0.0922	0.0592	0.0887	0.0635	0.0485	0.0496
ALR	0.3721	0.4104	0.4166	0.4160	0.4233	0.4367	0.4385
EM	1.8815	1.9152	1.9083	1.8828	1.9977	2.1731	2.8049

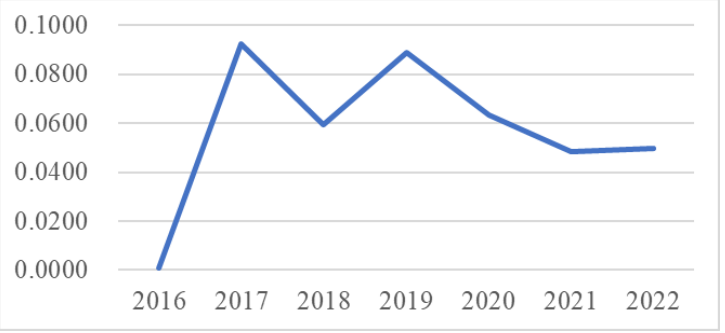

Figure 1: Trend of ROE.

The average ROE value of listed companies was 0.0010 in 2016, which was almost close to zero, and the ROE improved to 0.0922 in 2017.As shown in Figure 1, the ROE improved significantly from 2016 to 2017, while the change was not significant in the years after 2017. It indicates that the operating performance of companies was significantly improved in the year of completing M&A activities, and then fluctuated. The average value of ALR increased from 0.3721 in 2016 to 0.4104 in 2017, which shows that companies increased the proportion of debt financing in the process of cross-border M&A and improved their financial leverage. The average value of EM in 2017 was 1.9152, which was higher than that in 2016, meaning that although the debt of companies increased in cross-border M&A, the growth of their shareholders' equity was also relatively stable, maintaining relative financial soundness.

4.2. Multicollinearity

The magnitude of Variance Inflation Factor (VIF) measures the multicollinearity relationship between the variables, and it is usually considered that when VIF is greater than 10, the variables have a strong covariance problem. The multicollinearity test was conducted by SPSS software on the

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cross-sectional data for each year from 2017 to 2022, and it was found that there was a serious multicollinearity between the variables in each year's cross-sectional data. In order to solve the problem of multicollinearity, the data will be analyzed in this paper using regression by Ridge Regression. Ridge regression can reduce the estimated values of parameters by introducing regularization terms (ridge parameters), thus reducing the impact of covariance.

The principle of ridge regression is that when a system of linear equations has a unique solution at some matrix X, the solution can be found by solving $X\beta = Y$, where $\beta = (X'X)^{-1}X' Y$. Where X is the known coefficient matrix, Y is the outcome matrix, $X'$is the transpose matrix of X, and β is the ordinary least squares estimator in linear regression. However, if the coefficient matrix is not invertible, then it needs to be made invertible by adding a nonzero constant KI (where I is the unit matrix and K is the ridge regression parameter) to $X' X$. The estimated equation for ridge regression is:

$$\beta = (X'X + KI)^{-1}X'Y \tag{5}$$

The advantage of ridge regression over ordinary least squares is that it is able to solve the covariance problem while keeping all the variables without losing any information. Therefore, in this study, we will employ the Scikit-learn library in Python to perform ridge regression and the best ridge parameters will be selected through cross-validation to obtain better model performance.

4.3. Analysis of Ridge Regression Results

To perform ridge regression, we firstly divided the data into training and test sets in the ratio of 0.2:0.8, which was to construct and evaluate the model on an independent training set. Secondly, 95% confidence intervals of the ridge regression coefficients were estimated by Bootstrapping method to test the significance of the coefficients of the independent and control variables at 95% confidence level. Finally, the predictive performance of the model was assessed using Root Mean Square Error (RMSE) and Mean Absolute Error (MAE), and smaller RMSE and MAE values indicated good predictive performance of the model.

The results of the cross-section data ridge regression for the year in which the company completed its cross-border M&A and five years after its completion are presented in Table 2. From the regression results, it can be seen that the coefficients of the variables are all significant at the 95% level, and the RMSE and MAE values of the model are small, indicating that the model can well reflect the impact of the adjustment of the capital structure of a company's cross-border M&A on its operating performance.

Table 2: Results of Ridge Regression.

	T1	T2	T3	T4	T5	T6
α	0.1028	0.0730	0.0935	0.0956	0.0466	0.0483
β_1	0.0090 [-0.0810, 0.1080]	0.0765 [-0.0572, 0.2712]	-0.0313 [-0.1687, 0.1259]	-0.0219 [-0.1375, 0.1323]	0.0266 [-0.0502, 0.2878]	0.0254 [-0.0886, 0.3006]
β_2	0.0208 [-0.2787, 0.1360]	0.1215 [-0.4376, 0.1188]	-0.004 [-0.3316, 0.2497]	-0.0179 [-0.3360, 0.2035]	0.0927 [-0.6073, 0.0609]	0.0654 [-0.5602, 0.1509]
β_3	0.0283 [-0.0309, 0.0399]	0.0453 [-0.009, 0.1016]	0.008 [-0.0568, 0.1660]	0.0018 [-0.0456, 0.0679]	0.0508 [-0.0178, 0.2120]	0.0566 [-0.0275, 0.2453]

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Table 2: (continued).

β_4	0.01525 [-0.0281, 0.0429]	0.0329 [0.001, 0.1238]	0.0202 [-0.0238, 0.0740]	0.0226 [-0.0496, 0.0989]	0.0422 [-0.006, 0.1594]	0.0383 [-0.0201, 0.2294]
Ridge parameter K value	0.01842	0.0293	0.0017	0.3017	0.0737	0.0821
RMSE	0.1527	0.2467	0.0685	0.3534	0.1646	0.1284
MAE	0.0825	0.1512	0.0660	0.1898	0.1221	0.1016

Note: β_1,β_2,β_3,β_4 are the coefficients of the variables ALR, EM, CR, and CS, respectively, and the 95% confidence intervals of the coefficients are listed in [ ]

As can be seen from the results in Table 2, both control variables, current ratio and company size, positively affect return on net assets during the study period, which is in line with the economic significance. For the liquidity ratio, companies with high liquidity ratios are better able to withstand short-term business risks and maintain stable operations, which provides for sustained profitable activities. In addition, good liquidity gives companies the ability to invest in favorable growth opportunities during M&A activities, which can help increase operating income and profits. For the size of the company, high operating income indicates that the company performs well in the market and is able to efficiently convert its products or services into revenues, and with the completion of cross-border activities, the company can increase its profitability and return on net assets by realizing economies of scale.

From Table 1, it is known that both asset-liability ratio and equity multiplier have increased after cross-border M&A, so both ΔALR and ΔEM are positive. Through the regression results, it is found that in the year of completing cross-border M&A (T1), there is a positive and significant relationship between the increase in the gearing ratio or equity multiplier and the company's return on net worth, and this positive effect lasts until the first year after the completion of the M&A (T2). In cross-border M&A, companies usually raise funds by issuing bonds, loans, or other forms of debt instruments to pay acquisition consideration, repay debt, and other operations, and companies can realize earnings growth in the short term with lower-cost debt capital.

From the regression coefficients of T3 and T4, the increase in asset-liability ratio or equity multiplier has a negative impact on the return on equity of companies. This is due to the fact that the second and third years after the completion of cross-border M&A belong to the integration period of M&A, and companies face a series of problems such as business conflicts, cultural differences and so on will lead to a decline in operational efficiency. In addition, after the financial leverage effect is weakened in the initial period, the medium-term may need to face larger interest payments and principal repayments, which affects the net profit and return on net assets of the company.

In terms of the long-term impact, the coefficients of the independent variables are significantly positive at both T5 and T6, indicating that with the gradual repayment of debt, the financial cost is reduced, combined with the improvement of the company's operating efficiency, ROE can be improved. In addition, over time, if the companies can successfully solve the problems during the integration period, realize business synergies, and improve management efficiency and market competitiveness, profitability and ROE of the companies will be improved in the long run.

5. Conclusion

By analyzing the sustained changes in the capital structure adjustments of 44 listed companies in completing cross-border M&A on their operating performance five years after completing their cross-border M&A operations, we find that the asset-liability ratios and equity multipliers of the companies

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show an upward trend after conducting cross-border M&A, reflecting the increase in the proportion of debt used by the companies to raise capital. In the year conducting the cross-border M&A business and first year after that, the increase in debt capital has a positive impact on the return on net assets. However, in the second and third years after the completion of the M&A, the cost of debt incurred at the time of the M&A and the integration problems have a negative impact on the company's operating performance. With the passage of time and the gradual repayment of debt, the return on equity of the company is expected to increase gradually.

Therefore, we accept the research hypothesis H1 that capital structure adjustment in cross-border M&A can have an "N" shaped impact on the future operating performance of companies.

We also propose relevant recommendations for enterprises that need to conduct cross-border M&A business. Firstly, when conducting cross-border M&A, companies should ensure that they have sufficient liquidity to cope with the short-term business risks that may be encountered in the process of M&A [11]. They should also assess whether they can achieve economies of scale after cross-border M&A to improve efficiency and profitability. Secondly, companies should optimize their debt financing strategies and effectively manage debt costs by formulating medium and long-term financial planning to cope with problems that may arise during the post-merger integration period. Additionally, companies can also reduce their reliance on debt financing by exploring diversified financing channels, such as equity financing and internal retained earnings. Finally, companies should take proactive measures after a cross-border M&A to focus on maintaining and growing the stability of company performance. This includes an effective integration plan, continuous financial monitoring while focusing on the multicultural integration of the company with the foreign company and strategic planning of the international market to adapt to the changing global economic environment and adjusting the strategy to meet the challenges when necessary to sustain value creation.

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