The Potential Risk and Investment Analysis of China's Automobile Industry in the Context of Financial Crisis

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Abstract: In 2008, there came the striking financial crisis in the United States, which has exerted a huge negative impact on the stability of world economy. China's automobile industry, which serves as pillar of China's economy, was inevitably affected by the financial crisis. This passage, taking advantage of the stress test, respectively brings in possibility of default as well as Tobin's Q as stress factors and analyses the potential risk and investment prospect of China's automobile industry by making use of econometric and economic knowledge.

Key words: Financial Crisis; Stress Test; Tobin's Q; Value of asset; KMV model

1. INTRODUCTION

In 2008, there triggered the world-wide financial crisis, which has exerted negative impact on the global economy. China's automobile industry was inevitably affected in this crush. At the global dimension, the impact of financial crisis has spread from virtual economy to substantial economy, and the impact on substantial economy can be judged by consumption. The consumption can fall into two categories, one is daily consumption, and the other is free consumption. When economy is in boom, free consumption is large; while when economy is in recession, the free consumption will shrink significantly. Therefore, Auto sector which contribute a lot to the free consumption will be inevitably affected by the financial crisis. In order to further analyze the potential risk and investment prospect, this paper makes use of method of stress test by taking PD and Tobin's Q as stress factors, selecting several risky factors; tentatively measures the impact of financial crisis on the auto industry of China.

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2. THE SELECTION OF STRESS FACTORS

2.1 Possibility of Default (PD)

2.1.1 The generalization of KMV model

Secure the PD of China's auto industry by taking advantage of KMV model. In KMV model, the credit risk of a loan is determined by the market value of debtor's assets. While the debtor's assets are not actually traded in market, therefore, Black-Scholes equations are brought in to calculate the value and volatility of assets. With above-mentioned 2 variables PD could be deduced. PD gives out a measure of the possibility that a debtor goes bankruptcy. In details, the deduction of PD can be divided into the following steps:

First of all, calculate the value and volatility of the assets by use of Black-Scholes model:

$$E = AN(d_1) - De^{-rT}N(d) \quad (1)$$

$$d = \frac{\ln(A/D) + (r - \frac{\delta^2}{2})}{\delta\sqrt{T}} \quad (2)$$

$$d_1 = \frac{\mathrm{Ln}(A/D) + (r + \frac{\delta^2}{2})}{\delta\sqrt{\mathrm{T}}} \quad (3)$$

$$\sigma_E = \frac{N(d_1)A\sigma_A}{E} \quad (4)$$

E the market value of equity

A the market value of assets；

σ_A the volatility of assets（standard deviation）；

σ_E the volatility of equity value

D the value of debt；

r the risk less interest rate；

τ period of time；

In addition, calculate the distance to default (DD). Assume that the asset obeys normalized distribution with means of A, standard deviation δ_A, then secure DD by making use of the following equation :

$$DD = \frac{A - D}{A\ \delta_A} \quad (5)$$

Finally, deduce the possibility of default. With knowledge of possibility and statistics, assume the normalized distribution of asset, secure PD.

2.1.2 The collection of data

In order to calculate the possibility of default, here select five corporations listed China's A stock market as samples: they are ShanghaiQiche, DongfengQiche, Changanqiche, Zhongguozhongqi and Yiqijiaoche.(The very 5 corporations occupy 70% of the total assets of China's automobile industry)

(1) Calculation of equity value

To calculate the equity value of corporations in China's stock market, here take advantage of Chen Zhiwu's method:

Equity value = outstanding shares×market price+ non-tradable shares×market price×22% （6）

Respectively obtain the above –mentioned stocks' closing prices, outstanding shares and non-tradable shares from 1st quarter of 2004 to 3rd quarter of 2008, calculate the daily equity value and quarterly average equity value.(Data sources: Reset database)

（2）Volatility of equity value

Secure the daily yields of stock from reset database. On foundation of this, calculate the standard deviation, and then deduce the quarter standard deviation by the following equation:

$$\delta_{season} = \frac{\delta_{day}}{\sqrt{T}} = \frac{\delta_{day}}{\sqrt{\frac{1}{5*4*3}}} = \frac{\delta_{day}}{\sqrt{\frac{1}{60}}}$$

（3）Risk less interest rate

Select the risk less interest rate from 1st quarter 2004---3rd quarter from reset database.

（4）Period of time

Because the data are on quarterly basis， thus period of time：1/4=0.25year。

（5）Distance to default

In accordance with the all the long-term and short-term debts of ST corporations: deduce the following equation by regression:

$$DP = 1.187\ SD + 1.367\ LD \qquad (6)$$

DP: default point

SD: short-term debt

LD: long-term debt

(This equation comes from the outstanding dissertation of Dalian university of technology)

（6）value of assets and assets volatility

By taking advantage of KMV model, deduce the value of assets and volatility of assets.(This process uses Matlab software)

（7）The calculation of PD

According to the scales of asset of each corporation, calculate the PD for the auto industry.

2.2 Tobin's Q

2.2.1 The definition of Tobin's Q

The Q is defined as the ratio of market value to replaceable value. When q>1, the investment is valuable.

2.2.2 The calculation of Tobin's Q

As for the replaceable value is hard to evaluate, in practice, use the following equation to calculate the Tobin's Q:

$$\text{Tobin's Q} = \frac{MVE + PS + DEPT}{TA} \tag{7}$$

MVE (Market Value of Equity) Market value for common stock

PS liquidated value of Preferred Stock

DEPT，current liability – current asset+ long-term debt

TA (Total Assets) total asset

2.2.3 Tobin's Q

（1）Market value of common stock

Secure the closing prices of the sample corporations, multiple its outstanding shares each day. Average the daily market value in a quarter.

（2）Dept

In accordance with financial statement of the sample corporations, calculate the Dept.

（3）Total asset

In accordance with financial statement of the sample corporations, secure the assets.

3. SELECTION OF RISKY FACTORS

Generally speaking, the potential risk and investment prospect should consider macro and industrial factors

3.1 Macro Risky factors

With knowledge of macro-economy, the macro risky factors are as follows: 1.GDP（GDP）2.GDPgrowth rate of GDP （AGDP） 3.indispensable revenues of residents （REV） 5.consumer price index(CPI)6.Enterprise prosperity index(Pro)7.Enterprenuers' confidence index (Conf)

3.2 Risky factors for Auto industry

By analyzing the characteristics of auto industry, the industrial risky factors are selected as follows:1.return on equity（ROA）2.Auto production（APRO）4.Auto price index（ARPRICE）5.Auto industry revenues（AREV）6.growth of auto revenues（ARREV）7.price index of steel（SPRICE） 8. price index of fuel（OPRICE）

4. DATA PROCESSING

4.1 Granger causality test of PD

Based on 2.1 and 2.2, introduce risky factors. Taking advantage of Granger causality test, tick out the risky factors which are not explanative to stress factors log (PD/1-PD) and Tobin's Q

4.1.1 Granger causality test of log(PD/1-PD)

As for the risky factors: 1.Entrepreneurs' Confidence index (Conf) 2.Index of enterprise prosperity (Pro) 3.GDP 4. total production of Auto 5. Price index of steel (Sprice) 6. Return on asset of Auto sector (ROE) is statistically significant with P value less than 10%. Thus they are explanative to log(PD/1-PD)

4.1.2. Granger causality test of Q

As for the risky factors: 1.Index of enterprise prosperity (Pro) 2.Total production of auto industry (APRO) 3.Consumer price index (CPI) 4. Total revenues of Auto (AREV) 5. Price index of steel (Sprice) 6. Return on asset of Auto sector (ROE) is statistically significant with P value less than 10%. Thus they are explanative to **Q**

4.2 Stable examination of each variable

In case of false regression, conduct unit root test for each factors:

The results show that APRO、AREV、CONF、AGDP、CPI、Q、APRICE has a unit root, but their one degree differences are stable. Therefore there exists cointergration relationship.

5. SET UP OF REGRESSION MODEL

In order to explain the relationship between stress factors and risky factors, respectively make up model for each stress factors:

5.1 The Logit model for PD

As for the stress factor PD is between 0-1, bring in LOGISTIC model. The expression is as follows:

$$\log\left(\frac{pd_t}{1-pd_t}\right)=\alpha+\beta_1 x_{1,t}+\mathrm{K}+\beta_k x_{k,t}\alpha+r_1 y_{1,t}+\mathrm{K}+r_k y_{k,t} \qquad (8)$$

After ticking out the insignificant variables, the final expression is as follows(by OLS):

LG（PD/1-PD）=0.0104*SPRICE -0.6316*ARPRICE(-1) -0.322*LGGDP(-1)-3.167*ROE （9）

$$PD=\frac{e^{0.0104*sprice-0.6316*Aprice(-1)-0.322\,LGGDP(-1)-3.167\,ROE}}{1+e^{0.0104*sprice-0.6316*Aprice(-1)-0.322\,LGGDP(-1)-3.167\,ROE}}$$

Where SPRICE 、ARPRICE(-1)、 ROE are all significant at 5%。

LGGDP (-1) is significant between 5%-10%

5.2 The model of Tobin's Q

5.2.1 Long-term model

After ticking out insignificant variables, the final expression of Q is as follows(OLS)：

Q = -0.038*OPRICE + 0.0082*APRO + 4.387*AGDP + 0.0283*CPI (10)

OPRICE、APRO is significant at 5%

CPI is significant between 5%－10%

5.2.2 Error correction model （ECM）

Equation （10）gives a long-term relationship of Q and risky factors. Considering the unit root of the variables, here we bring in Error correction model to study the short-term relationship:

IQ = 0.5339*UQ1 + 0.0018*IAPRO + 26.73*IAGDP + 0.04503*ICPI - 0.0387*IOPRICE （11）

IQ, IAPRO, IAGDP, ICPI, IOPRICE are the first-order difference of Q, APRO, AGDP, CPI as well as OPRICE

UQ1: is residue of equation 10

UQ1, IAGDP, ICPI, IOPRICE are significant at 5%

IAPRO is significant between 5%-10%

6. THE SET OF STRESS CONDITIONS

6.1 Methods:

As for the historical discontinuity of financial crisis, the set of stress condition is on one hand take the historical conditions for reference; on the other hand, brings in experts to forecast the upcoming trend of the risky factors, thus deduce the probabilities for each condition.

The detailed method are as follows: 20 experts are voting for the possible upcoming trend of the risky factors, each expert can choose a point or an interval (less than 4 points).If an expert chooses a point, and then the corresponding point gets a vote, if an expert chooses an interval, all the points in the interval will get a vote. The distributive probabilities at each point are deduced by the number of votes at that point dividing the total votes. And the probabilities of stress conditions are all cumulative probabilities, which can be achieved by adding.

6.2 Concrete stress conditions

6.2.1 Set of conditions for PD's risky factors

From equation（9）, the PD is correlated with Auto price index, ROE, Price index of steel as well as GDP. The table below shows the conditions for each risky factor:

Table 1. Conditions for PD's risky factor

Risky factors	Mild		Moderate		Extreme	
	stress	Probability	stress	Probability	stress	stress
Auto price index	decreases 10%	87.5%	decreases 20%	48.2%	decreases 40%	8.9%
ROE of Auto industry	decreases 10%	83.3%	decreases 20%	55%	decreases 40%	9.8%
Price index of steel	increases 10%	89%	increases 20%	51%	increases 40%	12%
GDP	decreases 2%	90%	decreases 5%	47%	decreases 10%	9.7%

6.2.2 The set of conditions for Q's risk factors

By equation（10）,（11）, the Tobin's Q is determined by 4 risky factors, they are Fuel price index, Auto production, CPI as well as AGDP. The table below shows the conditions for each risky factor:

Table 2 Conditions for Tobin's Q's risky factors

Risky factors	Mild		Moderate		Extreme	
	stress	Probability	stress	Probability	stress	Probability
Fuel price index	increases 10%	87.5%	increase 20%	48.2%	Increases 40%	8.9%
Auto production	decrease 10%	83.3%	decrease 20%	55%	Decrease 40%	9%
CPI	decreases 10%	85%	decrease 20%	51%	decrease 40%	13%
AGDP	decreases 2%	91%	decrease 5%	47.5%	Decrease 10%	9%

6.3 Results of stress test

Table 3 Stress test for PD

Stress conditions	Auto price index（decrease）	ROE（decrease）	Steel price index（increase）	GDP（decrease）
Mild	PD increases 36.3%（10%）	PD increases 15.7%（10%）	PD increases 4.9%（10%）	PD increases 45%（2%）
Moderate	PD increases 37.8%（20%）	PD increases 19.3%（20%）	PD increases 7.7%（20%）	PD increases 75%（5%）
Extreme	PD increases 40.7%（40%）	PD increases 23.16%（40%）	PD increases 8.9%（40%）	PD increases 110%（10%）

Note： The indexes in this stress test are relative value

Table 4 Stress test for Tobin's

Stress conditions	Auto production (decrease)	CPI (decrease)	Fuel price index (increase)	AGDP (decrease)
Mild	Q decreases 20.4% (10%)	Q decreases 8.4% (3%)	Q decreases 38% (10%)	Q decreases 45% (2%)
Moderate	Q decreases 41% (20%)	Q decreases 14% (5%)	Q decreases 79% (20%)	Q decreases 75% (5%)
Extreme	Q decreases 82% (40%)	Q decreases 28.3% (10%)	Q decreases 158% (40%)	Q decreases 110% (10%)

Note: The indexes in this stress test are relative value

7. CONCLUSIONS AND POLICY SUGGESTIONS

The research in this paper shows that the potential risk of China's auto industry is determined by China's GDP, price of steel, price of auto as well as the return on assets; while the investment prospect is correlated with GDP, fuel prices, auto production and consumer price index. The conclusions are as follows:

7.1 Potential risk (PD) of China's auto industry:

1. GDP is key to the potential risk of auto industry. From stress test it is not difficult to see that the slowdown of GDP will greatly heighten the potential risk of auto industry.

2. The overall price level and return on asset could exert huge impact on the operating of auto sector. The decrease of the price will shrink the profit, thus heighten the potential risk of auto sector. However, the ROE's influences on PD are small. For in the context of financial crisis the corporations will take measure to cut their related expenses, it will trade-off the effects of shrink of sales.

3. The price level of steel to a certain extent affects the potential risk of auto industry. For steel as the main materials for auto production, will have effects on the cost of production. While from the results, the influences of steel price are limited, this may because the producer may transfer the price volatility to consumers; or the producer may negotiate with the supplier at a pre-fixed price, these will all decrease the effects of steel price.

7.2 Investment prospect (Q) of China's auto industry:

With the results in Part5, the conclusions are as follows:

1. The prospect of the macro-economy determines the prospect of auto industry. From the stress test, it is easy to find that the growth rate of GDP greatly affects the Q. This is close the reality, for the auto industry shares the same cycle with macro-economy.

2. The fuel prices are negatively correlated with investment prospect. The increase of the fuel prices will lower down people's expectation on auto industry.

3. The amount of production is positively correlated with the investment prospect.

4. CPI is positively correlated with investment prospect.

7.3 Suggestions and advice

From the analysis above, in order to ensure the survival and long-term development of auto industry, precautions as follows should be taken:

1. The prospect of auto industry is closely related to the macro-economy. The auto sector will recover only on condition of the recovery of macro-economy. Therefore, the government should take a series of policies to boost the economy: such as capital injection from fiscal budget, loosening the restriction on credit.

2. Certain preferential policies should be given to auto industry. The government should make an good effort to stabilize the price of fuel; adjust related tax policies, such as fuel tax to decrease the costs; standardize the operating of the auto industry in fear of vicious competition; place fewer restrictions on auto loans.

3. The corporations in auto industry should on one hand conduct industrial re-structuring, put more energy and effort on R&D, streamline the staff, decrease cost; on the other hand, cultivate sense of risk and try to use different methods to avoid the market uncertainties.

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