

Dynamic Recognition and Early Warning of Non Efficiency of Listing Corporation Investment based on Two-tier Stochastic and PVAR Model: Big Data Perspective

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Abstract

This paper use two-tier stochastic frontier model and panel vector autoregressive model to achieve the dynamic identification of the Inefficient Investment of listed companies in China: the investment game both parties as a result of underinvestment and excessive phenomenon exists generally, overall performance as inadequate investment, free cash flow positive influence on corporate investment, debt ratio negative influence on enterprises investment. On the basis of creatively proposed to the investment efficiency of dynamic early warning method: the method based on time, the shape of the three regions of the efficiency of investment behavior is different, in the future, the eastern weakened, central strong, west or weak or strong; Compared to the method based on location, in eastern China, the central region is more need to intervene, the western region the efficiency investment performance is more complex, however, change from the pope.

Keywords: Two-tier Stochastic; Vector autoregressive panel; Inefficient Investment

1. Introduction

Capital allocation efficiency has been highly concerned, and its efficiency is directly related to the success or failure of the company. Generally speaking, it is possible that the manager will invest in the net present value of free cash flow (NPV) is less than 0 of the project, lead to excessive investment, enterprises may also actively increase the debt ratio, to give up the net present value (NPV) of more than 0 projects to lead to insufficient investment. The phenomenon of excessive investment and insufficient investment is known as inefficient investment in the industry, and the results tend to force the company to deviate from the objective of maximizing the value, and then affect the company's survival and development. Therefore, how to restrain the problem of inefficient investment effectively, is an important direction for future research on the investment behavior of listed companies and efficiency, a major breakthrough is also effectively solve the listed company of the non efficiency investment dilemma.

How to identify the non efficiency of investment, the most recognized is construction investment expectation model proposed by Richardson [1], the model will be divided into enterprise's actual investment expenditures expected and unexpected investment in two parts, one part is used to express the level of investment is expected to moderate investment decisions by the company size, growth and other related factors, but not expected some are used to describe the actual expenditure on investment company from a modest investment expenditure level. If the investment is not expected to be part of the investment is greater than zero, it indicates that the company has been excessive investment, on the contrary, it means that the company's performance for the investment is insufficient. This method is widely used in capital allocation efficiency in foreign countries. But the method is applied to the non efficiency investment measure is not accurate [2-5], the regression residuals as the non efficiency investment measure, it has

the deviation, which means to measure the level of non efficient investment there are errors. For example: (1) Billett, *et al.*, (2011) found that low Quality Inc governance is more likely to occur the inefficient investment behavior [6]; Zhang Huili (2012) found that high Quality Inc governance can inhibit the non efficiency of investment. (2) Cheng, *et al.*, (2013) found that high quality internal control can restrain the inefficient investment of the company; in the (2009) found that the high quality of internal control can not restrain the company's inefficient investment behavior [7].

Domestic research on the inefficient investment of listed companies, many of which are carried out in the framework of Por La and so on. Zhang Honghui uses the expected investment model of 2000-2001, using the formula Richardson years of Chinese listed companies to study the impact of non efficiency on the performance of listed companies. Based on the FHP model, Vogt model and Richardson model, Zhang Gongfu overcomes the shortcomings of the model, and builds a benchmark Q, non-inefficient investment measurement model [8]. Dalin uses dynamic panel GMM System method, to study the dynamic relationship between the power of managers [9], investment opportunities and the company's inefficient investment between the three. in addition, there are some of the use of the average capital substitution method and investment cash flow sensitivity method of the literature [10-14].



Figure 1. Capital allocation

2. Theoretical Analysis and Research Hypothesis

2.1. Big data analytics

Big data is a phenomenon, the core is to dig the value of the data. Combined with the characteristics of data mining, especially its application, from the point of view of the application of large data to the following two points. First, the big data is the number one project". In an enterprise, big data usually involves a number of business departments, business logic complex. On the one hand, to collect and integrate the data, the needs of the business sector cooperation and communication and business personnel to participate, the needs of enterprise staff attention and recognition, to provide the necessary resources and support. On the other hand, to verify the results of the data mining and application, but also can not be separated from the decision of the relevant personnel. The results of data mining are mostly related to relationships rather than cause and effect, and these results may be uncertain. In addition, sometimes the results of data mining and business operation of common sense is not consistent, or even contrary to. So, how to look at these

possible uncertainties and anti sense analysis conclusion, make full use of the results of data mining, it cannot do without the foresight of decision makers.

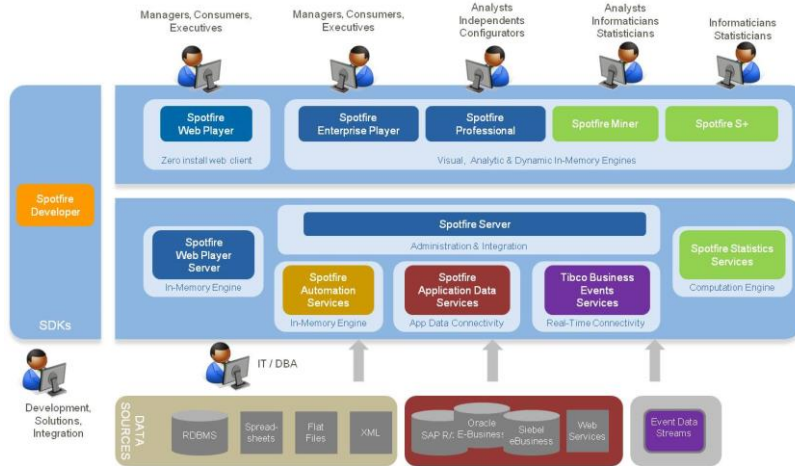


Figure 2. Network big data analysis

Second, big data requires data import, integration and pretreatment. When faced with a large number of complex data from different data sources, it is difficult to understand the business process and data flow of the business process and data flow. Therefore, enterprises in the implementation of large data may not be clear about what to dig and discover, the data mining in the end can help enterprises to do what is not intuitive and clear understanding. So, most of the time are not likely to put data planned and prepared, so that mining in the specific data, you need to have great flexibility in data import, integration and pretreatment, only through the cooperation business and data mining engineer, continue to try, to effectively business needs and enterprise data mining function link.

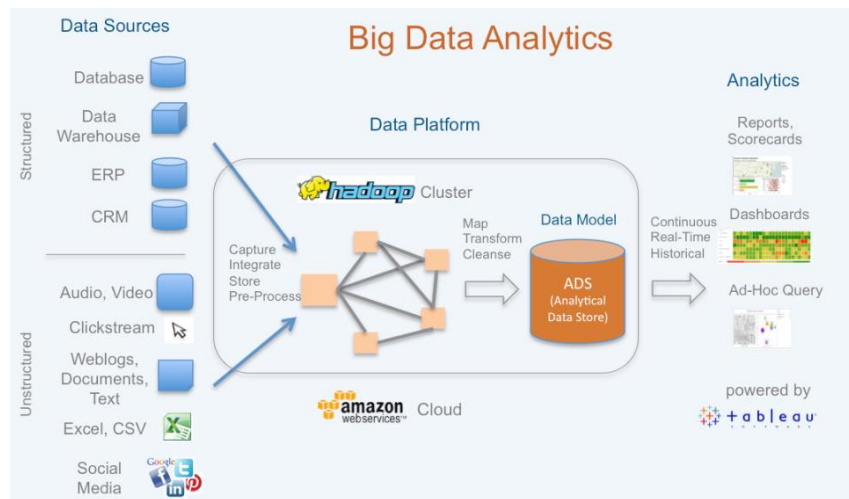


Figure 3. Big data analytics

2.2. Research hypothesis

Through the above literature review and summary, the investment expectation model applies only to distinguish a company whether there is the phenomenon of inefficient investment, and its deep causes to lead to non efficiency of investment is inadequate. In order to overcome this shortcoming, the Shanghai and Shenzhen Stock Exchange from

January 1, 2007 to December 31, 2013 data between A shares of listed companies as the research object, using stochastic frontier model and bilateral panel VAR model, not only can determine whether the company has a non efficiency investment phenomenon, but also for enterprises can be expected further decomposition of investment, dynamic presentation mechanism hidden behind the non efficiency investment, provide a better method to identify the early warning mechanism of non efficiency of investment and the intervention of non efficiency investment for enterprises. It should be explained that there is a lag phase or two of the variables in the model, so the actual sample period is 2009-2013 years. Jensen (1986) pointed out that appeared in the enterprise free cash flow, "empire" preference will encourage managers to actively transfer the surplus funds to expand the scale of non profitable projects, resulting in excessive investment in the enterprise, put forward hypothesis H1.

Hypothesis H1: free cash flow has a tendency to lead to excessive investment behavior of enterprises.

Jensen (1986) pointed out that the debt may lead to "control effect", in other words, remove the tax shield benefits, by way of debt to carry out investment enterprises have also introduced a creditor's supervision, may to some extent increase the investment behavior of managers about beam; in addition, business investment will decrease with pressure corporate debt leverage and put forward hypothesis H2.

Hypothesis H2: debt ratio has the tendency to lead to the lack of investment in enterprises.

3. Dynamic identification of inefficient investment

3.1. Modeling of bilateral stochastic frontier models

Two - tier Stochastic can realize the Richardson (2006) proposed investment expectation model of enterprise is not expected part of further decomposition, its principle is as follows:

First of all, to borrow Pissarides (2000), we propose a type (1):

$$I = \underline{I} + \eta(\bar{I} - \underline{I}) \quad (1)$$

Among them, I for the actual investment, \bar{I} the manager out of the investment list, \underline{I} as companies out of the investment list, $\eta(0 \leq \eta \leq 1)$ on behalf of the manager in the investment game of bargaining power, $\bar{I} - \underline{I}$ said the game space enterprises and investment manager in the game.

Secondly, Kumbhakar and Parmeter (2009) on (1), I on the basis of a representative to join the mathematical expectation of variables (also called expected investment) $\mu(x)$, and after deformation of identity:

$$I = \mu(x) + \eta(\bar{I} - \mu(x)) - (1 - \eta)(\mu(x) - \underline{I}) \quad (2)$$

Finally, the equation (2) of the three on the right $\mu(x)$, $\eta(\bar{I} - \mu(x))$ and $(1 - \eta)(\mu(x) - \underline{I})$ respectively $x'_i \beta$, w_{it} and u_{it} instead, can be set up as shown in (3) type of model:

$$I_{it} = x'_{it} \beta + \varepsilon_{it}; \varepsilon_{it} = v_{it} + w_{it} - u_{it} \quad (3)$$

On the basis of the above, this paper modeled (3) defines the following bilateral stochastic frontier model [15]:

$$I = b_0 + b_1 Invoppt_{it-1} + b_2 Lev_{it-1} + b_3 Cash_{it-1} + b_4 Age_{it-1} + b_5 Size_{it-1} + b_6 Return_{it-1} + b_7 I_{it-1} + \sum Industry + \sum Year + \varepsilon_{it}; \quad \varepsilon_{it} = v_{it} + w_{it} - u_{it} \quad (4)$$

The selection of the actual investment (I) as explanatory variables; debt ratio (Lev), free cash flow (Fcf) as explanatory variables; the operating income growth rate (Invoppt), cash stock (Cash), time to market (Age), enterprise scale (Size), the annual rate of return (Return) as control variable; industry (Industry) and annual (Year) as dummy variables; bargaining power price Lasheng manager investment game (w_{it}) and enterprise investment game code low pressure(u_{it}) as the bargaining power of instrumental variables.

3.2. Identification of bilateral stochastic frontier models

Table 1 presents the influence of investment game on investment decisions. We find that the investment game between managers and enterprises has a great impact on the investment decisions of the company. I could not explain part of the total variance of ($\sigma_u^2 + \sigma_w^2 + \sigma_v^2$) is 0.7869, which is 90.95% by the investment game behavior.

Table 1. The influence of investment on both sides of the investment game

	Index	Symbol	Numerical value
Both sides of the game	Low investment effect	σ_u	0.6172
	Pulled up the investment effect	σ_w	0.5876
Proportion of variance	Total variance of the error term	$\sigma_u^2 + \sigma_w^2 + \sigma_v^2$	0.7869
	Investment game both sides Proportion of variance	$(\sigma_u^2 + \sigma_w^2) / (\sigma_u^2 + \sigma_w^2 + \sigma_v^2)$	0.9095

In Table 2 $E(1-e^{-w_{it}} | \varepsilon_{it})$ and $E(1-e^{-u_{it}} | \varepsilon_{it})$ respectively represent the non efficiency of managers and enterprises in the investment game. Overall, the manager pulled the investment behavior of the actual expenditure is higher than expected investment of the listed companies in 36.42%, but on the contrary, the enterprise down investment behavior makes the actual investment expenditure of listed companies is lower than expected investment of 38.12%, the result of the game is the actual investment compared to the expected investment fell by 1.70%, the overall performance of investment shortage.

Table 2. The non efficiency value of both sides of the game

Index	Average value (%)	Standard deviation (%)	P25(%)	P50(%)	P75(%)
Manager: $E(1-e-w \varepsilon)$	36.42	17.52	23.34	28.37	43.97
Enterprises: $E(1-e-w \varepsilon)$	38.12	18.68	23.57	29.40	47.00
Gap: $E(1-e-w \varepsilon)$	-1.70	32.17	-23.66	-1.03	20.40

Figure 4-5 shows the dynamic non efficiency investment game between the two sides, the common characteristics of right tail showed that only a few enterprises have absolute dominance in the investment game.

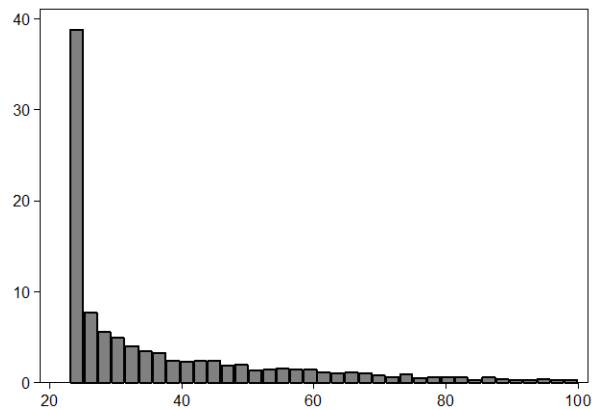


Figure 4. Manager Investment Game non efficiency distribution

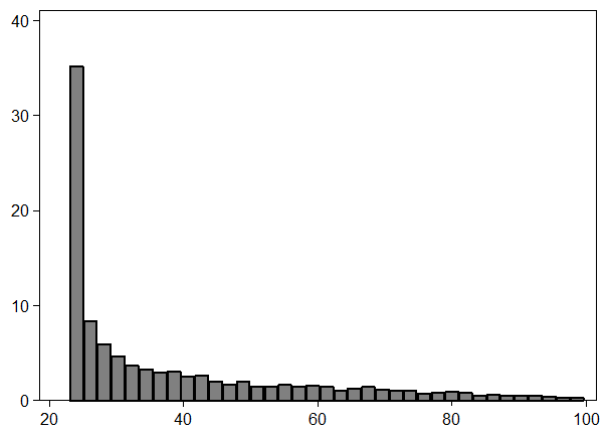


Figure 5. Enterprise investment game non efficiency

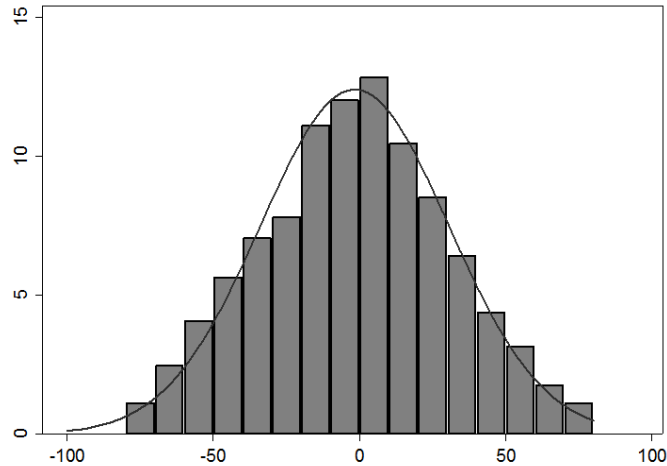


Figure 6. The distribution of the non efficiency of the two parties in the investment game

Figure 6 depicts the distribution of non efficiency investment game for both sides after synthesis, both non efficiency gap shows a normal distribution trend of typical, indicates the strength of both sides in a stalemate.

3.3. Modeling of panel vector auto regression model

Two-tier Stochastic can reveal the listed companies in China lack of investment and excessive investment in ubiquitous, in other words the mechanism behind, but failed to further indicate the efficiency of investment, what are the factors that lead to non efficiency of investment? Sims is equal to the vector autoregressive model proposed in 1980 (vector autoregressive, model, VAR) opened a window for us: (1) vector autoregressive model, in essence, is a kind of non structural model, it can through the real economic data, rather than the economic theoretical framework to examine the dynamic changes of the economic structure in the running of the system the so as to provide the possibility for us to objectively observe the relationships between variables; (2) VAR of all variables are regarded as endogenous variables, which provides convenience for the interaction between our research variables; (3) it is worth mentioning that the orthogonal impulse response functions, and demonstrate a better separation endogenous shocks to other endogenous variables bring much effect, dynamic effect between variables will be pushed to the front of us.

Therefore, we construct a first order lag PVAR model to investigate the relationship between debt ratio, free cash flow and investment level:

$$y_{it} = \rho y_{i,t-1} + \varepsilon_{it}; \quad \varepsilon_{it} = v_{it} + w_i + u_t$$

y_{it} is an enterprise with time and change of endogenous variables vector $\{\text{Lev}, \text{Fcf}, \text{I}\}$, ρ is the coefficient matrix of the lag is a variable, w_i for enterprise fixed effects, u_t is the time fixed effect, v_{it} classic error.

It is with fixed effects cannot be observed in the model, leading to $y_{i,t-1}$ and ε_{it} , so both LSDV and GLS are biased and inconsistent, if you want to get a ρ consistent estimator, is required as follows: (1) first, in order to eliminate the time fixed effects, we do the average annual deduction transform the sum of each of the variables, i.e. within the group to the heart (time-demeaned) (2); secondly, in order to eliminate the enterprise

fixed effect, do the deduction according to the average transformation from $t+1$ phase to T expectations and after each of the variables, namely forward mean difference method (forward mean-differencing (3)); finally, after conversion and variable lag regression between elements still are orthogonal, the system using GMM method is used to estimate the coefficient matrix ρ possible.

3.4. Recognition of panel vector autoregressive model

As mentioned above, the impulse response function can be used to estimate the random disturbance term single standard deviation positive impact on the degree of other variables, so it can intuitively show the dynamic interaction between situational variables, and can be used to describe the path variable in time. Here, the impulse response function image can be obtained by using the Carlo Monte method to simulate the 1000 times of the standard deviation of the random disturbance term. In Figure 7 the horizontal axis represents the response of the impulse response of the number, the lag period of 10, the vertical axis reflects the endogenous variable of the degree of response to shocks.

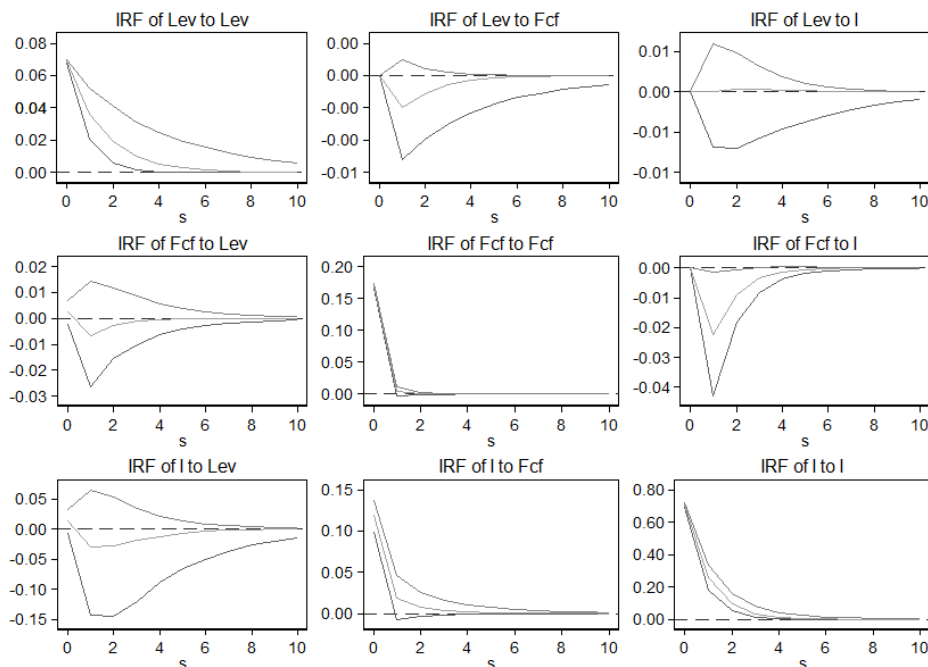


Figure 7. Pulse effect: a full sample of Listed Companies in China

First, as shown in Figure 7 left, the ratio of liabilities to a standard deviation of the impact, the current investment response is positive (0.0125), then will have a negative effect, and to underestimate at first years (-0.03), the cumulative effect of shock period is negative (-0.092). Second, as shown in Figure 4, the free cash flow to one standard deviation shocks, the current investment response is positive (0.1187), then decreased gradually, and in the ninth years to 0, the cumulative effect of the shock period is positive (0.1496). Third, as shown in Figure 4 is shown on the right, if the investment is a standard deviation shock to the current debt ratio, no response (0), then will produce positive response for a period of 5 years is very weak, no cumulative effect of shock period (0.001). Fourth, as shown in Figure 4 right, invest in a standard deviation shock to the current period, free cash flow (0), and no response will produce negative effects, and reached the valley value in first years (-0.0223), the cumulative effect of the impact period for positive and negative (-0.037). Fifth, as shown in Figure 4 left, the debt rate to

one standard deviation shock free cash flow is the current response (0.0024), then will have a negative effect, and reached the valley value in first years (-0.0066), the cumulative effect of shock period is negative (-0.0085). Fourth, as shown in Figure 4, the free cash flow to a standard deviation of the impact of current liabilities no response (0), then will have a negative effect, and reached the valley value in first years (-0.002), the cumulative effect of shock period is negative (-0.0043).

Overall: (1) free cash flow of enterprise investment has positive influence on corporate investment, debt ratio has a negative effect, assuming that H1 and H2 have been verified; (2) business investment has almost no effect on the debt ratio, debt ratio indicates that there is a simple relation between investment and (Grainger causality test found that Lev is Granger, I and Granger Fcf but not Lev all combination I Granger I reasons, not Lev), while corporate investment has a negative impact on free cash flow, free cash flow shows that the complex relations between investment and (Grainger causality test showed that the Fcf is not I Granger, Granger I, not Fcf Lev and I all combination is the Granger reason Fcf); (3) the debt ratio and free cash flow to each other all have negative effect, that debt ratio and free cash flow impact on investment When playing a very different role (Grainger causality test found that Lev is not the Granger of the Fcf reasons, Fcf is not the Granger Lev reasons, Lev and Fcf combination of all is the Granger I reason).

4. Dynamic Early Warning of Inefficient Investment

4.1. Dynamic early warning based on time

Another function Two-tier Stochastic is able to visually represent efforts to track different parts of the enterprise group in the game of both sides at different time points of investment, the following three groups from the East, and the western region to inspect. Figure 5-7 shows the different regions of the enterprise investment game dynamics, above the line represents the strength of the enterprise investment game, the following line is representative of the strength of the investment manager of the game. Enterprise investment game is high, indicating that enterprises will bear the risk of investment is increased; the manager investment game is high, indicating that enterprises will bear the risk of excessive investment.

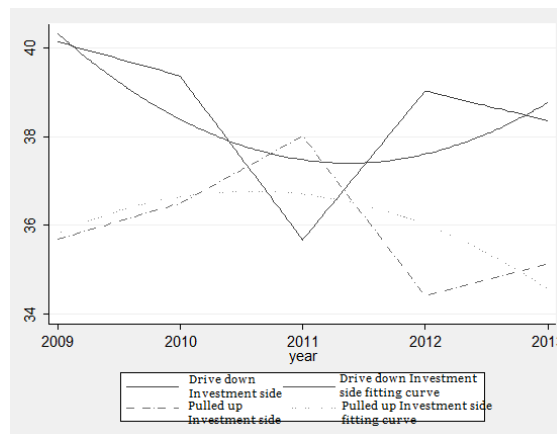


Figure 8. The game dynamics of enterprise investment in the eastern region

The fitting curve in Figure 8 shows: (1) the intensity of investment in the eastern region of our country is high - low - high during the period of 2009-2013, the intensity of the investment in the game is low - high - low. (2) although it is not difficult to find the eastern region companies down investment on the rise, should pay attention to the two

fitting curves in the region had obvious high left low right direction but also shows, the eastern region of the non efficiency investment degree will be weakened.

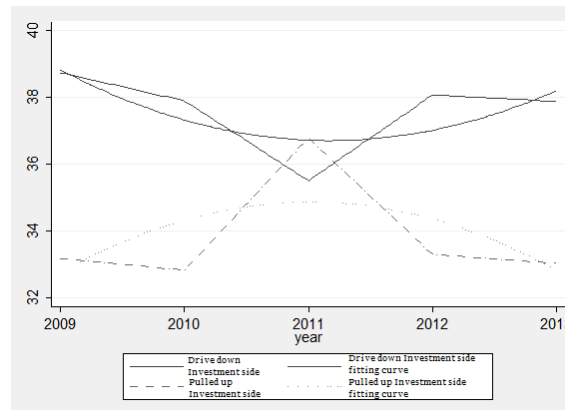


Figure 9. The game dynamics of enterprise investment in the central region

The fitting curve in Figure 9 shows that: (1) the intensity of the game of enterprise investment in the central region of our country is high - low - high during the period of 2009-2013. (2) seems to be completely consistent with the eastern region, but compared with the eastern region, the two curves in the area have significant features about flush, suggesting that the central region in the future direction of the investment behavior of non efficiency down enterprises will be strong.

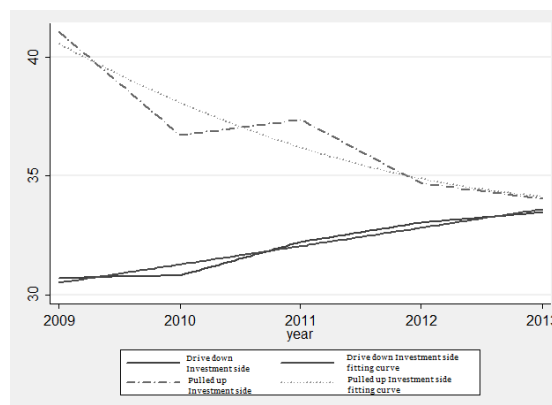


Figure 10. The game dynamics of enterprise investment in the western region

The fitting curve in Figure 10 shows that: (1) the intensity of the game of enterprise investment in the western region of our country is low during the 2009-2013 period. (2) manager of the investment game efforts to maintain high track long-term (more than 35) is a unique phenomenon in the western region, the western region has been the means of non efficiency investment manager pulled phenomenon is more prominent. (3) also, we can get more information from the path of the trend, that is we in the game force of western region investment manager that pulled in decline at the same time, game force must guard against companies in the region of depressed investment is rising.

4.2. Dynamic early warning based on location

Another feature of the PVAR is to tell us where you need more of what intervention, in a sense, even in advance of the possible intervention results of anticipation, the following three groups from the East, and the western region to inspect, see figure 11-13.

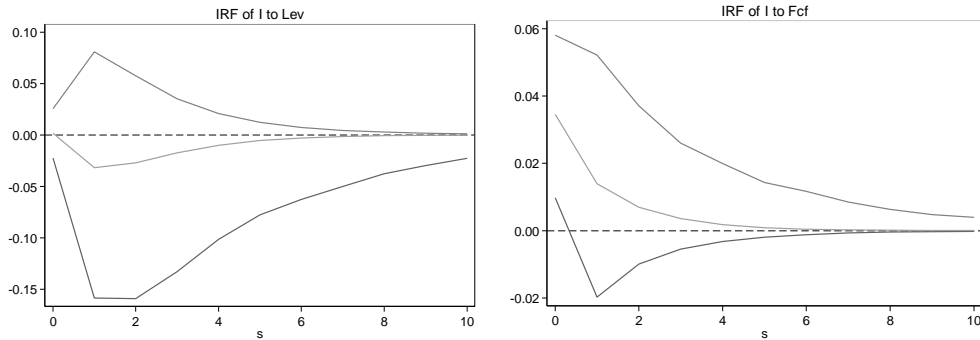


Figure 11. Pulse response: sub sample in the eastern region

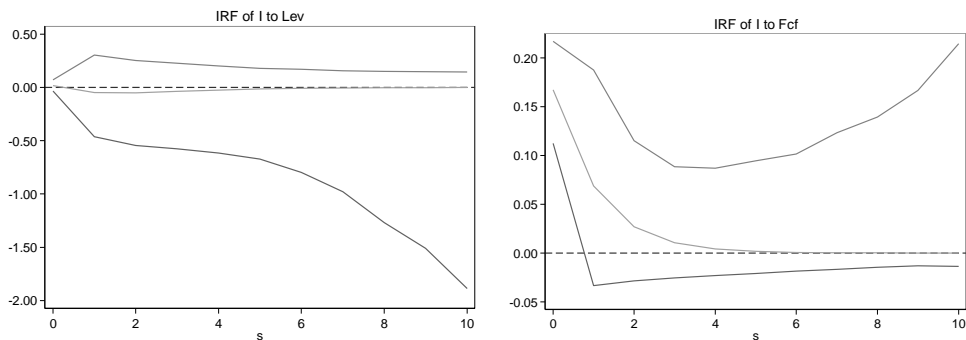


Figure 12. Pulse response: sub sample in the middle region

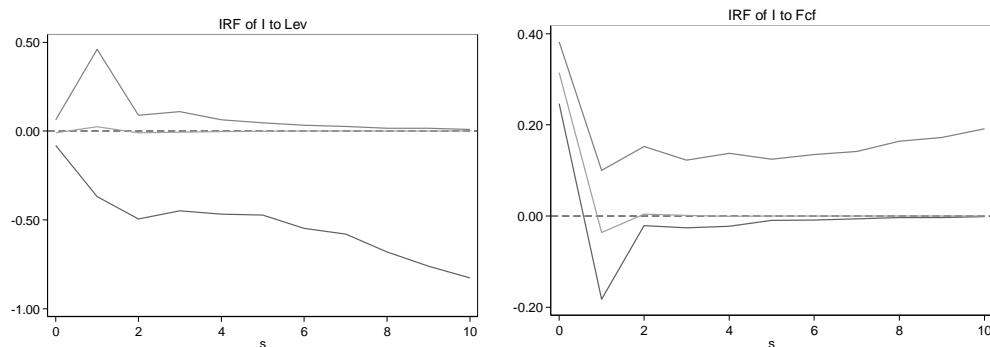


Figure 13. Pulse response: sub sample in the western region

This period to the debt ratio of one standard deviation shock: the eastern region of the current investment response is positive (0.0016), then will have a negative effect, and reached the valley value in first years (-0.0318), the cumulative effect of shock period is negative (-0.0955); the central region of the current investment response is positive (0.0161), then also has negative effects, and reached the valley value in second years (-0.051), the cumulative effect of shock period is negative (-0.1845); the western region of the current investment response is negative (-0.0091), then the positive upward, and

reached the peak at first years (0.0239), and then in the rest of the 6 year period by a slight negative reaction gradually tends to 0, the cumulative effect of the shock period is negative (-0.0038). The free cash flow to a standard deviation shock: the eastern region of the current investment response is positive (0.0345), then gradually downward, and in the tenth years to 0, the cumulative effect of the shock period is positive (0.0626); the central region of the current investment response is positive (0.1674), which is also with gradually down, and in the tenth years to 0, the cumulative effect of the shock period is positive (0.2809); the western region of the current investment response is positive (0.3145), then quickly inserted, and reached the valley value in first years (-0.0363), and then in the rest of the 4 year period by slight concussion reaction and gradually tends to 0, the cumulative effect of the shock period is positive (0.2834).

Overall: (1) compared to the eastern region, the central region of the increase in debt ratio to lower the investment efficiency of the phenomenon is more obvious, therefore, the need for greater intervention. (2) compared to other regions, the cause of the phenomenon of inefficient investment in the western region are complex and profound, specific performance in: on the one hand, debt rate promotion does not necessarily mean that the decreased level of investment; on the other hand, the improvement of free cash flow does not mean increase the level of investment therefore, at the time of the intervention to specific conditions. (3) fortunately, although the western region is the trend of pulse is very unique, but through the cumulative effect of the impact of symbolic attributes during the period before, we find that the hypothesis is still robust, which will undoubtedly give us on non efficiency investment intervention to bring confidence and direction enormous promise.

5. Conclusion

The organic combination of the bilateral stochastic frontier model and panel vector autoregressive model, the recognition model of existing non efficiency investment has complicated operation, the function of the lack of problems, put forward new relevant non efficiency investment simple dynamic identification and early warning methods, greatly facilitate the enterprises, regions and countries of different economic level the entity to carry out supervision, regulation and guidance of correct and effective.

(1) China's listed companies as a whole, universal investment game, the result of the game is the actual investment compared to the expected investment fell by 1.70%, the overall performance of the lack of investment; investment efficiency in the distribution of common features of non game right tail showed that only a few enterprises have absolute dominance in the investment game; investment game non efficiency gap shows a normal distribution trend of typical, indicates the strength of both sides in a stalemate.

(2) Free cash flow of enterprise investment has positive influence on corporate investment, debt ratio has a negative impact; debt ratio has a simple relationship with investment, and free cash flow are complex and investment relationship between the debt ratio and free cash flow; each other all have negative effect, that debt ratio and freedom cash flow plays a different role in affecting investment.

(3) The future, the eastern region of the non efficiency investment degree will be weakened; the central region in the future without efficiency down the investment direction of the enterprises will be stronger; the western region has been the non efficiency investment manager pulled phenomenon is more prominent, we pay attention to the western region by force in the investment game pulled down at the same time, also the area must be wary of game force companies to lower investment is rising.

(4) Compared to the eastern region of China, which increase the debt ratio to depress investment inefficiency in the central region is more obvious, therefore to intervene with greater demand; cause the phenomenon of inefficient investment in the western region are

complex and deeper than other regions; the cumulative effect of shock period show three regions have similar effect path of debt ratio and free cash flow.

Acknowledgments

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References

- [1] S. Richardson, "Over-investment of Free Cash Flow", *Review of accounting studies*, vol.11, (2006), pp. 159-189.
- [2] X. Wang, "Capital Allocation and Accounting Information Properties", Working paper, Emory University, vol.3, (2003), pp. 236-240.
- [3] R. Bushman, J. Piotroski and A. Smith, "Capital Allocation and Timely Recognition of Economic Losses: International evidence", Unpublished paper, University of North Carolina-Chapel Hill and University of Chicago, (2006), pp. 786-787.
- [4] T. H. Goodman, "How Do Contracts Adapt to an Increase in Free Cash Flow?", vol. 21, (2005), pp. 103-106.
- [5] R. S. Verdi, "Financial Reporting Quality and Investment Efficiency", Available at SSRN 930922, (2006), pp. 132-135.
- [6] M. T. Billett, J. A. Garfinkel and Y. Jiang, "The influence of governance on investment: Evidence from a hazard model", *Journal of Financial Economics*, vol.102, no.3, (2011), pp. 643-670.
- [7] T. J. Coelli, D. Rao and C. O'Donnell, "An introduction to efficiency and productivity analysis", Springer Science & Business Media, (2005).
- [8] Z. Honghui, "Inefficient investment and corporate performance under market competition: Empirical Evidence from Chinese Listed Companies", *System engineering*, vol.5, (2014), pp. 9-12.
- [9] Z. Gongfu and X. Zhong, "Investment of Listed Companies in China: over or under? Empirical measurement of inefficient investment of Listed Companies in Shanghai and Shenzhen stock markets", *Accounting research*, vol.5, (2009), pp. 69-77.
- [10] D. Stone, "The dynamic relationship between managers' rights, investment opportunities and corporate efficiency: An Empirical Study Based on dynamic panel GMM System model", *Financial aspect*, vol.5, (2014), pp. 62-69.
- [11] L. Changguo, "Corporate governance mechanism, free cash flow and over investment behavior of listed companies", *Economic science*, vol.4, (2006), pp. 50-58.
- [12] Y. Huajun, "Institutional environment and excessive investment of free cash flow", *Management of the world*, vol.9, (2007), pp. 99-106.
- [13] F. Hongxing, "Corporate governance, internal control and inefficient investment: theoretical analysis and empirical evidence", *Accounting research*, (2013), pp. 63-69.
- [14] L. Xing and D. Wei, "Equity concentration, the allocation of control rights and the inefficient investment behavior of the company: Also on the supervision of large shareholders or collusion?", *Journal of management science*, (2011), pp. 81-96.

