The Impact of Internet on the Trade-Off between Investment Return and Asset Structure

Baifang Liu¹*, Liqiu Sui², Jiahui Xia³, Tiantian Wang⁴, Yuna Cui⁵, Yanrong Song⁶ and Libo Yang⁶

¹School of Business, Beijing Language and Culture University, Beijing, China
²WEI Fang Bank, Weifang, China
³School of Management, Jinan University, Guangzhou, China
⁴Faculty of Business and Accountancy, University of Malaya, Kuala Lumpur, Malaysia
⁵Xiaomi Communications Co., Ltd., Beijing, China
⁶School of Business, Beijing Language and Culture University, Beijing, China

*Corresponding author e-mail: liubaifang@blcu.edu.cn

Abstract. The Internet has an important impact on optimizing the asset structure of enterprises. Restricted by internal and external factors, the optimization of enterprise asset structure is the result of multi-party game. Based on factor analysis, this paper constructs the production technology constraint model of asset structure and optimizes it with capital and income as constraints. In this paper, we study the agent constrained optimization model and discuss the possible solutions of asset structure optimization. This paper finds that the asset structure allocation model with production technology constraints is the basic model of asset structure optimization and has anchoring effect.

Key words: Asset Structure, Production Optimization, Asset Structure Trade-off

1. Introduction

Enterprise assets are the resources with future income owned or controlled by enterprises. Managers allocate assets, pay wages and loans to meet the normal production and operation of enterprises. In the short term, the total assets of enterprises remain unchanged. Different asset allocation methods may bring different benefits, and the dispersion degree of future income distribution may vary greatly [1]. In the society with the rapid development of Internet, the optimization of enterprise asset structure is affected by external and internal factors [2, 3]. The goal of asset structure optimization is to select the optimal asset allocation mode to maximize the total income of enterprises.

The rest of this paper is arranged as follows: Section 2, based on the production frontier analysis, constructs the production technology constraint model of asset structure, and optimizes it with capital and income as constraints. In the section 3, according to the production technology model, the agent constrained optimization model is established, and the possible solutions of asset structure optimization are discussed. Section 4 summarizes the research conclusion. The main contribution of this paper is to establish the asset structure allocation model with production technology as the...
constraint and put forward that the production technology model is the model anchor of asset structure optimization.

2. Theoretical Model of Production Technology Optimization

For certain industries or enterprises, fixed assets, production technology and market demand are relatively stable in a certain period of time [4]. This part first establishes the asset allocation model under the constraints of production organization and market demand.

2.1. Basic Model

It is assumed that the total assets (in a short-term) or expected assets (in a long-term) of the enterprise are \( L_A \) in a certain period, and the minimum asset allocation portfolio to meet the normal production and operation of the enterprise is \( K_A \).

Define \( I = \frac{L_A}{K_A} \).

\( R_m(i,j) \) is the income generated when the market demand of enterprise product is \( M \), and the enterprise whose total asset is \( iK \) adopts \( jK \) asset allocation strategy to optimize asset allocation. Where \( i = 1,2,3...1; j = 1,2,3...N; m = 1,2,3...M \).

\( C \) is defined as the total cost of asset allocation at portfolio \( i \), mainly including management cost, menu adjustment cost, etc. Assuming that the total cost of each adjustment is constant \( C \), then \( C_{ij} = \begin{cases} C, & \text{if } j < i \\ 0, & \text{if } j = i \end{cases} \). When \( j = i \), it means that the enterprise allocates resources according to the basic requirements of production technology, so there is no need to adjust asset allocation or asset structure.

The profit target of asset allocation or asset structure optimization is to maximize \( R_m(i,j) \). Therefore, this problem can be solved by dynamic programming.

Let \( f(i) \) be the maximum profit that an enterprise can obtain when the portfolio is \( iK \). Then there is a recursive equation: \( F(0) = 0, f(i) = \max_{j=1,2,...\min(i,N)} \{ R_m(i,j) - C_{ij} + f(i-j) \}, i = 1,2,3,...I \) (1)

The economic significance of this recursive equation is to assume that the total assets of an enterprise is \( iK \), and let \( f(i) \) be a revenue function of asset allocation strategy, that is, the asset allocation income of \( jK \) asset portfolio minus the cost of asset adjustment, and then add the income that can be obtained from the remaining assets.

2.2. The Meaning of Solution

The minimum asset allocation portfolio \( K_A \) and the return function \( f(i-j) \) determine the applicability and economic rationality of the recursive equation. Market demand \( M \) can be determined according to sales performance. The total assets of an enterprise are known or controllable. The adjustment cost \( C_{ij} \) is an internal variable of the enterprise, which can be determined according to the production and operation status and financial records. It is difficult to determine the minimum asset allocation portfolio \( K_A \) and the return function \( f(i-j) \). The parameters \( i \) and \( j \) depend on \( K_A \) and \( C_{ij} \). The return function \( f(i-j) \) is limited by \( K_A \). Therefore, determining the value of \( K_A \) is the key factor for the success of recursive equation.

The minimum asset allocation portfolio, \( K_A \), is an exogenous variable, which is the optimal quantity determined by production technology, and is brought into the model as a given value. Unlike \( K_A \), the return function, \( f(i-j) \), is an endogenous variable, which is affected by \( i, j \) and \( K_A \). Therefore, it is possible to solve the optimal dynamic programming by the combination of portfolio income function, minimum asset allocation portfolio and the cost of asset structure adjustment.

2.3. Model Optimization

2.3.1. Model under Capital Constraint. Asset ownership has an important impact on asset allocation [5]. It is assumed that the expected rate of return on asset allocation is \( r_t \), the cost of debt capital is \( dt \),
the cost of equity capital is \( st \), and the cost of comprehensive capital is \( wt \). Let \( wt = (adt + (1-a)st) \). Where \( 0 \leq a < 1 \), \( a \) is the weight of enterprise debt. Then, there is a weak constraint condition \( wt = (adt + (1-a)st) \) or a strong constraint condition \( rt > \max(dt, st) \).

Let the optimal asset allocation determined by recursive equation (1) be \( i^* \), the income function be \( f(i^*) \), and the overall income of the enterprise with \( i^* \) asset allocation is \( R_m(i^*, j^*) \). It is obvious from the recursive equation (1) that \( R_m(i^*, j^*) \) is the optimal profit that an enterprise can obtain under the constraints of current market demand and production technology.

Define \( r_t = \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} \), then,

- The weak constraint condition: \( r_t = \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > w_t = (adt + (1-a)st) \);
- The strong constraint condition: \( r_t = \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > \max(d_t, s_t) \).

Due to the tax shield income, the cost of debt capital is less than the cost of equity capital (Praveen and Vijay, 2017). Thus,

The optimal asset allocation determined by recursive equation (1) is \( I^* \) and the overall income \( R_m(i^*, j^*) \), which can be the optimal solution of asset allocation and structural optimization under capital constraints only if it satisfies weak or strong constraints.

If we first consider the weak capital constraints, then there are,

\[
\begin{align*}
    f(i) &= \max_{i=1,2,\ldots,\min(i,N)\in\mathbb{N}} \{ R_m(i, j) - C_{ij} + f(i-j) \}, i = 1,2,3\ldots \ 
    r_t &= \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > w_t = (adt + (1-a)st) \quad (2)
\end{align*}
\]

If we put the weak capital constraint into the recursive equation, then we have,

\[
    f(i) - f(i - j) > [f(i - j) - f(i-j-1)] \times (1 + w_t) \quad (3)
\]

If and only if, when \( f(i^*) \) satisfies the weak constraint condition (3), the asset structure is optimal. Similarly, for strong capital constraints, there are,

\[
    f(i) - f(i - j) > [f(i - j) - f(i-j-1)]s_t \quad (4)
\]

If and only if, when \( f(i^*) \) satisfies the weak constraint condition (4), the asset allocation is strictly optimized.

2.3.2. The model under revenue constraint. Both recursive model and capital constraint model assume that different asset portfolios can have the same return function. However, when the constraints of production technology are relaxed, the income of portfolio would be differentiated [6-8]. Enterprises adopt different production organization strategies, and their income functions are also different [9,10].

Here we still assume that the total assets or expected assets of the enterprise are \( L_A \), the minimum asset allocation portfolio to meet the normal production and operation of the enterprise is \( K_A \), and the total assets of the enterprise is predictable.

Define \( I = L_A / K_A \). Let \( I \) be a rational number, \( I \in \mathbb{Q} \). When \( R_m(i,j) \) is the profit when the market demand of enterprise product is \( M \), the enterprise whose total assets is \( iK_A \) adopts \( jK_A \) asset allocation strategy to optimize asset allocation (where \( i = 1,2,3\ldots I, j=1,2,3\ldots N \) and \( m = 1,2,3\ldots M \)).

When \( I \in \mathbb{Q} \), \( i-j \) is a rational multiple of the minimum production combination, which can not bring profit to enterprises according to production technology constraints. Enterprises can take various measures to deal with these assets.

\( G(i-j) \) is defined as the investment income obtained by the enterprise whose total assets are \( iK_A \) when they invest the remaining assets after allocating production assets with \( jK_A \). Therefore, the trade-off between production income and investment income can be attributed to the comparison of the size of the income function \( f(i) \) and \( G(i-j) \).

Situation 1: \( f(i) \leq G(i-j) \), that is, the investment income of the enterprise is more than or equal
Situation 2: \( f(i) > G(i - j) \), the investment income of the enterprise is less than the production income of the enterprise.

Let \( R_{it} \) be the average yield of \( i \) industry in \( t \) period. According to the above analysis, we can establish the following revenue recursive equation,

\[
\begin{align*}
    f(i) &= \max_{j=1,2,\ldots,\min(i,N)} \min_{m=1,2,\ldots,M} \{ R_{mt}(i,j) - C_{ij} + f(i - j) \}, i = 1,2,3 \ldots \ldots 1 \\
    r_t &= \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > w_t = (ad_t + (1 - a)s_t) \\
    r_t &\geq R_{lt}, t = 1,2,3 \ldots \ldots 
\end{align*}
\]

According to the recursive equation, when \( r_t < R_{lt} \), that is, the expected return of asset allocation is less than the industry average rate of return, the enterprise focuses on investment, which is in line with situation 1. When \( r_t \geq R_{lt} \), the enterprise optimizes the allocation of assets and the optimization and upgrading of asset structure, which is in line with situation 2.

It should be emphasized that whether the capital constraint \( r_t = \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > w_t \) or revenue constraint \( r_t \geq R_{lt} \) is a necessary constraint. In practice, enterprises can choose the expected income to replace it. At this time, the expected value should be adopted for capital constraint and industry average income to keep the consistency of recursive model data.

### 3. Agent Constrained Optimization Model

Shareholders and executives reach a compromise on risk sharing and revenue sharing in the enterprise operation, forming a performance incentive contract [11]. Among them, the key to guarantee the smooth operation of performance incentive contract is the sharing mechanism of revenue increment.

The utility function of executives is defined as \( U[s(i), c(t), r_p(i)] \). Among them, \( s(i) \) is the function of salary and on-the-job consumption, \( t(i) \) is the control function and \( r_p(i) \) is the reputation utility function. \( i \) is still the previous definition, that is, the asset allocation strategy with the asset portfolio of \( iK_A \) and the remaining assets of \( (i-j)K_A \).

If \( R_{it} \) is still the average rate of return of \( i \) industry in \( t \) period, the asset allocation model with agency constraint is as follows:

\[
\begin{align*}
    f(i) &= \max_{j=1,2,\ldots,\min(i,N)} \min_{m=1,2,\ldots,M} \{ R_{mt}(i,j) - C_{ij} + f(i - j) \}, i = 1,2,3 \ldots \ldots 1 \\
    r_t &= \frac{R_{mt} - R_{mt-1}}{R_{mt-1}} > w_t = (ad_t + (1 - a)s_t) \\
    U_t[s(t), c(t), r_p(t)] &\geq U_{t-1}[s(t_{t-1}), c(t_{t-1}), r_p(t_{t-1})] \\
    r_t &\geq R_{lt}, t = 1,2,3 \ldots \ldots 
\end{align*}
\]

The dynamic recursive model of agency constraints shows that the asset allocation and structure optimization scheme selected by the executives must satisfy the expected utility of executives not less than that obtained by the asset allocation strategy of the previous period.

### 4. Conclusion

The theoretical model of this paper considers that based on production orientation, asset allocation and structure optimization is the model anchor of asset structure optimization. Based on the allocation of productive assets, managers balance production income and investment income, and optimize asset production allocation and investment portfolio. The asset allocation that rational managers choose is a trade-off strategy among production allocation, investment portfolio and power rent-seeking. These optimal asset allocation strategies are influenced by production technology, capital market returns and enterprise control rights, which are dynamic. In the long run, the asset structure optimization strategy converges to the optimal production allocation portfolio. For the entity manufacturing enterprises, the strategy of asset allocation and structure optimization based on production technology boundary is a dominant strategy.
Acknowledgment
1. This Research findings is Supported by Science Foundation of Beijing Language and Cultural University (supported by the Fundamental Research Funds for the Central Universities. Approval number: 18PT02).
2. This Research findings is supported by Cultivation plan of excellent professional courses and the special fund of the basic research of the Central University, project number: JPZ201907.
3. This research was supported by 2020 ideological and political demonstration course construction project Beijing Language and Culture University (Grant No. SZ202012)
4. This Research finding is supported by the special fund of the basic research of the Central University (Grant No. 16ZDD01)

References
[1] F. Demoly, D. Kiritsis, Asset optimization and predictive maintenance in discrete manufacturing industry, IFAC Proceedings Volumes. 45(2012) 1-6.
[2] G. Yi, The process of interest rate marketization in the past 30 years of China's reform and opening up, Journal of Financial Research. 01(2009) 1-14.
[3] X. Z. Zhang, Z. Y. Liu, The effect of macroeconomic factors on the periodical change of China’s listed firm’s trade credit behavior, Economic Theory and Business Management. 06(2014) 41-56.
[4] L. Martellini, V. Milhau, A. Tarelli, Capital structure decisions and the optimal design of corporate market debt programs, Journal of Corporate Finance. 49(2018) 141-167.
[5] P. Kumar, V. Yerramilli, Optimal capital structure and investment with real options and endogenous debt costs, The Review of Financial Studies. 31(2018) 3452-3490.
[6] J. G. Zhu, F. C. Han, Z. F. Lu, Industrial policy, bank connections, and debt financing: An empirical research based on A-share listed companies, Journal of Financial Research. 03(2015) 176-191.
[7] Z. F. Lu, J. He, H. Dou, Whose leverage is more excessive, SOEs or Non-SOEs?, Economic Research Journal. 12(2015) 54-67.
[8] Y. K. Chang, R. K. Chou, T. H. Huang, Corporate governance and the dynamics of capital structure: New evidence, Journal of Banking and Finance, 48(2014) 374-385.
[9] J. Caskey, J. Hughes, J. Liu, Leverage, excess leverage, and future returns. Review of Accounting Studies, 17(2012), 443-471.
[10] M. L. Lemmon, M. R. Roberts, J. F. Zender, Back to the beginning: Persistence and the cross-section of corporate capital structure, The Journal of Finance, 10(2008) 1575-1608.
[11] Ö. Öztekin, M. J. Flannery, Institutional determinants of capital structure adjustment speeds, Journal of Financial Economics, 11(2011) 88-112.