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Research on Financial Supply Chain From View of Stability

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Abstract

The former research work on material and financial supply chain management has mainly adopted marginal analysis and EOQ model, which are based on the traditional idea of self interest maximization or "Efficiencism". However, this idea often drives those strong enterprises in a supply chain to occupy their weaker partners' funds by corporation finance policy; thus results in the break of the monetary flows along the chain. This paper discusses the interest unbalance within such a small system and its negative effects; then proposes a way to resolve it from view of alliance and cooperation. A simple model of stable money flow along supply chain is given.

Key words: Financial Supply Chain (FSC); "Efficiencism"; Stability of money flows

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INTRODUCTION

In the time of supply chain, the competition lies among supply chains other than individual enterprises. Supply chain is an alliance of a series of businesses upstream and downstream, which are supply-demand relation interlinked. There isn't a super-manager over all partners to compulsorily administrate them like within a singe enterprise. They ally on a voluntary basis, so the core problem of supply chain management is the coordination among the businesses along the chain.

A supply chain is an integration of harmonious flows of information, material and money. The performance of a supply chain is determined by the degree of the three flows' coordination. Any inconsistency and disharmony among them will weaken the whole chain. Many enterprises will make concerted efforts with orther partners on material flow, such as making orders and warehousing; while they prefer to make their fund management independly.We often see such phenomenon in reality: the stronger enterprise in a supply chain always makes its advantage in the business bargaining and ask for trade credit which allows it to make delay in payments for its suppliers, while for prepayments from its distributors or retailers downstream. As it often occupies the weaker partners' circulating fund, the latter's formerly insufficient fund will get worse, which frequently results in the break of the monetary flows through the supply chain,even the break of the supply chain itself. The main cause of this phenomenon is the stronger enterprises' inner motive of self interest maximization and disregarding others' benefit, even those of their partners. This motive is always affirmed and supported by all kinds of modern economic theories: the famous assumption of "*Economic Man*" is the foundation of them.

Although works on upstream money flow management among SCM are getting increased nowadays, most models they present are based on the assumption of "*Economic Man*", and this will encourage the formerly described dangerous tendency other than prevent it. In fact, this way of thinking is getting more and more practically unsuitable in such an interdependent and reciprocal symbiosis global economy time. We need to reconsider the problem from economic theories.

1. RELATED ECONOMIC THEORIES

The tradeoff between efficiency and fairness has long been paid attention to by economists. However, modern economics seems to emphasize more efficiency than fairness. Classical economists think that selfishness in the market is most efficient which can lead to Pareto best. So the whole social and economical system greatly encourages economic man behavior, which has enlarged the unfairness throughout the world. Obviously, the unfairness is not efficient. Recently, American financial crisis is the explosion of extreme economic man behavior, which has made great retrogression both on economic efficiency and social well-being. Economic man behavior and "efficiencism" will lead to income polarization and this is one of the greatest barriers of sustainable development in the economic system.

In fact, we should consider not only the sustainable development of economy within the narrow-sensed economic framework, but also that of human activities in the natural historical category, because human being's social and economic life closely relies on the natural ecological world. The historical and natural framework limits man's economical activities. That means a certain way of economic development decides the way of living and the ultimate degree of natural resource utilization and ecological damage in a certain long historical run, which form the natural and ecological border. This border in turn confines the economic activities themselves. During the primary stage of economic development, "efficiencism" has greatly helped to promote the whole society's economy, because the activities haven't reached by far or even being near to the natural border. Individual's economic efficiency brings not only oneself but also the whole society's wealth. That's its positive effect. As approaching to the boarder, the negative effect reveals. And the negative effect is the more and more serious income unfairness(resulting from initial endowment inequality adding "efficiencism") and all kinds of negative economic externality (resulting from economic man behavior and "efficiencism"), which can lower the whole society's efficiency. There's a trend that the negative effect will surpass the positive one. The key problem of negative effect is the unequillibrium of the society it makes. When the unequillibrium reaches a critical point, the system probably breaks down. Financial crisis is one of such situations. So the most important thing is to keep balance in the development in a system.

There are two traditional ways of resource allocation: market allocation and administrative distribution. Only using market allocation is easy to cause unequillibrium in the practical economy. It is the hotbed of economic man behavior and "efficiencism". Administrative distribution can be only used in a rather small system considering the high management cost. In fact, there's a third way other than the two. That is all kinds of alliance. It can remedy the unequillibrium problem of pure market economy. In a sense, alliance is the combination form of the two. But it has its own nature and functions. One of its most prominent functions is that it can help to construct the equilibrium in a economic and social system. It can keep the balance between competition and cooperation. So if we hope a system develop evenly, steadily and thus fast, some alliance methods are needed. Supply chain is one of such alliance methods. It has brought us great productivity and reduced negative externality all around the world. But it still hasn't fully functioned, because no enough cooperation.

Along this line of thinking, we argue that supply chain needs more deep cooperation to develop balancedly, stably, and integrately, not individual efficiently. It is by this means that can the development of supply chain and all its members be sustainable. In this paper, we focus on monetary flow of supply chain. We think the continuity and stability of its money flow is the foundation of the supply chain's good performance, and thus has the development and prosperity of each member. So the continuous money flow is the prerequisite of self economic interest maximization in the supply chain.

2. A MODEL

In order to obtain the continuity and stability of a supply chain's monetary flow, we establish a model of three-level supply chain, as shown in Figure 1.

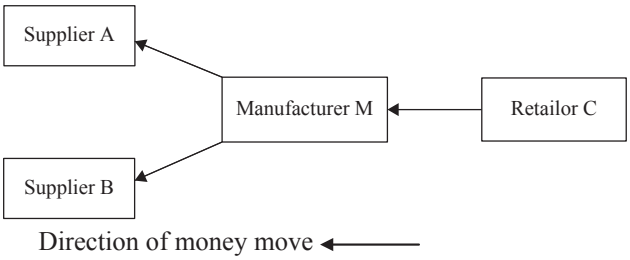

Figure 1
Three-Level Supply Chain Fund Flow Model

We suppose that the manufacturer M has only two suppliers, A and B; and it has only one retailer or distributor C. This is a very simple reproduction process, i.e.no more capital is invested to expand the business. The outflows of M only include the purchase of raw material from A and B, no other logistical cost and administrative expenses. The only inflows are the payment from C. M has no external financing. All cash outflows rely on inflows and the business' own capital. When the cash inflows are less than the cash outflows, the flow of money breaks out. The situation of M can represent any point of the supply chain. Now we consider the manufacturer's money flow. All transference of fund is immediate. The moment of transaction with retailer C is the reference time.

Its cash inflow is as:

$$\int_{-\infty}^{+\infty}[(a+b)(1+p\%)\delta(T+T_c)/(1+\alpha T_c)+F(1+\alpha T_c)]dT \quad (1)$$

Its cash outflow is as:

$$\int_{-\infty}^{+\infty}[a\delta(T-T'-T_a'+T_a)(1+\alpha T_a)+b\delta(T-T'-T_b'+T_b)(1+\alpha T_b)]dT \quad (2)$$

If we hope the flow of money does not break during the observation time period, we must make this happen:

$$\int_{-\infty}^{+\infty}[(a+b)(1+p\%)\delta(T+T_c)/(1+\alpha T_c)+F(1+\alpha T_c) -a\delta(T-T'-T_a'+T_a)(1+\alpha T_a)-b\delta(T-T'-T_b'+T_b)(1+\alpha T_b)]dT\geq 0 \quad (3)$$

a material A's cost
b material B's cost
p% profit rate
α capital's time value rate per day
F factory's own capital
T' the factory's lead time
T_a' supplier A's lead time
T_b' supplier B's lead time
T the time transaction happens
T_a time delay of payment for supplier A
T_b time delay of payment for supplier B
T_c time delay of retailor C's payment for the factory

This is an impulse function which can well describe the supply chain's upstream flow of money. a, b, p, F, T', T_a', T_b' are independent variables, and T_a, T_b, T_c are decision variables or dependent variables. What we want to do is to find the interrelation among T_a, T_b and T_c, and discuss their feasible ranges.

3. MORE EXPLANATION OF THE MODEL

According to the reality, we discuss three situations of payment time respectively, shown in Table 1:

Table 1
Situations of payment time

	Situation1	Situation2	Situation3
T_a or T_b	fixed	fixed	stochastic
T_c	fixed	stochastic	stochastic

Situation1.

The payment times of the factory for the supplier A and B, and that of the retailer C for the factory are fixed. This is a push mode of supply chain. So, the simplified result is:

$$F(1+\alpha T_c)^2-[a(1+\alpha T_a)+b(1+\alpha T_b)](1+\alpha T_c)+(a+b)(1+p\%)\geq 0 \quad (\alpha\geq 0,\ p\geq 0) \quad (4)$$

In which, Ta and Tb are decided by the turnover rate of circulating fund (TR), order quantity (OR), bargaining power (BP) and industry practice (IP).

$$T_a=f_{a1}(TR_a, OR_a, BP_a, IP_a) \quad (5)$$

$$T_b=f_{b1}(TR_b, OR_b, BP_b, IP_b) \quad (6)$$

If T_a, T_b, and all the lead times are decided, and it is supposed that the business A and business B have their own capital to pay the material for the first order from M. We can use another simpler way to calculate their relations. The condition of the money flow's continuity is:

$$T_c\leq T_a-T_a'-T' \quad (7)$$

$$T_c\leq T_b-T_b'-T' \quad (8)$$

Situation2.

The payment time of the manufacturer for the supplier A and B are fixed, and the payment of the retailer C for the manufacturer T_c is a random variable which is changed according to retail market fluctuation. This is a push-pull mode of supply chain. If the values of T_c are normal distributed, then

$$T_c\sim N(\mu_c,\sigma_c^2) \quad (9)$$

The condition of the money flow's continuity is decided by (3) and (9). We can choose the range of σ between (–3, +3) whose probability is 99.74%.

If we don't know the accurate probability distribution, we can use Chebyshev Theorem,

$$P(|X-\mu|<k\sigma)\geq 1-1/k^2,\ k>0$$

In order to get higher probability, here we choose k=4, the range will be (μ–4σ, μ+4σ) whose probability is 93.75%.

Situation3.

The payment time of the factory for the supplier A and B, and that of the retailer C for the factory M are all uncertain. Ta, Tb and Tc are random variables.

A. If this is a strict pull mode of supply chain, T_c is changed with the market demand, then T_a, and T_b are changed with T_c, then the expectationsμ_a, μ_b, are the same of μ_c , the variancesσ_a and σ_b are the same of σ_c^2 .μ_c, σ_c are determined by retail market demand and bargaining power. If we still use Chebyshev Theorem and the probability of range (μ–4σ, μ+4σ), the relationship among T_a, T_b and T_c must meet:

$$\mu_c-4\sigma_c\leq T_a-T_a'-T' \quad (10)$$

$$\mu_c-4\sigma_c\leq T_b-T_b'-T' \quad (11)$$

B. If μa, μb, are different fromμc, and σa and σb are different fromσc , which are determined by market

demand and other influencing factors such as the turnover rate of circulating fund (TR), order quantity (OR), bargaining power, and industry practice (IP), the situation will be a little more complicated. The condition of the money flow's continuity is decided by (3) and the random variables Ta, Tb and Tc.

4. EXPANDED MODEL

The expanded model relaxes the restriction of simple reproduction. We now suppose it is a extended reproduction. The condition of the money flow's continuity will change into this:

$$\int_2^{T_{\lim}} \int_{-\infty}^{+\infty} \{(1+p\%)^{i-1}[(a+b)(1+p\%)\delta(T+T_c)/ (1+\alpha T_c)+F(1+\alpha T_c)-a\delta(T-T'-T_a'+T_a)(1+\alpha T_a)- b\delta(T-T'-T_b'+T_b)(1+\alpha T_b)]\}dTdi \geq 0,\ (2\leq i\leq T_{\lim}) \quad (12)$$

$T_{\lim}$ all periods during the observation
i the number of the reproduction period
It can be simplified as:

$$\int_2^{T_{\lim}} \left\{(1+p\%)^{i-1}\left[(a+b)(1+p\%)/(1+\alpha T_c)+ F(1+\alpha T_c)-a(1+\alpha T_a)-b(1+\alpha T_b)\right]\right\}di \geq 0 \quad (13)$$

That means at the end of each period of production circle, the profit will be added to the material procurement investment, and the adding ratio is fix to (1+p%), except the initial fund F.

5. ANALYSIS TOOLS

In order to assure a continuous money flow in a supply chain, we analyze the relations among T_a, T_b and T_c from two type of production mode. In the first mode, i.e. the simple reproduction mode, we discuss three situations. The practical case studies will be given in another paper.

SUMMARIES

The monetary flow's continuity of supply chain has been explained from view of economic theory relating to fairness and efficiency. In this paper, impulse function is borrowed from signal system to build our basic model. Then we discuss three situations according to practical market. The whole process provides a theoretical method of developing continuous fund flow just by trade credit. Only when this internal financing is used to the most and is still not enough, external financing is added. More detailed analysis and conclusions will be provided in another paper.

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