Logist. Res. (2009) 1:149–161
DOI 10.1007/s12159-009-0020-y

ORIGINAL PAPER

Supply chain finance: optimizing financial flows in supply chains

Hans-Christian Pfohl · Moritz Gomm

Received: 10 March 2009 / Accepted: 4 November 2009 / Published online: 19 November 2009

Abstract Issues related to flows of goods and information are frequently discussed in the logistics and Supply Chain Management literature. But, only few contributions are exploring the financial flows associated with supply chains. This article reviews the state-of-the-art of research regarding financial flows in supply chains. In doing so, it becomes apparent that an explicit examination and optimisation of the cost of capital has been missing so far. In order to close this gap, a conceptual framework and a mathematical model of "Supply Chain Finance" is proposed.

1 Supply chain finance—research gap

Supply chain management (SCM) is applied in today's business world to optimise the flows of goods, information, and the financial flows within and between companies by functional and cross-company integration.[1] In the past, academic papers regarding SCM mainly dealt with the design and optimisation of the *flows of goods and information*.[2] The *financial flows* between companies of the supply chain, however, were often neglected and have only recently found greater attention in the academic SCM literature.[3]

This paper analyses the role of financial flows in supply chains and the impact SCM can have on optimising such flows in terms of capital cost.[4] A framework for the financial aspects of SCM is developed. Furthermore, a mathematical model is proposed to explain financing activities across supply chains, which are referred to as "supply chain financing" (SCF). The basic idea of the model is that supply chain information can be used to decrease investment risks and thus capital costs of financing projects within supply chains.

First, in this paper, supply chain flows are analysed, and the role of financial aspects are discussed on the basis of a preliminary review of related literature. It is shown that the cost of capital in supply chains has been mostly neglected so far. The following part of the discussion (Sect. 3) proposes a supply chain finance framework. It covers the objects, actors, and levers of supply chain financing. Finally, in part 4, a mathematical model is developed to better understand to what extent financial SCM can

H.-C. Pfohl (✉)
Chair of Management and Logistics,
Technical University of Darmstadt,
Hochschulstraße 1, 64289 Darmstadt, Germany
e-mail: pfohl@bwl.tu-darmstadt.de

M. Gomm
Momax GmbH,
Klappacherstr. 30, 64285 Darmstadt, Germany
e-mail: gomm@momax-gmbh.de

[1] Cf. [22, p. 32], [34, S. 1 ff], [43, p. 6 ff].

[2] Cf. [1, p. 40 ff], [30, p. 321 ff], [45, p. 18], [46, p. 1], [51, p. 30 ff]. An up-to-date summary of the empiric research regarding SCM can be found in [19, p. 417 ff].

[3] Cf. e.g. [20, p. 567 ff], [27, p. 104 ff], [51, p. 30 ff], [57], [59, p. 110 ff], [8, p. 44 f].

[4] This paper is based on the doctorate thesis of Moritz Gomm in German. [21].

contribute in decreasing the capital costs. The paper closes with a discussion of the results.

2 Literature review on financial flows in SCM

Supply chain management is an interdisciplinary management concept[5] which is based on the idea of holistic optimisation of the various flows constituting a supply chain. There are numerous suggestions about the kinds and levels of flows to be considered in the literature. Pfohl[6] distinguishes between flows of information, rights, goods and financial flows. Croom et al.[7] differentiate between goods, financial resources, human resources, information, knowledge, and technologies as "elements of exchange". Cooper et al.[8] include the flows of material, goods, and information in one direction, and reverse flows of information and financial resources. Mentzer et al.[9] consider products, services, information, financial resources, information about demand, and forecasts as "supply chain flows".

With respect to the range of activities covered in SCM, the *logistics channel* as well as the *marketing channel* are usually considered, i.e. the channel of interaction of a company with its sources of supply and sales markets.[10]

For the purposes of this discussion, the relevant fabric of flows is summed up under the notions of the flow of goods, the flow of information, and the financial flow, as shown in Fig. 1.

Reviewing the academic contributions on SCM regarding the optimisation of financial flows, again a number of different approaches are found.[11] Pfohl et al.[12] denominate the flow of financial resources as the "financial supply chain" and locate the latter at the interface between the fields of logistics and finance. They examine the management of the net current assets as an important issue within the scope of SCM.[13] Beyond the *optimisation of the flow of goods* with a focus on the physical reduction in stocks, they analyse the instruments of *cash management*. As primary levers for management, they consider optimal timing of activities, the control of receivables, liabilities, and advance payments. Moreover, the optimisation and support of the inventory and cash managements are described within the scope of *process management*.

Stemmler and Seuring[14] were amongst the first authors to use the term "supply chain finance". They speak of the control and optimisation of financial flows induced by logistics. Logistically induced financial processes comprise *inventory management*, the *handling of the logistically induced financial flows* as well as the *supporting processes* with an immediate reference to logistics as, for example, the insurance management for stocks.

Another approach to the optimisation of financial flows within supply chains is "logistics financing" as defined by Stenzel[15]: the "[…] active marketing of financial services in addition to logistics services by logistics service providers." This opens up another field of competence for logistics service providers within the scope of financing logistics structures.[16] In this context, Steinmüller[17] examines possibilities to finance logistics real estate and Feinen[18] particularly deals with the leasing of logistics real estates.

The term "Financial Chain Management (FCM)", which is also used in the context of financial flow research,[19] has to be seen in contrast to the term supply chain finance.[20] The former has particularly come to be known in literature and practice in connection to software products by SAP AG and is defined as the sum of the "financial flows in and across companies".[21] The processes that have to be managed by the FCM are thus reduced to the *processing steps of the business initiation and business transaction processes*.[22] FCM is supposed to optimize cross-company financial processes using collaborative and automatic transactions between suppliers, customers as well as financial and logistics service providers. Consequently, a decisive role is attributed to information and communication technology, so that mainly the flows of information or documents are affected.

A common ground for the contributions in the literature is the focus on the financial impact of SCM upon the value chain in terms of inventory, process, and cash management or by means of synchronisation and collaboration. These variables affect the free cash flow of each company involved by increased *sales or decreased costs* as well as the cost of capital by reduced *assets*. The explicit consideration of the influence of SCM measures on the *capital*

[5] Cf. [43, p. 6].
[6] [43, p. 6 ff].
[7] Cf. [12, p. 67 ff].
[8] [11, p. 10].
[9] [38, p. 19].
[10] Cf. [44, p. 168].
[11] Cf. [5, p. 574], [10], [8], p. 44 ff), [21], [25, p. 695 ff], [29].
[12] Cf. [46, p. 2 ff].
[13] Cf. [17, p. 149 f], [27, p. 103 f], [40, p. 123], [46, p. 2 ff].
[14] Cf. [51, p. 30 f].
[15] Cf. [52, p. 140].
[16] This contains according to [52, p. 142], logistics real estates, inventory, as well as logistics services to achieve financing effects.
[17] Cf. [50, p. 171 ff].
[18] Cf. [18, p. 187 ff].
[19] Cf. [42], [58, p. 74].
[20] Cf. [42], [58, p. 74].
[21] Cf. [42, p. 21].
[22] Cf. [42, p. 67].

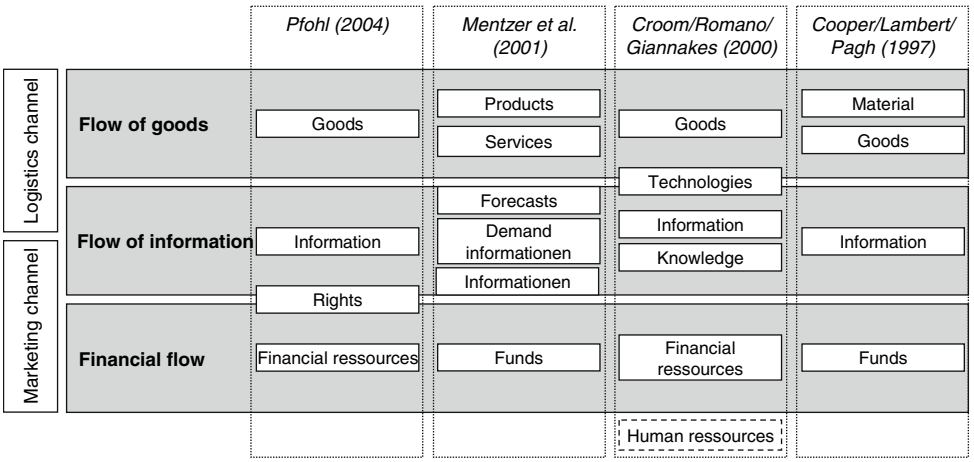

Fig. 1 Flows within supply chain management

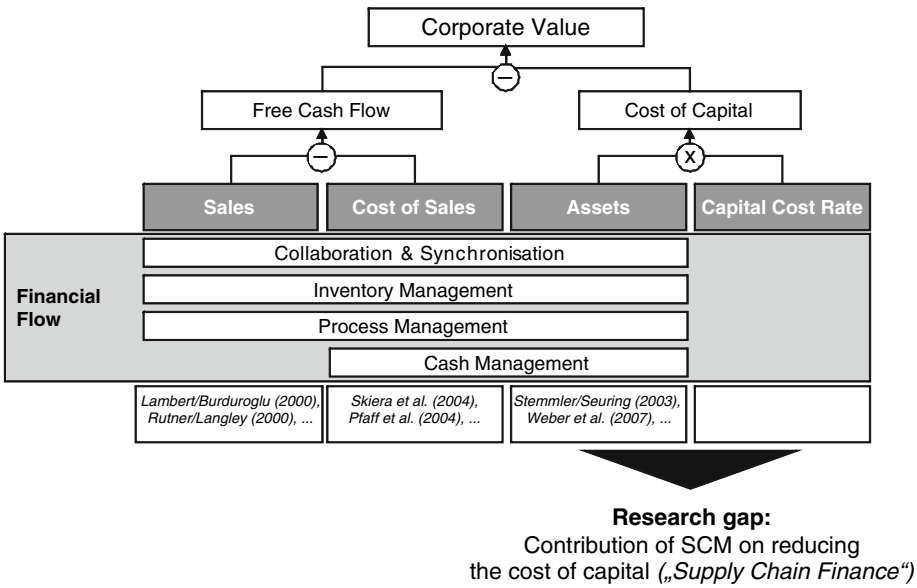

Fig. 2 Result of the analysis of literature concerning the influence of SCM on the corporate value and the gap of research

cost rate, however, has been lacking so far (cf. Fig. 2). Considering the growing importance of value orientation in management, this is methodically as well as practically critical since the capital costs are determined by the assets to be financed and the capital cost rate. This reveals a gap in research, which this paper targets at: how can SCM contribute to decrease the capital costs in terms of the capital cost rate.

The following part of the argument examine how the supply chain of a company can contribute to more cost-effective financing. Inter-company financing within the supply chain is called "supply chain finance" and is defined here as:

> Supply chain finance (SCF) is the inter-company optimisation of financing as well as the integration of financing processes with customers, suppliers, and service providers in order to increase the value of all participating companies.

The task of SCF is to save capital cost by means of better mutual adjustment or completely new financing concepts within the supply chain—eventually in combination with a changed role or task sharing. In order to substantiate this term, a conceptual framework will be developed in the following.

3 A conceptual framework of supply chain finance

In order to conceptualise the term supply chain finance, it has to be examined which **assets (objects)** within a supply chain are actually financed **by whom (actors)** and **on what terms (levers)**. These three dimensions add up to the

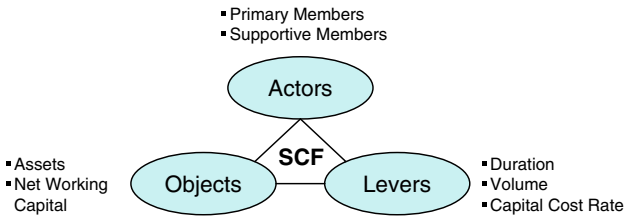

Fig. 3 Framework of supply chain finance

framework of the supply chain finance which is depicted in Fig. 3 as an overview and which is going to be illustrated in more detail in the following.

3.1 Objects of supply chain finance

Objects of finance may be *fixed assets*, i.e. those assets that permanently provide a basis for the business operations, and *working capital*, which is variable day-by-day.

According to Christopher,[23] *production facilities* and *stocks*, which build the logistics network, as well as the *equipment needed* for the customs clearance and the transport within this network, also rank amongst the fixed assets that are integrated into the supply chain. Since the supplier relationships of machines in industrial companies play an important role for the SCM as well, one also has to consider *machines*, i.e. technical facilities for the production.

The term working capital comprises all those asset items of the current assets that are retransformed into liquid assets within one production cycle or at least within one year.[24] The circulating assets minus the short-term liabilities are called the *net working capital*.[25] A key figure which—in this context—is suited for an examination of the cash flow is the cash-to-cash-cycle. The latter is calculated as follows[26]:

$$\begin{aligned}\text{cash-to-cash-cycle} = {} & \text{average turnover period} \\ & + \text{period of receivables} \\ & - \text{period of payables}\end{aligned}$$

The former indicates the period of time which is needed by a company to transform the cash drain resulting from paying the suppliers into cash inflow from the customers again. The cash-to-cash-cycle thus is a key figure to a dynamic and holistic treatment of the *net working capital performance*—both within the company and within the supply chain.[27]

3.2 Actors of supply chain finance

After having outlined the objects of supply chain finance, the actors within the supply chain that can take a share in financing have to be identified. Lambert et al.[28] refer to the suppliers, the customers, and the focal company of a supply chain as *primary members*, whilst logistics service providers are seen as *supporting members*. If one broadens the view of the supply chain concerning "delivery" of capital and financial services, the traditional circle of actors gets wider. Those range—according to Pfohl et al.[29]—amongst the "financial supply chain" and include financial intermediaries in the narrow as well as the broader sense.[30] According to the classification by Lambert et al., they are appointed to the *supporting members* of the supply chain.

Financial intermediaries in the narrow sense are specialised in the balance of asset and financial requirements between investors and acceptors within an economy based on division of labour.[31] Amongst these rank amongst others banking houses, insurances, leasing and factoring companies, as well as investment companies and private equity companies.[32] *Financial intermediaries in the broader sense* particularly offer performances in order to allow a completion of financial contracts between original and/or intermediary investors and acceptors or to effect this completion easier and cheaper, respectively.[33] This comprises the *procurement performances* of financial contracts, for example via brokers or stock markets, *information performances* in order to inform about existence and quality aspects of investors and acceptors (e.g. rating agencies) as well as the *risk assumption* of exactly specified risks of financial investments.[34]

If companies within a supply chain resume, the financing for others and thus replace classic financial intermediaries—banking houses in particular—one can refer to it as a form of disintermediation. In general, disintermediation denotes the omission of actors within a supply chain, as e.g. intermediary distributors or retail sellers. *Disintermediation in financing*—according to Löffler[35]—is the substitution of the traditional bank intermediation by

[23] [9, p. 87]. He speaks about "[…] plant, depots and warehouses that form the logistics network […]" as well as "[…] materials handling equipment, vehicles and other equipment involved in transport […]". See also [18, p. 193].

[24] Cf. [41, p. 152], [56, p. 176].

[25] Cf. [6], [26, p. 79], [31, p. 476], [48, p. 821].

[26] Cf. [54, p. 393].

[27] Cf. [16, p. 417].

[28] [34, p. 5 ff].

[29] [46, p. 15 f].

[30] Cf. [4, p. 15 ff].

[31] Cf. [2], [4, p. 14 f], [23, p. 193], [35, p. 382], [53, p. 105 ff].

[32] Cf. [15, p. 11].

[33] Cf. [4, p. 15 f], [15, p. 11].

[34] Cf. [4, p. 25 ff].

[35] [36, p. 53 as well as p. 64 f].

means of alternative forms of intermediation as regards the transformation of capital as to different amounts, periods, risks, and liquidity between investors and parties seeking capital.

The neoclassical financing theory, especially because of the rigid premise of the complete and perfect capital market, does not have the ability to explain the exchange of capital via financial intermediaries.[36] This only becomes possible by dint of the neo-institutional explanation approach, which assumes that the surplus cash flow of an investment is known beforehand and that there exist information asymmetries between investors and acceptors: the debtor usually knows more concerning the investment project and its prospects of success than does the lender.[37] On such an asymmetrical distribution of information, the financing thus is no longer to be seen as purchase (neoclassical execution via the market), but as relationship based on interaction or as a partnership. Jensen and Meckling[38] were the first to bring in these principal-agent aspects into the financing theory. On presuming endogenous uncertainty, asymmetrical information distribution, as well as incomplete markets and contracts, the allocation of capital on financial markets does not necessarily need to be Pareto efficient since transaction costs accumulate.[39]

3.3 Levers of supply chain finance

The **dimensions of financing** within supply chain finance comprise three aspects: which amount of assets (*volume of financing*) needs to be financed for how long (*duration of financing*) at which *capital cost rate*?[40] Multiplied with each other, the former add up for the capital costs that a company has to generate at least for the investment to be profitable:

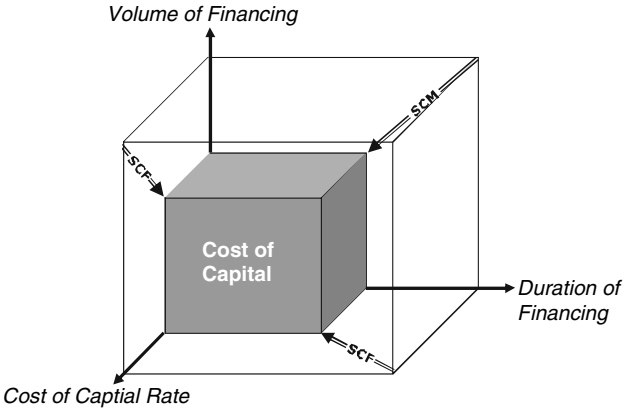

Fig. 4 Supply chain finance cube

$$\text{Capital costs}\,(€) = \text{Volume}\,(€) \times \text{duration time}) \times \text{capital cost rate}\,(\%/\text{time})$$

According to the value-oriented examination, the capital cost rate, which has to be used as a base, depends on the expected return of investment and risk expectance of the investors, on the demands of the outside creditors, as well as the financial structure of the company (Weighted Average Cost of Capital-approach).[41]

The three delineated aspects of the dimensions of financing can spatially be opposed to each other by the help of a "supply chain finance cube" (cf. Fig. 4). The cube indicates that SCM measures can apply to all three dimensions of the cube in order to reduce the capital costs within the supply chain. Classic SCM and logistics measures only apply to the extent and the duration of the financing, e.g. as regards to Just-in-Time-Production or other measures of stock optimisation. Supply chain finance, however, explicitly incorporates the capital cost rate of the financing in the examination as suggested in Fig. 4 by means of the arrows.

The central starting point for an inter-company optimisation of the financing within a supply chain beyond classical logistics measures is thus the capital cost rate. In the following, a model is presented, which demonstrates how the different refunding interest rates within a supply chain can be used in order to reduce overall financing costs.

4 A mathematical model of supply chain finance

4.1 Model overview

The subsequently developed mathematical model of supply chain finance is based upon the principle to benefit from information *within the supply chain* in order to decrease the

[36] Cf. [47, p. 69].

[37] Cf. [32, p. 107].

[38] [28, p. 305 ff].

[39] According to New Institutional Economics, there exist e.g. banking houses as control agents of the depositors who thus take over a quality transformation. Cf. [13], [14] as well as [36]. Moreover, financial intermediaries bear further transformation functions in oder to arrange a more efficient balance between asset requirements and financial requirements, cf. [4], p. 430 ff), [3, p. 120 ff], [4, p. 29 f], [15, p. 12 ff] as well as [13, p. 393 ff]. According to Löffler, financial intermediaries are thus more generally "[…] institutions to reduce financing costs under asymmetrical distribution of information."[7, p. 921], explains why the formation of financial intermediaries has to be seen as advantageously even from the point of view of the *capital seekers*. The transaction costs also play an important role for the explanation of the existence of financial intermediaries, cf. [15, pp. 28–30] and the literature quoted there.

[40] These dimensions can be found in similar styles elsewhere in corporate finance. Cf. [33, p. 1373].

[41] [39, p. 719 ff].

realised risk of a supply chain investment and the herewith combined expected rate on investment vis-à-vis the externals. It thus is assumed that there exist *information asymmetries* between companies *within* ("insiders") and *outside* ("outsiders") the supply chain and that these pieces of information cannot be communicated to actors outside the supply chain or can only be communicated on condition of high costs. The difficulty of information transfer in this case lies to a lesser extent in the technical aspects of transferring this information, but rather in the *principal-agent problem* between (external) investors and (internal) capital seekers. The model is based upon the presumptions of New Institutional Economics, especially on the asymmetric distribution of information and the danger of opportunistic behaviour.

The model includes *two actors of a supply chain* and an (external) *financial market* which offers both actors capital to unequal *interest rates* because of the differing company risks involved.[42] Within the supply chain, there exists another *investment alternative* ("project") that can be chosen by one of the two companies, but which could also be financed by the other actor. Due to their engagement in the supply chain and their connection to the project, both actors have *pieces of relevant information* that concern the risk related to the project and which are not as easy accessible outside the supply chain. The level of information of the actors (and thus their evaluation of the risk related to the project) can be altered by the help of *information transfer* within the supply chain. In doing so, information transfer implies the possibility to control the correctness of the information. The decision variables in the model, consequently, are (a) the decision concerning the (internal or external) financing bodies, (b) the requested financing rate, and (c) the allocation of information between the actors.

A **borrowing company** $\boldsymbol{N}$ wants to finance a "project" $\boldsymbol{P}$ with a demand for capital of one entity which is connected with its supply chain (e.g. a logistics real estate, a machine for the production or inventory stocks). $\boldsymbol{N}$ has information concerning the return on investment of the project which, however, it cannot—or only under prohibitively high costs—confer on an external investor: the company $\boldsymbol{N}$ knows that the project, independently from future conditions of the surroundings, has a rate of return of $r_{\mathbf{project}}$.[43] Let the project be so small relatively to the corporation that it has no consequences on the risk assessment of existing investors and outside creditors. Moreover, let the project be so small that a financing by dint of proprietary capital (e.g. by dint of new stocks) is not reasonable.[44] The company $\boldsymbol{N}$ has no free financial resources and only two financing options: The external investor $\boldsymbol{K}$ (financial market) or another company $\boldsymbol{G}$ from inside the supply chain (a supplier, customer, or logistics service provider). The project $\boldsymbol{P}$ in the model can only be realised to its full extent (investment of an entity) or not at all, and can only be financed completely either by $\boldsymbol{K}$ or $\boldsymbol{G}$.[45]

The moral hazard problem implicates that the external investor $\boldsymbol{K}$ cannot keep an eye on the investment process within the company.[46] The **prospective investor G from within the supply chain**, however, who is directly affected by the project $\boldsymbol{P}$ and involved in it respectively, can observe and evaluate the implementation and (at least partly) the success of the investment in $\boldsymbol{P}$. $\boldsymbol{G}$ has relevant information concerning $\boldsymbol{P}$ ($\boldsymbol{G}$ may for example deliver his goods to the *logistics real estate* $\boldsymbol{P}$, or be the provider for the *machine* $\boldsymbol{P}$, or be the provider for the *inventory stocks* with the value $\boldsymbol{P}$). Because of these pieces of information, $\boldsymbol{G}$ is able to calculate the success of the project $\boldsymbol{P}$ with a probability of $\boldsymbol{0 < p \leq 1}$. Examples for this better risk assessment and control of an actor *within* a supply chain are as follows:

- Better access to risk relevant information
- Higher competence for the evaluation of these pieces of information
- Better possibilities of control regarding the project
- Stronger possibility to take influence on the project risk
- Better access to the financing project (right of disposal)
- Better possibility of disposal of the financing object by third persons
- Implementation of positive external effects (as creditor or co-owner)

The advantage of the investor within the supply chain can also be systematised on the basis of the characteristics of the principal-agent theory. Thus, the *hidden characteristics*, which are of importance before closing the contract, are minimised by the help of the insight in structures and processes of the capital seeker. The problem of *hidden intentions*, which continues even after the conclusion of the contract, is reduced by dint of the existing confidence, the importance of the business connections on the operative

[42] In SCM research usually two members models of supply chains are used. A good overview over such a 2-actor-model can be found in [55, p. 13 ff].

[43] The one period approach in this case means no restriction since the rate of return could also be interpreted as actual cash value. The "statics" of the model refer to the moment of financing and of investment which, in the basic model—can only be made once (at the beginning).

[44] As an alternative, it could be assumed that the life span of the project is limited, so that a financing by means of additional proprietary capital is not reasonable. But this assumption is difficult to hold up e.g. concerning logisitcs real estates.

[45] This restriction eliminates the possibility of mixed financing that does not limit the results and the informational value of the model.

[46] Cf. [60, p. 508 f].

Table 1 Characteristics of the principal-agent-theory and supply chain advantages

	Hidden characteristics	Hidden intention	Hidden information	Hidden action
Point in time	Before conclusion of contract	Before or after conclusion of contract	After conclusion of contract, before decision	After conclusion of contract, after decision
Reason	Ex ante hidden characteristics of the agent	Ex ante hidden intentions of the agent	Level of information of the agent that is not observable	Activities of the agent that are not observable
Problem	Agreement of contractual relationship	Implementation of implicit claims	Evaluation of results	Evaluation of comportment and performance
Danger	Unstableness of quality, adverse selection	Hold up	Moral hazard, adverse Selection	Moral hazard, shirking
Supply chain advantage	Insight in structures and processes	Confidence, business connection, dependence	Insight in structures and processes, information systems	Insight in project, possibilities of sanctioning

Source: With supplementations from [47, p. 79]

level, and the mutual dependency of the actors. *Hidden information* also play a minor role between two actors of the supply chain due to the connection of investor and investment project via the flows of goods and information. The danger of *hidden actions* is smaller for the investor within the supply chain, since he has an insight in the investment project and efficient possibilities of sanctioning regarding the flows of goods and information. The characteristics of the principal-agent theory, the herewith connected problems and dangers, and the advantage of supply chain actors opposite to externals summarise Table 1.

The level of information of G may be fully described by p, and the project P may be the only investment alternative for G. G does not have own free financial resources neither and might borrow capital from the investor K in order to finance the project. Likewise, P may be so small relatively to the corporation that it neither influences the risk assessment of its investors and its outside creditors nor does a borrowing of proprietary capital for its financing seem reasonable.

If G finances project P, G may have an additional positive external effect (benefit) y due to its role as investor.[47] This **benefit** y is thus not connected to the rate of return for the financing, but has an indirect (external) effect as, for example, a higher level of customer loyalty regarding N. In this example, y may be the part of the future discounted cash flows which results from a better and/or longer customer relation.[48] Moreover, it is assumed that G acquires certain rights and possibilities of monitoring due to the financing of P which it does not have if P is financed by K.

The **investor K from outside the supply chain** (financial market) cannot judge the probability of success of P, but only knows the general risk of the two companies N and G, reflected in a financing interest of i_N (for N) and i_G (for G), respectively.[49] First of all, it is assumed that the financial reliability of G is higher than the one of N, so that $i_G < i_N$ applies.[50] The companies N and G do each have a credit crunch of one entity, i.e. they can never borrow more than one entity per period at an interest rate i_G and i_N, respectively.[51] If G finances project P, this requests a rate of return of r_G that depends on i_G and p, $r_G = r_G(i_G, p)$, i.e. all in all, a rate of return of i_G plus an extra risk charge depending on p is requested.

The situation of the three actors regarding P can be summarised as follows: G has more information concerning project P than K, but generally less information than N, or put in other words: K is—as far as the examined supply chain and project P are concerned—an "outsider", N an "insider", and G a "partial insider".

The decision makers within companies are employed to maximise the rate of return of the proprietors ("value orientation").[52] It is assumed that the proprietors have adequate incentive systems in place, which are not going to be discussed here. G expects a risk-adequate rate of interest of the project P, i.e. $r_G * p + y \geq i_G$ has to apply. It is assumed that G cannot judge the rate of return $r_{project}$ of the project P concerning its amount, but that G knows that it suffices

[47] This benefit thus does not exist if N finances the project via K.

[48] y can also be interpreted as positive (external) image effect since N delegates the financing of P to G (G could e.g. be a logistics service provider who takes over a real estate from N and organises the latter). The advantage of a financing by G results from third-party business in which the (better) image plays a role.

[49] Thus, neither can G transfer his information of p nor can transfer N his information of $r_{project}$ on the investor K in order to decrease the costs of financing; or the transfer is prohibitively expensive.

[50] This means that G either is a very large or risk-free company, while N e.g. is a smaller company, or it is in a sector of higher volatility.

[51] This can be achieved by precise additional conditions which do not influence the result of the survey on hand, as described in [49, p. 111].

[52] Out of this follows amongst other that the error rate regarding the expected rate of return of the managers is minor to the one of the external investors. For this purpose cf. [7, p. 916].

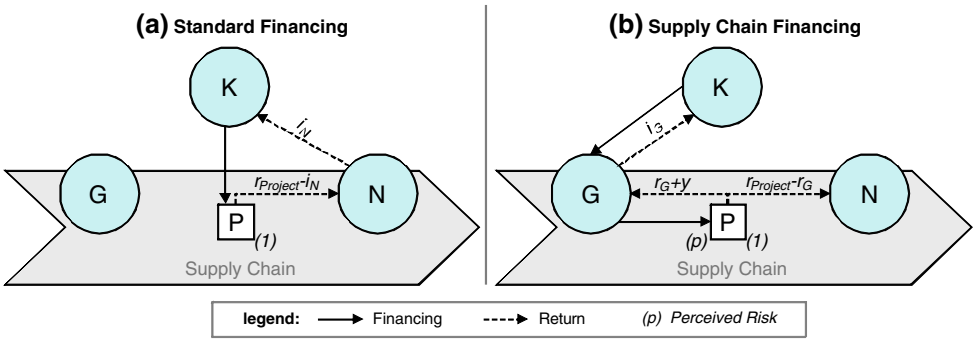

Fig. 5 Standard Financing (**a**) and basic model of supply chain finance (**b**)

in case of a successful project P to at least serve r_G. For a simpler illustration of the model, it, firstly, is assumed that concerning the profitability of the project P, the company G only knows that, as the case might be, the former is enough to pay the claimed rate of return r_G.[53] Thus, the company N is only going to communicate r_G, even if the actual rate of return of P is higher. For this reason, G at all times only receives r_G for which the equation $r_G{*}p + y = i_G$ is valid. The basic model is reproduced in Fig. 5.

The basic model is a *static model* with only one financing period, i.e. the financing decision is made at t_0 and at t_1, the returns from the projects are realised, and all debts paid off. Before the financing decision, i.e. at t_0, N can ask if G accepts the financing of the project P, and G states his demanded risk-adjusted rate of return. Then, N has still time to transfer information before t_0 to G,[54] before a final decision concerning the financing has to be made.

The questions to examine thus are as follows:

- under which conditions $(r_{project}; p; y; i_N; i_G)$ does a supply chain financing come about, i.e. that N does not borrow the assets from the investor K, but that G finances the project P?
- What is the rate of return r_{G_total} expected by G for the supply chain financing?

4.2 A static one period model without information costs

At first, it is assumed that the transfer of information between G and N is at no charge. Moreover, it is assumed that y is, indeed, larger than zero, but so small that it can be neglected compared to the financing effect. But the value y be still so large that G finances the project P even if $r_G{*}p - i_G = 0$ applies, and G thus neither makes losses nor profits from the supply chain financing. To simplify matters, **y** is not further going to be mentioned explicitly until it becomes itself object to the analysis at the end of this section.

In the basic model, G always opts for project P if it expects no obsolescence, i.e. if the following can be applied:

$$r_G \times p \geq i_G, \text{ i.e. } G \text{ has an overall rate of return in } t_1 \text{ of } r_{G\_total} \equiv \text{Max}[r_G \times p - i_G, 0] \quad (1)$$

Thus, if the risk-adjusted rate of return r_G from project P is larger or equal to the capital costs i_G. Financing its project by the help of G instead of by the investor K is profitable for N if the following applies:

$$r_{project} - r_G > ; r_{project} - i_N > 0, \text{ i.e. } N \text{ has an overall rate of return in } t_1 \text{ of } r_N \equiv \text{Max}[r_{project} - r_G, r_{project} - i_N] \quad (2)$$

SCF is realised if the Eqs. 1 and 2 are fulfilled simultaneously. From (2) follows that $r_G < i_N$ has to apply at the least.

We are now going to observe two extreme cases concerning the expectations of G on the success of the project P, i.e. extreme values for p:

(a) If G knows the reflux as well as **N** does, so if $p = 1$, there is no risk concerning P from its point of view, and thus G accordingly expects no risk charge. Since, as a "supply chain insider", G cannot transfer this knowledge to external investors, it must at least demand for its own capital costs i_G, so $r_G \geq i_G{*}p = i_G{*}1$. As—in the basic model—company G is, by definition, ready to finance if it does not loose from it, at the point $p = 1$, the equation $r_G = i_G$ applies.

(b) With a certain probability $p_{\min}$, the rate of return expected by G is as high as the one by the external investor K $(r_G = i_N)$, so that the SCF is not profitable for N beneath this point $p_{\min}$. $p_{\min} = i_G/i_N$ since for smaller p in Eq.1 is not met.

[53] This assumption implicates that—if N is able to achieve surplus returns by the help of G–G cannot claim a share in it, even though it theoretically could enforce it. G thus does not negotiate regarding the basic model.

[54] "Information transfer" means that G does not only obtain more and better information concerning project P, but also that G is able to better observe and evaluate all actions and results concerning P (monitoring), e.g. by the possibility of accession to the project.

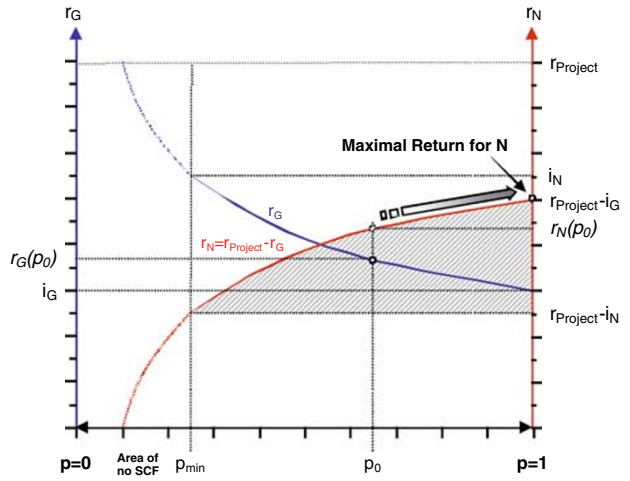

Fig. 6 Rate of return maximum for N and interest rate arbitrage to realise (*shaded area*) in the model without costs of information

For all values of p within the interval $[p_{\min}, 1]$ thus applies $i_N \geq r_G \geq i_G$, and the risk-adequate rate of return r_G claimed by G tends steadily downwards. The overall rate of return r_N of N according to this increases steadily and for all $p > p_{\min}$ applies $r_N = r_{project} - r_G > r_{project} - i_N$. According to the model assumptions, supply chain financing occurs in the interval $[p_{\min}, 1]$ (cf. Fig. 6).

All points (p, r_G) on the curve, to which applies $r_G{*}p = i_G$, are equivalent for G, i.e. G is indifferent concerning all p as long as it obtains the appropriate risk-adequate rate of return $r_G = i_G/p$. To the point of decision t_0, G has a level of information p_0, so that it expects a rate of return of $r_G = i_G/p_0$ for the financing of P. For N, there arises a rate of return of $r_N = r_{project} - r_G = r_{project} - (i_G/p_0)$. In order to increase its rate of return r_N, N is going to try to increase the perceived probability of success p of the company G by means of information transfer and so as to reduce its risk premium r_G. Since r_G decreases strictly monotonously in the interval $[p_{\min}, 1]$, the point of minimum capital costs for N within the simple basic model is $(1, i_G)$. N consequently continues to give further information (in the basic model free of charge) to G, until G has the same (complete) level of information as N and also knows with certainty $(p = 1)$ that the project P is successful. Thus, G also is a complete "insider" concerning project P, and r_G as well as i_G are identical, i.e. G obtains a rate of return from P of $r_{G\_total} = r_G - i_G = 0$ (plus the assumed, very small benefit y) and N a rate of return of $r_N = r_{project} - i_G$.[55] The (petty) rate of return maximum for N in the basic model without costs of information consequently lies at the verge of the interval $[p_{\min}, 1]$, as shown in Fig. 6.

[55] That company N can retain the complete surplus rate of return opposite to a financing by K is due to the assumed willingness of G to finance, even though he does not profit from it himself.

The entire interest rate arbitrage within the supply chain between i_N and i_G (shaded area) is thus realised by N if the sum of positive effects y for G is not taken into account.

4.3 A static one period model with information costs

The assumption that the generation and transfer of information between N and G concerning the probability of success of the project P be at no charge is hardly maintainable in practice. Hence, another variable c for the costs of information is introduced into the model. The costs of information could in principle accumulate either for G or for N or could be distributed on both. But finally, they will always be passed onto N because firstly, N is interested in transferring information and secondly—if G had to bear the costs—it would make N pay them in addition to the premium r_G.

It is assumed that each piece of information that increases p about the rate Δp costs an unchanging amount $c = c(\Delta p) = \Delta p{*}C$ of the costs of all pieces of information (C).[56] At the point of decision t_0, the company G—due to its position within the supply chain—already has a certain amount of information, which must no longer be transferred and, consequently, is not relevant regarding the costs. This "starting point" is identified by p_0.[57] The level of information after the information transfer be p_0', thus $\Delta p = p_0' - p_0$.

At the point of decision t_0, N has to ask the question if—regarding the given level of information—it is worthwhile to transfer information to G in order to decrease the noticed project risk of G and thus the capital costs r_G. Since the information transfer now is no longer free of charge, there exists a trade-off between the costs of further information transfer to the amount of $\Delta p{*}C$ and the increase in the rate of return by means of the reduction in the capital costs to the amount of $r_G(p_0', i_G) - r_G(p_0, i_G)$, whereas $p_0' > p_0$. For N, the transfer of further information is profitable as long as the marginal costs are smaller than the marginal rate of return. The maximum rate of return (i.e. the level of information concerning G that is the optimum for N) is termed p_{infopt} and is the osculation point of the rate of return curve with the slope of the information cost straight line.[58] In order to calculate this point, the first derivations of the two functions have to be equated and solved to p:

[56] Using a curved function for the cost of information transfer leads to the same fundamental results but complicates the calculation at this point.

[57] Consequently, in order to get complete information, only the costs in the amount of $(1 - p_0){*}C$ would be necessary.

[58] This optimum is annotated with the index *"infopt"* because it is the maximum rate of return to strive for if the overall rate of return of N can be increased by further information transfer. In the following, it will be notified that—depending on the point of departure—there exist different maxima.

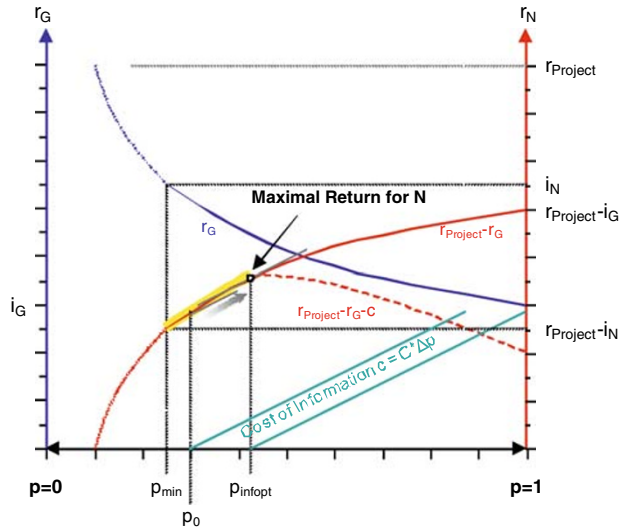

Fig. 7 Development of the rates of return in the model with information costs

$$r_N(p) = r_{\mathbf{project}} - r_G(p) \left| \frac{\mathrm{d}r_N}{\mathrm{d}p} \overset{!}{=} c(p) \right| \frac{\mathrm{d}c}{\mathrm{d}p}$$

By means of employing of $\boldsymbol{r_G = i_G/p}$ and $\boldsymbol{c = \Delta p^{*}C}$, it follows:

$$r_{\mathbf{project}} - r_G(p) \left| \frac{\mathrm{d}r_N}{\mathrm{d}p} = \frac{i_G}{p_{\mathrm{infopt}}^2} \overset{!}{=} C = c(p) \right| \frac{\mathrm{d}c}{\mathrm{d}p}$$

By means of solving and transforming the equation, one gets the point $\boldsymbol{p_{infopt}}$:

$$p_{\mathbf{infopt}} = \sqrt{\frac{i_G}{C}}$$

For all levels of information $\boldsymbol{p_0}$ that are located left of $\boldsymbol{p_{infopt}}$, it is profitable for $\boldsymbol{N}$ to transfer further information and to thus decrease the rate of return request of $\boldsymbol{G}$ furthermore. The rate of return maximum can be graphically detected by displacing the information cost straight line in a parallel way until it affects the rate of return curve of $\boldsymbol{N}$. As shown in Fig. 7, the overall rate of return of $\boldsymbol{N}$ increases to this point $\boldsymbol{p_{\mathbf{infopt}}}$. It should be pointed out that also concerning the points $\boldsymbol{p_0 < p_{\mathbf{min}}}$, it is profitable to transfer information until $\boldsymbol{p_{\mathbf{infopt}}}$ is reached.

If the level of information of $\boldsymbol{G}$ to the point of decision (accidentally) corresponds exactly to $\boldsymbol{p_{\mathbf{infopt}}}$, no amelioration is possible because the transfer of further information costs more than it saves regarding the capital costs. For all starting points $\boldsymbol{p_0 > p_{\mathbf{infopt}}}$, the capital costs $\boldsymbol{r_G}$ decrease by means of information transfer by each $\boldsymbol{\Delta p}$, but they are always more then compensated by the costs of the information transfer $\boldsymbol{\Delta p^{*}C}$. A movement in the other sense, i.e. a reduction in $\boldsymbol{p}$, is not possible, neither because information that at the point of decision $\boldsymbol{t_0}$ already is at hand for $\boldsymbol{G}$ and can neither be "taken away" by $\boldsymbol{N}$, nor can they be returned into revenues. In the static model (i.e. with only one period) with charged information transfer, every starting point $\boldsymbol{p_0}$ to the right of point $\boldsymbol{p_{\mathbf{infopt}}}$ simultaneously is the rate of return maximum for $\boldsymbol{N}$.[59] The point $\boldsymbol{p_{\mathbf{infopt}}}$ depends not only on the level of information $\boldsymbol{p_o}$ but also on the slope $\boldsymbol{c}$ of the information cost curve, thus smaller $\boldsymbol{c}$ (e.g. by a collaborative SCM-IT) have a positive effect on the competitiveness of supply chain financing.

4.4 The impact of external effects

Up to now, it has been assumed that the additional benefit (external effect) from the financing $\boldsymbol{y}$ is very small for $\boldsymbol{G}$. It shall now be shown that, with a sufficiently large $\boldsymbol{y}$, a supply chain financing can also be advantageous for both sides if the refinancing rate of $\boldsymbol{G}$ is larger than $\boldsymbol{N}$, i.e. if $\boldsymbol{i_G > i_N}$ applies. Examples for the benefit $\boldsymbol{y}$ are as follows:

- $\boldsymbol{G}$ can campaign with the fact that it can cover the financing for other, important companies like $\boldsymbol{N}$. This signal can have a positive effect on the *image* of the company on the market.
- $\boldsymbol{G}$ can get important *information* by the help of $\boldsymbol{P}$, which it can use in other areas, (for example, in the marketing sector or in research and development). This would e.g. be the case if $\boldsymbol{G}$ financed its products by the help of $\boldsymbol{N}$ and could learn more about its use in practice at the customer in return.
- $\boldsymbol{G}$ gains so much *influence* on the project by financing $\boldsymbol{P}$ and the rights connected to it that it can optimise its own value added without decreasing the benefit of the project for $\boldsymbol{N}$.
- $\boldsymbol{G}$ can achieve *synergies or diversification effects* with other financed projects in other companies by means of the financing of $\boldsymbol{P}$.
- $\boldsymbol{G}$ can—by means of the contractual framework of the SCF—complicate the access of its competitors regarding $\boldsymbol{P}$ and thus increase customer loyalty.

If the benefit $\boldsymbol{y}$ is large enough for $\boldsymbol{G}$, $\boldsymbol{G}$ would even finance $\boldsymbol{P}$ if $\boldsymbol{r_G{}^{*}p < i_G}$, as long as $\boldsymbol{r_{G\_total} = r_G{}^{*}p + y \geq i_G}$ applies. From the point of view of $\boldsymbol{G}$, the external effect

[59] The model is thus consistent with the intuitional insight that information are only valuable if other do not (yet) possess them. Due to the transfer (against payment), they lose their value for the sender as regards the receiver. However, the pieces of information could still continue to be valuable for the owner if he can sell them to third persons.It should be noted that there also are combinations in which there is absolutely no possibility for an optimisation by the help of information transfer. This always is the case if due to the parameters $\boldsymbol{i_N}$, $\boldsymbol{i_G}$ and $\boldsymbol{r_{\mathbf{project}}}$, the point $\boldsymbol{p_{\mathbf{min}}}$ is bigger than $\boldsymbol{p_{\mathbf{infopt}}}$ and the level of information $\boldsymbol{p_0}$ of $\boldsymbol{G}$ is smaller than $\boldsymbol{p_{\mathbf{min}}}$.

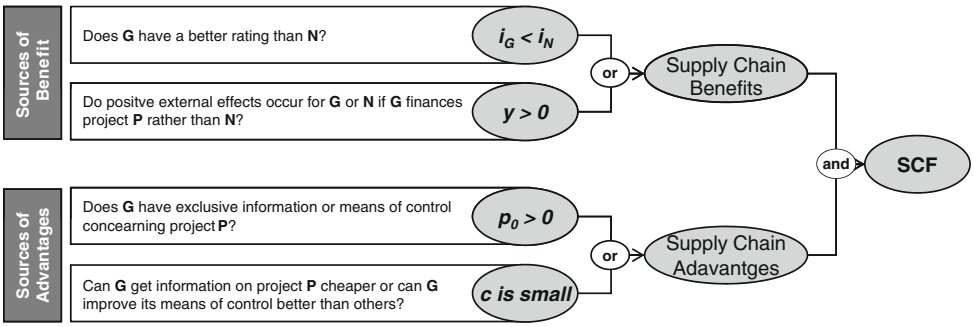

Fig. 8 Heuristic framework of the supply chain finance

corresponds to a shift of the benefit or rate of return curve upwards by y. Thus, the raising of capital by G at i_G and the transfer of the capital at an interest rate of $r_G < i_G$ can be profitable as long as $r_G{*}p + y \geq i_G$ can be applied. **N** then benefitted from the more favourable capital that is virtually "subsidised" by one share of the benefit y, which G can only realise by his financing of P and transfer to N for it. Thus, SCF is also profitable when there is a sufficiently high y also for interest rate combinations with $i_G > i_N$. Since the slope of r_G stays the same for each p the optimal point of information transfer p_{infopt} is not influenced by y.

5 Discussion and conclusion

SCF turns the actors within the supply chain into intermediaries who can partly overcome the problem of asymmetric information between capital markets (e.g. banks) and the parties seeking capital. The model shows that SCF is profitable for both sides under certain general conditions $(r_{\text{project}}, r_Q, i_N, i_G, p, y)$ at a rate of return r_G. Moreover, the model is able to show under which circumstances $(p, c(p, \Delta p))$ an additional transfer of information is profitable and when not.

The variables of explication of the model can be divided into two groups. On the one hand, there are the variables which show the **benefit of the investor** G in a supply chain. The latter are as follows:

- The difference between the interest rates of refinancing of the companies i_G and i_N *(arbitrage of financing)* as well as
- the operational benefit of a SCF y for G *(external effects of the SCF).*

Moreover, the investor G and the capital seeker N can have comparative **supply chain advantages** concerning the transfer of information for an evaluation of the investment risk, which third-party persons (outside the supply chain) do not possess:

- the *level of information* p_0 of the potential investor G within the supply chain as well as
- the possibility of a cheap *information transfer* within the supply chain at costs c.

The interaction of these four variables of explanation is depicted in Fig. 8. In this context, it can be seen that, according to the model, there must exist at least each of the two sources of benefit and advantage in order to achieve a SCF.

The results of the model show that a SCF is all the more probable and profitable respectively, the more the company G knows about the project P at the point in time t_0. It also intuitionally is reasonable since this knowledge p_0 is valuable if it can be used for a determination of the risk-adequate financing rate of return. But these pieces of information are only free of charge as long as they need not be transferred to another actor outside the supply chain. The results thus point to the fact that SCF is more beneficial for companies that are strongly integrated within the supply chain and have a high level of cooperation or collaboration. The approach of SCF thus also confirms the two agency cost-saving factors "monitoring" and long-term "commitment" identified by Hellwig.[60] Both factors exist between collaborating supply chain partners to a rather large extent. Mayer[61] also points to the latter. Diamond[62] argues in a similar way in saying that reputation being a "valuable asset" regarding financing.

So far the model has only been tested in a qualitative approach on a variety of practical financing scenarios in supply chains by Gomm.[63] These scenarios included financing of net working capital (e.g. by means of vendor-managed inventory, VMI, or cash-cycle optimisation) as well as financing of assets such as machines and logistics real estate (e.g. by means of pay-on-production schemas). The model was able to explain most of the net working capital financing as well as financing of movable assets. Financing of logistics real estate within supply chains could not be explained by the model. Gomm concludes that

[60] Cf. [24, p. 46].
[61] Cf. [37, p. 1178].
[62] Cf. [14, p. 852].
[63] Cf. [21].

risks in logistics real estate financing are more dependent on the market for real estate in the respective regions and much less on information from the specific supply chains involved.

A valuable field of further research in supply chain finance is a quantitative test of the model using data from a variety of corporate projects. From the organisational point of view, more evidence is needed in regard to the implementation of supply chain finance projects, e.g. involved parties, organisational structures, and appropriate processes. Furthermore, it would be very beneficial to analyse the influence of the specific market environment especially the chances and risks of supply chain finance for companies in times of economical slowdown.

Appendix: Model variables

P	A supply chain-related project
N	A company in the supply chain with demand for project P (e.g. N is an OEM)
G	A company in the supply chain related to P, thus having revenue-relevant information on P (e.g. G is a supplier of N)
K	A source of capital for N and G (e.g. K is a bank)
i_N	Interest rate of K for N
i_G	Interest rate of K for G
y	Benefit from positive effects for G if G finances project P
c	Marginal costs for transferring information on P from N to G
r_{project}	Rate of return of project P
p	Probability of project P success from the point of view of G ($0 < p \leq 1$)
r_G	Expected rate of return of G from N for financing project P
r_{G_total}	Overall rate of return of G
r_N	Overall rate of return of N
C	Cost for all information on project P

References

1. Avanzo R, Von Lewinski H, Van Wassenhove LN (2003) The link between supply chain and financial performance. Supply Chain Manag Rev 7(6):40–47
2. Baltensperger E (1980) Alternative approaches to the theory of the banking firm. J Monet Econ 6(1):1–37
3. Bessler W (1999) Bank: Theoretische Fundierung. In: Cramer JE, Dietz A, Fischer TR, Kohlhausen M, Köpfler T, Mathes M, Neuber F, Thiermann B (Hrsg.) Knapps Enzyklopädisches Lexikon des Geld-, Bank- und Börsenwesens, Band 1: A-I, Frankfurt am Main, pp 114–131
4. Bitz M (2005) Finanzdienstleistungen. 7., unwesentl. veränd. Aufl. München, Wien
5. Bohlmann B, Müller B (2006) Wertmanagement in der Logistik. Int Verkehrswesen 58(12):584–590
6. Brealey RA, Myers SC (2000) Principles of corporate finance. 6. Aufl. Boston u.a
7. Campbell TS (1979) Optimal investment financing decisions and the value of confidentiality. J Financ Quant Anal 14(5):913–924
8. Ceccarello C, Neser G, Pestre C, Roman N, Poisson V (2002) Financial indicators and supply chain integration: a European study. Supply Chain Forum 3(1):44–52
9. Christopher M (2005) Logistics and supply chain management—strategies for reducing cost and improving service. 3. Aufl. London u. a
10. Christopher M, Ryals L (1999) Supply chain strategy: its impact on shareholder value. Int J Logist Manag 10(1):1–10
11. Cooper MC, Lambert DM, Pagh JD (1997) Supply chain management: more than a new name for logistics. Int J Logist Manag 8(1):1–13
12. Croom S, Romano P, Giannakis M (2000) Supply chain management: an analytical framework for critical literature review. Eur J Purch Supply Manag 6(1):67–83
13. Diamond DW (1984) Financial intermediation and delegated monitoring. Rev Econ Stud 51(3):393–414
14. Diamond DW (1989) Reputation acquisition in debt markets. J Polit Econ 97(4):828–862
15. Disselbeck K (2007) Die Industrialisierung von Banken am Beispiel des Outsourcings. Frankfurt am Main 2007
16. Eitelwein O, Wohlthat A (2005) Steuerung des working capital im supply chain management über die cash-to-cash cycle time. Zeitschrift für Control Manag 49(6):416–425
17. Ester B, Baumgart G (2000) Cash-flow Aspekte bei der Supply-Chain-Gestaltung. In: Pfohl H-C (Hrsg.) Supply chain management: Logistik plus? Logistikkette, Marketingkette, Finanzkette. Berlin, pp 141–160
18. Feinen K (2003) Leasing von Logistik-Immobilien. In: Bundesvereinigung Logistik e.V. (BVL) (Hrsg.) Finanzierung—eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Berlin, pp 187–200
19. Fettke P (2007) Supply chain management: Stand der empirischen Forschung. Zeitschrift für Betriebswirtschaft 77(4):417–461
20. Franke J, Pfaff D, Elbert R, Gomm M, Hofmann E (2005) Die Financial Chain im Supply Chain Management: Konzeptionelle Einordnung und Identifikation von Werttreibern. In: Ferstel OK, Sinz EJ, Eckert S, Isselhorst T (Hrsg.) Wirtschaftsinformatik 2005—eEconomy, eGovernment, eSociety. Heidelberg, pp 567–584
21. Gomm M (2008) Supply Chain Finanzierung—Finanzierung in unternehmensübergreifenden Wertschöpfungsketten. Berlin
22. Göpfert I (2002) Einführung, Abgrenzung und Weiterentwicklung des Supply Chain Managements. In: Busch A, Dangelmeier W (Hrsg.) Integriertes Supply Chain Management—Theorie und Praxis effektiver unternehmensübergreifender Geschäftsprozesse. Wiesbaden 2002, pp 25–44
23. Gurley JG, Shaw ES (1960) Money in a theory of finance. Washington D.C
24. Hellwig M (1991) Banking, financial intermediation, and corporate finance. In: Giovannini A, Mayer C (Hrsg.) European financial integration. Cambridge, pp 35–63
25. Hendricks KB, Singhal VR (2005) Association between supply chain glitches and operating performance. Manag Sci 51(5):695–711
26. Hofmann E (2003) The flow of financial resources in the supply chain: creating shareholder value through collaborative cash flow management. In: Kotzab H (Hrsg.) 8th ELA Doctorate workshop 2003. Brüssel, pp 67–94

27. Hofmann E, Elbert R (2004) Collaborative cash flow management. Financial Supply Chain Management als Herausforderung der Netzkompetenz. In: Pfohl H-C (Hrsg.) Netzkompetenz in Supply Chains—Grundlagen und Umsetzung. Wiesbaden, pp 94–117
28. Jensen M, Meckling W (1976) Theory of the firm: managerial behavior, agency costs, and ownership structure. J Financ Econ 3(4):305–360
29. Karrer M (2006) Supply chain performance management. Entwicklung und Ausgestaltung einer unternehmensübergreifenden Steuerungskonzeption. Wiesbaden
30. Keebler JS (2000) Financial issues in supply chain management. In: Mentzer JT (Hrsg.) Supply chain management. ORT, pp 321–345
31. Keown AJ, Scott DF, Martin JD, Petty JW (1994) Foundations of finance. The logic and practice of financial management. Englewood Cliffs
32. Krahnen JP (1985) Kapitalmarkt und Kreditbank. Untersuchungen zu einer mikroökonomischen Theorie der Bankunternehmung. Berlin
33. Kümpel T (2006) Konzeptionelle Grundlagen der Rechnungslegung nach IFRS. Das Wirtschaftsstudium 35(11):1373–1377
34. Lambert DM, Cooper MC, Pagh JD (1998) Supply chain management: implementation issues and research opportunities. Int J Logist Manag 9(2):1–19
35. Leland HE, Pyle DH (1977) Informational asymetries, financial structure, and financial intermdediation. J Financ 32(2):371–387
36. Löffler E (1991) Der Konzern als Finanzintermediär. Wiesbaden
37. Mayer C (1988) New issues in corporate finance. Eur Econ Rev 32(5):1167–1183
38. Mentzer JT, DeWitt W, Keebler JS, Min S, Nix NW, Smith CD, Zacharia ZG (2001) Defining supply chain management. J Bus Logist 22(2):1–25
39. Miles J, Ezzell J (1980) The weighted average cost of capital, perfect capital markets and project life: a clarification. J Financ Quant Anal 15:719–730
40. Partsch W (2000) Free cash flow—Management des Nettoumlaufvermögens in der Supply Chain. In: Pfohl, H-C (Hrsg.) Supply Chain Management: Logistik plus? Berlin, pp 119–140
41. Perridon L, Steiner M (2004) Finanzwirtschaft der Unternehmung. 13., überarb. u. erw. Aufl. München
42. Pfaff D, Skiera B, Weiss J (2004) Financial supply chain management. Bonn
43. Pfohl H-C (2000) Supply chain management: Konzepte, Trends, Strategien. In: Pfohl, H-C (Hrsg.) Supply chain management: Logistik plus? Logistikkette—Marketingkette—Finanzkette. Berlin, pp 1–42
44. Pfohl H-C (2004) Logistikmanagement. Konzeption und Funktionen. 2., vollst. überarb. und erw. Aufl. Berlin
45. Pfohl H-C, Elbert R, Gomm M (2006) Supply chain finance—Antwort auf die Forderung nach einer wertorientierten Logistik. In: Wolf-Kluthausen H (Hrsg.) Jahrbuch Logistik 2006. Korschenbroich
46. Pfohl H-C, Elbert R, Hofmann E (2003) Financial supply chain management. Neue Herausforderungen für die Finanz- und Logistikwelt. Logistik Manag 5(4):10–26
47. Schäfer H (2002) Unternehmensfinanzen. Grundzüge in Theorie und Management. 2. überarb. u. erw. Aufl. Heidelberg
48. Scherr FC (1989) Modern working capital management. Englewood Cliffs
49. Stein JC (1997) Internal capital markets and the competition for corporate resources. J Financ 52(1):111–133
50. Steinmüller T (2003) Finanzierung von Logistik-Immobilien. In: Bundesvereinigung Logistik e.V. (BVL) (Hrsg.) Finanzierung—eine neue Dimension der Logistik. Ergebnisse des Arbeitskreises Logistik und Finanzen. Berlin, pp. 171–186
51. Stemmler L, Seuring S (2003) Finanzwirtschaftliche Elemente in der Lieferkettensteuerung. Erste Überlegungen zu einem Konzept des Supply Chain Finance. Logistik Manag 5(4):27–37
52. Stenzel J (2003) Finanzierung als Dienstleistungskomponente. In: Bundesvereinigung Logistik e.V. (BVL) (Hrsg.): Finanzierung—eine neue Dimension der Logistik: Ergebnisse des Arbeitskreises Logistik und Finanzen. Berlin, pp 139–150
53. Stillhart G (2002) Theorie der Finanzintermediation und Regulierung von Banken. Bern
54. Sure M (2004) Kosten- und Liquiditätsoptimierung durch integriertes working capital management. Controlling 16(7):393–398
55. Tang CS (2005) Perspectives in supply chain risk management: a review. In: Decisions, operations, and technology management. Paper CT39
56. Uhlig S (2007) Working capital: Stille Wasser gründen tief. Control Magazin 32(2):176–181
57. von Eisenhart-Rothe F, Jütte S (2003) Innovative Logistikfinanzierung rund um die Supply Chain. In: Bundesvereinigung Logistik e.V. (BVL) (Hrsg.) Finanzierung—eine neue Dimension der Logistik: Ergebnisse des Arbeitskreises Logistik und Finanzen. Berlin, pp 151–170
58. Wallmeier R (2004) Die Optimierung der Financial Supply Chain. In: Read C, Scheuermann H-D (2004) CFO—Die integrative Kraft im Unternehmen. Bonn, pp 71–106
59. Weber J, Eitelwein O, Wohltat A (2007) Cash-to-Cash Cycle als Instrument zur Steuerung des Working Capital im Supply Chain Management. In: Wolf-Kluthausen H (Hrsg.) Jahrbuch Logistik 2007. Korschenbroich, pp 110–114
60. Wenger E, Terberger E (1988) Die Beziehung zwischen Agent und Prinzipal als Baustein einer ökonomischen Theorie. Wirtschaftswissenschaftliches Studium 17(10):506–514