Inventory financing in supply chains
A logistics service provider-approach

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Abstract
Purpose – Against the background of the scanty knowledge about inventory financing in supply chains, the goal of this paper is to provide a conceptual explanation of the relevance and the implications of alternative inventory financing by a logistics service provider (LSP).

Design/methodology/approach – First, based on a literature review, inventory-related conflicts of interest between actors in the supply chain are discussed. Second, a concept of inventory financing through an LSP is developed. Third, the concept introduced is illustrated by means of a numerical example.

Findings – The results of an illustrative example from Switzerland and a rough revenue and expenditure calculation highlight the effects that inventory financing through a logistics service provider may have for LSP. For the LSP profit depends mainly on the value and amount of the goods to be financed.

Practical implications – The results of this paper can be applied to logistics service providers. The model developed can accordingly be used to calculate the additional effects of inventory financing service.

Originality/value – This research offers initial insights into the importance of inventory financing from an LSP perspective. As activities in this field may offer additional profits and differentiation options, decision makers at logistics service providers might want to estimate the potential resting in this expansion of their service catalogue.

Keywords Supply chain management, Retailing, Cost of capital, Interest rates, Switzerland

Paper type Research paper

1. Introduction
Starting point
Production or retail companies are usually faced with the temporal decoupled flow of goods and cash flows in their supply chains. On the one hand, the invoice is not issued necessarily at the time of delivery. On the other hand, the management of receivables usually grants a certain time frame for payments, which results in a demand for capital for the selling company to bridge the gap. According to Pike et al. (2005), the payment terms can vary substantially in the international context. In Switzerland, a period of grace of 30 days is usual on average whereas in Italy, 60 to 90 days apply. Approximately 90 percent of companies in Germany regularly record defaults in payments that account for more than 1 percent of total sales. Default events are defined on the basis of international standards, such as the ISDA (2009), i.e. failure to pay within a certain time frame, bankruptcy or unfavourable restructuring activities from a creditor’s point of view. As well as the consideration of debtors and potential defaults
in payments, which result in cost of tied-up capital, the performance-driven returns are also of importance.

In this context, a frequently aspired to multidimensional goal of shipping manufacturing companies is to achieve a certain production level with the lowest possible costs accompanied by a minimal tied-up capital (Wilson, 1991). As Presutti and Mawhinney (2007) stated:

[...] the firm needs to minimize the asset levels used to deliver [...] value. Factors such as capital utilization, cash velocity, inventory turns, and cycle time reduction will impact how effectively the firm is managing its assets.

Yet achievement of these goals is, however, rather rare as, e.g. shippers in supply chains demand high levels of delivery services in distribution in order to satisfy customer needs with short delivery times. This implies either holding high levels of inventory or the adoption of fast and flexible means of transport. While the latter implies higher costs for transportation processes a high level of inventory creates significant cost of tied-up capital (Farris and Hutchinson, 2002). Furthermore, strong credit-collection procedures (e.g. demanding payments in advance) or selling goods against payment in cash from customers is quite difficult, as Mian and Smith (1992) reported.

The dilemma illustrated for the different players in the supply chain leads to a strong demand for integrated logistics services (e.g. Bolumole, 2003; Persson and Virum, 2001; Stefansson, 2006) as well as financial services (e.g. Atkinson, 2008; Bernabucci, 2007; Barovick, 2007; Jones, 2008). Specialized logistics companies may therefore seize this opportunity to expand their original service portfolio of transportation, handling and storage with an additional service in financing.

Objectives, method and structure of the analysis

Despite the obvious practical relevance of the topic, business research has only recently started to deal with financing in supply chains in general and with financing inventory from a logistics service provider (LSP) perspective in particular (e.g. Lai et al., 2009; Buzacott and Zhang, 2004; Gunasekaran et al., 2001). Thus, to date, only few conceptual or empirical studies have been conducted in this interdisciplinary field. Moreover, logistics service providers have been entirely excluded from the existing studies. While considering this deficit the present paper contributes to the field by answering the following research questions (RQ):

**RQ1.** Which concepts can be derived from the existing literature (related research) to be applied to the field of inventory financing in supply chains through LSPs?

**RQ2.** How can traditional relationships between supply chain parties exchanging goods and capital be described? What kind of conflicts of interest could occur with regard to inventory?

**RQ3.** How can alternative inventory financing in supply chains by LSPs be structured?

**RQ4.** What influence would the new service of inventory financing have on the profit and loss of an LSP?
The methodological approach to answer these questions is based on “conceptual” theory building like in Meredith (1993) and Wacker (2008). The initial thoughts on inventory financing are further developed and exemplified using an illustrative example from Switzerland. This example rests on open-ended interview protocols with relevant decision makers of “SwissPostLogistics” (Schweizerische PostLogistics) in 2007 and 2008, along with financial reports, project presentations and newspaper excerpts. The Swiss LSP distributes over 300 different consumer goods of Procter & Gamble (P&G), manufactured in Germany and other EU-countries, to small and medium-sized retailers in Switzerland, like Volg (www.volg.ch), CC A Cash + Carry Angehrn (www.cca-angehrn.ch) or Manor (www.manor.ch). The LSP handles over 50,000 pallets and 200 points of delivery annually via one distribution centre near the city of Basel. The overall order volume is over 100 million Swiss Francs per year.

The underlying methodological approach of the paper is explorative and conceptual in nature. The explorative character seems to be necessary due to the immature scientific discussion of the topic. Accordingly, a linked query for key words (“financing”, “inventory” and “supply chain”) on the EBSCO-Host (Business Premier) for scientific articles between 1999 and 2009 provided only 15 results (EBSCO-Host, 2009) from scientific journals. A further query in EBSCO-Host (2009) with the key words “finance” and “supply chain” as well as “inventory” and “financing” in the abstracts of academic journals resulted in 36 hits for the time period between 1999 and 2009. If popular scientific “Trade Publications” are included in the query the hits increased to 176 for the past ten years. This shows that the topic is more a practitioner phenomenon. Concerning the conceptual approach theoretical and, if possible, also empirical findings will be conducted, analysed and consolidated in a simple numeric model. The results offer insights for future enhancements of the model as well as primary empirical studies. The methodological goal of the paper is thus a clarification of the formulated questions as well as an evaluation of the economic relevance of a discussion on the inventory financing in supply chains by logistics service providers.

The research questions guide the structure of the present analysis. A short overview of related research will first be given (Section 2, RQ1). Section 3 provides an explanation of the traditional relationships within a supply chain regarding the flow of goods and capital that are relevant in the context of inventory financing. Also, a closer examination is made of typical conflicts of interest between the supply chain parties (RQ2). Subsequently, Section 4 offers potential solutions to the problems. Additional thoughts are presented on the basis of a real Swiss case in which a logistics provider provides the financing of inventory (RQ3). The financial impacts for the LSP will be discussed within a simple theoretical case study (RQ4). Section 5 summarizes and concludes the paper.

2. Related research
This section provides an overview of related research in order to gain a comprehensive outline of the current state of inventory financing in supply chains by LSPs (see Figure 1). From a scientific point of view, mainly articles from the field of logistics and supply chain management, services industry as well as financing apply. These topics and their interrelations are well established and belong to the fundamentals of business administration with a variety of both scientific- and practitioner-oriented articles available. Especially, the conjunction between research in services and logistics
(logistics services), as well as services and finance (financial services), is an established intensively analysed area of study. In contrast, research in logistics financing is relatively scarce.

The scientific discussion in the area of logistics services mainly deals with topics such as “Third party logistics provider” (3PL) (e.g. Sheffi, 1990; Bask, 2001; Hertz and Alfredson, 2003; Juga et al., 2008). As the centre of interest these papers focus on the complex services package of logistics service providers in connection with outsourcing activities by a shipper (e.g. Bhakoo et al., 2007). Apart from the traditional transport, turnaround and storage functions, Knemeyer and Rabinovich (2006) and Selviaridis and Spring (2007) underline various supporting functions, which the LSP can use for differentiation purposes. The main financial issues in this context are invoicing, clearing and settlement functions of payment systems (e.g. Min, 2002) or – in an international context – export financing solutions (e.g. Ling-yee and Ogunmokun, 2001). Contributions, which focus on inventory financing as part of the services offered by logistics service companies cannot be identified in the literature, yet.

Current papers in the field of financial services focus on the changes in the banking sector in general (e.g. Angkinand, 2009; Gorton, 2009; Boyd et al., 2005), on the changes in credit risk management (e.g. Basel Committee on Banking Supervision, 2001; Felsenheimer et al., 2006) or on new fields of activities (e.g. Tam, 2007; Lerner, 2006). Single references are made to the field of logistics in the articles by Tibben-Lembke and Roger (2006) on the issue of a real option approach in the logistics sector or of Holdren and Hollingshead (1999) who develop a pricing scheme for inventory financing services. Nonetheless, a direct reference to LSPs cannot be found in this body of literature.

Research in the area of logistics financing is relatively young and mainly relates to topics such as “Financial supply chain management” (e.g. Fairchild, 2005) and “Supply chain finance” (e.g. Atkinson, 2008; Hofmann, 2005). Geunes and Pardalos (2003) address the interaction of supply chain management and financial engineering, while Badell et al. (2005) focus on financial budgeting in the supply chain context. Also, Buzacott and Zhang (2004) investigate the interrelations between logistics and finance.
Their paper “Inventory management with asset-based financing” provides an approach which does not limit inventory management to obeying budget restraints but interprets liquidity management as a component of inventory management. However, many articles are rather journalistic in nature (e.g. Hoffman, 2005; Lugli, 2006; Croft, 2007) and thereby disregard the LSP perspective.

Articles addressing all three areas cannot be found in the relevant literature. Therefore, this article provides an initial contribution to the field.

3. Traditional financing of inventory in supply chains

Initial situation
According to Walters (2008), end customer needs are the starting point for relations within the supply chain. This demand leads to orders and interaction-based activities in different steps of the value chain (Rainbird, 2004). Since interaction can evolve through several steps in the supply chain, the role of buyer and seller varies. For the initial situation described here a dyadic relationship is assumed between a manufacturer of consumer goods and a retail company while considering that manufacturers, in turn, work with other suppliers and retail companies serve additional customers.

The business relationship between the players is usually based on contracts. For instance, a supplier will arrange with a retailer a shipment of goods within a specific period including a scheduled time of transfer of ownership and the means of transportation. The latter, as the recipient, will compensate the manufacturer with a stipulated price. Nowadays, a logistics service provider is usually charged with the physical processing of the transactions within the supply chain (Selviaridis and Spring, 2007) while a financial service provider will be assigned to provide capital and settlement facilities.

A brief glance at the capital endowment of European companies provides evidence of a high debt rate (Gaud et al., 2007, p. 201). Even inventories are often financed with short-term borrowings from commercial banks (Hill and Sartoris, 1995). This can be explained through advantageous tax effects due to interests on debt (tax shield) and the so-called “leverage effect”: if the cost of debt capital is lower than the return on total capital, the company’s return on equity can rise even if overall risk is increased and creditworthiness deteriorates at the same time (Ross et al., 2005, p. 423).

The topic “inventory financing” is a short term financial management problem, as inventories are current assets and carrying such circulating capital is a commitment of funds that has to be financed. Short-term financial management is interdependent with decisions influencing the operating cash flows of a company (Hill and Sartoris, 1995). Thus, it encompasses decisions about activities that affect cash inflows, cash outflows, liquidity, back-up liquidity as well as firm-internal cash flows. From a shipper’s point of view, inventory financing is related to the classical approach used to determine the optimal level of inventory, the trade-off between setup costs and holding costs (Wilson, 1991). Any funds required for inventory can be covered by spontaneous financing related to the cash conversion cycle (because they arise in the course of the normal business transactions), or by other short-term sources like bank credit arrangements (e.g. single-payment loans, letters of credit) as well as unsecured or secured borrowings (Buzacott and Zhang, 2004). From a
financial service provider’s perspective, in the case of inventory financing firm’s current assets are used as security or as collateral for short-term loans. A basic problem is the “marketability” of inventory in the hands of the lender. Unlike accounts receivables or back-up liquidity, inventory does not turn to cash by itself. It has to be sold. The closer the inventory is to being a commodity item, the easier it is for the lender to sell and the higher its collateral value (Lasher, 1997). As for raw materials, commodity items such as iron ore used by a steel maker are easier to resell than customized items such as specialty pigments used to manufacture paint. Customized component parts may have only nominal resale value. Work-in-progress goods are frequently excluded from a collateral used to determine the borrowing base. Since work-in-progress goods require additional production activities to be converted to saleable merchandise, they have limited liquidation value. This is the reason why a shipper in general obtains easier an external financing for raw materials or finished (consumer) goods than for work-in-progress goods.

LSPs are usually debt financed with average equity ratios of 20 to 30 percent; according to van Laarhoven et al. (2000) they do not use this capital to finance inventory but for resources such as fleet, personnel or IT systems. An alternative form of financing would be factoring to sell receivables to specialized financial intermediaries: the logistics service provider could thereby transfer the entire credit risk to the factoring intermediary (Fiordelisi and Molyneux, 2004). Since the capital from factoring does not correspond with the flow of goods between supplier and recipient it will not be further discussed in this article. Also, bank guarantees, which ease the borrowing of money from a third party (from suppliers in the international business) will be disregarded (Kappler, 2006).

Figure 2 exemplifies a traditional supply chain including the involved parties and the relevant flow of goods and cash flow between them (including collateral). Thereby, the seller is mainly responsible for the inventory financing which is equal to a trade credit (Bougheas et al., 2009), and the compensation of the LSP. Owing to reasons of complexity the information flows are not considered.

Within this supply chain setting, the participants have different goals. In the following, we analyse these conflicts in detail.

![Figure 2. Flow of goods and capital in a typical supply chain](image-url)
Goals of the supplier/seller
One goal of the supplier is to sell finished products as fast as possible to transfer the ownership to the recipient. According to Nicholas et al. (2000) the supplier can thereby reduce the duration of tied-up capital. One way to achieve the latter is to shorten the time of payment, e.g. through prepayment or a more aggressive way of managing outstanding receivables (Paul, 2008). Ideally, a producer can manage to achieve a very short or even a negative Cash-to-Cash Cycle (Farris and Hutchinson, 2002, p. 288) by ordering products according to his own demands and making the customer pay on order. According to Gentry et al. (1990) the Cash-to-Cash Cycle – also called Cash Conversion Cycle – is based on days inventory hold (DIH) plus days sales outstanding (DSO) less days payables outstanding (DPO). The Cash-to-Cash Cycle measures the duration between the payment for input factors and the income from sold products thanks to an integrated view of the three components mentioned previously. The shorter the Cash-to-Cash Cycle, the lower the capital requirements of a company. Hence, cost of financing can be reduced (Jose et al., 1996). Nonetheless, a negative effect on the attractiveness of products due to short times of payment must also be considered.

Goals of the customer/recipient
A recipient wishes to assume ownership of products at the moment his demand occurs. Preferably, the customer not only seeks to determine the time but also the quantity of a delivery according to his needs. However, this goal creates a conflict of interest as the customer also seeks guaranteed availability of goods at any time. These goals can be achieved, for instance through consigned inventory (Lee and Wang, 2008) or vendor-managed inventory (VMI) solutions (Pohlen and Goldsby, 2003). This procedure helps to keep customers’ inventory capital costs low and hence reduce DIH. At the same time, the customer tries to pay the supplier as late as possible in order to keep DPO high. Finally, in order to have low DSO the recipient also pursues the goal of preferably early payment receipts by its own customers in order to reduce the dependency from outside creditors and to shorten its Cash-to-Cash Cycle. If the recipient cannot manage to establish a consignment pickup on the supply side, he will hold inventory for certain goods if inventory and capital costs are lower than the cost of shortfalls caused by inventory gaps. To determine the costs of shortfalls the probability of unexpected interferences due to lacking availability of input factors must be comprehended. The classification of these goods can be conducted on the basis of the critical value. As well, the recipient has a strong interest to keep the number of order activities low since they also create costs (mainly transaction costs). Thus, higher transportation and personal costs arise in performing the ordering process, accepting consignments and checking and stocking the received goods.

Goals of the financial service provider
The financial service providers, e.g. banks directly involved in the inventory financing process have two main goals: first, they demand a risk-adjusted price for the provided debt capital in the form of interest; and second, they want to ensure that the underlying counterparty risk does not deteriorate beyond priced expectations (migration risk) to avoid credit events causing default. To achieve both goals, the prices are risk-adjusted by the calculation of the expected loss (EL). The EL comprises two factors, probability
of default (PD) and loss given default (LGD) describing the loss severity (Altman et al., 2005).

PDs are usually derived from the application of a bank internal rating process to assess the creditworthiness of a counterparty and derive a probability for described default events to occur within a one-year time frame. Since the borrower (agent) knows his own creditworthiness very well but does not wish to share this information to the full extent with the lender (principal), problems of asymmetric information distribution arise. Hence, transaction costs occur (e.g. information costs, negotiation costs, monitoring costs), which also have an impact on the model discussed (Gordy, 2000).

As Caselli et al. (2008) pointed out, the LGD is mainly influenced by the attribution of collateral whereas in this context, physical securities, personal securities and additional agreements, i.e. covenants, apply. The value of physical securities such as pledging or assignments of receivables or goods is influenced by the liquidity of the underlying asset: the more liquid the market for the security, the better it can be sold if the borrower defaults. Buzacott and Zhang (2004) assumed for instance, that risk is less for raw materials than for semi-finished goods and finished goods. This may be connected to the fact that markets for raw materials like oil, steel and other similar materials are rather “liquid”, since these items are traded on stock exchanges. The larger the added value of a product, the higher its degree of specialization usually becomes and the harder it gets to achieve the highest possible return on a spontaneous forced sale. The creditor must compensate this risk by higher interest rates paid since the deficit increases in case of default. Thus, in the context of inventory financing, a financial service provider will stress that the type and quantity of inventory, which is financed is always transparent. Furthermore, the financial service provider can also define restrictions that determine which goods can be financed, e.g. in the form of covenants.

Even though the financial service provider is not directly involved in the operative value creation process they have an interest in the efficiency of the financed transactions as this is the only way to ensure a maximum return on the invested capital (although loans do not have an upside potential for the financial intermediary). However, with an increased return, the probability of repayment of interest and capital at maturity rises.

**Goals of the logistics service provider**

In the situation described, the ownership structure as well as the financing of the goods to be transferred is not (yet) relevant for the LSP. They are more interested in smooth process flows in the operative area (e.g. delivery supply, appropriate packaging, complete documents for customs) and the punctual payments of invoices by their debtors. In addition, the ownership structure is relevant as it has an impact on accountability or on customs declaration. Whether the logistics service provider is compensated by the supplying manufacturer or the demanding retailer primarily depends on the agreements between the supply chain parties. Under equal conditions the LSP does not have a preference for a specific party as debtor. It is, however, likely that the shipper and the recipient have differing financial characteristics in terms of creditworthiness. Hence, the service provider will favour the party with the lowest transaction costs and the lowest default risk (comparable to banks’ internal rating) as debtor. The search, negotiation, hedging, control and opportunity costs that arise from
these transactions accrue not only in the original logistics industry business, but also affect the relations in connection with the transfer of capital. Finally, LSPs also pursue market-oriented goals, such as providing value-added services or the commercialization of innovative products. Beside efficiency enhancements (e.g. cost-cutting) and an increase in sales by new customer acquisition the offering of new value-added services are an additional way the LSPs can generate profits.

Potential conflicts of goals
The discussion on individual goals of the supply chain parties has already pointed to certain inconsistencies. A first contrast (“conflict of goals 1”) is evidenced through a closer look at desired terms of payment between the supplying manufacturer and its receiving customer. While the supplier demands immediate payments or, even better, pre-payments for sold goods, the customer prefers to balance the account later since the DSO of the supplier correspond with the DPO of the recipient (Arcelus and Srinivasan, 1990). Hence the date of payment must be settled through negotiation. Potential conflicts of interest can also be found in the context of the flow of goods. The supplier would like to keep inventory of finished goods as low as possible for the customer due to the cost of tied-up capital. The recipient, however, prefers a high inventory by the supplier in order to ensure readiness of delivery. The effectively implemented terms of payment and the negotiated levels of service reflect the power game between the players and often turn out to be unsatisfactory for one of them.

A further conflict of interests (“conflict of goals 2”) can be found between the financial service provider and the producer. The conflict becomes especially evident with the assessment of creditworthiness by the financial service provider. This assessment has a direct influence on the level of risk-adjusted interest rates. The financial service provider demands all the available information about the company and the financed goods (type, amount, duration) in order to get a comprehensive overview. At the same time, the manufacturer or its recipient, do not want to provide more information than necessary. This asymmetrical information distribution causes transaction costs in the financing service as well as higher financing costs due to intransparency.

The described conflicts of interest can be overcome with an alternative approach, which suggests that the LSP takes over the inventory financing.

4. Alternative financing of inventory in supply chains
Conceptual approach
An alternative approach in the supply chain suggests that the LSP is not only responsible for transport, handling and storage, but also takes over the inventory financing function (see Figure 3). The logistics service provider buys the goods from the manufacturer and obtains an interim legal ownership before selling them to manufacturers’ customers after a certain time. In contrast to a mere commercial relationship, the LSP attracts a purchase guarantee from the manufacturer, which the seller has negotiated in framework agreements with its customers. For instance, this could be a logistics service provider who already organizes the transportation of goods between seller and recipient and thus already assumes the ownership of the goods for a certain time period. This solution was implemented – as will be shown in a further
section — by the SwissPostLogistics for a large consumer goods manufacturer and its retail customers in Switzerland.

The central idea of this alternative approach is to achieve an improvement in the inventory financing within the supply chain by adopting the “network perspective”. Accordingly, links can be found regarding the financed inventory amount, the duration and the cost of tied-up capital. In addition to established supply chain management concepts such as Just-in-Time (Lieberman and Asaba, 1997), Postponement (Mason-Jones and Towill, 1999) and Mass Customization (Mason and Lalwani, 2008), a proactive integration of LSPs can also lower inventory through bundling and coordination effects (Bahrami, 2002). Through a reduction of the DIH of the individual companies the overall Cash-to-Cash Cycle can also be improved within the examined supply chain section. Eventually, costs of cost of tied-up capital – defined as amount of capital multiplied by cost of capital per time unit – can be reduced in this network. This can be achieved by distributing the Cash-to-Cash Cycle of the supply chain section in a way that reduces the capital costs of all the involved parties. The Cash-to-Cash Cycle of the companies with the lowest weighted average cost of capital (WACC) will be extended, while those companies with higher financing costs are relieved by a shortened Cash-to-Cash Cycle.

Following these thoughts it seems evident that the LSP is an adequate candidate for inventory financing if the following condition is fulfilled. On the one hand, bundling and therefore an increase in efficiency is possible due to the position of the logistics service provider between the involved supply chain parties (e.g. one shipping manufacturer and several receiving retailers). This leads to a reduction of the amount of stock on hand as the inventory turnover can be increased. The refinancing rate of the LSP, on the other hand, has to be lower than that of the other players in the supply chain due to assumed sound creditworthiness. Furthermore, inventory financing through the logistics service provider is useful since they usually have information about turnover of goods, shipping lead-times and stock levels. Hence, they have a more precise notion of the effective risks than external players such as financial service providers might ever have.

Several conflicts of interest could be solved if the LSP takes over inventory financing. Besides being active in the flow of goods, the logistics service provider now also appears in the cash flows between the supplier and their recipients. “Conflict of

Figure 3. Flows of goods and capital in a supply chain with inventory financing provided by an LSP
goals 1” can thus be “transferred” from the manufacturer to the LSP. Depending on the concrete arrangement, the manufacturer profits in two ways. He can arrange short payment times with the logistics service provider (reduction of manufacturers’ DSO). Further inventory hold for recipients can also be reduced since the goods are kept ready in a sufficient amount (reduction of manufacturers’ DIH). The manufacturer can thus reduce the Cash-to-Cash Cycle and also the cost of tied-up capital. Recipients’ further profit from a relatively high inventory level held as a security stock at the LSP. To what extent the customer can keep its creditor period or even prolong it (expansion of customers’ DPO) depends on the conditions agreed on with the logistics service provider. Overall, for the recipients a slightly shorter Cash-to-Cash Cycle appears to be possible in this context.

The “conflict of goals 2” can thus be transferred from the manufacturer or recipient (depending on the party that was responsible for inventory financing before) to the logistics service provider. Now, from the financial service providers’ point of view it is not the creditworthiness or the rating of the shippers but that of the LSP that becomes relevant. Owing to the possibility of changing amounts and duration of the financed inventory, the composition of the portfolio and thereby the credit risk can vary. According to Buzacott and Zhang (2004), the financial service provider will adjust the interest rate according to the new risk situation and might even redefine its hedging strategy accordingly.

Within the scope of the presented alternative approach the logistics service provider is obliged to establish new focuses on activities since the financial side of the goods traffic gains importance. With the changes in roles within the supply chain an adaptation of goals must occur. First, the LSP takes over the ownership of the goods within the context of their financing activity. The ownership serves as collateral or security. In addition, the shipper or the receiver (possibly even both) will give the logistics service provider a commitment of purchase. Despite the collateral, the LSP will have to take new risks. Hence, it could be that they are confronted with additional costs, in the case of default by the recipient. In this case, new alternatives (e.g. larger temporary storage area, etc.) must be found and these create costs. At the same time, the risk exists that the recipient refuses to or cannot pay after delivery of the goods. In order to keep costs low, the logistics service provider will be eager to deliver goods quickly and be paid for them in the short term. Hence, this approach might also be seen as an incentive for them to process orders in the shortest time possible. Furthermore, they will strive to bundle consignments as much as possible, which also has a positive effect on their financial situation.

But why should a LSP be interested in becoming a merchant? The term “merchant” commonly refers to a company which buys goods at a (lower) wholesale price and sells them with a margin at a (higher) retail price. As opposed to a merchant the LSP neglects retail-pricing opportunities. The inventory model of the LSP is not linked to marketing (pricing) decisions (Boyaci and Gallego, 2002). Instead, the LSP profits from the interest rate for carrying the inventory and from the offering of additional logistics services (e.g. order picking, packing and labeling). Meanwhile the risk situation of the LSP is nearly unchanged due to the contractual arrangements (purchasing guarantee) with the shippers or customers. Especially when the inventory is a commodity item, the marketability eases the risk situation. For example, non-perishable consumer
goods as branded commodities are demanded by many retail companies. Such products have a high marketability.

Besides realizing economic benefits through inventory financing, the LSP has additional goals like the achievement of differentiation and additional logistics business. A firm differentiates itself from its competitors if it offers a unique service that is valuable to buyers (Day, 1994). The sustainability of differentiation depends on its continued perceived value to buyers. LSPs that are able to create value for their customers by satisfying their needs and demands generally increase their market share (Coyle et al., 1996).

However, the logistics service provider must build up finance-specific know-how in order to conduct their own assessments of the creditworthiness of suppliers and customers. If the LSP does not succeed in building up this specific know-how, they may alternatively seek co-operation with financial institutions or specialized service providers.

An interim conclusion shows that both manufacturer (shipper) and retailer (receiver) profit from inventory financing through the logistics service provider. However, this is only true if terms of payment are roughly linked to the physical flow of goods. Also, the compensation for the LSP may not exceed the emerging advantages. The concrete arrangement of inventory financing in the supply chain through logistics service providers will be clarified in the following sections.

A practical example
Elicited through the privatization of the postal system in most parts of Europe, many formerly public players have developed into become leading logistics service providers (Carbaugh, 2007). As Ruozzi and Anderloni (2000) suggested, since state-owned postal companies mostly offered to carry out the handling of payments (e.g. in the form of postal savings) the service is still affiliated to a Postal Bank today. The same happened with the Swiss postal company: even though it is still owned by the state, it has evolved into a private-like logistics company. As well as the letter post (SwissPostMail) and logistics services (SwissPostLogistics), the company also offers financial services (SwissPostFinance). Since mid-2006 the group has offered combined logistics and financial services in the context of inventory as a pilot project with Procter & Gamble (P&G) shows.

Procter & Gamble is a global manufacturer of branded goods in the consumer goods market and distributes 300 different products in Switzerland, whereas a direct delivery ex factory is only offered to large receivers (e.g. the retail company Coop). Many smaller retailers in Switzerland do not have the required size and demand and thus are disadvantaged. On the basis of the specific and international system of conditions (the so-called “P&G value pricing strategy”) composed of sales, logistics, range, assortment and activities, the ordered goods are more expensive (Ailawadi, 2001). These costs are either passed on to the end customers via higher prices or the costs force the company to cut back on its own margins. Furthermore, mid-size retailers with traditional low equity ratios suffer more from change to risk-adjusted prices from the financial service provider than do large companies. One reason for this is usually the lower creditworthiness of small- and medium-sized businesses, which results in lower ratings and higher capital costs (Berger and Udell, 2002). Finally, the majority of companies in
Switzerland (especially in retail) are still privately owned and not capital market oriented.

In order to level out the differences between large and small recipients in Switzerland, the flow of goods of mid-sized retailers was bundled into an integrated logistics platform. As the central service provider SwissPostLogistics has taken over logistics and financing activities in the function of an intermediary supply chain party. For P&G the LSP is a bulk buyer and resells the goods to retailers while processing the physical flow of goods as well as the flow of finance (e.g. invoicing, creditor and debtor management, debt collection) with the help of an information system. The order volume that SwissPostLogistics achieves with P&G is approximately 100 million Swiss Francs, which is comparable to the volume of large Swiss commercial enterprises (SSwissPostLogistics, 2006, p. 12). In addition, the LSP has a relatively low WACC (7.2 percent) because of the affiliated group and its size (SwissPost, 2006).

P&G and SwissPostLogistics came to an agreement that the LSP would not charge additional margins on goods sold since it would turn SwissPostLogistics into a wholesale trader within the supply chain. Profits should rather be made on the financial service and the logistics business than on reselling goods. The retailers can profit from additional services in the logistics service provider’s central warehouse to which P&G delivers goods: labelling of goods, display of prices, assembly of sales displays or bundling for promotions.

Even though an additional player is active between the manufacturer of consumer goods and the mid-sized retailers, P&G maintains control over brand and price policies. Hence, while SwissPostLogistics manages the goods and inventory system, P&G is still responsible for planning and controlling product launches and sales promotions. For this purpose SwissPostLogistics provides relevant data such as customer-specific sales, inventory stocks or dates of promotions via a standardized IT interface. Within the scope of this service model P&G sells the goods to SwissPostLogistics minus the logistics and finance costs. The LSP in turn invoices the goods to the Swiss retailers at given standard prices plus a logistics and finance charge. The conditions hold further benefits through the additional logistics business such as price labelling or assembly of displays.

The overall service model with the flow of goods, cash flows and information is illustrated in Figure 4. The example clarifies two issues: first, the logistics service providers are actually positioned to take ownership of goods; second, achieved volume discounts have a positive influence on the capital costs of the supply chain.

In addition to the SwissPostLogistics case discussed, other LSPs are involved in the inventory-financing sector. The following examples can be identified:

- Celistics (www.celistics.com), a LSP in Latin America, offers inventory-financing solutions for manufactures and operators of the Telefónica group.

- The Asian subsidiary of Toll Contract Logistics (www.toll.com.vn) provides collateral management solutions for inventory financing, especially for products such as raw materials and agricultural products in Vietnam.

- The American LSP UPS with its financial service unit UPS Capital (www.capital.ups.com) offers in-transit inventory financing solutions.

- The Transportation Logistics Division of Mitsui (www.mitsui.com) purchases inventory parts from Japanese vendors, consolidates and imports them to the
USA, holds them in a warehouse near its customer Caterpillar and finally feeds the parts just-in-time to the factory production line.

- Ufreight (www.ufreight.com) established in the Pacific Rim provides inventory services including inventory financing, procurement and sub-assembly to the automotive industry (manufacturer and suppliers).

- DHL Solutions (www.dhl.com) works with clients in the electronic industries, like the alliance with Avnet Supply Chain Services, a Phoenix-based electronic parts distributor in which DHL finances the components and handles all the logistics activities from Avnet to the contract manufacturers as well as to the customers.

- APL Logistics (www.apllogistics.com) includes inventory financing as part of a range of asset-management skills it brings to shippers.

All of these LSPs consider the interface between finance and logistics services as a future field of activity (Hoffman, 2005; Mount, 2007; Biederman, 2004).

At first glance it seems that only large logistics service providers are inclined towards the possibility of this kind of approach. However, inventory financing and other trade finance applications are attractive fields of activity not only for formerly state-owned postal companies but also for medium-sized LSPs as long as they have the ability to realize overall lower refinancing costs for the goods than the supplier of the goods. Thereby co-operation with specialized financial service providers such as Global Supply Chain Finance (www.gscf.com), Swiss Commercial Capital (www.swisscocap.com), EZD Global Financial Logistics Solutions (www.ezdglobal.com) or GE Money (www.gemoney.com) should be considered.
In order to decide whether entering the field of inventory financing is financially attractive, an LSP must analyse the effects. In the following section a numerical example will offer a first insight into this issue.

**A numerical example**

The following theoretical example refers solely to the perspective of the LSP concerning the calculation of additional profits taking financing activities into account. An LSP will only integrate inventory financing into its service portfolio if it can expect a positive impact from that business activity. Profits should arise:

- from the inventory financing activities itself (finance-related); or
- from additional demands in the traditional logistics business (physically-oriented).

In the ideal case, both businesses will provide higher profits.

In the following text a profit and loss calculation for a logistics company will be exemplified including logistics and financial businesses. According to Larreché and Srinivasan (1982), business activities should be at least included on the basis of revenues and expenditures. The assumption is that the logistics service provider will not earn additional margins by reselling the goods to the recipient. Furthermore, it is implied that the financing business does not affect profits from the logistics business and hence does not negatively influence the capital costs. The calculation of the additional profit (gain) from the financing activity $\Delta G_F$ can be described on the basis of the explained positions in a simplified way:

$$\Delta G_F = \frac{EF(W) - AW}{\text{Finance-related}} + \frac{EP(W) - AP(W)}{\text{Physically-oriented}}$$

where:

- $W$ = value of financed goods,
- $\Delta G_F$ = additional profit (gain) from the financing activity,
- $EF(W)$ = additional revenues from the financing activities,
- $AP(W)$ = expenditures from the refinancing activities,
- $EP(W)$ = additional revenues from the supplementary logistics business,
- $AP(W)$ = expenditures for the supplementary logistics business.

It is necessary to operationalize the single elements.

First, the assumption is made that the logistics service provider receives interest on the amount that is to be financed (Halskau, 2003, p. 687). According to the concept of present value, monetary flows can be interpreted as follows: the LSP takes over the goods minus interest payments for the number of periods in which the goods are financed. $EF(W)$ is calculated as the difference between the value of the financed goods $W$ and the present value of the financed inventory:
\[ E_F(W) = W - \left( \frac{W}{(1 + r_{FC})^t} \right), \text{ with } r_{FC} = r_0 + r_p \]  

where:

- \( t \) = duration of the financing contract (number of periods),
- \( r_{FC} \) = interest rate of the financing contract,
- \( r_0 \) = risk-free interest rate,
- \( r_p \) = premium for risk.

The interest rate \( r_{FC} \) embodies the compensation for the supply of funds. It is composed of the risk-free interest rate \( r_0 \) and a premium for risk \( r_p \). This premium is influenced by the risk estimation of the logistics service provider, the duration of the contract and the market interest rate (Ross et al., 2005). The calculated interest rate \( r_{FC} \) thereby affects the level of the net present value: the higher the interest rate the smaller is the present value. Hence, the LSP has an interest in setting the interest as high as possible.

\( A_F(W) \) mainly consists of the interest expenditures for financing the debt capital \( DC \). Since the idea of inventory financing through logistics service provider is to relieve shippers or receivers, suppliers or customers are left out as refinancing sources. Since interest charges are still cheaper for bank loans than the interest rate minus cash discount deduction and access to capital markets for SME is not provided, Brealey and Myers (2000) recommend using bank loans for the payment of liabilities (e.g. loan or an open credit). According to Degryse and Van Cayseele (2000), the expenditures for external financing through a bank is composed of the components refinancing rate, operating expenditures, cost of capital and expected loss. However, the LSP can only influence the latter (e.g. through collateral and an advantageous rating). The expenditures from refinancing \( A_F(W) \) for the logistics service provider can be calculated through the difference between the debt value after a multi-periodic interest with a nominal value of debt:

\[ A_F(W) = (DC \cdot (1 + r_{DC})^t - DC \]  

respectively

\[ A_F(W) = \left( \frac{W}{(1 + r_{FC})^t} \right) \cdot (1 + r_{DC})^t - \left( \frac{W}{(1 + r_{FC})^t} \right) \]  

where:

- \( DC \) = debt capital,
- \( r_{DC} \) = expenditures of debt capital,
- \( t \) = duration of the financing contract (number of periods).

The amount of capital debt in this case corresponds to the present value of the financed goods. The interest rate for refinancing \( r_{DC} \) depends on the creditworthiness of the LSP which is identified by the rating, the collateral, the duration of the contract, the market
interest rate and further cost components such as operating costs, cost of equity (of the bank) and the bank’s overall margin on loans. Figure 5 illustrates the additional finance-related revenues $E_F$ and expenditures $A_F$ from the inventory financing activities as a function of $W$ for two different time periods.

When calculating $E_F(W)$ a connection between the amount of financed goods $W > 0$ and the additional gained revenues in the logistics business is assumed. According to Bacon (2003), this interrelation can be explained by a function. By intensifying activities in financing goods the revenues from additionally gained logistics businesses grow exponentially before saturating after a certain point of inflexion (see Figure 6). The assumed concave path after the point of inflexion can be explained through the decreasing marginal utility of the logistics services to the manufacturer. A simplified view of this is given by:

$$E_F(W) = \frac{K}{1 + e^{a+b\cdot W}}, \quad (4)$$

where:

$K = \text{capacity limit},$

$a = \text{movement of inflexion point from rising marginal rate for revenue growth},$

$b = \text{control of the incline, i.e. how fast the capacity limit is achieved}.$

Initially, the revenues from the additional business are not displayed for several periods. This problem will be solved by displaying the additional revenues through the yearly financed amounts. Assumed that the LSP closes a contract with the value $W'$ over $T$ years the quotient will be formed with $W'$ and $T$ per year.

The capacity limit $K > 0$ describes the maximal possible revenues from the additional logistics business ($K = E_F$). The capacity limit demonstrates the

![Figure 5. Finance-related revenues and expenditures from inventory financing activities for the LSP](image-url)
theoretical additional revenues from the logistics business. The limit can be explained through the value-added services in logistics which depend on the specific logistics total expenditures of “single” goods or product groups. Hence in segments with relatively high requirements with regard to logistics, higher revenues can be achieved with logistics services. If $K$ rises, the potential loss can be reduced relative to the initial situation with faster achievement of the break-even point with less financing activities.

With the increasing amount of financed goods in the respective logistics business, economies of scale can be obtained. The latter are mainly highlighted by the fact that average expenditures $A_p(W)$ can be reduced with rising volumes. This effect can be simply explained by a “root” function:

$$A_p(W) = c \cdot \sqrt{W},$$

where:

$c = \text{factor which considers requirements related to logistics.}$

The sharp rise in the beginning is due to the fact that several expenditures occur independent of the financed amount of goods. Supply chains, for instance are characterized by high-levels of fixed costs as Prior et al. (2004) explains. Furthermore, the slope of the curve is influenced by the type of financed goods. Goods with high logistics requirements (e.g. dangerous goods or temperature-sensitive goods) result in higher expenditures than goods with comparably low logistics requirements. The model explains this by multiplication of the root function with variable $c$. Figure 6 illustrates the physically oriented revenues $E_p$ and expenditures $A_p$ as a function of $W$.

The operationalization of all the components lead to the following overall function for additional profit from the financing activities:

Figure 6. Physically oriented revenues and expenditures from inventory financing activities for the LSP
\[ \Delta G_F(W) = W - \left( \frac{W}{(1 + r_{FC})^t} \right) \cdot (1 + r_{DC})^t \cdot + \frac{K}{1 + e^{a+b \cdot W}} - c \cdot \sqrt{W} \]  

Respectively after conversion and simplification:

\[ \Delta G_F(W) = W - \left( \frac{W}{(1 + r_{FC})^t} \right) \cdot (1 + r_{DC})^t \cdot + \frac{K}{1 + e^{a+b \cdot W}} - c \cdot \sqrt{W} \]  

Since the additional profit from the financing activities primarily depends on the financed goods \( W \), the optimization problem of the logistics service provider can be explained through the first derivation. Provided that \( \Delta G'_F = 0 \) and \( \Delta G''_F \leq 0 \) the optimal financing amount results for the logistics company at \( W^* \).

For the exemplification of the optimization problem of the LSP, a numeric example will be used. Figure 7 illustrates the function of additional profits for the logistics service provider through inventory financing activities.

As shown in the graph, low rates of activities within the goods financing business initially lead to a negative profitability of the business. Higher financing volumes make profitability rise. In this case the point of inflexion is at a financed goods value of 770,000 monetary units. The slope of the curve beyond this point shows decreasing profits. From a financed goods value of approximately 1.75 million monetary units the business does not become profitable again. The slope of the curve is mainly influenced by the expenditures for goods \( A_F(W) \) and the revenues through newly gained businesses \( E_P(W) \). In the beginning, the expenditures are higher than the revenues. Only when revenues rise at a faster rate, can expenditures be exceeded (until the capacity limit is reached). From this point on no additional revenues can be generated while expenditures still rise. Hence the profits deteriorate.

Figure 7. Additional profits from inventory financing activities for the LSP
It is noteworthy that the slope of both curves is congruent at different time frames. The influence of the financing duration appears to be negligible. Profits seem to be slightly higher for short-term financing \((t = 1)\) than for long-term financing \((t = 5)\) solely after having reached the maximum on the curve. This is due to the revenues from the sale of goods. Since the sale of goods becomes negative after achieving the capacity limit, the yearly losses accumulate the longer the financing duration. This development cannot be compensated for through revenues from the financing business.

The numerical example demonstrates the impacts of inventory financing through the logistics service provider in its final statement. Nonetheless, the model falls short on the following aspects:

- inclusion of variable interest rates;
- limited availability of debt capital;
- consideration of demand uncertainties; as well as
- consideration of free available liquidity.

These flaws should be addressed by future research investigations.

5. Conclusions and outlook
The current article shows which mechanisms occur when an LSP expands its activities to the area of inventory financing. The starting point is an observation of the traditional division of tasks and roles of manufacturers, retailers and the logistics service provider as well as financial service providers in the supply chain. Accordingly, conflicts of interest that can arise in this constellation are discussed. The discussion is then supplemented by the analysis of an alternative financing activity from an LSP perspective. This analysis shows how the conflicts of interest can be solved by an alternative approach. It is necessary for logistics service providers to know what influence the additional financing business might have on their profit and loss statement. Therefore, revenues and expenditures from financing activities as well as potential revenues and expenditures from the supplementary traditional logistics activities are accounted for in a model. A simple example shows that next to the interest rate the value of the financed goods especially has an influence on the profits generated. The financing duration, on the other hand, seems not to play a major role.

The implementation of inventory financing within the range of services offered requires the LSP to supply the necessary knowledge and the corresponding resources. This aspect implies a question about the adequate business model for logistics service providers (Delfmann and Albers, 2002). In this regard co-operation with a financial service provider seems to be a feasible method since the requirements in the financing area are clearly different from those in the logistics sector (especially the risk assessment and collateral). As the case of SwissPostLogistics demonstrates, the formerly state-owned postal company has a competitive advantage due to their affiliated postal bank. Beforehand it is crucial to clarify whether the shipping supply chain players will accept an LSP as a partner concerning financing issues or, rather how trust can be built up. Medium-sized service providers are in particular faced with this challenge (Hoffman, 2005). Basically, the additional financing activities open up new opportunities for the logistics service provider to offer customers value-added services and to create an independent profile and a competitive advantage in a market.
The present paper offers an introduction to the topic of inventory financing in supply chains within an LSP perspective. It shows in which areas a logistics service provider can search for starting points in order to estimate the profitability of financing activities. However, the approach does not transcend the discussion of models, which are based on assumptions. The latter should be verified through research activities and backed by implementations in the real world. Furthermore, there are possibilities of specifying various notions. Hence data records would allow the interest rates to be split into a risk-free interest rate and a risk premium within the model. Further, it is imaginable that expenditures for goods $A_P$ as well as the revenues due to the additional gained business $E_P$ could be separated into further components. Finally, potential relationships between inventory financing activities of the LSP and its WACC should be addressed.

References


**Further reading**


**About the author**

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