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Supply Chain Finance techniques and risks

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Abstract

Supply Chain Finance is as a portfolio of financing and risk mitigation practices and techniques to optimize the management of the working capital and liquidity invested in supply chain processes and transactions. SCF techniques existing on the market can be divided into three categories: receivable purchase, advanced payable, and loans. These financing solutions are significantly ‘event-driven’, since they aim at satisfying the financial requirements of buyers and sellers, that are triggered by purchase orders, invoices, receivables, other claims, and related pre-shipment and post-shipment processes along the increasingly complex supply chains in which they are involved. Along the way from raw material procurement to production, sales and end-users, several source of risks can threaten the possibility of completing the transactions and the regular functioning of supply chain finance. Digitization can help in managing these risks, facilitating the control of the factors underlying them.

Key Words:

Supply chain, Supply chain disruptions, Supply chain finance, Supply chain risk, Digital supply chain

JEL code : G23-G32-G29

1) Introduction: a definition of Supply Chain Finance

Firms usually adopt three kinds of trade finance solutions: cash-in-advance, letters of credit, and open account (Foley et al., 2010; Schmidt-Eisenlohr, 2013; Antràs and Foley, 2015). Cash-in-advance trade finance terms impose importers to pay exporters before the shipment of the wares, thus requiring importers the need to secure finance. Letter-of-credit terms require banks to commit payments before exporters produce their goods and to pay exporters upon shipping, thus removing payment risk for exporters. Open account terms (trade credit) are predominant in current global business environments that are characterized by severe competitive conditions. In particular, they are commonly used in transactions between exporters from developed countries and importers from emerging markets, where documentary trade is interpreted as a lack of trust in the counterparty. In open account trade, importers are allowed to postpone the payment of exporters a certain time after receiving the wares. Thus, they are protected from the possibility that exporters may fail to deliver (performance risk). In addition, importers may resell the goods before paying exporters. On the other hand, they expose exporters to a high payment risk.

Several open account-based trade finance products and programs have been introduced through time, drawing deep attention from both the business community and scholars, as a new way of industry-finance integration and a new financing method compared to traditional ones. These instruments are commonly known as supply chain finance (SCF, hereinafter) and include a wide range of financing and risk mitigation techniques, connected to commercial relationships between companies.

After providing a definition of SCF and depicting the evolution of the literature on the topic, this paper describes the peculiarities of different SCF solutions and identify the risks that not only lead to the disruption of the whole supply chain but also cause substantial harm to the suppliers of funds. Therefore, they should be carefully analyzed and controlled to allow the SCF business to be realized safely. Digitization can help to manage these risks, facilitating the control of the factors underlying them.

The role of SCF can be better understood after a depiction of the relationship between physical and financial supply chains. The activities that are implemented in a physical supply chain allow to transform natural resources, raw materials and components into semi-finished and finished products or to perform services, that are moved from sellers to buyers, either in the national market or abroad. The transfer involves a network of organizations, people, activities, information, and resources. The purchase and sale of goods and services, as well as the payment for them, are facilitated by a range of corporate management practices and transactions, that are named ‘financial supply chain management’. This includes for example the conclusion of contractual frameworks, the sending of purchase orders and invoices, the matching of goods sent and received to these, the control and monitoring of activities including cash collections, the deployment of supporting technology, the management of liquidity and working capital, the use of risk mitigation such as insurance and guarantees, and the management of payments and cash flow. SCF is a set of financial services that support the financial supply chain. For a long time, there have been significant dissonances regarding the definition of existing SCF solutions, among companies, financial institutions, and in different countries, due to the continuous operational and technological innovation (Tavecchia, 2018). In 2016, a large number of operators within the Global Supply Chain Finance Forum (GSCF) coined a shared definition - enhanced in 2021 - which refers to SCF as a range of tools aimed at optimizing the management of working capital and liquidity, to the benefit of the subjects (sellers and buyers of raw materials, semi-finished products, goods, or services) who cooperate along an entire production chain. The diffusion of the SCF involves the transition from a traditional approach, in which each firm relates individually with a lender, to a vision of the supply chain in which in the credit relationship the firm exploits its role within the supply chain and the relationships with other participants.

According to the comprehensive definition provided by the Global Supply Chain Finance Forum (2016), SCF is as a portfolio of financing and risk mitigation practices and techniques to optimize the management of the working capital and liquidity invested in supply chain processes and transactions. This comprehensive range of techniques and solutions is largely ‘event-driven’, as it is

aimed at addressing financial requirements of buyers and sellers, that are triggered by purchase orders, invoices, receivables, other claims, and related pre-shipment and post-shipment processes along the increasingly complex supply chains in which they are involved (European Commission, 2020).

Figure 1 shows how SCF intervenes to support the trade and financial flows along end-to-end business supply and distribution chains.

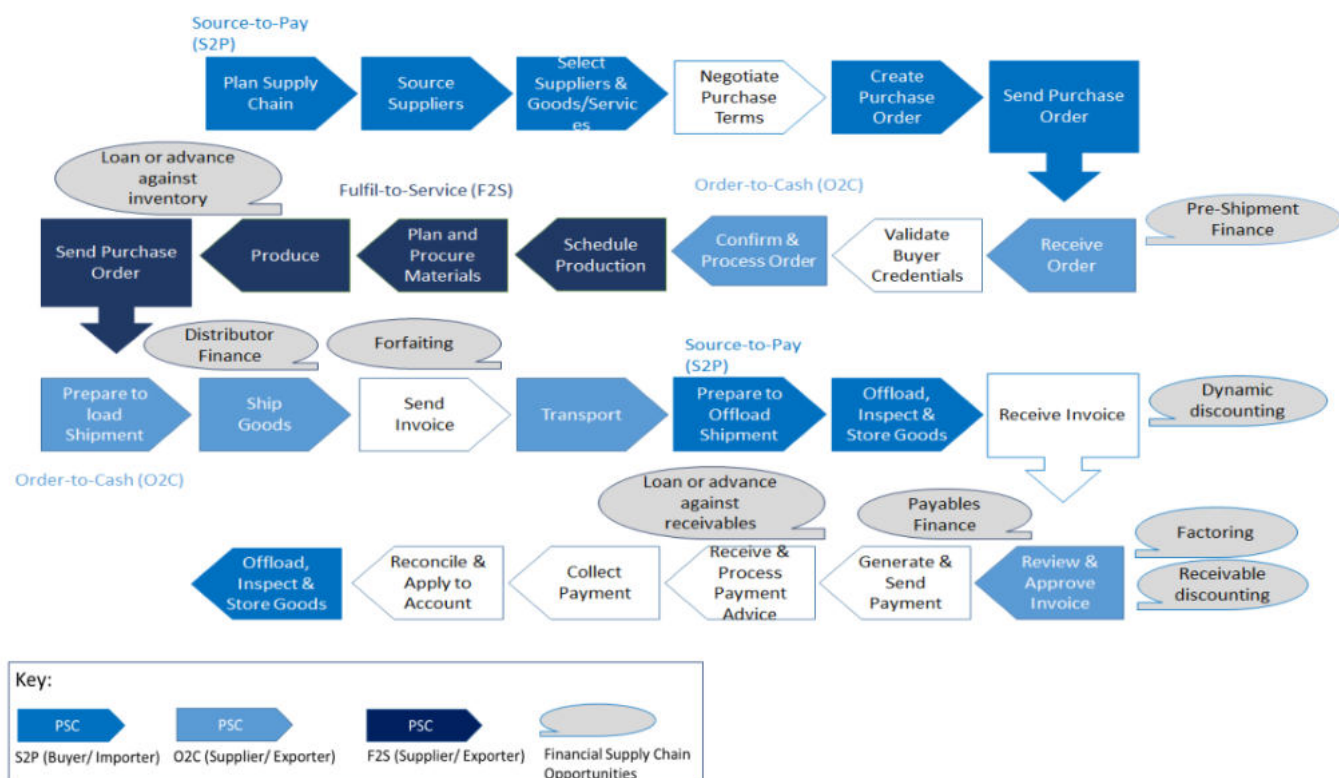


Figure 1. Financial Supply chain opportunities along the physical supply chain- Source: European Commission (2020).

GLOBAL WINNERS	
Best Supply Chain Finance Provider – Bank	Bank of America
Best Supply Chain Finance Provider – Non-Bank	Orbian
Best Customer Implementation	DBS
Best Dynamic Discounting Solution	Citi
REGIONAL WINNERS	
Africa	CIB
Asia-Pacific	ANZ
Caribbean	IDB Invest
Central & Eastern Europe	SupplierPlus
Latin America	BBVA
Middle East	First Abu Dhabi Bank
North America	Citi
Western Europe	MUFG

Figure 2. SCF Provider awards 2023 - Source: <https://www.gfmag.com/magazine/february-2023>

SCF volumes have grown significantly in recent years, reaching a total value of \$1.31 trillion in 2020, according to the latest BCR (2021) World Supply Chain Finance Report. In Europe, the flourishing of these instruments is also the consequence of the economic recession following the global financial crisis of 2007 and in particular of the credit crunch, which led companies to explore new sources of financing. SCF operations have spread especially in the food and beverage, manufacturing, automotive, consumer goods, transport and logistics, construction and chemical and pharmaceutical sectors (European Commission, 2020). Credit intermediaries - especially banks and factoring companies - play a leading role in offering SCF solutions, thanks to the long-term relationships they develop with their corporate customers, and which allow them to play the role of partner integrated into the daily running of the business.

However, fintech vendors and other service and solution providers are increasingly active in the enablement of SCF. Global Finance Magazine ranking shows the most active SCF providers in 2023, both globally and regionally (Figure 2).

2) The evolution of the literature on Supply Chain Finance

The theoretical exploration of SCF by scholars has followed the development of SCF practices. The literature on SCF has undergone an evolution through four stages, according to the maturity and scope of activities of SCF programs and the participants or geographical scope involved in SCF (Song, 2019): finance-oriented; supply chain-oriented; network ecology-oriented; fintech-oriented.

Most of the early research on SCF is finance oriented and underlines the crucial role of financial institutions in providing innovative financial solutions. According to Camerinelli (2009), SCF is a set of products and services provided by financial institutions that facilitate the exchange of goods and information in the supply chain. Chen & Hu (2011) look at SCF as an innovative financial solution that uses funds to create value by bridging banks with fund-starved companies in supply chain and reducing the supply-demand mismatch in fund flow. Finance-oriented research also explores the scope of business involved in SCF techniques. Some studies view SCF activities as a short-term financing process, or as a financing solution generated based on accounts receivable and payable. Lamoureux and Evans (2011) see SCF as a fusion of technology and financial services that brings together global supply chain companies, suppliers, and financial institutions (especially technology service providers) who improve financial supply chain benefits by preventing damage cost shifting and improving the visualization, availability, delivery, and cost of funds of global supply chain participants.

The authors also argue that the activities triggering SCF are mainly events that occur in the trade process, such as order receiving, shipping, issuing bills, and due payments. More and Basu (2013) define SCF as the management, planning, and control of all processes related to transaction activities and funds among all supply chain stakeholders in a bid to improve working capital for all parties. They distinguish SCF services into three stages based on the activity process, namely pre-shipment financing, in-transit financing, and post-shipment financing. Other finance-oriented studies consider SCF as a buyer-driven solution concerning working capital. For example, Wuttke et al. (2013b) view SCF as an automation solution that allows buyers to make flexible and clear payments based on the entire supply chain.

The second evolution stage of the literature on SCF includes supply chain-oriented research that considers SCF to be anchored in supply chain operations. As such, it includes solutions that lessen working capital requirements through inventory optimization throughout the supply chain, or transfer working capital to supply chain participants who have access to funds at lower cost. Pfohl and Gomm (2009) consider SCF as a way of financial optimization and integration with clients, suppliers, and service providers to increase value for all the participating members of the supply chain. Hoberg et al. (2017) investigate whether inventory management is impacted by capital constraints and whether companies take into account the cost of capital when making inventory decisions. Their results show that financially constrained companies have higher inventories, nevertheless capital constraints are not taken into account in supply chain inventory management and decision-making. Differently from finance-oriented research, supply chain-oriented studies state that even though financial institutions are actively involved in SCF, they are not always the dominant actors. The main players who promote and develop the supply chain financial services are the organizers of supply chain operations, including producers, distributors or third-party or fourth-party logistics providers.

More recently, the in-depth analysis of SCF practices has allowed scholars to point out some limits of supply-chain-oriented research. First, these studies pay no attention to the investigation of the conditions, scenarios, and innovative models for the development of SCF from a whole supply chain perspective (Caniato et al., 2016), limiting their research field to financial services originated by certain links of operations (e.g., inventory transfers) or assets (e.g., collateral and pledges). Moreover, the role of professional platform companies or service providers has not been explained enough by supply-chain focused research (Song et al., 2018). Thus, research on SCF has gradually entered the third stage of its evolution path, that is network ecology-oriented research.

Network ecology-oriented research show three main features. First of all, it tries to understand whether specific supply chain contexts ease the origination of SCF, that is, which contextual factors bring about SCF. For example, Caniato et al. (2016) suggest that the successful execution of SCF solutions depend on the degree of cooperation between enterprises in supply chain, the bargaining power, the degree of digitalization, and the appeal of financial services. Song et al. (2016) examine whether financing is influenced by SMEs' supply chain network characteristics. They find that weak relations play a crucial role for SMEs' access to financing. Another feature of network ecology-oriented studies is distinctive in respect to prior research, namely the investigation of the role of supply chain integration and the degree of cooperation among supply chain participants for financing services. Wandfuh et al. (2016) argue that successful implementation of SCF is conditioned to the concurrent occurrence of the elements: the strategic integration of corporate finance within an enterprise – through the realization of synergies between supply chain business department and finance department – and the synergies between suppliers and buyers, based on information sharing and finance integration between these two participants. Wuttke et al. (2016) added that financing performance is subject to further factors.

Specifically, the payment terms and purchase volumes that are negotiated between buyers and sellers in the course of business are able to affect the timing and the effects of SCF. Large purchase volumes and long payment cycles increase the need for early adoption of supply chain financial services.

The progress of network ecology-oriented research has been characterized also by the recognition of driving role of professional service providers in SCF, which has led to the formal introduction of the concept of ‘financial service provider’ in theoretical studies. Silvestro and Lustrato (2014) are the first scholars to suggest the enabling role of financial service providers – namely banks – in supply chain integration. Martin and Hofmann (2017) argue that different player may exercise the function of a financial service provider: either a traditional bank, or an innovative financial company, or a technology provider. The authors stress the crucial role of financial service providers in clearing up the mismatches existing between different supply chain participants and between financial institutions and commercial banks. Song et al. (2018) compare the differences between traditional commercial banks and new platform-based financial service providers in the process of providing supply chain financial services for pre-trade, mid-trade, and post-trade risk control. They find that traditional commercial banks are less able to control pre-trade, mid-trade, and post-trade risks by monitoring the whole process of supply chain operations through trading information, networks, and processes. On the contrary, platform-based financial service providers are more capable to perform this task, taking advantage from their experience as companies that directly engage in or organize supply chain operations.

The recognition of the driving role played by financial technology (fintech)¹ in SCF has led research on this topic to the current fourth evolution stage. Technologies help alleviate information friction that refers to incentive misalignment caused by information asymmetry between two parties of an economic or financial transaction, improving both information collection and information processing. On one hand, information collection technologies allow gathering additional new data, through digitization and automation, biometrics and identity management, and blockchain. Digitization enables lenders to have huge amounts of data ready to be analyzed. Advanced analytics and artificial intelligence help them in this task, drastically cutting the time needed to review documents and extract data. Biometrics and identity management allow lenders to recognize micro, small and medium enterprises and link their business history with their current status faster and more efficiently.

On the other hand, information processing technologies turn the enormous amounts of data lenders own into useful information in lending decisions. Therefore, not only are technologies able to collect more useful data, but they also enable lenders to extract more and better information, thereby increasing loan process efficiency. Thanks to digital transformation promoted by the implementation of digital technologies, financial technology (fintech) companies have become a new participant that empowers SCF (Moretto and Caniato, 2021). Several scholars have shown the unique advantages of using technologies in the context of SCF (Yan, 2017; Omran et al., 2017; Lee et al., 2019; Lee et al., 2021; Song et al., 2022; Soni et al., 2022; Le, 2022). Even if fintech companies may neither take part to specific transactions nor coordinate business operations, they can be embedded in the supply chain information network, thereby promoting the effective and smooth flow of signals between small and medium enterprises and lenders, improving the efficiency of processing information, and easing the lenders’ decision- making process.

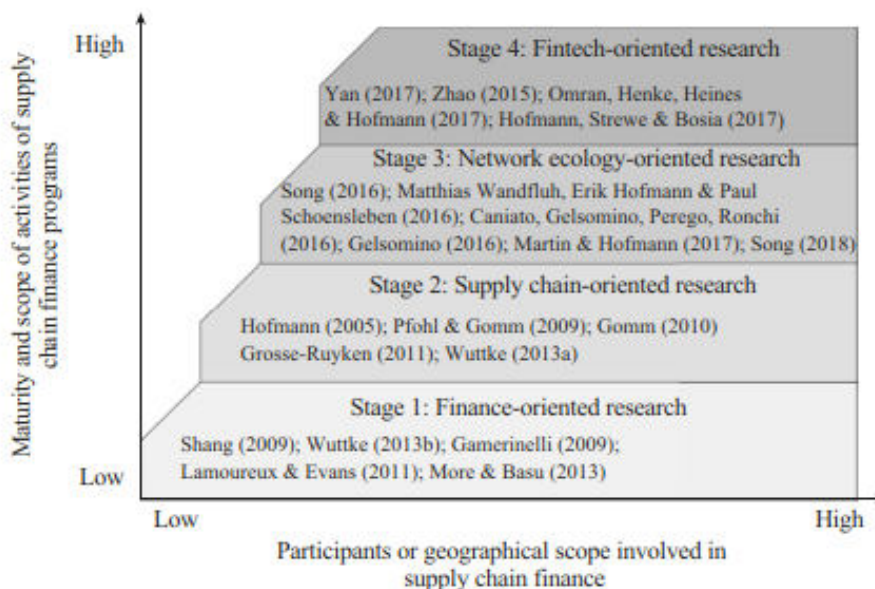


Figure 3. The evolution stages of SCF theories - Source: Song (2019).

3) Supply Chain Finance techniques

According to the definition provided by the Global Supply Chain Finance Forum (2021a), SCF techniques existing on the market can be divided into three categories: receivable purchase, advanced payable, and loans.

Hereafter, a depiction of the peculiarities of the different SCF solutions is provided.

3.1) Receivable Purchase

¹ According to the Financial Stability Board’s definition, fintech refers to “business models, technology applications, operating processes, and innovative products that promote financial innovation through technical means and have a significant impact on financial markets, institutions, and financial services” (see FSB, 2017).

The background of this kind of SCF solution is the finalization of a commercial agreement between a firm selling goods and/or services (supplier) and a buyer company. The seller issues invoice with payment details. In particular, the sale contract (or service contract) establishes a payment obligation from the buyer to the seller, at a future pre-agreed date. Through receivables purchase the supplier transfers all or a part of its receivables to a finance provider. After the transfer, the ownership of these assets lies with the finance provider. In return, the supplier receives an early payment for the receivables, which may include a deduction denoting the quality of the receivables, and a charge based on the pricing arranged with the finance provider. The receivables involved in these transactions exist (i.e., they can be clearly identified and validated), are assignable and enforceable against its debtor in the debtor's jurisdiction.

Included in this category are:

- receivables discounting;
- factoring;
- forfaiting;
- payables finance.

Receivables discounting is usually offered by finance providers to larger enterprises selling to multiple buyers. It may be provided on a one-off, seasonal or continuous program basis. According to these contracts, the seller trades single or multiple receivables - represented by outstanding invoices - to a finance provider at a discount. The finance provider may discount up to 100% of the receivables up front or apply a security margin to cover for possible credit deterioration. Typically, the finance provider will limit such offering to a client base, whose receivables comply with certain criteria, such as a minimum credit rating. The payment of the underlying invoices is hinged on the buyer company, so the buyer coverage depends on the number of buyers for which the finance provider is willing to take credit risk. The finance provider may limit its own risk exposure, by insuring or sharing the credit risk with a third party (e.g., trade credit insurance). If the transfer of receivables is disclosed to the buyer, the collection of the receivables may be undertaken by either the seller (acting as agent for the finance provider) or by the finance provider. The buyer may be required to confirm that specific invoices are authentic and approve invoices for payment within a certain timeframe. Figure 4 shows the functioning of a receivable discounting agreement.

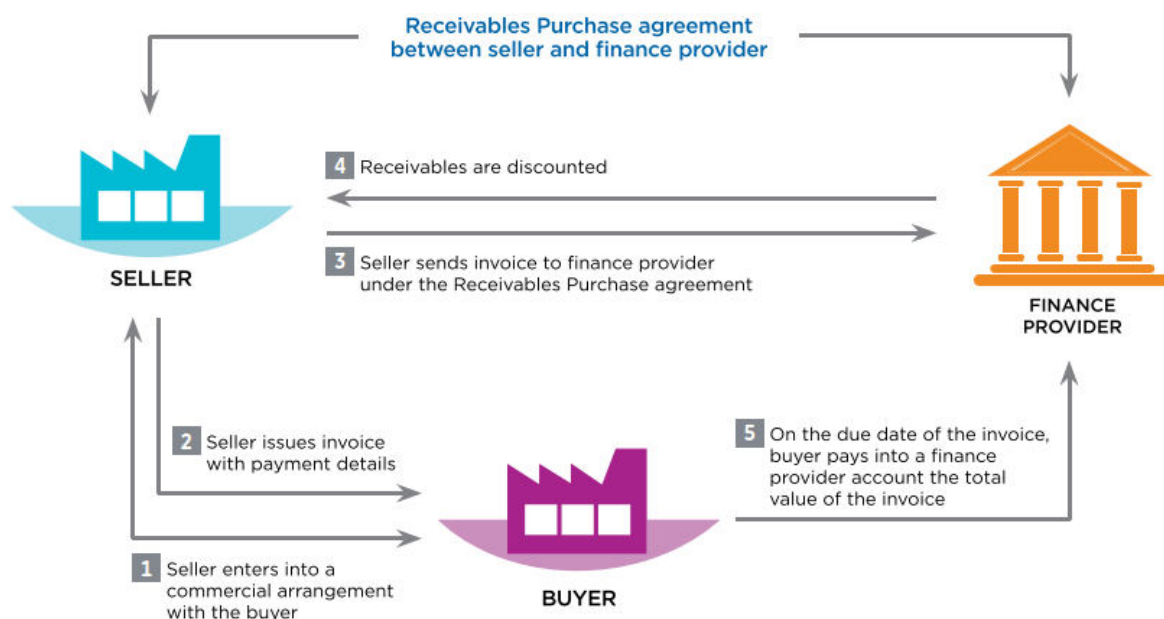


Figure 4. Illustration of the process for receivables discounting – Source: Global Supply Chain Forum (2016).

Factoring too implies the transfer of a seller's receivables at a discount to a finance provider (named 'factor'). The seller may assign all invoices or allowable invoices to the factor (whole turnover factoring), or it may select a range of invoices to be assigned (selective factoring). Usually, the factor is a specialized finance provider serving a variety of suppliers including most SMEs but also large value transactions.

The nature of factoring is the same as in receivables discounting, but the content of the contract may be slightly different, since the factor typically becomes responsible for managing the debtor portfolio and collecting the payment of the underlying receivables. Moreover, it often offers protection against the insolvency of the buyer. Within the factoring model, some variations exist. The buyer and the seller may be located in the same country (domestic factoring) or in two different countries (international factoring). In the second case, two factors are involved, one in each country.

In addition, the advanced payment to the seller can be provided with recourse (the factor has recourse to the seller in the case of buyer default) or without recourse, depending on aspects such as credit insurance, jurisdiction and market practice. Generally, the buyer is generally notified of the receivables assignment (disclosed factoring) and settles the invoice with the finance provider on the due date. In some cases, the invoice bears no notice of assignment, and the buyer is not aware of the factoring agreement between the seller and the finance provider (confidential factoring).

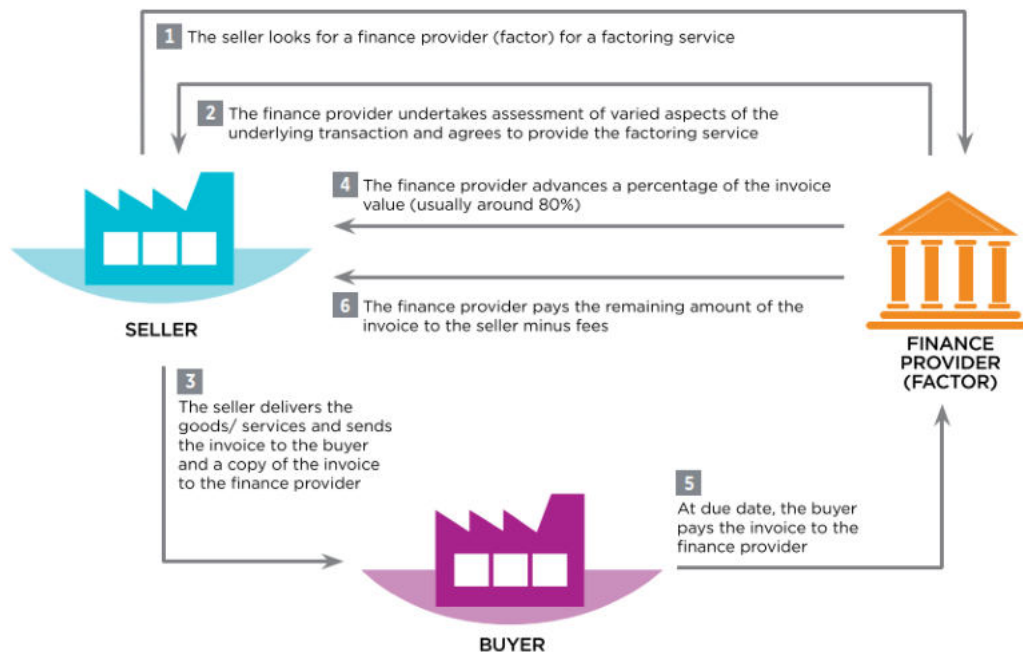


Figure 5. Illustration of a factoring scheme – Source: Global Supply Chain Forum (2016).

In forfaiting, the commercial contract between the buyer and seller is essentially the same as the one underlying receivable discounting and factoring. Differently from the two previous SCF solutions, forfaiting requires the existence of an underlying payment obligation that is usually embodied in a financial instrument or payment bond (normally in negotiable or transferable form), distinct from the commercial transaction (e.g., exports, imports) that originated it. Forfaiting consists in the without recourse sale of the payment obligations at a discount or at face value, in return for financing. These obligations may or may not be guaranteed by third parties (e.g., banks). Tenors can differ from one month to several years, unlike factoring and receivables purchase that are conducted on a short-term basis.

There is a primary and secondary forfaiting market. In the primary market, transactions are originated, and obligations can be purchased from sellers of goods/services or their buyers. Thus, there is a seller of goods/services or buyer that act as seller of the instrument or payment obligation to the initial finance provider (commonly the primary forfaiter). In this market, forfaiting is undertaken without recourse to the seller of goods and services. In the secondary market there are sellers and buyers (forfaiting), usually composed of finance providers and investors. In this case, forfaiting is undertaken without recourse to the seller of the forfeited asset.

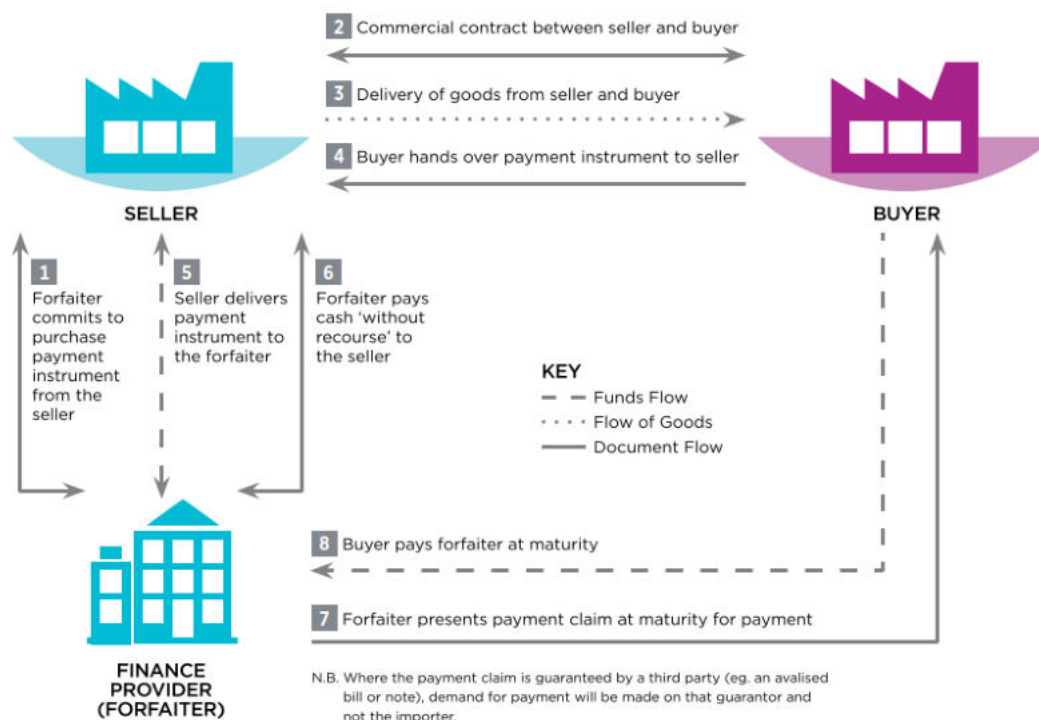


Figure 6. The phases of the process for forfaiting – Source: Global Supply Chain Forum (2016).

While the SCF techniques described so far are conducted based on a seller-led process, payables finance is provided through a buyer-led program in which sellers involved in the buyer's supply chain are able to access finance by means of receivables purchase. Given its structure, this SCF solution is commonly known as 'reverse factoring'.

Reverse factoring is usually directed to large buyer companies that have a wide and fragmented portfolio of suppliers and are willing to rationalize their accounts payable cycle. The buyer acts as 'anchor party' or program arranger: it sets up a payables finance program with one or more finance providers, according to which each seller is entitled to receive early payment of receivables (represented by outstanding invoices), at discount and at a financing cost aligned with the buyer's creditworthiness. Usually, the loan is provided 'without recourse' to the seller. Following the stipulation of the reverse factoring agreement, the leading company (i.e., the buyer) provides the financial provider with the names of the strategic suppliers on which to operate. The financial provider admits the sellers that are characterized by an economic-financial situation demonstrating business continuity, albeit in the presence of temporary financial difficulties. At the invoice maturity date, the buyer makes the payment of the principal amount to the financial provider. Often, the buyer company is granted a deferment on the original payment terms, which allows it to benefit from an extension of the duration of its accounts payable cycle, without negatively influencing the cash flows of its supplier base.

Thanks to this SCF solution, the suppliers have the opportunity of accessing dedicated credit lines at preferential conditions, benefiting from the credit standing of the buyer company. Signing a reverse factoring agreement has many advantages also from the buyer's point of view. The main benefit for the anchor party consists in the optimization and planning of treasury and financial flows. A further significant advantage concerns the uniformity and simplification of the administrative procedures related to accounts payable. The fact of interacting with a single interlocutor for the transmission of the flow of information, acknowledgments and payments, leads to a reduction in operating costs. Furthermore, these operations strengthen the relationships with suppliers, with a potential improvement in the quality-of-service levels. Finally, as anticipated, the buyer has the option of requesting an extension of the payment terms.

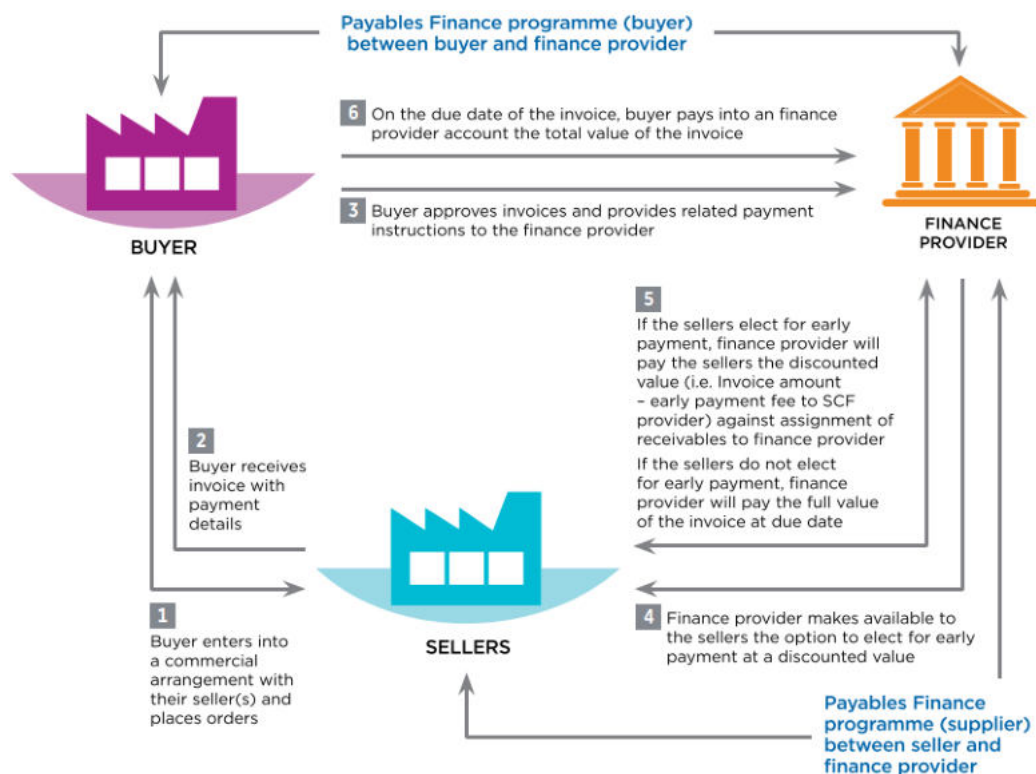


Figure 7. The structure of a payables finance program – Source: Global Supply Chain Forum (2016).

3.2) Advanced Payable

The second type of SCF techniques includes corporate payment undertaking and dynamic discounting.

Like payables finance, corporate payment undertaking is a buyer-led program which entitles sellers in the buyer's supply chain to receive in advance the payment of the discounted value of outstanding invoices (unconditionally approved by the buyer that will pay on the due date) from a finance provider, at a financing cost that is aligned to buyer's creditworthiness.

The peculiarity of corporate payment undertaking is that the early payment does not require receivables purchase but may ask the seller to confirm the finance provider's right to receive buyer payment and/or pass-through arrangements and/or acceptance as full payment of the approved invoice amount. Thus, in such a scheme:

- The buyer identifies the invoices to be involved on the SCF solution and after approval, it submits the details of the invoices to the finance provider, together with a corporate payment undertaking to make payment of the approved amounts to the finance provider at the confirmed invoice due dates.
- The seller has the option to request an early payment from the finance provider at a discount.
- The finance provider relies on the buyer's credit standing and generally provides early payments 'without recourse' to the seller.

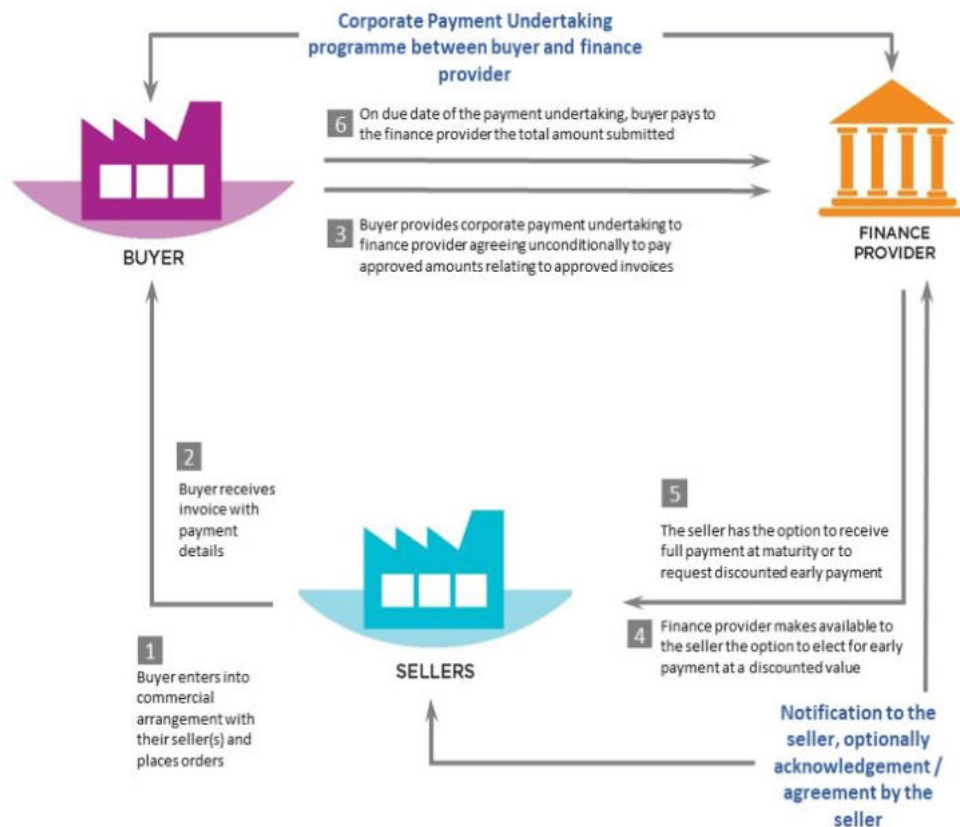


Figure 8. The scheme of a corporate payment undertaking – Source: Global Supply Chain Forum (2021b).

A dynamic discounting transaction is a peculiar form of SCF, since it consists in an advanced payment that is directly made by the buyer to its sellers. Differently from other SCF solutions, there is no financing from the finance provider. It is the buyer that finances its suppliers with early payment terms. Thus, from the seller company's perspective, dynamic discounting is a discounted payment. More precisely, buyers are allowed to choose the amount and timing of payment to their suppliers in exchange for a lower price or discount for the purchased goods and/or services. The discount is defined as 'dynamic', since it depends on the dates of payment to suppliers: the earlier the payment takes place, the greater the discount recognized to the buyer. Specific online platforms are used to initiate the collaboration between buyers and suppliers and to negotiate the discounts. The buyer is given flexibility in choosing how and when to pay the seller. It specifies how much of its own capital is available to generate additional purchasing discounts and it can also choose to approve individual invoices for early payment. From their side, the suppliers can ask advanced payment for specific invoices. Once the discounts are agreed between the parties, they are automatically initiated.

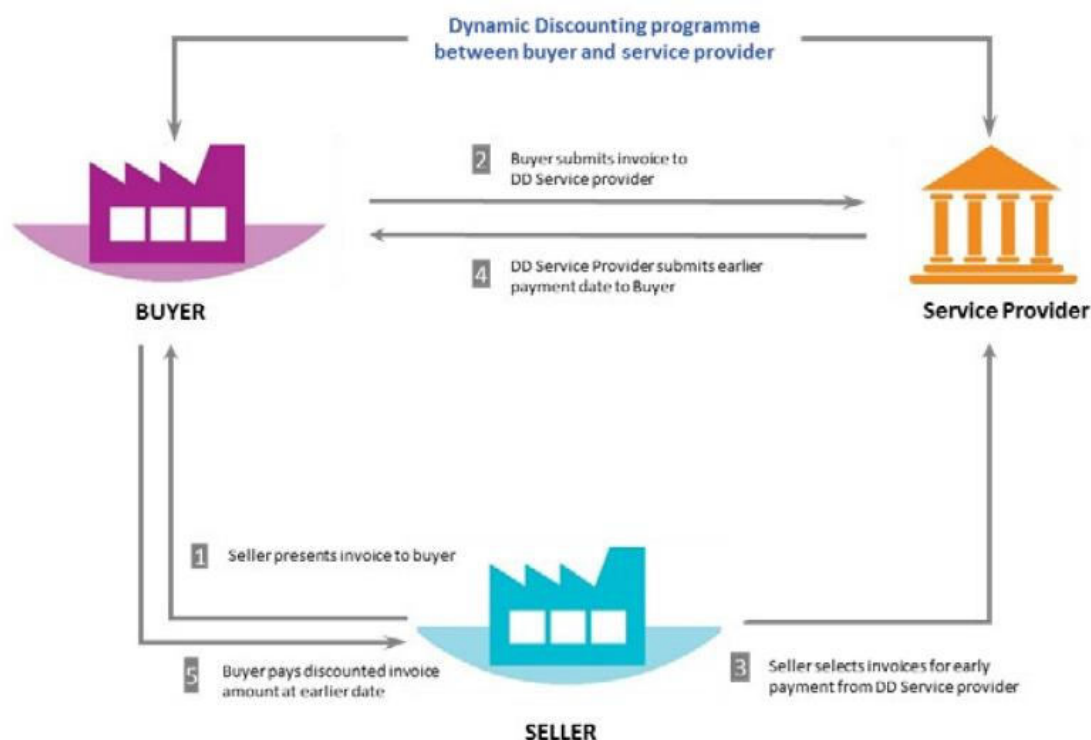


Figure 9. Illustration of dynamic discounting – Source: Global Supply Chain Forum (2021c).

3.3) SCF Loans

The third cluster of SCF solutions include loans and advances made against receivables, rather than by means of purchase, as seen before. In particular, the following transactions are provided:

- loans against trade receivables;
- loans against inventory;
- distributor finance;
- pre-shipment finance.

Loans against receivables refer to financing made available to a party involved in a supply chain on the expectation of repayment from funds generated from current or future trade receivables. The necessary background for these loans to be made is that the seller has or will acquire receivables, deriving from the sale of goods or services. If the seller has already the relevant receivables at its disposal at the time the loan is granted, the financing assumes the form of a secured loan collateralized such receivables. In some cases, the lender may consider the receivables as ideally satisfying financial covenants required to the seller. If these assets do not exist yet, the loan is disbursed on an expectation of such receivables arising at a future date.

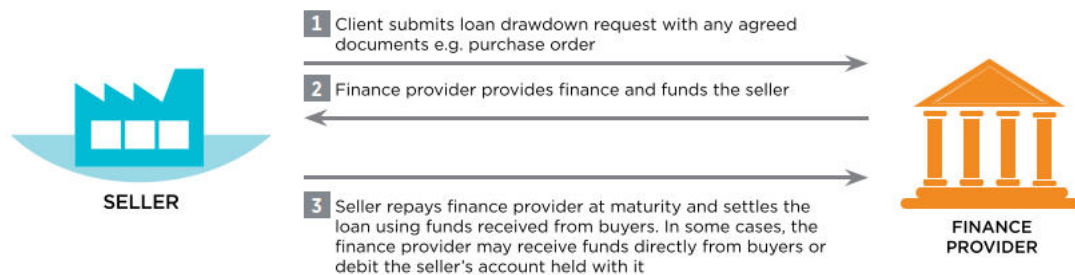


Figure 10. Illustration of loans against receivables – Source: Global Supply Chain Forum (2016).

Loans against inventory implies financing provided to a buyer or seller involved in a supply chain for the holding or warehousing of goods (pre-sold, un-sold, or hedged). This form of SCF technique may be used at any stage and by any party in a supply chain acting as seller and/or a buyer, and the tenor of transactions is short term.

A financing agreement is settled between the finance provider and the borrower (which could be a seller or buyer). In addition, a security agreement is established covering title to the underlying inventory and covering warehouse receipts (evidencing storage of the goods in the warehouse).

A third-party warehouse (certified or recognized by governmental or trade bodies) may also be involved, thus requiring ancillary agreements as well as third party collateral management or inspection agents.

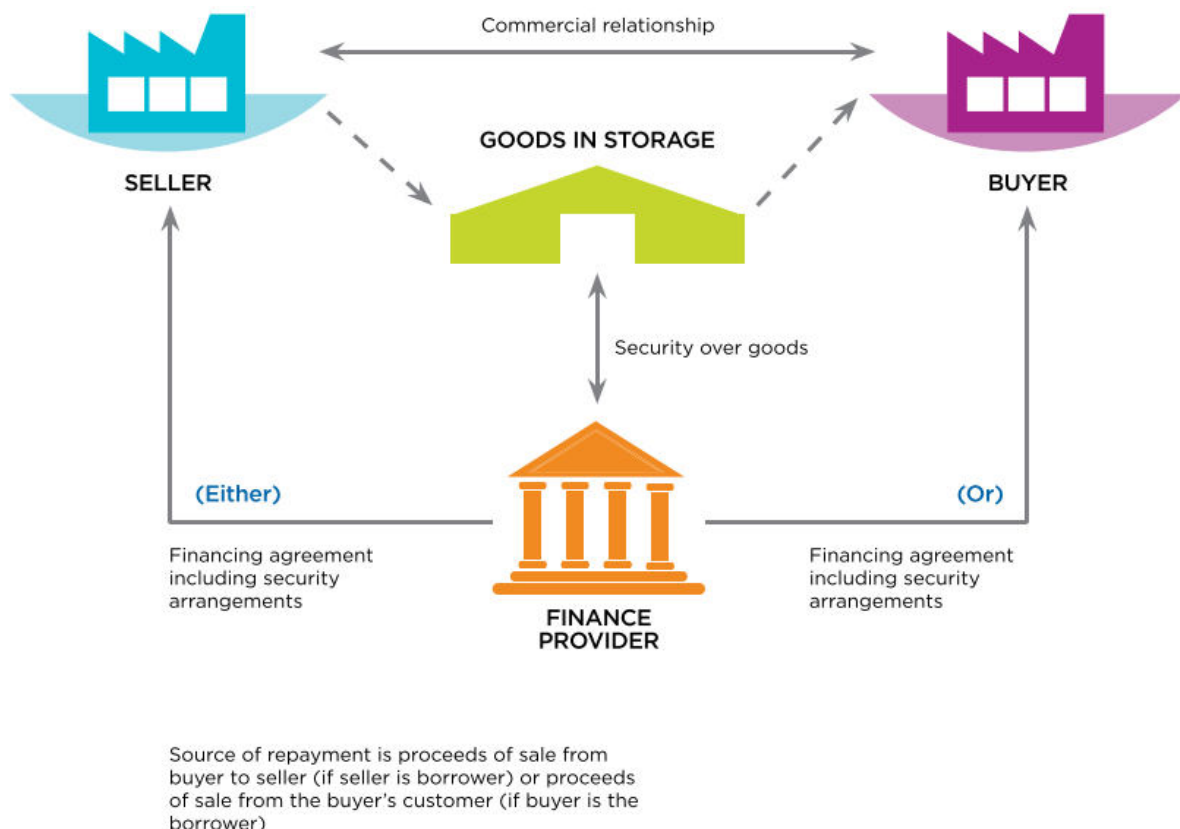


Figure 11. The parties involved in loans against inventory – Source: Global Supply Chain Forum (2016).

Distributor finance consists of a funding facility provided to the distributors of a large manufacturing firm/exporter acting as a seller (often called ‘anchor party’). The financing is intended to cover the holding of goods for re-sale to bridge the liquidity gap until the collection of funds from receivables following the sale of goods to retailers or to final consumers.

This facility is typically used for funding inventory and receivables on a short-term basis and is subject to annual review. The distributors and the finance provider directly set up a financing agreement (or sign a facility letter). Moreover, the seller and the financing provider establish a master agreement including the terms of engagement for the finance provider to grant loans for multiple distributors in a variety of global territories, any agreed risk-sharing arrangements, and the operating model applicable to the three parties involved.

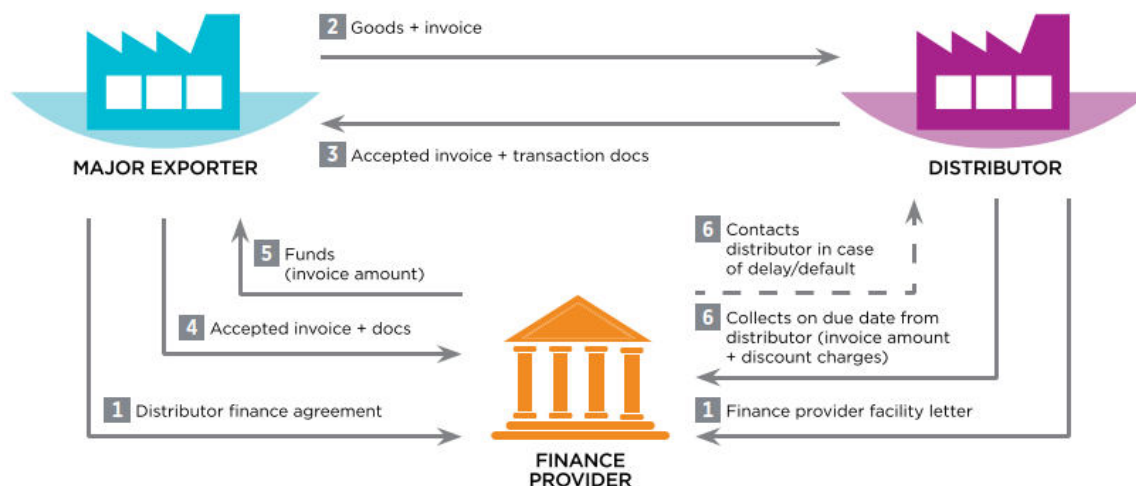


Figure 12. The scheme of distributor finance – Source: Global Supply Chain Forum (2016).

Pre-shipment finance (or purchase order finance) includes loans granted by a finance provider to a manufacturing or service company acting as a seller, to finance its operating cycle (purchase of raw materials and goods, transformation into semi-finished or finished products). Thus, the financing covers the seller’s working-capital needs, following the issuance of a purchase order for goods and/or services by a client company (i.e., the buyer). The purchase order from high standing buyer in favor of the seller is the key element motivating the financing (in addition to the ability of the seller to fulfill delivery to its buyer). The seller and the finance provider sign a financing agreement detailing the terms of the loan structure. Sometimes a security agreement is also included, covering assignment of rights (transfer of title or a pledge) to the underlying work in progress and finished goods prior to shipment. The source of repayment usually comes from the flow of sales.

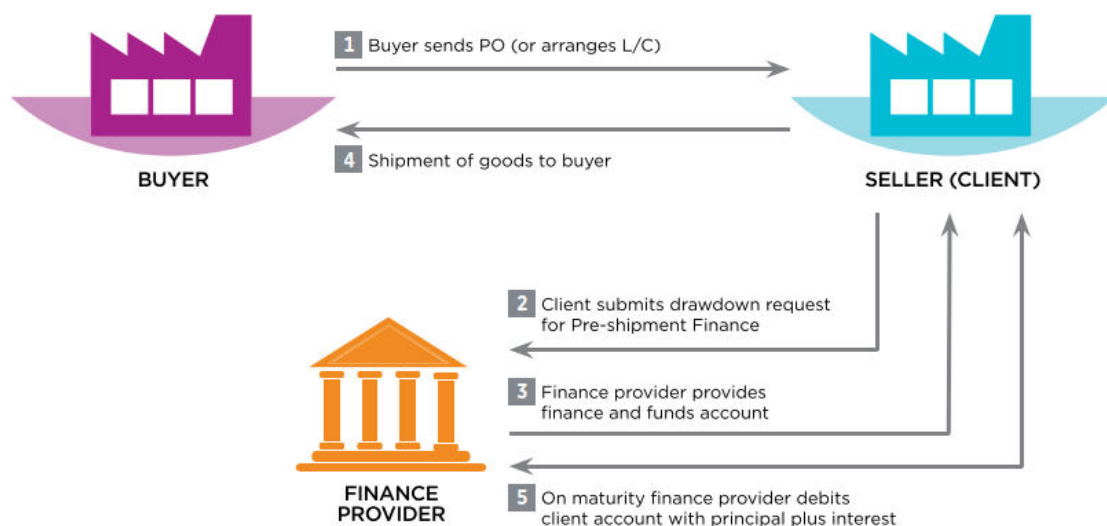


Figure 13. The architecture of pre-shipment finance – Source: Global Supply Chain Forum (2016)

4) The sources of risks in Supply Chain Finance

Risks in SCF can be distinguished in three main types: transaction flow risks, financial flow risks, and information flow risks.

Transaction flow risks involve the uncoordinated commodity flow and logistics flow of the parties involved in the supply chain. This type of risk affects:

- The procurement phase, in which supplier selection may be crucial. Choosing a single supplier often has a negative impact on the straight operations of the supply chain, as high concentration of supply can cause instability in procurement (Peck, 2005).

Relying on multiple suppliers gives firms more flexibility, allowing them to loosen the constraints on resource. At the same time this choice generates hidden costs. Levary (2007) points out that supplier selection requires a comprehensive consideration of supplier stability and reliability, national risks, and transport reliability. Besides supplier selection, risk factors to be considered in the procurement phase include lead time, supplied product monitoring, and control of supply capacity.

- The production phase in which supply chain operations may be negatively impacted by design risks for products and processes and the inability of firms to promptly update products or processes to answer to rapid market changes (Khan et al., 2008). These aspects increase the cost sustained by enterprises to position their products or processes in the market, exposing them to economic losses. Another important variable to consider in the production phase is production capacity, that is related to technology, skills, and quality capabilities (Korpela et al., 2002). Indeed, a shortage of resources and capabilities may prevent firms from carrying out normal production and operations. Moreover, the production and operations of an enterprise might not be carried out properly for either internal or external reasons (e.g., mismanagement, operational problems, economic downturn) that cause severe losses along the supply chain (Mizgier et al., 2015; Wagner et al., 2017).
- The distribution phase, one of the most important kinds of risk refer to excess and obsolete inventory resulting from fast changes in technologies or customer demand (Narayanan and Raman, 2004). In addition, the volatility or seasonality of demand is a key source of risk, that is likely to exacerbate uncertainty. The difficulties to determine the range and volumes of products or services to meet the needs of floating demand and markets, limit efficient and effective distribution (Wong and Hvolby, 2007).

Financial flow risks usually entail factors such as exchange rate risk, price risk and cost risk, and financial problems of supply chain partners. Exchange rate risk significantly affects firms that are involved in global supply chain operations, since exchange rate variations may directly influence after-tax profits, supplier selection, market development, and other related decisions. Exchange rate fluctuations may also cause increases in procurement costs of raw materials or input, as well as decrease in the price of firms' products (Papadakis, 2006; Christopher and Holweg, 2011).

Another important risk originates from the financial problems of partners in the supply chain, which may produce adverse consequences on upstream and downstream firms, which in turn may contaminate the entire supply chain (Tang and Nurmaya Musa, 2011).

Finally, risks in the information flow (Tang and Nurmaya Musa, 2011) mainly pertain to:

- The correctness of information. The efficient and effective functioning of the supply chain is based on the availability of several kinds of information that represent an important basis for decision-making, such as demand information, inventory information, order information, and production capacity information. If information is incorrect or not punctually available, the supply chain decision will be distorted. Information accuracy is linked to information accessibility, information efficiency, and data precision (Lee, 2002; Nishat Faisal et al., 2007). The failure of lead firms to build a smooth information sharing platform, the lack of transparency in each node of the supply chain, or the deliberate use of the supply chain by firms to disseminate false and poor-quality information in pursuit of their interests will damage the transmission and communication of information, resulting in a lack of reliability, integrity, and authenticity of information (Wu and Wu, 2022).
- The security and disruption of information systems that may arise from internal mismanagement, or hackers and natural disasters (Nishat Faisal et al., 2007), or application, firm-level, or cross-firm variables (Finch, 2004).
- Intellectual property rights. Intellectual property risks may result from the inability to protect the information shared due to dramatic increase in the amount of information in the supply chain, which also boosts the risk of data loss and confidential information leakage (Wu and Wu, 2022).
- Outsourcing data analysis and processing, which makes room to the opportunism of information service providers (Nishat Faisal et al., 2007).

Risks in SCF arise from two main sources: supply chain operations and moral hazard of the involved parties.

A physical supply chain involves production and distribution, and connects to wholesale, retail and end-users, relating to the whole value chain from raw material procurement to production, sales and end-users. Therefore, the first element that threatens the regular functioning of SCF is the disruption of supply chain operations, that negatively affects the possibility of completing the transactions and the future expected return of the whole supply chain. Thus, the transaction risk in the supply chain constitutes the financial risk in the supply chain (Sun, 2022).

The unstable states or uncertain resources that lead to supply chain disruptions refer to events that have a small probability of occurrence but may happen suddenly. Moreover, once these events happen, they produce a continuous harmful effect on the whole system (Tang and Nurmaya Musa, 2011).

The sources of risks affecting supply chain operations may be different: environmental factors, industry factors, and organizational factors (Rao and Goldsby, 2009). Environmental factors include macro-systemic variables (Miller, 1992; Wu and Wu, 2022) such as political stability, changes in government policies, macroeconomic uncertainty (e.g., fluctuations in bank interest rates or market prices due to an unstable economic environment), legal loopholes (due to inadequacy of laws and regulations), and natural uncertainty (e.g., natural disasters such as earthquakes, floods, and plagues). They are external events that affect the business scenario of each industry, or, rather, external factors that can negatively affect the industry (Ritchie and Marshall, 1993). Given their external nature, these risks are often more difficult for enterprises to control and manage. Differently from environmental variables, industry factors may not affect all industries of the economy, but specific sectors (Ritchie and Marshall, 1993).

These sources of risk regard either the uncertainty affecting the industry's production input factors, or unexpected variations in corporate or industrial demand (Miller, 1992), or competitive uncertainty. While input market uncertainty and product market uncertainty can arise both from changes in customer demand and the arrival of substitutes (Tang and Nurmaya Musa, 2011), competitive uncertainty is associated to market competition deriving from existing competitors and potential new entrants). Supply chain operations may be negatively influenced also by organizational features of enterprises (Ritchie and Marshall, 1993).

Despite their firm-specific nature, these variables may affect the entire supply chain. They include a wide array of uncertainties regarding:

- a) corporate operations: events occurring to firms during the settlement of their supply chain activities e.g., changes in employee productivity, uncertainty in production input elements such as raw materials, components, and equipment failure (Rao & Goldsby, 2009). Uncertainty may also derive from the inadequate knowledge base of staff, as well as substandard business skills resulting in operational errors (Wu and Wu, 2022).
- b) Outsourcing decisions: enterprises may outsource certain business processes to others, but outsourcing may increase the enterprises' vulnerability, making them lose control over those processes (Hallikas and Lintukangas, 2016; König and Spinler, 2016).
- c) Liabilities: unexpected events related to the production or consumption of a firm's products (e.g., issues in product safety, or environmental hazards).
- d) Inventory: market fluctuations (the longer the inventory is held, the more significant the impact of market price fluctuations it receives) and difficulty in preservation (due to the perishability of inventory and to the inability of the supervising company to match the various commodities with advanced preservation facilities for long-term storage) can affect the value of inventory.
- e) Credits: the insolvency of a customer may cause liquidity pressures to an enterprise that, in turn, may delay payments to its suppliers. Business or financial problems of strategic customers or suppliers are likely to spread to the entire supply chain, since each node of the supply chain involves the exchange and operation of financial flows, and changes in the financial position of individual firms can pass on financial risk to other participants in the supply chain (Finch, 2004; Kleindorfer and Saad, 2005; Wu and Wu, 2022).

As mentioned before, SCF risks may also originate from opportunistic behaviors of the participants involved in a transaction or exchange, who violate the agreements in order to act in their own interest at the expense of others. Often, opportunism arises from ex ante and ex post information asymmetry.

Ex ante information asymmetry occurs before a transaction or a lending business and leads to adverse selection. As borrowers, SMEs may disclose positive information in their favor to lenders and hide negative information, to put themselves in a good light and obtain loans. In addition, ex ante information asymmetry may also refer to guarantees that are usually considered an effective means of risk mitigation. Financial institutions may fail to effectively reduce the risk of loss in case of the borrower's default due to the shortage of information about the true state or the quality of the guarantees. In practice, ex ante opportunistic behavior mainly includes fictitious trade, illegal contracts with multiple parties, and financing under false guarantees. Differently from other lending transactions, the lending decision in SCF is based on the transaction structure and trade relationship developed by upstream and downstream firms along the supply chain. Some participants may use fictitious trade to fraudulently obtain funds from financial institutions: they set up a false trade relationship with their related parties and forge a series of transaction contracts and documents, to recreate a substantial transaction flow (buying and selling) and logistics flow (provision of logistics services) among different participants or service providers. The aim of this set-up is either to allow the related parties to falsify operating income and profits, or to obtain low-cost financing. Another form of ex ante opportunism reflects in the borrower obtaining funds from multiple parties thanks to real transactions and assets that are exploited in a variety of occasions. Since there is almost no information sharing between different financial institutions and supply chain financial service providers, borrowers may use their transactions or logistics business or their certain assets to apply for lending from multiple entities to raise more funds. Another practice that is related to ex ante opportunistic behavior is financing under false guarantees. When guarantees and pledges are requested by lenders as a prerequisite for lending, firms may ask fictitious guarantors, usually relatives, friends, or closely related parties.

Ex post information asymmetry influences the ability of the lenders to monitor the borrowers throughout the loan life, which may lead to moral hazard. Borrowers may take advantage of the difficulty to fully oversee their behaviors, the true movement of funds as well as their actions, and they may misuse the funds received by the lenders. A common fraud phenomenon in SCF is the duplication of false warehouse receipts. Borrowing firms collude with warehousing enterprises or related personnel to deceitfully issue or repeatedly issue warehouse receipts for some goods to the borrowing firms who again and again pledge the warehouse receipts to different lenders, in order to achieve many loans.

5) Improving the management of supply chain risks through digitization

The full adoption of modern information and communication technologies allows to control the various factors underlying supply chain risks. First of all, digital technologies optimize operations across the entire supply chain by enabling connectivity, data management, insights, and smart automation. Second, digital technology can reduce risks stemming from both asymmetric information and supply chain disruptions.

Regarding risks stemming from incomplete and asymmetric information, the transaction information between the upstream and downstream of the supply chain can be incorporated into a unified information platform, thanks to the distributed ledger of blockchain. Thus, all the parties involved are able to access information and confirm its accuracy through consensus authentication. Enterprises with financing needs register their contracts, debts and other proofs on the chain, which prevent the tampering or copying of these elements after digitization. The automatic contract system allows to predefine the transaction procedure and complete the transaction process automatically after the transaction passes the consensus authentication, thereby improving the efficiency and security of supply chain management and reducing the moral hazard risk deriving from asymmetric information. Besides, should a dispute arise, it would be easy to rapidly solve it, since all information is open, transparent and traceable (Sun, 2022).

As for supply chain disruptions, digitalization can provide a contribution in several fields (McKinsey & Company, 2016), as illustrated by Figure 14:

- planning;
- physical flow;
- performance management;
- order management.

Big data, advanced analytics, and the automation of knowledge work play a significant role either in demand planning or, production planning, or inventory control. An accurate and granular demand plan can be achieved thanks to predictive analytics that analyze thousands of internal and external demand-influencing variables (e.g., weather, trends from social networks, sensor data) with Bayesian network and machine learning approaches. Thanks to these new technologies, the accuracy of demand forecast improves dramatically, as the forecasting error is reduced by 30 to 50%. Moreover, the use of closed loop manufacturing resource planning software enables plans to be continuously checked and adjusted. Exploiting an information feedback feature, the purchasing or materials procurement plans are synchronized with the master production schedule. In addition, depending on the stock levels, expected demand, and capability to replenish, prices can be dynamically adjusted to optimize the overall profit.

Warehousing operations can benefit from the use of modern technologies too. Lead times, transportation costs, product handling and environmental cost are the main areas that can be positively influenced by the adoption of autonomous and smart vehicles. For example, automated-guided vehicles are increasingly present as transportation solutions in industrial environments, as they ensure that automated storage and retrieval systems are agile and safe, while reducing load movement times. In particular, these vehicles have a prefixed route that ensures the continuous, ensuring a uniform flow of goods. In addition, they allow 24-hour work cycles, since the automatization of the flow of goods allow operators to concentrate on higher value work. These vehicles also incorporate safety systems to optimally navigate the warehouse, avoiding interaction with operators and limiting the risk of accidents. Physical flows in the supply chain can also benefit from additive manufacturing. For example, 3-D printing has become much more relevant for a broad range of business applications, such as local production of slowly moving spare parts or tools (McKinsey & Company, 2016). The expanding range of printing materials, rapidly declining prices for the printers, and increased precision and quality boost the development of these tools.

As mentioned before, disruptions in supply chain operations are one of the main sources of SCF risks. Understanding the reasons for these events is therefore critically important. Root cause analysis is a process that allows the identifications of the causes for disruptions. A large number of data attributes go along with a given order e.g., the quantity of the item being ordered, its value, the plant that manufactures it, all events logged during the lifetime of the order, the supply levels for the item, the agreed delivery date, the order route, and many further factors. Causal discovery algorithms help mapping all cause-and-effect relationships among these variables, that is how these variables are interrelated and ultimately how they relate to the order being delayed or not. Once identified the root causes of an exception (e.g., on-hand inventory level falls below a minimum), the performance management system automatically triggers countermeasures, such as activating a replenishment order or changing parameter settings in the planning systems (e.g., safety stocks).

As for order management, it may be improved by no-touch order processing and real-time re-planning, which lead to lower costs through automation of efforts, higher reliability due to granular feedback, and superior customer experience through immediate and reliable responses (McKinsey & Company, 2016). No-touch order processing is the logical next step after implementing a reliable available-to-promise process (that provides a response to customer order inquiries, based on resource availability). No-touch order processing can be used to completely automate the ordering process, requiring no manual intervention between order intake and order confirmation. In addition to simplifying the ordering and sales process, touchless order processing integrates the business with the customer's needs, ensuring on-time delivery. In particular, this solution allows a drastic reduction of time to process orders, the elimination of human errors, a greater visibility of the entire process by the company, customers and suppliers, an increase in customer satisfaction, and a growth in productivity. The second technology-driven element that can positively impact on order management is real-time re-planning. The production process requires a re-planning to handle unexpected events occurring in the day-to-day operations of a production plant (i.e., disruptions to schedules, such as last-minute orders, out-of-stock raw materials, equipment failures) that can cause production or capacity problems along the supply chain. Internet of things (IoT) made real-time data available on equipment performance and analyze it in a few minutes to predict when a part is going to fail before it does (predictive maintenance).

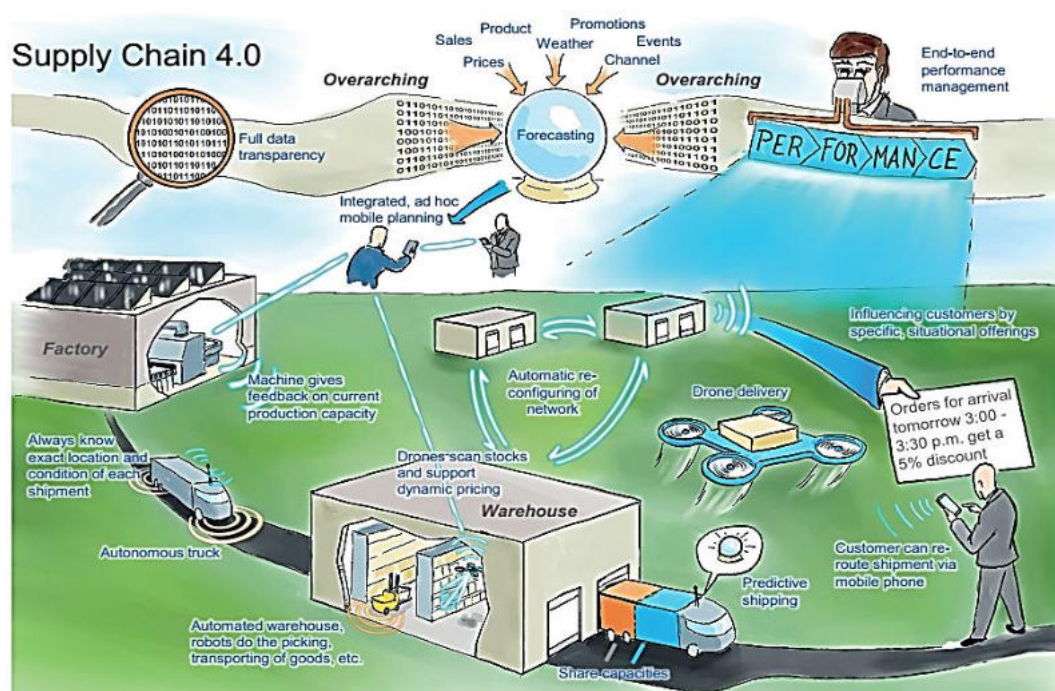


Figure 14. The components of Digital Supply Chain – Source: McKinsey & company (2016).

According to a recent survey published by Capgemini (2023), global supply chain bottlenecks and trade/ logistical disruptions are perceived to be the biggest risk to growth in the next 12–18 months. Coherently, 43% of executives across sectors including life sciences, retail, industrial manufacturing, and consumer products, say that the principal focus areas for investment by their organizations will be in supply chain technologies (enabling agility/transparency/visibility of supply chains) and diversification (of supplier base, production, and transportation partners). Nevertheless, the acquisition of information and digital technologies is not sufficient to improve supply chain risk management. Underlying processes and working methods of people need to be reviewed or redesigned, making use of the support of competent partners. Another fundamental element to carry out a successful digitization project is the ability to find and integrate within the organization the vertical skills relating to the specific technologies that are required to guide the transformation process.

Conclusions

Each SCF techniques shows its own peculiarities, depending on the financial needs of the parties involved and the stage of the supply chain in which they are settled. However, they are all exposed to several risk sources. While traditional forms of financing expose lenders to risks deriving above all from the borrower's features, besides factors related to macro-economic conditions, the functioning of SCF solutions can be negatively affected by supply chain disruptions and exceptions. Risk sources include a wide variety of uncertainties regarding corporate operations, outsourcing decisions, liabilities, inventory, and credits. In addition, SCF risks may originate from opportunistic behaviors of the participants involved in a transaction, who infringe the agreements in order to act in their own interest to the detriment of others. All these factors lead to serious troubles regarding the commodity and logistics flow along the supply chain, as well as the correctness/availability/security of information and the solvency of supply chain partners. The use of digital technologies can help managing the various factors underlying supply chain risks. As far as supply chain disruptions are concerned, the contribution of supply chain digitization is manifold as it can improve demand, inventory and production planning, physical flow, performance management, and order management. With regard to risks arising from incomplete and asymmetric information, the distributed ledger of blockchain can ease information access by all the parties involved in SCF, through the incorporation of transaction information between the upstream and downstream of the supply chain into a unified information platform.

Several organizational and strategic challenges remain to overcome to foster the success of the digital supply chain implementation. On the one hand, there must be a deep knowledge of the available technologies, which are fundamental for innovation. On the other hand, it is crucial to identify a cultural and organizational transformation strategy, establishing new processes and working methods in enterprises.

References

- [1] Antràs P., Foley C. Fritz (2015), "Poultry in Motion: A Study of International Trade Finance Practices", *Journal of Political Economy*, 123(4).
- [2] Capgemini (2018), "The Digital Supply Chain's Missing Link", <https://www.capgemini.com/wp-content/uploads/2018/12/Report-%E2%80%93-The-Digital-Supply-Chain%E2%80%93s-Missing-Link-Focus.pdf>
- [3] Capgemini (2023), "Advancing through headwinds: where are organizations investing?", <https://d110erj175o600.cloudfront.net/wp-content/uploads/2023/01/19155432/Final-Web-Version-Report-Davos-2023.pdf>
- [4] Christopher M., Holweg M. (2011), "Supply chain 2.0: Managing supply chains in the era of turbulence", *International Journal of Physical Distribution & Logistics Management*, 41(1).
- [5] European Commission (2020), "Study on supply chain finance", Final report, <https://op.europa.eu/en/publication-detail/-/publication/f0b68a88-5136-11ea-aece-01aa75ed71a1/language-en>
- [6] Financial Stability Board (2017), "Financial stability implications from Fintech: supervisory and regulatory issues that merit authorities' attentions", available at: www.fsb.org/wpcontent/uploads/R270617.pdf
- [7] Finch P. (2004). "Supply chain risk management", *Supply Chain Management: An International Journal*, 9(2).
- [8] Foley, C. Fritz, Johnson M., Lane D. (2010) "Note on International Trade Finance." Harvard Business School Background Note 211-007. <https://www.hbs.edu/faculty/Pages/item.aspx?num=39423>.
- [9] Global Supply Chain Finance Forum (2016), "Standard definition for techniques of supply chain finance", <http://supplychainfinanceforum.org/ICC-Standard-Definitions-for-Techniques-of-SupplyChain-Finance-Global-SCF-Forum-2016.pdf>
- [10] Global Supply Chain Finance Forum (2021a), "Enhancement of the Standard Definitions for Techniques of Supply Chain Finance", <http://supplychainfinanceforum.org/2021-GSCFF-Enhancement-of-the-Standard-Definitions.pdf>
- [11] Global Supply Chain Finance Forum (2021b), "Corporate Payment Undertaking", <http://supplychainfinanceforum.org/2022-04-19-Corporate-Payment-Undertaking.pdf>
- [12] Global Supply Chain Finance Forum (2021c), "Dynamic Discounting", <http://supplychainfinanceforum.org/GCSSF-Dynamic-Discounting.pdf>
- [13] Hallikas J., Lintukangas K. (2016), "Purchasing and supply: An investigation of risk management performance", *International Journal of Production Economics*, 171.
- [14] Khan O., Christopher M., Burnes B. (2008), "The impact of product design on supply chain risk: A case study", *International Journal of Physical Distribution & Logistics Management*, 38 (5).
- [15] Kleindorfer P. R., Saad G. H. (2005), "Managing disruption risks in supply chains", *Production and Operations Management*, 14(1).
- [16] König A., Spinler S. (2016), "The effect of logistics outsourcing on the supply chain vulnerability of shippers: Development of a conceptual risk management framework" *The International Journal of Logistics Management*, 27(1).
- [17] Korpela J., Kyläheiko K., Lehmusvaara A., Tuominen, M. (2002), "An analytic approach to production capacity allocation and supply chain design", *International Journal of Production Economics*, 78 (2).

- [18] Le T.D. (2022), "A shift towards household lending during the Fintech era: the role of financial literacy and credit information sharing", *Asia-Pacific Journal of Business Administration*, 9(4).
- [19] Lee H. L. (2002), "Aligning supply chain strategies with product uncertainties", *California Management Review*, 44(3).
- [20] Lee C.C., Li X., Yu C.H., Zhao, J. (2021), "Does Fintech innovation improve bank efficiency? Evidence from china's banking industry", *International Review of Economics & Finance*, 74.
- [21] Lee H., Yang S. A., Kim K. (2019), "The role of fintech in mitigating information friction in supply chain finance", ADB Economics working paper series, n.509, <https://www.adb.org/publications/series/economics-working-papers>.
- [22] Leary R. R. (2007). "Ranking foreign suppliers based on supply risk", *Supply Chain Management: An International Journal*, 12 (6).
- [23] McKinsey & company (2016), "Supply Chain 4.0 – the next-generation digital supply chain", <https://www.mckinsey.com/~media/mckinsey/business%20functions/operations/our%20insights/supply%20chain%2040%20%20the%20next%20generation%20digital%20supply%20chain/08b1ba29ff4595e9987344dcbc.pdf>
- [24] Miller K. D. (1992), "A framework for integrated risk management in international business", *Journal of International Business Studies*, 23(2).
- [25] Mizgier K. J., Hora M., Wagner S. M., Jüttner M. P. (2015), "Managing operational disruptions through capital adequacy and process improvement", *European Journal of Operational Research*, 245(1)
- [26] Moretto A., Caniato, F. (2021), "Can supply chain finance help mitigate the financial disruption brought by covid-19?", *Journal of Purchasing and Supply Management*, 27(4).
- [27] Narayanan V., Raman A. (2004), "Aligning incentives in supply chains", *Harvard Business Review*, 82(11).
- [28] Omran Y., Henke M., Heines R., Hofmann, E. (2017), "Blockchain-driven supply chain finance: towards a conceptual framework from a buyer perspective", IPSERA 2017: 26th Annual conference of the International Purchasing and Supply Education and Research Association. Budapest, Hungary.
- [29] Nishat Faisal M., Banwet D. K., Shankar R. (2007), "Information risks management in supply chains: An assessment and mitigation framework", *Journal of Enterprise Information Management*, 20(6).
- [30] Papadakis I. S. (2006), "Financial performance of supply chains after disruptions: An event study", *Supply Chain Management: An International Journal*, 11(1).
- [31] Peck H. (2005), "Drivers of supply chain vulnerability: An integrated framework", *International Journal of Physical Distribution & Logistics Management*, 35(4).
- [32] Rao S., Goldsby T. J. (2009), "Supply chain risks: A review and typology", *The International Journal of Logistics Management*, 20(1).
- [33] Ritchie B., Marshall D. V. (1993), *Business risk management*. Chapman & Hall.
- [34] Schmidt-Eisenlohr T. (2013), "Towards a Theory of Trade Finance", *Journal of International Economics* 91(1).
- [35] Song H. (2019), *Smart Supply Chain Finance*, Palgrave Macmillan.
- [36] Song H., Han S., Liu W., Ganguly A. (2022), "What role do FinTech companies play in supply chain finance? A signaling intermediary perspective", *Journal of Business & Industrial Marketing*, doi: 10.1108/JBIM-12-2021-0587.
- [37] Soni G., Kumar S., Mahto R.V., Mangla S.K., Mittal M.L., Lim W.M. (2022), "A decision-making framework for industry 4.0 technology implementation: the case of Fintech and sustainable supply chain finance for SMEs", *Technological Forecasting and Social Change*, 180.
- [38] Sun X. (2022), "Risk management in supply chain finance", in *Supply chain finance*, Springer, Singapore.
- [39] Tang O., Nurmaya Musa S. (2011), "Identifying risk issues and research advancements in supply chain risk management", *International Journal of Production Economics*, 133(1).
- [40] Tavecchia D. (2018), "Lo stato dell'arte nella terminologia del Supply Chain Finance: driver o ostacolo per lo sviluppo?", *The Procurement*, n° 2, anno 4.
- [41] Yan H. (2017), "Credit model of supply chain finance based on big data of E-commerce", *Industrial Economics System and Industrial Security Engineering (IEIS'2017)*, 2017 4th International Conference on.
- [42] Wagner S. M., Mizgier K. J., Papageorgiou S. (2017), "Operational disruptions and business cycles", *International Journal of Production Economics*, 183.
- [43] Wong C. Y., Hvolby H.H. (2007), "Coordinated responsiveness for volatile toy supply chains", *Production Planning & Control*, 18(5).
- [44] Wu T., Blackhurst J., Chidambaram V. (2006), "A model for inbound supply risk analysis", *Computers in Industry*, 57(4).
- [45] Wu T., Wu T. (2022), "Research on the identification and prevention of supply chain finance risks based on ISM-MICMAC model", *Highlights in Business, Economics and Management*, 2.