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Market adoption of reverse factoring

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Abstract

Purpose – The purpose of this paper is to show that market dynamics can significantly influence the lifecycle and value of a supply chain finance (SCF) arrangement.

Design/methodology/approach – Based on a review of scientific and trade literature, the authors construct a model of market dynamics for reverse factoring, a specific type of SCF arrangement. The authors assume that firms’ participation in a reverse factoring arrangement is determined by the direct benefits they can derive from it. The authors analyse the model by means of simulation in system dynamics.

Findings – The authors identify the following market factors as key for direct benefits: competition, interest rates, receivables volumes, and firms’ working capital goals. The authors find that reverse factoring can yield direct benefits for all supply chain participants, but that these benefits are highly sensitive to market conditions.

Research limitations/implications – The model is stylized, but this study shows the need for further research on the dynamic aspects of SCF arrangements.

Practical implications – The authors show that supply chain actors should carefully consider the expected evolution of market factors when deciding on participation in a reverse factoring arrangement.

Originality/value – Existing research on SCF arrangements almost exclusively considers a static context, where market factors take fixed, known values. The authors provide the first study that links the direct benefits of SCF arrangements to dynamic, interacting market factors. The authors utilize system dynamics, a methodology well-suited to the analysis of such settings, to show that a comprehensive assessment of SCF arrangements cannot neglect the evolutionary perspective.

Keywords Bass diffusion model, Benefits analysis, Market adoption, Reverse factoring, Supply chain finance

Paper type Research paper

Introduction

The landscape of trade finance has seen considerable change since the turn of the millennium. Despite some periods of economic stagnation, global trade flows have grown substantially and the trend is expected to continue. As supply chains evolve to meet new logistical challenges in this globalized context, financial solutions must also keep pace (Richter et al., 2011). This is the domain of supply chain finance (SCF). Explicit reference to SCF appears as early as the work of Stemmler (2002), and a general definition is offered by Pfohl and Gomm (2009): collaborative, integrated financing arrangements that realize benefits for all supply chain participants. The theory and practice of SCF are, however, by no means mature. Further analysis of the complex dynamics and management challenges in financial supply chains remains an important task (More and Basu, 2013).

The study we present here concerns a particular form of SCF, reverse factoring. Although the terms SCF and reverse factoring are often used interchangeably,
especially by practitioners (cf. Demica, 2012), the definition of SCF provided by Pföhl and Gomm (2009) positions it as a general concept that can encompass reverse factoring and many other financial supply chain solutions. The collaborative element mentioned above can be discerned in an enormous range of activities, from pre-shipment micro – financing of rural entrepreneurs (KIT and IIRR, 2010) to the investments provided by Intel to support the R&D activities of ASML, the Dutch manufacturer of lithography machines (Nuttall, 2012). Compared to such large and/or complex transactions, reverse factoring is a relatively well-defined and standardized arrangement: a creditworthy buyer systematically informs a financial institution of payment obligations to selected suppliers, enabling the latter to borrow against the value of the relevant accounts receivable at a cheap rate (cf. Klapper, 2005). The arrangement is thus similar to traditional factoring, but it is reversed in the sense that the buyer, not the supplier, takes the initiative toward the financial institution.

Reverse factoring aims to reduce working capital in supply chains and promote stability of cash flows. Despite these attractive goals, it has not yet seen massive adoption. Banks and firms in the supply chain are often hesitant, because it is unclear how they should implement a reverse factoring program – when, with which suppliers, under what terms, for how long? – and how the benefits for supply chain actors will materialize (Seifert and Seifert, 2009). The basic reverse factoring structure, outlined above, implicitly assumes that the market context is static, but managers may suspect that the system and its benefits will be affected by relevant economic and competitive dynamics. Relevant economic factors include interest rates and the working capital needs of the supply chain, while competitive factors include the number firms already using reverse factoring and a financial institution’s reputation as a provider of the service. Using the methodology of system dynamics, we connect these key factors to a quantification of the direct benefits for each party in a reverse factoring arrangement. Our model illuminates the adoption process of reverse factoring by determining when and to what extent the arrangement may be beneficial for participants.

Our work contributes to research on SCF beyond the theoretical and practical findings. It is one of the first to show the advantages of the system dynamics methodology for study of this domain. This methodology is well-suited to the analysis of dynamic processes such as SCF market adoption, since it allows for systematic consideration of the effects that result from implementation. Previously, the benefits of reverse factoring arrangements have been assessed purely in terms of the market state prior to implementation. Our findings point to the advantages of a comprehensive approach, where greater emphasis is placed on maintaining supply chain benefits throughout the lifetime of the reverse factoring arrangement.

**Literature review**

Multiple, diverse streams of literature are relevant to a study of reverse factoring. As noted earlier, it can be seen as specific form of a more general SCF concept, although some authors, particularly in the trade and commercial press, use the terms interchangeably. SCF may itself be seen as a specific topic within a broader line of enquiry that constitutes the interface of operations and finance. Reverse factoring is thus an element of this interface, although by virtue of its formal attributes and applicability, it can be seen in direct relation to research on some mainstream finance topics, such as trade credit, small business finance, and entrepreneurial finance. We consider briefly below each of these areas in turn. Finally, since we utilize the methodology of system dynamics, we also place our work in the context of this literature.
In the domain of studies that explicitly address the concept of SCF, the work of Pfohl and Gomm (2009) is preceded by several important conceptual articles, e.g., Pfohl et al. (2003) and Hofmann (2005). Subsequently, SCF concepts find various translations into quantitative terms. These quantitative analyses typically consider working capital benefits of mechanisms similar to reverse factoring and take the market context as static (e.g. Randall and Farris, 2009; Hofmann and Belin, 2011). Other formal modelling approaches include multi-criteria analysis (Liu, 2009), cost-benefit analysis (Yixue, 2010), contracting theory (Li and Xu, 2010), game-theory (Meng and Hui, 2011), and stochastic dynamic modeling (Miao et al., 2011). A comprehensive review and consideration of research on SCF is provided by Hofmann (2013).

Among empirical studies on SCF, Seifert and Seifert (2011), and Wuttke et al. (2013a) focus on solutions akin to reverse factoring, illustrating the success factors but also pitfalls and uncertainties that can affect adoption. Wuttke et al. (2013b) provide insight on why firms choose particular SCF solutions and extend the empirical perspective to include pre-shipment SCF, i.e., financing arrangements for situations where production is still underway or perhaps not even yet started, so an approved invoice is not available as collateral.

Wuttke et al. (2013b) also explicitly recognize that the topic of SCF lies at the interface of operations and finance. Although some of this interface literature concerns the application of methods from financial analysis to operational problems – e.g., real options analysis – many works are motivated by the recognition that the perfect capital market assumptions of the Modigliani-Miller theorem on capital structure (Modigliani and Miller, 1958) generally fail to hold in practice. This is indeed the theoretical motivation for application of reverse factoring (Tanrisever et al., 2012).

By explicitly approving a supplier’s invoice and confirming to pay it, a buyer mitigates the information asymmetry that otherwise reduces the collateral value of the corresponding account receivable. Reverse factoring is thus an efficient way to reduce the cost of trade credit. While there is well-established theory for the existence and benefits of trade credit (see Seifert et al., 2013, for a recent review of this literature), the burden of short-term financing costs that it imposes may be significant, especially for small or medium-sized enterprises (SMEs) or start-ups (cf. Rajan and Zingales, 1998; Berger and Udell, 2002).

Prior to the empirical work of Wuttke et al. (2013a) and Wuttke et al. (2013b), few studies consider the market adoption of reverse factoring or other SCF solutions, where problems are characterized by softer factors that may be difficult to quantify but are nonetheless critical drivers of firm behavior. Aside from the direct monetary advantages that reverse factoring may create, factors such as degree of supply chain participation (Striano, 2010), executive involvement (Seifert and Seifert, 2009), and operational complexity (Dunn, 2011) impact the adoption of an SCF arrangement. These soft factors are of great interest for practitioners, and many non-academic articles and white papers address them (e.g. Hughes, 2010; Au, 2011; Cavenaghi, 2011; Frohling, 2011; Hartung, 2011; Sylverberg and Albrektsson, 2011). These works are based on surveys and/or interviews. Moreover, each considers a particular topic and refers only superficially to the link between soft and hard factors that may underpin a successful implementation of reverse factoring.

In order to expand knowledge about SCF, explanatory research on the link between soft and hard factors is needed. A theoretical model that shows how market dynamics impact the adoption process of reverse factoring arrangements across supply chains may indicate why current programs are not as widely adopted as the apparent benefits
and clear interest in the topic would suggest. System dynamics is well-suited to this purpose, since it is able to analyze qualitative and quantitative links between factors.

System dynamics emerged from pencil and paper simulation in the 1950s for a first inventory-control system for General Electric (Forrester, 2007). According to the original definition by Forrester (1961, p. 13), System dynamics is “the study of information feedback characteristics of industrial enterprise to show how structure, amplification, and time delays interact to influence the success of the enterprise […] It is a framework for thinking about how the operating policies of a company and its customers, competitors, and suppliers interact to shape the company’s performance over time.” From a more recent perspective, it is “a methodology used to understand how systems change over time,” which is perfectly suited to model systems where behavior is significantly affected by feedback (Sweetser, 1999).

Angerhofer and Angelides (2000) give a taxonomy of research and development in system dynamics modeling in supply chain management, stating that recent research is split into three areas: contributions to theory-building; solving a problem; and improving the modeling approach. System dynamics has, however, seen very limited application to SCF or related areas. Kolay (1991) uses it to argue that the management process associated with working capital must be dynamic in nature. Shou et al. (2012) consider how prepayments (i.e. payment to a supplier in advance of delivery and the issue of an invoice) may improve supply chain performance. In a precursor to the current study, Dello Iacono (2012) uses system dynamics to explore SCF from the perspective of a financial service provider. Besides contributing directly to theory about reverse factoring, we emphasize the value of system dynamics as an addition to the methodological resources used to study SCF arrangements.

Model overview
Our model represents a set of buyer-centric supply chains that are considering the introduction of a reverse factoring arrangement. We focus on a single bank that will offer reverse factoring to each supply chain, i.e., a buyer and its associated suppliers. We assume that the market context can be represented by a common set of variables that impact all supply chain participants. The structure of the model is based on descriptions given by practitioners in dedicated treasury literature[1]. In this literature, direct benefits in short-term financing constitute the key factor that drives firms’ implementation and subsequent use of a reverse factoring arrangement. Nevertheless, direct benefits – or even the opportunity to engage in reverse factoring – are contingent on the characteristics of the market for reverse factoring, including the implementation and usage decisions of other firms, as well as relevant economic factors. We describe first a sub-model that allows quantification of direct benefits. We then describe our market model for reverse factoring. The market model encompasses the direct benefits sub-model and adds endogenous and exogenous factors that cause the direct benefits for supply chain members to evolve.

Sub-model: direct benefits
For a buyer and its suppliers, the direct benefits of a reverse factoring arrangement are reductions in working capital costs. For a bank, reverse factoring provides income through the interest and/or fees charged when suppliers borrow against the value of their accounts receivable. Table I lists and explains the variables that determine these benefits. Figure 1 shows three cases of working capital financing for a supplier that are relevant to the analysis of a reverse factoring arrangement.
Case 1 of Figure 1 shows the situation prior to implementation of reverse factoring. $T_b$ is the delay allowed for buyers to make payment to suppliers. For instance, payment may be due in full 30 days after the invoice is presented to a buyer. $T_s$ is the delay that suppliers incur between issuing an invoice to a buyer and receiving payment. In Case 1, $T_s = T_b$ and the supplier finances the associated accounts receivable at its cost of capital, $r_s$.

When reverse factoring is implemented, the buyer extends payment terms by $E_b$ days. Payment to the supplier is now due after $T_b,SCF = T_b + E_b$ days. For instance, if $E_b = T_b = 30$ days, then $T_b,SCF = 60$ days. This brings a saving in working capital for the buyer. Articles in the popular business press confirm that buyers in recent years see reverse factoring with an extension of payment terms as a means to safeguard or improve their financial position (Milne, 2009; Pezza, 2011; Ng, 2013). Case 2 of Figure 1 shows the unmitigated impact of the extended payment terms on the supplier: the supplier incurs additional costs due to longer financing period for its accounts receivable. Though favorable to the buyer in the short run, these additional costs can undermine the supplier’s performance and may ultimately threaten the buyer’s own competitiveness. These dangers are particularly relevant when buyers are dependent on critical goods and expertise of a key supplier.

The adverse effects that can result from Case 2 may, however, be obviated in the reverse factoring arrangement. This is shown in Case 3. Besides the extension of payment terms to $T_b,SCF$ days, the buyer communicates a payment guarantee to the bank, and thereby gives the supplier the possibility to advance payment by $R_s$ days at a relatively low financing rate, $r_{SCF} < r_s$. The supplier may thus choose to receive payment from the bank after a relatively short delay of $T_s,SCF$ days. If the extension of the payment term is not too long, the supplier’s cost of financing its working capital through reverse factoring may be less than in Case 1.
Supplier presents invoice to Buyer.

Day 0

Supplier receives payment from Buyer.

Day 30

Supplier finances at $r_s$

Case 1
Supplier's financing costs with original payment terms and no reverse factoring.

Case 2
Supplier's financing costs with extended payment terms, reverse factoring not used.

Case 3
Supplier's financing costs with extended payment terms, reverse factoring used.

Buyer's Payments Term Extension (working capital improvement) $E_s$

Supplier presents invoice to Bank.

Day 0

Supplier receives early discount from the Bank.

Day 10

Supplier finances at $r_{SCF}$

Interest Rate Arbitrage (funding cost reduction) $R_s$

Buyer settles invoice with the Bank.

Figure 1.
Cases for a supplier financing its working capital.

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If a supplier requests early payment of an invoice (Case 3), the bank benefits from the interest income generated. When a supplier does not request early payment (Case 2, or, equivalently, Case 3 with $R_s = 0$), no interest income is generated. Our approach here assumes that the bank that offers reverse factoring did not previously finance working capital for the supplier. If the bank previously financed working capital for the supplier, the calculation of direct benefits would require adjustments to reflect a net change in interest income. This case would fall outside the scope of our model, however, since direct benefits alone would not be an adequate measurement of the bank’s benefit. The bank may realize a considerable reduction in the riskiness of a portion of its loan portfolio, as well as a net savings of recovery and other administrative costs associated with bad debts. Other indirect benefits could include lock-in effects and cross-selling opportunities.

Following the approach used by Randall and Farris (2009) and Hofmann and Belin (2011), the three cases introduced above yield formal descriptions of the working capital costs. The resulting formulae show the annual benefit for each party in a reverse factoring arrangement. All variables are provisionally fixed in these formulae, although they will be dynamic in the context of the market adoption model.

For a buyer, the direct benefit of reverse factoring is the difference between Case 1 and either of the other two cases. Irrespective of whether the supplier advances payment through the bank, the extension of payment terms by $E_b$ days gives the buyer a reduction in the cost of financing working capital:

$$benefit_{buyer} = V \times \left( \frac{E_b}{365} \right) \times r_b$$

(1)

For suppliers, we compare Case 2 to Case 3. Following the cases described by Milne (2009) and Ng (2013), we assume that the supplier cannot choose to remain at Case 1. The supplier can, however, choose not to advance payment on receivables (remain at Case 2), if there would be little or no benefit from doing so. If the supplier advances payment, the resulting direct benefit is given by:

$$benefit_{supplier} = V \times \left( \frac{R_s}{365} \right) \times \left( r_s - r_{SCF} \right)$$

(2)

Finally, the bank profits from any additional interest charge incorporated in the rate offered to the supplier. This interest charge is the difference between $r_{SCF}$, the reverse factoring rate, and $r_s$, the bank’s own funding cost. The bank’s revenue also depends on $R_s$, the number of days by which the supplier advances payment:

$$benefit_{bank} = V \times \left( \frac{R_s}{365} \right) \times \left( r_{SCF} - r_f \right)$$

(3)

Again, in a dynamic setting, variables in the above equations may change. We assume that a party will participate in a reverse factoring arrangement only if the benefit for that party is positive. It is important to note, however, that the meaning of participation is not identical for the different parties. For the bank, participation means offering the reverse factoring product to buyers who have not yet adopted it. For a buyer, participation means initiating a reverse factoring arrangement with the bank, i.e., moving from Case 1 to Case 2 (or Case 3, depending on the actions of the supplier). For a supplier, participation means advancing payment of accounts receivable, i.e., moving from Case 2 to Case 3.
A dynamic system, where participation is endogenously determined, will allow patterns in market evolution and the usage of reverse factoring to be discerned. We describe next the market adoption model that brings the necessary dynamic aspects. The direct benefits sub-model described above and the market adoption model together form the basis for our study. The full model is depicted in Figure 2.

**Full model: market adoption**

We allow for the evolution of market factors by means of a bass diffusion model. This is a well-established model for product diffusion in a market (Sterman, 2000). Although the bass diffusion model is aimed at consumer markets, while reverse factoring occurs in business-to-business (B2B) markets, it has highly relevant features; particularly, the importance of word-of-mouth as a basis for adoption.

Modeling the lifecycle of an SCF application on a well-established archetype grounds our study in existing research. In the market for reverse factoring solutions, the “word-of-mouth” concept corresponds with the importance of a bank’s track record on existing arrangements. Relationships and reputation are important drivers in the financial services industry (Hughes, 2010) and specifically for SCF arrangements (Ras, 2012; Böhme, 2013). Therefore, bank’s track record is the principal factor that drives the feedback loops in Figure 2.

Successful implementations of reverse factoring will provide learning effects: the bank’s reverse factoring product can be marketed more effectively in the future (Wuttke et al., 2013b). Also, increased operational knowledge will drive down implementation costs, making reverse factoring a more attractive proposition. Such improvements will lead overall to increased viability of new implementations. The factor commercial attractiveness for bank is therefore ultimately determined by two underlying measures: the direct benefits available to the bank from reverse factoring, and the cost to the bank of offering reverse factoring. The latter is based on the bank’s track record of implementation and portfolio management, closing the main loops in the reverse factoring product life-cycle (see feedback loop R2 “Word of Mouth”). These factors link the supply chain benefits with the market adoption model.

The complete reverse factoring lifecycle entails evolution through the following stages:

1. **Market potential:** the reverse factoring market potential denotes the number of buyer-centric supply chains that could implement a reverse factoring arrangement with the bank. These prospective supply chains have not yet adopted reverse factoring. Market potential can diminish due to competition and/or loss of interest by supply chain participants. This can occur, for instance, if they are not able to foresee a positive benefit from the arrangement upon adoption.

2. **Implementation:** in this phase, buyers that have agreed to enter a reverse factoring arrangement with the bank are engaged in the necessary platform installations. Subsequently, suppliers may participate in the buyer’s reverse factoring program.

3. **Portfolio management:** the system is in place and supply chain participants can make use of it. The prescriptions of the direct benefits model are now relevant for buyers, suppliers, and the bank.

The stocks in the model of Figure 2 represent this lifecycle and form the basis for the market model. As described above, the market model is linked to the participation decision of the bank through the factor commercial attractiveness for bank.
Notes: Causal loop diagrams aid in visualizing how related factors affect one another. Causal loops also can give insight in particular system behavior (Sterman, 2000). The relationships between the factors are represented by arrows, labeled as positive or negative. A positive causal link indicate that the two factors change in the same direction, i.e. if the originating factor increases or decreases, the related factor will also, respectively, increase or decrease. A negative causal link indicates that two factors change in opposite directions, i.e. if the originating factor increases or decreases, the related factor will, respectively, decrease or increase. The overall effect of a loop can be determined by multiplying the signs. A negative loop exhibits balancing behavior: a steady state will be achieved. Whereas a positive loop exhibits reinforcing behavior: unlimited growth will continue.
model is linked to the participation decision of buyers and suppliers through the factor attractiveness of SCF arrangement. This latter is shown for simplicity as a single factor in Figure 2, but it comprises in fact the separate direct benefits resulting from Equation (1) and Equation (2).

In addition to the endogenous factors that are driven by the bank’s track record for reverse factoring, exogenous factors affect direct benefits and thereby also the market adoption process. Micro- or macroeconomic factors may be relevant here. We recognize the following exogenous factors in our model of market adoption:

1. Market competition: our model focuses on a single bank, yet other banks or financial institutions may offer solutions for working capital finance (including possibly competing reverse factoring programs). Market competition specifies the fraction of the potential market for reverse factoring that is available to our focal bank.

2. Supply chain receivables volume: the total receivables in a supply chain may fluctuate, corresponding with the notion of business cycles. Supply chain receivables volume denotes the theoretical maximum annual value of receivables that suppliers could offer to the bank for financing through a reverse factoring arrangement.

3. Interest rates: the benchmark interest rate in the market (e.g. EURIBOR or LIBOR) impacts the final cost of funding for all supply chain actors. The bank’s funding cost $r_f$ is equivalent to the benchmark rate. The other rates in the model are related to this rate, so the reverse factoring rate always lies between the standard borrowing rate available rate to large buyers or smaller suppliers: $r_b < r_{SCF} < r_s$. The relative advantage of $r_{SCF}$ is consequently not fixed.

4. Working capital goals: in order for buyers to implement reverse factoring programs, they must have working capital goals that aim to extend the duration of accounts payable by $E_b$ days. In order for suppliers to discount their receivables, they must have working capital goals that aim to reduce the duration of their accounts receivable by $R_s$ days.

Each of these exogenous factors can be adjusted to reflect specific scenarios. We can also allow for appropriate correlation among exogenous factors: for instance, working capital goals are likely to depend on interest rates and supply chain receivables volume.

Together with the direct benefits sub-model, the endogenous and exogenous factors described above complete the market adoption model. We now turn to the analysis of the model, where we explore the impact of variation in the exogenous factors on the market adoption of reverse factoring.

Analysis

The market model is analyzed through simulation. The initial model parameters are based on numerical examples found in literature and case – studies that describe supply chains where a reverse factoring arrangement is expected to be beneficial (cf. Hofmann and Belin, 2011; Dunn, 2011). We set the time horizon for the study at ten years, in order to allow for a full development of market potential. This period corresponds roughly to two economic bust-and-boom cycles, each lasting five years. Appendix 1 gives an overview of all initial values in the simulation model.

All exogenous factors affect the calculations of direct benefits underlying the market adoption model. Nevertheless, we further elaborate the working capital goals of suppliers
by means of two distinct types of supplier discount behavior. Supplier discount behavior has been noted as an important indicator for a successful implementation of reverse factoring (Dunn, 2011), though it is usually not quantified. The first type of supplier behavior is auto-discounting. In this case, suppliers have a constant working capital goal and always use the reverse factoring arrangement, in order to advance payment on receivables to the earliest possible moment. The second type of supplier behavior is selective discounting. In this case, the working capital goals are not constant. Suppliers only advance payment of receivables when funding and liquidity problems arise, for instance as a result of deteriorating economic conditions where demand falls. Otherwise, a supplier that uses selective discounting will choose to receive payment from the buyer at the final due date of the invoice, even though the buyer has extended payment terms.

We allow for the two types of discounting behavior by means of a variation in the payment term reduction ($R_s$) component of the supplier benefit formula (2). Specifically, in the case of selective discounting, the working capital goal of each supplier is quantified as follows:

$$T_{s,SCF} = \max(10 \text{ days}, T_{b,SCF} - R_s)$$  \hspace{1cm} (4)$$

Equation (4) decomposes the payment reduction into several components. After an extension of payment terms by the buyer to $T_{b,SCF}$ days, the payment delay available to the supplier can vary between a maximum of $T_{b,SCF}$ days and a minimum of ten days. (We take a period of ten days to be, from an operational point of view, the shortest time for the supplier to receive early payment through the reverse factoring arrangement.) Correspondingly, the desired payment reduction of a supplier ($R_s$) can range from zero days to 60 days. With auto-discounting, $R_s$ is fixed at 60 days, which results in an early payment from the bank after ten days. For the case of selective discounting, we assume that $R_s$ is approximately inversely correlated with supply chain receivables volume. Suppliers will have adequate cash flow when receivables volume is high, so they then set $R_s = 0$. When receivables volume is low, suppliers want to improve cash flow, so they set $R_s = 60$ days.

In order to broaden our exploration of the market adoption process for reverse factoring we define two distinct scenarios for the entire set of exogenous factors: a regular market scenario and an exceptional market scenario. Table II summarizes and contrasts the two scenarios. Appendix 2 gives a graphical overview of the evolution of the external factors in each scenario.

In the regular market scenario, reverse factoring arrangements face moderate market competition and receivables volumes fluctuate in accordance with bust-and-boom cycles. Interest rates are correlated with the macroeconomic conditions: lower interest rates during bust periods and higher interest rates during boom periods. We evaluate the effect of constant or variable working capital goals in this scenario: auto-discounting or selective discounting by suppliers. As described above, selective discounting will entail that suppliers advance payment on receivables when economic conditions are recessive, while they will be satisfied to receive payment upon maturity of an invoice when the economy is buoyant.

The exceptional market scenario is characterized by a sudden demand shock, where the economy is distressed. Market competition is excluded in this scenario, in order to investigate fully the effects of the demand shock. The shock is implemented by means of a sudden drop in receivables volume near the beginning of the simulation period. This scenario corresponds to the trade situation that was precipitated by financial crisis of 2008: the distress or even collapse of reputable financial institutions sparked
a sudden drop in consumer demand and a substantial global reduction of interest rates. We assume that suppliers will auto-discount their receivables throughout this scenario, given the fragile state of the economy and their expected funding needs.

Results
The following two subsections give the results of the simulation. For each scenario, we highlight the development of the market for reverse factoring and the underlying fluctuations in the benefits that are available to the different members of the supply chain. We consider first the regular market scenario, then the exceptional market scenario. The set of initial values for all variables, which is the same across both market scenarios, is described in Appendix 1. The evolution of the exogenous factors for each scenario is shown graphically in Appendix 2.

Regular market scenario
The simulation of the regular market scenario confirms the presumption that supplier discount behavior influences the adoption of reverse factoring. Figure 3 shows the development of the market when suppliers use selective discounting. There are two periods where the market potential drops to zero. The market is stagnant during these periods: no new reverse factoring arrangements are undertaken. Market adoption reaches a steady, maximum level after six years. When suppliers use auto-discounting, the development shown in Figure 3 changes: the second period of stagnation is absent. Consequently, with the assumption of auto-discounting, market adoption reaches a steady, maximum level in less than five years.

The more complex pattern of market development that appears when suppliers use selective discounting corresponds with the impact of selective discounting on supply chain benefits. Figure 4(a) shows the benefits of each party when selective discounting is used, while Figure 4(b) shows the benefits when auto-discounting is used.
The first period of market stagnation, which occurs irrespective of the assumption made about suppliers’ discounting behavior, coincides with a reduction of benefits for all parties. At this point, approximately the start of the second year in the simulation, the business cycle leads to a low volume of receivables in the supply chain. Although suppliers are willing to discount any available receivables – see Figure A1(d) and (h) in Appendix 2, which show that suppliers aim for the shortest possible payment delays during this period – the revenue potential is insufficient to entice banks and buyers to initiate new reverse factoring arrangements.

The second period of market stagnation, which occurs only in the case that suppliers are assumed to use selective discounting, coincides with a reduction of benefits for suppliers and the bank. At this point, approximately the start of the second half of the third year in the simulation, the business cycle leads to a high volume of receivables in the supply chain. Cash flow for suppliers is improved. Paired with the assumption of selective discounting, this entails that suppliers temporarily cease to advance payment of their receivables, so the benefits of reverse factoring drop for suppliers and the bank. As the business cycle proceeds, the volume of receivables falls and suppliers again start to advance payment. The adoption rate for reverse factoring again becomes positive. The adoption rate after this second period of stagnation is, however, lower than the adoption rate after the first period of stagnation, since the market becomes saturated and potential for new arrangements diminishes.

The results presented above show that suppliers’ working capital goals, though often unobserved by other supply chain participants – for instance, when suppliers are not yet participating in a reverse factoring arrangement – can impact market potential significantly. In order for a new reverse factoring arrangement to be feasible, all parties need to benefit from it. When suppliers change their discount behavior or receivables volume drops substantially, the incentive for other supply chain participants to initiate new reverse factoring arrangements may evaporate.

Reverse factoring arrangements are often portrayed as win-win situations for all supply chain participants (More and Basu, 2013). Our results suggest that this may not always be the case, once implementation costs are considered. We assume that the bank bears all costs for a reverse factoring arrangement: investment in the technological platform, connecting and training buyers and suppliers, maintenance, etc. While not providing specific figures, Hurtrez and Salvadori (2010) indicate that investment in a technological
platform to enable SCF is a significant consideration for a bank. The platform represents a sunk cost, but the bank is unwilling to add new buyers to the reverse factoring platform when the prospective benefit does not outweigh the variable costs, e.g., during the periods of market stagnation or when the prospective client is considered to be non-strategic (Böhme, 2013). If buyers and/or suppliers also face costs to join or maintain a reverse factoring arrangement, the market development will be further constrained.

**Exceptional market scenario**

We envision an exceptional market scenario as something similar to the financial crisis that manifested itself in 2008. Key aspects are a sudden, system-wide drop in demand, managerial attempts to reduce working capital and improve cash flow, and economic stimulus policies, including the reduction of benchmark interest rates. Although the goal of reducing working capital and improving cash flow suggests that reverse factoring should be a desirable recourse in an exceptional market, our simulation shows instead that the value of reverse factoring may be negated by the reduced level

![Figure 4](image_url)

**Notes:** (a) With assumption of selective discounting by suppliers; (b) with assumption of auto-discounting by suppliers
of outstanding receivables and interest rates. In the darkest moments of the exceptional market scenario, reverse factoring can bring little benefit, yet any costs associated with initiating new arrangements with buyers or supplier will remain.

Figure 5 shows the development of reverse factoring in the exceptional market scenario, while Figure 6 shows the corresponding evolution of benefits for the supply chain participants. The demand shock occurs in the middle of the third year in the simulation, and the effects of it last until the start of the sixth year in the simulation.

Prior to the demand shock, the number of active supply chains increases steadily. This results from two key assumptions: the economy during this period is sufficiently buoyant to allow positive benefits for all supply chain participants; suppliers consistently use auto-discounting, so the benefits of reverse factoring are always available to the bank. The growth rate will of course be less strong if selective discounting and/or periods of low volume of receivables are assumed.

In the period immediately subsequent to the demand shock, the number of active reverse factoring programs remains constant. Although buyers and suppliers alike are
in principle interested to improve their working capital position and cash flow, the lack of receivables entails that reverse factoring is not an effective means to realize this goal. Likewise, the bank is not willing to incur the cost to initiate new arrangements when these do not promise any revenue.

With the return to economic activity at the beginning of the sixth year in the simulation, new reverse factoring arrangements are undertaken. The market for reverse factoring grows, however, at a slower pace than before the demand shock. This slower growth results in part from an ongoing low volume of receivables and low interest rates. Even though suppliers are still assumed to use auto-discounting, the volume of receivables and interest rates entails that the benefits available to buyer and bank are significantly less than they were before the demand shock. Another reason for slower growth comes from the impact of the demand shock and its aftermath on market sentiment. Growth in the variables that reflect the bank’s track record and word of mouth is limited during this period, since little or no positive feedback comes from new and pre-existing reverse factoring arrangements. This result of the simulation provides some insight to the observed development of reverse factoring after the financial crisis of 2008. Even though market interest for SCF has in general been high, growth rates for reverse factoring programs have been low (Camerinelli, 2013; Ras, 2012).

**Discussion**

The exogenous factors in our market scenarios are the primary drivers that impact the adoption of reverse factoring arrangements. Although other factors may be relevant, the ones we have chosen are most readily quantifiable and have greatest impact on the direct benefits for the supply chain participants. By using the system dynamics methodology, we can allow for effects that result from interaction of the various exogenous factors, and thereby reveal the development of the market.

**General attractiveness of reverse factoring**

The simulation shows that the viability of reverse factoring arrangements depends on specific market conditions. The attractiveness of these arrangements for different supply chain participants fluctuates with changing receivables levels, interest rates, and supplier working capital goals. Buyers are generally able to derive positive benefit from reverse factoring. Nevertheless, when the volume of receivables, interest rates, and the bank’s track record are all low, buyers may hesitate to initiate a reverse factoring arrangement. If we were to include an initial cost of reverse factoring for a buyer, the simulation would show more points where buyers defer adoption.

Besides being even more sensitive to the market factors that affect the benefits for buyers, the benefits of reverse factoring for the bank and suppliers are contingent on the discounting behavior of the latter. If suppliers take a discriminating approach to reverse factoring, so that they do not (or would not) advance payment when economic conditions already ensure sufficient cash flow, the market will take longer to reach a given level of adoption of reverse factoring, and the path of adoption will be characterized by more periods of stagnation.

The standard methods used to assess supply chains for viability of reverse factoring arrangements focus on working capital benefits and operational requirements. While these are indeed important basic considerations, a comprehensive view should also put emphasis on the persistence of supplier working goals through business cycles.
Current context

As a financial product, reverse factoring differs substantially from other financial instruments that offer working capital solutions for supply chains. Reverse factoring tends to be technologically driven and requires investments at several points in the adoption process. This places a substantial operational burden on the arrangement, since market conditions can suddenly change and render the investments obsolete if suppliers no longer discount their receivables.

Current market conditions can be characterized as a period after a demand shock, where economic growth has been stagnant. This has had several consequences for the market adoption of reverse factoring. Lower economic growth and reduced external demand entails that fewer supply chains find reverse factoring to be a viable solution. This is a direct result of the observation that reverse factoring requires a minimum amount of receivables volume (Böhme, 2013). Implementation rates are low, which entails a low level of positive feedback into the market.

Conclusion

The market for SCF products is inherently dynamic: exogenous factors, such as interest rates, and endogenous factors, such as reputations, influence the evolution of the system. We model a specific type of SCF solution, reverse factoring, by means of system dynamics. This methodology allows us to explore the influence of exogenous and endogenous factors on the direct benefits that supply chain participants can obtain from a reverse factoring arrangement. On the further assumption that participation decisions are based on direct benefits, our model reveals the evolution of the market in different scenarios.

Main findings

Results indicate that initiation of reverse factoring arrangements is only feasible under specific market conditions. The introduction of reverse factoring programs can sometimes be challenging. Changes in key exogenous factors such as interest rates, receivables volumes, and supply chain working capital goals can lead to stagnation of market for reverse factoring, irrespective of the economic significance these factors may otherwise have.

Reverse factoring arrangements are typically presented as a win-win solution for all participants, but this is not always the case. Moreover, the direct benefits that a supply chain participant might obtain from an SCF arrangement can change over time. Changes in direct benefits from a reverse factoring arrangement are driven by natural economic changes, but the working capital goals of suppliers are particularly important. For a successful introduction of a reverse factoring arrangement, transparency is crucial: launch should not just occur when all participants can benefit, but also when the behavioral preconditions that can sustain benefit are as far as possible in place.

Significance of findings

Market factors are relevant for understanding the adoption of reverse factoring arrangements. Traditional methods used to assess the value that firms can obtain from reverse factoring – and by extrapolation, potential market value – consider direct benefits based on a snapshot of market conditions. A holistic approach to reverse factoring should also focus on the persistence of supplier working goals throughout the lifetime of the arrangement. The most promising industries are those that face lower margins or are prone to funding difficulties, since in those industries, suppliers are more likely to use auto-discounting of receivables.
Limitations and future research

Study of the market adoption of reverse factoring – or other SCF solutions – can be refined beyond the basis presented here. We focus on the most readily quantifiable market factors, including a critical soft factor, suppliers’ working capital goals. Other benefits could be included in the model, many of which may be indirect. For example, buyers may have reasons other than working capital goals as a motivation for reverse factoring: for example, helping key suppliers to finance working capital, by implementing reverse factoring with little or no payment extension; establishing a long-term supplier relationship; or streamlining of processes through e-invoicing. Buyers may impose a price reduction instead of an extension of payment terms.

While we do not expect the main findings to change significantly, the introduction of heterogeneity across and within supply chains – difference in financing rates, working capital goals, or volume or receivables – would add additional realism to our analysis. Heterogeneity in a temporal sense may also be relevant: credit rating of firms may change in time, leading to different direct benefits of reverse factoring in a given supply chain.

Besides the cost that a bank incurs to initiate a reverse factoring arrangement, systems or training costs could also be recognized for buyers or suppliers (cf. Pezza, 2011). A factor that may well have a significant effect on direct benefits and the market adoption of reverse factoring is competition from other forms of invoice financing (Demica, 2012). The inclusion of competing products could therefore enhance the concept of competition among banks that we have implemented in this study.

Our study is exploratory. By means of an elementary but coherent model, we show that system dynamics is a promising methodology for integration of different aspects of existing research in the domain of SCF. It can integrate the hard and soft factors that underlie adoption processes, thereby confirming insights that were previously only based on heuristic reasoning or even revealing new perspectives.

Notes

1. Commercial descriptions of reverse factoring solutions are readily available and invariably consistent in all key aspects. The sources consulted for this paper include Global Trade Review, gtnews.com, Trade and Forfaiting Review, Trade Finance, and Treasury Management International.

2. Practitioners generally use the verb “discount” to refer to a supplier’s action of advancing payment by means of reverse factoring. The interest cost that the supplier thereby incurs is analogous to a discount on the face value of the receivable. It is important to note, however, that this is in principle quite different than a price discount offered directly to the buyer as part of the commercial terms, e.g., in return for early payment.

References


### Appendix 1

<table>
<thead>
<tr>
<th>Exogenous factor</th>
<th>Initial value</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td><strong>Market potential and implementation</strong></td>
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<td></td>
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<tr>
<td>Market competition</td>
<td>0</td>
<td>%</td>
</tr>
<tr>
<td>Average number of suppliers per buyer</td>
<td>100</td>
<td>Supplier/buyer</td>
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<tr>
<td>Supplier participation rate</td>
<td>100</td>
<td>%</td>
</tr>
<tr>
<td>On-board capacity, buyers</td>
<td>2</td>
<td>Buyers/year</td>
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<tr>
<td>On-board capacity, suppliers</td>
<td>25</td>
<td>Suppliers/month</td>
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<tr>
<td><strong>Supply chain working capital and benefits</strong></td>
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</tr>
<tr>
<td>Buyer’s cost of capital</td>
<td>8</td>
<td>%</td>
</tr>
<tr>
<td>Supplier’s cost of capital</td>
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<td>%</td>
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<tr>
<td>Supplier’s SCF funding rate</td>
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<td>%</td>
</tr>
<tr>
<td>Buyer days payable outstanding (DPO)</td>
<td>30</td>
<td>Days</td>
</tr>
<tr>
<td>Supplier days sales outstanding (DSO)</td>
<td>30-60</td>
<td>Days</td>
</tr>
<tr>
<td>Buyer working capital goals (new supplier DSO)</td>
<td>60</td>
<td>Days</td>
</tr>
<tr>
<td>Supplier working capital goals</td>
<td>10</td>
<td>Days</td>
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<tr>
<td><strong>Commercial attractiveness and bank’s operating model</strong></td>
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<tr>
<td>Avg. supply chain receivables volume</td>
<td>$100 \times 10^6$</td>
<td>Euro/year/buyer</td>
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<tr>
<td>Bank’s funding cost</td>
<td>1.5</td>
<td>%</td>
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<tr>
<td>Depreciation of SCF programs</td>
<td>10</td>
<td>Year</td>
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<tr>
<td>Learning effect</td>
<td>10</td>
<td>%</td>
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<tr>
<td>On-board cost per buyer</td>
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<td>Euro/buyer</td>
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<tr>
<td>On-board cost per supplier</td>
<td>1,000</td>
<td>Euro/supplier</td>
</tr>
</tbody>
</table>

Table AI. List of base values of the exogenous model parameters

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Appendix 2

Figures A1-A4 illustrate the exogenous factors for regular market scenario and exceptional market scenario.

Notes: (a) Market competition; (b) receivables volume; (c) interest rates; (d) selective discount, receivables days; (e) market competition; (f) receivables volume; (g) interest rates; (h) auto-discount, receivables days.

Market adoption of reverse factoring

Figure A1.
About the authors

Umberto Dello Iacono received an MSc in Operations Management and Logistics from the Eindhoven University of Technology in 2012. His graduation thesis was on Supply Chain Finance market adoption for financial service providers. He holds an MSc degree in Finance from the University of Amsterdam in addition to BSc degrees in Industrial Engineering and Systems Engineering from, respectively, Eindhoven University of Technology and Delft University of Technology. Umberto Dello Iacono is the corresponding author and can be contacted at: u.dello.iacono@alumnus.tue.nl

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