

MASTER

**Modelling international reverse factoring
and the future of supply chain finance**

van Laere, M.C.C.M.

Award date:
2012

[Link to publication](#)

Disclaimer

This document contains a student thesis (bachelor's or master's), as authored by a student at Eindhoven University of Technology. Student theses are made available in the TU/e repository upon obtaining the required degree. The grade received is not published on the document as presented in the repository. The required complexity or quality of research of student theses may vary by program, and the required minimum study period may vary in duration.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain

Eindhoven, February 2012

**Modelling international reverse
factoring** - and the future of supply
chain finance

By
Mark van Laere

BSc. Industrial Engineering and Management Science — TU/e 2009

Student identity number:

TU/e: s0610366

UvT: s190415

in partial fulfilment of the requirements for the degree of

**Master of Science
in Operations Management and Logistics**

and

**Master of Science
in Finance**

Supervisors:

dr. F. Tanrisever, TU/e, OPAC

prof. dr. B.J.M. Werker, UvT, Econometrics & Operations Research

TUE. School of Industrial Engineering.

Series Master Theses Operations Management and Logistics

Tilburg University. Faculty of Economics and Management.

Department of Finance

Subject headings: supply chain management, international finance, factoring

Abstract

In this study a model is developed that can be used to value the quantifiable benefits from reverse factoring for the buyer, supplier and bank in an international setting. This model is used to value a reverse factoring program in a real business case. A sensitivity analysis is performed on this case study to gain insight in (1) the contract development and (2) changes over time in risk and deadweight cost of capital. This study shows that international reverse factoring has more profit potential than domestic reverse factoring and the conditions under which reverse factoring is (more) profitable. Further this study examines the impact of the Basel III banking regulation on supply chain finance and reverse factoring specific, however at this point in time this impact on product level is not clear. Despite this uncertainty combined with legal issues and economic uncertainties, the future outlook of supply chain is expected to be good with high growth rates in the coming years.

Executive summary

In this thesis a model is developed to value international reverse factoring. Reverse factoring is a specific form of supply chain finance. Though lots of different definitions of supply chain finance go around in the market, this thesis will use the definition by Camerinelli (2008): "...the name attached to the collection of products and services that financial institutions offer to facilitate the management of the physical and information flows of a supply chain." One of the products within the scope of this definition is reverse factoring. Reverse factoring is a three party value creating transaction between a bank, supplier and buyer. In reverse factoring a bank works together with a buyer to provide a financing solution to suppliers. In this transaction the supplier is able to sell its accounts receivable to the bank in exchange for immediate cash. This enables the supplier to obtain credit at a lower cost, increase balance sheet liquidity and keep pace with the buyer's growth. The buyer is able extend its payment period, hereby the buyer reduces its financing costs, improves the relationship and financial position of its critical suppliers. The bank is able to charge an extra premium on the discount rate of the accounts receivable, access a new market and cross sell other product to these suppliers. Next to quantitative research in the first part of this thesis, the second part will take a more applied approach. In this section managerial implications and future threats, opportunities and expectations of reverse factoring and the supply chain finance market in general will be derived from the model and from current practical issues.

Research

In a time in which traditional trade finance, as letters of credit and letters of guarantee are losing popularity, banks have lost visibility in information flows of trade and the related corporations. About 80% of global trade is conducted on open account and transaction services are becoming a commodity, hereby putting pressure on margins. The financial crisis and recent natural disasters, as the Japan tsunami, have exposed the fragility of today's supply chains, where corporations have pushed their suppliers to the limit by demanding longer payment terms and pushing more raw material inventory up the supply chain. The crisis also led to a significant drop in demand for goods and services and made banks tightening their credit terms, resulting in firms having difficulties financing their production cycle (Vasilescu, 2010).

In the literature study it appeared that though reverse factoring has had much attention by practitioners, academic publication are still rather rare. Most publications are qualitative and discuss pro's and con's of reverse factoring. The only quantitative research is the working paper of Reindorp & Tanrisever (2011) that has not been published yet. The model developed in this thesis differs from the model from Reindorp & Tanrisever (2011) by introducing default probability and taking a new approach to value reverse

factoring. Under practitioners it is believed that international reverse factoring is more profitable than domestic reverse factoring. Therefore, based on the literature study, two research questions have been formulated that will be answered in this thesis:

- (1) *What factors influence international reverse factoring and how to model these?*
- (2) *What managerial implications can be derived from the model proposed under (1) and from current practical issues in the supply chain finance market and within RBS?*

Model

The model that is developed to value reverse factoring examines the difference between a trade transaction without reverse factoring and with reverse factoring. Since future cash flows are uncertain, they are made risk neutral before discounting with the risk free rate. A risk neutral cash flow is a deterministic cash flow with the same present value as the risky cash flow. However since this cash flow is risk free, it can be discounted with the risk free rate to determine the present value. Since the risk neutral probability of default can be obtained from the interest rate, the actual default probability does not need to be known and hence simplifies the valuation.

The first model derived in this thesis is under the assumption of perfect capital markets. Perfect capital markets refer to a situation in which assets are traded against their net present value and therefore no arbitrage opportunities, no market frictions such as information asymmetries and taxes exist. Further a firm's financing decision does not influence future cash flows nor does it reveal information. Due to these properties, reverse factoring should not add value to the supply chain in perfect capital markets. In the next step information asymmetries are introduced, meaning that the bank can have more information on firm's than the market does. This difference is assumed to be fully absorbed by the bank, though relaxing this assumption would not impact the results. Finally the model is put in an international setting to check whether international reverse factoring provides indeed more value than it does domestically.

Results

According to theory, it has indeed been proven that, in perfect capital markets, reverse factoring does not add value to the supply chain. By introducing information asymmetries into the model, it has been proven that, under the right contract set-up, all three participants are able to make a profit. Based on the developed model, the following conclusions on the profitability can be drawn:

Supplier – In order for reverse factoring to add value, the supplier needs to have; (1) *higher information asymmetry with financial markets than the reverse factoring fee charged by the bank, corrected for the payment period extension* and (2) *a significant need for external short term capital*. The benefit for the supplier is larger when (1) *the initial payment period is larger*, (2) *the supplier has more information asymmetry with financial markets*, (3) *when the reverse factoring fee is smaller* and (4) *when the payment period extension is smaller*.

Buyer – For the buyer reverse factoring adds value when (1) *the payment period is extended*. And hence the benefit from reverse factoring for the buyer is larger when (1) *the payment period extension is larger* and (2) *the buyer's interest rate is larger (independent of composition between risk premium and deadweight cost of capital)*.

Bank – For the bank the benefit from reverse factoring is positive when (1) *the reverse factoring fee plus the buyer's deadweight cost of capital is positive*. The benefit for the bank is larger when (1) *the deadweight cost of capital from the buyer is larger*, (2) *the reverse factoring fee is larger* and (3) *the extended payment period is larger*. For banks it is therefore more profitable to focus on buyers of which they have more information. This means the bank has already invested in information on this buyer and therefore information asymmetry between the bank and financial markets on this buyer is bigger, implying more value for the bank.

Supply chain – For the total supply chain reverse factoring is value adding when (1) *all participation constraints are met*. Total supply chain finance benefit is larger when (1) *deadweight cost of capital from both the buyer and the supplier is larger* and (2) *initial payment period is larger*. Hence reverse factoring adds more value in industries where payment periods are larger.

International – Apart from additional parties that are involved in the deal, international reverse factoring does not differ significantly from domestic reverse factoring. By adapting a few definitions and expressing interest rates in the same currency, the model stays the same. However, since international differences in information asymmetry, deadweight cost of capital and credit rationing are much larger, the value adding potential of international reverse factoring is bigger than domestically.

From the sensitivity analysis performed on a real business case within RBS, it appeared that over time, the value of the program for the supplier can become negative. Therefore the supplier should ensure the contract has enough safety margins for the interest rate of the buyer to fluctuate. Further the supplier should monitor the program and quite the program or renegotiate the terms once the program does not add value anymore.

At this moment it is too early to fully capture the impact of Basel III on a product level. Basel III will increase capital requirements, and thereby costs, over the full spectrum of supply chain finance offerings. At this moment the liquidity coverage ratio is expected to have the biggest impact on banking. Since the Basel Committee only provides guidelines, and therefore leave space for regional governments to make changes, differences in implementation can skew supply chain finance to different regions.

Another issue with supply chain finance is that though they are treated as having the same risk as regular bank loans, in reality trade related products tend to have lower risk. This is confirmed by ICC banking commission's research, however for Basel regulations to change more evidence is required.

Despite the upcoming economic crisis in Europe, supply chain finance is expected to grow by 10% to 30% in developed countries and 20% to 25% in developing countries. This growth will primarily be driven by developed regions such as the USA and Europe and the larger emerging markets as China and India. Target industries for reverse factoring in those countries are currently retail, consumer goods, manufacturing, automotive, engineering and machinery industry. For the future the chemical, pharmaceutical and telecom industries are believed to have further growth potential.

In order for supply chain finance to take the next step some conditions have to be met. *(1) Market consensus, (2) Standardization* and *(3) Organizational changes within banks*. Within the supply chain market, different definitions of supply chain finance exist. Mostly supply chain finance is used as synonym for reverse factoring, while by others it is used as a collective noun for all financial products supporting the end to end supply chain. In order for banks and other players in this market to move to the next stage in answer a growing demand for web-based multi-bank solutions, banks should agree on those definitions. Further standardization is needed in order to make supply chain finance offerings available for a wider public. Currently SCF programs need high development investments, these can only be compensated by onboarding large clients. Once products and IT become more standardized these offerings will also become available to the SME market. Finally banks need to change their internal structure from a product based silo structure to a holistic structure that is able to bundle different financial products and support the end to end supply chain.

“Do not expect to be hailed as a hero when you make your great discovery. More likely you will be a ratbag—maybe failed by your examiners. Your statistics, or your observations, or your literature study, or your something else will be patently deficient. Do not doubt that in our enlightened age the really important advances are and will be rejected more often than acclaimed. Nor should we doubt that in our own professional lifetime we too will repudiate with like pontifical finality the most significant insight ever to reach our desk.”

Samuel Warren Carey (1911-2002), 1988

Preface

This thesis is written in light of my graduation in a dual degree MSc program consisting of the MSc program Operations Management and Logistics at Eindhoven University of Technology and the MSc program Finance at Tilburg University. This research was conducted at The Royal Bank of Scotland, Global Transaction Service Amsterdam, where I was part of the Implementations Management & Advisory team stationed partly at the New Deals Team and partly at the Trade team. I would like to take this opportunity to thank all people that motivated and supported me during my time as a student and my graduation project.

I would like to thank my supervisors at RBS, Bart Kooijmans and Eric Lemmens, who provided me the opportunity to conduct my research within RBS. And provided me invaluable guidance and advice in times I needed it regarding my thesis and future career moves after graduation. Most of all I would like to thank them for the confidence and freedom they gave me to self explore and shape my project.

Second I would like to thank both my mentors dr. F. Tanrisever from Eindhoven University of Technology and prof. dr. B.J.M. Werker from Tilburg University with whom I had tough debates on my thesis. However they always motivated me and brought me back on track by providing new insights or demanding clarifications where it was needed.

I would also like to thank all my colleagues at RBS who were always interested, very open, eager to help me gathering information and provide me advice. Further I would like to thank my close colleagues for all non thesis related insights and advise they gave me, for all hilarious moments and for their time when I bothered them with my jokes.

Further I would like to thank my uncle prof. dr. P. Verheyen for his input and ideas on how to further strengthen and improve my thesis.

Finally I would like to thank my family and friends who have always supported me during my time as a student. Thanks to them I have had a great time as a student, on which I can look back with much joy and pleasure which has come to an end by finalizing this thesis (for now at least).

Mark van Laere

Contents

1. Introduction.....	1
1.1. Working capital management.....	2
1.2. Reverse factoring.....	4
1.3. Research design.....	11
2. Literature review	12
3. Model formulation	14
3.1. Risk neutral valuation.....	14
3.2. Perfect capital markets	14
3.3. Imperfect capital markets.....	23
3.4. Non auto-discounting	28
3.5. Operational issues	30
3.6. Conclusion.....	32
4. International factors	34
5. Case study	37
5.1. Sensitivity analysis.....	37
5.2. Cost of implementation, maintaining and operating	39
5.3. Geographical region	39
6. Supply chain finance.....	40
6.1. Payment method.....	40
6.2. SCF products	41
7. Basel III.....	45
7.1. Impact on supply chain finance.....	48
7.2. Conclusion.....	50
8. Future of supply chain finance.....	51
8.1. Impact of current financial circumstances	52
8.2. Target markets & industries	53
8.3. Challenges & Opportunities.....	55
9. Conclusions & Future research.....	57
9.1. Conclusions	57
9.2. Future research & Recommendations	59
Bibliography	62
Appendices.....	65

1. Introduction

Before corporations started optimizing supply chain flows, they optimized their own profit by focusing on internal process flows and hence regarding themselves as being independent of the supply chain. Due to competitive pressure firms started looking at increasing operational efficiency and optimizing supply chains. A supply chain is defined by Hofmann & Belin (2011) as “a network of partners that supplies raw materials, assembles manufactures products and then distributes them via single or multiple distribution channels to end customers”. A supply chain consists of three parallel flows; the goods and/or services flow, the information flow and the financial flow. Supply chain management focuses on improving the goods and services flow, by better alignment between internal departments and external trading partners, and cost reductions in the physical supply chain, resulting in better sourcing, procurement, logistics, increased efficiency, reduced inventory and improved forecasting. Little attention was paid however to the financial flows of a supply chain. The financial flows consist of invoices, credit notes and payments, and works in the opposite direction of the physical supply chain. The combination of the financial flow and information flow is also called the financial supply chain (Hofmann & Belin, 2011). Supply chain finance is the name attached to the collection of products and services that financial institutions offer to facilitate the management of the physical and information flows of a supply chain (Camerinelli, 2008).

Since the introduction of supply chain management around 1980, supply chain managers have pushed their supply chains to the limit by implementing just-in-time and lean principles. In today’s globalizing marketplace competition is putting more pressure on managers to innovate and streamline their organizations even further (Hofmann & Belin, 2011). Some corporations have however already wrung all efficiencies out of their physical supply chain, by sourcing production to low salary countries and removing all waste out of the processes (Croft, 2007). However, recent developments have shifted the attention from lean and just-in-time to a just-in-case approach (Cavenaghi, 2011). The financial crisis and the recent Japan tsunami have exposed the fragility of today’s supply chains, where corporations have pushed their suppliers to the limit by demanding longer payment terms and pushing more raw material inventory up the supply chain. The crisis also led to a significant drop in demand for goods and services and made banks tightening their credit terms, resulting in firms having difficulties financing their production cycle (Vasilescu, 2010). During the crisis in 2009, nearly one third of the large western world corporations had to deal with bankruptcy problems from their suppliers, no matter how good or bad their track record was. Corporations are therefore looking at supply chain finance, to proactively ensure their suppliers keep operating in healthy financial conditions, even if a new crisis shows up (Cavenaghi, 2011).

In a time in which traditional trade finance, as letters of credit and letters of guarantee are losing popularity, about 80% of global trade is conducted on open account. Further transaction services are becoming a commodity hereby putting pressure on margins; banks have lost visibility in information flows of trade and the related corporations. Banks are therefore broadening their view on supply chain finance, to reestablish market share in trade, increase margins on their transaction services and build closer customer relations to better understand their clients business and financing needs (Sylverberg & Albrektsson, 2011) (World payments report, 2011).

Although supply chain finance gets much attention by practitioners, the attention in academic literature has been rather low. Most studies focused on practical issues, but these left many research gaps (Hofmann & Belin, 2011) (Reindorp & Tanrisever, 2011). One supply chain finance product is reverse factoring, which is currently also often referred to as supply chain finance and is a special form of the traditional factoring (Seifert & Seifert, 2009). This thesis will be a combination of both rigorous and relevant research on reverse factoring, by deriving managerial implications from both a model, which will be developed in the first part, and from current issues in supply chain finance, which will be discussed in the second part, from a banks perspective.

1.1. Working capital management

As discussed in the introduction, suppliers face, due to a globalizing market place, a demand for longer payment terms by their customers and increasing cost of short term finance due to the recent crisis. These effects result in a higher need for working capital at a higher cost. Working capital entails all assets of the current assets that are transformed into liquid assets within one production cycle or at least within one year (Pfohl & Gomm, 2009). Net working capital (NWC) is defined as the current assets minus the current liabilities. The amount of working capital gauges the amount of liquidity that a firm needs daily to execute its operations profitable and reflects the time between cash flowing out of the firm, at the start of the manufacturing process, and the moment cash flows back into the firm, when final products are sold (Berk & DeMarzo, 2007) (Camerinelli, 2008). Normally a firm buys and sells products on credit, this means that the effective time between in and outflows of cash is different than the in and outflow of products. The time between the in and outflow of cash is measured by the cash conversion cycle (CCC).

$$CCC = \text{Inventory days} + \text{Accounts Receivable Days} - \text{Accounts Payable Days}$$

These three elements of the cash conversion cycle measure the length of three working capital sub cycles, order to cash, order to delivery and purchase to pay cycle. Treasurers can not regard these sub cycles as

independent and have to take the effects of supply chain management decisions on all sub cycles into account. If for example a lengthening of the payment term to suppliers can only be established by placing larger orders, this will result in higher inventory, the overall working capital costs might end up higher than the initial situation.

The items in the cash conversion cycle are closely related to the capital investment needed to finance the day to day operations, the investment in net working capital. The opportunity cost of investing in these three items is determined by their value and the short-term financing cost r . This is represented in the following equation:

$$\text{Financing cost} = r * NWC = r * (\text{average INV} + \text{average AR} - \text{average AP})$$

Where INV is the value of the inventory and AR and AP are respectively the value of the accounts receivable and accounts payable.

Since the elements of the cash conversion cycle are closely related linked to the physical supply chain, it is also a measure of how effectively the supply chain is managed. It is therefore highly important for supply chain managers to pay attention to the different elements in the cash conversion cycle and whether operational changes affect those elements positively or negatively. Since working capital is needed to finance operations, it needs to be managed well. Even though a firm has sound products, services and operations, if its working capital is not managed well, it can run out of cash and default.

The first element of working capital is the account receivable, however in relation to supply chain management it is better to refer to its time equivalent, the days sales outstanding; the time it takes to collect the proceeds from sales. Poorly managed payment collections and extensions of the payment term to customers increase the working capital and hence the funding cost. The second element is the inventory, where its time equivalent is days in inventory, this is as well raw materials as work in process as final goods inventory, so practically the cash tied up in the production process. Here inefficiencies in the production process, such as internal waiting times or stock build up, results in unnecessarily tying up cash in the supply chain, hence increase financing costs. The final element of working capital is the account payable and its time equivalent days payable outstanding. Extending the days payables outstanding reduces the capital requirements, by putting more financial pressure on the suppliers

1.2. Reverse factoring

In traditional factoring a bank buys accounts receivables from a corporation, here called the supplier. Factoring can be divided in two main categories, factoring with and without recourse, in factoring with recourse, the firm selling the accounts receivable stays exposed to the default risk of the buyer. In case the buyer defaults, the bank turns to the supplier to get back their funds. Factoring without recourse means the bank taking over the default risk of the supplier, this type of factoring is in practice often called receivable purchase. Generally a bank only buys accounts receivable from firms that are in their client base, or they buy complete portfolios of accounts receivable from multiple buyers, in order to diversify the risk of default from one single buyer. The bank then however, needs to assess the risk of a whole portfolio of receivables which is time consuming and costly, since the bank needs to collect credit information of many buyers (Klapper, 2006). Factoring has also not been profitable in developing countries since track records and reliable credit rating agencies are missing. Further, fraud is a big issue in those countries and the weak legal environments make it difficult to check on and deal with those firms. Factoring with recourse was presented as possible solution in case the credit worthiness of the buyer was hard to assess, however, when the buyer defaults the bank turns to the supplier to get their funds back, this supplier might not have enough financial sources to repay the obligation. In case of a buyer default, the bank becomes exposed to the supplier's credit risk which is generally high.

To overcome all issues above, reverse factoring is developed. Reverse factoring is a form of supply chain finance which overcomes the problem of information asymmetry between banks and supplier. In a reverse factoring agreement a buyer and supplier work together with a bank in order to optimize the financial flows (Reindorp & Tanrisever, 2011). The principle behind reverse factoring is the same as behind the more traditional factoring. In a reverse factoring transaction the bank only buys accounts receivable from partner corporations (the buyer) with a high credit rating. In this set-up the bank convinces the buyer organization to participate in the reverse factoring program. This buyer on its turn on-boards its suppliers. If this supplier wants to convert his accounts receivable into cash at a certain moment before maturity, the supplier contacts the bank, who then buys the accounts receivables at a discount, which is dependent on the creditworthiness of the buyer. Since in reverse factoring the buyer is part of the agreement too, the buyer wants a piece of the pie and usually demands a certain benefit as well. This incentive can come in different forms, extended payment period, price reduction or a fee from the bank. Usually the payment period is extended or the buyer does not demand a financial benefit at all. An extended payment period will reduce the cash conversion cycle and the net working capital, and therefore reduces the short term financing cost, as shown in the prior section on working capital management.

The process of reverse factoring starts at the time when the supplier delivers the products to the buyer. The buyer will then send an approval of invoice to the bank, meaning the invoice will be paid within the agreed payment term. If the supplier needs cash between the moments the buyer has send the approval of invoice and the final payment of the buyer, the supplier contacts the bank and sells the accounts receivable against a discount. The risk of these accounts receivable is dependent on the credit worthiness of the buyer, with high credit rating, and not on the supplier, with low credit rating. The supplier gains by this transaction compared to an ordinary bank loan, since they can sell the account receivables at an interest lower than their own interest rate. The discount the bank charges for factoring the accounts receivable is the interest rate of the buyer plus some additional factoring fees times the remaining payment term.

1.2.1. Benefits and concerns

Reverse factoring is a three partite value creating transaction which enables a win-win-win situation for the supplier, the buyer and the bank. This paragraph will state the benefits and concerns of reverse factoring for these three actors separately.

The supplier

First of all reverse factoring offers the supplier access to off balance sheet, cheaper short-term credit. Since underlying risk of the accounts receivable is not the supplier's credit worthiness, but the buyer's. As discussed in the chapter on working capital management, the financing cost of the net working capital is the product of the amount to be financed, the duration of the financing and the cost of capitals. Since reverse factoring reduces the cost of capital, by keeping the other variables constant, it will reduce the financing cost. Next to providing firms a lower cost of capital, reverse factoring is also beneficial for firms in developing countries. Due to the discussed information asymmetry and fraud in those countries SMEs did not have or restricted access to financing. Since reverse factoring is a cooperation between the buyer and the bank, the legitimacy of the accounts receivable is ensured. And since the buyer brings in the supplier, only the reliable, high quality suppliers are on-boarded and the probability of fraud is hereby reduced. Due to these improvements over traditional forms of finance, SMEs in developing countries get access to a whole new market of financing. And because this bank only works together with reliable, high quality, creditworthy firms, these SMEs are able to factor their receivables without recourse. Further, since accounts receivables are sold to the bank, they are immediately converted into cash and hence are not reported as bank loan on the balance sheet. Therefore, reverse factoring does not affect the interest rate and debt capacity of the supplier.

A second benefit of reverse factoring to the supplier is the increased liquidity. Due to the reverse factoring program, the supplier is able to transfer his accounts receivable into cash at any moment in time, which increases the liquidity of the supplier’s assets. Since the liquidity of the assets has increased by reverse factoring, the supplier is able to reduce his cash holdings. This is best illustrated by the reduction in the cash conversion cycle, as already discussed, the cash conversion cycle reflects the liquidity of the assets and is closely related to the capital investment that is needed to finance day to day operations. A reduction in the cash conversion cycle against a lower cost of capital leads to lower financing cost. The reduction in the cash conversion cycle is illustrated in Figure 1.

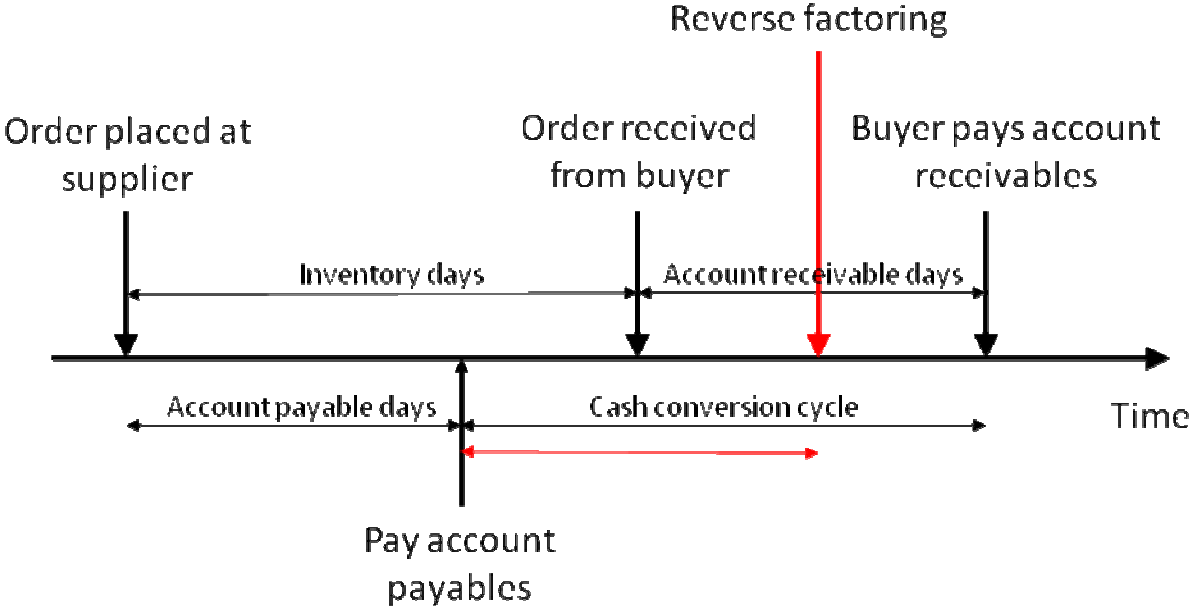


Figure 1: Effect of reverse factoring on the cash conversion cycle of the supplier (source: RBS presentation, F. Tanrisever)

A third benefit to the supplier is better (trade) relationship and better integrated systems with the buyer and the bank. Since the reverse factoring agreement is supported by a technological platform, firms can automate the invoicing and payment system and remove all paper from the process, making it more reliable and less labor intense. This results in lower costs and faster processing, it will also give the supplier more insight in the supply chain. Due to reverse factoring, processing time might reduce from 30/60 days to approximately 10 days (Hurtrez, 2010). Further, the trade relation with the buyer improves since both benefit from reverse factoring. The supplier hereby secures future trade with this buyer and due to improved working capital management tools the future financial stability can be increased.

Differences in payment practices - Target payment periods in international comparison

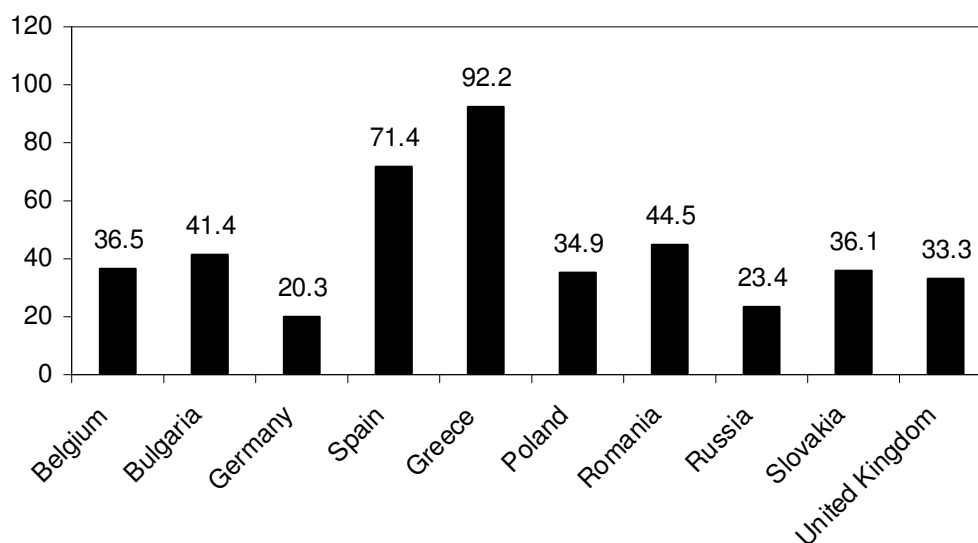


Figure 2: International differences in target payment period (EOS, 2011)¹

In the figure above, target payment periods of ten countries are compared. Firms in Greece have the longest payment periods and hence suppliers of those firms need to bridge the largest gap with external financing. Important to note is that the target and not the actual payment periods are shown and hence the payment reliability should also be considered. Recent research by Dun & Bradstreet (2011) over 2.8 million European firms has shown that payment behavior of certain European countries is impacted more heavily than other countries. In Germany, 60% of all invoices are paid on time, the other 40% are paid on average only three days overdue. The Netherlands closely follow Germany, 55% is paid on time and 45% is paid on average 5 days overdue. Portugal, Ireland and England are the slowest payers, on average they pay 19, 17 and 16 days overdue respectively. When working with firms in those countries it is highly important to monitor their payment behavior and thereby prevent cash shortages, further a certain increase in delayed payments might indicate cash shortages or even upcoming bankruptcy from your client.

Although reverse factoring is potentially profitable, suppliers have some concerns in participating in the reverse factoring program. First of all might a SME not have the required knowledge about finance and working capital management to fully understand the benefit from reverse factoring. Due to distrust created by years of exploitation by their buyers, where buyers wrung out their supplier by demanding

¹ http://www.eos-solutions.com/fileadmin/user_upload/studies/2011_EOS_Ten_Nations_Survey/en_grafiken/EOS-Survey-2011_Target-Payment-Periods_150dpi.jpg

longer payment terms, price reduction, higher service levels etc., suppliers feel reluctant to participate in reverse factoring programs. Suppliers lack the internal financial knowledge to fully understand the concept and dynamics of reverse factoring needed to convince suppliers to participate. A related concern is that a reverse factoring agreement that was profitable at the beginning might get out of the money due to changing market conditions as interest rate and changing firm conditions as creditworthiness. When a firm does not know whether to convert accounts receivable into cash or not, participating in a reverse factoring program might harm the firm instead of making it stronger. Although reverse factoring does provide the firm flexibility in their financing and working capital management, a lack of understanding might even reduce flexibility. When a firm reduces its cash holdings and at the same time factors the accounts receivable, the firm will become vulnerable in case of adverse demand and cash flow shocks or seasonality in demand. Another result of low understanding of working capital might be that the supplier gets cash addicted and abuses the extra liquidity to pay down long-term debt, which could result in cash shortages again during periods with low demand or adverse cash flow shocks.

A second concern to the supplier is the duration of the program. When the supplier factors its receivables and all of a sudden the bank and/or the buyer decide to pull the plug out of the program, the supplier ends up in a period in which it will not receive money from the buyers but it still needs to finance the ongoing business. The supplier therefore needs to have certainty from the buyer and the bank about the length of the program, otherwise they need to lend money at high cost in case the program ends.

Another concern for the supplier comes from the existing debt holders, they might not allow the firm to sell the accounts receivable. Since the underlying firm of the accounts receivable has a high credit rating, the accounts receivable provide high residual value in case the supplier defaults. When the supplier would sell those assets and invest in less liquid assets, the risk on existing debt increases, and therefore existing debt holders might be worse off. These existing debt holders might have agreed upon some debt covenants with the supplier, which do not allow the supplier to participate in the reverse factoring arrangement.

The buyer

Since reverse factoring is a form of buyer initiated supply chain finance, the buyer needs an incentive to participate in the program and to bring supplier into the program as well. The incentive can come in many ways, extended payment period, price reduction or a fee from the bank. In case the payment period is extended, the benefit for the buyer is in the reduced demand for net working capital and therefore in the reduced short-term financing cost. Due to the extended payment period, the cash conversion cycle decreases and thereby the liquidity of the assets increases. If the reverse factoring agreement specifies that

the benefit from the buyer will be in a reduced price or a fee, the buyer will get his benefit from a lower unit cost and therefore a higher margin.

As the supplier, also the buyer benefits from a better relationship with its suppliers and a better integrated payment system. The buyer does not need to take one of the financial benefits discussed above, they might only provide the factoring opportunity to their suppliers in order to create a better relationship and secure their supplier base. Due to the program, suppliers are less likely to get cash shortages and hence are more likely to keep operating in down times.

In practice, the reason to adopt reverse factoring for the buyer differs significantly from country to country and industry to industry. More important than the financial benefit, the buyer implements a supply chain finance solution on strategic grounds. Buyers in industries where the suppliers have more bargaining power, like in the automotive industry, where manufacturers often rely on one or two suppliers per component, are more likely to adopt a reverse factoring program to secure their supplier base. In financial down times, where SME's are capital constraint and supply chains become increasingly vulnerable to defaulting suppliers, production of the buyer is in danger because of financially distressed suppliers not being able to finance their production cycle and deliver on time. This might disturb the production process of the buyer, or even force them to shut the process down till a new supplier has been found. So in industries where the buyer is highly dependent on its suppliers and those suppliers are not easily replaceable, buyers are more open to reverse factoring. Further, demand for reverse factoring is bigger in industries which are more sensitive to the economy. Again the automotive industry is a good example of the influence of economic sensitivity. Automotive industry is one of the industries which are the first to notice an upcoming crisis, by significant order reductions. Due to the nature of the products, demand is highly dependent on the economy, where demand is low during economic down times. Since their high riskiness, SME's in this industry are locked out of bank loans first, harming the whole supply chain. Industries which are less sensitive to the economy do not experience such a big demand drop and do not have such a need for extra finance. In case more bargaining power is at the buyer, the reverse factoring program can be used to acquire a better negotiation position to the supplier and be able to negotiate better payment term, lower prices, higher service levels etc.

Concerns for the buyer are the fear that the reverse factoring solution might hamper their debt capacity, if the payment term is increased, the total amount of account payables on the balance sheet will increase too and hence might reduce the total debt a firm can attract. Experience tells debt capacity is only affected when accounts payable are transferred into bank debt, in reverse factoring however, accounts payable are still booked as accounts payable on the buyers balance sheet, and hence does not affect debt capacity.

Of course also the buyer faces some risks by participating in the reverse factoring program. The buyer needs to agree to participate for a certain period in the program, this is needed so the supplier is not facing the risk of an unexpected end of the program that would result in liquidity problems as discussed. The buyer needs to bind himself to a certain bank for a certain period while in the mean time better opportunities might arise.

The bank

For the bank the benefit is of course in the extra income from buying the accounts receivable at a discount. Since the underlying risk of the accounts receivable is the default risk of the buyer, with high credit rating, the bank has access to the SME market with only limited risk in both developed as well as developing countries. Since the bank is cooperating with the buyer, the bank has access to more detailed credit and supply chain information than in traditional financing. The bank is because of this information better able to estimate the creditworthiness of these firms and spot opportunities and threats in the market. The bank also gets access to markets that were initially too risky due to fraud and information asymmetry, like developing countries. Since these markets lack well functioning credit rating agencies, determining the creditworthiness and reliability of a firm and its accounts receivable is very costly. Because in reverse factoring the buyer is cooperating with the bank, and this buyer only on-boards high quality suppliers, the reliability of the suppliers is ensured. Also fraud was a concern of traditional factoring in developing countries, suppliers could try to factor accounts receivable of non-existing firms (Klapper, 2006) or factor accounts receivable multiple times. Since the buyer uploads his accounts payable on the platform and payment is performed via the bank, the legitimacy of the accounts receivable and the final payment are ensured.

Since the bank has access to a new market in which it would otherwise not lend, the bank is able to increase its market share by reverse factoring, but since it gains new contacts in the SME market the bank will also be able to expand its existing business in these markets by cross-selling existing solutions.

A final benefit from reverse factoring for the bank might be the compliance with the new Basel III regulations. Since the risk on a reverse factoring arrangement is much lower as on a normal loan to a SME, the bank does not need to hold as much capital reserves to back its funding to these high risk firms.

Concerns for the bank are that reverse factoring might cannibalize on their existing business. Firms that originally lend money at high interest rate from the bank will jump to reverse factoring. Dependent on the margin on both of these loans and the underlying risk, this might be beneficial or not. Further banks have to develop or pay for a technological platform. This investment might be too large with respect to the income that reverse factoring will generate and thereby put pressure on margins.

1.3. Research design

Based on the literature review, mentor discussions and discussions with my supervisors within RBS, the following research questions have been defined:

(1) *What factors influence international reverse factoring and how to model these?*

In this thesis a model will be developed to value reverse factoring. The model will be different than, but based on the model from Reindorp & Tanrisever (2011). Later on some assumptions of the base model will be relaxed and impact of international factors will be discussed.

(2) *What managerial implications can be derived from the model proposed under (1) and from current practical issues in the supply chain finance market and within RBS?*

Once the model under (1) is developed, managerial implications will be derived. Further practical issues of reverse factoring will be discussed from a bank's perspective and the future of supply chain finance will be analyzed.

The remainder of this thesis will be organized as: In Chapter 2 the current state of academic literature will be discussed. Chapter 3 will show the reverse factoring model, and in Chapter 4 the international aspects of reverse factoring will be presented. In the second part of this thesis the focus will move from reverse factoring to supply chain finance, therefore Chapter 5 will give a short introduction to supply chain finance. In Chapter 6 the impact of Basel III on reverse factoring will be discussed. In the final chapter the future of supply chain finance will be discussed.

2. Literature review

As most corporate finance literature also this study starts from Modigliani and Miller (1958). Modigliani and Miller show in their study that, under specific assumptions, a firm's value is not affected by its capital structure, it is therefore also called the capital structure irrelevance theory. This implies that capital structure is not value creating and value is only created by a firm's operations. The three assumptions under which this theory holds are respectively: perfect capital markets, rational behavior and perfect certainty. The first assumption, perfect capital markets, means that all investors have the same costless information, so no information asymmetry, and no transaction costs, taxes etc. Capital markets in reality are however not perfect, first of all because firms have to pay taxes and transaction costs and second because information asymmetry exist. This information asymmetry exists because of difficulties or high associated costs in transferring this information from the firm to the bank and due to the principle agent problem (Pfohl & Gomm, 2009).

Due to information asymmetry the cost of internal finance may differ significantly from the cost of external finance. Since banks lack the information and insight in SMEs they charge high interest rates on short-term finance, if they are willing to provide credit at all. The phenomenon of banks not providing capital at all is called credit rationing, credit rationing refers to a situation in which either loan applicants who appear to be identical some receive a loan and others do not, the applicants who don't receive a loan would still not receive one if they would be willing to pay a higher interest rate or when there are identifiable groups in the population who are unable to obtain a loan against any interest rate, even when the credit supply would increase (Stiglitz & Weiss, 1981). Since a bank's profitability is dependent on the extent to which borrowers repay their loan, a bank would like to be able to determine the likelihood of a borrower repaying its loan on forehand. One such screening device is the interest rate a borrower is willing to pay, if a borrower is willing to pay a higher interest rate they are assumed to be more risky at some point. First firms with projects yielding higher NPV's are expected to have a higher willingness to pay a higher interest rate, however, at some point the bank assumes firms perceive the chance of having enough profit to repay the loan this low, that they are willing to accept higher interest rates. This mechanism makes that positive NPV yielding projects are not able to obtain credit even against higher interest rates after a bank's optimal interest rate.

Although supply chain finance has had much attention by practitioners, its attention in academic literature has been rather low. Hofmann (2005) proposes a supply chain finance framework and conceptual insights, by discussing supply chain finance dynamics. Pfohl & Gomm (2009) state in their paper that supply chain finance is a way of mitigating the information asymmetry between a supplier and the financial markets,

by stating that due to the buyer supplier relationship, the buyer has more and cheaper information on the suppliers creditworthiness than the financier. Hence, the buyer can charge a lower risk premium on its financing to the supplier than the financier would. Supply chain finance and reverse factoring are currently used interchangeably in the supply chain finance market (Seifert & Seifert, 2009).

As on supply chain finance, little has been published on reverse factoring. Since reverse factoring is not an open market transaction, little data is available and hence empirical research is quite rare. On the more traditional factoring, some data studies have been performed. Klapper (2006) concludes that factoring is larger in countries with greater economic development, growth and developed credit bureau's. However reverse factoring potentially mitigates the shortcomings of traditional factoring, whereby these result might not generalize to reverse factoring. Summer & Wilson (2000) find that firm size is a significant measure on a firm's decision to use factoring, where small firms are more likely to factor their account receivables.

Quantitative research on factoring has been done by Sopranzetti (1998) who modeled a moral hazard problem in factoring, when the credit monitoring of the supplier is unobservable, the financier will expect a moral hazard problem and this will be reflected in the price. This makes a seller with significant high default probability unable to sell its high risk accounts receivable without recourse. However, since in reverse factoring, the bank cooperates with the buyer, the bank is significantly better able to monitor the payments and legally enforce payment, therefore this result is hard to generalize to reverse factoring.

The only quantitative model on reverse factoring is the working paper of Reindorp & Tanrisever (2011). In their paper they develop a mathematical model for integration, optimization and analysis of the effect of operational and financial decisions on the buyer, supplier and bank as well as the supply chain as a whole. This paper provides the optimal reverse factoring contracts under a make to stock and a make to order production system. However this model is developed on a domestic reverse factoring situation and only looks at risk neutral cash flows, it doesn't model default probability explicitly. Since practitioners see even more opportunities for reverse factoring in international setting, a new model will developed, first in perfect capital markets and later in imperfect capital markets, next the scope of the model will be extended to an international setting, in order to see the effect of this on the value of reverse factoring.

3. Model formulation

In this chapter the model to value reverse factoring will be developed. In the first paragraph some theoretical background on risk neutral will be provided. Paragraph 2 starts with a description of perfect capital markets, next the model description, variables, parameters and the model itself will be derived. Paragraph 3 will relax the assumption of perfect capital markets will be relaxed by introducing information asymmetry in the model. Paragraph 4 and 5 will deal with the relaxation of auto discounting and analysis of operational issues respectively. Finally Paragraph 5 will provide a summary of the obtained results and conclusions will be drawn from the model.

3.1. Risk neutral valuation

In the real or physical world, investors are (on average) risk averse, meaning they want to have a compensation for the risk they take. Since investors receive a risk premium for risk, the price of an asset is below its expected payoff. Further, in a risk averse world, the price of an asset depends on the risk aversion level of investors, which is normally hard to quantify. In a risk neutral world, investors are assumed to be indifferent to risk and hence do not require a premium for the risk they take. Therefore, in a risk neutral world, the return of an asset is equal to the risk free rate and contrary to the real world, but in line with asset pricing theory, the price of an asset is equal to its expected discounted payoff. The big advantage of risk neutral valuation is the fact that the real probabilities of an up or down movement of the asset are not required to calculate the value of an asset. The asset is priced by using the so called risk neutral probabilities, which are chosen such that the expected payoff of an asset is equal to the risk free rate. The asset is then priced by calculating the expected payoff by using these risk neutral probabilities. Important to notice is that the value of an asset in the risk neutral world is equal to the value of an asset in the real or physical world, since two effects tend to offset each other. First, in the real world the value of an asset is below its expected payoff due to the risk premium. Second, the risk neutral probability of a down movement of an asset is overestimating the probability of a downward movement in the real world. Since both effects are of equal size, the obtained prices are not only correct in the risk neutral world, but in the real world as well (Hull, 2009).

3.2. Perfect capital markets

In the previous chapter perfect capital markets have already been mentioned, in this section perfect capital markets will be defined in more detail. Modigliani and Miller (1958) proved that under a set of

conditions, called perfect capital markets, leverage does not affect total firm value. This set of conditions is (Berk & DeMarzo, 2007):

1. Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows.
2. There are no taxes, transaction costs, or issuance costs associated with security trading.
3. A firm's financing decisions do not change the cash flows generate by its investments, nor do they reveal new information about them.

Perfect capital markets form the basis from reasoning on corporate capital structure, from hereon factors such as bankruptcy cost, information asymmetry, tax and transaction costs can be included to see there influence. A perfect capital market is a market without arbitrage opportunities. In real markets, investors generally require a higher risk premium for bearing more risk which makes the price of an asset lower than its actual net present value.

3.2.1. Model description

In this base model, the buyer approves the invoice of a supplier at $t = 0$. This invoice is immediate available for discount to the supplier and the supplier makes use of auto discounting, meaning the invoice is sold to the bank at time $t = 0$ automatically. For simplicity, the invoice amount is being normalized to one and benefits are calculated on a pre-tax basis.

In the original, pre reverse factoring situation, the buyer pays an invoice after l_{nrf} periods to a supplier. This buyer finances its short term capital against an annual short term financing rate, r_b , which is continuously compounded, and since the base model assumes perfect capital markets, this interest rate consists of the risk free rate plus a risk premium beta, $r_b = r_f + \beta_b$, this risk premium is charged by the lender to compensate for the risk of holding that asset. The supplier finances its working capital against a financing rate of r_s , where $r_s = r_f + \beta_s$. In this model the supplier needs a short term loan at $t = 0$ of L_0 , which is being repaid at l_{nrf} . At maturity, the buyer, if not defaulted, pays its outstanding account payables to the supplier. Since this buyer can default within the payment period, the pay off at maturity is stochastic. To value this stochastic cash flow the risk neutral cash flow is used, this is a deterministic cash flow with the same value as the stochastic cash flow, however since this cash flow is deterministic it can be discounted by the risk free rate. The default between $t = 0$ and $t = t$ of the buyer and the supplier respectively is indicated by D_t^b and D_t^s , these are binomial variables, where 1 indicates the actor does

not default between time 0 and t , and 0 in case of default. This makes the value at $t = 0$ of the stochastic cash flow, $V_0[\cdot]$:

$$V_0[D_t^i] = E_t^Q[D_t^i]e^{-r_f t} = e^{-(r_f + \beta_i)t}$$

Explanation:

Take a situation where firm i takes a loan of 1 euro at a bank, in 1 period i pays a stochastic cash flow which is either $e^{r_f + \beta_i}$, or i defaults and pays 0. In perfect capital markets the value of this cash flow should be equal to the initial loan of 1, which should be the risk neutral cash flow discounted by the risk free rate. The risk neutral probability of default is q , so:

$$e^{r_f} = qe^{r_f + \beta_i}$$

$$q = e^{-\beta_i}$$

This makes the value at $t = 0$ of a stochastic cash flow, D_t^i , which is either 1 or 0, equal to the discounted risk neutral cash flow, $E_t^Q[D_t^i]e^{-r_f t}$, where $E_t^Q[D_t^i] = 1 * q = e^{-\beta_i t}$, so the value of this cash flow is: $V_0[D_t^i] = E_t^Q[D_t^i]e^{-r_f t} = e^{-(r_f + \beta_i)t}$.

In the situation with reverse factoring, the buyer will extend its payment period from l_{nrf} to l_{rf} , therefore the supplier has to wait longer to get its invoices paid. However, in case of waiting for this money, the supplier immediately sells its invoices, at a discount, to the bank at $t = 0$. The bank charges a reverse factoring fee, b , for this service, making the reverse factoring discount rate $r_f + \beta_b + b$. The supplier still needs short term financing at $t = 0$ of L_0 . However, since the invoice will be sold to the bank, this short term loan will be reduced by the proceeds from this sale. The remaining amount, if any, will be repaid at $t = l_{nrf}$, if the supplier did not default. Since the bank took ownership of the invoice, the buyer will pay the invoice directly to the bank.

In this model it is assumed that the supplier can default, and hence not repay its debt to the bank. At the same time there might still be value in the firm left because the buyer has paid its obligation to the supplier. This assumption is however not affecting the results, since if there would be a recovery rate on

the bank debt, this would be incorporated in the interest rate and hence cash flows would be valued the same way as it is done in this model.

3.2.2. Assumptions

In developing the base model of reverse factoring, some assumptions have to be made. These assumptions allow to model reverse factoring, without losing practical relevance of the model.

Assumption 1: Actors are in the same currency union

The first assumption deals with the program set-up, for the base model the buyer, supplier and bank are assumed to be located in the same country. This thereby implies that payments made by the buyer and the bank are in the domestic currency which is the same as payments received by the bank and the supplier.

Assumption 2: No set-up cost/operational cost

Next there are no fixed costs and variable costs, meaning there are not set-up costs involved, neither are there transaction cost and operational costs, so maintaining and operating the reverse factoring program does not cost money.

Assumption 3: No banking regulations

Further the new proposed regulations on capital and liquidity requirements, Basel III, are not taken into account in calculating the financial benefit for the bank.

This bank is assumed not to predate on its existing business, i.e. the supplier in the reverse factoring program is not an original client of the bank nor does it substitute borrowings by new reverse factoring.

Further the bank is assumed not being capital constraint.

Assumption 4: No time dependent interest rates

Interest rates are not time dependent.

Assumption 5: Buyer and supplier default is independent

The short term loan a supplier needs to take at $t = 0$, can be settled at maturity with proceeds from other sales. In case the buyer defaults, the supplier can settle its debt with proceeds from other sales, and hence does not automatically default as well.

3.2.3. Parameters

Decision variables

l_{wf}, l_{rf} Payment term without and with reverse factoring respectively in years

b Supply chain finance premium charged by the bank to the supplier

Parameters

r_f Annual Risk-free rate

r_i Annual financing rate of actor i , where $i \in \{b, s\}$ for the buyer and supplier respectively

β_i Risk premium for actor i , where $i \in \{b, s\}$ for the buyer and supplier respectively

π_i Benefit from reverse factoring where $i \in \{b, s, f, sc\}$ for the buyer, supplier, financier and supply chain respectively

L_t Loan at time t

D_t^i Binomial stochastic variable, 0 in case of default between time 0 and t , where $i \in \{b, s\}$ for the buyer and supplier respectively

$E_t^Q[\cdot]$ Risk neutral expected cash flow at time t

q Risk neutral probability of default

N.B.: All interest rates are continuously compounded

3.2.4. Model

In this section the model to value reverse factoring under perfect capital markets will be derived, based on the theory, situation, assumptions and parameters from the previous sections. First the value for the buyer will be derived, followed by the supplier and the bank. Eventually those benefits will be taken together to get the total value to the supply chain. The correctness of the model is then tested, since in perfect capital markets financing should not add value, this total supply chain profit should equal zero.

Buyer

In the original situation the buyer pays the invoice after l_{nrf} periods, where by making use of reverse factoring, the buyer only needs to pay after l_{rf} periods, on a time line this looks like:

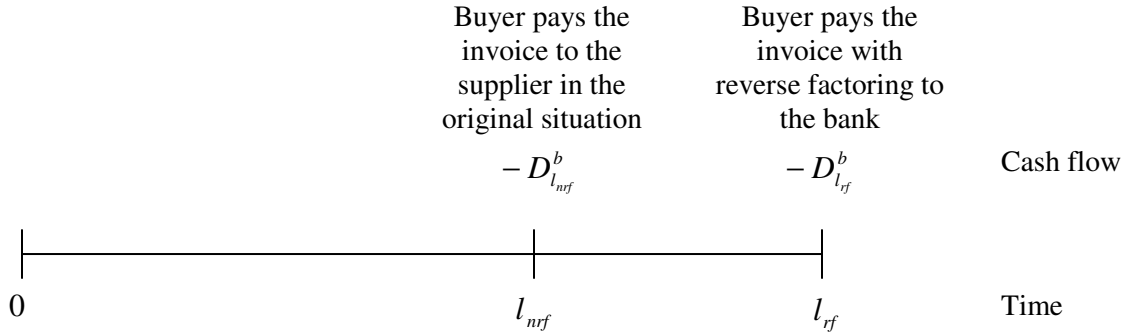


Figure 3: Buyer cash flows with and without reverse factoring

Table 1: Buyer cash flows without reverse factoring

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-D_{l_{nrf}}^b$	0	
Value of the cash flow at time $t=0$	0	$-e^{-(r_f + \beta_b)l_{nrf}}$	0	$-e^{-(r_f + \beta_b)l_{nrf}}$

Table 2: Buyers cash flows with reverse factoring

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	0	$-D_{l_{rf}}^b$	
Value of the cash flow at time $t=0$	0	0	$-e^{-(r_f + \beta_b)l_{rf}}$	$-e^{-(r_f + \beta_b)l_{rf}}$

From these tables it is evident that the total benefit from reverse factoring equals:

$$\pi_b = e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}}$$

To make this result more interpretable, the first order Taylor approximation is used. The first order Taylor approximation of e^x is: $e^x = 1 + x$

This gives: $\pi_b = (r_f + \beta_b)(l_{rf} - l_{nrf})$

Therefore, the buyers benefit from reverse factoring in perfect capital markets is positively related to the payment period extension and its risk premium.

Supplier

In this situation it is assumed that the supplier needs a short term loan in the original situation at time $t = 0$ of L_0 , this money is immediately invested in the production process or other operations. This short term loan is repaid at time l_{nrf} when the buyer pays the invoice if he did not default. In calculating the value of the cash flows, it is assumed that the supplier repays the full loan, or pays zero when he defaults, independent of the cash flow that is received from the buyer. In case the supplier defaults, the cash that is received from the buyer will be dispersed over more senior claim holders than the bank. Since the supplier takes out a loan of L_0 , the amount that needs to be repaid is equal to $L_0 e^{(r_f + \beta_s)l_{nrf}}$, however since the supplier can default, this amount needs to be multiplied by the default indicator to obtain the cash flow, $L_0 e^{(r_f + \beta_s)l_{nrf}} D_{l_{nrf}}^s$. At the same time, $t = l_{nrf}$, the buyer pays its invoice, which is normalized to one so equals the default indicator $D_{l_{nrf}}^b$. These cash flows are then valued by the way described in paragraph 3 of this chapter.

Table 3: Supplier cash flows without reverse factoring

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-L_0 e^{(r_f + \beta_s)l_{nrf}} D_{l_{nrf}}^s + D_{l_{nrf}}^b$	0	
Value of the cash flow at time $t=0$	0	$-L_0 + e^{-(r_f + \beta_b)l_{nrf}}$	0	$-L_0 + e^{-(r_f + \beta_b)l_{nrf}}$

In the new situation with reverse factoring, the buyer again approves the invoice at time $t = 0$, but only pays the invoice after l_{rf} periods to the bank. The supplier sells the invoice at time $t = 0$ to the bank in exchange for immediate cash, this amount is the final payment of the buyer discounted by the borrowing rate plus an additional fee set by the bank: $r_b + b$. At maturity, the buyer pays its outstanding accounts payable to the bank, if the buyer did not default between $t = 0$ and $t = l_{nrf}$. In case the buyer defaults, it does not pay out anything. In case the buyer does not default, it is assumed to pay at maturity, so no early or delayed payments. Since the buyer in the original situation needed a loan of L_0 , the buyer now only needs a loan of $L_0 - e^{-(r_f + \beta_b + b)l_{rf}}$, since the second part is the amount that is obtained by discounting the accounts receivable.

Table 4: Supplier cash flows with reverse factoring

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-(L_0 - e^{(r_f + \beta_b + b)l_{rf}})e^{(r_f + \beta_s)l_{nrf}} D_{l_{nrf}}^s$	0	
Value of the cash flow at time $t=0$	0	$-L_0 + e^{-(r_f + \beta_b + b)l_{rf}}$	0	$-L_0 + e^{-(r_f + \beta_b + b)l_{rf}}$

Taking Table 3 and

Table 4 together, the following benefit from reverse factoring will be obtained:

$$\pi_s = e^{-(r_f + \beta_b + b)l_{rf}} - e^{-(r_f + \beta_b)l_{nrf}}$$

Again, the Taylor approximation is used to make these results more interpretable:

$$\pi_s = (r_f + \beta_b)l_{nrf} - (r_f + \beta_b + b)l_{rf}$$

Hence, the benefit from reverse factoring for the supplier is negatively related to the payment period extension, the reverse factoring fee and the buyers risk premium, assuming the payment period is extended.

Bank

The banks benefit is calculated by assuming the opportunity cost of money for the bank is equal to the risk free rate. At time $t = 0$, the bank buys the accounts receivable from the supplier for $e^{-(r_f + \beta_b + b)l_{rf}}$, where the total invoice amount is paid at time $t = l_{rf}$ by the buyer directly to the bank, this payment is

$$D_{l_{rf}}^b.$$

Table 5: Bank cash flow with reverse factoring

Time	0	l_{nrf}	l_{rf}	total
Cash flow	$-e^{-(r_f + \beta_b + b)l_{rf}}$	0	$D_{l_{rf}}^b$	
Value of the cash flow at time $t=0$	$-e^{-(r_f + \beta_b + b)l_{rf}}$	0	$e^{-(r_f + \beta_b)l_{rf}}$	$e^{-(r_f + \beta_b)l_{rf}} - e^{-(r_f + \beta_b + b)l_{rf}}$

From Table 5 it evident that the value of reverse factoring for the bank is:

$$\pi_f = e^{-\beta_b l_{rf}} (e^{-r_f l_{rf}} - e^{-(r_f + b)l_{rf}})$$

Again the Taylor approximation is used to make the result more interpretable, the benefit then becomes:

$$\pi_f = bl_{rf}$$

Hence the benefit for bank is only dependent on the reverse factoring fee and the payment period in reverse factoring.

Supply chain

The total supply chain benefit can be obtained by adding the benefits of the three individual participants calculated before, since this model is developed under the assumption of perfect capital markets, this result should be in line with Modigliani and Miller and the total supply chain benefit from reverse factoring should equal zero.

$$\pi_{sc} = \pi_b + \pi_s + \pi_f = e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}} + e^{-(r_f + \beta_b + b)l_{rf}} - e^{-(r_f + \beta_b)l_{nrf}} + e^{-\beta_b l_{rf}} (e^{-r_f l_{rf}} - e^{-(r_f + b)l_{rf}}) = 0$$

Participation constraints

By deriving the participation constraints for the buyer, supplier and bank, the optimal contract can be determined under the assumption of perfect capital markets. For determining the optimal contract, all actors are assumed to maximize their financial benefit. In this situation there is only one contract in which neither party loses money, this is the situation in which the buyer does not extend its payment term and the bank does not charge any fee. This contract is Pareto efficient, since by changing the payment term, l_{rf} , or the reverse factoring fee, b , at least one actor loses money in this transaction. Pareto efficiency is referred to as a situation in which no Pareto improvement is possible, a Pareto improvement is an improvement in which resource allocation is changed which makes at least one person better off, but does not make the other persons worse off. Since by increasing b or l_{rf} , at least one person gets a negative benefit, so the optimal contract in perfect capital markets is a contract in which $l_{nrf} = l_{rf}$ and $b = 0$.

$$\text{Buyer: } e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}} \geq 0$$

$$l_{rf} \geq l_{nrf}$$

$$\text{Supplier: } e^{-(r_f + \beta_b + b)l_{rf}} - e^{-(r_f + \beta_b)l_{nrf}} \geq 0$$

$$(r_f + \beta_b + b)l_{rf} \leq (r_f + \beta_b)l_{nrf}$$

$$\text{Bank: } e^{-\beta_b l_{rf}} (e^{-r_f l_{rf}} - e^{-(r_f + b)l_{rf}}) \geq 0$$

$$b \geq 0 \text{ and } l_{rf} \geq 0$$

Putting all these participation constraints together, the optimal contract becomes:

$$l_{nrf} = l_{rf} \text{ and } b = 0, \text{ in this contract all participants will not make any profit or loss.}$$

As Modigliani and Miller already concluded in their paper, capital structure does not create, nor destroy value. Although the supply chain finance market reasons as if it does. The market assumes no default probability of the buyer and the supplier, though there is a risk premium charged, which is in conflict with the assumption of perfect capital market. In the next section the assumption of perfect capital markets will be relaxed and will be shown where the benefit from reverse factoring comes from.

3.3. Imperfect capital markets

In the previous section, a model has been developed which could be used to calculate the benefits for the buyer, supplier and bank in a reverse factoring program under perfect capital markets. However, in reality capital markets are not perfect, since market imperfections such as, transaction costs, taxes and information asymmetry exists. By relaxing the assumption of perfect capital markets, the following model is obtained.

The financing rate of a firm was composed of the risk free rate plus a risk premium. Due to the existence of information asymmetry now a factor representing the deadweight cost of capital is added. This deadweight cost of capital is caused by difference in information between the market and a bank. Since a bank invests in its relationship with the buyer and the supplier, it has more information than the market, and therefore could charge a lower interest rate. However, in this model, it is assumed that the bank charges the same rate as the market, but the difference between the market and the bank is deadweight cost of capital for the supplier and profit for the bank and is indicated by epsilon:

$$\varepsilon_i \quad \text{Dead weight cost of capital where } i \in \{b, s\} \text{ for the buyer and supplier respectively}$$

Further it is assumed that the supplier does not have more information on the buyer than the market, although it has a trade relation with the buyer. The financing cost of the buyer and the supplier

respectively become: $r_b = r_f + \beta_b + \varepsilon_b$ and $r_s = r_f + \beta_s + \varepsilon_s$. Where beta is the risk premium and epsilon is representing the deadweight cost of financing.

Buyer

For the buyer two situations can be distinguished, a situation in which the buyer has working capital shortages, and a situation in which the buyer has enough cash to finance its own production cycle, so he does not borrow money from the bank or the market. First the benefit from reverse factoring in a situation in which the buyer has working capital shortages will be developed, next a model will be developed where the buyer is not capital constraint and hence does not borrow money from the bank or the market.

Capital constraint buyer

Since the buyer is capital constraint in this first situation, the buyer lends his money at the bank/market at a rate of $r_b = r_f + \beta_b + \varepsilon_b$. Therefore, the risk neutral cash flows of the buyer need to be discounted by risk free rate plus the deadweight cost of capital, in other words, since the buyer is lending money, he is paying interest for the information asymmetry between himself and the market. The value of a stochastic cash flow D_t^i hereby becomes: $V_0 [D_t^i] = e^{-(r_f + \beta_i + \varepsilon_i)t}$.

Explanation

Again the stochastic cash flow from the buyer is transferred in a deterministic cash flow which has the same value, the risk neutral expected cash flow. However, even when the cash flow is corrected for risk, the risk neutral cash flow can not be discounted by the risk free rate because of the deadweight cost of capital. Therefore the value at $t = 0, V_0$, of a risk neutral cash flow $E^Q [D_1^i]$, where i 's interest rate is

$$r_i = r_f + \beta_i + \varepsilon_i :$$

$$V_0 [D_1^i] = E^Q [D_1^i] e^{-(r_f + \varepsilon_i)}$$

$$\text{Since } E^Q [D_1^i] = e^{-\beta_i}, V_0 [D_1^i] = e^{-(r_f + \beta_i + \varepsilon_i)}$$

Further the situation is comparable to the situation under the assumption of perfect capital markets. In the initial situation, the buyer pays the invoice of the supplier after l_{nrf} days, still this invoice is normalized to 1. In the new situation with reverse factoring, the buyer pays the normalized cash flow after l_{rf} periods.

Table 6: Cash flows of the buyer without reverse factoring in imperfect capital markets

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-D_{l_{nrf}}^b$	0	
Value of the cash flow at time $t=0$	0	$-e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$	0	$-e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$

Table 7: Cash flows for the buyer from reverse factoring in imperfect capital markets

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	0	$-D_{l_{rf}}^b$	
Value of the cash flow at time $t=0$	0	0	$-e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}$	$-e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}$

Combining Table 6 and Table 7 makes the total benefit from reverse factoring for the buyer:

$$\pi_b = e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}$$

The first order Taylor series approximation hereby becomes:

$$\pi_b = (r_f + \beta_b + \varepsilon_b)(l_{rf} - l_{nrf})$$

Not capital constraint buyer

For a buyer who is not capital constraint, the benefit from reverse factoring can be obtained in the same way, however, the cash flows should then be discount by only the risk free rate plus the risk premium, since the money is not lend at a bank or the market and hence does not have to pay for the information asymmetry with the financial markets. The benefit for the buyer then becomes:

$$\pi_b = e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}}$$

First order Taylor series approximation:

$$\pi_b = (r_f + \beta_b)(l_{rf} - l_{nrf})$$

Hence the benefit from reverse factoring for the buyer depends on its need for external short term finance. When the buyer needs external finance the benefit is positively related to the payment period extension and to the interest rate, risk free rate, risk premium and deadweight cost of capital. When the buyer has no

need for external finance the benefit is still positively related to the payment period extension, however the total benefit is reduced since there the deadweight cost of capital falls out.

Supplier

As for the buyer, also for the supplier two situations can be differentiated, one in which the supplier is capital constraint and one in which the supplier has enough cash to finance its own production cycle. In this section the effect of limited need for short term finance will also be investigated.

Capital constraint supplier

In the first situation the supplier is capital constraint and hence its cash flows should be discounted by $r_f + \beta_b + \varepsilon_s$. In the original situation the supplier again receives the payment from the buyer after l_{nrf} periods, where in the situation with reverse factoring the supplier receives his cash immediately at a discount, the amount the supplier will obtain by making use of reverse factoring is equal to: $e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$. At time $t = 0$ the supplier's short term borrowings equal L_0 . Where it is assumed that the loan needed is larger or equal to the proceeds from reverse factoring $L_0 \geq e^{-(r_f + \varepsilon_b + b)l_{rf}}$ and this borrowing will be repaid at time $t = l_{nrf}$ in total when the supplier does not default.

Table 8: Cash flows for the supplier without reverse factoring in imperfect capital markets

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-L_0 e^{(r_f + \beta_s + \varepsilon_s)l_{nrf}} D_{l_{nrf}}^s + D_{l_{nrf}}^b$	0	
Value of the cash flow at time $t=0$	0	$-L_0 e^{\varepsilon_s l_{nrf}} + e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$	0	$-L_0 e^{\varepsilon_s l_{nrf}} + e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$

Table 9: Cash flows for the supplier from reverse factoring in imperfect capital markets

Time	0	l_{nrf}	l_{rf}	total
Cash flow	0	$-(L_0 - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{nrf}}) e^{(r_f + \beta_s + \varepsilon_s)l_{nrf}} D_{l_{nrf}}^s$	0	
Value of the cash flow at time $t=0$	0	$-(L_0 - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}) e^{(r_f + \beta_s + \varepsilon_s)l_{nrf}} e^{-(r_f + \beta_s)l_{nrf}}$	0	$-(L_0 - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}) e^{\varepsilon_s l_{nrf}}$

Taking together Table 8 and Table 9 this gives:

$$\pi_s = e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf} + \varepsilon_s l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$$

First order Taylor series approximation:

$$\pi_s = (r_f + \beta_b + \varepsilon_b + \varepsilon_s)l_{nrf} - (r_f + \beta_b + \varepsilon_b + b)l_{rf}$$

By assuming the buyer does not want a payment period extension, so $l_{nrf} = l_{rf}$, the supplier makes a profit when $\varepsilon_s \geq b$. So in this situation, the supplier makes a profit when the reverse factoring fee charged by the bank, is smaller than its own deadweight cost of capital.

Not capital constraint supplier

When the supplier is not capital constraint, the benefit from reverse factoring can be obtained in the same way. However the supplier does now not need a loan at time $t = 0$, the cash flows which are received from the buyer still need to be discounted by the interest rate which includes the dead weight cost of capital, since the supplier does not have more information than the market. The benefit for the buyer then becomes:

$$\pi_s = e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$$

First order Taylor series approximation:

$$\pi_s = (r_f + \beta_b + \varepsilon_b)l_{nrf} - (r_f + \beta_b + \varepsilon_b + b)l_{rf}$$

So the benefit for the supplier will never be positive, even when the buyer does not require a payment period extension.

Limited capital constraint supplier

For the supplier also a third situation can be distinguished, when the short term capital needs of the supplier are smaller than the total amount that will be discounted due to reverse factoring, $0 \leq L_0 \leq e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$, in this assumption it is still assumed that all capital costs can, if needed, be offset by the proceeds from other sales. Total benefit from reverse factoring in this scenario becomes:

$$\pi_s = e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}} - L_0 + L_0 e^{\varepsilon_s l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$$

Taylor series approximation:

$$\pi_s = -(r_f + \beta_b + \varepsilon_b + b)l_{rf} + L_0 \varepsilon_s l_{nrf} + (r_f + \beta_b + \varepsilon_b)l_{nrf}$$

Depending on the amount of the initial loan of the supplier, reverse factoring might be profitable in this situation, for the supplier to make a profit, the short term loan at $t = 0$, should at least be:

$$L_0 \geq \frac{(r_f + \beta_b + \varepsilon_b + b)l_{rf} - (r_f + \beta_b + \varepsilon_b)l_{nrf}}{\varepsilon_s l_{nrf}}$$

In case the buyer does not require a payment period extension, this equation can be written as:

$$L_0 \geq \frac{b}{\varepsilon_s}.$$

Hence in the situation of auto-discounting, the supplier must have a certain need for external short term finance. Further the benefit from reverse factoring is negatively dependent on the payment period extension and the reverse factoring fee, however positively dependent on its own deadweight cost of capital.

Bank

The banks benefit from reverse factoring is calculated as in the situation assuming perfect capital markets, since auto-discounting is assumed, the bank is not affected by the financing needs of the supplier. The bank provides a loan of $e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$ to the supplier at time $t = 0$, and the buyer repays this loan at time $t = l_{rf}$, if he did not default.

Table 10: Cash flows for the bank from reverse factoring in imperfect capital markets

Time	0	l_{nrf}	l_{rf}	total
Cash flow	$-e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$	0	$D_{l_{rf}}^b$	
Value of the cash flow at time $t=0$	$-e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$	0	$e^{-(r_f + \beta_b)l_{rf}}$	$e^{-(r_f + \beta_b + \varepsilon_s)l_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$

$$\pi_f = e^{-(r_f + \beta_b)l_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$$

From this, the Taylor series approximation becomes:

$$\pi_f = (\varepsilon_b + b)l_{rf}$$

Supply chain

Combining the benefits from the buyer, supplier and bank gives the supply chain finance benefit from reverse factoring. This is given by:

$$\pi_{sc} = e^{-(r_f + \beta_b)l_{nrf}} + e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf} + \varepsilon_s l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$$

The Taylor series approximation of this is:

$$\pi_{sc} = (\varepsilon_b + \varepsilon_s)l_{nrf}$$

3.4. Non auto-discounting

By relaxing the assumption that all suppliers make use of auto discounting, two uncertainties arise. The moment of discounting and the amount of the total invoice that is being discounted. Here only the amount that will be discounted will be introduced in the model, only in case the short term loan that is needed by the supplier is between zero and the maximum amount available for discounting, the benefit from reverse factoring will differ from the situation in which the supplier made use of auto-discounting and had shortage of short term capital.

Assuming $0 \leq L_0 \leq e^{-(r_f + \varepsilon_b + b)l_{rf}}$.

In this situation, only the benefit from the supplier and the bank changes, the benefit from reverse factoring for the buyer, who has no shortage of short term capital stays:

$$\pi_b = e^{-(r_f + \varepsilon_b)l_{nrf}} - e^{-(r_f + \varepsilon_b)l_{rf}}$$

The benefit for the supplier becomes:

$$\pi_s = e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}} + L_0 e^{\varepsilon_s l_{nrf}} - L_0 e^{bl_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$$

The benefit for the bank becomes:

$$\pi_f = L_0 (e^{(\varepsilon_b + b)l_{rf}} - 1)$$

For banks non auto-discounting is however more risky than auto-discounting, first of all because it reduces benefit in case the supplier has no high short term capital demands or when the short term capital demand of the supplier declines over time. And second because the bank becomes dependent on the involvement of the supplier, when the supplier has low understanding of the program and its benefits, the supplier might not discount its invoices although this might be profitable. Since banks have high set up costs, they are better off by inducing auto discounting on the suppliers.

In Figure 4 the suppliers benefit from reverse factoring is show against the amount of short term capital that it needs. Under a certain amount, the benefit for the supplier is negative, this is the point where

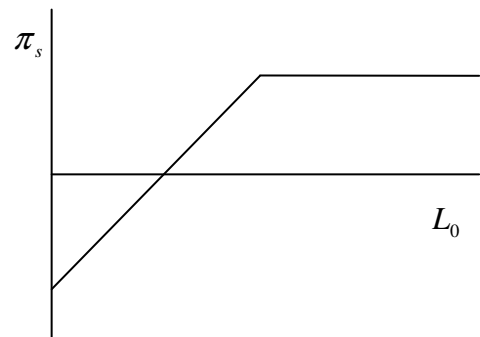


Figure 4: Suppliers benefit from reverse factoring

$$L_0 = \frac{e^{-(r_f + \beta_b + \varepsilon_b)l_{inf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}}{e^{\varepsilon_s l_{inf}} - e^{bl_{rf}}}. \text{ After a certain amount, the benefit from reverse factoring does not}$$

increase anymore, this is the amount where the full invoice is discounted, so $L_0 = e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$.

In Appendix A the effect of a stochastic short term loan of the supplier is shown.

3.5. Operational issues

In a reverse factoring program some operational issues need to be managed by the bank in order to execute the deal profitable. In this paragraph these issues will be listed, as far as they have not yet been mentioned in the introduction.

1. *High set up costs:* Banks that are targeting the retail market with their reverse factoring solution have to cope with high set up costs of the technological platform where buyers can upload there invoices. The retail market is characterized by high volume, low value invoices, for these clients manual entering these invoices on the platform is not an option. Therefore an interface needs to be build for those firms to automatically upload their invoices. Developing such a system is generally costly and hence the deal needs to be of significant size in order to be profitable. Since there are no broadly accepted international standards for invoices and e-invoicing, the system needs to be adapted for every single buyer in order to be able to communicate with the buyer's systems, and therefore those initial investments need to be made for every new buyer that is on-boarded. More interesting target industries are markets which are characterized by low volume, high value invoices, since these deals do not require a sophisticated software solution and hence do not need a high initial investment.
2. *Credit notes:* After the buyer has approved the invoice, the buyer might notice some short comings or defects in the goods that are supplied by the supplier. The buyer will subtract the costs of these goods from the total invoice amount, however, if the supplier has already discounted the whole invoice, the bank will make a loss, since the buyer does not pay the full amount, or the bank has to get funds back at the supplier, which has a low credit rating and/or does not have a client relation with the bank. For this reason, the bank and the buyer agree on a retention rate, this is a percentage of the total invoice amount that is not available for discounting. At maturity, the buyer will pay the full invoice amount minus the credit notes to the bank. What is left from the retention minus the credit notes will be transferred to the supplier, if the total credit notes are larger than the retention, the buyer has to settle these with future invoices.

3. *Buyer and supplier default:* The underlying risk of the invoice/account receivable is the buyer's risk, hence a default of the buyer would seriously affect the bank, and result in long juridical processes and/or high losses. In practice though, it turns out that also supplier default might be harmful to the bank, where the buyer will try to find a way out of paying the invoice, by par example creating a credit note as large as the invoice. Banks need to design their contracts in such a way that those credit notes are not allowed exceed a certain Percentage of the invoice value, in case the credit note exceeds this percentage, it needs to be settled with future invoices. In case of a supplier default, this would result in a loss for the buyer, but the buyer should only invite high quality suppliers in to the program, such that credit notes are not likely to exceed this percentage.
4. *Too high exposure:* Although the benefit from reverse factoring might be positive according to the model which is developed in previous paragraphs, the loss from the bank might be of such size, compared to its total assets, that a buyer default would significantly harm the bank. In situations in which the exposure to a buyer becomes too large, the bank needs to find outside investors, as other banks, to participate in the deal and share the exposure, this is called distribution. These external investors might however want to be involved for longer periods and hence reduce revenues over a longer period.
5. *Economic crisis:* The current unsecure and volatile European financial markets provide a source of potential danger to banks. What will happen? Will the Euro zone be split up in a different currency for the disciplined Northern countries, the Neuro, and the Southern countries with budget and credit issues, the Zeuro? Will Greece be kicked out of the Euro, will their borders be shut down over night for financial transactions and hence will banks not get back their funds? At this moment nobody knows and hence investing in Greece and other southern European countries brings some risks with it.

3.6. Conclusion

Table 11: Summary of benefits and participation constraints of reverse factoring for a non capital constrained buyer and a fully capital constrained supplier in imperfect capital markets. The first formula in the cell of the benefit is the real benefit, the second formula is the Taylor series approximation.

	Benefit	Participation constraint
		$\pi_i \geq 0$
Buyer	$\pi_b = e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}}$ $\pi_b = (r_f + \beta_b)(l_{rf} - l_{nrf})$	$l_{rf} \geq l_{nrf}$
Supplier	$\pi_s = e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf} + \varepsilon_s l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$ $\pi_s = (r_f + \beta_b + \varepsilon_b + \varepsilon_s)l_{nrf} - (r_f + \beta_b + \varepsilon_b + b)l_{rf}$	$\frac{l_{rf}}{l_{nrf}} \leq \frac{r_f + \beta_b + \varepsilon_b + \varepsilon_s}{r_f + \beta_b + \varepsilon_b + b}$
Bank	$\pi_f = e^{-(r_f + \beta_b)l_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$ $\pi_f = (\varepsilon_b + b)l_{rf}$	$\varepsilon_b + b \geq 0$
Supply chain	$\pi_{sc} = e^{-(r_f + \beta_b)l_{nrf}} + e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf} + \varepsilon_s l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$ $\pi_{sc} = (\varepsilon_b + \varepsilon_s)l_{nrf}$	

In Table 11 the benefits from reverse factoring are shown in a situation in which the buyer is not capital constrained and a supplier whose need for short term financing exceeds the amount of cash that can be raised by reverse factoring. From these formula's and formula's from other scenario's which are discussed in this chapter, it can be concluded that in order reverse factoring to add value in a situation of auto-discounting, the supplier needs to have (1) *higher information asymmetry with financial markets than the reverse factoring fee charged by the bank, corrected for the payment period extension* and (2) *a significant need for external short term capital*. The benefit for the supplier is larger when (1) *the initial payment period is larger*, (2) *the supplier has more information asymmetry with financial markets* (3) *when the reverse factoring fee is smaller* and (4) *when the payment period extension is smaller*.

For the buyer reverse factoring adds value when (1) *the payment period is extended*. And hence the benefit from reverse factoring for the buyer is larger when (1) *the payment period extension is larger* and (2) *the buyer's interest rate is larger*.

For the bank the benefit from reverse factoring is positive when (1) *the reverse factoring fee plus the buyer's deadweight cost of capital is positive*. The benefit for the bank is larger when (1) *the deadweight cost of capital from the buyer is larger*, (2) *the reverse factoring fee is larger* and (3) *the extended*

payment period is larger. For banks it is therefore more profitable to focus on buyers of which they have more information. This means the bank has already invested in information on this buyer and therefore information asymmetry between the bank and financial markets on this buyer is bigger, implying more value for the bank.

For the total supply chain reverse factoring is profitable when *(1) all participation constraints are met.* Total supply chain finance benefit is larger when *(1) deadweight cost of capital from both the buyer and the supplier is larger* and *(2) initial payment period is larger.* Hence reverse factoring is more profitable in industries where payment periods are larger.

4. International factors

The model developed in chapter 3 reflects a reverse factoring situation in a domestic setting. In practice the experience is that reverse factoring is much more profitable in international trade transactions. In international reverse factoring the set up does not differ significantly from the set up in domestic reverse factoring, only the inclusion of a local bank in the supplier's country is included. This local bank can be a branch of the buyer's partner bank in the program, or it can be another bank that has a local footprint. This local footprint is important so banks can leverage their local network and knowledge. A local bank is able to perform processes as on-boarding and know your client more efficient and can communicate to clients more easily. For the domestic bank this is interesting since it does not need to fulfill the supplier on-boarding and thereby including know your customer processes and for the foreign local bank this is interesting since it can take a margin of the total reverse factoring fees. The international reverse factoring set up is shown in the figure below.

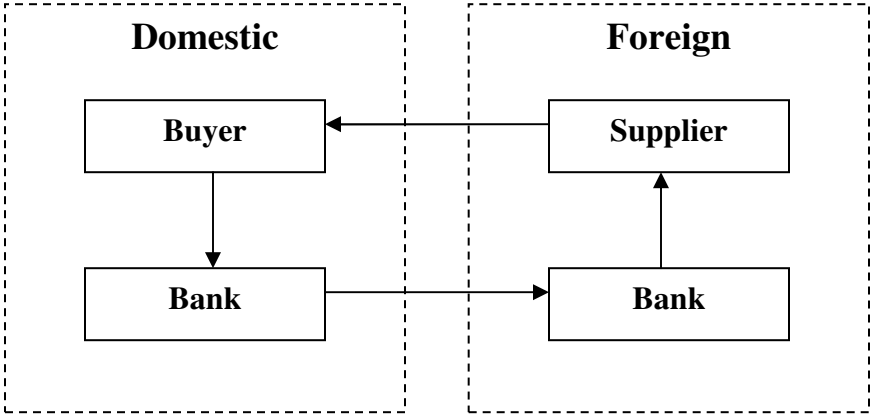


Figure 5: International reverse factoring set-up

The previous paragraph discussed set up changes between domestic and international reverse factoring and mentioned that the inclusion of a local bank in the suppliers region can result in cost advantages in the on-boarding and know your customer processes, however, still the question remains why is international reverse factoring more beneficial than domestic reverse factoring? This will be discussed by making use of the model developed in the previous chapter. In the previous chapter is concluded that the benefit from reverse factoring is positively related to the initial payment period, so the longer the initial payment period the higher the potential benefit from reverse factoring. Generally, payment periods in international trade are longer than in domestic trade and therefore international trade transactions are potentially more beneficial.

A second conclusion from Chapter 3 is that the total benefit from reverse factoring is positively related to the information asymmetry between the supplier and the market. Because of country specific and macroeconomic situations, the information asymmetry of suppliers might be larger in foreign countries than domestically. Country specific issues which contribute to increased information asymmetry are issues such as poor financial markets, no rating agencies and no financial track record of the suppliers. These issues are generally all present in developing countries, since those countries do not have well developed financial markets, firms in those countries experience credit rationing. This means that they can not or hardly not obtain credit. SME's therefore do not have credit to fund growth and are not able to withstand a financial crisis. Since those firms have no capital markets or institutions to communicate information to the market, they are charged a high deadweight cost of capital. Therefore reverse factoring accounts receivable of firms in developing countries has higher profit potential than those of firms in developed countries.

Another country specific factor that contributes to the profitability of international reverse factoring is the capital availability to the financial institutions, as currently observed in China, see the example below, where again SME's are not able to obtain credit, since banks simply do not have enough capital to finance all the demand and therefore invest in more reliable firms.

Example: Capital Constraint Banks China

Lots of SME's in China are encountering financial problems, since they are not able to obtain credit at the regular government banks. Those banks prefer to lend to large government corporations, since they like the risk profile of these firms over the risk profile of SME's. Lots of SME's have therefore switched to alternative channels, some of them illegal, where high interest rates are charged, sometimes up to 100% a year.

The Chinese government is desperate to overcome those financial issues, since SME's make up 80% of the total employment. Those SME's can currently not cope with their fiscal and credit claims and have trouble in finding credit. The Chinese government has expressed their concerns about the current situation. (Dijk, 2011)

Macro economical issues as a crisis, as in 2008/2009, result in a higher profitability of international reverse factoring, since during this crisis, banks were tightening their credit policies, resulting in increased costs of capital or firms that were not able to obtain credit at all. These firms therefore faced huge amounts of deadweight cost of capital and hence reverse factoring provides a solid working capital solution to ensure working capital stability and keep operations going.

Model

In an international reverse factoring transaction, payments are made in the same currency, usually the buyer's currency, the exchange rate risk is thus at the supplier. The bank pays the supplier in the domestic currency and the buyer at maturity pays the bank also in the same currency. However, since the supplier receives the domestic currency and operates in the foreign currency, there is some exchange rate risk. Since the buyer and the supplier do not operate in the same currency, calculating the benefit from reverse factoring is not just comparing nominal interest rates of the buyer and the supplier. To value the benefit from reverse factoring for the supplier, the interest rates have to be expressed in the same currency. Here the interest rate of the supplier will be expressed in the domestic currency, in order to do this, two new variables have to be introduced, the exchange rate between the domestic and foreign currency, FX_t , where at time t , 1 unit of the domestic currency is FX_t units of the foreign currency. The second variable that is introduced is F_T , the forward price at time $t = 0$ of the foreign currency at time T . Further it is needed to redefine the suppliers interest rate, r_s^i is the suppliers interest rate in currency i , where $i \in \{d, f\}$, respectively the domestic and foreign currency. The same definition holds for the interest rate components, ε_s^i , β_s^i and r_f^i . It is now possible to rewrite interest rates in different currencies by using the covered interest rate parity (Hull, 2009). The covered interest rate parity states that it is indifferent whether money is domestically interest bearing and then converted with a forward contract into a foreign currency or that money is converted with the spot exchange rate to a foreign currency and bears interest in that currency, in formula form this looks like:

$$e^{r_s^d T} F_T = e^{r_s^f T} FX_t$$

By rearranging those variables, it is possible to obtain the interest rate expressed in a different currency, in this case the foreign interest rate is expressed in the domestic currency.

$$r_s^d = \ln\left(\frac{e^{r_s^f T} FX_t}{F_T}\right) / T, \text{ and hence also } \varepsilon_s^d = \ln\left(\frac{e^{\varepsilon_s^f T} FX_t}{F_T}\right) / T.$$

By redefining r_s , β_s and ε_s as the supplier's interest rate, risk premium and deadweight cost of capital expressed in the domestic currency, all formulas from the model in Chapter 3 still hold. The risk free rate of the supplier does not need to be expressed in the domestic currency since the risk free rate should be the same all over the world when expressed in the same currency and hence the domestic risk free rate can be used.

5. Case study

In this case study the model from previous chapters will be put into practice. The buyer and supplier under consideration settle their payments in Euro's, 3 month's Euribor is 1.5% and the financing rates for the buyer and the supplier expressed in the domestic currency are 2.5% and 5.5% for the buyer and supplier respectively. The original payment period is 60 days, by participating in reverse factoring, this payment period is extended to 90 days. The financing rate of the buyer is composed of 0.5% risk premium and 0.5% deadweight cost of capital. The financing rate of the supplier is composed of 2% risk premium and 2% deadweight cost of capital. The reverse factoring fee charged by the bank equals 0.25% and a year is assumed to consist of 360 days. In this situation, the value of reverse factoring, where both the buyer and supplier are capital constrained, as percentage of the total invoice amount are equal to:

Buyer: 0.21%

Supplier: 0.06%

Bank: 0.19%

Supply chain: 0.46%

5.1. Sensitivity analysis

Contract development

In this paragraph the sensitivity of the reverse factoring benefits on the contract will be investigated. In the contract the reverse factoring fee and the extended payment period will be specified, in the graphs below, the sensitivity on these variables is shown.

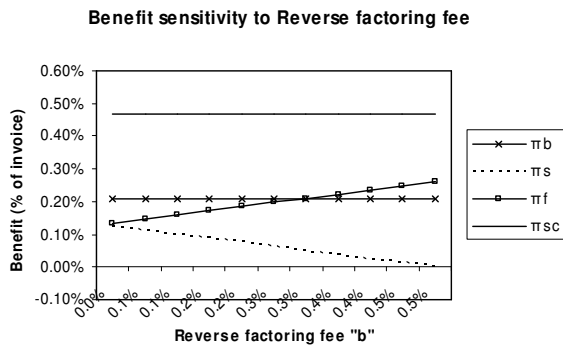


Figure 7: Benefit sensitivity to the reverse factoring fee

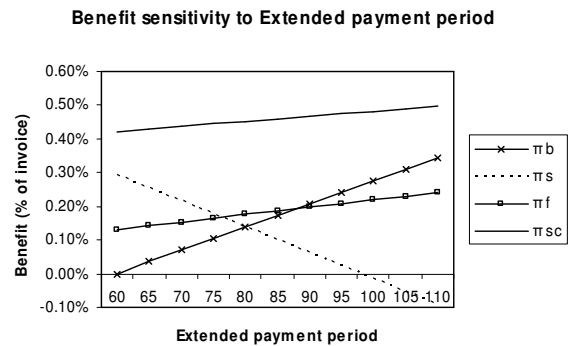


Figure 6: Benefit sensitivity to the extended payment period

From Figure 6 can be observed that the total supply chain benefit is positively related to the payment period extension, as also the benefit to the bank and the buyer. The benefit for the supplier is logically negatively related to the payment period, as also observed in the model. The supplier has the highest absolute gradient in this situation, meaning that a change in payment period has the highest effect on its benefit. The buyer has the highest positive gradient with the extended payment period, larger than the bank, since the benefit for the buyer is dependent on the risk premium and deadweight cost of capital, where the bank's benefit is only dependent on the deadweight cost of capital and the reverse factoring fee, which is smaller in this situation. Due to the high bargaining power of the bank and the buyer, they will most probably extend the payment period as much as possible, where the supplier does not make a loss. In the eventual contract, the extended payment period was fixed at 90 days, showing the bank and buyer took the largest portion of the total supply chain benefit.

In Figure 7 it can be observed that, as in the model, the buyer is not dependent on the reverse factoring fee and on the total supply chain benefit. It is a redistribution of the benefits between the buyer and the supplier, the buyer and the bank distribute the supplier's deadweight cost of capital between each other, in the eventual contract they split it evenly, both 0.25% of the total 0.5%.

Time effect

In this section the effect of changes over time will be examined after the contract is established. The extended payment period and the reverse factoring fee are already fixed, however risk premiums and deadweight costs of capital might change. In the graphs below, the effect on the value of reverse factoring due to changes in interest rates is displayed.

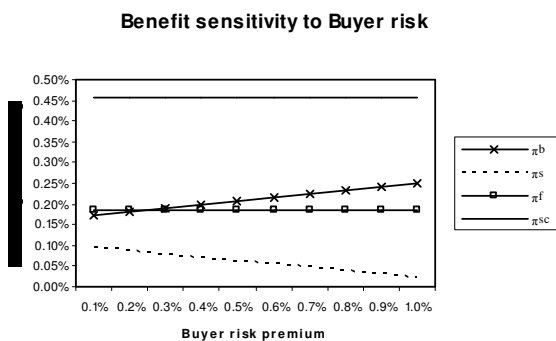


Figure 9: Benefit sensitivity to the supplier's deadweight cost of capital

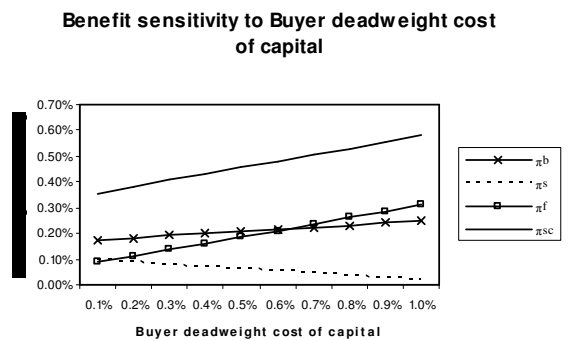


Figure 8: Benefit sensitivity to the buyer's deadweight cost of capital

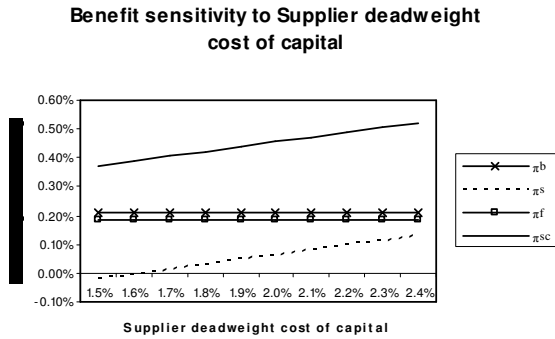


Figure 10: Benefit sensitivity to the supplier's deadweight cost of capital

Figure 9 shows again that the bank is not affected by an increase in the risk premium of the buyer, this is because the total discount rate is defined as the buyer’s interest rate plus a reverse factoring fee, hence the reverse factoring discount rate is adapted when the risk of the buyer changes. Also again it shows that as the buyer’s risk premium increases over time, the supplier’s benefit decreases, on the interval the benefit to the supplier is still positive however, once the risk premium becomes higher than 1%, the supplier should be careful in this case.

In Figure 8 it is shown that when the buyer’s deadweight cost of capital increases over time, by keeping the risk premium the same, the benefit of reverse factoring increases for the buyer and the bank and decreases for the supplier. Overall the supply chain’s benefit increases. Again, when the buyer’s deadweight cost of capital increases above 1%, the positive benefit for the supplier is in danger. Combining this result with Figure 9, the supplier’s positive benefit from reverse factoring is in danger when the total interest rate of the buyer increases above 3%.

For the supplier the benefit from reverse factoring drops when its deadweight cost of capital drops over time, as can be observed in Figure 10. Hence the supplier should be careful when its information asymmetry with financial markets is decreasing and should negotiate new terms or quite the program in time.

5.2. Cost of implementation, maintaining and operating (Confidential)

5.3. Geographical region (Confidential)

6. Supply chain finance

In the introduction it has already been mentioned that in this thesis supply chain finance is defined as by Camerinelli (2008) as the name attached to the collection of products and services that financial institutions offer to facilitate the management of the physical and information flows of a supply chain. According to Belin and Hofmann (2011) can these products/solutions be characterized by the following key elements:

- Dematerialization and automation: By removing paper from the process and automating the financial and information processes, processes and decision making can be accelerated.
- Transparency: Since information is easily available due to automation and both internal and external sources can exchange information more easily.
- Predictability: Due to an increased availability of data, the supply chain behavior can be studied more intensively and hence its behavior can be understood and predicted better.
- Control: Because of more transparency and predictability, the supply chain can be controlled better. Controls and checks can be automated and implemented in the system which improves monitoring and controlling of the supply chain.
- Collaboration: Both internal and external sources are triggered to exchange more data and collaborate, to create more trust, win-win situations and more stable relations within the supply chain.

6.1. Payment method

Within international trade, two broad payment methods can be identified (Hofmann & Belin, 2011), letters of credit (LC's) and open account (OA), where globally around 80% of all transactions are currently performed on open account (WPR, 2011). An open account transaction is based on mutual trust between the buyer and the supplier. A LC is a letter from a bank guaranteeing that, provided that the supplier shows the right (legal) documents to the bank, the bank will pay the right amount on a predetermined moment. Therefore it transfers the credit risk from the buyer to the buyer's (domestic) bank. This transaction by the bank is solely based on documentation, regardless of physical delivery, if the documentation is correct, the bank is obliged to pay. The bank will, if possible, credit the buyer. In some international transactions, the supplier is not satisfied if the buyer's domestic bank takes over the credit risk and demands a local bank to "confirm" the LC. Meaning the supplier's domestic bank, at its

turn, takes over the credit risk of the foreign bank. So where open account is based on trust, the supplier is trusting the buyer to pay the correct amount in time, a LC transaction is to overcome credit risk of the buyer. From a banks perspective, a LC is a contingent claim, when the buyer is not able to pay the supplier, the bank has to pay the supplier and hence the LC stays off balance sheet until that moment. Therefore LC's are called off balance sheet items from the bank's perspective.

6.2. SCF products

Originally finance decisions by the bank were based exclusively on financial parameters from the firm. By the automation and standardization of supply chain processes, which lead to the integration of the physical, informational and financial processes, financial institutions have broadened their traditional trade product offerings by developing financial products based on trade documentation and trade trigger points. In the case of reverse factoring, this trade document is the invoice and the trigger point is the confirmation of the invoice by the buyer. Along the trade process within a supply chain, more documents and trigger points can be identified (Camerinelli, 2008). The commonality between all different supply chain finance offerings is that they all mitigate information asymmetries one way or the other. In the remainder of this chapter will be focused on specific supply chain finance offerings: receivable finance, inventory finance and purchase order finance.

6.2.1. Receivable finance

Receivable finance can be divided in different product offerings, factoring, reverse factoring, receivable purchase and receivable securitization. Of these products, factoring and reverse factoring have already been discussed in the introduction, where it was mentioned that factoring could be both with and without recourse, factoring without recourse is also called receivable purchase.

In receivable securitization, a firm puts its account receivables in a special purpose vehicle (SPV), usually this is done by a sales agreement, which means that the firm has sold its account receivables to the SPV and hence in case of default can not be retained to settle debt obligations, in exchange for immediate cash. The account receivables form the collateral for the notes issued by the SPV. When the account receivables in the SPV are settled, the SPV is able to buy more account receivables from the firm, for this reason the notes issued by the SPV have generally a longer tenor than the account receivables itself. In this way the firm is able to get finance with the receivables as collateral. Because this SPV usually gets a higher credit rating than the firm itself, the firm can obtain credit against lower rates and costs than a normal bank loan. Another advantage from receivable securitization for the firm is that it is off-balance

sheet financing, like reverse factoring, and hence does not affect the debt capacity and credit rating of the firm (Blatt & Katz, 2008), though it does improve days sales outstanding.

6.2.2. Inventory finance

Inventory finance is a collateralized loan, backed by the inventory of a firm. Inventory is however more risky collateral than account receivables, since inventory might be perishable and lose value quickly or it might be hard to resell. To be sure about the inventory value and how this changes over time, a bank should be able to monitor the inventory closely. Two methods to control the inventory can be identified; warehouse storage and direct assignment by product serial or identification numbers (Seidman, 2004). Under warehouse storage, the inventory is stored in a (on- or off-site) warehouse, managed by a third party. Once inventory is stored in the warehouse, the firm receives a receipt, this receipt can be provided to the bank in exchange for a loan. Only with the receipt, inventory can be retrieved from the warehouse, and hence only when the firm has repaid its loan, it receives back the receipt and has access to its inventory again. The second method works in the same manner, however, than the products that are pledged are reported to the bank with their serial number. Main disadvantages of inventory finance is that it has high administrative and transactional costs and that it is on balance sheet financing, and hence it might affect credit rating and debt capacity. Lots of working capital and liquidity is tied up in inventory, causing increased risk and costing money and space, reducing inventory would free up capital but on the other side it would reduce the service level to customers. For firms that have little accounts receivable and are not in the position to obtain a regular bank loan, inventory finance is a good alternative, without losing service level to customers.

For the bank an issue of inventory finance is the residual inventory value in case the firm defaults. Banks should therefore focus on industries in which the inventory is non perishable, price stable and third party buyers can be found easily, commodities meet all those requirements. Commodities are highly liquid since they are market traded assets and value stable and hence are ideal for inventory finance.

To overcome the problem with on balance sheet financing, the firm might temporarily sell the inventory to the bank, in this case the bank however gets the invoice on its balance sheet and becomes liable for it. A solution for these problems might be, just as in receivable securitization, to create a SPV to which the firm sells its inventory. Still the inventory needs to be closely monitored by the bank, or third party warehouse manager, to assure the quality, amount and value, of the inventory. Ideally the inventory of the firm would be monitored via a third party or a direct linkage to the clients ERP system.

6.2.3. Purchase order finance

Receivable finance is a form of pre shipment finance where inventory finance and purchase order finance are forms of post shipment finance. Inventory finance is a finance solution for firms who have already invested in inventory as raw materials and finished goods, but not yet sold these. Purchase order finance goes further upstream in the supply chain cycle by already providing finance when raw materials need to be purchased, hence it is a form of pre shipment finance (Camerinelli, 2008). Though the dynamics are the same, two types of purchase order financing can be distinguished. In the first type the bank provides cash to the firm based on the purchase order, in the second type the bank provides letters of credit to the suppliers. The advantage of the second type over the first one is that it overcomes moral hazard. When cash is provided to the firm directly it can be used to finance other unsecured purchase orders (Fenmore, 1998), where by providing LC's to the suppliers the funds of the bank are used to buy raw materials for sure. Still the firm needs to have sound operations to produce and deliver the goods to the buyer. The dynamics of purchase order finance by making use of LC's are:

1. A firm gets a purchase order
2. A bank provides LC's to the suppliers of that firm
3. The firm manufactures the goods and ships those to the buyer
4. The buyer pays the invoice to the bank
5. The bank withholds the financing fees and transfers the remaining to the firm

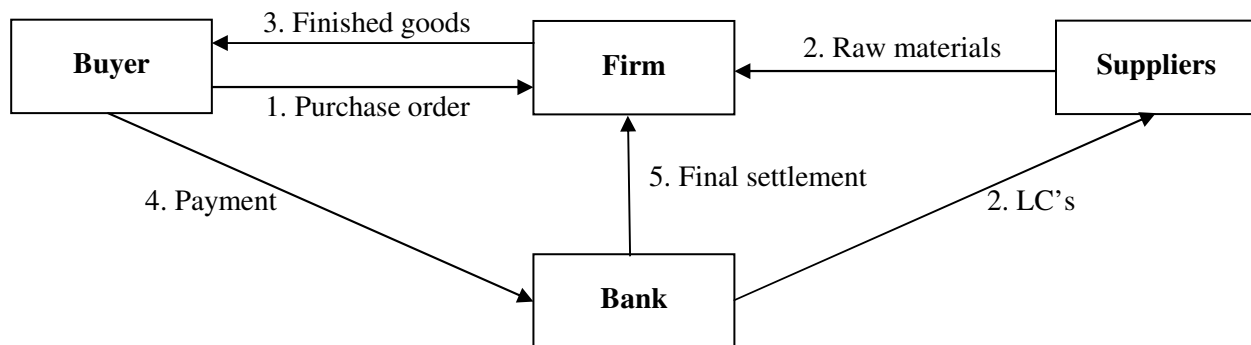


Figure 11: Purchase order finance dynamics

Since the firm is able to receive finance based on future cash flows instead of its current financial situation, the firm is able to obtain more financing and hence take on bigger purchase orders. Traditionally, banks focused on current credit standings and financial ratios of a firm to determine the

credit limits and rates. With purchase order finance, the firm is able to obtain credit based on a confirmed purchase order, even when the assets on the balance sheet do not allow the firm to take on more debt. Purchase order finance is interesting for firms which are locked out of traditional credit due to the financial crisis from the last years and the hypercompetitive market, but still have healthy operations. Further purchase order financing is mostly a non-repetitive business, firms who experience an extraordinary or peak demand can use it to finance their production cycle (Maselli, 2000). Firms that do not have the funds to purchase their raw materials or finance their production process could use it to cope with this demand. This allows suppliers to keep pace with the (unpredictable) growth of their clients (Maselli, 2000). According to King (2011) is purchase order finance a financing method for firms to grow back to their pre-crisis size. However, purchase order finance is not only an effective solution in economic down times, it allows businesses to capitalize opportunities irrespective of the economy's state. (King, 2011).

For the bank, purchase order finance is more risky than the other forms of supply chain finance discussed above (Fenmore, 2004). It entails more risk than account receivable finance, since the bank is not only dependent on the buyer paying its invoice, but also on the firms operating quality. When the firm produces low quality products, or defaults during production or even before production has started, the buyer will not pay and hence the bank will not get its funds back. The risk purchase order financing is thus determined by the probability of the buyer paying for the products and by the quality and continuity of the firms operations. Therefore banks should focus on trade relations in whom the buyer has proven to be a reliable trade party in paying its bills and where suppliers have proven to have reliable operations, in producing high quality goods, and can be expected to fulfill the order. Unless this, banks will have to invest in monitoring the supplier, to assure the supplier is investing the funds in the right purchase order and to assure the operational quality. Once products are shipped and the invoice is confirmed, the purchase order financing transfers into accounts receivable financing.

Purchase order finance has more risk than inventory finance, since in inventory finance the bank takes ownership of the inventory, or uses the inventory as collateral, which is more reliable than a purchase order. As mentioned, the exposure in purchase order finance is on both the manufacturer and the buyer, if one of these defaults the purchase order is worthless, inventory has residual value so banks can recover their funds.

7. Basel III

The Basel committee, established in 1974 by central-bank governors of ten countries, currently consists of representatives from 27 countries and is chaired by Mr. Stefan Ingves, Governor of Sveriges Riksbank, who succeeded Mr. Nout Wellink. Countries are regularly represented by their national banks and by the authority which is responsible for bank supervision where this is not the central bank. The regulations developed by the Basel committee, are not and were never intended to be legally binding to its members. It provides however, supervisory standards and guidelines to its members, who on their turn are supposed to use those standards and guidelines to develop detailed arrangements which suits the local circumstances best. “The most important objective of the Committee’s work has been to close the gap in international supervisory coverage in pursuit of two basic principles: that no foreign banking establishment should escape supervision; and that supervision should be adequate.”² To accomplish this, the committee has developed a series of documents since 1975.

The Basel regulation as we know it today, started in 1988, when the committee published Basel I, also called the Basel Capital Accord, to introduce a capital measurement system, for a consistent application of rules across international banks. This credit risk measurement framework aimed to build a general minimum capital standard of 8%, meaning that 8% of the bank’s total balance sheet should be backed by own funds in order to be flexible enough to absorb unexpected losses. Since its introduction in 1988, the framework has become the standard in not only member, but also in non member countries with international banks. In 1999, the Basel committee, published the revised Capital Adequacy Framework, known as Basel II. This framework allowed banks to measure risk more granularly by applying relevant probability of default rates and recovery rates on collateral, so that banks could price in risk more accurately. The framework consists of three important pillars; minimum capital requirements, supervisory review of an institution’s internal assessment process and capital adequacy, and effective use of disclosure to strengthen market discipline as a complement to supervisory efforts.² In 2004, the committee published the final version of Basel II, where this could be a basis for national regulators to implement new banking regulations. Under Basel II, banks could choose between different implementation approaches, dependent on the level of resources devoted to risk management. Advanced Internal Ratings-Based approach (AIRB) is expected of international operating banks, where banks with limited resources are expected to use standardised and Foundation Internal Ratings-Based approaches (FIRB).

The financial crisis of 2008 has exposed vulnerabilities and shortcomings in the Basel I and II banking regulations. Although Basel II was, via increased transparency, designed to effective operation of market

² <http://www.bis.org/bcbs/history.htm>

forces while at the same time ensuring proportional costs of regulation to the risks banks were running , banks failed on both however (Ashby, 2011):

- Certain banks, so called shadow banks, virtual banking organizations created as vehicles to hold a range of financial securities, did not fall under the Basel II disclosure regulation. Under these securities belong the collateralized debt obligations (CDO's), the securitized mortgage packages that were bundled and sold, and rebundled again until visibility and risk were too hard to assess. Since these banks did not fall under the Basel II regulation, some banks used them to escape from the regulation, whereby visibility dropped even further.
- Basel II did little to improve banks risk management, or may even have worsen it, since banks developed their own risk models in such a way that they helped reduce their regulatory liabilities and banks lost sight in the risk accumulating on their balance sheet.

In reaction to the 2008 financial crisis, the Basel committee issued the new banking regulations called Basel III in December 2010, this new regulation is based on the lessons learned from the financial crisis where capital appeared not loss absorbing, liquidity management failed, banks held excessive leverage and inadequate risk management (World Payments Report, 2011)(Basel III,2011). The new regulation is developed to improve banks resilience to shocks arising from economic and financial stress, whatever the source³, by improving risk management and governance and strengthen banks' transparency and disclosure, called the three pillars of Basel III. Basel III moves from a uni-dimensional approach, Basel I and II banking regulation only focused on capital requirements, to a multi-dimensional approach, where the regulation focuses on three measures, capital, liquidity and leverage ratio's³:

1. Capital requirements

To ensure banks keep enough capital to back their exposure, the Basel committee has increased capital requirements. Capital is divided in 2 categories in Basel III, Tier 1 and Tier 2 capital, where Tier 1 capital is the most secure capital. The objective of Tier 1 capital is to provide loss absorption on a going concern basis and consists of Common Equity Tier 1 (CET1), capital such as common share issued by the bank, retained earnings and other CET1 qualifiable capital, this capital is currently also being referred at as the core tier 1 capital. And Additional Tier 1 capital that is not included in CET1. The objective of Tier 2

³ <http://www.bis.org/publ/bcbs189.pdf>

capital is to provide loss absorption on a gone concern basis, and consists of items such as undisclosed reserves, revaluation reserves, general provisions, hybrid instruments⁴ and subordinated term debt⁵.

The capital ratio's are calculated as capital to Risk Weighted Assets (RWA), and set at a minimum of: CET1 ratio of 4.5%, total Tier 1 Capital ratio of 6% and total Capital ratio (Tier 1 + Tier 2) of 8%⁶.

On top of these ratio's, the committee introduces two buffers, the capital conservation buffer and countercyclical buffer. The capital conservation buffer is introduced for banks to build up capital in times of economic growth, where this buffer can be used in times of stress. When the buffer is below 2.5% of CET1, the bank will be restricted in its distribution of earnings proportional to the shortage.

Where the conservation buffer is used to build up and withdraw cash on a micro level basis, so when the bank is in up or down time, is the countercyclical buffer used to be resilient over the macro economic cycle. The countercyclical buffer is determined by the national authority and will differ between 0 and 2.5% and must be composed of CET1 or other fully loss absorbing capital. For international operating banks, the countercyclical buffer will be a weighted average over its exposures in all regions it is operating. In Appendix D a summary of the total capital requirements can be found.⁷

2. Liquidity ratio's

The first ratio the committee developed is the Liquidity Coverage Ratio (LCR). This ratio should promote short-term resilience of a bank's liquidity risk profile by ensuring that the bank has sufficient high quality liquid assets to survive an acute 30 day lasting stress scenario.

The second ratio is the Net Stable Funding Ratio (NSFR). This ratio promotes the long-term resilience of a bank's liquidity risk profile by ensuring banks are matching long term obligations with long term funding. The NSFR aims to limit over-reliance on short-term wholesale funding during times of buoyant market liquidity and encourage better assessment of liquidity risk in both on- and off-balance sheet items.

⁴ Note: A form of hybrid capital, called contingent capital or contingent convertible bonds (CoCo's) may since only recent belong to Tier 1 capital. On a recent Euro crisis meeting, G20 leaders have agreed to count these CoCo's, under specific conditions, as Tier 1 capital since this may help banks to increase their capital requirement to 9% (Willems, 2011)(Horde, 2011).

⁵ http://en.wikipedia.org/wiki/Capital_requirement

⁶ Percentages are as of in June 2011 Basel III review. Recent Euro crisis meeting (Okt. 2011) the capital requirement has increased from 8 to 9% (Jenkins, 2011).

⁷ These capital requirements are not the same for all banks, Basel III introduces different minimum capital requirements for different banks, where so called Systematically Important Banks (SIBs), banks with significant international coverage, will be imposed higher minimum capital requirements than smaller banks.

3. Leverage ratio

One of the features of the financial crisis was the buildup of on- and off-balance sheet leverage, while still producing good capital ratios. The leverage ratio is a simple, transparent, non-risk based ratio that is calibrated to act as a credible supplementary measure to the risk based capital requirements and is the ratio between the tier 1 capital and exposure. The initial tier 1 leverage ratio test level is 3% where it is not intended to be a binding constraint in the current market for most banks. In this ratio, the exposure measure does not make any difference between on- and off-balance sheet items since off balance sheet are a potential source of significant leverage and are therefore counted for 100% instead of with a credit conversion factor (CCF). A CCF reflects the likelihood of an off-balance sheet position becoming an on-balance sheet item, and is used in calculating the risk weighted assets.

7.1. Impact on supply chain finance

The biggest impact at overall banks will probably come from the LCR, early studies from the Clearing House in the US have indicated that the top 10 US banks will need an additional \$1.1 trillion US Government bonds, which was about 60% of the outstanding US T-bills in June 2010, since this is assumed to be the most secure and liquid asset. However, this will require banks to take on more sovereign risk, as currently with Greece and Italy, the impact of this increased demand on market liquidity and pricing of government bonds is yet unknown.

Another issue of Basel III, which is not particularly affecting the supply chain finance market, but the whole banking system, is differences in geographical implementations of the guidelines. Basel III delegates the implementation to national authorities, for traditional trade finance products this is probably going be the European Banking Authority (EBA) for setting the LCR and NSFR. Therefore supply chain finance could be skewed towards countries in which lower requirements are set. A further issue is the timing of the implementation of the Basel III guidelines, where banks in regions with later implementations will be favored. Another issue of Basel III is that it only affects banks, other non-bank financial institutions are not subject to Basel III and hence have a benefit over banks providing supply chain finance.

Further Basel III regards import/export loans as every other credit or regular bank loan. The Committee seems to have overlooked the fact that regularly those loans are collateralized by the products that are being shipped and hence provide a higher security to the bank than a regular bank loan. Therefore those loans are charged with higher capital requirements and costs than their risk demands (Spinardi, 2011).

In the “Global Risks – Trade Finance” report published by the ICC Banking Commission (2011) nine international operating banks have pooled together information on their trade finance transactions, default rates, tenors, recovery rates, loss given default. Though trade finance is treated as every other asset in Basel III, the main conclusion of the report is that default probability is minimal, even during the economic crisis (fewer than 3,000 defaults on 11.4 mln transactions over 2005-2010). Off-balance sheet financing has an even lower default probability (947 defaults on 5.2 mln transactions). During the crisis losses also appeared to be minimal (500 losses over more than 7.5 mln transactions). Off-balance sheet assets do not convert to on-balance sheet items when paid, since banks immediately reimburse themselves to their clients and are usually heavily collateralized.

7.1.1. Impact on reverse factoring

In general, reverse factoring will not be impacted differently than other assets on the banks balance sheet. Capital requirements have risen over all assets, therefore also for reverse factoring, which makes it more costly for banks to offer reverse factoring, however, since all on balance sheet items are impacted the same, this is not expected to influence reverse factoring demand differently than other on balance sheet supply chain finance products.

More of an issue is the risk which is associated with reverse factoring and the seniority of a trade claim in case the buyer defaults, who has a higher seniority, a suppliers claim, or a banks claim? In Dutch law, in case of default, all claimholders are in principle equal, *paritas creditorum*, and receive a proportional part of the revenue from liquidating the firm, however the government distinguishes between three claim holder categories in which this principle is executed. When all claims in one category are settled, the next category is paid. The three categories are⁸: (1) Preferred claimholders (2) Unsecured claimholders (3) Subordinated claimholders.

However, before those claimholder’s claims will be settled, the costs of default will be paid, these are costs incurred during the default procedure as taxation of the residual value, salaries, rent etc. After these claims are settled, the preferred claim holders get paid, these are employees who are still entitled to receive overdue salary, the UWV (Dutch employee insurance provider) and the Government tax authority. When all debt obligations to preferred claim holders are fully repaid, it’s the unsecured claim holders their turn to get paid in total or partially depending on the residual value of the firm. Unsecured claim holders are suppliers who supplied goods or services but do not have insurance or collateral on those claims, these claimholders can be both corporations and financial institutions. When all claims of

⁸ [http://nl.wikipedia.org/wiki/Faillissement_\(Nederland\)](http://nl.wikipedia.org/wiki/Faillissement_(Nederland))

the preferred and unsecured claim holders are settled, the subordinated claim holders get paid. If by then, there is still value left, this is returned to the equity holders.

As this Dutch bankruptcy law suggests, reverse factoring assets (accounts receivable) are treated the same normal bank loans to the buyer and therefore are assigned the same risk weighting in calculating the RWA. In practice however, it seems that a buyer is more likely to default on a regular bank loan than on a trade claim to its suppliers, since paying the supplier guarantees business continuity, where debt can be restructured more easily. Therefore reverse factoring assets should actually be treated as having lower risk than a regular bank loan. However banks are lacking a proper database on reverse factoring transactions with default and recovery rates to back up this experience and therefore are unable to change regulations.

7.1.2. Impact on off balance sheet supply chain finance

Where the impact on on-balance sheet items, as reverse factoring, will mainly be the impact of higher capital requirements and thereby higher costs, will the impact on off-balance sheet trade finance products be more rigorously, for those interested in the Basel III regulations on off-balance sheet finance, this can be found in Appendix C.

7.2. Conclusion

At this stage, it is not possible to determine exactly how Basel III will impact supply chain finance on product level. Most probably it will cause banks product portfolio to change, by removing products that are impacted the heaviest and developing products that fit the new legislation better. As costs of the whole portfolio of supply chain finance products will increase, banks will need to review their pricing and the influence of price changes on demand. Further banks need to assure their market share and competitive position compared to non-bank supply chain finance providers, since these are not subject to Basel III and therefore have lower capital costs.

8. Future of supply chain finance

Recent months the global economical outlook has worsened significantly. After optimism earlier this year, due to positive signals at the end of 2010 about recovery from the financial crisis, risks and uncertainties have increased during the last months. Global activity slowdown, unbalanced economic performance over countries, increasing debt and financial volatility, high unemployment rates in many countries and confidence in the economy has decreased sharply. The measures taken by Governments so far have not been able to calm down financial markets and restore confidence.

During recent months, global trade has grown less rapid as expected. Developed economies have been hit problems in the range from shrinking demand, the consequences of natural disasters, the sovereign debt crisis, national budgetary issues and credit conditions. Growth in developing countries has also been negatively influenced by global developments, as signs of overheating in major emerging markets show. Because of these signs, the expected 2011 global growth expectations have been revised from 6.5% to 5.8%, where developed countries see their export grow by 3.7% and developing countries by 8.5%. (World trade organization, 2011)⁹

Currently traditional trade instruments as letters of credit are losing popularity, about 80% of global trade is done on open account. Though in times of crisis firms tend to step back to safer traditional instruments sooner, the trend towards open account is expected to persist, however at a lower rate than before.

The world payments report (2011) states that coming years standardization initiatives continue to improve efficiency, streamline processes and reduce costs. It also provides new opportunities for banks in terms of new product offerings, for example supply chain finance offerings. However it also implies that some payment instruments and/or aspects of the value chain are becoming commoditized in the process. For example the introduction of SEPA, Single European Payments Area, has removed all transaction fees on cross border payments within Europe. Such developments make it for banks more difficult to differentiate themselves in the global transaction services market. A development that offers new opportunities to banks is the SWIFT TSU, Tread Service Utility, the respond from SWIFT of the trend towards open account trade. *“The TSU is a centralized matching and workflow engine providing timely and accurate comparison of data taken from underlying corporate purchase agreements and related documents, such as commercial invoices, transport, insurance”*¹⁰. SWIFT is mainly used for exchange of documents between banks, new in the SWIFT TSU is the BPO, Bank Payment Obligation, an irrevocable conditional obligation from one bank to pay another bank, subject to the presentation of compliant data in the TSU

⁹ http://www.wto.org/english/news_e/news11_e/WTTPROV14.doc

¹⁰ http://www.swift.com/products/trade_services_utility

and the notice of intent to pay, which is a message that one's company intends to pay another company. These two new features offer new possibilities for banks to build new product offering as pre-shipment, post-shipment, and reverse factoring.

Where financial markets showed reluctance towards CDO's and securitized products in the aftermath of the previous financial crisis, banks see demand for those products increase again. Therefore the demand for securitization of accounts receivable is expected to increase again as well, be it on a firm specific basis. Reluctance towards off-balance sheet structures will remain and hence only firm specific solutions will show growth, like other supply chain finance solutions.

In a recently published research report by Demica (2011)¹¹, Demica discusses the future growth prospects for supply chain finance based on a survey amongst the top 40 European banks. Despite the economic conditions in Europe, these banks believe that growth perspectives for SCF remain strong, though growth prospects have reduced slightly since last year.

Respondents also anticipate annual SCF growth rates between 10% to 30% per annum in mature markets, and 20-25% in emerging markets, where the need for working capital finance is even bigger in order to cope with rapid expansion. SCF growth will primarily driven by developed countries markets such as Europe and the US, along with larger emerging economies such as China and India.

8.1. Impact of current financial circumstances

Respondents to the Demica research report (2011) noted that the financial crisis during 2008/2009, followed by slow economic recovery and the spread of the sovereign debt crisis across the Eurozone and globally, has given optimizing liquidity and working capital the highest priority within companies. In times of worsening financial positions, firms tend to extend their payment periods to their suppliers. The financial position of these suppliers is than impacted double as hard, by deteriorating demand and increased days sales outstanding. Further banks tend to increase credit rationing, making it even harder for those suppliers to obtain financing. In these situations supply chain finance provides the solution to solve all those issues (Cavenaghi, 2011).

Though demand for supply chain finance increases in times of crisis, bank's policies might be contrary to this development. When banks become capital constrained during a financial crisis, they need to free up capital and therefore remove assets from their balance sheet (especially now with the increased capital

¹¹ http://www.demica.com/images/PDFs/international_links.pdf

requirements by Basel III and local authorities). However, long term assets are hard to liquidate, so the most conventional way to free up capital in the short term is done by cutting assets on short term self liquidating products, as supply chain finance. As in previous sections of this thesis has been proven, SCF is more profitable than normal bank loans, apart from expensive IT developments, and hence should get devoted more assets instead of less. Banks therefore become in a split in which a tradeoff has to be made between freeing up capital to comply with the capital requirements, or invest more money in supply chain finance since demand for this type of finance is rising. Due to the increasing demand and standardization of IT solutions, fixed costs can be covered by more deals. In crisis time the capital requirements are regarded more important by banks, budget on supply chain finance will be cut on the short term. However it is expected that on the long term banks will devote relatively more assets to supply chain finance. First of all because in times of crisis banks realize the steadiness of the transaction services, defer from the risky investment banking and are willing to invest more in the transaction services. Secondly because capital can be freed up on long term obligations and invested in the short term, self-liquidating supply chain finance.

8.2. Target markets & industries

Although the growing importance of domestic SCF facilities, banks expect that reverse factoring solutions will take a next step as corporates and banks are increasingly interested in extending this success into global programs (Cavenaghi, 2011). It has already been mentioned that in Demica's research report (2011) banks identify developed markets as Europe and US as well as large developing markets as China and India as their target markets. Regarding the conclusions drawn from the model which has been developed in this thesis, it can be concluded that banks should target their reverse factoring programs on markets where they have low information asymmetries with their clients, and on clients that have suppliers with high information asymmetries. In general these are, as banks target, the more developed economies or large developing economies where credit rationing is high.

The motivation to adopt a supply chain finance program differs across developed and developing countries. In developed countries firms adopt such programs mainly in order to (1) *optimizing working capital* and (2) *minimizing supply chain risk*. In developing countries supply chain finance programs are adopted mainly in order to (1) *get access to liquidity* and (2) *enable suppliers to keep pace with buyers' growth*. (Demica, 2011) Hence banks should approach the buyer and suppliers in the reverse factoring program differently, by putting more emphasis on the benefits mentioned above.

Industries that are regarded the heaviest users of SCF are retail, consumer goods, manufacturing, automotive, engineering and machinery industry. For the future the chemical, pharmaceutical and telecom industries are believed to have further growth potential of SCF. From the model it appeared that for reverse factoring, the benefit for the supply chain is larger when the initial payment period is larger. In Table 12 the top five longest days sales outstanding are shown.

Table 12: Top five longest days sales outstanding.

Industries are based on the 48 Fama French industry groups based on SIC, excluding financial industries such as banking, insurance, real estate, and trading companies¹². Not enough data is available on aerospace and defense, business services, business suppliers, coal, environmental control, measuring and control equipment, personal services and tobacco. DSO, DPO and DII are averages in Europe.

Industry	Days Sales Outstanding	Days Payables Outstanding	Days In Inventory
Computer Software	88	67	54
Machinery	82	47	87
Medical Equipment	77	60	132
Printing and Publishing	74	59	40
Computer Hardware	71	59	31

Based on this table, the industry with the longest days sales outstanding would provide the most profit potential, in Europe, by reverse factoring, so computer software. However, as discussed, the profit potential of international reverse factoring is larger than domestically. The buyer should still be located in Europe, but the supplier should be located in for example Asia. It is therefore better to look at the payment term European buyers have to their Asian suppliers, and therefore European industries with high days payables outstanding are of interest. In Table 13 it is shown that Biotechnology and pharmaceuticals have the longest days payables outstanding on average in Europe, though it has to be noted that all industries are quite close.

¹² <http://workingcapital.booz.com/>

Table 13: Top five longest days payables outstanding.

Industries are based on the 48 Fama French industry groups based on SIC, excluding financial industries such as banking, insurance, real estate, and trading companies¹². Not enough data is available on aerospace and defense, business services, business suppliers, coal, environmental control, measuring and control equipment, personal services and tobacco. DSO, DPO and DII are averages in Europe.

Industry	Days Sales Outstanding	Days Payables Outstanding	Days In Inventory
Biotechnology and pharmaceutical products	68	78	137
Apparel	50	76	157
Computer Software	88	67	54
Electrical equipment	62	64	83
Consumer goods	64	63	89

Higher differences can be found in days in inventory, inventory finance has most potential in the home builders industry, where average days in inventory are 453 days. The complete list of working capital measures per industries in Europe can be found in Appendix E.

8.3. Challenges & Opportunities

In practice lots of different definitions of supply chain finance exist. Banks or other financial institutions refer with supply chain finance normally to reverse factoring. Corporates regularly place supply chain finance on a broader spectrum, including all trade related financing solutions. Banks already offer a lot of products that support the entire customers supply chain, from pre shipment finance to post shipment finance, but do however not define it as being supply chain finance. The reason for this is the traditional product based silo structuring of bank's internal organization. This structure prevents banks from selling combined product offerings and cross selling of different products (Sylverberg, Albrektsson, 2011)

Banks are structured this way since it offers economies of scale in the back office, however this structure has translated into the sales force and hence products are only offered separately and clients have many different contacts within the bank. By offering SCF services instead of individual products, banks can support a client's supply chain end to end. According to Sylverberg & Albrektsson (2011) should banks be able to answer a clients question as: "If I need 10 million for a month to bridge my liquidity, what are my options?" The bank should then be able to propose different alternatives to the client as: "You can discount your four Chinese export LCs, increase your factoring to 75% or use your overdraft facility". To be able to offer such solutions banks should consolidate their sales force and change their KPI to support complete SCF services.

To support such services, banks should have the right technological platforms in place. Bank's digital channels are also developed upon the product silo's and therefore clients have several logins and interfaces with their banks. According to Sylverberg & Albrektsson (2011) banks could build an additional application on top of their current applications with a modular structure, which makes it easy to offer different products, or develop new services based on the old products. However they mention that technology is not a restrictive factor in developing those consolidated offerings, banks should make advantage of systems that are already in place. On IT solutions Camerinelli (2011) states that a bank's business is to manage money and not IT, although they need to keep pace with market trends and developments on the technology side. He also mentions a trend towards IT solutions which provide clients access to all products and their own financial status in one overview. Corporate clients are demanding standard IT solutions that can operate with third party software solutions and provide finance from multiple banks. Banks that have already invested in proprietary SCF IT solutions are expected to maintain their own systems and invest in new enables for collaboration and multi-bank connectivity. Banks that do not yet have a fully integrated supply chain finance service will adopt SCF IT solutions provided by specialized third party vendors. (Camerineli, 2011)

For the supply chain finance market to move to the next phase, more uniformity and standardization is needed. Uniformity in understanding and definition of SCF within the market and standardization in IT solutions, without a consensus on the meaning of SCF term, collaboration between banking institutions might prove difficult (Demica, 2011). Currently all solutions need to be tailored to every single customer, once for example e-invoicing would be accepted and implemented on a large scale, a large reverse factoring market would open up.

In Demica's research report (2011) responding banks indicate that next to the implementation of the program and technological issues, legal and jurisdictional issues is one of the top concerns banks face.

9. Conclusions & Future research

9.1. Conclusions

In this thesis a model has been proposed to value reverse factoring for the buyer, supplier and bank, in both domestic and international settings. It has been proven that, as theory already suggested, reverse factoring does not add value to the supply chain in perfect capital markets. In perfect capital markets it might only cause a redistribution of income. However, since always one of the three participants will make a loss by changing the payment period or introducing a reverse factoring fee, the trade terms will remain the same and hence nobody will make a profit.

By introducing information asymmetries into the model, it has been proven that, under the right contract, all three participants are able to make a profit. Based on the developed model, the following conclusions on the profitability can be drawn:

Supplier - In order for reverse factoring to add value, the supplier needs to have; *(1) higher information asymmetry with financial markets than the reverse factoring fee charged by the bank, corrected for the payment period extension and (2) a significant need for external short term capital.* The benefit for the supplier is larger when *(1) the initial payment period is larger, (2) the supplier has more information asymmetry with financial markets, (3) when the reverse factoring fee is smaller and (4) when the payment period extension is smaller.*

Buyer - For the buyer reverse factoring adds value when *(1) the payment period is extended.* And hence the benefit from reverse factoring for the buyer is larger when *(1) the payment period extension is larger and (2) the buyer's interest rate is larger (independent of composition between risk premium and deadweight cost of capital).*

Bank - For the bank the benefit from reverse factoring is positive when *(1) the reverse factoring fee plus the buyer's deadweight cost of capital is positive.* The benefit for the bank is larger when *(1) the deadweight cost of capital from the buyer is larger, (2) the reverse factoring fee is larger and (3) the extended payment period is larger.* For banks it is therefore more profitable to focus on buyers of which they have more information. This means the bank has already invested in information on this buyer and therefore information asymmetry between the bank and financial markets on this buyer is bigger, implying more value for the bank.

Supply chain - For the total supply chain reverse factoring is value adding when *(1) all participation constraints are met.* Total supply chain finance benefit is larger when *(1) deadweight cost of capital from*

both the buyer and the supplier is larger and (2) initial payment period is larger. Hence reverse factoring adds more value in industries where payment periods are larger.

By extending the frame work from domestic reverse factoring to international reverse factoring, it has been proven that in international setting the potential added value is much bigger. This is because internationally differences between information asymmetry and credit rationing are much bigger.

From the sensitivity analysis performed on a real business case within RBS, it appeared that over time, the value of the program for the supplier can become negative. Therefore the supplier should ensure the contract has enough safety margin for the interest rate of the buyer to fluctuate. Further the supplier should monitor the program and quite the program or renegotiate the terms once the program does not add value anymore.

For the bank some operational issues were identified as well, though not from the model's perspective. For banks, important operational issues are, credit notes, buyer and supplier default, too high exposure, economic crisis, high set up cost and Basel III regulation. High set up costs come from the IT development needed to build an automated interface between the buyer and the bank. Though Basel III does not impact reverse factoring differently than other on-balance sheet assets, it appears in practice that the risk of a trade claim is lower than that on a regular bank loan.

Despite the upcoming economic crisis in Europe, supply chain finance is expected to grow by 10% to 30 in developed countries and 20% to 25% in developing countries. This growth will primarily be driven by developed regions such as the USA and Europe and the larger emerging markets as China and India. Target industries for reverse factoring in those countries are currently retail, consumer goods, manufacturing, automotive, engineering and machinery industry. For the future the chemical, pharmaceutical and telecom industries are believed to have further growth potential.

In order for supply chain finance to take the next step some conditions have to be met. *(1) Market consensus, (2) Standardization and (3) Organizational changes within banks.* Within the supply chain market, different definitions of supply chain finance exist. Mostly supply chain finance is used as synonym for reverse factoring, while by others it is used as a collective noun for all financial products supporting the end to end supply chain. In order for banks and other players in this market to move to the next stage en answer a growing demand for web-based multi-bank solutions, banks should agree on those definitions. Further standardization is needed in order to make supply chain finance offerings available for a wider public. Currently SCF programs need high development investments, these can only be compensated by onboarding large clients. Once products and IT become more standardized these

offerings will also become available to the SME market. Finally banks need to change their internal structure from a product based silo structure to a holistic structure that is able to bundle different financial products and support the end to end supply chain.

9.2. Future research & Recommendations

The model that is developed in this thesis is a single period model, in which it is assumed that the invoice is discounted immediately and that the total invoice amount is known upfront. Though in reality, a reverse factoring program is established for multiple years and hence future interest rates and invoice amounts are unknown. To investigate the effect of variable interest rate the sensitivity analysis is performed in Chapter 5, though more research is needed on this topic. It is expected by practitioners that the short term interest rates normally do not tend to fluctuate much and hence the value of the program is quite stable over several years. However this feeling needs to be confirmed by future research.

Next to interest rate also the future invoice amount is uncertain. Though the impact of stochastic need for short term financing is investigated in Appendix A and by (Reindorp & Tanrisever, 2011), more research is needed on improving current forecasting models. Especially for banks this is important since they need to make high initial investments in the program to build the IT platform. In Chapter 5.2. the costs of the program are estimated and it has been shown that a considerable amount of invoices need to be discounted to outweigh those costs.

The method to estimate those costs should also be refined by RBS. For this analysis the input of Trade Advisors, who estimated the time that people spend on several activities, is used. To make a better estimate of these costs, more input on these handling times is needed. This can be done by diving deeper into the process and go to the people actually performing the activities, though Trade Advisors are involved in most activities and have a pretty good overall view of the process there might exist some misconceptions leading to erroneous estimates of program costs.

Though in this thesis the Basel III regulation has been addressed, it is yet too early to provide the impact on a product level. Will due to increased cost and capital requirements product offering skew to specific products? At this moment it is expected that all on-balance sheet items will be impacted the same, though this should be investigated more thoroughly when the regulation be rolled out and implemented by banks. Overall banks need to reassess the pricing of their product portfolio and assure their market share and competitive position compared to non-bank SCF providers, since these are not impacted by Basel III.

Although academic publications on reverse factoring are lacking behind on the more pragmatic literature, the entire field of reverse factoring has been explored quite well. In order to allow banks and other players in the supply chain finance market to take a holistic approach to SCF and offer end to end solutions to support the entire supply chain, more research should be done on both individual SCF products and holistic SCF solutions. In this thesis inventory finance, purchase order finance, receivable securitization and the bank payment obligation are already addressed briefly, more research is needed.

Bibliography

- Albrektsson, M., & Sylverberg, M. (2011, August 30). Supply Chain Finance Opportunities and Challenges: From a Bank's Perspective. *gtnews* .
- Allen & Overy. (2008). *Regulatory Capital, Allen & Overy Briefing Paper No. 4, Internal Ratings Based Approach to Credit Risk In The Bnking Book*. Allen & Overy.
- Ashby, S. (2011, October 3). The Basel III changes and global bank reform. *Financial Times* .
- Bank for international settlements. (sd). *History of the Basel Committee and its Membership*. Opgeroepen op 2011, van <http://www.bis.org/bcbs/history.htm>
- Basel Committee on Bankin Supervision. (December 2010 (rev June 2011)). *Basel III: a global regulatory framework for more resilient banks and banking systems*. Basel: Bank for International Settlements.
- Basel Committee on Bankin Supervision. (2011). *Treatment of trade finance under the Basel capital framework*. Basel: Bank for International Settlement.
- Berk, J., & DeMarzo, P. (2007). *Corporate Finance* (International Edition ed.). Pearson.
- Blatt, J., & Katz, A. (2008). Funding through the Use of Trade Receivable Securitizations. In F. Fabozzi, *Handbook of Finance* (pp. 779-788). John Wiley & Sons, Inc.
- Booz & Co. (sd). *Working Capital Profiler*. Opgeroepen op December 2011, van <http://workingcapital.booz.com>
- Camerinelli, E. (2009). Supply chain finance. *Journal of Payments Strategy & Systems* , 3 (2), 114-128.
- Camerinelli, E. (2011). *Supply Chain Finance IT Solution Providers*. Aite.
- Capgemini, The Royal Bank of Scotland, Efma. (2011). *World Payments Report 2011*.
- Cavenaghi, E. (2011, August 30). Supply Chain Finance: A Tool for Manageing Suppliers' Counterparty Risk. *gtnes* .
- Cavenaghi, E. (2011, July 12). the Evolution of Supply Chain Finance: Multi-domestic Solutions. *gtnes* .
- Croft, J. (2007, January 30). Supply chain finance utilised to save money financial services. *Financial Times* , p. 18.
- DEMICA. (2011). *International Links? DEMICA*.
- Dijk, B. v. (2011, October 13). Schuldencrisis bij Chinees midden- en kleinbedrijf. *Het Financieel Dagblad* .
-

- Dun & Bradstreet. (2011, Augustus 29). *Nederlandse bedrijven betalen rekeningen sneller dan andere EU-Landen*. Opgeroepen op January 17, 2012, van Dun & Bradstreet: <http://www.dnb-nederland.nl/index.php?pageID=21&messageID=22>
- EOS. (2011). *EOS Ten Nations Survey 2011 'European Payment Practices'*. EOS.
- Fenmore, E. (1998). Purchase-order financing. *The Secured Lender* .
- Fenmore, E. (2004). Making Purchase-Order Financing Work for You. *The Secured Lender* , 20-24.
- Hofmann, E. (2005). *Supply Chain Finance: some conceptual insights*. St. Gallen: Univesität St. Gallen.
- Hofmann, E., & Belin, O. (2011). *Supply Chain Finance Solutions*. Heidelberg: Springer.
- Horde, C. d. (2011, November 2). Bufferobligatie krijgt nieuwe kans dankzij uitkomst Europese top. *Het Financieel Dagblad* .
- Hull, J. C. (2009). *Options, Futures, and other Derivatives*. Pearson.
- Hurtrez, N. (2010). *Supply chain finance: From myth to reality*. McKinsey on Payments. McKinsey.
- ICC Banking Commission. (2011). *Global Risks - Trade Finance 2011*. International Chamber of Commerce.
- Jenkins, P. (2011, October 11). Europe's banks face 9% capital rule. *The Financial Times* .
- King, E. (2011). Growth in a Down Market: Purchase Order Finance Grows Companies. *The Secured Lender* , 32-34.
- Klapper, L. (2006). The role of factoring for financing small and medium enterprises. *Journal of Banking & Finance* , 3111-3130.
- Maselli, J. (2000). Using purchase order financing to complement senior lending. *Commercial Lending Review* .
- Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review* , 261-297.
- Pfohl, H.-C., & Gomm, M. (2009). Supply chain finance: optimizing financial flows in supply chains. *Logistics research* , 149-161.
- Reindorp, M., & Tanrisever, F. (2011). Value of Reverse factoring in Multi - stage Supply Chains (Working paper).
- Seidman. (2004). Working capital finance. In Seidman, *The basics of business finance* (pp. 91-110).
- Seifer, R. W., & Seifert, D. (2009, October). Supply chain finance - What's it worth? *IMD Perspectives for managers* .
-

- Sopranzetti, B. (1998). The Economics of Factoring. *Journal of Economics and Business* , 339-359.
- Spinardi, J.-L. (2011, May 17). Trade Finance and Basel III: When Regulation Becomes Counterproductive. *gtnews* .
- Stiglitz, J. E., & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *The American Economic Review* , 71 (3), 393-410.
- Summers, B., & Wilson, N. (2000). Trade Credit Management and the Decision to Use Factoring: An Empirical Study. *Journal of Business Finance & Accounting* , 37-68.
- SWIFT. (sd). *Trade Services Utility*. Opgeroepen op 12 2011, van http://swift.com/products/trade_services_utility
- Vasilescu, L. g. (2010). *Factoring - financing alternative for SMEs*. University of Craiova, Romania, Faculty of Economy and Business Administration.
- Willems, M. (2011). Waak voor te veel optimisme rondom bufferobligaties. *Het Financieel Dagblad* .
- World Trade Organization. (2011). *Overview of Developments in the International Trading Environment*. World Trade Organization.

Appendices

Appendix A Stochastic short term loan in imperfect capital markets

In the model in prior chapters the short term loan the supplier needs at time $t = 0$ was assumed to be deterministic, what will happen to the benefits from the supplier and the bank when this short term loan is made stochastic. By making the short term loan stochastic, the benefit to the buyer does not change, since this benefit is not dependent on the supplier's loan, the benefit for a buyer who does not need short term financing stays:

$$\pi_b = e^{-(r_f + \beta_b)l_{nrf}} - e^{-(r_f + \beta_b)l_{rf}}$$

First the short term loan is assumed to be risk neutral uniformly distributed on $0 \leq L_0 \leq M$, where in first instance M is assumed to be smaller than the maximum amount that can be discounted by making use of reverse factoring, so $M \leq e^{-(r_f + \beta_b + \varepsilon_b + b)l_{rf}}$.

$$E[\pi_s] = \int_0^M \frac{1}{M} \left(e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} + L_0 e^{\varepsilon_s l_{nrf}} - L_0 e^{bl_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} \right) dL_0$$

$$E[\pi_s] = \left[\frac{1}{M} L_0 \left(e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} + \frac{1}{2} L_0 e^{\varepsilon_s l_{nrf}} - \frac{1}{2} L_0 e^{bl_{rf}} - L_0 e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} \right) \right]_0^M$$

$$E[\pi_s] = e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} + \frac{1}{2} M e^{\varepsilon_s l_{nrf}} - \frac{1}{2} M e^{bl_{rf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}}$$

Taylor series approximation:

$$E[\pi_s] \approx (r_f + \beta_b + \varepsilon_b)l_{nrf} - (r_f + \beta_b + \varepsilon_b)l_{rf} + \frac{1}{2} M (\varepsilon_s l_{nrf} - bl_{rf})$$

Reverse factoring adds value in this situation when:

$$L_0 \geq \frac{e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}}{e^{\varepsilon_s l_{nrf}} - e^{bl_{rf}}}$$

The probability of reverse factoring being value adding hereby becomes:

$$P \left\{ L_0 \geq \frac{e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}}{e^{\varepsilon_s l_{nrf}} - e^{bl_{rf}}} \right\} = 1 - P \left\{ L_0 < \frac{e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}}{e^{\varepsilon_s l_{nrf}} - e^{bl_{rf}}} \right\} = 1 - \frac{e^{-(r_f + \beta_b + \varepsilon_b)l_{nrf}} - e^{-(r_f + \beta_b + \varepsilon_b)l_{rf}}}{M (e^{\varepsilon_s l_{nrf}} - e^{bl_{rf}})}$$

The risk neutral benefit for the bank in this situation is given by:

$$E[\pi_f] = \int_0^M \frac{1}{M} L_0 (e^{(\varepsilon_b + b)l_{rf}} - 1) dL_0$$

$$E[\pi_f] = \left[\frac{1}{M} \frac{1}{2} L_0^2 (e^{(\varepsilon_b+b)l_{rf}} - 1) \right]_0^M$$

$$E[\pi_f] = \frac{1}{2} M (e^{(\varepsilon_b+b)l_{rf}} - 1)$$

When the short term loan is again assumed to be risk neutral uniformly distributed and again $0 \leq L_0 \leq M$, but now $M \geq e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}}$, the expected benefits from reverse factoring in a non auto-discounting situation become.

$$E[\pi_s] = \int_0^{e^{-(r_b+b)l_{rf}}} \frac{1}{M} (e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}} + L_0 - L_0 e^{\varepsilon_s l_{rf}} - e^{-(r_f+\beta_b+\varepsilon_b)l_{nrf}}) dL_0 +$$

$$\int_{e^{-(r_b+b)l_{rf}}}^M \frac{1}{M} (e^{-(r_f+\beta_s+\varepsilon_b+b)l_{rf}+\varepsilon_s l_{nrf}} - e^{-(r_f+\beta_b+\varepsilon_b)l_{nrf}}) dL_0$$

$$E[\pi_s] = \frac{(e^{-r_b l_{rf}} - e^{-r_b l_{nrf}}) e^{-(r_b+b)l_{rf}} + \frac{1}{2} e^{-2(r_b+b)l_{rf}} (e^{\varepsilon_s l_{nrf}} - e^{b l_{rf}}) + (e^{-(r_b+b)l_{rf}+\varepsilon_s l_{nrf}} - e^{-r_b l_{nrf}}) (M - e^{-(r_b+b)l_{rf}})}{M}$$

$$E[\pi_f] = \int_0^{e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}}} \frac{1}{M} L_0 (e^{(\varepsilon_b+b)l_{rf}} - 1) dL_0 + \int_{e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}}}^M \frac{1}{M} e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}} (e^{(\varepsilon_b+b)l_{rf}} - 1) dL_0$$

$$E[\pi_f] = \left[\frac{1}{2M} L_0^2 (e^{(\varepsilon_b+b)l_{rf}} - 1) \right]_0^{e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}}} + \left[\frac{1}{M} e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}} (e^{(\varepsilon_b+b)l_{rf}} - 1) L_0 \right]_{e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}}}^M$$

$$E[\pi_f] = \frac{1}{M} (e^{(\varepsilon_b+b)l_{rf}} - 1) (M e^{-(r_f+\beta_b+\varepsilon_b+b)l_{rf}} - \frac{1}{2} e^{-2(r_f+\beta_b+\varepsilon_b+b)l_{rf}})$$

However, the formula for the probability of reverse factoring adding value remains the same.

Appendix B Cost of implementation (Confidential)

Appendix C Impact of Basel III on off-balance sheet items

In Chapter 7 the general outline of Basel III and its impact on on-balance sheet supply chain finance and in particular supply chain finance have been discussed. In this chapter the impact of Basel III on off-balance sheet trade finance will be discussed.

In Basel III off-balance sheet items, as letters of credit, are subject to the same measures as other assets, capital requirements, liquidity ratio's and leverage ratio. Capital requirements are calculated based on a 20% credit conversion factor (CCF) under both internal rating based (IRB) credit risk evaluation methods. In Foundation IRB (FIRB) and Advanced IRB (AIRB) the banks provide their regulator with their estimates of the probability of default (PD) of their credit exposure. In FIRB the other measures (Loss Given Default (LGD), Exposure At Default (EAD) and the effective maturity of exposure (M)) are provided by the regulator. In AIRB banks calculate all those risk measures with their internal models (Allen Overy, 2011). The 20% CCF expresses the probability of the off-balance sheet position becoming on-balance sheet, it is not related to the risk of the counterparty which is expressed by the PD. Banks would like to have a CCF lower than 20% and the ICC Banking Commission backed this up with data on trade finance default and losses, pooled from nine international active banks. The Basel Committee and the ICC Banking Commission did however conclude that the CCF is more than sufficient, the Basel Committee added that the data presented was more relevant on the probability of default than on the off-balance sheet asset becoming on-balance sheet and hence did not lower the CCF as.

As already mentioned, under the AIRB, banks are required to measure the effective maturity for each facility in calculating the risk weighted assets. However, this maturity is subject to a one-year maturity floor. Some exceptions to this rule exist for transactions which are short-term self-liquidating. It has been argued that this one year maturity floor is also inappropriate for short term self-liquidating trade transactions due to their short tenor well below one year. This is also backed by the ICC Banking Commission (2011), they state that the average tenor of all trade products in their data set is 147 days, for off-balance sheet products is 103 days. The Basel Committee has agreed with this and hence risk weighted assets on those transactions can be calculated with the effective maturity below one year (BIS, 2011).

Trade finance has an important function in low income countries in stimulating trade. Especially confirmed letters of credit, where a local bank of a party exporting to a low income country takes over the risk of foreign bank by confirming the letter of credit of this bank. Normally a credit claim to a bank in a low income country is subject to a risk weighting of 50% or even 20% for short term claims (three months or less). However Basel regulation states that the risk on a financial institution can never be lower

than the sovereign in which the bank is located, normally 100% in those low income countries. This would make trade finance extra costly in those countries or would even lock those countries out of trade finance. Therefore the committee has decided to remove the sovereign floor on short-term self-liquidating letters of credit (BIS, 2011).

Though assets are off-balance sheet, they are treated with a CCF of 100% in calculating the leverage ratio. Although it could mean higher capital requirements, it does not necessarily mean that banks need to hold more capital. It could only mean that their capital composition should change, by holding more liquid assets. Banks felt this 100% CCF was too high for short-term self-liquidating trade finance, however the Committee did not change its regulation accordingly. The leverage ratio has been designed to be simple and not based on any differential risk weighting, hence by giving these forms of trade finance a different treatment the Committee would deviate from the objective of this ratio (BIS, 2011).

Appendix D Basel II capital requirements

Table 14: Basel III capital requirements in percentages (source: Basel III)

	Common Equity Tier 1	Tier 1 Capital	Total Capital
Minimum	4.5	6	8
Conservation buffer	2.5		
Minimum plus conservation buffer	7	8.5	10.5
Countercyclical buffer range	0 - 2.5		

Appendix E Working capital measures per industry

Table 15: Working capital measures per industry in Europe

Industries are based on the 48 Fama French industry groups based on SIC, excluding financial industries such as banking, insurance, real estate, and trading companies¹². Not enough data is available on aerospace and defense, business services, business suppliers, coal, environmental control, measuring and control equipment, personal services and tobacco. DSO, DPO and DII are averages in Europe.

Industry	Days Sales Outstanding	Days Payables Outstanding	Days In Inventory
Aerospace and defense	-	-	-
Apparel	50	76	157
Auto & Trucks	46	58	77
Beverages	52	61	167
Biotechnology and pharmaceutical products	68	78	137
Business services	-	-	-
Business suppliers	-	-	-
Chemicals	57	52	49
Coal	-	-	-
Computer Hardware	71	59	31
Computer Software	88	67	54
Construction and building materials	50	48	83
Consumer goods	64	63	89
Diversified Manufacturing	62	48	81
Electrical equipment	62	64	83
Electronic equipment	64	57	106
Entertainment	35	42	18
Environmental Control	-	-	-
Food Products	35	54	54
Healthcare	40	44	30
Home Builders	26	54	453
Machinery	82	47	87
Measuring and Control Equipment	-	-	-
Medical Equipment	77	60	132
Mining and Metals	34	48	98
Oil and Gas	40	49	65
Oil and Gas Services	68	57	41
Packaging and Containers	52	57	65
Paper and Pulp	54	59	60
Personal Services	-	-	-
Printing and Publishing	74	59	40
Recreation	30	55	41
Restaurants and Hotels/Motels	47	58	36
Retail	27	60	86
Steel Works	62	48	93
Telecommunications	56	61	19
Tobacco	-	-	-
Transportation	42	39	37
Utilities	62	48	35
Wholesale	43	60	53

