The world's first stock exchange: how the Amsterdam market for Dutch East India Company shares became a modern securities market, 1602-1700
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4 RISK SEEKING AND RISK MITIGATION

Introduction

The development of the derivatives market, which already started in the first decade of the seventeenth century\(^1\), enabled traders to participate in the share trade and hence benefit from share price movements without locking up a large amount of money in VOC capital stock. This was not the only advantage the derivatives market provided, however. From the mid-seventeenth century onwards, it also offered sophisticated risk-management possibilities to the traders who were active on the derivatives market. According to Ranald Michie, ‘the design of trading methods which permitted investors to buy and sell securities remuneratively, without exposing themselves to undue risk’ was even the most important innovation of the Amsterdam securities market.\(^2\) Using data from protocols of Amsterdam notaries and private papers of merchants who were active on the market, this chapter explores which trading methods were available on the market and how traders could use these to manage and control their financial risks. I will show that in the second half of the century, the derivatives market allowed investors to allocate and mitigate risks according to their needs. It thus fulfilled a core function of financial systems as designated by Merton and Bodie.\(^3\)

There were two kinds of risk involved in trading on the secondary market for VOC shares. Firstly, each transaction, and especially those on the forward market, carried a risk that the counterparty would default. The legal framework and the private enforcement mechanism of the trading clubs significantly reduced the chance of reneging, but counterparty risk was not negligible. Secondly, every investor with a position in the VOC faced portfolio risk – the risk of fluctuations in the value of a portfolio.

I will show in this chapter how traders managed counterparty risk by choosing between different derivatives. More specifically, they chose to use derivatives instead of spot transactions to reduce the risk of non-payment. Moreover, they shifted from forwards to repos if they deemed contract nonperformance risk too high. The next section analyzes how traders used derivatives to control portfolio risk. They used both forwards and options to leverage their risk and to protect their portfolios against un-

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\(^1\) See chapter 1, section 1607 – The emergence of a derivatives market on page 20 ff.
wanted price fluctuations. Lastly, contingency claims were added to derivatives contracts in order to specifically allocate price risks that could result from certain events, such as peace negotiations.

The picture that emerges from this chapter is that the high level of sophistication of the derivatives market allowed share traders to allocate and mitigate risks according to their needs. This development completed the transition from an accidental market where corporate equity could be bought and sold to a full-fledged financial market. It is important to note that it became possible to control financial risks on the derivatives market only with the entry of a large pool of short-term speculators on the market that started in the 1640s. These speculators specialized in trading risks. Moreover, they were generally less risk-averse than the long-term horizon investors on the market. The speculators were willing to take on the risks that other investors wanted to mitigate.

The market for VOC share derivatives has been the subject of two previous studies. Smith tried to unravel the workings of the derivatives market by studying the official rules and regulations for forward and option trading in Amsterdam in the seventeenth and eighteenth centuries.4 Gelderblom and Jonker paid attention to the emergence of repo transactions in the first decade of the seventeenth century5 and to the beginnings of option and forward trading in Amsterdam from the late sixteenth until the first half of the seventeenth century.6 I will add to these historical studies by analyzing how investors used the market to manage and control their financial risks. Murphy did something similar for the London option market of the 1690s.7 She showed that a wide range of speculators used options for both risk-seeking and risk-management purposes. Interestingly, it becomes clear from Murphy’s study that the late-seventeenth-century option traders had good knowledge of the factors that determine the size of the option premium. This indicates that they did not use this relatively complex financial instrument for gambling purposes; they were aware of how they could use options to hedge risks.

4 Smith, *Tijd-affaires*.
5 Gelderblom and Jonker, ‘Completing’. Gelderblom and Jonker argue that investors used the shares they owned in the VOC to attract extra debt capital to finance their businesses. Extensive research in primary sources has led me to come to a different interpretation of the use of repos: traders solely used this type of transaction to be able to finance their share dealings. I will go deeper into the use of repos in the section Counterparty risk.
6 Gelderblom and Jonker, ‘Amsterdam as the cradle’.
Counterparty risk

Both parties to a transaction face contract-nonperformance risk, either in the form of non-payment or non-delivery of the underlying asset of the transaction. Chapter 3 has analyzed how formal and informal institutions guaranteed the enforcement of contracts. This chapter, on the other hand, will discuss how different types of transactions and settlement procedures carried different levels of nonperformance risk. It will, in other words, explore how traders could use the diversity of options available on the market to manage their risk.

In the most basic form of a share transaction, a spot transaction, there is no time lag between negotiation and settlement of the transaction. Still, counterparty risk in a VOC share spot transaction was not negligible, because a large amount of money was needed for the purchase of a share – particularly from the 1640s onwards, when shares with a nominal value of £3,000 cost on average more than £12,000. Spot transactions therefore carried a risk that the buyer could not accumulate the money needed on short notice. Traders could use derivatives to reduce non-payment risk, because fewer and smaller payments were needed for the settlement of forwards and options. However, counterparty risk in these transactions is higher because the underlying asset is transacted over time, thus increasing the risk that the counterparty would not live up to his agreement, due to a changing situation during the term of the contract.

Reduction of non-payment risk was effected when derivatives were settled without actually transferring the underlying asset and having to pay for the full value of the asset. The parties to a derivatives contract could also negotiate a monetary settlement, in which case one of the parties would pay the price difference between the contract and the market price. This settlement method is called direct settlement – the contractors negotiate the settlement directly with each other. It was widely used on the Amsterdam market for shares from the first decade of its existence. Hans Thijs († 1611), for example, regularly noted in his ledger that he had settled his forward contracts by paying the price difference.

It was possible to use direct settlement to complete forward transactions throughout the century, but ringing, a more advanced settlement method, soon complemented the choice of settlement procedures. In a ring settlement procedure, not
only the original counterparties to a contract can settle or cancel out that particular transaction, but also other traders holding similar contracts. Hence, fungibility of the traded assets is a necessary precondition for this settlement method. Contracts needed to have, in other words, the same underlying asset and settlement date. Then, if trader X held a forward purchase of trader Y, and trader Y held a similar forward purchase of trader Z, these three contracts could be settled by a transaction between X and Z.

Ringing works most efficiently when all possible counterparties for contract settlement are present in the same location. It was therefore not until the *rescontre* meetings, with a high concentration of possible counterparties, reached a high level of development, that traders started to frequently use this settlement method. All traders present at the *rescontre* were willing to settle forward contracts, and, more importantly, all participants owned forward contracts that were due on the same date. The transition from direct to ring settlement went through an intermediate stage: direct settlement of multiple forward contracts. The chain of forward traders, discussed in chapter 3, where the last person in the chain eventually received a fraudulent share, is an example of this settlement method. Each pair of traders in this chain individually negotiated direct settlement. It then turned out that several traders could cancel out their contract with another contract and this made it possible to settle all contracts in a single share transfer.

To sum up, the advantages of ringing over direct settlement were reduction of counterparty risk and transaction costs. Counterparty risk was lower because a trader could settle his contract with a range of other traders; the chance of successful settlement thus became higher, which reduced the risk of non-payment. Ringing also reduced transaction costs because fewer and smaller monetary payments were needed. However, as I have argued in chapter 3, the use of forward contracts also involved a risk that the counterparty would simply walk away. The legal system of the Dutch Republic did not enforce the contracts if they were short sales – which was often the case. By submitting its participants to a private enforcement mechanism, the risk of reneging became lower, but traders remained subject to exogenous risk: in periods when the share price fluctuated heavily, for example, forward buyers could be tempted to renege on their contracts, even though this damaged their reputations. The reputation-based enforcement mechanism was, put differently, not a watertight system.

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10 See infra, page 101.
Traders therefore always had to assess the risk that a possible counterparty would renege. There could be several reasons why a trader could deem the risk of reneging too high to enter into a forward contract. Firstly, high share-price volatility increased the chance of suffering a large loss on a forward contract and hence also increased the chance of reneging. Forward sellers could then become more hesitant to enter into a forward contract. Secondly, a trader could have information that a possible counterparty possessed other high-risk assets that could contaminate the forward contract. And finally, if a possible counterparty did not participate in any of the trading clubs, it was difficult to assess how he valued his reputation and thus also to assess the risk of his reneging.

For these situations, another derivative could be used: the repo (short for re-purchase agreement), in which a trader temporarily pawned his share with a money-lender. A repo was a loan, but it was disguised as a purchase of a share by the money-lender and the repurchase of the share by the borrower at a certain date in the future for a price fixed. The repurchase price was always higher than the purchase price; the difference being the interest due on the loan. The interest was a compensation for the money-lender who held the legal ownership of the share during the term of the contract without being entitled to its economic benefits.

An example will clarify how repos worked. Trader X considered buying a share with a nominal value of $3,000. This share would cost him $15,000 on the exchange, but he could not afford to have that much money locked up in a share. He could then choose to negotiate a repo with trader Y, a wealthy moneylender. Trader X would then pledge his share as security for a loan with Y, for which Y agreed to give him a loan of, say, $12,000. This was the purchase part of the agreement: Y purchased a share of X and paid him $12,000 for it. They also agreed that X would repurchase the share in one year’s time for $12,480. Put differently, X would redeem the loan and pay 4% interest. So, a repo was actually a loan on the security of a share.

The Dutch traders called this kind of transaction beleen{11}, derived from the word lenen, meaning ‘to borrow’ or ‘to lend’. The contracts used for these transactions did not mention a loan or an interest rate, however; they only mentioned a purchase and a repurchase price of the share, which equaled the principal of the loan and the

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11 Joseph Deutz, for example, kept accounts of beelende actiën, shares on which he had granted loans: e.g. SAA, Deutz, inv. nr. 294, fo. 117, 168; inv. nr. 295, fo. 22.
principal plus interest, respectively. The traders’ reluctance to call these transactions loans had nothing to do with usury regulations. To be sure, moneylenders generally charged interest rates of between 2.5 and 4% on repos, well below the usury limit of 6%. The share traders rather made the beleningen look like repurchase agreements because this eased the procedure in case of default on part of the borrower. The share was transferred to the lender’s account for the term of the contract and hence he unequivocally received the ownership of the collateral. This was important, because it allowed the moneylender (trader Y) to sell the share on the market if trader X failed to live up to his agreement.

The counterparty risk of a repo was considerably lower than the counterparty risk of a forward. If the borrower were to renege, the lender would lose money only if the share price had sunk under the purchase price, but then he would lose only the difference between the market price and the purchase price. So, in the fictitious example of traders X and Y, trader Y would lose money if X reneged only when the shares traded for less than 400%. The benefits of the active secondary market for VOC shares were substantial when the borrower defaulted: it enabled lenders to quickly and cheaply sell the collateral in case of a default. Moreover, the constantly updated market price kept the lenders informed about the value of the collateral – they could anticipate a possible default.

Clearly, then, traders preferred repos if they had doubts whether the borrower/buyer would live up to his agreements. From the perspective of the borrower/buyer, however, the choice between negotiating a forward or a repo depended on other considerations. Repos were, of course, the only option for traders with insufficient cash to buy a spot or too low a reputation to enter into a forward contract, but they could also offer a solution to traders who were stuck with a share they did not want or could not pay for. If, for example, a forward buyer was unable to find a seller to settle his contract with or to contract a rollover with, he would have to actually accept a share and thus pay the full market value of the share. If he was unable or unwilling to do so, however, he could pledge the share as collateral and use the loan to pay for it. The forward buyer – who now became a borrower in a repo – would only

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12 See for examples of the contracts used: NA, Case files, IIM99 (Machado vs. Cappadoce). The contracts used for repos were called renversaals, a reversal – a contract, in other words, that specified the repurchase of the share on maturity. The earliest evidence of a bekening in the form of a purchase and a repurchase dates from 1645: NA, Case files, IIH21 (l’Hermite vs. Van Hoorn).
13 SAA, Deutz, inv. nrs. 291-5.
14 Cloppenburch, Christelijke onderwijsinge van woeker, 21.
have to pay the amount not covered by the loan he received on the collateral.\footnote{An insinuatie of Luis Gonsales d’Andrada reveals this procedure. He had sold a forward contract to Vincent van Bronckhorst on 20 August 1688. According to this contract, Van Bronckhorst would buy a f6,000 share on 1 September at 502%. However, during the eleven-day term of this contract, the VOC share price fell considerably. The contractors did not come to a settlement agreement until 6 November, when Van Bronckhorst pledged the share as collateral. He got a six-month loan (with a yearly interest rate of 3.5%) of 400% of the share’s nominal value from Gonsales d’Andrada. This means that he had to pay f6,120 (502% - 400% of f6,000) immediately; the remaining sum (f24,000) was postponed until a later date. Gonsales d’Andrada served an insinuatie upon Van Bronckhorst, because he had failed to pay the f6,120; insinuatie 14 December 1688, SAA, Notaries, inv. nr. 4136, fo. 468. Jeronimus Velters explained to his correspondent Pierre Macaré that he used this strategy to postpone payment on a forward contract that had resulted in a loss: Velters to Macaré, 25 September 1676, SAA, Velters, inv. nr. 2, fo. 514.} The forward seller was often unable to act as moneylender, but the sources clearly show that there were a number of wealthy merchants in Amsterdam who were willing to facilitate this kind of transactions, for it provided them a low-risk investment opportunity. They thus contributed to the functioning of the forward market.\footnote{An example may clarify how this worked: on 11 August 1681, Reijnier Lieftingh arranged a repo with Joseph Deutz. Lieftingh borrowed f10,000 on a f3,000 share; the loan had a three-month term and Deutz charged 3% interest. Lieftingh had bought the share from Willem Kerckrinck and sold it, three months later, to Martinus Alewijn. During this period, Lieftingh held the economic ownership of the share, but it never passed through his account in the ledger of the VOC; put another way, he never legally owned the share. The share was directly transferred from Kerckrinck to Deutz and from Deutz to Alewijn. Furthermore, Deutz paid out the principal (f10,000) to Kerckrinck and received it back from Alewijn. Lieftingh, for his part, paid the surplus money to Kerckrinck, was liable for the interest payment to Deutz and received surplus money from Alewijn. To sum up, Lieftingh used Deutz’ liquidity to bridge the time between his transactions with Kerckrinck and Alewijn. In return for his services, Deutz received the interest payment. NA, VOC, 7072. SAA, Deutz, inv. nr. 295, fo. 22 and 76.}

There were also traders, however, who were offered a choice to enter into either a forward or a repo. These transactions had a similar outcome for the borrower/buyer: both forwards and repos separated the economic and legal ownership of a share for a certain period of time. The economic owner (the forward buyer or the borrower in a repo transaction) ran the risk of any share-price movements during the term of the contract and was entitled to any intermediate dividends. He had not (fully) paid for the share, however, and therefore paid the legal owner a fee in recompense for the economic ownership – the forward premium in a forward transaction and the interest over the loan in a repo. Figure 4.1 presents both transactions from the buyer/borrower’s perspective in diagram form. The left sides of these diagrams show the actions taken by the buyer/borrower when he entered into the forward/repo. The right sides show how both kinds of transactions were settled.

An example from the correspondence of Jeronimus Velters, a wealthy Amsterdam merchant, shows that he was well aware of the similarities between these types of transactions. When he wrote his business partner Pierre Macaré in Middelburg, in the
province of Zeeland, that he had bought a forward on his account on 21 October 1676, he explained to him that he had also considered contracting a repo instead. The forward had a share with a nominal value of ƒ6,000 as underlying asset and was to be delivered on December 1 at 456%. If he had contracted the repo, he would have pledged a ƒ6,000 share as collateral, but he had calculated that a forward contract was cheaper than a loan bearing an interest of 4% or even 3.5%, all the more so since lenders would only be willing to grant loans of at most 366 2/3% of the nominal value of the security.17 Unfortunately, I do not know the price at which spots were traded on October 21, but two weeks earlier, on October 9, the spot price had been 453.75%.18 Hence, the maximum size of a loan granted on a share pledged as collateral was slightly over 80% of the share’s market value. Hereafter, I will assume that the share price was 454% on the contract date; the annualized forward premium in the forward contract would then have been 4%, which is plausible for a wealthy and reputable trader such as Jeronimus Velters.

Table 4.1 adds some figures to Velters’ assessment of these transactions.

| Forward - 40 day term - underlying asset ƒ6,000 |
| Spot price | Forward price | Total cost (ƒ) |
| 454        | 456            | 120             |

| Loan - 40 day term - share with nominal value ƒ6,000 as security |
| Interest (%) | Principal (ƒ) | Principal + interest (ƒ) | Total cost (ƒ) |
| 3.50         | 22000.00     | 22082.87             | 82.87          |
| 4.00         | 22000.00     | 22094.50             | 94.50          |

| Extra loan - 40 day term - market value share minus costs ƒ22,000 loan |
| Interest (%) | Principal (ƒ) | Interest cost to break even (ƒ) | Interest rate (%) |
| 3.50         | 5240.00      | 37.13                     | 6.67             |
| 4.00         | 5240.00      | 25.50                     | 4.54             |

Table 4.1 Estimated costs of Jeronimus Velters’ forward and repo transactions
Please note that for these calculations, I have used a spot price of 454% for October 21.

The total costs of the forward contract amounted to ƒ135 (2.25% · ƒ6,000). If, however, Velters chose to take out a loan and pledge the ƒ6,000 share as security, he would get a loan of at most ƒ22,000 (ƒ6,000 · 3 2/3). The total costs of this loan amounted to either ƒ82.87 or ƒ94.50 – depending on the interest rate. He would

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17 Velters to Macaré, 21 October 1676, SAA, Velters, inv nr 2. Interestingly, only a few months earlier (in June), Velters had been able to contract two loans of 400% of the nominal value of the shares pledged as security with Joseph Deutz: SAA, Deutz, inv. nr. 276, fo. 98. The share price had not dropped in the intervening months, so it remains unclear why Velters now feared that he could only get 366.67%.
18 Velters to Macaré, 9 October 1676, SAA, Velters, inv nr 2.
come short £5,240 to pay for the share (a £6,000 share cost £27,240 on the market), meaning that he would have had to take out another loan to finance the share purchase. If he could get the additional £5,240 for a yearly interest rate of less than 6.67% or 4.54% (depending on the interest rate of the secured loan), it would be profitable to pledge the share as security for a loan rather than contract a forward transaction.

The same calculation holds if Velters had enough spare money to finance the £5,240 himself. This changes the reasoning behind the calculation, though, for he now had to consider whether it was more profitable to take out a loan on collateral and have less liquid money at his disposal, or to contract the more expensive forward deal. The forward transaction would become the best option if Velters could get a rate of return of at least 6.67% or 4.54% (again depending on the interest rate of the loan on collateral option) on the £5,240 he did not have to lock up in the repo.

Velters preferred the forward. As he was a very wealthy merchant, he probably had sufficient cash at hand to finance the share himself and, therefore, the choice he made was that he could allocate the £5,240 in a more profitable way than to lock it up in the share used as security; i.e. he could invest it at more than 4.54%. So far, however, I have omitted some factors that also came into play. The transaction costs for a loan secured on stock were higher than for a forward contract. The brokerage – which, of course, had to be paid only if the traders used a broker’s services – was the same for both transactions, but the share that was pledged as collateral had to be transferred at the East India house twice. Moreover, four bank transfers were needed to take out and eventually redeem the two loans. The fees for these transactions were relatively small, but added together and taking into account that the time to perform all these actions was costly for a busy merchant like Velters, they probably persuaded him to choose for the forward.

Velters was probably always in a position to choose between competitively priced forwards and repos – the chance that he would renge on a forward was relatively small. A small adjustment to the figures in the example shows what happened if a certain trader had a slightly lower reputation. Forward sellers would then charge a higher forward premium as a compensation for the increased risk of reneging. If an extra 0.5 percentage point was added to the forward premium (the forward price in the example would then have gone up to 456.5%), the secured loan would have become the cheaper option as long as the borrower could find the extra financing at maximum interest rate of 12.35% (instead of 6.67% if the forward price was 456%) –
which cannot have been difficult on the Amsterdam money market of the second half of the seventeenth century. A small increase in forward premium thus already tipped the scale towards a repo.

Comparing the Velters example from 1676 to two transactions dating from August 1671 reveals how the markets for forwards and repos reacted during periods of large price fluctuations – more specifically the crash of 1672. On 1 August 1671, Abraham Salvador was granted a six-month loan of 93% of the market value of the £3,000 share he pledged as collateral. The interest rate of this loan was 3%. Clearly, this loan was a better deal than the one in the Velters example: Salvador received more money on his collateral and he paid a lower interest rate. A fortnight later, on 15 August 1671, Sebastiaen Cotinho bought a forward with an underlying asset of £3,000 and a term of 3.5 months. He paid 538%, while the spot price was 532.5%. Hence, the cost of carry on this contract was 3.5% – again a lower rate than in the Velters example.

These transactions were not as competitively priced as those offered to Velters. The total costs of Cotinho’s forward amounted to £165, or £282.86 for a term of six months. Salvador’s interest due on his loan was £220.36, which means that he had to be able to finance the £1,175, the money he came short to buy the collateral, for less than £62.50 for this option to be cheaper. Hence, he had to get a loan with a yearly interest rate of less than 10.1%, which would probably have been no problem on the Amsterdam money market.

The loan secured on stock was seemingly the cheaper option. This is not surprising; it had to be better priced to be competitive with forward contracts – in 1671, there was, as yet, hardly any restraint on contracting forward transactions. The share price fluctuated within its normal boundaries, the rescontre system functioned well and there was no reason to fear that forward buyers would not live up to their agreements. Hence, share traders preferred forward contracts to repos; they assessed the risks involved in both transactions to be similar, but the transaction costs of a forward were lower. At the same time, however, there was a lot of money available among the rich inhabitants of Amsterdam. These rich persons were willing to invest in low-risk repo

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19 Insinuatie 5 February 1672, SAA, Notaries, inv. nr. 2238.
20 Insinuatie 10 February 1672, SAA, Notaries, inv. nr. 2238.
21 A spot cost £15,975; Salvador was granted a loan of £14,800.
transactions, but for the repos to be competitive with forward contracts, they had to charge low interest rates.

The price crash of 1672 changed the situation on the derivatives market. As I have shown in chapter 3, the large price drop (from 560 in July 1671 to 290 in July 1672) induced a number of traders to renege on their forward contracts. These traders now considered the losses they were about to suffer on their contracts too large to offset an undamaged reputation. The impact on the derivatives market was large. Since many traders held balanced portfolios, a single reneging caused an uncovered position in his counterparty’s portfolio, which could force him to also renege on one of his contracts. The price crash thus brought the market to a standstill. Jeronimus Velters wrote on 29 November 1672 that there was hardly any trading activity; he was probably referring to the forward market, for the transfer register of the Amsterdam chamber of the VOC does not show a trough in the number of share transfers around that date (see Figure 2.4 on page 79).

Consequently, traders became hesitant to sell forward contracts unless they had near absolute certainty that the counterparty would live up to his agreements. Repos were, of course, not immune to the price fall either. In June 1672, for example, Bartholomeus Rodrigues Hendriques was not able to redeem his loan of ƒ10,500 secured on a share with a nominal value of ƒ3,000. The Court of Aldermen had permitted the moneylender, Hendrick Staets, who, incidentally, was a sworn broker, to sell the collateral on the market. Staets made a final attempt to persuade Rodrigues Hendriques to repay the loan through a notarial insinuatie, but this was to no avail. Staets lost the difference between the loan and the market value of the share (around ƒ1,500), but Staets could lay a claim for this amount against Rodrigues Hendriques’ property – this was an important advantage of repos over forward transactions; forwards were simply null and void if they concerned short sales and hence the sellers had no right to lay a claim to the counterparty’s property.

Staets was lucky that he had granted Rodrigues Hendriques a loan of only 350% of the nominal value of the collateral. The price fluctuations that started in the autumn of 1671 had probably made him more cautious when he granted a loan. This immediately reveals the main advantage of repos over forward contracts: the lending

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22 See page 113.  
23 See page 138.  
24 Velters to Fletcher, 29 November 1672, SAA, Velters, inv. nr. 1, fo. 292.  
25 Insinuatie 20 June 1672, SAA, Notaries, inv. nr. 2239, fo. 503.
party in a repo could adjust the risk of the transaction to the circumstances by adjusting the size of the loan granted to the borrower – a ‘haircut’ in modern parlance. The smaller the loan granted, the higher became the chance that the lender would be able to fully recover the principal on the market in case the borrower defaulted. Similar risk adjustments were impossible with forward contracts. Forward sellers could ask a higher forward premium to cover higher risk, but this would above all create an extra incentive for the counterparty to default on the contract.

Figure 4.2 shows the size of the loans granted on shares pledged as collateral or the period 1649-88. The size of the loans is expressed as a percentage of the market value of the share on the contract date. The size of the loans varied from 63% (December 1681) to 103% (October 1671) of the market value of the collateral. The graph clearly shows that the average loan was higher in the early 1650s than in the later decades of the seventeenth century. Changing market conditions explain a large part of this variation. The early 1650s were the final years of a period of rising share prices that had lasted for more than two decades. There was as yet no reason to believe that the share price would fall in the near future. In the following decades, however, the First and Second Anglo-Dutch Wars had a large impact on the share price. The increased price volatility led to a higher risk of default and lenders adjusted their loans accordingly. The peak of 1671 depicts that year’s sense of optimism: a record high dividend payment and good news from the East Indies boosted the share price and moneylenders were willing to lend almost the full value of the collateral – and on one occasion even slightly more. The price volatility in 1672 brought the size of the loans down to about 70%. In fact, the 1672 price crash disrupted the market even more than this graph shows. Moneylender Jan Witheyn, for example, was willing to roll over a repo with Jeronimo and Manuel Gomes Pessoa in June 1672, but not only did he change the conditions of the loan, he also demanded extra security in the form of a government bond.

Market conditions cannot explain the fluctuations after 1672, however. These must be attributed to circumstances related to the individuals involved in these repos.

26 Very few data are available for the period before 1649 – the year in which Elisabeth Coymans started facilitating repo transactions. Antoni Thijs was granted a loan of 97% of the market value of his share in 1618: BT, inv. nr. 113, fo. 47.
27 Rollover, 15 June 1672, SAA, Notaries, inv. nr. 2905, fo. 167. Originally, on 26 November 1671, Witheyn had lent £12,000 on the security of a £3,000 VOC share. The term of this repo was 6 months and Witheyn charged a yearly interest rate of 3.75%. In the renewed contract, Witheyn only granted £10,000 at 4% interest. Furthermore, he demanded a £3,200 bond of the States of Holland as extra security.
The low values for April and October 1679, as well as those for May and December 1681 come from the books of Jacob Athias and Manuel Levy Duarte, who were the borrowers in these transactions.\(^28\) The other data from the 1670s and 1680s stem from the records of Joseph Deutz, a very wealthy merchant who acted as moneylender in all these transactions.\(^29\) The counterparties to the repos of Athias and Levy Duarte apparently had their doubts about the creditworthiness of these merchants.\(^30\) Deutz, on the contrary, was willing to grant his counterparties larger loans. He probably selected his counterparties for their creditworthiness.

It is interesting to note, finally, that there was little variation in interest rates charged on repo contracts. Elisabeth Coymans charged yearly interest rates between 3.75 and 4% in the 1650s\(^31\); during the following decade, Louis Trip charged 3%\(^32\) and Joseph Deutz lent money secured on stock shortly after the 1672 price crash at 3.5%.\(^33\) Clearly, risk management was carried out through adjusting the size of the loan rather than the interest rate.

The collateral/loan ratio, or size of the haircut, could function as a risk-management technique only if moneylenders could easily and quickly sell the collateral on the market if the borrower defaulted. Moneylenders would be less inclined to participate in this type of transaction if lengthy court proceedings were required to get permission for the conversion of collateral into real money, since this would considerably increase the transaction risk – the time it took to get permission increased the chance of large fluctuations in the value of the collateral. The earliest example I have found of a repo transaction, which dates from June 1618, shows that the share was transferred to the lender’s account in the capital books of the VOC for the duration of the loan.\(^34\) An official regulation on repos, first proclaimed in 1623\(^35\), stated that this was not the right procedure; collateralized shares should be transferred to the time account of the moneylender.

\(^{28}\) SAA, PIG, inv. nr. 858, fo. 89, 214. They contracted some of these repos on the accounts of Salvador de Palacios, Pieter Hunthum, Luis da Costa and Luis Alvares. There does not seem to be a difference between the size of the loans they contracted on their own account and those on the accounts of third parties.

\(^{29}\) SAA, Deutz, inv. nr. 293-5.

\(^{30}\) Incidentally, their fears proved to be correct. Attestations dating from 1698 give evidence that Jacob Athias was hiding from his creditors: SAA, Notaries, inv. nr. 6004, fo. 361, 383.

\(^{31}\) SAA, Deutz, inv. nr. 276, fo. 220.

\(^{32}\) E.g. SAA, Merchants’ accounts, inv. nr. 50, 2 April 1663.

\(^{33}\) SAA, Deutz, inv. nr. 293, fo. 113.

\(^{34}\) BT, inv. nr. 113, fo. 47. Anthoni Thijs received a loan of almost 94% of the nominal value of the collateralized share. He paid 5% interest for the four-month loan.

\(^{35}\) Placard 3 June 1623: Cau, Groot placaet-boeck 1, 555-9.
These time accounts, however, were hardly ever used36 – understandably, because in case of default, the moneylender would have had to officially seize the share before he could freely dispose of it. Permission to seize a share that was registered on a time account could be obtained from the Court of Aldermen, but this was a time-consuming process; the moneylender would need to start litigation, claiming the right to legally dispose of the share. If he won the case, he would have to ask the court to execute the sentence by seizing the share.37 However, if the defendant appealed the court’s permission to seize the share, the moneylender would still not be able to sell the share on the market. Hence, moneylenders required their counterparties in repo transactions to transfer the share that was used to secure a loan to their ‘normal’ accounts in the ledger of the VOC. The bookkeeper of the VOC did not oppose this procedure.38 Incidentally, he could not easily distinguish repos from other transactions, because the traders disguised repos as standard purchases and repurchases.

When the collateral was stored on a normal account, a moneylender could more easily dispose of the share in case of default. There were two different procedures. Moneylenders could ask official permission from the Court of Aldermen to sell the share by handing in a request. The Aldermen would then approve this request by way of a marginal note; this was a mere formality if the moneylender could prove that the borrower had not redeemed the principal – no court case was started.39 This also indicates that the Aldermen implicitly approved the way traders customarily traded repos. Finally, contractors of a repo transaction could add a clause to the contract that stated that the moneylender was allowed to sell the collateral on the market after the end of the contract term without further judicial procedure.40 Before taking any steps,

36 In the year 1688, for example, the VOC bookkeeper registered only two transfers from/to a time account: NA, VOC, 7072, fo. 181 and 183.

37 For the procedure of executing sentences: Le Bailly, Hof van Holland, 51. The bookkeeper of the VOC made notes of seizures in the margin of shareholders’ accounts. He also added a reference to the date of the sentence of the Court of Aldermen and, from 1684 onwards, a reference to the VOC register of seized shares. This register, in which all documents requesting the seizure of a share were collected, allows for a quick count of the number of seizures. The Amsterdam bookkeeper administered two to seven seizures per year between 1684 and the end of the seventeenth century. Most seizures concerned conflicts over estates and the size of the seizures was generally small (seized shares with nominal values of between ƒ100 and ƒ500), with the exception of two claimants to Van Beuningen’s shares (1688), who seized ƒ6,000 each: NA, VOC, inv. nr. 7122.

38 Joseph Deutz distinguished in his private administration between shares that were his own investment and shares he had received as security for loans; these two types of shares were not treated differently on his account in the official VOC ledger.

39 E.g. insinuatie 20 June 1672, SAA, Notaries, inv. nr. 2239, fo. 503. The case file that has survived of the lawsuit Samuel Cotinho vs. Vincent van Bronckhorst shows that the local court of Amsterdam responded quickly to such requests: NA, Case files, HK98.

40 E.g. insinuatie 5 February 1672, SAA, Notaries, inv. nr. 2238, fo. 276.
however, they should always inform their counterparties about the steps they were about to take – preferably through a notarial insinuatie.

To summarize, repos mimicked the separation of legal and economic ownership of a share over a certain period of forward transactions. Counterparty risk in a repo was considerably lower, but in exchange for that advantage, traders had to perform at least two share transfers and arrange several payments. The choice between these instruments was thus an assessment of transaction costs and counterparty risk.

It is striking that the traders on the Amsterdam market for corporate equity did not come up with a hybrid transaction – a forward transaction that adapted certain elements of the repo to lower counterparty risk. The most obvious way to lower counterparty risk of a forward transaction would have been through the establishment of margin accounts. The principle of a margin account is that both parties to a contract deposit a certain sum upon concluding the transaction. This sum (the margin) is a form of collateral; it covers a large part of the credit risk of the counterparty. If one of the parties defaults, the other party has recourse to the sum deposited. Dynamic use of a margin account can even provide full coverage of credit risk. An extra clause should then be added to the contract, which states that traders should deposit an extra sum in the event of a certain change in market conditions – e.g. a 10% price change of the underlying security. If, for example, the market price of the underlying security falls 10% during the term of the contract, the buyer – whose incentive to renego becomes larger due to this price change – should deposit an extra sum in the margin account. Similar dynamic margins are always used in modern-day derivatives markets.41

This use of margin accounts significantly reduces counterparty risk in forward contracts, but there is no evidence that Amsterdam traders used it in the seventeenth century. I have only found a single example of a forward contract where the seller asked for extra security to reduce the counterparty risk. This contract had a VOC share with a nominal value of £12,000 as underlying asset and was therefore riskier than the more common £3,000 forwards. The parties to the contract were Vincent van Bronckhorst (the seller) and Samuel Cotinho (the buyer). They agreed on 25 June 1683 that the share would be delivered on 1 September of that year at a price of

41 Today, the exchange organization is often, if not always, the counterparty to derivatives contracts. Each trader holds an account with the exchange and has to update his margin to price changes on a daily basis.
422.625%. The traders added an extra clause to the contract: Cotinho gave Van Bronckhorst a *renversaal* as security for the contract – this *renversaal* was the repurchase part of a repo Cotinho had entered into. It gave Van Bronckhorst the right to settle Cotinho’s repo in case he defaulted.\(^4^2\)

This collateral provided some cover for the contract’s credit risk. If Cotinho defaulted, which would have been feasible – at least, from an economic point of view – if the VOC shares traded at a price below 422 5/8% on expiry of the forward, Van Bronckhorst could use the *renversaal*. This gave him the right to receive ownership of a \(\mathcal{f}6,000\) share if he redeemed a loan of \(\mathcal{f}22,000\) (plus interest), which Susanna de Neufville had granted to Cotinho. This means that Van Bronckhorst would not suffer a loss as long as the share price did not fall below 408 5/8%.\(^4^3\) It is questionable to what extent this extra security would really reduce credit risk; to be sure, a real incentive for Cotinho to renege would arise only if the share price fell even further. In my opinion, therefore, the strength of the extra clause was merely symbolic; by handing over his repurchase agreement with De Neufville, Cotinho showed that he was committed to complying with the agreement.

Interestingly, there is evidence of the use of margin accounts for the eighteenth century. John Law and Lord Londonderry (born Thomas Pitt, Jr.) used one in 1719 for a one-year forward contract with EIC stock with a nominal value of \(\mathcal{L}100,000\) as underlying asset – an incredibly risky contract. Each trader deposited \(\mathcal{L}30,000\) and they had to adjust their deposit if a 10% price movement occurred.\(^4^4\) Data from 1772 indicate that traders from Amsterdam were by that time familiar with the use of margin accounts, although in these instances only the buyer had to deposit a margin.\(^4^5\)

The seventeenth-century traders might have been wary of using margin accounts because it can lead to moral hazard.\(^4^6\) A trader could be tempted to enter into a forward transaction with a trader with a bad or unknown reputation because he thinks that the margin account will cover the loss in case of default. This is of course what a margin account is supposed to do, but there is always a possibility that a trader

\(^{4^2}\) NA, Case files, inv. nr. IIK98 (Cotinho vs. Van Bronckhorst).

\(^{4^3}\) Calculation: Van Bronckhorst would make a profit as long as the proceeds from the sale of the collateral would be higher than the loss incurred in the forward contract. The break-even point lies at a market price halfway between the forward price (422 5/8%) and the size of the loan (366 2/3%). However, the collateral had a nominal value of \(\mathcal{f}6000\), whereas the forward contract involved a share of \(\mathcal{f}12000\). Hence, the break-even point lies at 422 5/8 – (422 5/8-366 2/3)/4 = 408 5/8%.


\(^{4^5}\) SAA, Notaries, inv. nrs. 10600-5. (Thanks to Peter Koudijs.)

\(^{4^6}\) Cf. Angelo Riva and Eugene N. White, ‘Danger on the exchange: How counterparty risk was managed on the Paris Bourse in the nineteenth century’, *NBER working paper* Nr. 15634 (2010).
with a bad reputation will not update the margin according to the agreement. A margin account might, put differently, provide spurious certainty, enticing traders to enter into transactions they would otherwise have deemed too risky. The legal sphere could provide an additional explanation for the absence of margin accounts in seventeenth-century Amsterdam. The main advantage of the use of shares as collateral (in a regular repo) was that the collateral was registered on the lender’s account in the capital books of the VOC. The lender thus held legal ownership of the share and could easily dispose of it in case of default. It might have been problematic to give a party to a forward contract – in many cases an illegal contract – legal ownership of the margin in case his counterparty defaulted.

Moreover, a forward transaction would have lost its dynamic character if traders needed to deposit margins for each transaction. And it was of course the dynamics of the forward market that proved to be so alluring to the traders. The stock-jobbers needed a market where they could negotiate many deals in a short period of time for their trading strategy to be profitable. So, to conclude, counterparty risk was manageable on the Amsterdam market for VOC shares, but traders had to give up on the advantages of the forward market (low transaction costs) in exchange for the lower counterparty risk of a repo. They therefore often preferred to face the higher counterparty risk of a forward. The manageability of counterparty risk contributed to the accessibility of the market. It enabled merchants with reputations that were inadequate for the regular forward market to participate in the share trade without necessarily locking up the full market value of a share by holding a positive position in the capital books of the VOC.

**Portfolio risk**

Portfolio risk is the risk that the share price, and hence the value of the portfolio makes unwanted movements. Portfolio risk falls into a different category of risk than counterparty risk; whereas every trader tries to minimize counterparty risk, while taking care that transaction costs do not get too steep, the level of portfolio risk an individual trader is willing to take on depends on his risk-averseness. Speculators, for example, trade on short-term price movements and they are therefore willing to take a higher short-term portfolio risk. People who regard their investment as a pension scheme, on the other hand, require a long-term positive return on their investment, and do not want to run the risk that the value of their portfolio will be reduced to zero due to
sudden price movements. There are several ways to mitigate or allocate portfolio risk; I will successively discuss how the seventeenth-century share traders used contingency claims and derivative transactions to this end.

Traders could add a contingency clause to their derivatives contracts. A contingency clause is a clause that comes into effect if a certain described event happens; put another way, the clause is contingent on the event described in the clause. The risk allocating effect that contingency clauses could have becomes clear in the following example. In the fall of 1618, Anthoni Thijs and Abraham Govertsz. van de Graef contracted a forward transaction that was due on 1 January 1619. Earlier that year, five VOC ships had safely returned from the East Indies. However, Thijs and Van de Graef had the impression that there might still be still be more ships bound for the Dutch Republic under way, but they were unsure how many. They therefore stipulated that Van de Graef should pay Thijs 158% if two more ships would arrive from the East Indies before the end of the year, 152% if one more ship would arrive and 144% if none. They settled the contract on 2 January 1619; Van de Graef paid 152%, because one more ship had arrived.

This transaction thus brought about the following risk allocation: Thijs was the seller, so he would not suffer a loss if the share price were to fall during the term of the contract. If the share price were to rise as a result of the safe arrival of one or more VOC ships, he would get a fixed profit. Van de Graef, on the other hand, would suffer a loss if the share price were to fall and he would profit from the arrival of additional ships only to the extent that this did not accrue to Thijs. Moreover, he would suffer a loss if the share price did not react as positively to the arrival as laid down in the contingency clause. So Thijs knew exactly how much he would get paid on January 1; he had covered his risk. Van de Graef, on the other hand, was willing to take on these risks. He might have been rewarded through a low forward premium, but the sources do not allow for a reconstruction of the premium. It is also possible that Van de Graef was willing to take on the risk because he had a more positive expectation on the share price reaction to the arrival of ships.

47 There were standard forms available for derivatives contracts (in printed form from about 1630 onwards, but before that time traders already used a standard formulation for their handwritten contracts), but traders could always tweak the transaction by adding extra clauses at the bottom of the contract.

48 BT, inv. nr 113, fo. 48. The last ship, called Goede Fortuijn, arrived in Zeeland on 15 November 1618: DAS. Incidentally, both traders proved to have been very good at assessing how the market would react to the arrival of ships: on 27 December, Thijs paid the exact same 152% for a spot transaction.
Hubertus Pollius and Anthony Alvares Machado entered into a similar transaction on 8 August 1678. They agreed that Alvares Machado would buy a share (nominal value ƒ3,000, price 405%) if peace were to be concluded in the coming month. Otherwise, the contract would become null and void. So, in this particular transaction, neither party ran a risk if the peace negotiations failed. If, however, they succeeded, Pollius knew for sure that he would get 405%. Alvares Machado would suffer the loss or get the profit if the price were lower or higher in a month’s time. Again, this contract is partly a bet (by Alvares Machado) and partly a way to control the impact of political circumstances on the value of a share portfolio. Pollius was willing to forgo the chance of a very high return for the certainty of getting 405% were peace to be concluded.49

Traders also used the derivatives market for commodities to hedge the price risk of the VOC shares in their portfolios. For an effective hedge, the price of these commodities should go up if the price of the VOC shares were to go down and vice versa. The goods that were brought to the Dutch Republic by the VOC satisfied this requirement to an extent that made hedging feasible. The share price reacted positively on large return fleets, but large ladings of spices and other goods from the East Indies of course also saturated the markets for these commodities. The general trend was thus that the market price for spices went down when the share price went up. If, however, part of the fleet was lost at sea, the share price decreased whereas spices became scarcer on the European markets and their price increased. A good way to hedge against price risk was thus to invest in pepper or other spices when these were abundantly available. The goods brought over from the East Indies were not perishable, so they could be stored in a warehouse until the price went up.

Jeronimus Velters did so in the fall of 1676 when the pepper price was very low. He bought pepper on the Amsterdam and Hoorn markets for Pierre Macaré and himself and immediately pawned it. He received 4.5% loans secured on the pepper;

49 The contractors later disagreed on the interpretation of the contingency clause. Peace with France was signed on 11 August – only three days after they had drawn up the contract, but Alvares Machado was not willing to receive the share, stating that the contract was valid only if a general peace was concluded, whereas the Peace of Nijmegen solely concerned France and the Dutch Republic. Pollius then sold the share to another trader. A year later, however, when VOC shares traded at 410-3%, Alvares Machado changed his mind and he started a civil case against Pollius to force him to deliver the share. Both the Amsterdam court and the Court of Holland dismissed Machado’s claim. Anthony Alvares Machado vs. Engelbert de Geyselaar (guardian to Pollius’ heirs), 25 March 1681, HvH, inv. nr. 816, 1681-55.
the storage costs were included in this interest rate. Based solely on the letters to Macaré in which Velters wrote that he was going to buy pepper, it could seem as if Velters had simply speculated on a price rise of pepper – buying low and hoping to sell high. This was not the case, however; Velters was actually hedging the price risk of his shares, since his entire correspondence with Macaré was focused on trading shares and other financial transactions (insurance, bills of exchange). The sole purpose of their correspondence was to make better financial deals by using each other’s business networks. This example of buying and storing commodities must thus also be seen in the context of their financial dealings.

The aforementioned examples are chance findings in the sources; it is unclear how often traders used these risk-mitigating strategies. The very frequently traded share derivatives were also fit for risk-reducing trading strategies, however. Both forwards and options could be used to mitigate the risk of unwanted price fluctuations. Below I will discuss how this worked and to what extent the traders used share derivatives to manage and control the risk of their portfolios.

Forward short sales, to begin with, are often used for making a hedge. The possibilities for this trading strategy were rather limited on the seventeenth-century forward market, however, because VOC stock was the only asset that was regularly traded and that could thus be sold short. Traders could therefore not, for example, use forward options to hedge against systematic risk – the class of risk associated with market returns (i.e. of the market as a whole, not of an individual asset). This is a category of risk that cannot be reduced by portfolio diversification. If, for example, the government of a specific country is replaced as a result of a coup d’état, this will affect the return of all stocks traded on the market in that country. Some stocks will react more heavily to this event than others, but the price reactions will be positively correlated. A portfolio that consists of only long positions in different stocks will therefore always be affected by systematic risk. Short-selling, however, can protect against this type of risk. If a long position in stock X is combined with a short position in the market with the same value, the systematic component of the return on stock X is reduced to zero. A positive systematic return will then still result in a positive return on stock X, but this will be fully offset by the negative return on the short position in the market. So, what is left is the unsystematic, or stock-specific, risk and return of stock X. On the

50 Velters to Macaré, 25 September 1676, SAA, Velters, inv. nr. 2, fo. 514; 6 November 1676, SAA, Velters, inv. nr. 3., fo. 5.
Amsterdam financial market of the seventeenth century, however, it was not possible to take a short position in the market as a whole, so traders could not hedge against this type of risk. A combination of a long VOC position and a short WIC position would have come the closest to cancelling out systematic risk, but the trade in WIC shares was too irregular to make this feasible and I have not found any evidence in the sources that traders used this strategy.

The Amsterdam share traders could also use forward short positions in the VOC to limit the risk of their long position in the same VOC. This technique is very simple. A long position limits downward risk (the value of a long position can go only to zero), but gives unlimited upward potential. A short position, on the other hand, has unlimited downward risk (there is no limit to a rise of the share price, hence there is no limit to the loss on a short position), whereas upward potential is limited to the point where the asset becomes worthless. Hence, a combination of a long and a short position fixes the loss or profit on the portfolio. This is exactly what the forward traders on the market for VOC shares did; they always tried to net out their positions by making opposite contracts. The ledger containing the trades of Jacob Athias and Manuel Levy Duarte in trading clubs during the 1680s clearly shows this; they traded a very high number of forward contracts, but always made sure that their net position in the market was (close to) zero. A flat position not only yielded the best settlement possibilities, it also limited the portfolio’s profit or loss to the difference between the average prices of its long and short positions. The portfolio was not exposed to additional share-price risk.

Option contracts provided more sophisticated hedging possibilities. An option is the right to buy (call option) or sell (put option) a share with a certain nominal value at a certain price on a certain date in the future. The holder of the option has the right to exercise the option, but he can also choose not to do so – he will exercise it if the option is in the money, meaning that the market price makes it profitable to exercise the option. The main difference between forward and option contracts is that the holder of an option has the right to exercise it, whereas the buyer of a forward is obliged to buy the underlying asset on expiry or settle the contract in some other way. Options can therefore be seen as an insurance against a certain share-price movement. A put option, for example, guarantees the buyer that he can sell the underlying asset at a certain price at a future date. He is thus insured against a reduction in value

31 SAA, PIG, inv. nr. 687-8.
of the underlying asset from the point where the option is at the money. Of course, insurance does not come for free; the buyer of an option has to pay an option premium that is similar to an insurance premium.

So, put another way, the holder of a forward contract holds the economic ownership of the underlying asset, postponing payment until the contract’s expiry date, whereas the holder of an option contract holds an insurance against certain price movements. This makes an option a more complicated instrument and it is therefore also much more complicated to assess the price of an option. The price of a forward can be assessed by taking the spot price at the contract date, to which a cost-to-carry is added. The size of the cost-to-carry is dependent on the contract’s term in relation to the prevailing interest rate and on the risk of default. In the case of an option contract, however, the size of the premium is dependent on more factors. It is, of course, to a large extent determined by the nominal value of the underlying asset, the length of time to expiry and the relationship between the market price and the strike price of the option. Because of the time value of money, the premium increases as the term lengthens. It is harder to price the relationship between the market price and the strike price, however. The option premium increases as the chance that the option will be in the money on expiry becomes greater – the seller of the option demands a higher compensation for the greater chance that he will incur a loss if the option is exercised. This component of the option premium is thus dependent on the variation of the share price. The seventeenth-century options traders were definitely aware of this relationship, but they did not have the mathematical knowledge to perform the calculations needed. To be sure, it was not until the 1970s that the Black-Scholes model was developed, presenting a method for option valuation.52

However, even the Black-Scholes model does not capture all factors influencing the size of the option premium. Most importantly, it does not take the risk preferences of the options traders into account, but exactly these different risk preferences are the source of all trading activity in options. The buyer of an option always considers whether the coverage for a certain price risk offsets the option premium. The trader who writes the option, on the other hand, receives the premium, but has to consider whether it offsets the extra risk exposure. They can come to an agreement only if they value risk differently.

52 Murphy, ‘Trading options’, 20-1.
The sources give few clues regarding how the seventeenth-century options traders assessed the size of the option premium. The available data on option contracts give the impression that there was something like a market price for options with a similar exercise date – although I have never seen any quotations of option prices in share-traders’ correspondence. Two put options, one between Jacob da Costa Athias and Antonio do Porto and the other between Manuel Mendes Flores and Josep Francees, give evidence for this view. The former option was contracted on 22 October 1671 and the latter one day later. Both had the same underlying asset, strike price and exercise date. Da Costa Athias paid a premium of £600 and Mendes Flores £585. This certainly gives the impression that these traders took a market price as a starting point, adjusting it slightly to their personal expectations.53

Apart from this observation, it is impossible to find out how the traders priced their option premium. There are simply too many factors at play and, what is more, the traders used several types of option contracts. For example, both what are nowadays called American-style and European-style options were used.54 The difference between these two styles is that European options can be exercised only upon expiry of the contract, whereas the holder of an American-style option has the right to exercise it on or before the date mentioned in the contract. It makes a big difference for the size of the premium whether it is an American or a European option. On 28 February 1680, for example, Joseph Deutz bought four call options, paying a premium of £510.55. The total underlying asset of these options was £12,000. The strike price in these contracts was 410% and the exercise date 1 May 1680. The original contracts have not survived, but these must have been European options, because the VOC spot price at the contract date was around 420%. If these had been American options, the contracts would have had an intrinsic value of £1,200 on the contract date – Deutz

53 **Insinuaties** 1 August 1672, SAA, Notaries, inv. nr. 2239, fo. 968, 999.
54 The exact details of option contracts have survived only in very few instances. The court case Abra- ham Cappadoce vs. Isaack le Boulanger gives evidence of an American-style option: Cappadoce had bought the right to receive a share from Le Boulanger between the contract date (19 October 1689) and 1 January 1690 at 460%. NA, Court of Holland, inv. nr. 853, nr. 1694-31. The option contract between Johannes van Gistelen and Moses Gabay Henriques (1672) that is transcribed in the protocol of notary Lock is also American-style: SAA, Notaries, inv. nr. 2238, fo. 773. The contract (30 August 1688) between Manasse Ababanel and Jacob Poppen, however, reads that Ababanel had the right to sell a £9,000 VOC share to Poppen only upon the contract’s exercise date: 1 January 1689 (‘op den eersten january 1689 eerstcomende dein dagh alleen’). SAA, Notaries, inv. nr. 4135, fo. 533-4. The options that were traded on the London market in the late seventeenth century were American-style: Murphy, ‘Trading options’, 12 (in footnote).
could have immediately exercised them and he would then have made a profit of almost £700.\textsuperscript{55}

There were more factors that complicated the valuation. The seller could, for instance, insert a penalty clause for non-compliance in the contract. This meant that he could reduce his downward risk stemming from writing the option. On 6 October 1671, for example, Bartholomeus Rodrigues Enriques sold a put option to Michiel Rodrigues Nunes. Rodrigues Nunes paid £78.75 for the right to deliver Rodrigues Enriques a share of £3000 at a price of 530% on or before 1 August 1672. The contractors added a penalty clause that Rodrigues Enriques should pay 10% of the nominal value of the underlying asset (£300) to Rodrigues Nunes if he refused to accept the share.\textsuperscript{56} Hence, if the share price dropped to 517 3/8% or lower, the seller would choose not to accept the share, but rather pay the fine. There are also examples of contracts with a 20%-penalty clause. Unsurprisingly, the premium paid for these contracts was higher – these contracts gave the buyers a profit potential of £600 instead of £300.\textsuperscript{57}

Option contracts could be used for both risk-mitigating and speculative purposes. The speculative use of options works as follows. A trader who believes that the share price will increase can hold a positive position in the stock, but he can also buy a call option or short a put option.\textsuperscript{58} The option transactions allow him to get the profits of a larger number of shares for a relatively small amount of money; he does not have to actually buy the shares, but he can still gain from the expected price increase. A trader who believes that the share price will decrease, however, can short the stock, buy a put option or write a call option.\textsuperscript{59} The available data on the use of option contracts shows that this speculative use was by far the one most employed by the share

\textsuperscript{55} SAA, Deutz, inv. nr. 287.

\textsuperscript{56} \textit{Insinuatie} 1 August 1672, SAA, Notaries, inv. nr. 2239, fo. 993. This procedure could be compared to the very common early-modern Dutch practice of \textit{rouwkoop} ('grieving money'): a fee to cancel a contract. This was basically a fine for not behaving honorably; by paying it, a trader restored the honorable relations: Goldgar, \textit{Tulipmania}, 210.

\textsuperscript{57} E.g. \textit{insinuatures} 1 August 1672, SAA, Notaries, inv. nr. 2239, fo. 995, 997. The net profit of the buyer in case the seller did not live up to his agreements did, of course, not equal the penalty payment. To calculate the net profit, the option premium should be subtracted from the penalty payment.

\textsuperscript{58} The difference between buying a call and writing a put is that the buyer of the call has unlimited profit potential, whereas his loss is limited to the option premium. The writer of a put, on the other hand, gains the option premium if the share price is above the strike price on the exercise date, whereas his potential loss amounts to the total value of the underlying asset.

\textsuperscript{59} The buyer of a put option gains as soon as the share price falls below the strike price to an extent that it offsets the option premium. The profit potential is limited to the value of the underlying asset; the loss to the option premium paid. The writer of a call gains the option premium if the share price falls below the strike price. He loses – and the potential loss is unlimited – as soon as a share price increase offsets the option premium he received.
traders in Amsterdam. Louis Trip, for example, bought two call options for shares with a total nominal value of £42,000 on 16 January 1660.\textsuperscript{60} The strike price of these options was 400\% and they expired on 16 April 1660. They were just out of the money on the contract date. Trip had a large long position in the VOC at that time: he owned share capital with a nominal value of £53,000.\textsuperscript{61} The combination of his long position and the large long call indicates that he was speculating heavily on a share-price increase.

Unfortunately, Trip did not systematically register the details of his option contracts – for the most part, he noted in his journal only the premium he paid or received, without specifying put or a call, strike price or underlying asset – so it is not possible to analyze whether he also used options for risk-hedging purposes.\textsuperscript{62} Joseph Deutz, however, kept his accounts more meticulously. He also used options for purely speculative purposes. On 12 March 1675, for example, when Deutz held a long position in the VOC with a nominal value of £36,000, he bought five call options. These options all had a £3,000 VOC share as underlying asset, a strike price of 450\% and expiry date May 1\textsuperscript{63}, while the spot price on the contract date was 447\%. Deutz was clearly speculating that the share price would increase in the next few months; he enlarged his long position’s exposure to price fluctuations with call options for VOC shares with a nominal value of £15,000.

Deutz also used options for other investment strategies, however. On 4 May 1678, for example, he wrote a call option with a £3,000 VOC share as underlying asset, a strike price of 340\% and expiry date August 1. He received a premium of £360 for this call.\textsuperscript{64} At this date, his long position in the VOC amounted to a nominal value of £8,090 and the spot price was 319\%.\textsuperscript{65} This combination of a long position and a short out of the money call option, called a covered call, indicates that Deutz was hedging against short-term fluctuations in the value of part of his portfolio. With this covered

\textsuperscript{60} Journal entry, 16 January 1660, SAA, Merchants’ accounts, inv. nr. 50. The counterparties to these contracts were Aron Gabay Pharo and Nicolaes van Bambeeck. Sworn broker Hendrick van Meyert participated for 50\% in the option with Gabay Pharo (underlying asset £30,000).
\textsuperscript{61} Journal entry, 24 December 1659, SAA, Merchants’ accounts, inv. nr. 50.
\textsuperscript{62} The same goes for Jacob Athias and Manuel Levy Duarte; they traded options on the accounts of Salvador de Palacios and Olympe Mancine, the Countess of Soissons, but never registered all details of their options. SAA, PIG, inv. nr. 858, fo. 113, 150, 202, 216 and 298.
\textsuperscript{63} SAA, Deutz, inv. nr. 286. The counterparties to these contracts were Rodrigo Dias Henriques, Manuel Mendes Flores, Manuel Anthonio Rodrigues, Samuel Elisa Abrabanel and Joseph Gonsalves de Assevedo. Deutz paid a £180 premium on three contracts and £165 on the remaining two contracts.
\textsuperscript{64} SAA, Deutz, inv. nr. 286. The counterparty to this contract was Guilliam Venturyn.
\textsuperscript{65} SAA, Deutz, inv. nr. 294, fo. 155.
call, Deutz received an option premium and he still profited from a share-price increase up until the point where the market price equaled the strike price. A further increase in the share price would accrue to the buyer of the option. If the share price were to decrease, however, the option premium would cover part of the loss on the long position in Deutz’ portfolio.

Deutz performed a different type of hedge in May/June 1680, when his long position in the VOC amounted to a nominal value of f15,000. On May 8, he bought a call option with a f12,000 VOC share as underlying asset, a strike price of 430% and exercise date of August 1. The premium paid for this option was f840. So far, it seems that Deutz leveraged his portfolio, speculating on a share-price increase. One month later, however, on June 6, he also bought a put option. This option had a f18,000 VOC share as underlying asset, a strike price of 415% and exercise date of August 1. Deutz paid a f495 premium for this put. Combined, these two options formed a straddle*. Deutz obviously expected a big price movement, and he wanted to profit from it, but he was unsure in which direction the price would go. Using these option transactions, he safeguarded his portfolio against too big a price decrease, whilst at the same time enabling him to fully profit from a possible price increase.

Straddles could also be bought in a single transaction. Raphael Duarte, for example, bought one from Josep Francees on 26 October 1671. He paid Francees f1,200 for the right to either receive or deliver a share of f3,000 at a price of 500% from/to Francees on or before 1 August 1672. Duarte could always exercise this option, unless the price were exactly 500%, in which case the option would be worthless. He would make a profit if the share price were to drop under 460 or rise over 540. For any share price in between these values, he would be able to partly recover the option premium he had paid in October. Francees, on the other hand, would make a profit as long as the price did not change too much. Clearly, straddles were the perfect transaction for traders who did not want to be exposed to large downward risks, but who at the same time wanted to benefit from possible price increases. It is not surprising, then, that the premium that had to be paid for these options was rather high.

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66 SAA, Deutz, inv. nr. 295, fo. 20.
67 SAA, Deutz, inv. nr. 287. The counterparty to the call was Jan Haen, for the put Egbert de Vrij.
68 Insinuatie 1 August 1672, SAA, Notaries, inv. nr. 2239, p. 962.
To conclude, all financial techniques needed to take hedged positions on the market were available in the second half of the seventeenth century. The extent to which they were actually used for hedging purposes seems to have been limited, however. Joseph Deutz at times certainly used options to protect his portfolio against short-term price fluctuations, but for the most part he used options in a speculative way; to get a larger exposure to price risk rather than to be insured against unwanted price risk. This does not alter the fact that for each option transaction to be concluded, a certain amount of price risk was traded. Each trader that entered into an option transaction had to consider how much risk was involved in the transaction and how much he was willing to pay to transfer the risk or how much he wanted to be paid to take on the risk.

Consequently, as I have mentioned before, the buyer of each option transaction needed to have a different level of risk-averseness than the seller. The sophisticated options market allowed the traders to get the risk exposure they wanted for their portfolios; they could pay for insurance against a certain amount of risk or be paid to take on extra risks. It is clear, then, that this kind of options market could exist only if there were a large number of traders active on the market who were concerned with short-term market movements. Only these traders were sufficiently well up on the market to be able to put a price on the risk. It is not surprising, therefore, that only the frequent share traders participated in the options trade. The same names that are found in the register of Jacob Athias and Manuel Levy Duarte listing their activities in the trading clubs dominated the options trade. Indeed, options were also traded in the meetings of the trading clubs.\[69\]

An additional advantage of trading options with participants of trading clubs was of course that they were subject to the private enforcement mechanism in force in the clubs. Stock options were never explicitly mentioned in the bans on short-selling\[70\], but it is to be expected that the courts would judge similarly traders who wrote options without owning the underlying asset as they did the short-selling of forward contracts. The fact that I have not found court cases of reneging option sellers could be an indi-
cation that the private enforcement mechanism also functioned well for the options trade. Option buyers thus had to choose their counterparties carefully – all the more so since it was obviously tempting for exchange dealers to write options; this being an easy way to get ready money. Josep Francees, for example, who sold a straddle to Raphael Duarte (see the example on page 143) received ƒ1,200 by just signing a piece of paper. And this was not the only option he wrote; within a month’s time, Francees received ƒ3,285 in his bank account by writing two straddles and a put option. The options market thus not only allowed investors to carefully transfer part of their portfolio risk, it also tempted traders to take on risks they would never be able to bear.

Conclusions
The development of the derivatives market enabled investors to manage and control their financial risks. The evolution of the various types of transactions made the risks involved in trading VOC shares ascertainable and tradable. Furthermore, the active and speculative traders on the market were willing to trade financial risks. The risk-management possibilities provided by the market are the best proof that the secondary market for VOC shares had become a modern securities market.

It is important to note that the traders could never have used the derivatives market to its full potential without both the legal framework and the private enforcement mechanism of the trading clubs and the rescontre being in place, for the derivatives market also tempted traders to take unbearable risks. Writing options, for example, resulted in an immediate positive cash flow. Furthermore, entering into a forward contract required no payment up front, but it did yield the prospect of possible profits. The legal framework and the private enforcement mechanism ensured to a high extent that traders could not just enter into derivatives transactions and walk away if they yielded a loss. Hence, a combination of the availability of sophisticated derivative transactions, a sufficiently large pool of active traders and an efficient enforcement mechanism were required for investors to be able to manage and control their risks according to their needs. The secondary market for VOC shares satisfied these conditions in the second half of the seventeenth century and, as a result, became a modern financial market.

71 SAA, Notaries, inv. nr. 2239, p. 964, 968, 989.
Figure 4.1 Forward and repo transactions represented in diagram form
These diagrams show both transactions from the perspective of the buyer/borrower. On the left side, the steps to be taken to enter into either a forward or a repo are shown. The right side of these diagrams shows the settlement procedures for both transactions and the resulting net cash position of the buyer/borrower. Most importantly, however, the middle part shows that both transactions were similar: they separated the legal and economic ownership of the underlying share during the term of the contract.
Figure 4.2 Size of loans granted on shares pledged as collateral, 1649-1688

The size of the loans is depicted as a percentage of the market value of the share on the contract date. Sources: SAA, Deutz, inv. nr. 275, 285-8, 293-5. SAA, Merchants’ accounts, inv. nr. 50. SAA, PIG, inv. nr. 858. Number of observations: 140.