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# Learning how to manage risk by hedging: the VOC insurance contract of 1613

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We examine an unusual contract which the Dutch East India Company (VOC) sold to investors in 1613. The firm was in a position as modelled by Froot, Scharfstein and Stein for modern corporations: facing heavy, strategic investment, about to reap the benefits, but unable to attract the necessary capital. Hedging or insurance then makes sense to safeguard continued operations. Understanding this, the VOC directors took out insurance on incoming cash from return cargoes. We analyze the contract's price and underwriters and contrast the VOC's single use of this peculiar instrument with the English East India Company's later repeated application.

## 1. Introduction

A curious contract lies hidden in the deeper recesses of the Dutch East India Company VOC's archive. On March 1, 1613 the company's board asked shareholders to underwrite an insurance contract. For a 5 percent premium underwriters guaranteed that, if by August 1616 the sales revenues of cargo coming in from Asia remained below 3.2 million guilders, they would pay the difference. Until now scholars have dismissed the contract as a con trick trapping shareholders into guaranteeing their own dividends ([Stapel and Den Dooren de Jong 1928](#), pp. 83–84). This view appears to be supported by shareholders' reluctance to sign up; it took almost two months to get the contract underwritten and only a small minority signed ([Van Dillen 1958](#), pp. 75–78). However, the company's directors themselves took a large share and it is hard to believe they would buy exposure to a con of their own making. Moreover, the underwriters included seasoned investors with first-hand experience of marine insurance who must have understood the terms and conditions and therefore took the 5 percent premium as good compensation given the risk. They were proven right, the insurers did not pay up. Nor did the VOC resort to such an insurance policy again, two facts which raise the question what problem the contract had been designed to solve. That question becomes all the more interesting when we realize that, a couple of years later, the English East India Company repeatedly used very similar contracts.

We therefore analyze the contract in order to better understand the VOC's motives for issuing it and the underwriters' motives for buying. We unpick the contract's terms and implications and also the underwriters' motives, conceiving the contract as a form of

hedging. As [Lessard \(1991\)](#) argued and [Froot \*et al.\* \(1993\)](#) modelled, insurance contracts can safeguard the continuity of business operations of corporations with volatile cash flows. These result either in a demand for external finance or fluctuations in investment. The latter are undesirable, because valuable growth opportunities may be missed, whereas the former may not be available because of the increasing marginal cost of external finance. Under such circumstances risk management through insurance can reduce cash flow volatility, secure a firm's investment through internal finance, and thereby enhance firm value.

Combining current finance and risk theory with a reconstruction of the VOC's financial situation helps us to distill the contract's purpose. The VOC, a corporation with limited shareholder liability, possessed valuable growth potential, but having no financial buffer the company risked being unable to realize it. To cover that risk, the board drafted a contract consistent with the [Froot \*et al.\* \(1993\)](#) model so as to persuade its main shareholders to temporarily increase their exposure to the VOC. We discard alternative explanations. Firstly, using a valuation model we demonstrate that the board did not seek to profit from a mispricing of the insurance contract. Secondly, we show that bankruptcy costs are an unlikely explanation, because the VOC debts formed only a small portion of the insurance contract.

Our findings are highly relevant for the history of early Modern business finance, because they show how the rise of corporate enterprise also prompted sophisticated risk-management techniques. This is underlined by the fact that the EIC used a similar type of contract some twenty years later to escape from a different type of risk which also limited its ability to unlock growth potential. The EIC was primarily financed with debt and its shareholders, unlike those of the VOC, had no limited liability. Therefore, if the company went bankrupt, they risked being held liable for residual debts, in addition to losing their shares. To avoid that possibility the EIC directors hedged the risk with a series of insurance contracts essentially similar to the VOC's 1613 contract whose pay-outs covered current debt. The amount insured matched the debt positions. Therefore our case study also contributes to the modern finance literature by demonstrating that risk management motivations tested for today's corporations are relevant for their early modern forerunners as well. Conversely, our case highlights how those forerunners were acutely aware of various types of risk and knew how to devise ways of hedging them, an aspect until now absent from the literature on the two colonial trading companies.

We start the article with a brief overview of the current risk management literature and list potential motivations for the insurance contract. Then we describe the VOC's position in 1613 and the contract terms. Next we confront the VOC setting with the finance literature. We use a valuation model to test the contract's price and conclude that it was fair given the risk. We also model the subscribers' choices to understand their motivations. Finally, we consider the EIC's financial position in order to explain its repeated use of similar contracts.

## 2. Motives for risk management

Let's start with probing the potential motives for using such insurance contracts. Modern corporations regularly buy cover against exceptional events, such as fire or hurricanes, but they also use derivatives to reduce potential negative effects of price risks on firm value. The contemporary finance literature treats these risk management decisions similarly to other financial decisions, which [Modigliani and Miller \(1958\)](#) show to be irrelevant if market imperfections such as taxation, contracting costs and distortions of optimal investment

policies are absent. In other words, the motivation for risk management can be derived from real world imperfections.

Stulz (1996) argues that the primary reason for risk management is to reduce bankruptcy costs, because hedging against negative outcomes will reduce the probability that the firm cannot meet its obligations towards creditors. Bankruptcy is expensive in case of inefficient liquidation, but also when stakeholders require a premium for the costs they incur in case of a default. In the situation of the early colonial trading companies the liability of shareholders becomes a relevant factor. In a situation of full liability with distress, the shareholders risk being held liable for debt on top of losing their share, which was the case for the early EIC. However, the VOC's limited liability shareholders stood to lose only their share. In addition to the previous arguments, based on maximization of shareholder value, Stulz (1984) and Smith and Stulz (1985) have introduced managerial risk aversion as a motive for risk management. Because managers are typically poorly diversified with human (reputation) and financial (shareholdings plus future salary) capital, bankruptcy costs are high. If managers cannot hedge personally against these bankruptcy costs, they will want the firm to reduce its risks. In the case of the VOC in 1613, the managers were personally liable for company debt.

Froot *et al.* (1993) argue that risk management may be motivated by strains between cash flow and investment opportunities. They model corporate investment as dependent on volatile cash flows, so firms need external finance to avoid losing growth opportunities. In perfect capital markets external finance will always be available, but in more realistic settings firms constantly face the risk of losing opportunities to financial constraints. Risk management to reduce cash flow volatility can then enhance firm value by protecting investment policy from unwanted fluctuations. An interesting outcome of the Froot *et al.* (1993) model is that full insurance is typically not the optimal strategy, because safeguarding future investment is a sufficient goal for risk management. Moreover, the authors find that non-linear (option-like) instruments are better in coordinating financing and investment policies than linear instruments (futures, forwards, etc.), because value-creation stems from preventing downside cash flow surprises.

Mayers and Smith (1982) argue that comparative advantages in bearing risk may motivate the use of risk management instruments and their price. For example, if managers expect insurers to have a comparative advantage in bearing the risk or to underestimate the risk, they could agree on a low premium compared to a fair compensation for the guarantees. We refer to the motivation based on a comparative advantage or underestimation by insurers as a price inefficiency, because under this explanation, the actual premium is below an efficient price that the insurer would require in case they capture the benefits of the comparative advantage and correctly estimate the risks.

### 3. The VOC's 1613 position

The Fall of Antwerp in 1585 sparked a fierce struggle between Portugal, Spain, Britain, and the Dutch Republic for control over the supply of Asian spices to Europe (Kellenbenz 1956; De Vries 2003). All faced similar, formidable challenges: to set up permanent trading posts in southeast Asia, organize a regular flow of spices to Europe, secure access to markets around Europe, and keep up prices. To meet them, the Dutch created the VOC in 1602. It received a monopoly on trade the area between Cape of Good Hope and the Straits of Magelhan, considered necessary to obtain sufficient muscle for dealing with its European

rivals and with its Asian counterparties (Van der Chys 1856, pp. 130–131). The VOC would only exploit that monopoly during an initial ten years, until 1612. The board would then present full accounts, liquidate the company, return its capital to the shareholders, and launch a new venture to exploit the monopoly's until 1623. The VOC consisted of six chambers, Amsterdam with half a share in the total, Middelburg in Zeeland with one quarter, and Rotterdam, Delft, Hoorn and Enkhuizen sharing the rest.

Despite its ample capital of 6.4 million guilders, the VOC operated under serious financial constraints. The directors' financial policy was poorly suited to the heavy military investment which a powerful presence overseas required. The entire capital was spent during 1603–1606 on the first three fleets in the expectation, on the basis of the earlier expeditions to Asia, that sales of return cargoes generated sufficient revenues for subsequent expeditions. This worked well enough for the leading chamber, Amsterdam, and possibly also for the second biggest, Middelburg, but the four other, smaller chambers found it hard to muster sufficient resources (Schalk, Gelderblom and Jonker 2012; Gelderblom *et al.* 2013). Paying dividends was out of the question. As debt mounted, directors realized that they stood no chance of attracting fresh capital if they did liquidate the company's first ten years' account in 1612.

The VOC needed permanence. Lobbying the Estates General to get it started in 1608, but the directors waited another three years before sending a formal petition to lift the obligation to liquidate in 1612. Their request ran into firm resistance from representatives demanding cash dividends for shareholders or directorships for provinces which had none. In July 1612 the Estates-General permitted the VOC only to roll over money into its next expedition. The following year liquidation was postponed until the charter renewal in 1623, when it was finally decided to continue operations for an indefinite period of time (Mansvelt 1922; Steensgaard 1982; Dari-Mattiacci *et al.*, 2017).

Permanence did provide the basis for further investment that strengthened the VOC's grip on the lucrative Asian trade (Gelderblom *et al.* 2013; Dari-Mattiacci *et al.* 2017). But in the short run it reduced the company's funding options, for raising equity was now out of the question. Moreover, permanence also undermined the VOC's financial position. To appease shareholders the board had awarded, from March 1610 onwards, a series of dividends totalling 162.5 percent, that is to say, effectively a full reimbursement of the shares plus an annual 6.25 percent compensation for the company's first decade. These dividends were to be mostly in kind, i.e., in spices, and only a little cash. Many shareholders refused to accept that, forcing directors to offer three cash payments instead, spread out over 1612, 1614, and 1616. These payments drained the VOC's cash (table 1).

Table 1. *Estimated cash payments needed by the VOC Chambers to fulfil the 162.5 dividend obligation (guilders)*

Term	Dividend	Amsterdam	Other chambers
	Paid until December 1612	2,594,630	1,709,615
I	Cash (57.5 percent)	684,637	451,111
II	Cash (42.5 percent)	1,022,463	673,706
III	Cash (62.5 percent)	1,991,541	1,312,236
Total I–III		3,698,641	2,437,053

Source: NA 1.03.02 Inv. No. 7066 (Journaal van Actien 1607–1612).

Using the entries for dividends paid from the Amsterdam chamber's share administration ledger, we estimate the total amount of cash dividends due at six million guilders.<sup>1</sup> The Amsterdam Chamber needed about 700,000 guilders by December 1612, one million in August 1614 and almost two million in August 1616. Assuming shareholders elsewhere had similar preferences, payments due there amounted to 450,000 in 1612, 670,000 in 1614, and 1.3 million guilders in 1616.

These promised dividends threatened the company's opportunities to invest. The board first tried to raise additional income by asking the Estates General for a subsidy, but got no more than 225,000 guilders. With company debt already exceeding two million guilders for Amsterdam alone, directors were reluctant to increase their exposure, so they agreed only to raise some additional short-term loans.<sup>2</sup>

Consequently the company had no choice but reduce the number of ships sailing in 1613. On February 14, 1613 the board decided to send seven large vessels, cut the number of yachts originally proposed from eight to five, and postpone the sailing of the Amsterdam Chamber's ships to July. The amount of silver destined for Asia was set at only 400,000 guilders which, at the then current gross margins, would buy a return cargo with a sales value of 1–1.5 million guilders at most.<sup>3</sup> These measures lowered expenditure to 1.8 million guilders, that is to say, one third less than the previous fleet.<sup>4</sup> Even so the company risked being unable to pay the agreed dividends totalling five million guilders. That must have convinced the VOC directors to try something new.

#### 4. The contract's terms

On the final day of the VOC board meeting in Amsterdam, 28 February, 1613, the directors fixed the insurance contract's terms.<sup>5</sup> Underwriters received a 5 percent premium to insure "that from East India into these lands of Holland and Zeeland arrive for the aforesaid company, and will be stored in its warehouse or warehouses, return goods for a value of 32 tons of gold" by the contract's expiry on 31 August, 1616. So, if the value of incoming cargo fell short of 3.2 million guilders, underwriters would pay the difference, half in February 1617, the other half in August 1617. For goods arriving after August 1616 the underwriters would be reimbursed pro rata and with interest calculated at 6.25 percent. The underwriters had to pledge their VOC shares to the company as guarantee for the sums insured, so those shares were effectively taken out of circulation

<sup>1</sup> National Archives The Hague (NA) 1.03.02 Inv. No. 7066 (Journaal van Actien 1607–1612).

<sup>2</sup> According to an anonymous pamphlet the VOC as a whole owed 1.6 million guilders in deposits in January 1610 (Van Dillen 1930, pp. 59). The surviving accounts of the Amsterdam ships belonging to the fleets of 1611 (Blok) and 1614 (Stoop and Spilbergen) reveal total interest payments of 133,500 guilders and 128,100, respectively, for deposits bearing 6.25 percent interest, which amounts to debts outstanding of 2.1 and 2 million (NA 1.04.02, Inv. Nr. 14337, fol. 53–70; Inv. Nr. 14338, fol. 36–84).

<sup>3</sup> Comparing the amount of silver carried to Asia (Bruijn *et al.* 1987, vol. III, pp. x–xi, 15–31) with incidental references to the sales revenues of spices bought with this silver, shows that the "Rotterdam", one of the 1611 return ships, realized a gross margin of 176 percent (NA 1.04.02 (VOC), Inv. Nr. 11349, Copieboek rekeningen Zeeland, carta 142). Two ships returning to Enkhuizen in 1618, the "Enkhuizen" and the "Postpeert", realized gross margins of 313 and 335 percent, respectively (NA 1.04.02 (VOC), Inv. No. 14854 (Grootboek), fol. 428, 531). A 1618 memo on the value of silver shipments found amongst the papers of an Amsterdam director used a gross margin of 250 percent as a default (NA 1.11.01.01 (Aanwinsten Eerste Afdeling), Inv. No. 255, fol. 78–79).

<sup>4</sup> Gelderblom *et al.* 2013, Online Appendix.

<sup>5</sup> See Appendix 1 for a translation of the contract.

for the duration. The underwriters waived their right to litigation and also allowed the company “to deal both friendly and unfriendly, offensively and defensively, on water and on land”, i.e., the insurers would have to pay even if losses resulted from the company knowingly jeopardizing cargo through fighting.

Maritime insurance covering the risk of loss of ships or cargo was a widely practiced business in the Republic’s ports (Barbour 1929; Spooner 1983; Go 2009; Leonard 2016). Several VOC directors had first-hand experience with it from their trade with the Iberian Peninsula, Italy, and the Levant, i.e., shipping routes with a high piracy and privateering risk and corresponding premiums (Van Niekerk 1998, pp. 575; Go 2009). In 1600 one of the VOC’s predecessors, the *Oude Oostindische Compagnie*, had insured its ships prior to their departure for Asia; two years later the VOC’s Amsterdam chamber insured six ships of Warwijck’s fleet (Van Dam 1927, pp.16). The company then stopped doing so, probably because the risk of loss turned out to be comparatively limited (Table 3). From 1602 to March 1613 the VOC had lost only three ships on the outward voyage and one homeward bound on a total of 125 trips, a chance of 3.2 percent overall.

However, the 1613 contract was not a conventional policy covering ships or cargo. According to Stapel and Den Dooren de Jong (1928) and Van Dillen (1958) the insurance covered the entire fleet of 1613. In previous work we took this for granted (Gelderblom *et al.* 2013, p.1067). The terms of the contract as related by the company’s first chronicler, Pieter van Dam (1621–1706), prove otherwise (Van Dam 1927) and made us revise our opinion. The 1613 contract insured the company’s cashflow, because it guaranteed a sum of money arriving between March 1613 and August 1616 and defined as the total value of all incoming cargoes calculated at fixed prices for all goods.

That future cargo volume included goods to be purchased with the silver laden in the ships ready for departure, but the company and its insurers had considerably more to expect. In March 1613 the VOC had 37 ships with a capacity of over 19,200 tons in Asia (cf. table 2) and it must have possessed considerable stocks there waiting to be dispatched. Whether or not the company received goods worth 3.2 million therefore depended on considerably more ships than the nine ready for departure and on much more cargo than this fleet alone could carry home.

Table 2. *The number and tonnage of ships and yachts under the VOC insurance contract*

Departure	Ships	Yachts	Tonnage
January 1610	4	1	2,780
December 1610	3	0	1,369
May 1611	2	0	1,500
December 1611–May 1612	12	4	6,710
January–July 1613	9	2	6,900
Total	30	7	19,259

Source: Bruijn *et al.* (1987), outbound voyages (ships): 0135.1; 0140.2; 0146.2; 0149.1; 0150.3; 0152.2; 0154.1; 0155.1; 0157.1; 0158.1; 0163.3; 0164.1; 0166.1; 0172.1; 0173.3; 0174.1; 0143.3; 0144.2; 0138.2; 0142.1; 0145.2; 0159.3; 0161.3; 0169.2; 0170.1; 0171.2; 0147.2; 0156.2; 0165.1; 0160.3; (yachts) 0148.2; 0151.1; 0153.1; 0162.1; 0175.1; 5100.3; 0168.1.

Table 3. *The VOC's shipping pattern, 1602–March 1613*

<u>Ships departed from the Republic</u>	92
Lost on outward voyage	3-
Arrived in Asia	89
Stayed in Asia	66-
Returned to Republic	23
<u>Returned to Republic</u>	23
Lost on homeward voyage	1-
Too late to observe	1-
Arrived in Republic without stay in Asia	21
<u>Stayed in Asia</u>	66
Lost in warfare	7-
Lost due to shipwreck	9-
Broken up	2-
Other reasons for not returning	17-
Lost on homeward voyage	4-
Lost in Asia or homeward voyage	39-
Too late to observe	5-
Arrived in the Republic after stay in Asia	22
Probability of not arriving in Asia $3/92 = 3.26\%$	
Probability of not arriving in Republic when no stay in Asia $1/(23-1) = 4.55\%$	
Probability of not arriving in Republic when stay in Asia $39/(66-5) = 63.93\%$	
Probability to stay in Asia after arrival $66/89 = 74.16\%$	
Statistics on arrival in Republic without stay in Asia (19 observations)	
Average: 670 days	
Standard deviation: 210 days	
Minimum: 246 days	
Statistics on arrival in Republic with stay in Asia (22 observations)	
Average: 1270 days	
Standard deviation: 245 days	
Minimum: 941 days	
Silver cargo non-yachts (73 observations)	
Average: 79,389 guilders	
Standard deviation: 25,567 guilders	
Minimum: 23,970 guilders	
Silver cargo yachts (16 observations)	
Average: 45,307 guilders	
Standard deviation: 12,400 guilders	
Minimum: 23,643 guilders	

*Note:* Data from Bruijn *et al.* (1987). The other reasons for not returning are that ship stays in Asia permanently (8 ships), out of sight (2 ships), unknown (7 ships). Stayed in Asia is defined as ships having a duration of stay in Asia of more than one year.

The fact that the contract insured a cashflow is also evident from its maturity date. By August 1616 the VOC had to have an estimated 3.3 million guilders for paying the third dividend, i.e., the equivalent of the return cargo value insured. Stapel and Den Dooren de Jong (1928, pp. 84) therefore concluded that the board tricked shareholders into guaranteeing their own dividend with a complicated contract stacked against them. The likelihood of

insider–outsider conflicts in the early corporations also resonate in the recent literature (Harris 2009). However, this position appears difficult to hold. As we will see below the policy was sold almost exclusively to shareholders, but the directors amongst them also underwrote large sums which they would not have done if they knew it to be a trick (cf. Van Dillen 1958, pp.75–76).

### 5. The risk of trips to Asia

The contract was valuable for the VOC if the 5 percent premium cost outweighed the chance of incoming revenues falling short of 3.2 million, whereas insurers gained if the 5 percent premium exceeded that chance. Four factors determined the volume of revenues coming in: the number of ships present in Asia or on the way back in March 1613; the likelihood of ship loss; and the likelihood of ships being detained for duties in Asia. Both VOC and alert insurers could judge their chances using the company's shipping patterns during the ten years prior to the contract plus the revenues from incoming cargoes.

The priceless database compiled by Bruijn *et al.* (1987) renders those data also available to us (Table 3). We applied them to estimate a backward-looking model using ship movements and sales revenues which an alert insurer could have observed in the ten years prior to the contract. This test assumes equal information: potential underwriters and the VOC directors knew or could know the actual outcomes since 1602. However, the board possessed additional information. It knew more about what happened in Asia, about the position and actions of the EIC and of competing nations like Portugal, and it determined policy, for instance the number of ships coming back or remaining in Asia. Potential underwriters therefore were at a disadvantage, which they probably priced in. Our tests also assume independence of the loss probabilities. Moreover, our model accounts for known risks, but not for uncertainty (Knight 1921). Thus, if our model yields a premium value higher than the contract's 5 percent, this would be consistent with an inefficiency driving the contract, but does not enable us to specify the information asymmetry.

The shipping data includes 1. ships departed from the Republic; 2. ships lost on the outward voyage; 3. ships kept in Asia; 4. ships that returned to Republic within one year after arriving in Asia; and 5. homeward bound ships lost (Table 3). The main risks of the Dutch-Asian voyages included running aground, warfare and bad weather. Two uncertain factors are whether ships did or did not return, and the duration of trips. From this information, we calculated the probability of ship loss and the average, minimum, and standard deviation of trip duration. We also calculated average, minimum, and standard deviation of the arrivals of silver in Asia for ships and yachts, because the amount of silver determined the volume of purchases (Gelderblom *et al.* 2013). We then estimated return cargo values per ship using the contract's fixed prices for pepper, nuts, cloves, and mace, and market prices for other goods.

Our model conceives the insurance contract as an option on the difference between the revenues ( $S$ ) per August 1616 and 3.2 million guilders ( $X$ ), with a minimum of zero revenues (contract pays 3.2 million) and a maximum of 3.2 million or more (contract pays 0). Between those extremes the contract pays 3.2 million minus the revenues. We used the terms of the contract and information about voyages from 1602 until March 1613, i.e., all information available to an insurer when the contract was first proposed, and simulated revenues and the timing of the revenues. In each simulation run we compared the 5 percent premium with the simulated payoffs to the VOC.

For the VOC the pay-off is  $\text{Max}[X-S; 0]$ . This is the equivalent of a long position in a European put option. For the insurers, with a short position in the put option, the pay-off is  $-\text{Max}[X-S; 0]$ . In this analysis we take the perspective of the insurer. The pricing of the option to find option price  $P$  requires the modelling of the outcomes of  $S$ , the revenues. In case the revenues can be described with a single stochastic process, the pricing is simple, because we can use the Black–Scholes formula for European options. However, for the 1613 contract the revenues  $S$  are dependent on several underlying processes and contingent on decisions of the VOC. Moreover, the contract involves payments after maturity. In this setting the valuation can only be performed via Monte Carlo simulation.<sup>6</sup>

The key terms of the contract are as follows. On March 1, 1613 the contract is initiated. The principal amount is 3.2 million guilders of revenues (based on fixed prices for pepper, nuts, cloves and mace and market prices for other goods). In May 1614, a 5 percent fee payment is received. In August 1616, the contract expires and in February and August 1617 payments to the VOC are due. Although the contract is settled based on revenues per August 1616, revenues after this date are also taken into account and insurers receive a compensation for these revenues including 6.25 percent interest. The contract pay-off is paid in equal parts in February and August 1617. Thus, the payments are made respectively 33 and 39 months after the payment of the premium (assuming all payments are made on the same day of the month). In order to compare the payments with the premium we need to discount the payments with monthly compounding in order to find the present value of the payments per May 1614. We use 6.25 percent as our discount rate.

From information about the completed voyages from 1602 until March 1613 we calculate the probabilities of ship losses and the average, minimum, and standard deviation of trip durations. We calculate average, minimum, and standard deviation of silver arrivals in Asia for ships and yachts, because we assume (with Gelderblom *et al.* 2013) that the return cargo values per ship depend on the amount of silver available for purchasing spices times a sales/purchases margin.

We define the simulation structure of our model in eight steps. 1. We start with the nine ships in the 1613 fleet, the 21 ships in earlier fleets that did not yet return and are not reported missing, and seven yachts (see Appendix 2). For each vessel we simulate arrival or loss based on a random draw and probability of non-arrival of 3.26 percent. 2. For each arrived vessel we determine the simulated amount of silver cargo from the distributions described in table 3, using the average and standard deviation as well as applying the minimum value. We sum the amount of silver in Asia for Amsterdam, Zeeland and the collective of smaller chambers, and then divide the silver over the ships that have arrived. We thus assume that the only purpose of yachts is to transport silver to Asia. 3. Then, we simulate arrival in the Republic for the ships without a stay in Asia, again based on a random draw, and with probability of non-arrival of 4.55 percent. 4. We also simulate arrival in the Republic for the ships with a stay in Asia, again based on a random draw, and with probability of non-arrival of 63.93 percent. 5. For each ship returning to the Republic we simulate the journey duration, including a stay in Asia—so as to simulate the timing of the revenues. We randomly draw from a normal distribution with averages and standard deviations as in table 3. We also impose a minimum duration, based on actual data. In this simulation we distinguish journeys with and without a stay in Asia, because the latter journeys take much longer. For all arrivals we have the simulated silver intake in Asia, which we multiply by margins of 2.5, 3, or 3.5 (each with equal probability). This provides us with a

<sup>6</sup> Hull (1993); Section 14.1 describes Monte Carlo simulations for the valuation of European options.

Table 4. Simulation results

	Average	Median	Standard deviation	Standard error	Minimum	5th Percentile
Number of ships arriving in Asia	35.79	36	1.07	0.0107	30	34
Number of ships arriving in Republic	15.22	15	2.75	0.0274	4	11
Average travel time in days <sup>a</sup>	992	992	98	0.981	1426	1154
Value of goods arriving before August 1616	3,708,092	3,688,875	776,367	7,764	1,054,716	2,470,842
Value of goods arriving after August 1616	405,204	329,244	314,180	3142	0	0
Pay-off to VOC per Aug 1616 <sup>a,b</sup>	0.0301	0	0.0696	0.0007	0.5561	0.1890
Total payoff to VOC <sup>a,b</sup>	0.0122	0	0.0430	0.0004	0.5406	0.0953

<sup>a</sup>The minimum and percentiles show the largest values.

<sup>b</sup>Discounted to May 1614 values in percentage of 3.2 million.

return date and value for each ship. 6. Per August 1616 we determine the total value of the returns. In case the value exceeds 3.2 million the contract is terminated without further cash flow consequences. In case the revenues are insufficient, payments will take place in two instalments. 7. For a period of ten years after August 1616 we make a monthly overview of returns. In case the contract has been terminated in step 6, these revenues have no consequences. Otherwise we simulate that the VOC returns these late revenues to the insurers taking the 6.25 percent (not compounded, according to seventeenth century practice) interest into account. We keep returning cash to insurers until the total revenues equal the 3.2 million. 8. Finally, we discount all cash flows to May 1614 values, when the 5 percent premium is received. This allows a comparison of all relevant cash flows in equal terms. Note that we apply monthly continuous compounding.

Following this simulation structure we perform 10,000 runs ( $n$ ) of this simulation. This yields 10,000 simulated  $P$ 's. We take the average of the  $P$ 's ( $\bar{P}$ ) and the standard deviation ( $\sigma_P$ ). The standard error of the estimate is  $\sigma_P/\sqrt{n}$ , i.e., more simulations increase the accuracy of the estimate.<sup>7</sup> The expected price is  $\bar{P}$ . We also describe the distribution of the outcomes, both per August 1616, i.e., excluding late revenues and including them.

Table 4 presents the results. The simulated average payoff to the VOC per August 1616 (in values of May 1614) equals 3.01 percent, i.e., 2 percent lower than the contract's 5 percent. This 3.01 percent is the average outcome of all simulations and represents the fraction of the subscription an insurer has to pay to the VOC upon the contract's maturity. Thus, the 5 percent premium paid considerably exceeded the equal-information model price at the contract's August 1616 maturity. If we take potential revenues after August 1616 into account, the company's average payoff even falls to 1.22 percent, because in our simulation over the years after 1616 fleets are returning with sufficient cargo.<sup>8</sup> These outcomes suggest that the board really wanted insurance, because it overpaid the likely risk.

<sup>7</sup> Hull (1993, pp. 333).

<sup>8</sup> It should be noted that the simulations do not yield 0 percent outcomes in case of late but sufficient arrivals, because we compound interest while the VOC used simple interest in its calculations. In other words, we value late arrivals less due to the compounding, compared to the VOC compensations.

The insurers' risk is also best illustrated by considering the worst possible outcomes. For example, the simulations yield a lowest revenue per August 1616 of 1,054,716 guilders. In that case the insurers would have had to pay almost 2.2 million guilders, discounted to May 1614 values a loss of 55.61 percent. However, since the contract's option features yield abnormal payoffs, we used the 5 percent value-at-risk (VAR) measure, a widely used metric for risk in non-normal distributions, as gauge. [Jorion \(1997\)](#) defines VAR as a summary of the expected worst loss over a specific horizon within a given confidence interval. The 5 percent VAR, for example, measures the worst outcome with a 5 percent probability, or, in other words, the amount of money one can lose in the fifth worst of one hundred outcomes. We find the 5 percent VAR by ordering the outcomes of our simulation and presenting the fifth percentile. The VAR was small, 18.90 percent until August 1616 and 9.53 percent over the full period.<sup>9</sup> In other words, in one out of twenty simulations the underwriters have to pay 18.9 percent in 1616, with a final balance of 9.53 percent. In 74.36 percent of the simulations no payment is required in 1616. However, we need to realize that our simulations are based on known risks, historical distributions measured over 1602–1612, whereas the underwriters likely based their decisions on unpredictable and unforeseeable events ([Knight 1921](#)).

Summing up, based on the VOC's performance over the previous ten years there existed a real possibility that the company would not receive cargoes worth 3.2 million guilders by August 1616. Insurance therefore made sense, but with more than 30 ships in service, carrying up to 2.5 million guilders in silver, the VAR was small, and the 5 percent premium generous. However, given the uncertainties and the information asymmetries it was not a treat. Shareholders must have sensed that, for they did not rush to underwrite.

## 6. The underwriters' motives for signing

The contract was underwritten almost entirely by shareholders; we identified only five underwriters without current or past VOC shareholdings. The company probably targeted its shareholders because they were wealthy and most likely to be concerned about the VOC's future. However, from a portfolio perspective shareholders might have been reluctant to increase their exposure to the firm's risk, and indeed only a small minority signed up. In other words, underwriters did not participate in the contract to optimize their investment portfolios. To understand why shareholders did or did not underwrite we examined the subscription process and examined the entire group of shareholders to tease out further likely motives of those who did. Given the paucity of non-shareholding underwriters we cannot probe the question of why the insurance contract was almost exclusively underwritten by shareholders.

We reconstructed the underwriting pattern from the VOC's Amsterdam chamber ledgers, linking available data on shareholders and insurers to their share in the contract, the value of company shares owned by them, their role as directors and/or creditors of the company, dividends received, and shares traded by them during the preceding decade. At the

<sup>9</sup> Of course our assumptions do influence the simulation outcomes. In particular the margins of 250–350 percent may affect the simulations. In order to describe the effects on our results we perform several additional simulations with other parameters. For example, we hold the margin constant at 300 percent. As a result the value of the contract is 2.89 percent (5 percent VAR is 18.54 percent) with arrivals until August 1616 and 1.14 percent (5 percent VAR of 8.94 percent) for all arrivals. Those results are very similar to our initial simulation.

same time we gauged the directors' reaction to the ebb and flow of subscriptions by charting their subscriptions separately (see figure 1).

Until March 20 the subscription was exclusively open to shareholders, with the aim of having them subscribe for half of their nominal holdings, in the case of Amsterdam a total of 1.8 million guilders on the chamber's 3.6 million capital (Van Dillen 1958, pp. 74). This failed utterly. By March 20 only 44 out of 964 shareholders had underwritten for a total of 198,075 guilders. Among them were five directors with 68,800 guilders, not much, but still more than double their share in the chamber's capital, so they had wanted to give a firm push. After consultation with other chambers the Amsterdam directors decided to improve the conditions by allowing shareholders to underwrite the policy up to the full nominal value of their shares from 1 April.<sup>10</sup> This helped; during the first week of April, subscriptions rose to almost 900,000 guilders and the number of underwriters more than tripled to 153 out of a total of over 900. Even so the vast majority still held back. The Amsterdam directors then raised their own subscription to 450,000 guilders, against their total share of 570,000 in the chamber's capital.<sup>11</sup> By further oversubscribing, directors signalled to shareholders that the contract was not a con trick, an insurance policy with too low a premium given the risk (Harris 2009). Moreover, the directors' move demonstrates that managerial self-interest cannot have motivated the 1613 contract, or else they would not have wanted others to join in. The directors also allowed shareholders who had already underwritten 50 percent of their share in the policies of other chambers to take their subscription to 100 percent by underwriting in Amsterdam (figure 1).<sup>12</sup>

These measures persuaded some stragglers. During the next three weeks fifty new shareholders signed and an equal number raised their initial subscription, taking the total to 1.5 million guilders on April 20, and almost 1.8 million two weeks later. Several of the latecomers had already signed in other chambers.<sup>13</sup> Nearly all underwriters were also shareholders, but in the end a total of only 214 Amsterdam shareholders signed, less than a quarter of the total.<sup>14</sup> The same was true for the other chambers of the VOC.<sup>15</sup>

<sup>10</sup> Resolutions of the Amsterdam Chamber: NA 1.04.02 VOC, Inv. No. 227, fol. 91–93 (1 and 4 April 1613). Cf. also Van Dillen (1958, pp. 78).

<sup>11</sup> Based on their initial shareholdings and share transactions registered in the "Journaal van Actien" of the company (NA 1.04.02 VOC, Inv. No. 7066) we calculate the holdings of the directors in function in December 1612 at 537,500 guilders. In 1613 fourteen directors signed the insurance contract for a total of 462,060 guilders (Van Dillen, 1958, pp. 81, 97).

<sup>12</sup> NA 1.04.02 VOC, Inv. No. 227, fol. 91–93 (1 and 4 April 1613).

<sup>13</sup> A comparison of the names of underwriters in Amsterdam (NA 1.04.02 (VOC), Inv. No. 7064) with those in Enkhuizen (NA 1.04.02 VOC Inv. No. 14854 (Grootboek), fol. 395, 397) reveals six Amsterdam shareholders underwriting both policies. Leonard Rans, for instance, signed Amsterdam's policy for 75,000 guilders, up from 44,800 in December 1612.

<sup>14</sup> Comparing the names of the 230 insurers of the Amsterdam chamber with those of its shareholders reveals that the latter took up more than 98 percent of the sum. Van Dillen (1958, pp. 81, 97) counted 252 subscriptions but these subscriptions relate to only 230 people. The names of six of them are illegible, while another eleven cannot be found among the company shareholders (NA 1.04.02 VOC, Inv. No. 7066). We can identify 213 underwriters as shareholders. Another eight cannot be properly identified because their names are (partially) illegible. Four out of the remaining nine insurers who did not own shares at the end of 1612 are known to have traded shares before that date. (Share sales in the Amsterdam Chamber recorded in: NA 1.04.02 VOC, Inv. No. 7066; the Amsterdam insurance policy: NA 1.04.02 VOC, Inv. No. 7064.)

<sup>15</sup> The administration of insurers kept by the directors of the Zeeland chamber reveals that 69 shareholders and 4 outsiders underwrote the policy in Middelburg (NA 1.04.02 VOC, Inv. No. 13860, 13861). In Enkhuizen 68 out of 77 insurers owned shares in the local chamber. Their subscription amounted to 249,800 out of 283,500 guilders (82 percent). At least three of the remaining nine insurers (subscribing 15,000 guilders, or 5 percent) owned shares in the Amsterdam chamber (NA 1.04.02 VOC Inv. No. 14854, Grootboek, fol. 395, 397).

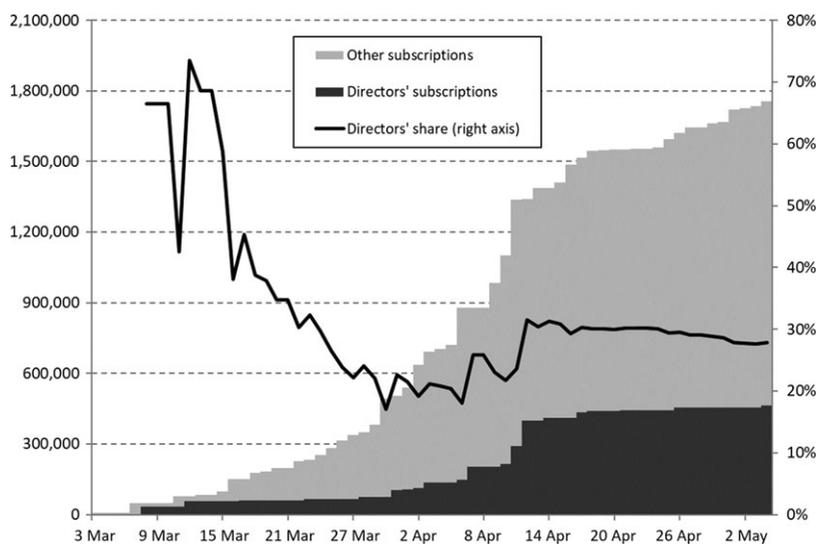


Figure 1. Subscriptions to the insurance contract of the Amsterdam chamber by directors and other subscribers (3 March–2 May).

Source: NA 1.04.02 (VOC), Inv. No. 7064.

Why was a small minority keen, whereas so many others could not be bothered? To further explore potential motives we take a closer look at both underwriters and abstainers (table 5). The average subscriber to the insurance contract underwrote for 7,689 guilders. They tended to be large shareholders, much larger than the shareholders who abstained, and the group included all but one of the directors. Underwriters also had higher dividend rights and they had collected more of the dividends in kind due than the abstainers: for pepper, 78.0 percent versus 44.1 percent and for nutmeg, 41.8 percent versus 24.0 percent.<sup>16</sup> Insurers also appear to have had more complex businesses, because 31.3 percent had an account with the *Wisselbank*, established in 1609, against only 13.9 percent of shareholders-non subscribers.

Thus it would seem the insurance contract had the greatest appeal to big investors with a keen interest in the company's survival, but we have to tread carefully as the group characteristics reported in Table 5 are correlated. In order to deal with this issue, we estimated four multivariate regression models, investigating the choice to subscribe explained by (1) the amount of shares owned, and whether they were directors and/or bondholders; (2) the amount of dividend claims; and (3) the amount of shares bought or sold. Model (4) summarizes the significant effects. Table 6 presents the results as odds ratios: coefficients above one imply a positive effect and coefficients between zero and one a negative effect. Large shareholders were more likely to participate, i.e., increase their exposure to the VOC, and this is a strong effect: changing the share capital from the 25th (600 guilders) to the 75th percentile (3,600 guilders) raises the probability of underwriting by 3.15 times. On the other

<sup>16</sup> In subsequent analyses we log-transform share capital and transaction size, because these variables have relatively large values for some observations. The transformation allows for a decreasing marginal influence and limits the impact of few large values on our inferences.

Table 5. Differences between averages for underwriters and abstainers

	Underwriters	Abstainers	t-Value difference
Insurance contract subscription (guilders)	7,689	—	—
Share capital 1612 (guilders)	8,688	2,615	10.65***
Director in 1612	0.079	0.003	7.31***
Bondholder in 1612	0.014	0.007	1.04
Transaction size 1608–1612 (ratio)	0.775	1.062	-1.23
Dividend right (guilders)	13,350	3,905	10.71***
Dividends received (guilders)	6,543	1,546	10.31***
Unpaid dividends/dividend right (ratio)	0.513	0.586	-2.29**
Received pepper in dividend	0.780	0.441	9.10***
Received nutmeg in dividend	0.418	0.240	5.11***
Received mace in dividend	0.234	0.183	1.66**
Received cash in dividend	0.140	0.136	0.15
Wisselbank account 1609–1612	0.313	0.139	5.98***
Observations	214	749	

Note: Reported are means and *t*-statistics of an independent sample test of differences. Significance levels are indicated with \*\*\* (1 percent) and \*\* (5 percent). Transaction size is the sum of annual values of shares bought and sold, scaled by average shareholdings. Variables are indicator variables unless defined otherwise.

Table 6. Logistic regression results

	(1)	(2)	(3)	(4)
Intercept	0.002*** (-10.69)	0.002*** (-9.99)	0.002*** (-9.56)	0.003*** (-10.23)
Log(1+Share capital 1612)	4.05*** (8.63)	3.15*** (6.67)	3.33*** (6.41)	3.51*** (7.04)
Director in 1612	7.84*** (2.66)	7.15** (2.51)	6.69** (2.42)	7.01** (2.49)
Bondholder in 1612	0.97 (-0.03)	0.87 (-0.16)	1.07 (0.08)	
Received spices in dividend		4.08*** (6.09)	3.83*** (5.74)	3.36*** (6.10)
Received cash in dividend		0.54** (-2.27)	0.55** (-2.17)	0.49*** (-2.81)
Unpaid dividends/dividend right		1.61 (1.60)	1.44 (1.21)	
Log(1+ Transaction size 1608–1612)			0.52* (-1.82)	0.48** (-2.05)
Wisselbank account 1609–1612			1.22 (0.53)	
Pseudo R-squared	0.1227	0.1672	0.1708	0.1689
Observations	963	963	963	963

Note: Logistic regression models explaining participation in the insurance contract. Reported are odds ratios and *z*-statistics. Significance levels are indicated with \*\*\* (1 percent), \*\* (5 percent) and \* (10 percent).

hand it did not matter whether VOC shareholders also owned the company's bonds.<sup>17</sup> As one would expect, the director variable is significantly positive: directors were almost eight

<sup>17</sup> It should be noted that only eight shareholders (0.8 percent) also held VOC debt.

Table 7. OLS regression results

	(1)
Intercept	1.575*** (5.47)
Log(1+Share capital 1612)	-0.192** (-2.33)
Director in 1612	0.287* (1.86)
Received spices in dividend	0.082 (0.68)
Received cash in dividend	-0.123 (-1.04)
Unpaid dividends/dividend right	-0.121 (-0.81)
Log(1+ Transaction size 1608-1612)	0.246 (1.39)
Wisselbank account 1609-1612	-0.036 (-0.37)
R <sup>2</sup>	0.0584
Observations	214

Note: OLS regression models explaining the fraction of insurance participation. Reported are coefficients and *t*-statistics. Significance levels are indicated with \*\*\*(1 percent), \*\*(5 percent) and \*(10 percent).

times more likely to underwrite compared to other shareholders, and this holds after correcting for ownership stakes. This result—combined with the fair pricing of the contract—helps us to understand the management’s position: since there was no financial gain and additional risk involved, the directors were most likely subscribing to commit to the contract and thus the continuity of the VOC.

The outcomes of model 2 show that shareholders who collected dividends in kind were four times as likely to underwrite than those who had not. Conversely, shareholders who received cash dividends were, after controlling for other factors, significantly less likely to subscribe. We interpret these findings as evidence that shareholders with an interest in the spice market also had a long-term interest in the VOC and its continuity, because as traders they depended on supplies from Asia. The amount of unpaid dividends appears not to have mattered. As for shares bought and sold, the most active shareholders were significantly less likely to underwrite.<sup>18</sup> Thus actively trading shareholders did not have a long-term interest in the company and abstained from the insurance contract.

We can get further insight by probing the characteristics of the underwriting shareholders with an OLS regression including all variables from the preceding analyses (table 7). Share capital has a significant negative effect, which complements the effect in table 6: shareholders with more capital were more likely to subscribe, but they did so for a smaller fraction of their capital, that is to say, they limited their overall exposure to the VOC. Changing share capital from 25th to the 75th percentile (1,025 to 9,000 guilders), for instance, lowers the participation in the insurance contract by 0.18, which should be compared to the average (median) participation of 0.87 (1.00). Only the company directors behaved differently. They subscribed 28.7 percent of their shareholdings more than one would expect on the basis of either the value of their shares, the dividends they received, or their previous share transactions. This might be interpreted as the board taking advantage from a self-designed perk, a generous premium, but we know that the 5 percent was fair overall. This interpretation is also contradicted by the directors’ collective behavior. They only raised their subscriptions from the second week of April onwards, either as a publicity effort to draw other

<sup>18</sup> We find no effect for account holders of the *Wisselbank*, but we should note that to date our identification of shareholders in the *Wisselbank* accounts is based on family names and therefore remains incomplete.

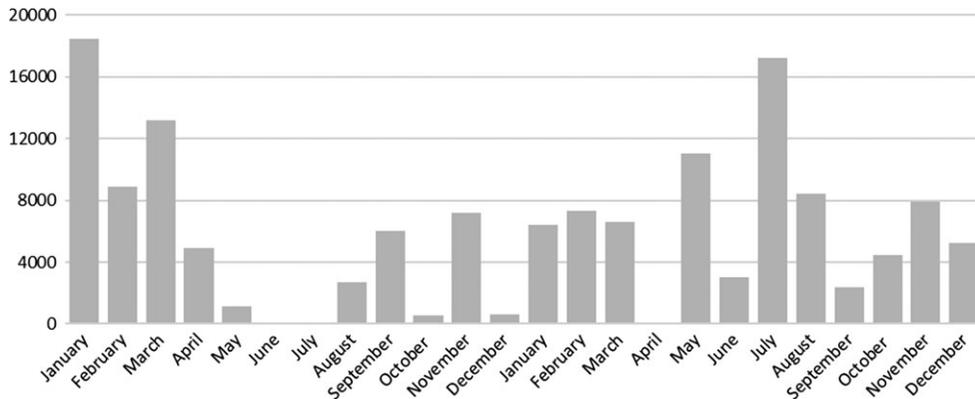


Figure 2. The value of monthly share transactions in the VOC chamber of Enkhuizen. (January 1613–December 1614).

Source: NA 1.04.02 (VOC), Inv. No. 14854 (Journal).

shareholders in, or because they themselves still found the conditions insufficiently attractive and held out for more, i.e., the right to top-up discussed above.

One condition which some shareholders clearly found onerous was the obligation to pledge shares in proportion to the amount underwritten in the insurance contract, which robbed them of potentially rewarding trading opportunities for the duration. Consequently, for shareholders who were active traders, the 5 percent premium needed to compensate not just the maritime risk, but also that opportunity cost. This will have deterred some shareholders from underwriting. Memories of Isaac Lemaire's 1609 bear raid on the company may have persuaded the board to put in the pledge clause in the hope of pre-empting another attack during a difficult operational period (Gelderblom *et al.*, 2011). If so, they were disappointed, if only because the vast majority of shareholders did not sign up. Even so share trading did suffer a dip (figure 2).

We reconstructed the share transfer volumes for Enkhuizen, the only VOC chamber where this is possible. Transfers collapsed during the summer of 1613, presumably because the difficulty of pricing pledged shares laden with uncertain future pay-outs halted trade, but during the autumn transfers resumed with fits and starts as news of substantial incoming cargoes encouraged investors to start trading shares again.

## 7. Removing the rationale for insurance

After describing the contract, its valuation, and the subscribers in more detail, we can revisit the likely motives for the contract. We can discard bankruptcy costs as a plausible motivation, since the amount covered by the contract was much larger than the VOC debt. We can also discard managerial self-interest and mispricing, because the board subscribed heavily and the contract price was fair.

We do find that the contract is consistent with the predictions of Froot *et al.* (1993): the insurance contract was non-linear (conditional) and the underlying value (revenues) matched the VOC's immediate need for continuity. Moreover, from the Froot *et al.* (1993) perspective the contract does make sense as a safeguard for the operational continuity of a company unable to attract new equity or debt financing at reasonable cost. In addition, the

dividend claim of VOC shareholders could threaten the company's continuity and thus have motivated hedging.

The VOC did not claim compensation under the insurance contract, leaving the subscribers their 5 percent premium gain. Nor did the company use a similar contract again. In October 1613 the board still kept its options open, asking the Estates General permission to insure return cargoes if and when the chambers thought it necessary.<sup>19</sup> Though cash remained tight for another couple of years, the directors managed to avoid that necessity, largely by widening the options for raising debt while reducing their exposure to it.<sup>20</sup> In 1617 they transformed their individual liability for company debt raised into a joint one (Schalk *et al.* 2012; Gelderblom *et al.* 2013). That mutual guarantee among the 60 directors divided over six chambers gave the board sufficient confidence to raise a total of eight million guilders between 1616 and 1623. This included a conversion of shareholders' claims to the final dividend instalment of 1616 into company debt at the going interest rate of 6.25 percent. With this renewed access to external funding the rationale for insurance disappeared.

### 8. Structural solutions versus continuing constraints: VOC and EIC

Limited access to finance in motivating risk hedging is also demonstrated by the behaviour of another company with financial constraints, the EIC, which started using insurance to secure its operational continuity during the 1630s. However, the way in which it did so reveals telling differences between the two companies' early history. Whereas a single contract enabled the VOC to risk a continuing expansion overseas while searching for more lasting solutions to its financial constraints, the EIC had to use insurance repeatedly simply to stay put and ensure debts were serviced. The 1631 Third Joint Stock was meant to finance multiple fleets during the following ten years, but money soon ran out, forcing the company directors to keep going by borrowing (Scott 1912, pp. 114). Five years later the EIC's creditors became restive when its prospects appeared to worsen; the Crown had allowed a rival company to enter the Asian trade, one homeward bound ship was lost and another one ran late. On November 25, 1636, the EIC board decided to appease investors by issuing a "policy of assurance" guaranteeing a return cargo worth 150,000 pounds sterling:

"Consideration had of the present low state of the Company's cash consequent on their recent great loss, and that many to whom money is due on interest are beginning to call it in; whereupon a proposition is made to assure 150,000£, which, with the estate at home, will be sufficient to pay all debts, and prevent any question as to the security of the Company."<sup>21</sup>

The EIC had taken out insurance before, but those policies had covered single voyages of individual ships and sometimes even separate outward or homeward trips.<sup>22</sup> The new policy

<sup>19</sup> NA 1.04.02 (VOC), Inv. No. 100, fol. 215.

<sup>20</sup> To be sure, the total value of any new insurance contract would be much smaller than the 1613 contract as the latter already covered the risk of insufficient cargo from all ships at sea by March 1613. Obviously, any new policy could only cover the cargo value of ships sailing after that date.

<sup>21</sup> Stapel and Den Dooren de Jong (1928, pp. 87–90) and Sainsbury (1907, pp. 202).

<sup>22</sup> Stapel and Den Dooren de Jong (1928, pp. 86–90), found evidence that the EIC took out ordinary marine insurance from 1629 onwards. According to Rossi (2016, pp. 216), such policies were already written in the early 1620s. The first references to such policies in the Court Minutes date from 1632 and 1634: Sainsbury (1892), vol. VIII, 306, 513.

was for “the return of good estate in any one of the ships now abroad”, that is to say a general cover of incoming cargo similar to the VOC’s contract before. The policy’s purpose was similar as well in aiming to secure the funding of future voyages, but with a twist. Whereas the VOC bought insurance so it could pay dividends in 1616 without jeopardizing its operations, the EIC directors took cover so they could service the company’s debt, failing which creditors could seize both company assets and the directors’ private assets.<sup>23</sup> Setting terms and conditions took some time; the policy was finally sold to insurers in the spring of 1639.<sup>24</sup> The contract appears to have worked to satisfaction, because in March 1640 the EIC, with liabilities exceeding assets, sold another one. Shareholders underwrote this one and presumably the earlier one as well, but there is no evidence that they were the exclusive or indeed preferred subscribers, nor of a fixed ratio between shareholdings and sums underwritten.<sup>25</sup> The second policy differed from the first, however, in covering just a single fleet. In September 1640 directors rejected a third contract proposed to cover the ships sailing in the following spring, because the company’s debt would mature before those ships were expected back. Directors decided instead to conserve cash by delaying dividend payments.<sup>26</sup> Following the granting of a Fourth Joint-Stock in 1642 the EIC directors sold two further contracts to secure the company’s cash position, but they then dropped the practice, having tailored operations to be financed from equity and sales revenues alone.<sup>27</sup>

At first sight the EIC seemed to do the same as the VOC, using insurance to secure cash flows. However, the companies’ relative positions and thus the purpose of their contracts differed fundamentally. Whereas the VOC used insurance once to avoid the risk of funding constraints curtailing its expansion, the EIC resorted to it repeatedly to avoid bankruptcy. Moreover, the London company’s need to pay dividends limited the funds available for reinvestment and weakened its competitive position in terms of ships sent, personnel employed, and goods traded (De Vries 2003, pp. 46–47, 67, 86). As a result the EIC’s scale remained modest compared to the VOC. During the 1630s the company’s Third Joint-Stock averaged four outbound ships a year against fifteen for the VOC.<sup>28</sup> When the necessary new charter failed to materialize in 1641 the EIC haphazardly organized a single voyage of five ships.<sup>29</sup> The charter was finally granted at the end of 1642, but for a Fourth Joint-Stock with only 100,000 pounds capital (1.1 million guilders). As a result the EIC’s operations remained modest with an average of four ships a year during the 1650s.

## 9. Conclusion

The VOC’s 1613 insurance contract demonstrates that firms, in any day and age, may want to hedge risk. Empirical research on recent samples studying the determinants of using financial hedging instruments documents a multitude of motives, including bankruptcy

<sup>23</sup> Stapel and Den Dooren de Jong (1928, pp. 80) and Sainsbury (1907, pp. 204, 220, 221, 257–259).

<sup>24</sup> In May 1637 underwriting was postponed with six months (Sainsbury, 1907, pp. 269). No Court Minutes survive between July 1637 and July 1639 but on May 6, 1640, underwriters of the first policy who had subscribed “a year and a month ago” asked the EIC for payment, presumably of the insurance premium Sainsbury (1907, pp. 38).

<sup>25</sup> On April 15, 1640, one merchant who is being refused a higher subscription to the policy, refers to another who has underwritten “six times more than his adventure.” (Sainsbury (1907, pp. 30–31).

<sup>26</sup> Sainsbury (1907, pp. 178).

<sup>27</sup> Scott (1912, pp. 119–120) and Sainsbury (1907, pp. 314–316).

<sup>28</sup> Sainsbury (1892); Chaudhuri (1965, pp. 226–234); and De Bruijn *et al.* (1987).

<sup>29</sup> Scott (1912, pp. 116–118).

costs, tax advantages, and managerial self-interest (Tufano 1996; Bartram *et al.* 2009). We show that the VOC setting is consistent with Lessard's (1991) intuition and the model of Froot *et al.* (1993). We highlight that hedging serves firms with growth potential and financial constraints to create value, so they can manage risk, and safeguard and smooth investments. Empirical studies have also found that characteristics of firms with and without hedging programmes differ with respect to growth opportunities and financial constraints (e.g., Tufano 1996; Bartram *et al.* 2009).

Our case study shows that the use and motivation of risk management practices detailed in the modern finance literature also applies to companies in the early Modern age. Our case, the VOC in the 1610s, closely matches between Froot *et al.* (1993) finance model. Our analysis provides direct evidence of the strategic value and competitive advantage of risk management instruments, as argued by Lessard (1991) and Froot *et al.* (1993).

The permanence achieved by the VOC in 1612 secured the company's long-term military and commercial success, but created acute financial constraints in the short run. Raising equity became impossible and borrowing money was no option either, because the directors were personally liable for company debts, which already exceeded the value of the directors' total shareholdings. In addition the company faced the need to pay out large cash dividends in 1614 and 1616. The insurance contract secured the availability of cash when the third of these instalments fell due.

Our analysis shows that the VOC board had several opportunities to expropriate wealth from shareholders and insurers, but did not (Harris 2009). For example, by subscribing less to the 1613 contract than other shareholders, the board could have insured their positions—as board member and shareholder—at the risk of the insurers. Also after 1613 the board may have had opportunities to delay cargo or invest in non-revenue generating activities and have the insurer pay up according to the contract. However, we have found no evidence of board members developing such self-interested behaviour.

The 1613 contract reveals the directors' deep understanding of the company's financial position. The contract was carefully tailored to expected cash flows, and the premium sufficiently high to cover the value at risk, while attractive enough to lure investors. Nor did insurance serve only directors' self-interest. They subscribed large sums themselves, but only to boost flagging subscriptions; moreover, the underwriters included many spice traders and big shareholders with an obvious stake in the survival of the company. If insurance served the VOC's continuing expansion, it remained a defensive measure for the EIC, a means for securing its capacity to serve debts while keeping modest operations going. As a consequence the EIC's transition to permanence and limited liability had to wait several decades.

### Supplementary material

Supplementary material is available at *European Review of Economic History* online.

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### Appendix 1: A translation of the 1613 insurance contract

Translated by the authors from *Bijlage 1* in Stapel and Den Dooren de Jong (1928), pp. 97–99.

We the undersigned promise and bind ourselves to insure and we insure hereby through this document on behalf of the directors of the General Chartered East India Company, that is to say each one of us for the sum for which he signs, from the East Indies until here in Holland or Zeeland, on all possessions of the aforesaid company on islands, continents, or on what location or on locations in the East Indies it may have, or on its way there or back, no location or locations excepted or set aside, be it the island of Japan or even further away, wherever the company may possess any money, goods, or assets, on condition that the Governor-General, Sublieutenants, head merchants, clerks, and assistants, wherever they so desire, shall be permitted to trade and deal with the money and trade goods from these lands for Indian or other goods, to trade and sell, unload and load, sail and dispatch, to those destinations and as often as they shall think fit and proper. And they shall also be free to deal both friendly and unfriendly, offensively and defensively, on water and on land.

And the insurance shall cover money, every kind of spices, drugs, indigo, sugar, silk textiles, amber benjoin, linen textiles, cotton, yarn, gemstones, and further all kinds of merchandise of whatever kind or kinds they might be, none excluded or excepted, not even those that ought to be named and specified according to the customs of insurance and that are not specified here. And this only and for no other risk than that from East India into these lands of Holland and Zeeland arrive for the aforesaid company, and will be stored in its warehouse or warehouses, return goods for a value of 32 tons of gold, to be calculated a pound of pepper, coarse or small, at thirty groats a pound, a pound of assorted nutmeg nuts at 16 stivers a pound, cloves 54 stivers a pound, mace 48 stivers a pound, everything as it arrives on the quayside dry and in good condition. And further all other kinds of merchandise traded or obtained peacefully or otherwise (to the extent that the company can lay claim to them) for as much as they shall be worth in ready money in these lands. Nor shall any costs, be they crew pay, lighter costs, sorting and sifting, or other costs to be charged here, be deducted from the spices or other merchandise, or shall the aforesaid merchandise be burdened with them.

But the ships, cannon, ammunition of war, and everything pertaining to that, shall be left out of consideration and they shall not be counted as return goods, the company's East Indian ships being permitted, both outbound and homebound, to sail forward and back again, to turn and swing around left or right and into all directions, and to enter, out of necessity or free will, any harbour or roads that pleases the head merchants or captains or deemed fit by them. And if out of necessity or free will the goods are unloaded and reloaded onto any other ship or ships, big or small (which they will be permitted to do on their own authority, without waiting on our consent or order) we will bear the aforesaid risk and adventure as if the aforesaid goods had never been unloaded.

We will also insure you for any sea risk, bad weather, fire, and wind, for friends and for enemies, for arrests and seizures by Kings, Queens, Princes, Lords, and Commons, from letters of marque and of countermarque, for bad faith and negligence from Governors, Sublieutenants, head merchants, clerks, assistants, ship's captains, ship's crew and soldiers, and for all other risks and adventures to which the aforesaid goods might foreseeably be exposed, with or without intent, usual or unusual, none excepted. In such cases we put ourselves in your position to protect you from all losses and damages. And if, which God forbid, the return of 32 tons of gold should not have arrived between now and ultimo August 1616, we bind ourselves herewith to pay to the directors of the General East India Company the aforesaid 32 tons of gold or that part of it which is lacking, each one of us in proportion to what he has signed for (both the first and the last insurer in the six policies in the respective Chambers, which we hold to be one policy), one half ultimo February 1617 and the other half ultimo August following, promptly, without protests. Nor shall a formal abandoning of the insured property be required, only a public posting of a claim for payment, which we shall take for such an abandoning, an announcement, and a claim for payment.

And if subsequently any return goods might arrive, each one will receive his money back pro rata and as far as the amount stretches with interest calculated at 6.25 percent. And should the goods suffer any damage (which God forbid) we fully authorize the directors of the aforesaid company and any other person to help in salvaging and recuperating the aforesaid goods, be it to our profit or to our loss. And should any of such goods arrive in this country burdened with costs of salvage, of freight rates on another ship, of additional crew pay, or any other costs, to such an extent that they are worth only half of their original value, then only this remainder shall count. That is to say, all the aforesaid costs, which we

will accept from those who have made them on their oath, shall be deducted from that amount. And this all on bad tidings and good tidings.

And whereas in accordance with the uses and customs of insurance the insured has to present the cargo lists and bills of lading on which the insurance is based to those risking 10 percent or a certain amount, and whereas in this case such custom cannot be upheld, because that would require lists and accounts of the goods in India in so many and different offices, countries, and places, and also of that which is outward bound and homeward bound, from which would arise endless issues and disputes, therefore, we relieve and discharge the insured from this obligation, stating hereby that the insured or company shall not have to hand over anything or to present bills, cargo lists, bills of lading, or any other kind of evidence than only this present policy of insurance, inscribed in the ledgers of the respective chambers and signed by us. And of the goods sent over we shall accept and be entirely satisfied with the lists and calculations which will be made by the board of seventeen and will be signed by the directors delegated by that board, provided that they shall pay the premium in full and not by deducting it from any amounts due. Similarly we promise not to deduct payments from amounts due.

Nor shall the insured be held to send out for this present account any more ships than are now being readied to sail this coming spring. But subsequently the decision whether or not to send out ships for this account shall be solely for the board of seventeen to take and resolve, without us having the right to interfere in any way or to have a say in it, even if the ships that might be sent out for this account, and the goods that they might bring back, if this happened, would be to the benefit of this insurance. And we are satisfied that the insured, as they promise herewith, will pay us the price of this insurance on the first of May 1614 being 5 percent. And in order to avoid turgidity, we hold this insurance policy to be of such great value as if it had been drawn up before the city officials, and so succinct as if all the clauses stated therein had been drafted as one could imagine them to your benefit and our disadvantage. Everything in good faith and also, as men of honour, renouncing all official regulations and customs with respect to insurance which run counter to this policy, promising that we will not take resort to them, nor to any disputes or excuses, within law or outside it.

For this we bind ourselves and our possessions, present and future ones, and also our share in the company to the amount for which we shall have signed this policy. Drawn up this first March of 1613.

I, [name] am satisfied with this insurance which God may preserve for the sum of [amount in letters] guilders on the [date], say [amount in figures]

First two signatures dated 7 March, 1613.

## Appendix 2: Ships under the insurance contract

DAS	Name	Tonnage	Chamber	Leaves
	<u>SHIPS</u>			
0135.1	WAPEN VAN AMSTERDAM	800	Amsterdam	30-Jan-10
0140.2	ZWARTE LEEUW	600	Amsterdam	30-Jan-10
0146.2	BANDA	800/(600)	Amsterdam	16-Mar-11

(Continued)

*Continued*

DAS	Name	Tonnage	Chamber	Leaves
0149.1	GROTE AEOLUS	300	Amsterdam	29-Dec-11
0150.3	CEYLON	340	Amsterdam	29-Dec-11
0152.2	GELDERLAND	700	Amsterdam	29-Dec-11
0154.1	RODE LEEUW	400	Amsterdam	29-Dec-11
0155.1	GROTE MAAN	500	Amsterdam	29-Dec-11
0157.1	STER	160	Amsterdam	29-Dec-11
0158.1	ZON	500	Amsterdam	29-Dec-11
0163.3	GEÛNIEERDE PROVINCIEËN	700	Amsterdam	12-May-12
0164.1	AREND*	300	Amsterdam	31-Jan-13
0166.1	WITTE VALK*	360	Amsterdam	31-Jan-13
0172.1	WAPEN VAN AMSTERDAM*	1,000	Amsterdam	2-Jul-13
0173.3	HOLLANDIA*	800	Amsterdam	2-Jul-13
0174.1	MAURITIUS*	800	Amsterdam	2-Jul-13
0143.3	GOUDA	260	Amsterdam	28-Dec-10
0144.2	RODE LEEUW MET PIJLEN	400	Amsterdam	28-Dec-10
0138.2	TER GOES	240	Zeeland	30-Jan-10
0142.1	VLISSINGEN	600	Zeeland	30-Jan-10
0145.2	TER VEERE	700	Zeeland	28-Dec-10
0159.3	ORANJE	700	Zeeland	2-Jan-12
0161.3	ZEELANDIA	500	Zeeland	2-Jan-12
0169.2	MIDDELBURG*	800	Zeeland	4-Apr-13
0170.1	ZEELANDIA*	800	Zeeland	4-Apr-13
0171.2	DELFT*	800	Other	5-Jun-13
0147.2	BANTAM	900/(700)	Other	2-May-11
0156.2	PATANIA	340	Other	29-Dec-11
0165.1	HOORN*	700	Other	31-Jan-13
0160.3	ROTTERDAM	800	Other	2-Jan-12
	<u>YACHTS</u>			
0148.2	HALVE MAAN	80	Amsterdam	2-May-11
0151.1	DUIFJE	50	Amsterdam	29-Dec-11
0153.1	GROENE LEEUW	140	Amsterdam	29-Dec-11
0162.1	HOOP	500	Amsterdam	12-May-12
0175.1	NASSAU	300	Amsterdam	2-Jul-13
5100.3	WITTE LEEUW	540	Amsterdam	30-Jan-10
0168.1	KLEINE AEOLUS	240	Other	4-Apr-13

Source: Bruijn *et al.* (1987); (\*) marks the ships of the 1613 fleet.