

A Short History of Derivative Security Markets

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Abstract

Contracts for future delivery of commodities spread from Mesopotamia to Hellenistic Egypt and the Roman world. After the collapse of the Roman Empire, contracts for future delivery continued to be used in the Byzantine Empire in the eastern Mediterranean and they survived in canon law in western Europe. It is likely that Sephardic Jews carried derivative trading from Mesopotamia to Spain during Roman times and the first millennium AD, and, after being expelled from Spain, to the Low Countries in the sixteenth century. The first derivatives on securities were written in the Low Countries in the sixteenth century. Derivative trading on securities spread from Amsterdam to England and France at the turn of the seventeenth to the eighteenth century, and from France to Germany in the early nineteenth century. Circumstantial evidence indicates that bankers and banks were at the forefront of derivative trading during the eighteenth and nineteenth centuries.

Modern textbooks in financial economics often misrepresent the history of derivative securities. For example, in the opening sentence Hull (2006) suggests that derivatives became significant only during the past 25 years, and that it is only now that they are traded on exchanges.

"In the last 25 years derivatives have become increasingly important in the world of finance. Futures and options are now traded actively on many exchanges throughout the world." (Hull 2006, p. 1)

Mishkin (2006) is even more adamant that derivatives are new financial instruments that were invented in the 1970s. He suggests that an increase in the volatility of financial markets created a demand for hedging instruments that were used by financial institutions to manage risk. Does he really believe that financial markets were insufficiently volatile to warrant derivative trading before the 1970s?

"Starting in the 1970s and increasingly in the 1980s and 90s, the world became a riskier place for the financial institutions described in this part of the book. Swings in interest rates widened, and the bond and stock markets went through some episodes of increased volatility. As a result of these developments, managers of financial institutions became more concerned with reducing the risk their institutions faced. Given the greater demand for risk reduction, the process of financial innovation described in Chapter 9 came to the rescue by producing new financial instruments that helped financial institution managers manage risk better. These instruments, called derivatives, have payoffs that are linked to previously issued securities and are extremely useful risk reduction tools." (Mishkin, 2006, p. 309)

The widespread ignorance concerning the history of derivatives is explained by a dearth of research on the history of derivative trading. Even economic historians are not well informed about the long history of derivative markets. A review of three leading economic history journals - the *Journal of Economic History*, the *Economic History Review* and the *European Review of Economic History* - has yielded not a single article after 1990 with a title that would indicate that it deals with some aspect of the history of derivative securities. Similarly, the *Oxford Encyclopedia of Economic History* (2003) gives short shrift to derivative markets; it includes an entry on commodity futures in the United States in the nineteenth century and options are shortly

mentioned in the entry on the stock market. At the moment, articles on the history of derivatives can be found only in working papers and edited volumes. Goetzmann and Rouwenhorst (2005) includes an article by Gelderblom and Jonker on derivative trading in Amsterdam from 1550 to 1650, and two volumes edited by Poitras (2006/2007) contain the so far most comprehensive collection of articles and sources on derivative markets during the past four hundred years.

The history of derivatives has remained unexplored because there are few historical records of derivative dealings. Derivatives left no paper trail because they are private agreements that have been traded in over-the-counter markets for most of their history. Even today, the international commodity and financial markets, which have always been a primary focus of derivative dealings, remain beyond the reach of national statistical offices. Another reason why historical records of derivatives are scant is conceptual. A forward contract has no market value when it is set up, although its notional value may be large. Thus, how should a forward contract be recorded when it is set up? There is naturally no point in recording a zero value. This problem is even more acute with futures contracts whose market value does not deviate much from zero during their entire life. At the end of each day, the value of a futures contract is set back to zero by crediting or debiting the daily change in value to a margin account. The *Triennial Central Bank Survey of the Bank for International Settlements*, which was first published in 1989, for the first time addressed the conceptual and practical difficulties of recording derivative dealings in international over-the-counter markets.

Since there are no official statistics on derivatives, economic historians must rely on other sources that provide evidence that derivatives were used, including laws and regulations, court decisions, charters and business conditions of exchanges and trading companies, and surviving derivative contracts. Undoubtedly, the long history of derivatives is little known because the examination of this material is a laborious task that requires special skills. Kindleberger (1996, p. 5) remarked that “Historical research of a comparative sort relies on secondary sources, and

cannot seek for primary material only available in archives.” There are also not many historians and economists who are experts both in ancient languages and scripts and in financial economics. In this article, whenever possible secondary sources are used that quote primary sources, for example Ehrenberg (1928) and Swan (2000). A less reliable source that is also used is the testimony of financial practitioners who lived and worked in the period under consideration, including de la Vega (1688), Coffinière (1824) and Proudhon (1857).

In this chapter the pioneering works of Louis Bachelier (1900) and Vincenz Bronzin (1908) are put into the historical context. In the first section a definition for the generic term “derivative” is given, and the origin of contracts for future delivery of goods in Mesopotamia and their use in the Greek and Roman world are discussed. In the second section it is shown how the use of derivatives spread from commodity markets to security markets in Italy and the Low Countries during the Renaissance. In the third section, which deals with speculation in Amsterdam in the seventeenth century, it is argued that derivative trading was based on reputation in pre-industrial times and beyond. Derivative trading in London and Paris in the eighteenth century is discussed in the fourth section, and the spread of derivative trading in continental Europe during the nineteenth century is considered in the fifth section. Around 1870, financial practitioners developed graphical tools to represent derivative contracts. Profit charts made derivatives accessible to young scientists, including Louis Bachelier and Vincenz Bronzin, who had the mathematical knowledge for the rigorous analysis of derivative pricing. In the last section two issues are considered that show how difficult it is to provide an unbiased account of the history of derivatives, using available sources. The focus in this chapter is on the mechanics of derivative dealings; no attention is paid to the emergence of the random walk hypothesis of asset prices, which provided the mathematical foundation for Bachelier and Bronzin’s work. The origin of the random walk hypothesis is discussed in Jovanovic (2006a) and Preda (2006).

1. The Origins of Derivatives in Antiquity

It is now hard to believe that the generic term “derivative”, which stands for all kinds of derivative products, has emerged only very recently, in the 1980s. Swan (2000, p. 5) traces it back to the 1982 New York Federal Court case of *American Stock Exchange vs. Commodity Futures Trading Commission*. A reliable definition of derivatives is crucial for regulators who are in charge of derivative markets, but the rapid development of new derivative products has rendered definitions quickly obsolete. A derivative should not be defined as a financial instrument whose value depends (is derived) from the value of some underlying asset because there is no such asset in the case of weather derivatives, electricity derivatives and the derivatives whose value depended on the outcome of papal elections in the sixteenth century (Swan 2000, p. 142). Therefore, financial textbooks - for example Hull (2006, p. 1) - now define derivatives as financial instruments whose value can depend on “almost any variable”.

Yet, also this definition of a derivative is incomplete because it does not recognize the risk that the counter-party of a derivative contract may default. During the financial crisis in 1987, the standard models of derivative pricing failed because they did not take account of the default risk that arose after the near-failure of *Long-Term Capital Management*. For this reason, Swan (2000, p. 18) defines a derivative contract as a “promise” whose market value depends, first, on the strength of the promissor’s ability to perform and, second, on the value of the underlying asset or variable. Similarly, Moser (2000, 1994), who investigates the history of clearing arrangements at the *Chicago Board of Trade*, uses a definition of futures contracts that recognizes the non-performance option of contract holders because “many futures-contract terms are best understood as efforts to minimize non-performance costs ...” Defining a derivative as a promise with a default option is crucial in historical research because differences in legal institutions and customs created wide disparities in non-performance costs across places and time.

Derivative contracts emerged as soon as humans were able to make credible promises. In a commercial environment, it is essential for a credible promise that it is somehow recorded. Writing was invented in Mesopotamia in the fourth millennium BC. The invention of writing satisfied the administrative and commercial needs of the first urban society in human history. The first derivative contracts were written in cuneiform script on clay tablets, which, luckily for financial historians, are extremely durable. These derivatives were contracts for future delivery of goods that were often combined with a loan. Van de Mieroop (2005) reproduces a tablet in which a supplier of wood, whose name was Akshak-shemi, promised to deliver 30 wooden [planks?] to a client, called Damqanum, at a future date. The contract was written in the nineteenth century BC.

“Thirty wooden [planks?], ten of 3.5 meters each, twenty of 4 meters each, in the month Magrattum Akshak-shemi will give to Damqanum. Before six witnesses (their names are listed). The year that the golden throne of Sin of Warhum was made.” (van de Mieroop 2005, p. 23)

Swan (2000, p. 28) displays a tablet from about 1700 BC, in which two farmers received from the King’s daughter three kurru of barley, which had to be returned at harvest time. The farmers, who were brothers, probably used the barley, about 0.9 cubic meters¹, as seed stock for planting a field.

“Three kurru of barley, in the seah-measure of Shamash, the mesheque measure, in storage, Anum-pisha and Namran-sharur, the sons of Siniddianam, have received from the naditu-priestess Iltani, the King’s daughter. At harvest time they will return the three gur of barley in the seah-measure of Shamash, the mesheque measure, to the storage container from which they took it. Before (two witnesses whose names are listed). Month Ulul, 19th day, year in which King Abieshuh completed the statue of Entemena as god.” (Swan 2000, p. 28)

This contract may either be viewed as a commodity loan or as a short-selling operation, in which the brothers borrowed barley, used it for planting the crop, and then returned it after harvest. This operation was less innocuous than it looks because the brothers carried some risk. If

¹ In the second millennium BC and earlier, one kurru (kur, gur) was 300 qa, where one qa was about one liter (Segrè 1944).

the crop failed they were required to buy barley in order to be able to return it to the royal granary. This operation would not have been possible without the sophisticated Mesopotamian irrigation system, which reduced the risk of crop failure due to drought. It is also possible that the King's daughter, who represented the state, did not enforce the contract if a widespread crop failure due to climatic conditions or a locust plague led to famine. In that case the state carried the risk of general crop failure.

Derivatives played an important role in the funding of long-distance trade. Zohary and Hopf (2000, pp. 140-141) maintain that the sesame plant was cultivated in the Indus Valley between 2250 and 1750 BC. The following tablet, which is from 1809 BC, shows that a Mesopotamian merchant borrowed silver, promising to repay it with sesame seeds "according to the going rate" after six months. He may have used the silver to finance a trading mission to the Indus Valley to obtain sesame seeds. This contract combines a silver loan with a forward sale of sesame seeds.

"Six shekels silver as a šu-lá loan, Abuwaqar, the son of Ibqu-Erra, received from Balnumamhe. In the sixth month he will repay it with sesame according to the going rate. Before seven witnesses (their names are listed). These are the witnesses to the seal. In month eleven of the year when king Rim-Sin defeated the armies of Uruk, Isin, Babylon, Rapiqum and Sutium, and Irdanene, king of Uruk." (van de Mieroop 2005, pp. 21-22)

While six shekels of silver was a fair amount of money, it seems not to be enough to finance a trading mission from Mesopotamia to the Indus Valley.² But the merchant probably traded in a range of goods. Therefore, he may have concluded similar contracts for other goods to attract more funding.

It is a tragic fact that slave trade was prevalent during much of commercial history. A tablet from 1750 BC provided a slave trader with funding and insurance. At the time when the contract

² Around 1800 BC, the price of a slave was about 24 shekels, the wage of a hired worker was one third of a shekel per month, and it cost one to three shekels to rent a house for a year (Source: Farber 1978). The Eshnunna Code, which was written ca. 2000 BC, stipulated a monthly wage of one shekel.

was written, he received $204 \frac{2}{3}$ qu of oil in the measure of Shamash. In return, he had to deliver healthy slaves from Gutium after one month, with an option of paying $\frac{1}{3}$ mina $\frac{2}{3}$ shekels of silver instead of delivering slaves.

“ $204 \frac{2}{3}$ qu of oil in the measure of Shamash, to the value of $\frac{1}{3}$ mina $\frac{2}{3}$ shekels of silver, as the price for healthy slaves from Gutium, Warad-Marduk son of Ibni-Marduk has received from Utul-Ishtar the troop-commander on the authority of Lu-Ishurra son of Ili-usati. Within one month he shall bring healthy slaves from Gutium. If he does not bring them within one month, Lu-Ish(k)urra son of Ili-usati will repay $\frac{1}{3}$ mina $\frac{2}{3}$ shekels of silver to the bearer of this tablet. Before (four witnesses whose names are listed). Month Ab, sixth day, year in which King Ammisaduqa, etc.” (Swan 2000, p. 29)

This contract provided the slave trader with capital to procure slaves from Gutium. The option to pay $\frac{1}{3}$ mina $\frac{2}{3}$ shekels of silver limited his loss if he was not able to buy slaves at a price that made the transaction profitable. It also provided insurance against all other hazards of the slave trade, including the risk that the slaves fell ill, they ran away, etc. The counterparty agreed to this transaction if the price of $\frac{1}{3}$ mina $\frac{2}{3}$ shekels of silver for $204 \frac{2}{3}$ qu of oil exceeded the spot price of oil by an amount that was sufficient to adequately compensate for supplying the initial loan of oil and for the risks inherent in the slave trade. The cuneiform tablet gave the slave trader the option to pay silver to the *bearer* of the tablet. This suggests that the holder of the tablet could transfer the contract to a third party. But not enough is known on Mesopotamian trading practices to determine the significance of the transfer of tablets.

About half a million clay tablets have been found so far, with more than 200,000 being held by the *British Museum*. The cuneiform digital library initiative (cdli), which is a joint effort of the *Vorderasiatisches Museum Berlin*, the *Max Planck Institute for the History of Science* and the *University of California at Los Angeles*, has digitalized about 225,000 tablets, making them available on the internet and supplying translations and comments.³ This provides a research opportunity for economists who are interested in the history of economic institutions. An

³ The addresses are: <http://cdli.mpiwg-berlin.mpg.de> and <http://cdli.ucla.edu>.

important economic institution that determines economic outcomes is the market itself. The evolution of markets reflects changing transaction and information costs, which depend on technological advances in transport, information processing and administration. The emergence of contracts for future delivery enhanced the efficiency of agricultural markets in Mesopotamia and they were a prerequisite for the expansion of long-distance trade.

The ascendancy of Greek civilization began around 1000 BC. It is more difficult to document the use of derivatives for Greek commerce than Mesopotamia. Greek philosophers and historians, whose writings profoundly influenced Western civilization, were not interested in commerce. The Greek did not use a medium for commercial contracts that was as durable as clay tablets, and laws that have survived as inscriptions on murals and columns were generally hostile to contracts for the future delivery of goods. But it is hard to imagine that farmers were able to fully fund the crop cycle, and merchants had enough capital to finance risky commercial expeditions, while rich individuals found no way to invest their wealth in commercial endeavors that promised a return in the future. The fact that Greek law favored spot transactions does not prove that there were no contracts for future delivery because commercial history is littered with laws and ordinances against derivatives that were ignored by the public. In fact, the Greek were quite practical in commercial affairs. According to Swan (2000, p. 61), Athens allowed contracts for future delivery in sea-borne trade because the city depended on the import of grain from Egypt. Alexander, who invaded the Middle East in the fourth century BC, left the local commercial and legal system intact, which had descended from Mesopotamia. Therefore, the use of derivatives continued in the Middle East under Greek dominance. Hellenistic Egypt is the second period in commercial history from which a large number of commercial contracts has survived because papyrus is almost as durable in the desert climate of Egypt as the earlier clay tablets.

The Romans, who copied much of Greek culture, initially adopted the Greek restrictions on contracts for future delivery. But these restrictions clashed with the commercial realities of the vast Roman Empire, which reached from Britannia to Mesopotamia at its peak. Commodities moved along a network of new roads and the ships of Roman merchants criss-crossed the Mediterranean. The city of Rome, whose population grew to one million people, depended on trade with the provinces, particularly the import of wheat from Northern Africa. During the third century BC, Roman law caught up with commercial practice, providing for contracts for future delivery of goods. Swan (2000, Chapter 3.2) considers the treatment of contracts for future delivery in Roman law. Sextus Pomponius, a lawyer who wrote in the second century AD, distinguished between two types of contracts. The first, *vendito re speratae*, which was void if the seller did not have the goods at the delivery date, provided insurance against crop loss and the hazards of long-distance trade, including the loss of ships in maritime trade. The second, *vendito spei*, was a straightforward forward contract that did not provide for any reprieve to the seller in case he was unable to deliver the goods. It is unclear whether *vendito re speratae* involved the same rights as a modern put option because the seller may have been obliged to deliver the goods if he had them.

Early Roman law upheld the principle of privity of contract, which implies that a contract establishes a relationship that is exclusive to the parties in the contract. A contract was not transferable because a third party was unable to enforce it. For example, a credit contract established an exclusive relationship between lender and borrower. The lender could not assign his right to repayment of principal and interest to someone else because the borrower was only obliged to pay to the initial lender. Similarly, the holder of a contract for future delivery could not sell it because only the holder was entitled to receive goods in the future, and no one else. The principle of privity of contract held back the emergence of security markets in the Roman economy. According to Swan (2000, pp. 80-81), the principle of privity of contract eroded only

slowly in a legal process that lasted until the end of the Roman Empire. The legal codes of the East Roman Emperor Theodosius II (401-450) and Byzantine Emperor Justinian (482/83-565) suggest that Rome had developed a law of assignment, which made it possible to trade derivatives over-the-counter after they had been written.

There were no corporations in Roman times, with one notable exception that is documented by Malmendier (2005). *Societas publicanorum*, which were private companies that tendered for government contracts, issued shares that were widely held by Romans. Cicero, who lived from 106 to 43 BC, commented on the trade in these shares, which is said to have taken place near the Temple of Castor on the Forum Romanum. The trade in these shares indicates some erosion of the principle of privity of contract. The fact that the subscriber to a share could sell it implies that there existed no exclusive relationship between the subscriber and the company. Malmendier (2005) avoids taking a position “on how much of a stock market there was in ancient Rome”, and there is no evidence for or against the view that derivatives were written on the shares of *societas*. The available sources only support the conclusion that Roman derivatives included contracts for future delivery of goods that initially were held until the delivery date and that were traded over-the-counter after some unknown date.

The barbarian tribes that overran the Roman Empire lacked commercial codes. Instead, Church bodies, which had increasingly assumed administrative functions in the late Roman Empire, continued to apply Roman commercial law during the Dark Ages. Thus, the legal framework for contracts for future delivery remained in place during the Dark Ages, but there was no further progress in the design of derivatives because there was not much need for them in the Medieval economy which was both local and feudal.

2. Derivative Markets During the Renaissance

Security markets emerged during the Renaissance, a period of cultural and economic revival that lasted from the fourteenth to the seventeenth century. During the Renaissance, the Italian city states and the Low Countries were the economically most advanced regions in Europe. In the twelfth century, Italian cities began to issue so-called monti shares. By the thirteenth century, monti shares had become negotiable, making them tradable in secondary markets. Pezzolo (2005) provides a detailed account of the finances of Italian cities and their use of monti shares. Monti shares were the first securities that were traded in secondary markets. They were followed by bills of exchange, which provided the medium of exchange in long-distance trade from the fifteenth century until the early twentieth century. The buyer of some commodity accepted a bill of exchange and passed it to the payee instead of sending gold or silver coins. The payee either held on to the bill until maturity or he sold it to a third party. In fact, bills of exchange, whose maturity typically ranged from a few days to 90 days, could pass through many hands. The holder of a bill earned interest because bills were traded at a discount that gradually diminished until maturity. The domestic currency price of foreign bills of exchange was the exchange rate.

The main trading centers in northern Europe were Bruges from the twelfth to the fifteenth century, Antwerp in the sixteenth century, and Amsterdam in the seventeenth century. Bruges was a center for the trade of wool, cloth and other commodities. Around 1540, Antwerp legalized the negotiability of bills of exchange and a royal decree made contracts for future delivery transferable to third parties. At about this time, an important innovation occurred in derivative markets. Merchants discovered that there is no need to settle forward contracts by delivering the underlying asset, as it is sufficient if the losing party compensates the winning party for the difference between the delivery price and the spot price at the time of settlement. Contracts for differences were written on bills of exchange, government bonds and commodities. Although it is

likely that similar deals had been done in Bruges and with monti shares in Italy, contracts for differences were used on a large scale for the first time in Antwerp.

The following quote by Cristobal de Villalon (1542) refers to a contract for differences on bills of exchange, which was settled by a cash flow that depended on the exchange rate between bills of exchange in Antwerp and Spain.⁴ Note that the author was accustomed to contracts for future delivery in marine insurance, the Roman *vendito re speratae*.

“Of late in Flanders a horrible thing has arisen, a kind of cruel tyranny which the merchants there have invented among themselves. They wager among themselves on the rate of exchange in Spanish fairs at Antwerp. They call these wagers *parturas* according to the former manner of winning money at a birth (*parto*) when a man wagers whether the child shall be a boy or a girl. In Castile this business is called *apuestas*, wagers. One wagers that the exchange rate shall be at 2 per cent., premium or discount, another at 3 per cent., etc. They promise each other, to pay the difference in accordance with the result. This sort of wager seems to me to be like Marine Insurance business. If they are loyally undertaken and discharged, there is nought to be said against them. But there are many ruinous tricks practiced therein. ... This is a great sin.” (Cristobal de Villalon 1542. Quoted in Ehrenberg 1928, pp. 243-244)

Contracts for differences were precursors of modern futures contracts. Like contracts for differences, futures contracts are usually settled by paying the difference between the delivery price and the spot price of the underlying asset, instead of delivering the asset itself. But futures have some safeguards that contracts for differences did not possess. Both parties in a futures contract must maintain a margin account into which some money must be paid upfront. At the end of each business day, the value of a futures contract is reset to zero by crediting and debiting the change in value that had occurred during the day to the margin accounts. In fact, a futures contract is settled incrementally by daily cash flows between the margin accounts of both parties. If the balance of a margin account falls below some minimum value, there is a margin call and the account holder must provide new funds. The use of margin accounts with daily cash flows reduces the counterparty risk of futures contracts because daily price changes are smaller than

⁴ Cristobal (Christoval) de Villalon was a Spanish humanist.

cumulated price changes over long periods of time. Contracts for differences were less secure because they were settled by a single, potentially much larger cash flow at some distant date.

After the sack of Antwerp by Spanish troops in 1576, Amsterdam became the leading commercial center in northern Europe. Amsterdam had a cosmopolitan population with Calvinist fugitives from Antwerp and Jews who were harassed by the Catholic Church in Spain and Portugal. The Golden Age of Amsterdam lasted for about 80 years, from 1585 until the mid-seventeenth century. Dutch merchants dealt in a wide range of staples that were imported from Italy, the Baltic, the West Indies (Caribbean) and the East Indies (South East Asia). The financial needs of maritime trade created a supply of forward contracts and securities, including bills of exchange and shares of joint-stock companies. The *Dutch East India Company* and the *Dutch West India Company*, which were founded in 1602 and 1621, were the first large enterprises that issued shares as a source of funds. Right from the beginning, share trading involved contracts for differences. In an essay on the speculative activities of Isaac Le Maire (1558-1624), van Dillen (1935, pp. 53, 58) noted that shares were traded “on term” (for future delivery): “... shares sold not only for cash but also on term. This wasn’t anything new in Amsterdam, since term sales had been the custom for trade in wheat and herring.” He also found that forward contracts on shares were usually settled as contracts for differences: “Instead of delivering the shares, people were content most often to pay the surplus, the difference between trading rates, which had to be settled later.” Amsterdam was the first city where derivatives that were based on securities were used freely for a long period of time.

The foundation of the *Dutch East India Company* was met with public enthusiasm, which turned into disenchantment when the *Company* developed more slowly than expected. The share price doubled within a few years, but about one half to three quarters of this gain was lost by 1610 (Neal 2005). Reacting to the disappointing performance of the *Dutch East India Company*, Isaac Le Maire, a fugitive from Antwerp, conducted the first recorded bear attack on an

underperforming firm by selling its shares short. Thus, he borrowed shares and he then sold the borrowed shares. This was profitable if he could buy the shares back and return them to the owner at a lower price in the future. Conceptually, there is no big step from a contract for differences to a short-selling operation. In a contract for differences the expected profit depends on the difference between the expected future spot price and the delivery price. In a short-selling operation the expected profit is determined by the difference between the expected future spot price and the current spot price.

Short-selling attracts public scorn when prices are falling because it is thought that it creates an extra supply of the asset that further depresses prices. In Amsterdam short-selling was banned in 1610. Yet, Kellenbenz (1957, p. xiv) is right that restrictions on short-selling were difficult to enforce. The ban on short-selling was ineffective because it was impractical to determine whether a seller indeed owned the asset to be sold or whether the asset was borrowed. It is hard to imagine how the authorities could have ascertained the ownership of every commodity and financial instrument that was sold in Amsterdam, without severely interfering with the operation of markets. Amsterdam would not have become the foremost merchant city in northern Europe with such stifling controls.

In the mid-seventeenth century, Amsterdam became entangled in wars with France and England and the plague decimated the city's population. Toward the end of the century, a renewed influx of religious fugitives contributed to the city's recovery. Large numbers of Huguenots - French Protestants - moved to Holland and Switzerland after the *Edict of Fontainebleau* in 1685. It is estimated that by the end of the century, Huguenots accounted for 20 to 25 percent of Amsterdam's population. Financial services contributed much to the revival of the city in the late seventeenth century. Commodity trade, however, moved to London because England now dominated maritime trade.

In 1688, Joseph de la Vega (1650-1692?) wrote a book on stock trading in Amsterdam, which he gave the suggestive title *Confusion de Confusiones*. In the introduction to the English translation, Hermann Kellenbenz, remarks that it “is a book written in Spanish by a Portuguese Jew, published in Amsterdam, cast in dialogue form [used by Greek philosophers], embellished from start to finish with biblical, historical and mythological allusions, and yet concerned primarily with the stock exchange ...” De la Vega’s work has been translated into several languages and a new Spanish edition was published in 1997; Cardoso (2006) includes a complete list of references. De la Vega was fascinated by options, which he considered to be safer than contracts for differences. At the beginning of his treatise, he notes that a long forward contract can be settled in three ways:

“First there is the sale of the shares, through which profit or loss will arise according to the purchase price; then there is the hypothecation of the shares to four-fifths of their value (which is done even by the wealthiest traders without harm to their credit); and, finally, the buyer may have the shares transferred to his name and make the purchase price payable at the Bank - which can be done only by very wealthy people, because a “regiment” [the standard notional value of a forward contract] today costs more than a hundred thousand ducats.” (de la Vega 1688, pp. 5-6)

This quote implies that forward contracts were contracts for differences. The holder of a long forward contract usually did not take delivery of the underlying shares because the notional value of a contract was extremely high, a hundred thousand ducats (3290.75 kilograms of silver).⁵ If the holder took delivery, he could pay for the shares by borrowing up to four-fifth of their value, using the shares as collateral (hypothecation). This was done if settling for the difference produced a large loss that would have inconvenienced the holder of the contract. Thus, the first method of settling a long forward contract - the sale of the shares - amounted to settling for the difference; and the second method - hypothecation - was a way out if settling for the difference

⁵ In 1702, one Dutch ducat was 21.16 pennyweights (dwt) of silver, where one pennyweight is 1.555174 grams. Thus, one ducat was 32.91 grams of silver. The letter d in dwt stands for penny (denarius), as in the traditional notation for pound/shilling/pence, £/s/d. (McCusker 1978, Table 1.1.)

would bankrupt the holder of the contract; whereas the third method - taking delivery of the shares - was only practical for rich investors. Forward contracts are risky because the delivery price can differ by a large amount from the spot price at settlement. Therefore, de la Vega (1688) favored options, which he considered new instruments for speculation that were safer than contracts for differences.

“The price of the shares is now 580, [and let us assume that] it seems to me that they will climb to a much higher price because ... of the good business of the Company ... of the prospective dividends ... Nevertheless, I decide not to buy shares through fear that I might encounter a loss and meet with embarrassment if my calculations should prove erroneous. I therefore turn to the persons who are willing to take [write] options and ask them how much premium they demand for the obligation to deliver shares at 600 each at a certain later date. I come to an agreement about the premium, have it transferred [to the writer of the options] immediately at the Bank, and then I am sure that it is impossible to lose more than the price of the premium. And I shall gain the entire amount by which the price [of the stock] shall surpass the figure of 600 ... In the case of a decline, however, I need not be afraid and disturbed ...” (de la Vega 1688, p. 8)

After this description of a call option, de la Vega (1688) turns to put options:

“... I can do the same business (in reverse), if I reckon upon a decline in the price of the stock. I now pay premiums for the right to deliver stock at a given price ...” (de la Vega 1688, p. 8)

Finally, he summarizes the option business:

“The Dutch call the option business “opsies,” a term derived from the Latin word *optio*, which means choice, because the payer of the premium has the choice of delivering the shares to the acceptor of the premium or demanding them from him, [respectively].” (de la Vega 1688, p. 9)

De la Vega may have looked for a less risky method of speculation because Amsterdam had experienced the first recorded financial bubble, the tulipmania, about half a century before he wrote his book.

3. The Tulipmania

Carolus Clusius, an Austrian botanist, who became head of the Botanical Garden in Leiden in the 1590s, introduced tulips in Holland. Tulips, which belong to the indigenous flora of Turkey, quickly became fashionable among the affluent. During a speculative frenzy in 1636-37, some bulbs are said to have been traded at a price equal to the value of a house. The traditional view of the tulipmania, which has been put forward by Mackay (1852), Kindleberger (1996) and others, is that it was a speculative bubble during which the public behaved irrationally. Garber (1989, 2000) and Goldgar (2007) cast doubt on this interpretation, arguing that earlier authors exaggerated prices rises and that it was not irrational to invest in tulip bulbs. French (2006) argues that monetary factors created the right conditions for an asset price bubble in Amsterdam in the 1630s.

The speculation with tulip bulbs was done with contracts for differences, and possibly options. By the time of the tulipmania, contracts for differences had been used in Holland for about a century. It is unlikely that speculators were wealthy enough to buy tulip bulbs and hold on to them. Indeed, contracts for differences were controversial because they gave people leverage to speculate. In Antwerp contracts for differences were outlawed shortly after forward contracts had been made transferable, around 1541 (Swan 2000, p. 144). But it is unlikely that this restriction was effective because a forward contract does not show how it will be settled. Even if the contract requires the delivery of the underlying asset, the parties to the contract can informally agree on a cash payment at the delivery date. In Amsterdam contracts for differences were not made illegal, instead, in 1621, 1630 and 1636, three edicts were issued with the intention to undermine contracts for differences by making them unenforceable in the courts (Kellenbenz 1957, p. xiv). However, these edicts did not prevent the use of contracts for differences during the tulipmania. Derivative markets continued to work because the failure to honor a contract made a speculator an outcast, practically excluding him from further dealings.

The following quote from de la Vega (1688) shows that most people valued their credit(worthiness) and reputation, although his friend did not fit the norm:

“There are many persons who refer to the decree [which proclaims the unenforceability of short sales] only when compelled to do so, I mean only if unforeseen losses occur to them in their operations. Other people gradually fulfill their obligations after having sold their last valuables and thus meet with punctuality the reverses of misfortune. But I also knew a friend, a strange man, who recovered from the grief of his loss by pacing up and down in his house, not in order to wake up the dead like Elias, but to bury the living. And after half an hour of such soliloquies he uttered five or six sighs in a tone which betrayed more his relief than his despair. When asked the reason for his joy, which pointed to some sort of compromise that he had come to with his creditors, he answered, “On the contrary, just this moment I have made up my mind not to pay at all, since my peace of mind and my advantage mean more to me than my credit and my honour.”” (de la Vega 1688, p. 7)

In Amsterdam derivative trading was based on reputation because personal business relationships were important in a city whose population grew from about 50,000 to 200,000 people during the seventeenth century.

A consequence of the absence of legal enforcement of derivative contracts was that they were traded only over-the-counter. The default risk of derivative contracts was idiosyncratic because it depended on how strongly people valued their “peace of mind” and their “advantage”. In addition, the edicts of 1621, 1630 and 1637 were ambiguous, leading to some court cases. For this reason, in Amsterdam contracts for differences did not evolve into futures contracts that were traded anonymously at exchanges, and options did not become warrants. The absence of legal enforcement of derivative contracts may also explain why the tulipmania did not lead to a strong economic recession. Since holders of long forward contracts had the right to repudiate them, there were no widespread bankruptcies when the price of tulips collapsed in 1637. The history of the tulipmania suggests that in derivative markets a moratorium is preferable if enforcing contracts would cause widespread ruin and a recession.

4. Great Britain and France in the Eighteenth Century

The development of English financial markets lagged behind continental Europe by about two centuries. During the sixteenth century, England was still a rural-agricultural country that lacked the dynamism of the urban Italian and Dutch societies. In the seventeenth century, the country was held back by political strife, which culminated in the Civil War of 1642-1651. Since Parliament withheld funding, the King financed a floating (short-term) debt by imposing compulsory loans and borrowing from a motley crew of money dealers, gold smiths and bankers. English public finances were a shambles, preventing a market for government debt in the seventeenth century. The political turmoil also retarded the evolution of commercial law. Swan (2000, p. 171) found a court case that indicates that the negotiability of bills of exchange was a matter of contention as late as 1736, two hundred years after bills of exchange had become negotiable in the Low Countries. Finally, the shares of joint-stock companies did not play a significant role until the 1690s, although the first joint-stock companies had emerged in England at about the same time as in Amsterdam. The *Royal Exchange*, which had been established by Sir Thomas Gresham in the 1560s, was a commodity exchange.

In the Revolution of 1688, a group of Parliamentarians offered the crown jointly to Mary and her husband William of Orange, both grandchildren of James I of England. The couple lived in Holland where William held the office of Stadtholder. The move of William and Mary from Amsterdam to London had a profound impact on English society. Parliamentary rule was strengthened, setting England on course toward a constitutional monarchy. Jardine (2008) portrays how the English benefited from the administrative, commercial and scientific achievements of the Dutch. Public finances were reformed, leading to the establishment of the *Bank of England* in 1694 and the introduction of Exchequer (Treasury) bills in 1696. The *Bank of England*, which celebrated its Dutch heritage in 2002, discounted bills of exchange and Exchequer bills. By buying Exchequer bills, the Bank monetized the floating public debt. These

financial reforms gave rise to a money market in which bills of exchange and Exchequer bills were traded. At the same time, there were improvements in the capital market. In the 1690s, a large number of joint-stock companies was founded whose shares were traded in the stock market, using the same techniques as in Amsterdam. Gerderblom and Jonker (2005) conclude “the financiers following William [of Orange] to Britain possessed a full range of financial techniques, and for which they found a ready market indeed. This transfer of knowledge formed the basis of derivatives trading in London, firmly linking Amsterdam’s pioneering work to the emergence of modern markets.”

After the successful financial reforms in the 1690s, the British government blundered when it took part in the creation of the *South Sea Company* in 1711. The *South Sea Company* was given the exclusive right to trade with South America (not the South Pacific), including the slave trade between Africa and South America. This right turned out to be illusory because Spain restricted trade between South America and Great Britain to a single ship per year in the Treaty of Utrecht in 1713, and even the slave trade was not profitable for the *Company* because local agents siphoned off large sums of money. Instead, the *South Sea Company* became a vehicle for the financing of long-term government debt, which may have been the government’s intention all along. The *Company* issued shares and it bought long-term government bonds, which were inadmissible for discounting at the *Bank of England*. This was an unattractive business because the shareholders could buy government bonds directly. The idea seems to have been that the *Bank of England* would control the money market and the *South Sea Company* would dominate the capital market.

The combination of a colonial trading monopoly with public finances proved to be a disaster, leading to the South Sea bubble in 1719. Exaggerated expectations of future returns from trade with South America drove the share prices far above the value of government bonds held by the *Company*. Dale et al. (2005) find evidence for irrational behavior. It seemed that the *South Sea*

Company had achieved the impossible, funding the long-term government debt and, at the same time, enriching shareholders by issuing shares whose value rose above the funded government debt. The success of the *South Sea Company* led to a wave of new joint-stock companies with dubious business plans, which tried to cash in on the public's seemingly insatiable appetite for shares. In April 1720, shortly before the South Sea bubble burst, the government restricted the establishment of new joint-stock companies. The limitation on new joint-stock companies, which remained in force until 1825, was a futile attempt to support the price of the shares of the *South Sea Company* by reducing the overall supply of shares.

During the South Sea bubble, the tools of speculation included call and put options, where the former were called "refusals". In addition, there was an innovation, a warrant-like instrument. The *South Sea Company* issued partially paid shares that subscribers could buy by making several installment payments. Shea (2007) maintains that these shares were compound call options because the payment of an installment gave the subscriber the right to pay the next installment, thus keeping alive the option to eventually own the share. If the share price fell below a certain value, the subscriber could refuse to make the next installment payment, forfeiting the option on the shares. The partially paid shares of the *South Sea Company* were warrants because the privileged position of the *South Sea Company* made them so fungible that they were anonymously traded in a secondary market.

The economic aftermath of the South Sea bubble remains contentious. Schumpeter (1939, pp. 250-251) claims that there was no major economic downturn after the South Sea bubble, but Carswell (1960) argues that the bubble had severe economic repercussions, delaying the onset of the Industrial Revolution by almost half a century. Kindleberger (1984, pp. 282-283, and 1996, p. 191), who avoids taking a position on the economic consequences of the South Sea bubble, notes that "London stopped growing from 1720 to 1750". There is reason to believe that the economic downturn after the South Sea bubble was more severe than after the tulipmania. Unlike in

Amsterdam, speculators could not easily abandon a contract. The more rigorous enforcement of financial contracts in Great Britain led to bankruptcies when the bubble burst. To avoid the worst, the *Bank of England* belatedly and “grudgingly” bailed out the *South Sea Company* (Kindleberger 1984, p. 282).

In 1734, the British Parliament passed the *Sir John Barnard’s Act*, which declared contracts for the future delivery of securities to be “null and void”. Fines amounted to £500 for “refusals” and “putts” and £100 for short-selling operations. The *Act* applied only to derivatives on securities because, as debated in Parliament, it was feared that commodity markets would move back to Amsterdam if contracts for the future delivery of commodities were outlawed in London. Adam Smith (1766) realized that the *Sir John Barnard’s Act* did not prevent derivative dealings in security markets.

“This practice of buying stock by time is prohibited by the government, and accordingly, tho’ they should not deliver up the stocks they have engaged for, the law gives no redress. There is no natural reason why 1000 £ in stocks should not be delivered or the delivery of it enforced, as well as 1000 £ worth of goods. But after the South Sea scheme this was thought upon as an expedient to prevent such practices, tho’ it proved ineffectual. In the same manner all laws against gaming never hinder it, and tho’ no redress for a sum above 5 £, yet all the great sums that are lost are punctually paid. Persons who game must keep their credit, else no body will deal with them. It is quite the same in stock jobbing. They who do not keep their credit will soon be turned out, and in the language of Change Alley be called a lame duck. (Smith 1766, pp. 537-538.)

The *Sir John Barnard’s Act* made derivative contracts on securities unenforceable in the courts. As a consequence, Great Britain moved to a system of derivative trading with securities that was based on reputation, similar to that in Amsterdam a century earlier. The restriction on derivatives that involved securities explains why shares were traded in the *Exchange Alley* and not at the *Royal Exchange*. Share trading took place in the *Exchange Alley* because derivatives on securities were illegal. Thus, share traders were not banished from “the august surroundings of the second *Royal Exchange*” to “the shady precincts of *Exchange Alley* and nearby coffee houses”, as maintained by Swan (2000, pp. 188-189). Instead, share traders avoided the *Royal*

Exchange because they could not deal with options and conduct short-selling operations in the open. Commodity traders, however, stayed at the *Royal Exchange* because there were no restrictions on contracts for the future delivery of commodities.

The South Sea bubble was the first financial crisis with an international scope. In Paris, the shares of the *Compagnie des Indes*, which had absorbed the *Mississippi Company* and the *Banque Royale* in 1719, were even more prone to speculation than those of the *South Sea Company*. Like its British counterpart, the French company possessed a colonial trading monopoly and it funded the Royal treasury by issuing shares. In addition, the French company discounted bills of exchange and it issued bank notes, the business that was assigned to the *Bank of England* in London. The *Compagnie des Indes* was the brain child of John Law (1671-1729), who had fled Scotland after being sentenced to death in 1694 for killing an adversary in a duel. Niehans (1990, p. 48) opined that Law “became influential for classical monetary theory in two respects, (1) by being the first to assign paper money an important economic role, and (2) by providing a dramatic example for the disasters that may result from the failure to have a correct understanding of this role.” Law put forward the “real-bills doctrine”, which, as discussed in Niehans (1990, pp. 48-51) and Weber (2003), does not provide an effective constraint on the issue of paper money. Murphy (2006) provides an introduction to Law’s monetary and financial innovations. The price of shares of the *Compagnie des Indes* rose about 20-fold, whereas the shares of the *South Sea Company* rose only about six to seven-fold. Speculation was more intense in Paris than in London because unrealistic expectations on the prospects of colonial trade were reinforced by an inflationary overissue of paper money. After the collapse of the bubble in 1720, Law, who had been appointed as French finance minister a few months earlier, fled the country, spending his final years as an impoverished gambler in Venice. The timing of the collapse in share prices - May in Paris and September in London - suggests that the panic spread from Paris

to London. Kindleberger (1996, pp. 111-112) indicates that other financial centers were affected, including Amsterdam and Hamburg.

Coffinière (1824, pp. 1-50) reviewed the restrictions on derivative trading that were imposed in the wake of the financial collapse in Paris. On August 30, 1720, the State Council stripped the privilege to deal in financial markets from the sixty security dealers. Over the next five years, a series of laws and ordinances established a stock exchange with first twenty and then again sixty authorized dealers. The purpose of the French legislation was to confine security and commodity dealings to the premises of the stock exchange in order to control activities. This is just what share traders in London feared the most, to be forced to work at the *Royal Exchange*. Article 17 of a State Council Decision of September 24, 1724, restricted all dealings in securities and commodities to the privileged dealers “in order to prevent short-sales”. Despite the threat of heavy fines, unauthorized people visited the stock exchange, trading took place outside the exchange building in some restaurants, and deals for future delivery were common. In 1736, a policy order banned thirty persons from the stock exchange, imposing a fine of 6000 livres on each.

The French Revolution, which upheld the principle of freedom of trade, initially led to the abolishment of the guild-like privileges of the authorized dealers, but the *Commercial Code* of 1807 and supporting legislation returned to a regulatory framework that was virtually indistinguishable to that of the preceding century. Dealings in securities and commodities were again restricted to authorized dealers at the stock exchange. Article 321 and 422 of the *Penal Code* of 1810 imposed fines and prison terms on wagers with government bonds, which were contracts for differences. But trading continued outside the stock exchange in some restaurants. The preamble to a police order of January 24, 1823, bears witness to the futility of more than a century of legislation against derivative trading in Paris. Note that the State Council Decision of September 24, 1724, remained in force after the French Revolution.

“Since the Police-Prefect has been informed that the laws and ordinances on the stock exchange are often circumvented, that many people meet at several places, especially at the Tortonic Coffee House, to deal with bills of exchange, money and commodities, interfering without authorization with the business of security and commodity dealers; considering that these infractions can only be explained by a lack of knowledge of the law or a disregard of it; considering Articles 1, 2 and 25 of the Decree of July 1, 1801; - (2) Article 1 of that of March 19, 1801; - (3) Articles 76, 78, 79, 85, 86, 87, 88 of the Commercial Code; - (4) the State Decisions of September 24, 1724 (Article 12) and August 7, 1785 (Article 182); - further considering Article 3 of the Government Decision of June 16, 1802;” (Coffinière 1824, p. 47. Translated by E.J. Weber).

After all these weighty considerations and listing a century of futile legislation, the Police-Prefect once more outlawed derivatives, and trading in securities and commodities was restricted to authorized dealers at the stock exchange - again to no avail. As in Great Britain, derivatives continued to be traded informally outside the premises of the exchange, based on reputation with no recourse to the court system. This made people more cautious with whom they dealt, and it avoided the spread of bankruptcies when there were speculative excesses. In the eighteenth and nineteenth centuries, European governments lacked both the will and political power to suppress financial transactions between enterprising individuals.

5. Derivative Markets in the Nineteenth Century

In the early nineteenth century, a wave of derivative trading encompassed France that was based on government bonds. After the defeat of Napoleon in 1815, the Allied powers - Great Britain, Prussia, Austria and Russia - asked for financial compensation for a quarter of a century of war in Europe. Although France had lost the war and there had been a hyperinflation during the revolutionary period, the French government gained surprisingly quickly access to domestic and international financial markets. This made it possible to pay for the reparations with a mix of taxes and borrowing that was politically and economically less damaging than relying on exorbitant taxes without borrowing. At the same time, the growth in public debt created a market for government bonds, which provided a pool of fungible assets for derivative trading.

The remarkable recovery of investor confidence in French public debt was caused by several favorable circumstances. After the collapse of the Napoleonic regime, France continued to benefit from Napoleon's monetary and fiscal reforms. Napoleon had stabilized the French currency, reforming public finances and establishing the *Bank of France*. It is a popular myth that Napoleon was a fiscal conservative because he did not borrow much. Actually, he found it hard to borrow because European banking houses perceived him as a dangerous adventurer with uncertain prospects. In any case, Napoleon's early military campaigns were self-financing because he plundered the treasuries of occupied countries. The loot from the city of Bern financed the campaign in Egypt, a mode of finance that pained the Bernese aristocrats for some time. White (2001) also points to political factors that explain the relatively smooth transition of government after Napoleon. The goal of the four Allied powers, all monarchies, was to restore the Bourbon monarchy and not to destroy France. Even during the peace negotiations, Great Britain became an ally of France against Prussia and Russia, whose territorial claims in Eastern Europe threatened to unsettle the balance of power in Europe. Thus, at the end of the Napoleonic Wars, France had a stable currency, the public debt was small, the government was accepted as legitimate at least by monarchists, and France was supported by Great Britain in the peace negotiations. These circumstances were more favorable than those in Germany after World War I.

White (2001) reckons that the French reparation payments were "in most dimensions somewhat smaller than the post-World War I German reparations" but "larger than any other nineteenth and twentieth century indemnities." As a consequence of the reparation payments, the French public debt that was funded by long-term bonds rose from 1.3 billion francs in 1814 to 4.2 billion francs in 1821 (White 2001, Table 4). This made the French public debt the second highest in the world, behind Great Britain whose total interest bearing public debt was 570 million pounds in 1820, or about 14.4 billion francs (Barro 1997, p. 511). The British public debt had expanded during the eighteenth century and, unlike Napoleon, the British government had

been able to raise funds in the capital market to finance the war effort. Wright (1999) presents estimates on British government borrowing during wars from 1750 to 1815.

In the 1820s, derivative trading with government bonds flourished in Paris. Coffinière (1824) and Proudhon (1857) wrote manuals on the techniques of derivative trading and the regulatory framework. Proudhon (1857, Chapter V) subdivided contracts for future delivery (*négotiations à terme*) into forward contracts (*marchés fermes*) and options (*marchés à primes, marchés libres*). A call option is called an “achat à prime” and a put option is a “vente à prime”. He also considered repurchase agreements, which were called “reports”. Both manuals were widely read but their style is bizarre, albeit for different reasons. Coffinière (1824) expressed moral outrage about the uses of contracts for future delivery that were settled by paying differences. He emphasized time and again that these activities were illegal because they were tantamount to wagers and illegal gambling. The police order against derivative trading, whose preamble was cited above, was issued in January 1823. Coffinière, who was an advocate (solicitor), could not afford to give the appearance that he supported illegal financial transactions.

By the time Proudhon (1857) published his manual, derivative trading involved a wide range of government bonds and shares. The second part of the manual includes a long list of securities that were traded at the *Paris Stock Exchange* in the 1850s. Yet, the regulatory framework had not kept up with the expansion of derivative markets in the first half of the nineteenth century. Proudhon (1857, p. 47) noted that the government of Louis-Philippe had put up with derivative trading in the *Café Tortoni* and the *Passage de l'Opéra*, but the police cleared the *Cercle du Boulevard des Italiens* of derivative traders in 1849 and the *Passage de l'Opéra* and the *Casino* in 1853. The purpose of the police action was to protect the monopoly of the authorized security dealers at the stock exchange who earned hefty monopoly rents. Despite the large expansion in trading volumes, their number had been frozen at sixty for 150 years! In the mid-1850s, the authorities yielded and the stock exchange opened its doors to the public, charging a modest

entrance fee. Proudhon (1857, p. 81) also reports that contracts for future delivery were now lawful if the delivery date did not exceed two months (one month for railway shares). Hence, unlike Coffinière in 1824, Proudhon (1857) felt no need to hide the purpose of this manual, which he called “Manuel du Spéculateur à la Bourse”.

Proudhon’s manual on speculation is unusual because its author hated the stock exchange. In 1853-54, he had accepted the commission to write the manual because he needed money. The first two editions were published anonymously and, only when the success of the book had been established, he put his name on the third edition. It was an odd decision by the booksellers *MM. Garnier frères* to ask Proudhon to write a manual on derivative trading. Proudhon was a well known social philosopher who had collaborated with Karl Marx until, after falling out with Marx, he developed his own brand of anarchistic socialism. Proudhon’s treatment of the contracts for future delivery in Chapter V is more succinct than that of Coffinière, whose book he knew (Proudhon 1857, p. 61). In his book, Proudhon also made valuable contributions to economic theory, anticipating modern information economics. He applied the principal-agent model to the conflict of interest between shareholders and management, and he put forward a model of the stock market in which noise traders interact with well informed professionals. However, all this valuable material is swamped by his polemic against the capitalists and government officials who controlled the stock exchange. Despite his tirades against the stock exchange, the book was popular because Proudhon, who survived on journalism, was a seductive writer who appealed to a base instinct of his readers - envy.

Between the sixteenth and the eighteenth centuries, in several German cities exchanges sprang up for the trade with bills of exchange. Most exchanges served a local clientele, but Hamburg maintained links with Amsterdam and the Hanseatic cities in the Baltic in the seventeenth century, and Frankfurt gained in importance in the second half of the eighteenth century. In the nineteenth century, the development of German security markets followed the

same pattern as in France. Bonds of German states were first introduced at exchanges, and shares of railways, banks, insurance companies and industrial companies followed later. In 1806 the exchange in Berlin started to quote government bonds, two years later 21 government bonds were listed. In 1840 shares of three railways were added, and by 1848 there were 44 of them. In the second half of the nineteenth century, the number of listed securities grew rapidly: 163 in 1867, 358 in 1870, 1273 in 1894, and more than 2000 in 1906. In Frankfurt the number of securities rose from 20 in 1800 to 1104 in 1900 (all figures are from Schanz 1906).

Zurich is typical for the development of financial markets in a small city in central Europe. In 1850, the exchange rates for bills of exchange from 13 cities and the shares of two banks - the *Bank in Zürich* and the *Bank in St. Gallen* - were listed in the *Tagblatt der Stadt Zürich*. Within a few years, corporate bonds were introduced at the exchange and the number of shares rose markedly. In 1856, the *Neue Zürcher Zeitung* listed 13 exchange rates, bonds of six railways, and shares of eight railways and six banks. Figure 1 reproduces a leaflet published by the *Schweizerische Kreditanstalt (Credit Suisse)* on January 4, 1867, which includes quotes for the three categories of securities that were traded at exchanges: bills of exchange (Wechsel) on top, bonds (Obligationen) in the middle, and shares (Actien) at the bottom. There were 15 exchange rates, 10 bonds, and eight shares of railways and industrial companies. The exchange rates for Basel, Genf (Geneva) and St. Gallen were 100, as one would expect with a single currency. Note that the exchange rate for Triest, the home of Vinzenz Bronzin, is specially mentioned in the table. On September 3, 1869, the first issue of the *Wechsel- und Effekten - Coursblatt von Zürich* includes a bond of the Swiss federal government. In the first half of the nineteenth century, government bonds had been unimportant in Switzerland because of the political fragmentation of the country. In addition there was an American government bond, and two foreign shares from *Crédit Lyonnais* and *Gaze Belge*. In 1869, 59 bonds and shares were traded at the exchange in Zurich. All listings are reproduced in Schmid and Meier (1977, pp. 61-99).

Wechsel-Kurse der Schweizer. Kreditanstalt
in Conto Corrent.
Zürich, 4. Januar 1867.

	Brief.		Geld.	
	Kurze Sicht.		Sicht bis 3 Monat.	
Amsterdam	213 1/2	timbré.	213	÷ 4 1/2 %
Antwerpen u. Brüssel	100	timbré.	99 7/8	» 3 %
Augsburg	212 1/4	—	211 3/4	» 4 1/2 %
Basel	100	timbré.	100	» 4 1/2 %
Berlin u. Leipzig	371 1/2	—	370	» 4 1/2 %
Frankfurt a./M.	212 1/4	—	211 3/4	» 3 1/2 %
Genau u. Turin	—	timbré.	—	» —
Genf	100	timbré.	100	» 4 1/2 %
Hamburg	187 3/4	timbré.	187 1/4	» 4 %
Italienische Bankplätze	—	timbré.	—	» —
London	25. 20	—	25.17 1/2	» 3 1/2 %
Mailand	—	timbré.	—	» —
Paris, Lyon u. Marseille	100	timbré.	100	» 3 %
St. Gallen	100	—	100	» 4 1/2 %
Wien u. Triest	—	—	—	» —

Disconto : 4 1/2 %. Nebenplätze 5 à 5 1/2 %.

Disconto-Abzug wenigstens 3 Tage bei Wechseln auf Winterthur, Basel, St. Gallen.
40 „ „ „ „ alle andern Plätze.

Effecten-Kursblatt der Schweizer. Kreditanstalt.

Obligationen :	Verzinsung.	Rückzahlung.	Ausgeböten.	Gesucht.	Begeben
Kurs pro %.	Marchzinsen extra.				
50%	Schweiz. Nordost-Bahn	31. März. 30. Sept.	1868/1888	—	100 1/2
4 1/2 %	» »	31. Jan. 31. Juli.	1865/1879	—	—
*4 1/2 %	» »	28. Febr. 31. Aug.	1873/1892	95	94 1/2
4%	» »	30. April. 31. Oct.	1870/1890	—	—
*3%	» »	28. Febr. 31. Aug.	1872/1892	—	—
*5%	Schweiz. Central-Bahn	Ganzjährlich, diverse Termine.	Div. Term.	—	100 1/2
*4 1/2 %	» »	10. Mai. 10. Nov.	1877	—	—
5%	Exportgesellschaft	31. Dec.	1873/1878	100	—
5 1/2 %	Honggeler Graf. & Cie.	30. Juni. 31. Dec.	1876/1879	100	—
4 1/2 %	Schweiz. Nordost-Bahn Emission 1865.	31. Mai. 30. Nov.	1877/1895	95	94 1/2

*Mit Coupons, zahlbar auch auf sünddeutschen Plätzen à 28 Kr. resp. 8 Sgr. pr. 1 Fr.

Akten :	Dividendenzahlung.		Ausgeböten.	Gesucht.	Begeben
Kurs pro Stück, inclusive Coupons.	à compte Dividenden.	Rest-dividend.			
Schweiz. Nordost-Bahn*	2 % 30. Juni.	3 Jan.	635	625	627 1/2
» Central-Bahn	2 % 31. Aug.	15. April.	435	430	—
Banque Commere. Genevoise	4 % 31. Dec.	1 Trimest.	500	495	500
Basler Handelsbank	2 % 15. Sept.	1m März.	420	410	415
Schweiz. Kreditanstalt	2 1/2 % 31. Aug.	31. März.	—	570	570
» Export-Gesellschaft	5 % 31. März.	30. Juni.	—	—	—
» Rückversich.-Gesell.	—	1. Mai.	—	—	—
Zürcher Gasgesellschaft	2 1/2 % im Mai.	1m Nov.	—	—	—

Figure 1. "Kursblatt" for bills of exchange, bonds and shares published by *Credit Suisse* on January 4, 1867.

Derivative trading spread from France to Central Europe. Coffinière's book was translated into German and published in Berlin in 1824, and a sanitized German summary of Proudhon's book was published in Zurich in 1857. The anonymous editor highlighted Proudhon's concern with the precarious position of shareholders, using a new title "The Stock Exchange, Stock Exchange Operations and Deceptions, and the Position of Shareholders and the Public". In Germany contracts for future delivery were called "Zeitgeschäfte", which Emery (1896, p. 46, n. 2) translated as "time-contracts".⁶ Contracts for future delivery were subdivided into forward contracts (fest abgeschlossene Geschäfte, feste Geschäfte, Fixgeschäfte) and options (Prämiengeschäfte, Dontgeschäfte). A literal translation of "Prämiengeschäfte" is "premium businesses", which points to the premium that is paid for an option. In France, Switzerland and Austria the premium on an option was also called "dont". The terms for call option (Geschäft mit Vorprämie) and put option (Geschäft mit Rückprämie) failed to describe these transactions. This was even worse for the positions that can be taken in option markets: long call (Kauf mit Vorprämie), short call (Verkauf mit Vorprämie), long put (Verkauf mit Rückprämie) and short put (Kauf mit Rückprämie). Therefore, Bronzin (1908) introduced a more intuitive terminology: long call (Wahlkauf), short call (Zwangsverkauf), long put (Wahlverkauf) and short put (Zwangskauf). In addition, Moser (1875) and Bronzin (1908) mentioned a straddle (Stellgeschäfte, Stellagen) and "Nochgeschäfte". "Noch" means "again". In a "Wahlkauf mit m -mal Noch", an investor at the same time buys a share and m call options on the share. Thus, he has the right to buy another m shares in the future. Similarly a "Wahlverkauf mit m -mal Noch" combines a sale of a share with m long puts on it.

By the mid-nineteenth century, many publications on derivatives competed for the public's attention. But these publications were ill-suited as manuals for derivative trading because the authors, who often had a background in law, overemphasized regulations that were largely

⁶ Emery (1896) gives some space to Proudhon (1857) at the beginning of his treatise on futures markets in the United States.

ineffective, and derivatives were explained with the help of tedious numerical examples. In effect, virtually no advance had taken place in the professional discussion of derivatives since de la Vega had published *Confusion de Confusiones* in Amsterdam in 1688. By the mid-nineteenth century, the shortcomings of the financial literature held back the development of derivative markets. A verbatim discussion of contracts for future delivery stretches the possibilities of everyday language, and the use of numerical examples is not suitable for the analysis of combinations of derivative contracts. The straddle was discussed as a separate contract because the authors did not notice that it combined positions in call and put options, and combinations of derivative contracts that produced more complicated payoffs were beyond the reach of the financial literature. Cohn (1867, pp. 3 and 36), who became Professor of Economics at the Federal Institute of Technology (ETH) in Zurich, still relied on Coffinière (1824) in his doctoral dissertation on the difference business.⁷

The invention of profit charts, which occurred around 1870, contributed much to the understanding of derivative contracts. Profit charts clarified the nature of forward contracts and options and they made it possible to combine derivatives in novel ways, achieving payoffs that had hitherto been impossible. The invention of profit charts was a decisive step in the evolution of derivative markets. They made it possible to explain a derivative contract with a single graph instead of long-winded explanations, numerical example and tables. Both Bachelier (1900) and Bronzin (1908) used profit charts in their works. It is unlikely that Bachelier and Bronzin, who had studied mathematics and physics, would have turned to the analysis of option pricing if profit charts had not provided an easy way for young scientists, who lacked experience in financial markets, to learn about derivatives.

⁷ Gustav Cohn (1840-1919) was a renowned German economist who wrote several books on public finance and transportation economics. He completed the doctoral dissertation at the University of Leipzig in 1867. From 1875 to 1884, he held the chair of economics at the Federal Institute of Technology (ETH) in Zurich, and afterwards he moved to the University of Göttingen.

The first profit charts were published by Lefèvre (1873) and Moser (1875). Jovanovic (2006b) reproduces four charts from Lefèvre (1873): a long forward contract (achat ferme), a long call option (achat à prime dont), a straddle which combines a long put with a long call, and a complex operation. The graph simplified the presentation of a straddle, which Lefèvre cumbersomely called “achat à prime direct contre vente à prime inverse”. Figure 2 to 4 reproduce profit charts from Moser’s book, which includes many more charts. Figure 2 displays a long call option on top and a short call option at the bottom, and Figure 3 shows a straddle on top and a long contract with 2-times Noch at the bottom. In the contract with Noch it is assumed that a person buys a share and two call options on the share with a strike price of 61, paying 60 for the entire package. As there is no premium involved in a transaction with Noch, the price of 60 equals the sum of the share’s spot price and two premiums for the call options. Moser (1875) used the profit charts to investigate the relationships between various derivative contracts. The top panel in Figure 4 shows how a long forward contract can be combined with a long put option to create the profit of a long call option (solid line), and in the bottom panel a long put option and a long call option are combined to produce a straddle (solid line).

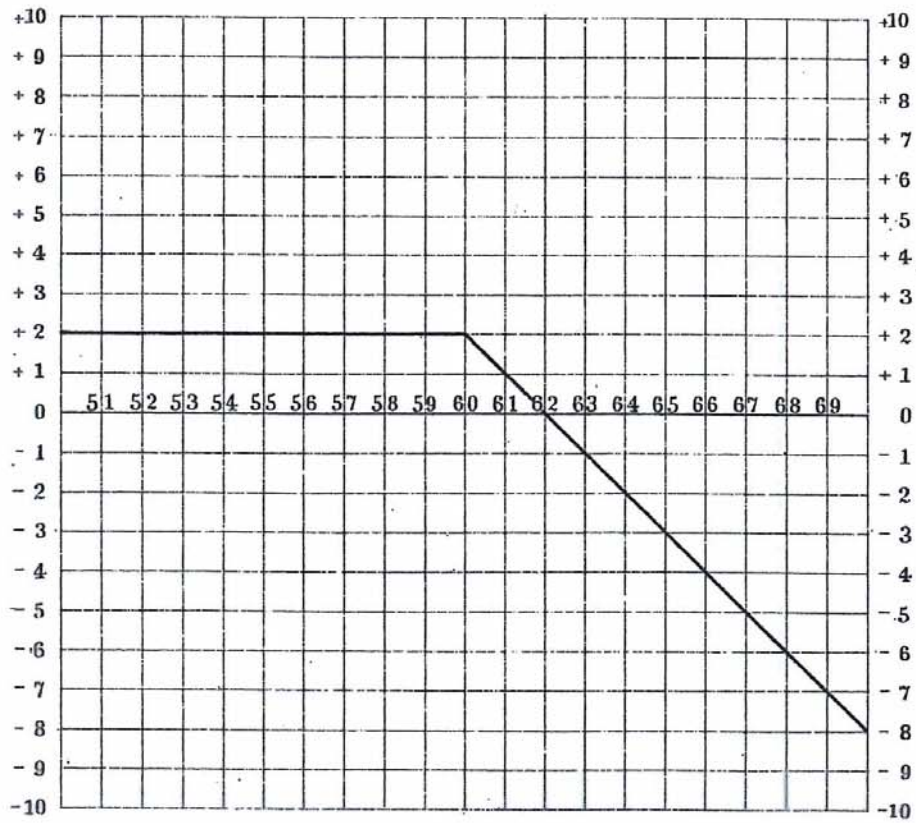
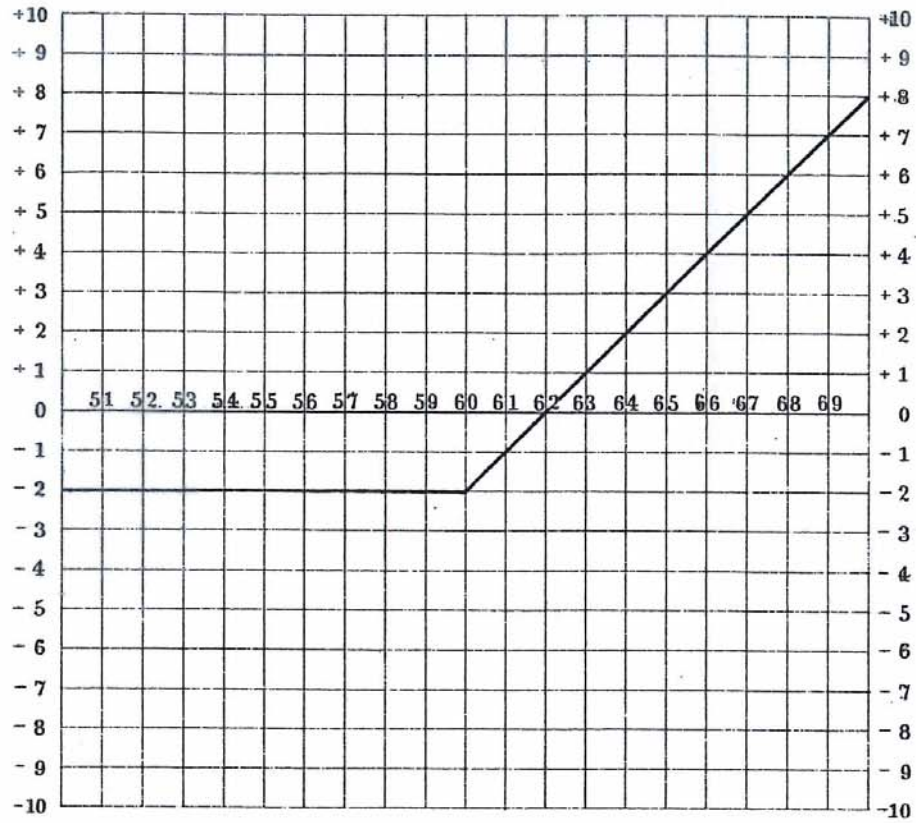


Figure 2. A long call (top) and a short call (below).

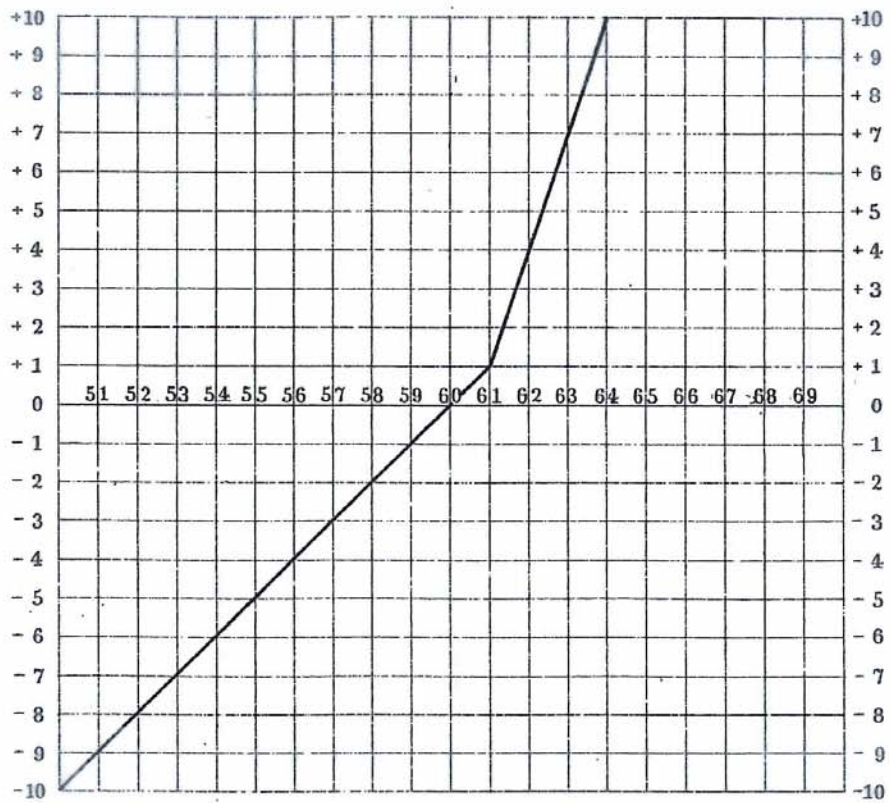
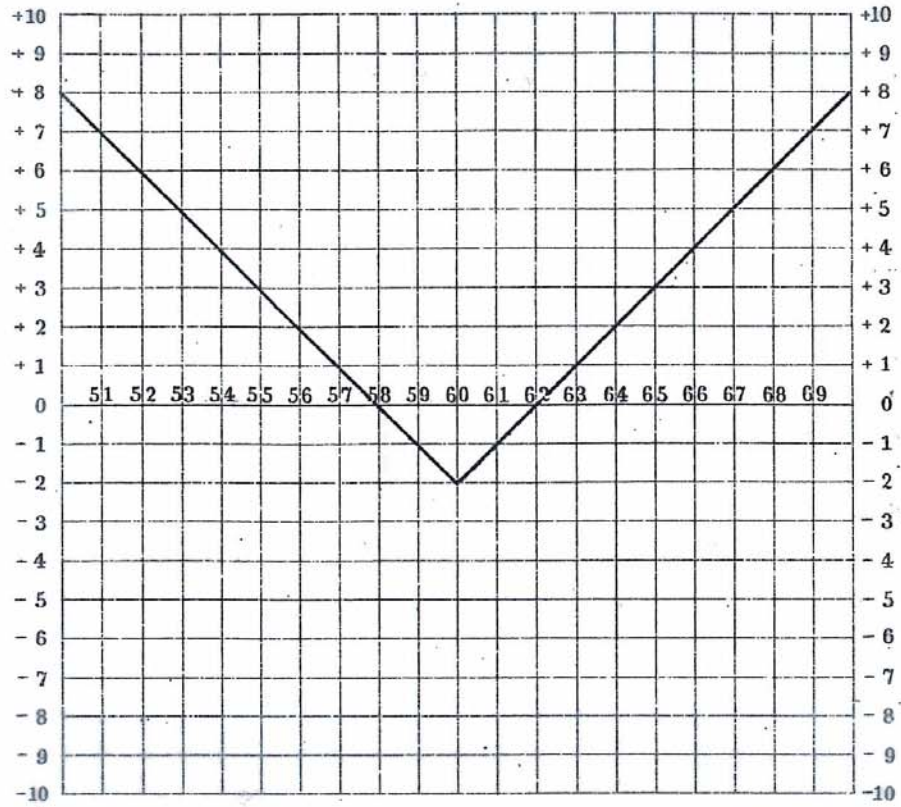


Figure 3. A straddle (top) and a long contract with 2-times Noch (below).

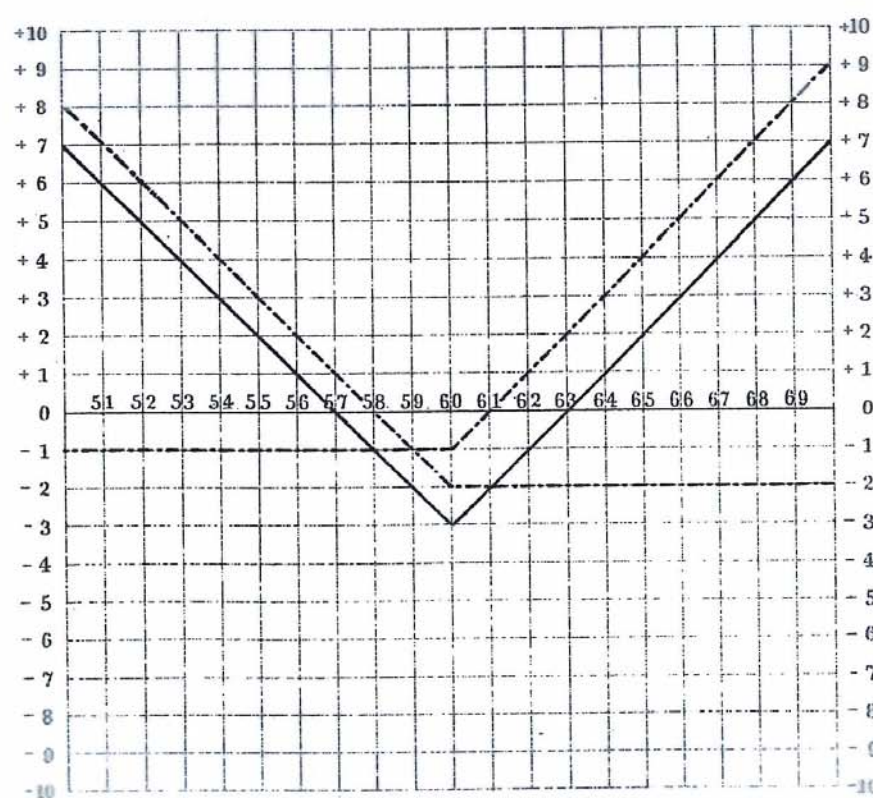
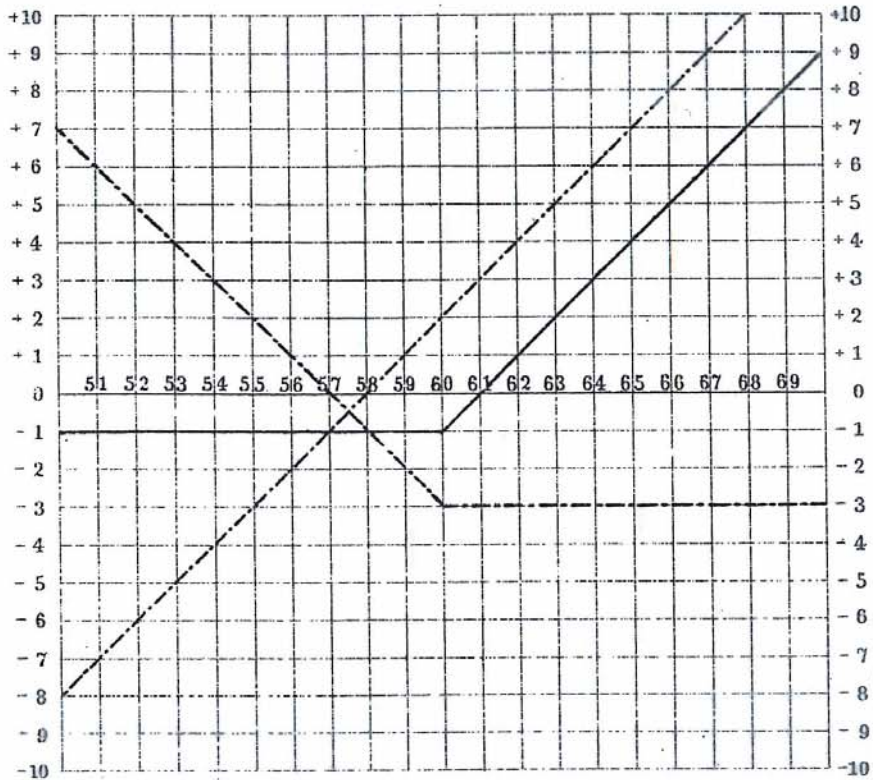


Figure 4. A synthetic long call using a long forward contract and a long put (top) and a synthetic straddle using a long put and a long call (below).

It is unclear who invented profit charts. Moser (1875, p. V) mentions that he started to work on his book in 1870, but Lefèvre published profit charts before Moser. After studying science, Lefèvre had turned toward financial journalism and a career in banking and insurance. On the title page of some of his works he mentions that he was a private secretary of Baron de Rothschild. It is possible that Lefèvre invented profit charts, but it is more likely that they originated in financial markets in Paris in the 1860s and Lefèvre became aware of them through his interaction with derivative dealers and bankers, including Baron de Rothschild. As Moser started to work on his book in 1870, profit charts must have been known in financial circles in Berlin by that time.

In 1885, derivative contracts became legally enforceable in France, although it was still possible to raise the objection against gambling under some circumstances. In Germany the regulatory framework was similar to that in France for most of the nineteenth century, i.e. derivatives were traded in a legal limbo. In Prussia contracts for future delivery were outlawed for Spanish government bonds in 1836, for all foreign securities in 1840, and for securities of railways in 1844. After the unification of Germany in 1871, it was up to the courts to decide whether a contract for future delivery was legitimate or whether it was motivated by illegal gambling. The courts took into consideration the contract's terms, the profession and wealth of each party and anything else that might shed light on the contract's purpose, which all gave rise to considerable legal uncertainties. In 1896, Germany passed a law (Börsengesetz) that severely restricted derivative dealings. It became illegal to conclude contracts for the future delivery of wheat and milling products, and for shares of mines and factories. The government also could regulate and prohibit contracts for all other goods and financial assets. These severe restrictions disrupted commodity markets and financial markets in Germany, diverting trade in commodities and securities to foreign exchanges. By the end of the nineteenth century, German financial markets had reached a size that it was no longer possible to avoid regulations by moving into

coffee houses and allies. Schanz (1906, pp. 527-536) claimed that commodity prices became more volatile and, since more cash transactions were conducted, the demand for cash increased. The business community also complained that in some locations price quotations for commodities ceased because exchanges had closed down.

The German law of 1896 also determined that contracts for future delivery were enforceable only if both parties had registered as dealers. The unintended consequence of this provision was that most dealers chose not to register, returning to a system of trading that was based on reputation. In 1900, there were only 212 registered commodity dealers and 175 registered security dealers at all 29 German exchanges. But German commodity and financial markets had long outgrown the small-town conditions of pre-industrial derivative trading, where reputation based trading worked well. The presence of a large number of persons whose contracts were not enforceable caused problems because people had become accustomed to trading anonymously. Schanz (1906, p. 533) maintains that during the downturn in stock prices in the spring of 1900, many unregistered persons, including merchants and bankers, simultaneously bought shares forward and sold them forward. Allegedly, they then abandoned the position that produced a loss, thus taking advantage of the fact that their contracts were legally nonbinding. The German restrictions on derivative trading were a self-inflicted wound on the German economy at the turn of the nineteenth to the twentieth century. Although the German government again relaxed some restrictions, Germany lacked an effective regulatory framework for derivative markets at the beginning of the twentieth century.

6. Conclusion

The history of derivatives is as old as the history of commerce. Farmers, manufacturers and merchants face risks because the production and distribution of goods takes time. Prices may change between the time the production decision is made and the sale of goods, and unforeseen circumstances may arise during the production process and distribution of goods. Forward contracts remove the price risk of future transactions, and options limit the risk of future transactions to the option premium. An efficient allocation of the risk of future transactions increases output because it enhances specialization among producers both locally and between distant markets.

In this chapter, the history of derivatives from antiquity to the time of Louis Bachelier and Vinzenz Bronzin is traced. Contracts for future delivery of goods spread from Mesopotamia to Hellenistic Egypt and the Roman world. After the collapse of the Roman Empire, contracts for future delivery continued to be used in the Byzantine Empire in the eastern Mediterranean and they survived in canon law in western Europe. During the Renaissance, financial markets became more sophisticated in Italy and the Low Countries. An important financial innovation were securities, which were issued as a source of funds by merchants (bills of exchange), governments (bonds) and joint-stock companies (shares). The first derivatives on securities were written in the Low Countries in the sixteenth century. Derivative trading on securities spread from Amsterdam to England and France at the turn of the seventeenth to the eighteenth century, and from France to Germany in the early nineteenth century.

During the process of writing this chapter, two issues arose that should be investigated further by someone who has access to the sources and the skills to use these sources. The first issue is the role of Sephardic Jews in the spread of derivatives from the Roman world, across the divide of the Middle Ages, to the Low Countries. Swan (2000, pp. 105-107) argues that during the Middle Ages derivatives continued to be used in monasteries and at fairs under the auspices

of the Church because derivatives survived in canon law, which was influenced by Roman law. This argument fails to explain why derivatives on securities emerged in the Low Countries in the sixteenth century, and not in Italian city states where securities (monti shares) had become negotiable much earlier, in the thirteenth century. Certainly, canon law must have been more influential in catholic Italy between the thirteenth and fifteenth centuries than in the protestant Low Countries in the sixteenth century.

An alternative hypothesis is that derivatives were introduced in the Low Countries by Sephardic Jews, who lived in Spain and Portugal and whose ancestry lay in Mesopotamia and Persia. Jews had prospered in Spain under Moslem rule from the eighth to the twelfth century. During the Christian reconquest of Spain, they were in and out of favor with rulers, depending on political and economic expedience. In 1492, Jews were either expelled from Spain or forcibly converted to Christianity. Sephardic Jews were transported to northern Africa and the eastern Mediterranean, and a significant group moved to Portugal, where they had the misfortune to be expelled again in 1497. From Portugal they fled to northern Europe, including the Low Countries. Both Isaac Le Maire (1558-1624), who conducted the short selling operation against the *Dutch East India Company*, and Joseph de la Vega (1650-1692?), who wrote *Confusion de Confusiones*, belonged to the community of exiled Sephardic Jews in Amsterdam. The comment of Cristobal de Villalon (1542), which was reproduced in Section 2, shows that contracts for differences were used in Spain and the Low Countries.⁸ It is a promising hypothesis that Sephardic Jews carried derivative trading from Mesopotamia to Spain during Roman times and the first millennium AD, and to the Low Countries in the sixteenth century. The hypothesis that derivative trading spread from Mesopotamia via Spain to the Low Countries should be investigated by an economic

⁸ Cristobal de Villalon lived in Valladolid, a city in north-central Spain. He published a book on Spanish grammar (*Gramática Castellana*) in Antwerp in 1558. The moral outrage that he expressed about contracts for differences may have been a ruse to elude the Inquisition. Similarly, Coffinière (1824) feigned moral outrage to protect his reputation as an advocate (Section 5). Nothing is known on de Villalon's ancestry.

historian with a background in finance who has access to Spanish archives and knowledge of Arabic, Hebrew, Latin and Spanish. Given these demanding requirements, it is not surprising that nobody has so far considered the role of Sephardic Jews in the spread of derivatives.

The second issue that needs further investigation is the role of banks in derivative markets. Not much is known on the use of derivatives by banks, but there is reason to believe that bankers and banks were at the forefront of derivative trading during the eighteenth and nineteenth centuries. Banks underwrote government bonds and shares of joint-stock companies and they invested in these securities. The business with securities (Effektengeschäft) was highly profitable and it is likely that it involved deals that were settled at a future date. Since personal relationships remained important, derivatives continued to be traded over-the-counter until the nineteenth century. This provided an opportunity for well connected banking houses, for example *Bank Rothschild*, which operated informal derivative markets either in-house or between banks. Mayer Amschel Rothschild (1744-1812), who founded the *Bank Rothschild* in Frankfurt, sent his sons Nathan, James, Salomon and Carl to London (1798), Paris (1812), Vienna (1820) and Naples (1821) to open banks; first-born Amschel stayed in Frankfurt. Reputation based derivative trading survived until the nineteenth century because it was supported by a strong constituency of security dealers and bankers.

The information on derivative dealings of banks is scarce because they kept operations secret as far as possible and their customers valued privacy. Many banks operated as sole proprietors and partnerships, with no need to divulge information to shareholders and the public. The following circumstantial evidence suggests that banks were active in derivative markets during the nineteenth century. (1) Henri Lefèvre, who - as mentioned in Section 5 - published the first profit charts for options, was a private secretary of Baron de Rothschild in Paris. (2) Bankers jealously guarded the profitable business with securities. The *Bank in Zürich*, which issued bank notes, was founded with the help of private banking houses in 1836. Bleuler (1913, p. 30, n. 1)

argues that the *Bank in Zürich* did not deal with securities as a concession to private bankers whose support it needed. Indeed, *Bank Rothschild* of Frankfurt subscribed to five percent of the bank's capital at its foundation (Bleuler 1913, p. 26, n. 1). (3) The Swiss Federal Law on the Issue of Bank Notes of 1881 made it illegal for banks of issue to participate in contracts for future delivery of securities and goods, both on their own account and on account of third parties.⁹ To avoid the restriction on derivatives and other regulations, large Swiss banks, the so-called "Grossbanken" which included the *Schweizerische Kreditanstalt (Credit Suisse)*, *Bank in Winterthur*, *Basler Handelsbank* and *Schweizerische Volksbank*, chose not to issue bank notes in the nineteenth century. The *Eidgenössische Bank* and some smaller banks abandoned the issue of bank notes after the enactment of the Federal Law on the Issue of Bank Notes.¹⁰ Derivative dealings of banks and bankers almost certainly surpassed dealings in coffee houses and allies, which attracted the ire of the authorities in Paris and elsewhere. The fact that it is difficult and even impossible to find solid quantitative information on a historical issue does not prove that the issue was not important. This is particularly true in the history of derivative markets and in financial history in general.

⁹ Article 16 of the Law applied the restriction on derivative dealings only to banks of issue that specialized in the discount of commercial bills (Diskontbanken), and not to banks that kept securities as reserves and state-run cantonal banks. The charters of some small Swiss banks included provisions against time dealings.

¹⁰ The *Bank in Winterthur*, *Basler Handelsbank* and *Eidgenössische Bank* became UBS, and *Credit Suisse* absorbed the *Schweizerische Volksbank*. The *Eidgenössische Bank* and the short-lived *Banque Général Suisse* were the only large banks that issued bank notes for some time. Weber (1988, 1992) deals with the issue of bank notes by Swiss banks in the nineteenth century.

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