9. Development of Derivative Securities

What are Derivative Securities?

Generally speaking, a derivative security is a security that involves a contingent claim; it is a security that has some essential feature, typically the price, that is derived from some other event. This event is often, though not always, associated with the price of a security or commodity transaction to take place at a future date. The contingent claim can be combined with other security features or traded in isolation. The implicit and explicit embedding of derivative features was common in the types of securities traded in the 15th to 18th centuries. Examples of such securities include: claims on the Florentine *mons* that had a provision for redemption at 28% of par, though that provision was seldom exercised; bills of exchange that combined a loan with a forward exchange contract; and life annuities that featured terms to maturity dependent on specific life contingency provisions.

In addition to securities with embedded derivative features, the financial markets of the 15th to 18th centuries can be credited with beginning exchange trading in derivative securities that were pure contingent claims, that is, forward and option contracts.[1] Though the precise beginnings are difficult to trace, it is likely that active trading in both forward and option contracts was a common event on the Antwerp bourse during the 16th century. By the mid-17th century, active trade in options and forward contracts was definitely an integral activity on the Amsterdam bourse. Trading in both options and forward contracts was an essential activity in London's Exchange Alley by the late 17th century. For want of a better term, the narrow class of pure contingent claims, the option and forward contracts, will be referred to as 'pure derivative securities'. This category excludes fixed income securities with embedded derivative features such life annuities where the value is contingent on life risk. The narrow definition also excludes callable or convertible bonds.[2]

Derivative securities trading is not a modern development. The basis for such trading arises from the essence of commerce. Markets depend fundamentally on the process of exchange. This process involves two steps. First, buyers and sellers agree on a market clearing price for the goods involved in the transaction. Second, the exchange is completed, typically with a cash payment being made in exchange for adequate physical delivery of the goods involved. In many transactions, time can separate the pricing agreement, the cash settlement or the delivery of goods. For numerous reasons, such as delays in transfer or transportation, many transactions in early markets involved separation between pricing and settlement or delivery. Under certain circumstances, this separation creates contingent claims that are the source of derivative securities trading.

Variations in the method of contracting for delivery have led to the development of different types of derivative securities. For example, forward contracts are associated with the *obligation* to take delivery at the agreed price. Options contracts are associated with the *right*, but not the obligation, to take delivery at the agreed price. The use of derivative securities has, almost always, been tailored to the needs of trade. As Hieronymus (1971) observes, the use of derivative securities to facilitate trade has been an integral part of development of markets. This was especially the case in the earliest markets, where the great distances and difficulties associated with travel and transportation meant that contracting for forward delivery was a necessary adjunct to trading done on a barter and cash-and-carry basis.

An essential feature of options, futures and forward contracts, the pure derivative securities, is the action of setting a price today for a transaction to take place at a date in the future. However, this feature is also present in other types of financial securities. A bond, for example, sets a price today for a sequence of fixed cash flows that will be received in the future. A 16th century bill of exchange would set a price today for a fixed amount of foreign exchange to be paid at a future date and in specific foreign location. Even a joint stock or modern common stock sets a price today for a sequence of uncertain cash flows that will be received in the future.

One element that distinguishes pure derivative securities from financial securities such as bonds or bills of exchange is the timing of the settlement. A forward contract involves settlement and delivery at maturity while a bond involves settlement today with delivery in the form of payments at future maturity dates. Using this approach, an option contract is somewhat anomalous, requiring a payment today to acquire the right to make a settlement at a price that is set today. The distinction between the various cases lies with the respective cash flows. The notion of synthetic securities follows appropriately. A synthetic security is a portfolio of securities with a combined cash flow that replicates the cash flow of some other security. In this fashion, for example, the cash flow associated with a forward contract can be replicated using a portfolio containing puts, calls and a fixed income security.

Because the cash flow characteristics of various financial transactions change over time, tracing the development of derivative securities trading is not easy. One essential feature of pure derivative securities, the separation of the pricing decision from settlement and delivery, is also present in other types of transactions. In ancient and medieval markets these distinctions are blurred even further by the inherent difficulty of setting current prices when the goods being priced require transportation. Another difficulty arises with the practice of using commodity money in the current pricing decision, when the monetary unit is also an important consumable, such as barley or salt. As a consequence, pragmatism dictates that the history of derivative securities be structured around specific features of transactions, as opposed to focusing on the specific types of securities being traded.

A key point in the development of derivative securities trading

occurred when market liquidity was sufficient to permit the securitization of contracts that were purely derivative, effectively forward contracts and option contracts. Ehrenberg (1928) is insightful in recognizing that this event required the emergence of sufficient speculative trading to sustain market liquidity. As modern writers have later recognized, for example, Feiger (1978), trading by both hedgers and speculators is essential to the adequate functioning of a derivative securities market.[3] While there were sporadic and specific instances of previous trade, the start of active trading in pure derivatives can be traced to the 16th century Antwerp bourse.

The history of economic thought on pure derivative securities is sparse. Relatively little of substance was written until the 20th century. There is good evidence that market participants had a subtle understanding of derivative security pricing, even though those who chronicled the trading activities did not fully grasp the inherent structure of the arbitrage trades that were, apparently, being done. Of the available sources, two stand out: Joseph de la Vega, *Confusion de Confusiones* (1688) and Isaac de Pinto, *An Essay on Circulation on Currency and Credit* (1771) that includes the attachment *Jeu d'Actions en Hollande*. In neither case was the study of derivative securities the main subject of the text. Information on derivative securities is an inclusion, albeit not overly detailed. In addition to these two contributions, there are also a number of other descriptive accounts, such as those contained in the 1694 articles included in John Houghton, *A Collection for the Improvement of Husbandry and Trade* (1692-1703).

The Earliest Markets

The earliest records of transactions that had features of derivative securities occur around 2000 BC in the Middle East. Einzig (1970) reports about a document originating in Assyria in the first year of Hammurabi's reign authorizing the 'bearer to receive in 15 days in the City of Eshama on the Tigris 8½ *minae* of lead deposited with the Priestess of the Temple'. Recognizing that lead was the currency of Assyria, this negotiable instrument can reasonably be taken as the earliest evidence of the use of a bill of exchange, albeit in bearer form and possibly representing an 'inland bill'. The corresponding use of similar types of bills of exchange in Babylonia during the same period, where silver and barley were the local currency, raises the possibility that bills of exchange were used to facilitate rudimentary forward foreign exchange trading. However, there is no direct evidence supporting this hypothesis.

The earliest reports of bills of exchange being used in international transactions occurred 'when the merchants of what is now Bahrain Island took goods on consignment for barter in India'.[4] In the consignment process, goods are taken for 'on-the-spot' delivery at the agreed upon price, with settlement at a later date, giving rise to the bill of exchange. In practice, bills of exchange can arise from various types of transactions. In a 'merchant's exchange' transaction, a bill originates

when the goods are purchased on credit, sold in another location and the proceeds of the sale used to settle the debt specified in the bill. By the 15th century, settlement was conventionally made in a different currency making the bill of exchange a combination of a credit transaction and a forward exchange contract. Because the locations involved in the initial purchase and later sale of the goods were often in different political jurisdictions, the bill of exchange became an important feature of international trade.

During the Greek and Roman civilizations, transactions involving elements of derivative securities contracts had evolved considerably from the sale for consignment process. Markets had been formalized to the point of having a fixed time and place for trading together with common barter rules and currency systems. These early markets did exhibit a practice of contracting for future delivery. This involved setting a current price for a delivery and settlement to take place at a later point in time. This process was a natural outcome of having to transport goods over significant distances under difficult conditions. Due to limitations of transporting goods in size and volume, trading on samples was common. Other situations where forward pricing was used included setting prices for the purchase of agricultural produce prior to harvest or for fish prior to the arrival of fishing ships. Unfortunately, such arrangements were haphazard and evidence on the specific features of these transactions is largely anecdotal.

Like forward contracts, the use of options contracts or 'privileges' has a long history. While in modern markets many option transactions have been securitized, commercial agreements in early markets often included option-like features that were bundled into a loosely structured agreement that was governed largely by merchant convention. For example, because trading on samples was common in the medieval markets, an agreement for a future sale would typically have a provision that would permit the purchaser to refuse delivery if the delivered goods were found to be of inadequate quality when compared to the original sample. As reflected in the notarial protests of the time, disagreements over what constituted satisfactory delivery were common occurrences.

Like forwards, options arise from separation in time of the pricing decision and the cash settlement or delivery of goods. However, unlike forwards that involve the obligation to deliver at the agreed price, options do not require that the future transaction be completed. The option purchaser only completes the transaction if it is advantageous to do so. In exchange for this right to forego completion, the option purchaser pays a premium to the grantor or writer of the option. In many cases, such as with a convertible bond, the option is combined with some other commercial transaction and the option premium is embedded in the initial pricing decision. Other types of options transactions involve paying the option premium on the delivery date. There are an almost limitless number of possible option variations.

The heuristics of an options transaction involves the payment of a premium to acquire a right to complete a specific trade at a later date. These types of transactions appear not only in early commercial activity

but also in other areas. For example, an interesting ancient reference to an options-like transactions can be found in Genesis 29 of the Bible where Laban offers Jacob an option to marry his youngest daughter Rachel in exchange for seven years labour.[5] The difficulties associated with options trading appeared even in early markets, as illustrated by the delivery failure associated with this Biblical example. After completing the requisite seven years labour required to complete payment of the option premium, Jacob was to discover that Laban would renege on the agreement and offer Jacob his elder daughter Leah. Fortunately for Jacob, the then socially acceptable practice of polygamy permitted the eventual completion of the transaction and Jacob's subsequent marriage to Rachel.

During the Greek civilization, options trading was an accepted type of commercial transaction. Aristotle in his *Politics* provides a reference to the use of options involving the philosopher Thales. Being a careful observer of local olive growing conditions, Thales was able to forecast that the coming year's olive crop in Miletus would be much larger than normal. He then proceeded to take options on the use of all available olive presses in the surrounding area for the harvest season. When the bumper crop materialized, Thales was able to lease the presses at a substantial premium thereby making a considerable fortune. However, while such anecdotes provide evidence for the use of option transactions in early markets, there was limited examination of these transactions. Aristotle maintained that to consider 'the various forms of acquisition … minutely and in detail might be useful for practical purposes; but to dwell long upon them would be in poor taste' (Book I, ch. 11, sec. 5).[6]

While Aristotle's anecdotes provide interesting evidence of options

Aristotle on Options

Aristotle's reference to Thales in *Politics* is in Book I, Chapter 11, sections 5-10:

> A general account has now been given of the various forms of acquisition: to consider them minutely, and in detail, might be useful for practical purposes; but to dwell long upon them would be in poor taste … There are books on these subjects by several writers: Charetides of Paros and Apollodorus of Lemnos have written on the cultivation of cornland and land planted with olives and vines: others have written on other themes; anyone who is interested should study these subjects with the aid of these writings. A collection ought also to be made of the scattered stories about the ways in which different people have succeeded in making a fortune. They are all useful to those who value the art of acquisition. There is, for example, the story which is told of Thales of Miletus. It is a story about a scheme for making money, which is fathered on Thales owing to his reputation for wisdom; but it involves a principle of general application. He was reproached for his poverty which was supposed to show the usefulness of philosophy; but observing from his knowledge of meteorology (so the story goes) that there was likely to be a heavy crop of olives [next summer], and having a small sum at his command, he paid down earnest-money, early in the year, for the hire of all the olive-presses in Miletus and Chios; and he managed, in the absence of any higher offer, to secure them at a low rate. When the season came, and there was a sudden and simultaneous demand for a number of presses, he let out the stock he had collected at any rate he chose to fix; and making a considerable fortune he succeeded in proving that it is easy for philosophers to become rich if they so desire, though it is not the business which they are really about.

contracting in ancient times, tracing the evolution of options through time is complicated by the similarity of options contracts to other types of contracts, for example, gambles, and the embedding of option features in other types of contracts, for example, for the purchase or sale of a commodity. Put options have many of the features of insurance contracts. Prior to the emergence of exchange trading of options contracts in Amsterdam during the 17th century, the history of options contracting has a direct connection to the evolution of insurance contracts, such as bottomry agreements. Similarly, there is the related issue of replicating cash flows, for example, a portfolio that combines a long cash position with an insurance contract has the same features as a portfolio that combines a call option with a bond investment.

Antwerp, Amsterdam and London

Some method of contracting for forward delivery is an essential feature of commerce. Even medieval society featured crude forms of forward contracting, for example where the manorial lord agreed to provide various services, such as protection from attack, to his subjects in exchange for payments in agricultural goods that had not yet been produced. With the expansion of trade and the rise in the importance of urban centres, forward contracting became more essential. Urban merchants would contract with agricultural producers for crops prior to harvest or with fisherman for catches prior to arrival in port. Such contracts would have a range of implicit and, possibly, explicit buyer and seller option provisions that related to delivery dates, acceptable quality at delivery, and so on.

Evolution of derivative security contracts revolved around two important elements: enhanced securitization of the transactions; and the emergence of speculative trading. Both these developments are closely connected with the concentration of commercial activity, initially at the large market fairs and, later, on the bourses. Though it is difficult to attach specific dates to the process, considerable progress was made at the Champagne fairs with the formalization of the *lettre de foire* and the bill of exchange. The sophisticated settlement process used to settle accounts at the Champagne fairs was a precursor of the clearing methods later adopted for exchange trading of securities.

Over time, the Champagne market fairs came to be surpassed by trade in urban centres such as Bruges and, later, in Antwerp and Lyons. Of these two centres, Antwerp was initially most important for trade in commodities while Lyons for trade in bills. Fully developed bourse trading in commodities emerged in Antwerp during the second half of the 15th century. The development of the Antwerp commodity market provided sufficient liquidity to support the development of 'to arrive' contracts. These contracts were actively traded by speculators, usually by individuals either directly or indirectly involved in trading that commodity but not in need of either taking or making delivery of the specific shipment. In particular, the rapid expansion of seaborne trade led to transactions in 'to arrive' grain that was still at sea.

Van der Wee (1977) on the Emergence Forward Trading in Antwerp

The new Antwerp Exchange, opened in 1531, was originally intended for both commercial and financial transactions. But gradually it developed into a real monetary and financial exchange. Commercial contracts and agreements were increasingly concluded on the 'English Exchange', which opened one hour before the monetary exchange. This gradual separation of trade from finance created a favourable context for the technical development of financial instruments. The Exchange had so powerful an image that in 1571 Thomas Gresham established a similar Exchange in Lombard Street, London, modelled precisely on Antwerp.

The concentration of financial transactions on the Antwerp Exchange also furthered speculation. Speculation was in no way new, even in the northern towns, but on the Antwerp Exchange it acquired a more systematic and organized character, though still closely bound up with the medieval traditions of gambling. Wagers, often connected with the conclusion of commercial and financial transactions, were entered into on the safe return of ships, on the possibility of Philip II visiting the Netherlands, on the sex of children as yet unborn etc. Lotteries, both private and public, were also extremely popular, and were submitted as early as 1524 to imperial approval to prevent abuse.

In this speculative atmosphere transactions in 'futures' gradually developed. First came fixed purchases for future delivery: purchasers bought goods to be paid for later and, speculating on the rise in prices before the due date, sold the goods and pocketed the difference in price; conversely, vendors speculated on a fall in prices (difference dealing). Where prices were subject to considerable fluctuations (such as grain, salt and herring) this form of speculation was common. In addition, *premium transactions* were already popular in Antwerp, for example for the purchase of herring before they had been caught. The buyer made a contract for future delivery at a fixed price, but with the condition that he could reconsider after two or three months: he could then withdraw from the contract provided that he paid a premium to the vendor (*stellegelt*). Speculators gambled on the rise or fall of the exchange rates at the Castilian or Lyons fairs, reserving the right to pay premiums.

Because of possibly substantial variations in quality associated with cargo transported under the uncertain conditions of those times, these transactions were typically structured as options, where the buyer could either take up the agreed upon quantity or pay a fixed fee in lieu of delivery. Trade in Antwerp was settled largely in bills, with substantial discounts provided for cash purchases. During the period up to the collapse of Antwerp in 1585, the bill on Antwerp was the most common form of commercial currency in Europe. Trading in foreign bills as well as specie was conducted on organized foreign exchange markets in Antwerp and elsewhere, such as Lombard Street in London. The collapse of Antwerp led to the emergence of important commodity exchanges in Amsterdam, the Amsterdam bourse established in (1611),

and in London, the Royal Exchange established in (1571). During the 17th and 18th centuries, derivative security trading on these exchanges, especially Amsterdam, exhibited many essential features of trading in modern derivative markets.

Exchange trading of options can also be traced to Antwerp in the 15th

Wilson (1941) on the *Rescontre* System Used in Amsterdam Share Trading

Wilson (1941) provides a detailed account of stock trading in Amsterdam which seems to follow the discussion in da Pinto (1762) and, to a lesser extent, de la Vega (1688) quite closely. Wilson (p.83) relates a stock-jobber's description of the trading in British securities in Amsterdam. The securities being traded were referred to as British funds because the highest capitalization joint-stock companies, such as the Bank of England and the British East India Company, had exchanged almost all the initial capital raised with the Government for British government debt and other considerations, such as a monopoly on British trade to a certain region:

> The technique of speculation in the British Funds at Amsterdam … was a kind of gamble carried on every three months: no payments were made except on *rescontre* (settlement or carry-over), i.e., the period for which funds were bought or sold and for which options were given or taken. *Rescontredag* (contango day) occurred four times a year, and on these occasions representatives of the speculators gathered round a table to regulate or liquidate their transactions, and to make reciprocal payments for fluctuations or surpluses. Normally these fluctuations were settled without the actual value of the funds in question being paid —— only real investors paid cash for their purchases. Speculative buyers paid to sellers the percentage by which the funds had fallen since the last contango day, or alternatively received from them the percentage by which funds had risen in the same interval. After surpluses had been paid, new continuations were undertaken for the following settlement. In such a *prolongatie* (continuation) the buyer granted the seller a certain percentage (a contango rate) to prolong his purchase to the next *rescontre*: in this way he stood the chance of benefiting by a rise in quotations in the interval, without tying up his capital: he was only bound to pay any possible marginal fall.
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and 16th centuries. Options trading was a natural development from the trade in time bargains, where buyers could either take delivery or could pay a fixed fee in lieu of delivery. In effect, time bargains were actually options contracts with the option premium to be paid at delivery. Following Wilson (1941) and others, by the middle of the 17th century

exchange trading of options on the Amsterdam bourse had progressed to where puts and calls with regular expiration dates were traded. Options on a number of different commodities, including joint stocks, were traded. The bulk of option market participants appear to have been speculators, attracted primarily by the urge to gamble. Over time, activities associated with the Amsterdam bourse came to be practised in other locales.

Wilson (1941) on the *Rescontre* System Used in Amsterdam Share Trading ... (cont'd)

Wilson (1941) hints at the possibility of forward prices being determined by cash-and-carry trading but, ultimately, he concludes that speculation played an essential role:

> The *prolongatie* was charged for at a rate based on the dividends which the funds bore. But if there were many speculators *à la hausse* (bulls) the contango rate became proportionately dear, bringing a clear advantage to the sellers. Conversely, a big proportion of sellers reduced the contango rate. Under the pressure of political events in 1755 the 'backwardation' rate appeared, paid by speculators *à la baisse* (bears) for the privilege of deferring delivery of stock sold. To take a hypothetical case: a speculator buying £1000 Annuities on the August settlement for November could either pay cash and actually take the stock, or he could arrange to mortgage it until November, or ——and this was the most common procedure ——he could continue his transaction until the next account day.

The bulk of trade on the London and Amsterdam commodity exchanges was in the form of cash transactions. However, building on trading practices common in Antwerp, the Amsterdam bourse also exhibited considerable trading for future delivery, called 'time bargains' by Wilson (1941). These transactions differed significantly from 'to arrive' agreements that involved the sale before delivery of commodities in transit or production actually owned by the seller. The early transactions in time bargains were purely speculative, involving the sale of fictitious commodities. The speculator's objective in these transactions was to either buy back the promise at a lower price or, if delivery is demanded, to secure the deliverable commodity on the spot market on the expiration of the time bargain. This trade was carried out as early as the mid-15th century in grain and herring, then in colonial goods and later in a wide range of other commodities such as whale oil, salt and joint stock securities (van Dillen 1927; Barbour 1950). In this fashion, the products of a whole fishery would be sold prior to the fishing fleet arriving back in harbour. In addition to time bargains, options on commodities were also traded.

Initially, speculative trading activity in time bargains centred on a number of wealthy individuals, almost invariably merchants, who were willing to absorb the price risk for other merchants by agreeing to a

establish a current price for a future transaction where the seller receives funds in the future when the goods are delivered. The emergence of purely speculative trading was a byproduct of the stapling trade that was central to Dutch economic strength in this period. The Dutch seaborne trading system was designed to ensure that goods would enter Holland and be warehoused in Amsterdam before being reexported. In this process, Dutch merchants sometimes bought commodities for their own account or took goods on consignment, for the purpose of securing a buyer. In order to be involved in consignment, it was essential that the individual be involved in the commodity business in order to stand for delivery in the event the buyer did not complete. The middlemen or 'commission agents' would seek out buyers, in the process agreeing to deliver goods of standardized levels of quality. In this process, considerable reputation was associated with a specific firm's ability to achieve desired quality levels for the delivered commodity.

Over time, purely speculative transactions in time bargains and options on Amsterdam came to involve 'men of moderate wealth indulging in a little speculation' and 'pure gamblers' (Wilson 1941, p. 105). One of the most significant developments of this period was the emergence, during the 17th century, of derivative securities trading in shares of joint stock companies. Even though the first joint stock ventures were, arguably, attempted by the English for overseas trade in the middle of the 16th century, it was the establishment and success of the English and Dutch East India Companies, chartered in 1600 and 1602, that marks the beginning of the era of the joint stock form of business organization. In addition to overseas ventures such as the Hudson's Bay Company and the Dutch West India Company, by the end of the 17th century, the joint stock company was also being used in domestic business ventures such as banking, mining and manufacturing. Trading on the Amsterdam bourse treated stock like another commodity by offering time bargains and options: 'With the appearance of marketable British securities, and the application to them of a speculative technique that was already well understood, the Amsterdam bourse became the scene of international finance at its most abstract and most exciting —— gambling in foreign securities' (Wilson, p. 79). Because these securities involved both joint stock shares and 'British funds', this trading on the Amsterdam bourse is the first historical instance of exchange trading in financial derivative securities.

Many of these speculative practices used in Amsterdam were adopted in England where stock trading had a highly developed spot market by the mid-1690s. Dutch investors and speculators also conducted a considerable amount of their British securities trading outside the Amsterdam bourse at various locations in London, such as on the Royal Exchange and in 'Change Alley where curb trading was conducted. After a collapse of share prices in 1696, dealing in stock of joint stock companies, so-called stockjobbing, left the Royal Exchange and business was conducted in other locations, most notably in coffeehouses near the Royal Exchange. While it is not possible to precisely date the beginning of the regular three month *rescontre* for time bargains on stock in

London, there is considerable evidence that it was firmly established by the middle of the 18th century, prior to the formal establishment of the London Stock Exchange (1773). Trading in stock options was also widespread though the full impact of derivative securities trading in the infamous South Sea Bubble is unclear.[7]

The history of stockjobbing up to 1773 reflected considerable and generally disapproving interest in Parliament. A number of attempts were made to regulate stockjobbing, starting in 1697 with an Act 'To Restrain the number and ill Practice of Brokers and Stockjobbers'.[8] In addition to restricting the number of practices of commodity brokers, this Act was designed to deal with three main difficulties associated with the trade in shares: unscrupulous promotion activities; manipulation of prices for shares; and, misuse of options. The pressures to further regulate stockjobbers intensified leading to the Bubble Act of 1720 and, following the South Sea Bubble, to the passage of 'An Act to prevent the infamous Practice of Stock-jobbing' in 1733, also known as Barnard's Act. While this Act contained substantial penalties for speculative trading in options and time bargains, the Act was quite ineffective in restricting this trade. However, Barnard's Act was successful in removing legal protection for these transactions, making the broker a principal in speculative transactions, responsible for completion of transaction in the event of default by a client. The ensuing increased need for honesty and integrity in these speculative dealings was a significant factor leading a looseknit group of brokers to form the London Stock Exchange.

A major technical innovation in securities trading emerged between 1650-1688, when the Dutch introduced the quarterly *rescontre* days for settlements of share transactions on the Amsterdam bourse. The term 'rescontre' was derived from the practice of Dutch merchants to 'indicate that a bill had been paid by charging it to a current account —— "solvit per rescontre" as distinct from "per banco", "per wissel" and so on' (Dickson 1967, p.491; Mortimer, *Everyman*, 5th ed., p.28n). Prior to this time settlement procedures had been less formal. A key feature of the *rescontre* was the concentration of liquidity that, for example, permitted prolongations to be done more readily (Dickson 1967, p.491; van Dillen 1931).

The first documented instance of stock option contract traded in

Wilson (1941) on Amsterdam Options Trading

Again drawing from de Pinto (1762), Wilson (pp.84-5) provides an account of options trading conducted on the Amsterdam bourse:

> Options were the province of the out-and-out gamblers. A *prime à délivrer* (a call) was the option which A gave to B, obliging him to deliver on the following *rescontre* certain English securities —— say £1000 East India shares —— at an agreed price. If the speculation of the giver of the option was unsuccessful, he merely lost his option: if, on the other hand, the funds rose, he had the benefit of the rise. The *prime à recevoir* (a put) was the option given by A to B by which B was pledged to take from A on *rescontre* £1000 East India shares, say, at an agreed price. B became, in fact, a kind of insurance for A, obliged to make good to him the margin by which the funds might diminish in the interval.

London is for 1687. Though Houghton (1694) reproduces examples of printed options contracts, it was also common practice to use covenants and indentures drawn up by scriveners, and the surviving contract is of this type (Dickson 1967, p.491):

> The earliest (English option contract) so far traced, dated 29 July 1687, is a covenant by Sir Bazill Firebrass (as he spelt himself) of Mark Lane to deliver £1,000 East India stock at 200 to Sir Thomas Davill on or before 1 March 1688, in return for a premium of 150 guineas. Sir Stephen Evance, a leading banker, King's Jeweller, and Chairman of the Royal Africa Company, used both covenants like this and indentures (where the premium is not stated) to record a series of bargains in the summer of 1691, mostly in shares of the Company of White Paper Makers, but also in African and East India stock. In each contract Evance was undertaking to deliver stock in six months' time at a given price; when the premium is stated it amounted to roughly 20% of this.

It seems that the option trading practices adopted in London were, almost certainly, transplanted from Holland, around the time of the Glorious Revolution.

De la Vega on Stock Option Trading in Amsterdam

In *Confusion de Confusiones*, de la Vega makes a number of references to options trading. There is a general description (p.155) of the potential gains to options trading: 'Give "opsies" or premiums, and there will be only limited risk to you, while the gain may surpass all your imaginings and hopes.' This statement is followed by a somewhat exaggerated claim about the potential gains: 'Even if you do not gain through "opsies" the

first time … continue to give the premiums for a later date, and it will rarely happen that you lose all your money before a propitious incident occurs that maintains the price for several years.' Presumably, de la Vega has call options trading in mind, the possibility of trading put options appears later (p. 156).

De la Vega proceeds to describe a crude call option trading strategy: 'As the contracts are signed because of the premiums and as the payer of the premiums gains in reputation for his generosity as well as his foresight, keep postponing the terminal dates of your contracts, and keep entering into new ones, so that one contract in time becomes ten, and the business reaches a fine and simple conclusion.' The trading strategy described is uninteresting, as it depends on the naive assumption of a relatively constant upward movement in stock prices. However, the references to options contracts and extension of the expiration dates, with regular marking-to-market, is interesting. De la Vega takes up the uncertain legal interpretation of option contracts at a later point (p. 183) and explicitly recognizes that the Dutch restriction on short sales could impact put and call options differently.[9] The reference to extending contracts is further elaborated in de la Vega's discussion of the *rescontre* system (p. 181).

De la Vega (p.155) goes on to describe an even more naive trading strategy: 'If you are [consistently] unfortunate in all your operations and people begin to think that you are shaky, try to compensate for this defect by [outright] gambling in the premium business, [i.e., by borrowing the amount of the premiums]. Since this procedure has become general practice, you will be able to find someone who will give you credit (and support you in difficult situations, so you may win without dishonor).' The possibility that the losses may continue is left unrecognized. However, recognition of a 'general' practice of borrowing funds to make premiums payments is interesting. The extension of funds was possibly tied into the *rescontre* settlement process.

Houghton on London Option Trading

Houghton's 1694 contributions to his circular *A Collection for the Improvement of Husbandry and Trade* can be fairly recognized as containing possibly the first coherent and balanced description of early stock trading in London, for example, Neal (1990, p. 17), though the description provided by Houghton is so brief that Cope (1978, p. 4) credits Mortimer (1761) with being the 'first detailed description of the market'. Though Houghton (1694) does provide some description of stock trading, the most significant contribution is actually on the specific subject of options trading. For seven weeks, from 8 June, 1694 until 20 July, 1694 Houghton dedicated the first page of his circular to discussing stock trading. About 2 1/2 of the seven weeks are dedicated to trading in 'puts and refusals'. On June 22, 1694, Houghton provides the following insightful discussion of the profit to be obtained from call option trading:

> The manner of managing the Trade is this: The Monied Man goes among the *Brokers*, (which are chiefly upon the *Exchange*, and at *Jonathan's* Coffee House, sometimes at *Garaway's* and at some other Coffee Houses) and asks how *Stocks* go? … Another time he asks what they will have for Refuse of so many Shares: That is, How many Guinea's a Share he shall give for liberty to Accept or Refuse such Shares, at such a price, at any time within Six Months, or other time they shall agree for.
>
> For Instance; When *India* Shares are at Seventy Five, some will give Three Guinea's a Share, Action, or Hundred Pound, down for Refuse at Seventy Five, any time within Three Months, by which means the Accepter of the Guinea's, if they be not called for in that time, has his Share in his own Hand for his Security; and the Three Guinea's, which is after the rate of Twelve Guinea's profit in a year for Seventy Five Pound, which he could have sold at the Bargain making if he had pleased; and in consideration of this profit, he cannot without Hazard part with them the mean time, tho' they shall fall lower, unless he will run the hazard of buying again at any rate if they should be demanded; by which many have been caught, and paid dear for, as you shall see afterwards: So that if Three months they stand at stay, he gets the Three Guinea's, if they fall so much, he is as he was losing his Interest, and whatever they fall lower is loss to him.
>
> But if they happen to rise in that time Three Guinea's, and the charge of Brokage, Contract and Expence, then he that paid the Three Guinea's demands the Share, pays the Seventy Five Pounds, and saves himself. If it rises but one or two Guinea's, he secures so much, but whatever it rises to beyond what it cost him is Gain. So that in short, for a small hazard, he can have his chance for a very great Gain, and he will certainly know the utmost his loss can be; and if by their rise he is encouraged to demand, he does not matter the farther advantage the Acceptor has, by having his Money sooner than Three Months to go to Market with again; so in plain *English*, one gives Three Guinea's for all the profits if they should rise, the other for Three Guinea's runs the hazard of all the losses if they should fall.

This insightful description is quite remarkable in that, unlike de la Vega or de Pinto, Houghton was not an active participant in the market; Houghton was 'not much concern'd in Stocks, and therefore (had) little occasion to Apologize for Trading therein'.

An important, but overlooked, feature of Houghton's discussion appears in the contributions of 29 June and 6 July where samples of put and call option contracts are given in detail. That standard contracts were available indicates that the market was well developed and that brokers, in conjunction with notaries, were the likely vehicles for executing trades. Examination of the specific clauses in these contracts provides useful information about option trading practices.[10] In the 29 June, 1694 circular, Houghton provides a sample contract for a 'refusal' or call option, how 'for Security to the giver out of Guinea's, the Acceptor gives him a contract in these or like words':

> In consideration of Three Guinea's to me A.B. of London, Merchant, in hand paid by C.D. of London, Factor, at and before the Sealing and Delivery hereof, the Receipt whereof I do hereby acknowledge, I the said A.B. do hereby for my self, my Heirs, Executors and Administrators, covenant, promise, and agree to and with the said C.D. his Executors, Administrators and Assigns, that I the said A.B. my Executors, Administrators or Assigns shall and will transfer, or cause to be transferred to the said C.D. his Executors, Administrators or Assigns, one

> Share in the Joint stock of the Governor and Company of Merchants of London, trading to the East-Indies, within Three Days next after the same shall be demanded, as herein after is mentioned, together with all Dividends, Profits, and Advantages whatsoever, that shall after the Date hereof be voted, ordered, made, arise or happen thereon, or in respect thereof (if any shall be) Provided the said C.D. his Executors, Administrators or Assigns shall make demand of the said One Share personally by Word of Mouth of me, my Executors or Administrators, or by a Note in Writing under his or their Hand, and leave such Note unto or for me, my Executors or Administrators, at my now dwelling House situated in Cornhil, London, at any time on or before the Nineteenth day of September now next coming. And also pay, or cause to be paid, or to the Use of me the said A.B. my Executors, Administrators or Assigns, for the said One Share, and Dividends as aforesaid, within the said Three Days next after demand, the full Summ of Seventy five pounds of lawful Money of England, at the place where the Transfer Book belonging to the said Company shall for the time being be kept, together with all Advance-Money (if any shall be). But if the said C.D. his Executors, Administrators or Assigns shall not demand the said One Share, as aforesaid, within the time aforesaid; and also pay, or cause to be paid to, or to the Use of me, my Executors, Administrators or Assigns, the said Summ of Seventy five Pounds, and all Advance Money, as aforesaid, at the place of refund, within the said Three Days next after such Demand, then this present Writing to be utterly void and of none Effect. And the said Three Guinea's to remain to me the said A.B. my Executors and Administrators for ever. Witness my Hand and Seal the Nineteenth Day of June, Anno Dom 1694 and in the Sixth Year of the Reign of King William and Queen Mary of England, &c.
>
> Sealed and Delivered in the Presence of E.F. G.H. A.B.

Upon signing of the contract and payment of the three guineas, the Acceptor then provides the purchaser with a receipt for payment.

The first useful piece of information in Houghton's sample contract is the price, three guineas for a three month call option, with exercise price of seventy-five.[11] Though Houghton does give weekly quotes for East India stock, a price is not available for 19 June. Houghton quotes prices for 15 and 22 June at £73, so £75 could represent an option that is at-the-money.[12] This is consistent with the option practices observed by Cope (1978, p.8) where the 'price at which the option was exercisable was the same as, or very close to, the price of the stock for ready money when the option was arranged'. How the option price is determined, and the interest rate associated with the put-call parity arbitrage are not examined by Houghton. The statement about profit at a 'rate' of twelve guineas per year indicates that these issues were not well understood.

The next point of interest concerns the description of the parties. The writer of the option is described as 'A.B., my Heirs, Executors and Administrators' while the purchaser is 'C.D. his Executors, Administrators or Assigns'. This wording binds the writer to the contract, whether in death or bankruptcy, while permitting C.D. to 'assign' the contract to another party. The well-developed case law on negotiable instruments, for example, Munro (1998), is found to apply to the option contract with the result that the option purchaser could resell the contract to another party, prior to the expiration date. While this feature substantially enhances potential market liquidity, the mechanism for assigning a contract, particularly where there has been a significant

change in the price and there has been dividends or other advantages paid in the interim, is unclear.

Modern exchange traded options contracts, such as those traded on the Chicago Board Options Exchange, are American style, that is, the option can be exercised at any time up to and including the expiration date, and are not dividend-payout protected.[13] Houghton's sample contract provides information about related features at his time. The sample contract contains the agreement to transfer the share together with 'all Dividends, Profits, and Advantages whatsoever, that shall after the Date hereof be voted, ordered, made, arise or happen thereon'. Taking the 'Date hereof' to be the date the option contract is signed, this feature provides what in modern terms is known as 'dividend payout protection'. This feature is combined with the feature that, upon proper notification, the writer agrees to sell one share of stock 'at any time on or before the Nineteenth day of September'. The Houghton option contract is American-style with dividend-payout protection.

Perhaps the most important theoretical result in the modern study of options is the Black-Scholes option pricing formula. As originally presented (Black and Scholes 1973) this formula provides a closed form solution for the price of a European call option on a non-dividend paying stock. Hence, even though most traded options are American, the European feature plays an important theoretical role. As conventionally presented, a European option can only be exercised on the expiration date. In general, the price of an American option is equal to the price of a European option, plus an additional non-negative early exercise premium. An American *call* option on a non-dividend paying security is a special case where the early exercise premium is zero because, in the absence of transactions costs, the option will never be exercised early. Significantly, inclusion of a dividend payout protection provision in the option contract converts the option valuation problem for a dividend paying security to the non-dividend paying case.

What has all this to do with Houghton? The origins of the European and American features in options contracts are obscure, though early sources such as Bachelier (1900) indicate that the European feature predates the American. What Houghton provides is evidence that 17th century option contracts were transferable, dividend payout protected, American options with settlement that required physical delivery of the security. Yet, in the absence of transactions costs, an American option with dividend payout protection will not rationally be exercised early; it will always be more profitable to sell the option.[14] This effectively equates the American option to an European option. The upshot is that the modern interpretation of the European feature may be a fiction. Instead of restricting exercise to the expiration date, the 'European' option contract was structured with transferability and dividend payout protection provisions that made early exercise unprofitable.

A number of other less significant features of Houghton's option contract that are of some modern interest can also be identified. In particular, modern exchange traded option contracts permit cash settlement, in lieu of the exchange of stock for money. The Houghton

contract only allows for the actual purchase of stock. The possibility of a *rescontre* method of settlement is not admitted, though de la Vega's option contracts would seem to be designed for *rescontre* trading. There is also a provision in Houghton's contract for advance money, which may have been akin to a margin account, to ensure that the option purchaser actually has sufficient funds to complete the transaction. However, why this would be required in an options transaction is unclear. Finally, as evidenced by the issue of a receipt, the option contract did require that the three guinea premium be paid up front. The possibility of delaying the premium payment until the expiration date is not admitted.

The South Sea Bubble and Barnard's Act[15]

Options and other types of derivative securities were associated with the early stock trading in London. By the 1690s, an organized options market had emerged in London in support of the increasing number of joint stock issues.[16] There was considerable disagreement in the broker community about whether options transactions were reputable. While potentially useful in some trading contexts, reputable brokers felt that options contributed to the speculative excesses common in the early financial markets. While trading in options and time bargains did contribute to the most important English financial collapse of the 18th century, the South Sea Bubble of 1720, this event was due more to the cash market manipulations of 'John Blunt and his friends' (Morgan and Thomas, ch. 2). In any event, dealing in time bargains and, especially, options were singled out as practices that were central to 'the infamous practice of stock-jobbing'. In 1721, legislation aimed at preventing stockjobbing passed the Commons but was not able to pass the Lords. It was not until 1733 that Sir John Barnard was able to successfully introduce a bill under the title: 'An Act to prevent the infamous Practice of Stock-jobbing.' This Act is generally referred to as Barnard's Act.

The abuses associated with stockjobbing were due, at least partly, to the standard market practice of a significant settlement lag for purchases of joint stock. In effect, stock was sold but the short position had a considerable lead time to deliver the security. The separation of pricing from settlement and delivery leads to the immediate creation of time bargains. Similar settlement lags also applied to new stock issues. Initial trading involved establishing a price and paying a small deposit against the future delivery of stock. In cases where the selling broker did have possession of the underlying stock when the transaction was initiated, there was little or no speculative element in the time bargain. However, this was not the case when the seller did not possess the stock. In addition, the purchaser did not usually have to take possession of the stock at delivery but, rather, could settle the difference between the agreed selling price and the stock price on the delivery date.

Barnard's Act (1733) was designed to regulate those features of stock dealings associated with excessive speculation (Morgan and Thomas 1962, p.62):

> The main provision of the Act was that 'All contracts or agreements whatsoever by or between any person or persons whatsoever, upon which any premium or consideration in the nature of a premium shall be given or paid for liberty to put upon or deliver, receive, accept or refuse any public or joint stock, or other public securities whatsoever, or any part, share or interest therein, and also all wagers and contracts in the nature of wagers, and all contracts in the nature of puts or refusals, relating to the then present or future price or value of any stock or securities, as aforesaid, shall be null and void.' There was a penalty of £500 on any person, including brokers, who undertook any such bargain. All bargains were to be 'specifically performed and executed', stock being actually delivered and cash 'actually and really given and paid', and anyone settling a contract by paying or receiving differences was liable to a £100 penalty. It was further provided that 'whereas it is a frequent and mischievous practice for persons to sell and dispose of stocks and securities of which they are not possessed', anyone so doing should incur a penalty of £500.

There is disagreement among modern writers, such as Cope (1978) and Dickson (1967), concerning the extent to which Barnard's Act actually limited options trading. That it had some impact is evident. However, the extent of the impact is less clear.

Despite Barnard's Act making options trading illegal, options trading continued to the point where, in 1820, a controversy over the trading of stock options nearly precipitated a split in the London Stock Exchange.[17] A few members of the Exchange circulated a petition discouraging options trading. The petition passed, and members formally agreed to discourage options trading. However, when an 1823 committee of the Exchange followed up on this with a proposal to implement a rule forbidding Exchange members from dealing in options (which was already illegal under Barnard's Act), a substantial number of members voted against. A dissident group even began raising funds for a new Exchange building. In the end, the trading ban rule was rejected because options trading was a significant source of profits for numerous Exchange members who did not want to see that business lost to outsiders.

The Pricing of Futures and Options Contracts

One of the most interesting, unanswered questions in the early history of financial economics concerns the methods used for pricing derivative securities transactions, particularly options and time bargains. Trading for deferred delivery has a history going back to antiquity. Such transactions were inherent in trade involving long distances, slow transport and poor communications. The uncertainties associated with the quality and timing of delivery led naturally to embedding options into contracts. As commodity markets developed, the deferred delivery and options features of the transactions were gradually securitized. Speculative trading in both commodity time bargains and options was well-developed on the Antwerp bourse. Initially, the bulk of the derivatives transactions were concerned with goods involved in seaborne trade, making it difficult to identify whether the transactions were initially purely speculative or were motivated by hedging considerations.

However, over time, participation by traders with purely speculative motives became considerable.

Following the collapse of Antwerp in 1585, much of the commodities trading business gradually shifted to Amsterdam where trading in derivatives was refined substantially. The information that is available about the trading of derivative instruments on the Amsterdam bourse, for example, de la Vega's *Confusion* (1688) and de Pinto's *Jeu d'Actions en Hollande* (1771), indicates these securities, especially options, were used primarily for speculating and not for purposes of risk management. Almost from the beginning of trade on the bourse, the speculative aspects of trading attracted the attention of the Dutch authorities. Following a speculative 'bear raid' in 1609 involving sales of Dutch East India company shares by a group of speculators led by Isaac le Maire, speculative trading involving uncovered short positions was banned in 1610. While violation of the ban did not lead to prosecution, it effectively removed the protection of the courts for the purposes of enforcing the contracts. This left enforcement of contracts up to the individual brokers involved. While it was possible to repudiate a losing position, available sanctions involved exclusion from trading on the bourse, a sanction sufficiently severe to ensure that brokers would settle all but the most substantial losing positions.

Despite the ban on trading in uncovered positions, the development of cash market trading in joint stocks was associated with similar progress in derivatives trading. By the middle of the 17th century, speculative trading had progressed to the point where gains or losses on positions were settled on *rescontre* (settling day) without delivery of the cash securities, and positions could be carried forward to the next rescontre. By the late 17th century a regular monthly (changing to quarterly) rescontre process was in place. Derivatives trading also spilled over into other areas of Dutch economic life, leading in one instance to the tulipmania of 1635-1637.[18] Trading in options and time bargains on joint stocks had spread to London by the end of the 17th century (Morgan and Thomas 1962, p. 59-64), inheriting the essential features of derivatives trading conducted in Amsterdam. Much as in Holland, various legislative attempts were made to restrict or prohibit derivatives trading culminating in Barnard's Act of 1734 which banned trading in options and speculative time bargains. As in Holland, this did not prevent the trading of derivatives but, rather, made brokers the principals in derivatives transactions, liable for any settlement failure on the part of clients.

In the absence of a primary source directly concerned with the methods of pricing of derivative securities, it is still possible to infer that while prices were, at times, determined by forces of supply and demand, there was also some understanding and application of the concept of cash-and-carry arbitrage (Wilson 1941, pp. 83-4):[19]

> Speculative buyers paid to sellers the percentage by which funds had fallen since the last contango day or alternatively received ... After surpluses had been paid, new continuations were undertaken for the following settlement. In such a

> prolongatie (continuation) the buyer granted the seller a certain percentage (a contango rate) to prolong his purchase to the next rescontre … The prolongatie was charged for at a rate based on dividends which the funds bore. But if there were many speculators à la hausse (bulls) the contango rate become proportionately dearer, bringing a clear advantage to sellers. Conversely, a big proportion of sellers reduced the contango rate. Under the pressure of political events in 1755, the 'backwardation' rate appeared, paid by speculators à la baisse (bears) for the privilege of deferring delivery of the stock sold.

The typical contango in prices for time bargains was associated with the requirement that the seller would make any relevant dividend payments to the buyer. 'The basic contango rate for 4% Annuities was 1% for each rescontre, coming to 4% per annum: East India funds bearing 6% had a 1½% contango rate' (Wilson 1941, p.85).

In normal markets, it was not possible to make arbitrage profits by borrowing money in order to purchase funds, receiving the dividends and selling the funds forward at the next *rescontre* (turning the dividend payments over to the purchaser). However, 'when opinion was optimistic (and) prolongers had to pay for time and hope, and 1% became 2 or 3%' (Wilson, p.85), then there were potential arbitrage opportunities and, it appears, arbitrage trading did take place, providing the necessary market liquidity to clear the positions required by speculators. However, it is clear that the related trade 'hypothecation' was much more common. Hypothecation involves 'wealthy people' who 'sell at once for future delivery the shares which they have bought for cash' (de la Vega 1688, p.193), in effect investing in the cash-and-carry return implied by the spot-forward price differential.

Hypothecation was not limited to Amsterdam. In a discussion about stock dealing, Houghton (13 July, 1694) observes: 'Some buy for Shares and sell them again for time, at such advance as they can agree, which very often of late have been after the rate of Twenty or Thirty *per Cent.*' While this return would have to be adjusted for the dividends that would have to be paid to the long position in the forward contract, the promised returns are quite remarkable. As recorded prices for these forward dealings are lost forever, it is only possible to speculate as to the returns earned in hypothecation. However, John Houghton (FRS) was a careful researcher. In only a few pages in *A Collection…*, Houghton captures the essence of security trading in London, circa 1694. There is little reason to doubt Houghton's 20-30% estimate.

By Mortimer's time, trading in forward contracts was definitely sophisticated. In a discussion of de Pinto's claim about the advantages that stockjobbing contributes to marketing of government debt, Mortimer (1761) presents a discussion that almost details the trading mechanics for a long cash-and-carry arbitrage. Mortimer also provides anecdotal evidence that such trades were actually done:

> Both the old funds, and the circulating subscription for new loans, generally sell at a better price for time, than for ready money; it therefore most frequently happens, that when the payments are making upon a new subscription, the old funds (but I will confine myself to the three per cent consolidated annuities, being the larger mass) are very low indeed; and then it is that our Dutch friends

> step in and purchase, some ten, some fifteen, and others twenty thousand pounds in these annuities, which most probably will rise, after the demand for ready money is over; they therefore sell them for a distant period, most commonly three months from the time of purchasing; or for the following rescounters. It is highly probable that, by this method, they may get a premium or difference of three per cent; which, for the loan of money to government, or to her subjects, to enable them to make their payments to the new loans, is at the rate of twelve per cent per annum.

Insofar as ready money was available to 'our Dutch friends' at less than 12%, then the preconditions for a long cash-and-carry arbitrage have been described. However, Mortimer does not explicitly recognize the arbitrage potential of borrowing money, buying annuities for ready money and selling for time at a greater price than the purchase cost plus net interest payments.

The mixed level of Mortimer's understanding of these transactions is illustrated in the following discussion:

> Still there rests a difficulty as to the certainty of this alluring gain; and it is so tempting, that many of my countrymen will expect I should remove it; but this I confess is beyond the line of my capacity: for it cannot well be supposed, that the brokers for the Dutch are so expert as to buy in for money, and sell for time, to the same amount, in one and the same hour; but admitting they were, it sometimes happens that an unfavorable variation occurs in less than that time; the price for time, at Jonathan's, after the books are closed, may be lower than it was for ready money at the Bank, just before the last transfer hour expired. In this case, the latter transaction could not take place, and the Dutch agents must wait a favorable opportunity; but it is possible, from circumstances during the war, that they might continue falling, and not recover, for many months, perhaps for a whole year, the price given at the books. What then becomes of the certainty of this scheme; nearly as visionary and delusive as any of the jobbing kind!

An important practical risk associated with executing an arbitrage involves the difficulty of establishing all the relevant transactions at the same time. In Mortimer's time these risks would be amplified due to factors such as the method used to transfer stock and establish forward contracts. Yet, it is not clear why the trader would not close out the position as soon as possible, suffering a small loss in the process instead of continuing to hold an uncovered cash position 'for many months', as indicated by Mortimer. If the arbitrage profit potential were large enough, then short-term fluctuations in prices would only tend to cut into profits. Again, there is a hint of understanding about arbitrage trading, but there is also confusion.

Mortimer's views on arbitrage and related trading activities are significant, if only because he was an intelligent and informed observer of trading in the security market of mid-18th century London. Unfortunately, Mortimer was only an observer, as he himself was willing to point out:

> One would be apt to think our author writes from experience of himself and his friends, who might have hit the lucky moments for buying and selling during the

> last war when nothing but the frequent necessities of government lowered the price; and when our signal, repeated successes, gave frequent opportunities to sell at a considerable advantage. But reverse the case; and suppose a chain of unfortunate events in war, and the fallacy of the scheme is apparent. As to leaving the risk of the variations to their brokers, or jobbers, I own I do not understand it; and I intreat the author, or his friends in England, to set me and the public right, if in any instance I have unwittingly misunderstood him.

Mortimer's attempt to describe the operations of security market participants goes well beyond that of other contemporary writers, such as de Pinto. But, as in a number of other areas of financial economics, the actual traders were not concerned with detailing their operations. Historical guesswork is still required to surmise the level of sophistication that those at the centre of market activity had achieved.

Unlike time bargains, arbitrage requirements seem to have had less impact on option prices. Wilson (1941, p.122), for example, provides quotes for options on East India Company and South Sea Company shares in 1719 that reflect some pricing inefficiencies. Option prices reflect a general pricing advantage for writers, consistent with the view that most buyers were 'out-and-out gamblers'. Option writers quoted prices at premiums consistent with exploiting market sentiments. The tendency of options trading, at least in England, to be concentrated among less reputable brokers (Morgan and Thomas 1962, pp.61-2) and to be associated with market manipulation also argues against sophisticated understanding of option pricing.

Put-Call Parity Conditions

Put-call parity is an arbitrage-based relationship between the price of put and call options. For practical purposes, put-call parity is, arguably, the most important distribution-free property of option prices. Both de la Vega (1688) and de Pinto (1771) contain statements that indicate that put-call parity was understood, as it applied in specific circumstances of late 17th century and 18th century Amsterdam option markets. The exact specification of put-call parity depends on the underlying commodity being traded and the restrictions imposed on the arbitrage transactions, for example, transactions costs, timing of transactions, and the difference between lending and borrowing rates.[20]

Assuming perfect markets, at any time $t = 0$ put-call parity for European options written on a spot position in a non-dividend paying security can be stated:

$$P_0[X,T] = C_0[X,T] + \frac{X}{1 + rT} - S_0$$

where $C_0[X,T]$ and $P_0[X,T]$ are the $t = 0$ prices of call and put options

with exercise price X and time to expiration T (measured in fractions of a year), r is the annualized interest rate and S_0 is the security price at $t = 0$.[21] In the absence of market imperfections, put-call parity has to hold because, if not, then it is possible to execute an arbitrage. For example, if $P < C + (X/(1 + rT)) - S$ then the following trades can be executed: write the call, borrow $X/(1 + rT)$, buy the put and buy the stock. By assumption, this transaction would generate positive cash flow at $t = 0$, yet the value of the position will always be zero at $t = T$.

Modern textbook presentations of put-call parity use European options on a spot security to motivate the explanation of put-call parity because the underlying arbitrage trades are more intuitive. Similar arbitrage conditions apply to options written on forward contracts. The precise statement of put-call parity in this case depends on whether the forward contract underlying the transaction will mature on the expiration date of the option, permitting delivery of the spot commodity, or whether a forward contract is to be delivered on the option expiration date. For de la Vega and de Pinto the exchange traded options typically corresponded to forward contracts with the same expiration date. In this case, put-call parity requires:

$$P_0[X,T] = C_0[X,T] - \left\{\frac{F[0,T] - X}{1 + rT}\right\}$$

The arbitrage condition is slightly different from the spot case because taking a position in the security no longer involves a $t = 0$ cash flow associated with purchasing the security.

For example, if $P[X,T] < C[X,T] - \{F[0,T] - X\}/(1 + rT)$ then the arbitrageur will buy the put, write the call, take a long forward position in the security at $F[0,T]$ and borrow $\{F[0,T] - X\}$ if $F[0,T] < X$ that will convert to an investment in the fixed income security if $F[0,T] > X$. The intuition behind the net investment if $F[0,T] > X$ is that, if the call is in the money, then the put will be out of the money, and there will be money left over after the proceeds from the written call position have been used to purchase the call. This surplus is invested in a riskless, zero coupon, fixed income security maturing at T. Similarly, if the put is in the money, the call will be out of the money and the proceeds from writing the call will be insufficient to purchase the put so funds have to be borrowed to fully fund the arbitrage at $t = 0$. This follows by definition because an arbitrage is a riskless trading strategy requiring no net investment of funds.

Neither de la Vega or de Pinto directly discuss the put-call parity condition or the underlying arbitrages. What is presented is a 'conversion' strategy that converts a call option position to a put option. De la Vega (p. 156) describes the strategy as follows:

> I come to an agreement about the (call) premium, have it transferred [to the taker 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 case of a decline, however, I need not be afraid and disturbed about my honor nor suffer fright which could upset my equanimity. If the price of shares hangs around 600, I [may well] change my mind and realize that the prospects are not as favorable as I had presumed. [Now I can do one of two things.] Without danger I [can] sell shares [against time], and then every amount by which they fall means a profit … and with a rise in price I could lose only the bonus (premium).

In effect, this says that a long position in a call at $C[X,T]$ combined with a short forward contract at $F[0,T]$ (= X) produces a position with a payoff equal to that of a long position in a put at $P[X,T]$. Because the options involved are both at the money, this strategy reduces to the replication strategy underlying put-call parity for at-the-money options written on forward contracts with the same expiration date as the option contracts.

As an aside, the second strategy suggested by de la Vega for a trader confronted with a change in expectations about the future movement in prices is also of interest. De la Vega (p. 156) suggests that 'if I reckon upon a decline in the price of stock' then the trader with a long call position ought to 'now pay premiums for the right to deliver stock at a given price'. In modern terms, de la Vega is suggesting that the trader undertake a straddle, in this case a combination of a long call with a long put, both options being at-the-money. De la Vega provides no further discussion of the strategy. There is no recognition that the straddle is not a bet on the direction of stock prices but, rather, is a play on volatility. In effect, an at-the-money straddle is a bet that the actual future volatility of prices will be greater than the volatility implicit in the quoted option premiums.

Writing over eighty years later, it is not surprising that de Pinto has a much more developed understanding of options trading than de la Vega. De Pinto also has an example with a trader, Paul, holding a long position in a call option, in this case with an exercise price of 150. De Pinto (1771a, p. 300) considers what happens if 'the speculation stops':

> Another transaction, more curious, is to convert this premium to deliver, which was betting for an increase, into a premium to receive. First we thought the stock was going to increase a lot, we paid 2½% to deliver at 150. The stock took indeed some value, but we heard that the cause for this increase has disappeared. Therefore, we sell on the Closed Market for the same *rescontre* £1000 at 150 and we convert by this process the premium to deliver into a premium to receive.

In this case, the recognition of the put-call parity relationship is explicit. De la Vega goes on to describe a more sophisticated variation of this strategy where, after the initial call option has been successful and the stock price has risen to 155, Paul can lock in the 5% profit and create a put option by shorting the forward contract at 155.

The Japanese Rice Market

Trading in early forms of derivative securities was not restricted to Europe. Schaede (1989) and others argue that the first organized futures

exchange appeared in 18th century Japan, with rice as the featured commodity.[22] That derivative trading in rice futures appeared during this period is somewhat unusual, as the political system in Japan during the Tokugawa period (1603-1867) was feudal. Japan also has been historically extremely isolationist, with long periods where contact with the outside world was difficult. However, unlike feudal Europe where religious and other restrictions inhibited markets, feudal Japan had a developed market system based on an urban merchant and artisan class, even though the economy was largely agrarian. In the 17th century, Japan also had some limited exposure to Western business via a Dutch trading monopoly involving barter through the port of Nagasaki.

As early as the 1600s, for geographical and political reasons, Osaka had emerged as the primary trading centre for rice in Japan. Though it was no longer used as a commodity money, rice in Japan during this period played an important economic role: it was the main agricultural crop and was used as the basis for assessing taxes. A certain percentage of the farmers' annual harvest was paid in tax and the remaining surplus above consumption was sold to local merchants. In turn, the local surpluses of the merchants and feudal lords were brought to Osaka for sale. By the 1670s, in addition to the large rice merchants, all the important feudal lords had warehouses in Osaka. In 1673, there were 91 warehouses in Osaka, growing to 124 by 1730.

In local markets, rice trading was on a spot basis. However, the large volume of rice trade in Osaka led to the development of the *rice bill*, a certificate that came to perform a number of different functions. Initially, rice bills were warehouse receipts, a title to rice stored in a warehouse. Following an auction to determine the price of the rice, the rice bill was issued upon making a 'good-faith' deposit. Up to the early 17th century, the margin requirement was 100% with delivery within 30 days. However, as the Osaka market developed margin deposits fell to around 30%, with the size of the deposit depending on factors such as the credit of the purchaser, current market conditions and the practices of the particular warehouse. Delivery dates were also extended to cover periods of more than one year. Because the bulk of the rice arriving was associated with the harvests, delivery dates for rice bills many months after the auction facilitated the regularity of consumption requirements throughout the year. At delivery, the full price was paid, together with any agreed upon storage charges. These rice bills were fully backed by rice stored in a warehouse. Active trading in rice bills became an important activity in Osaka. Because the traded price for a rice bill set a current price for a commodity transaction occurring at a future date, trading in rice bills was a type of forward transaction.

Securitization of claims against rice held in warehouses led to the emergence of rice bills with decidedly different features. Two general classes could be distinguished: bills representing ownership claims to rice, *auction bills*; and, rice bills that were used as credit instruments, *prepayment bills*. Auctions bills could be both backed, delivering bills, or unbacked, monk bills. One advantage of an unbacked auction bill was the absence of storage fees. Though typically issued as unbacked rice

bills, prepayment bills were not regarded as titles to rice delivery but, rather, as credit extended by a merchant to a warehouse, with the deposit representing the funds advanced. The warehouse was obligated to repurchase the prepayment bill with interest before the stated maturity date. The growth of the markets also evidenced the emergence of specialized activities, including *clearinghouses* that facilitated the holding of deposits and the settlement of the often sizable number of rice bill positions that individual merchants had outstanding. A key development occurred in 1730, when an official decree transformed the Osaka market into an organized exchange. Licences were sold and traders were registered into two classes: rice wholesalers and rice brokers. By 1732, 1300 traders were registered, 500 wholesalers and 800 brokers. In addition, 50 clearinghouses were registered. Participants in the rice auctions were selected from the rice wholesalers. Brokers were confined to trading rice bills previously bought at the auction by the wholesalers.

The market rules for trading rice bills (cho-ai-mai-kaisho) on the Osaka exchange operated under rules strikingly similar to those of modern *futures* exchanges: (1) limited contract duration; (2) all contracts with a given term to be standardized; (3) an agreed upon grade for a given contract period; (4) no contract to be carried over into a new contract period; (5) all trades to be cleared through a clearinghouse; (6) each trader must have a line of credit with a clearinghouse. There were some practical differences with modern futures trading. For example, margin was traded along with the position, and was not an accounting entry with the clearinghouse. The method of daily settling of positions was also somewhat different. However, it is reasonable to conclude that the Osaka rice market provides the first historical instance of a functioning futures exchange.

As an aside, perhaps the most interesting feature of the Osaka exchange was the method of setting the daily closing price to be used in settling of accounts at the clearinghouses. The price fixing was supposed to involve setting a wooden box, hung on a ridge pool in the exchange building, on fire. When the fire went out trading was supposed to stop; the prevailing price at this moment thereby setting the closing price. If no price was observed or the box did not burn completely, then all transactions for the day were cancelled and the previous day's price was used. In practice, traders typically ignored the event of the fire going out and continued trading until exchange employees, known as watermen, threw buckets of water on the crowd of traders. The price at this time, known as the bucket price, was the acknowledged closing price. This system was often effective in preventing market manipulations involving dumping or hoarding of rice. When this activity was recognized by other traders, trading activity would cease and no price would be observed when the fire went out, cancelling trades for the day. The market in rice bills persisted for centuries until, in 1869, the Imperial government ordered trading in rice bills to stop but was forced to resume trade less than two years later due to the resulting chaos in the cash market for rice.

Appendix: English Translation of 'Jeu d'Actions en Hollande', de Pinto (1771)

The *Traite de la Circulation et du Credit* (1771a) by Isaac de Pinto is an interesting, if not overly important, 18th century tract. Much of the text is concerned with the benefits that accrued to the English government from the presence of a well-developed market for English government debt. Included in the text are a number of attachments, *Lettre sur la Jalousie du Commerce, L'Essai sur le Luxe*, *Lettre sur le Jeu des Cartes,* and an essay on specific operations of the Stock Exchange in Amsterdam, *Jeu d'Actions en Hollande* (1771b). While not a pathbreaking work, the *Traite* was of sufficient importance that the work was translated from the original French into English in 1774 by the Reverend S. Baggs. However, while Baggs did translate the text of the *Traite* and the *Lettre sur la Jalousie du Commerce*, the other attachments were not translated.

Unfortunately for Baggs and de Pinto, the *Traite* did not survive to be considered a text of first rank importance while the *Jeu d'Actions en Hollande* is still of modern relevance as one of the few sources detailing 18th century options trading. As much of the practice in England and other countries was adapted from Holland, it is likely that the basic elements of de Pinto's description are also generally descriptive of 18th century options trading throughout Europe.[23] Hence, de Pinto's observations on options trading have considerable relevance to the historical study of 18th century financial economics. The absence of an accessible English translation greatly restricts the usefulness of this source, though an abbreviated summary of the contents is given in Wilson (1941, pp.83-7). This Appendix corrects the limitations posed by the absence of a complete English translation.

In his translation of the *Traite*, Baggs makes an explicit reference to the *Jeu d'Actions en Hollande.* This occurs in a section where de Pinto refers to stock trading as 'a very complicated subject' (p.40) and refers the reader to the *Jeu d'Actions en Hollande*, a title that Baggs's translates as 'Essay on Stockjobbing'. Baggs's explanation for not translating this part of the text is one of the interesting curiosities of 18th century financial economics:

> This essay (on stockjobbing), relating chiefly to the practice in Holland, is not translated. No good purpose can be answered by explaining a science, which it is no honest man's interest to study, and which no man can be master of, without engaging in the practice. To speculate with safety, the author makes it a condition that you shall not be governed by your broker. This condition alone amounts to an interdiction.

Wilson's direct quote of Baggs (p.83) that he did not translate because a tract on stockjobbing would be 'injurious to public and private morality' appears to be an exaggeration of Baggs's stated reason for not doing the translation.

Jeu d'Actions en Hollande
[Trading of Stocks in Holland]

from an Appendix to

Traite de la Circulation et du Credit (1771a)
by Isaac de Pinto

APPENDIX:

An Expose of what one calls the *Commerce*, or rather the *Trading of Stocks, in Holland*

Page 291 - T2

Trading on the Stock Exchange in Holland (*Jeu d'Actions en Hollande*) is like a wager that is done over a period of three months, without cash outlay, until the *rescontre* or, in other words, during the term for which the purchase or the sale of stocks in the English Funds is made.

rescontre is defined as the term for which we do [forward] purchases or [forward] sales of funds (stocks) and for which we give premiums to deliver [calls] or premiums to receive [puts] on the associated funds or stock.[1]

There are 4 terms in a year at which time we do the *rescontre* which is like an account balance that is made in order to settle or liquidate a position. Payment is made or received according to a negative or a positive variation in the stock's price.

Usually, we calculate the balance without including the initial value of the funds, unless we actually want to invest in this stock or to sell [clear] our investment. Therefore, the one who purchased [a long position] pays to the seller [the short position] the % the stock went down during the term or receives the % the stock went up during the term. And so one has recourse to some new moneys for offset or for prolonging the transaction until the next *rescontre*.

Page 292

The 4 *rescontre* that I mentioned take place in February, May, August, and November. When the % change in the stock price is calculated, payment and settlement is made at the *rescontre*'s date or we can hold again for another term. Therefore to keep our position: purchase [for the long position] or sale [for the short position] until the next *rescontre* date. This operation is called prolongation or continuation [extension].

The long position [the one who purchased] usually gives to the short position 1% or more for an annuity of 4 terms in exchange for the right to hold the position until the

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[1] Funds is translated from the French 'Fond'. At various points, the meaning also seems to imply a stock.

next *rescontre*.[2] This is due to the fact that during that period of time, the long position will extend his chance to benefit from an increase in the stock price without effectively investing any money. Indeed, the long position is liable only for the possible decrease in the stock price.

This transaction that we named *prolongation* [extension] has some benefits since the return or the dividend attached to the underlying stock is the property of the Long position [the purchaser]. However, when there are a lot of speculators for an increase, the *prolongation* is bid higher than the proportion [dividend or return], which is in the interest of the short position [the seller] and, vice versa, the *prolongation* is sometimes lower when there are too many sellers, and it is therefore in the best interest of the Long position [the purchaser].

Those purchases and sales made on a term basis, that we have the right to extend through *prolongation*, are called Marches Fermés [Closed Market], to be distinguished from the Premium trade [Option Market] that I will talk about below.

Page 293

From this, it follows that a person, who took a long position in August for £1,000 maturing in November, has 3 months to resell the £1000 with either a profit or with a loss. Then the game is *rescontred*. This involves receiving the cash in his bank account, or by seeking some other arrangements or, most frequently, by extending to the next *rescontre* as explained above.

Remember that in the case of a *prolongation* [extension], the long position is entitled to receive the profit at each *rescontre* if there is an increase in price or is liable for the loss if there is a decrease in price during the time interval between the purchase contract date and the *rescontre* date.

Let's talk now about premiums to deliver [calls] and premiums to receive [puts]. We refer to premiums to deliver [call] as a premium that Paul gives to Peter in exchange for Peter's obligation to deliver £1000 in English Funds for the next *rescontre* at a certain price. If the speculation [of the premium giver] fails, he loses the premium. But if during the term the price goes up above the price agreed on, he benefits through his option with all the benefits of having risked only the premium.

A premium to receive [a put] is when Paul gives a premium to Peter obligating Peter to accept at *rescontre* time £1000 in annuities or other stocks, at a certain price. Peter, in some way, becomes Paul's insurer. He is liable for the decrease (below the price agreed on) in the stock price during the term.

When *rescontre* time approaches, we can do *prolongation* [in English funds] and extend the premium to limit the loss. This *prolongation* always costs more than the one available on the *Marché Fermé*, because during the speculation [time of speculation], we have the opportunity to limit the loss thanks to the premium.

This is all the simple transactions taking place on the stock market, for which miscellaneous combinations give interesting calculations and results for *agioteurs* and *rentiers*. I will present an example for people interested in an introduction to the Stock market.

Assume that Peter expects in June 1762 that peace would be settled before winter. He

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[2] This is what is said at this point in the text. However, later it is stated that it is common to pay 1% per *rescontre*. Therefore, there is a total of 4% or more for the annuity of 4 *rescontre*.

knows that this will make the English Funds go up; but he did not have enough cash money to invest in the funds.

P. 295 - T4

He gave an order to his broker to buy on credit £1000 of 4% English annuities for the *rescontre* of August. Assume that he purchased at £82. In August, the annuity price went up to £88 based on peace rumours. Peter, persisting in his belief regarding the peace, took arrangements with the seller or with another seller (it is indeed the same) to give him a *prolongation*, it is 1, 2, 3-% to have the opportunity to postpone the payment of £1000 to November. This *extension* is more or less expensive depending on the beliefs and number of speculators as well as the scarcity of money. In a calm [quiet] period, the *extension* has an intrinsic value based on the rate of interest that the funds yield. For example, the extension of the 4% English fund has to be worth 1% for each *rescontre*. The English East India funds that give 6% annually are worth 1½% at each *rescontre*.[3] But when speculation is important, like it is in my example with Peter, we pay the interest yielded + the expectation. That is why people sometime paid a very expensive Extension such as 2 and 3% when it is worth intrinsically only 1%.

Page 296

It is good to note that people who have invested in the funds for 3 years, without any risks except when selling, what we called *prolongation* from *rescontre* to *rescontre* for speculators, earned 10 to 12% on their money without being taxed on the interest or having the least *censure*. Even conservative people have done and can do this Commerce. For those who purchased the stock on credit, and paid 4% interest, they benefited from surplus of 10 to 12% and over. There is a number of persons, for the last 3 years, during the war of 1744, who have earned large amounts by only taking *prolongations* [extensions].

We also observed that someone who possessed resources to cover only the variation in the stock price [% change], can purchase or sell for thousands having invested only 10 to 15%, which is usually the maximum variation [volatility] during a *rescontre*, unless an extraordinary event happens, such as a peace treaty, a war, a change in dividend or any other revolutions that can sometimes create volatility of 30% and more.

Page 297 - T5

Restating once more so everyone understands, the one who purchased the £1000 at £82, and that we assumed to have increased to £88, has several alternatives:

1. He can pay [for the security] and receive on 'his account and name' if he has £844.[4]

2. He can go to the Amsterdam or London Stock Exchange, in which case he needs only £200 downpayment. That is because we never give the entire value of the stock that we deposit/mortgage. Therefore we benefit very much from interest on the downpayment. This transaction is very easy to do in quiet periods, but much more

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[3] Note from the author: 'at present, 1770, [the] India [Funds] give 12%'.

[4] The method used to calculate the £844 is unclear. It is possibly £820 plus the 2% for the coupon plus transactions costs, but this is, at best, a speculative estimate.

difficult for the last three years,[5] money being scarcer due to the large positions [engagements] taken. Everybody prefers to buy at this time for their own account, rather than giving *sur le fond à gage* [wager funds]. This transaction in stocks is very dangerous, when it is done without care and when we take positions beyond our capacity to settle our losses, especially in a volatile period or at a time of an unforeseen events. However, this transaction is always certain and very profitable when it is done with the intention of *prolongation* without taking the risk of stock price volatility, as long as we are dealing with loyal people [no default risk].

3. The third transaction that is available is to sell the £1000 that we purchased and to liquidate our *rescontre* either with a Gain or a Loss, paying or collecting the differences.

Page 298

4. Finally, the fourth transaction, which is more common, is to do *prolongation* of the £1000 until the next *rescontre*. This requires payment of the variation and trying to obtain this *prolongation* at the lowest price. This becomes even more critical if you repeat the *prolongation* 4 times in a long run speculation.

It will do to observe again that the price of the *prolongation* is arbitrary, subject to numerous variations, and mainly due to the *agiotage*. I will present below a historical analysis of the *prolongation* and events of 1748, 1755 and 1762.

I define the purchase and sale on credit as the *marchés fermés* [Closed Market], in order to distinguish it from the *marchés des primes* [Options Market]. But before finishing the details of the operations of the Closed Market, it is critical to note that, on the Closed Market, not only one can buy on credit for more than what his wealth normally allows him and that, thanks to the *prolongations*, he is liable for only the variations, but one can also sell for more than he really possesses and, if the basis for the decrease does not happen, he can delay [push forward] his *contremine* by taking the *prolongation* from *rescontre* to *rescontre*.[6]

Page 299

This creates an advantage if the *prolongation* is expensive, or a disadvantage if it is cheap. People can also, by buying their part, terminate their affairs. These are the two choices that people can make. This is different from the 4 choices offered to the purchaser (resell, receive, engage, use prolongation).

I said that there are premiums to receive [puts] and premiums to deliver [calls]. These are paid from *rescontre* to *rescontre*, respectively on February 1st , May 1st , August 1st , November 1st.

As I said before, a speculation for an increase, called a premium to deliver, is when Paul believes that stocks of the English India Co. that are worth today £147 for the November *rescontre* will increase a lot with the peace treaty that Paul believes will be signed soon. However, because Paul cannot be certain of this fact or because he does not have enough credit to buy on the Closed Market, he risks a premium of 2 maybe 2.5%, that he pays to Peter. By taking this premium, Peter becomes liable to deliver £1000 of the English India Co. on November 1st at £150 if Paul asks for

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[5] Note from de Pinto: 'This part of the text was written in 1763'.

[6] Note from de Pinto: One says contremine when we sell funds one does not have, or when we sell premiums for a decline, that are called premiums to receive [puts].

delivery.[7]

Page 300

Both the one who buys the [call] option for Nov. 1 and the one who receives the premium make a contract by which one is obligated to deliver £1000 in the English East India funds at the *rescontre* to the one who gave the premium under the agreed terms.

Let's analyze the future of this premium in all of its possible cases. We must first observe that if we approach the *rescontre*, and that the stock does not go up, the value of the premium falls. And instead of 2½% that it cost initially, it will be worth only 1% and sometimes even less. If the speculation stops, the holder can exercise his premium with a loss. Another transaction, more curious, is to convert this premium to deliver, which was betting for an increase, into a premium to receive. First we thought the stock was going to increase a lot, we paid 2½% to deliver at 150. The stock took indeed some value, but we heard that the cause for this increase has disappeared. Therefore, we sell on the Closed Market for the same *rescontre* £1000 at 150%[8] and we convert by this process the premium to deliver into a premium to receive.

Page 301[9]

By risking only the premium, one never knows if the premium will be lost, we can now earn 10, 20, and 30 if the stock was to fall by these amounts. In volatile times, we sometimes do these deals 3 or 4 times in the same *rescontre* period on the same premium, buying at one time and selling at another. We only risk the original premium. The benefits from these transactions can be always profitable. Expert *agioteurs* who, at the end of each *rescontre*, give the premiums to deliver or receive for the next *rescontre* always win and often make an abundant number of them with a variable advantage according to events and volatility during the period. Those who wait for gamblers can always *peloter* [to wait] and wait for the appropriate game.[10] There are other *arbitrages* and other profitable combinations independent of gambles or events, which are executed by combining 2 or 3 simultaneous transactions. By buying or selling premiums (options), those who know these calculations benefit from ¼, ½ or 1% in addition to an opportunity to receive or deliver free of charge. The multiplicity of these transactions, often repeated, goes further than we could think. These are the most brilliant transactions of the expert Agioteurs or, rather, *actionistes* (recognizing that there is harm in taking this word to mean that all has been acted in a plain and odious way).

Page 302

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[7] This time the calculation seems correct (2% * Strike of 150 = £3 and £150-£3 = £147).

[8] The % symbol is in the original text. This is presumably a reference to the price being 150% of par value.

[9] In the following section, the *Jeu d'Actions en Hollande* is significant for mentioning the word 'arbitrage'. However, de Pinto does not provide a precise definition or an accurate description of an arbitrage trading strategy.

[10] *Peloter* is an old ball game and, basically, corresponds to an activity you can do while you are waiting.

Let's go back to the giver of the premium for speculative purposes and not as an *agioteur or actioniste*. If before the 1st of November, the underlying stock went up higher than 150, for example 155, he can retire his premium in two different ways. These ways merit much more attention. The easiest way is to sell his contract for money at 5½ or 6%. If one asks why it is possible to sell at 5 or 6%, I reply that these 5 or 6% are justified because the premium to receive at 150 (strike price) is worth something, especially when the *rescontre* date is still far away and the events are uncertain. This is what makes that gain favourable to one which does all these operations, winning beyond the value of the stock while achieving his value of 5%, in addition to the put.[11] The second way to realize the premium in question is by doing what the buyer of the contract would do. He could sell a [forward] contract for £1000 at 155. What will happen? If the stock goes back to 150, he has still earned the 5%. If the stock goes up tremendously, he could not care less since he can exercise his premium to deliver at 1000 at 150 and he delivers to the one who he sold to at 155.[12]

Page 303

But if the stock was to go down to 140, the premium is worthless. The premium was there only to protect him from a stock increase (like an anchor to protect a boat from the thunder).[13] Therefore he wins 15% on the original premium instead of 5 or 6% he could originally win in the first transaction. We observed cases where, with an original premium of 1 or 2%, the investors were winning 20 to 30% in a *rescontre*, risk free, with an original premium that we convert sometimes for an increase, sometimes for a decrease.

The same choice is offered, vice versa, for the premium to receive [put], if we give a premium to receive at 145, and if the stock goes down to 140 due to terror (that is quite common in the countries from which the stocks originate). If the other person exercised the option, then we must purchase the stock. Afterwards, it is common that the stock goes up again and lets say reaches 160. Then we have won the 20% + the 5 from the premium without having risked more than the premium. The premium to receive is also an insurance premium for people who own the stock and fear future events, if they do not want to sell the stock, but want to protect themselves from the crisis they fear.

Page 304

In a quiet period of time, people who give premiums either to deliver or receive, just on pure speculation, usually suffer a loss. Those who own stocks, sometimes take a premium to deliver at a higher price than the current value of the stock, and therefore, by this process, benefit at each *rescontre* from a « double » interest. If the stock goes up, they sold it at a good price. If they do not want to sell, then they change routes and exercise a *prolongation*, and wait for the moment that prices drop. They then take a premium to receive, which coupled with the *prolongation*, generates a good return. All these resources are very advantageous, and suggest that everybody should be interested in these funds. There are advantages not only for investors who invest

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[11] The text is tortuous at this point. While the simple strategy being described is apparent, the surrounding dialogue is obscure.

[12] At this point the text refers to delivering on the short at 150 which, if the discussion is to make sense, must be a misprint. Using 155 as the short sale price, the discussion is insightful.

[13] Compare this with the wording to be found in de la Vega (1688, p.156).

their money at a good return but also for the government that can use this funds market when it needs to borrow money.

The development of causes that can make the stock go up or down during the crisis of the rescontre, independent of real or political events.

Page 305

These changes, even though momentary, are sometimes substantial, and require attention. In order to have a clear picture of what the *rescontre* is, it is first required to analyze the nature of the different transactions that we settle and remember what was said above. We observed that some people sell the stock itself, but some keep their investment, either by keeping the stock or by selling it in *prolongation*. This last method is a means of earning a return on the holding. There is also a large number that place their money in the funds only to benefit from an advantageous *prolongation* by settling the change in value at each *rescontre* with the *agioteurs*, either in paying what the stock has earned or by receiving what the stock has lost. That has no influence anyway, since they do not lose or win anything in the variation. The only influence is from the interest. Except for those who receive or carry the funds, the others, which are composed of the *actionistes* and gamblers, do not purchase or sell anything. They operate with what we call 'of the wind'. Now who comes to the *rescontre*? At *rescontre* time, on the 15th of the month of each *rescontre*, all the parties gather in a room around a grand table. *Rescontring* persons do the *rescontre* for 10 to 12 people, and all the transactions are settled.

Page 306-8

Here is the process. The *rescontring* person says: one [my client] has sold 1000 to Mr. X. and Mr. X responds. If the *rescontring* person receives the *rescontre* [from X], then it is settled, or if he takes the *prolongation* [from X], it is also settled since *prolongation* involves a purchase and a sale at the same time. The one who makes the *prolongation* is supposed to have purchased his part for cash and sold at term [credit] and vice versa for the seller, therefore this is settled. However, because one could have sold his part to another party that also would have resold his part and so on, until the seller or purchaser find the final transaction, which completes the transaction for real. In terms of *rescontre,* we refer to marrying the seller to the purchaser of last resort [the purchaser ultimately making cash payment for the initial cash sale]. This is a *navette* [= shuttle] or a perfect circle.

But here is where the mystery of the stock gambler resides. If it happens at a *rescontre* date that among the sellers there are large numbers who sold their stock [for real], who carry it, who do not want to write *prolongations*, that is called *reste* [= remainder, rest] and it causes a decrease in the stock price. When it is the contrary, and there are more people who want to make real purchases than there are people wanting to carry stock, that is called the *faute* [default, lack], or lack of stock that automatically creates an increase in price, the ones who sold are obliged to purchase at any price. But when there are no receivers, such that there is not enough money to execute real purchases, then the *prolongations* increase tremendously, and the stock price decreases without any other motives than the number of traders seeking to transport [through prolongation] and the powerlessness of purchasers to receive in proportion. This obliges traders to sell at any price and therefore liquidate their *rescontre.*[14] Eventually some receivers or new buyers appear, attracted by the low price of the stock or the enormous price of the prolongation. If, on the contrary,

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[14] De Pinto notes: A parallel situation was the cause in 1769 of the huge drop in value of the English India Co. stocks.

there are a lot of receivers wanting to make real purchases and not too many carriers with actual stock to deliver, then the *prolongation* decreases and sellers, not finding anybody willing to give the *prolongation*, are obliged to purchase stock at whatever the price. And, since this crisis is often forecast by the *actionistes*, they do what we call *un jeu aux acheteurs* [a game to buyers] or *un jeu aux vendeurs* [a game to sellers] in order to increase or decrease the funds at the time of the *rescontre.* These variations are due entirely to the *rescontre* date and the impact of the vender on the purchaser. Experts judge this aspect of the *rescontre* just by looking in the office and by observing the transactions that have passed, information that ordinarily is relatively well known. However, it is often possible to make mistakes due to the appearance of combinations [strategies involving more than one holding position]. For example, one or two *rescontres* before the peace treaty was signed in 1748, everybody was a buyer and therefore a *prolongation* giver [issuer]. As a result, enormous *prolongations* were paid, which were, however, well compensated by the increase that the signature caused. Those who chose the prolongation by vending their real stock, benefited from the sizeable interest earned; but the venders of *wind*, that we call *contremineurs*, lost a lot despite the enormous advantage of the high and *usuriere prolongation.*

At the beginning of the war in 1755, a strange phenomena happened in the stock exchange to which the English have assigned a special name. We will do the same [in Holland] as well. Here is the fact. The *contremine* was so big, the number of venders was so large, especially in the India stock, that we sold more stocks than existed, or at least what was found in circulation on the stock exchange. The consequence was that, instead of having a buyer giving a *prolongation*, that we call in London a continuation, he received one from the seller to delay [remove back] his purchase to the next *rescontre.* That is what the English call a *backwardation*, or *retrogradation.*

Page 309

At this time, some buyers received advantages in the India funds of 7 to 8% and even more, other things being equal, during two years, and to the prejudice of *Contremineurs*, or venders, who always have disadvantage in respect to the buyers. Buyers, either with money or on credit, can sustain the gamble, keep their funds, earn the yield, and wait for a better time to sell. On the other side, somebody who sold a stock that he does not have, if prices do not move in his favour, finds that with all the money of the world he cannot deliver what he cannot buy. *Contremineurs* in the English India Funds in 1755, 1756, and 1757, were forced to borrow stocks from people who owned some, by paying a large interest, to support and push forward the *contremine*. The whole thing depended on the outcome of Mr. de Lally' s expedition. Those who benefited from the decrease at the time that Fort David was taken, haven' t earned anything yet, being damaged by the *backwardation* or *retrogradation*. I am now talking about old transactions, because the most recent *rescontre* has yielded a lot, considering that the premium to receive, which had cost 1 or 1½%, had become worth 10, 12 and 15%. On the contrary, it happened that over the last 2 years that money has become scarcer, this increased the value of *prolongation*, which has increased due to the expectation of future peace; because of this hope there are more buyers, more givers of *prolongation*, than there are *contremineurs.*

Page 310-12

We must also add that there are transaction costs for each £1000, no matter which English Funds: in all the annuities for the loans of 3, 3. 5, 4%, in the East India funds, in the Bank and in the South. They are always equal to 15 florins for sales, purchases, *prolongations*, and premiums over 2%. When the premiums that we give

or receive are below the 2%, we pay only 3 florins 10 fols.[15] Brokers do not enter a price war between each other: they look for Actionists, establish communication bridges and provide safekeeping of securities for all transactions. For this they earn the brokerage fees on both sides. This is a big disadvantage for gamblers who create the wealth of both *actionistes* and brokers. Observe also that, in the recent past, almost all transactions have occurred in the *Banque du Sud* [Southern Bank] and the English East India funds. It is true that, at this time, Oriental and Occidental India of Holland Co. are more active. But since the last war, the spirit of the game has increased and money is more abundant.

As a result, the circle became too small and trading extended into the vast ocean of annuities where gamblers are less disturbed by the *rescontre*. Gambling in the annuities became necessary and critical when the government needed to borrow 6, 8 and 12 millions. That is why I believe that if the peace lasts for a few more years, the abundance of money plus the gambling spirit will push to the roof the English East India stocks. The rate on annuities will become stable after there are no questions concerning future borrowings and there will be no more trading or gambling on these stocks. All the gamblers will inevitably fall on the East India stock in the expectation that the dividend will increase or there will be some other kind of shaking news that we can expect from a Mercantile company.[24] The supply of stocks to trade will be too small for the number of players. This is due to the fact that a lot of people will decide to hold and not trade. This is to the advantage of people who gamble for the increase since the potential growth of such a company is huge. These are the principal elements of the game that seems to influence the European political system.

Notes

1. Numerous sources, for example, Barbour (1950), Garber (1989), Posthumus (1929), Neal (1990b), make reference to trading 'futures' contracts, instead of using the more correct reference to trading of 'forward' contracts, for example, Hieronymus (1971, ch. 3). The term 'futures contracts' has a precise modern meaning which the contracts of the 15th-18th centuries did not satisfy, though the Japanese rice market did come close to trading contracts which could qualify as futures contracts. As to the general classification of pure derivatives, modern swap and futures contracts would be classified under forward contracts.

2. There are numerous instances of explicit and implicit call or conversion provisions in 15th to 18th century security issues. For example, the Venetian *prestiti* had a call provision that allowed for principal value to be repaid at par, as finances permitted. Various 18th century government debt restructuring plans involved the introduction of conversion provisions. For example, there was the conversion of English government life annuities, issued under William III and Queen Anne, into long annuities, or John Law's Mississippi scheme which introduced conversion provisions for exchanging French government debt obligations into *Compagnie des Indes* stock.

3. In this statement, speculators are traders with no underlying position in the security or commodity. Speculators are motivated exclusively from the desire to benefit from price changes. In contrast, hedgers are traders which either have or will have underlying positions in the security or commodity. Hedgers trade in order to protect the underlying cash position from future changes in price. Arbitrageurs are also participants which will be present in a derivative securities market. However, these participants can also be conceived as a subset of hedgers, that is, traders forming riskless hedge portfolio with no net investment of funds. Practical features of markets typically dictate that brokers are also essential market participants. The situation is different in markets where the securities being traded are not pure derivatives but, rather, only have embedded option features. In this case investors will also be present. This class of trader has a wide range of motivations, such as a desire to preserve capital or the achieve the maximum expected return on capital. Individual trades can combine different motives and it is theoretically possible for markets to clear without the presence of pure speculators.

4. Futures Industry Association, *An Introduction to Futures Markets*, Washington, DC, 1984. Also, J. Markham, *The History of Commodity Futures Trading and Its Regulation*, Praeger, 1987, D. Carlton, 'Futures Markets: Their Purpose, Their History, Their Growth, Their Successes and Failures', *Journal of Futures Markets*, 1984: 237-71, G. Gold, *Modern Commodity Futures Trading*,

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[15] This is likely a reference to a fraction of a Florin.

CRB, 1975 and Chicago Board of Trade *Commodity Trading Manual*. Earlier historical literature on the origins of futures trading are referenced in Hieronymus, ch.4, n.1. S. Clough and R. Rapp (1975) covers the historical issues such as the nature of the feudal economic system and the associated trading routes.

5. There is some debate over the validity of this example as an options contract. In particular, it was Hebrew custom for a suitor to make payment when desiring marriage and this payment could be made in labour, instead of goods. Malkiel and Quandt (1969, p.7-8) give a further discussion of this issue.

6. Aristotle goes on to say: 'The story is told as showing that Thales proved his own wisdom; but … the plan he adopted —— which was, in effect, the creation of a monopoly —— involves a principle which can be generally applied in the art of acquisition.' A further connection is made to a Sicilian who cornered the cash market for iron by buying up all available supplies. Aristotle questioned the use of derivative securities transactions to manipulate the cash market without recognizing that Thales may have benefited in the absence of any monopoly. This reflects the relative lack of understanding that ancient writers had concerning speculative transactions.

7. The intricate dealings that were involved in the South Sea Bubble are discussed in various sources, particularly Morgan and Thomas (1962, ch. 2) and Mackay (1852, ch. 2) and Wilson (1941, ch. IV).

8. A broker in this period was an intermediary or mutual agent who served as a witness, for a commission, to contracts between two parties. In London, brokers had to be licensed and sworn. While much of the commodity and joint stock business was conducted through brokers, dealing was not confined to sworn brokers and, at various times, many unlicensed dealers operated in the market.

9. De la Vega's well reasoned discussion (p.183) of the legal implications of option contracts stands in stark contrast to his naive views on profitable option trading strategies: 'As to whether the regulation (banning short sales) is applicable to *option contracts*, the opinions of experts diverge widely. I have not found any decision that might serve as a precedent, though there are many cases at law from which one [should be able to] draw a correct picture. All legal experts hold that the regulation is applicable to both the seller and buyer [of the contract]. In practice, however, the judges have often decided differently, always freeing the buyer from the liability while holding the seller [to the contract] … If … the opinion is correct that it applies only to the seller, the regulation will be of no use to me [as a person wanting to seek shelter] when I receive call premiums, for in this case I am in fact a seller; but it will help me if I have received a put premium, as I am then the buyer of stocks. With regard to the put premium… law and legal opinion, the regulation and the reasons for the decisions are contradictory. The theory remains uncertain, and one cannot tell which way the adjudication tends'.

10. From de la Vega's sketchy description of Amsterdam options contracts, it is possible that Houghton's English contract was similar to those traded in Amsterdam: 'For the *options business* there exists another sort of *contract form*, from which it is evident when and where the premium was paid and of what kind are the signatories' obligations. The *forms of hypothecating* are different also. Stamped paper is used for them, upon which the regulations concerning *dividends* and other details are set down, so that there can be no doubt and disagreement regarding the arrangements' (de la Vega 1688, p.182).

11. The use of guineas to facilitate the premium payment reflects the status of that coin in transacting cash business. The guinea was a gold coin first minted in 1663 under warrant 'to the officers of the Mint requiring them to stamp all gold and silver which might be brought to them by the African Company to be coined, with a little elephant, the mark of the Company. This was the fourth company which had been formed to trade with Africa ... At a time when so many different coins were circulating, the gold pieces with the little elephant were soon distinguished, from the place of origin of the metal as "guinea pieces"' (Feaveryear 1931, pp.89-90). Due to fluctuations in the gold/silver ratio and among different coins, the price of the guinea in terms of the silver-based pound sterling was variable. Houghton provides regular quotes for guineas. In particular, on 15 June, 1694 Houghton quotes guineas at 22 *l.* and on 22 June, 1694 the quote is 23 *l.* In 1696, the Government began a process of attempting to fix the value of the guinea in terms of the silver sterling measure. On 10 April, 1696 a value of 22 shillings was set, which was later lowered to 21s 6p in 1699 and 21s in 1717.

12. An at-the-money option has the exercise price approximately the same as the current stock price. This is in contrast to out-of-the-money (in-the-money) options which have exercise price greater than (less than) the stock price for calls and less than (greater than) the stock price for puts.

13. An American option can be contrasted with an European option, which can only be exercised on the expiration date, and a Bermuda option, which can only be exercised at prespecified, discrete times prior to expiration.

14. Early exercise for a dividend payout protected put option can occur if the security price is sufficiently close to zero that there is insufficient potential for further increase in the put value due to

further reduction in the stock price. In this case, the put can be exercised and the profit invested at interest. In Houghton's time, the securities on which options were traded had prices that were sufficiently above zero that the early exercise event had such a low probability that the early exercise premium for the put can also be set to zero.

15. It is not surprising that both Law and Cantillon engaged in derivative security trading, though the main speculative connection between Law and Cantillon was a £20,000 loan that Cantillon made to Law's brother, William Law, to make a speculative cash purchase of copper. William Law was later to default on the loan, as victim of the collapse of the Mississippi scheme. Murphy (1986, 1997) provides detailed reports on trading of derivatives by John Law and Richard Cantillon.

16. The early history of options trading in England can be found in Morgan and Thomas (1962). An early discussion can be found in Duguid (1901). Barnard's Act was repealed in 1860.

17. Cope (1978) takes a somewhat different view of these events.

18. Garber (1990a) examines to what extent there really was a tulipmania. The bulk of irrational pricing appears to have been associated with tavern trading of unenforceable contracts: 'The authorities did not prosecute people for participating in proscribed futures contracts. They simply refused legal enforcement of such contracts ... The futures trading, the centre of the (tulipmania) activity, was clearly banned by the edicts; and, in the end, the courts did not enforce deals made in the (taverns), all of which were repudiated. It is incomprehensible that anyone involved in the fluctuating associations of the taverns would have entered such unenforceable agreements in the first place unless they were merely part of a game' (Garber, p.19). Schama (1987) also provides a detailed discussion of the tulipmania and its social underpinnings.

19. Wilson (1941, ch.III (iii) and ch.IV (v)) provides a useful summary of de la Vega, de Pinto and some correspondence between David Leeuw and Peter Crellius.

20. Haley and Schall (1979) provide a particularly complete set of the assumptions invoked by perfect markets: costless capital markets, neutral taxes, competitive markets, equal access, homogeneous expectations, no information costs, no default risk.

21. An European option can only be exercised on the expiration date. An American option has the additional feature that it can be exercised at any time up to and including the expiration date. Being intimately connection to the *rescontre* settlement process, the options being examined by de la Vega and de Pinto were European options. As stated the options are written for one unit of stock though for modern options contracts, such as those traded on the Chicago Board Options Exchange, 100 units of stock is the typical contract size. More generally, C and P would be the option premium paid for the contract of Q units of stock, the bond would have par value QX and Q units of stock would be traded.

22. Schaede (1989) extends the work of Miyamato, which is available only in Japanese. In addition to Schaede (1989), the workings of the rice market are also discussed in Sansom (1964). The Osaka rice market is sometimes referred to as the Dojima rice market, after a small island in the northern part of Osaka where the bulk of rice trading was conducted after 1697.

23. For example, the *rescontre* was adapted to derivative security trading in London. Option and forward contract trading in London was disrupted by Barnard's Act.

24. De Pinto notes: This happened in 1766 when the stock price of English East India funds increased to 230. The author claims to have forecast this increase in advance.