Rational Pricing of Options during the South Sea Bubble: Valuing the 22 August 1720 Options

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ABSTRACT

We present evidence of rational pricing South Sea Company liabilities and call options written on South Sea shares. A previously unstudied dataset on South Sea share options is presented. The Company's capital structure of the firm is redefined so that the application of modern financial economic theories can be applied to its valuation. We present evidence that a significant portion of South Sea equity liabilities was in the form of share warrants and conversion (from bonds to shares) privileges and should be so valued. Finally we present a model of the cross-sectional behaviour of share prices, South Sea Company debt and call option values. The model is calibrated and simulated in order to produce estimates of the required return on the Company’s debt and the volatility of the firm’s asset values. We conclude that the jointly estimated value of the firm, its constituent liabilities, third-party call option values and implied volatilities are consonant with rational pricing behaviour during the Bubble, although the model requires extension in several directions in order to present a more complete picture of the South Sea Bubble.

Introduction

To write that the South Sea Bubble was a 'bubble' is to offer no positive explanation of the great events of the summer of 1720. Except in a relative small number of financial economic theoretical studies, the term 'bubble' stands for no positive economic theory of explanation. No positive bubble theories have ever been successfully used to explain modern financial market collapses, such as the East Asian financial crisis of 1997 or the equity market dip of 1987, nor have any of these financial theories of bubbles ever been empirically linked to the number of historical events that have long been called 'bubbles'.[1] In a few studies the best empirical proxies for bubbles are still nothing more than econometric residuals from models of rational pricing behaviour. The studied behaviour of these residuals has opened the way for a fruitful wave of theoretical and empirical work that now sits under the umbrella of 'behavioural finance' from which someday may come a new paradigm that delivers a set of potentially falsifiable theories of bubbles that can weather repeated testing. Until that time comes, however, the most useful empirical financial economic research continues to feature models of rational financial pricing behaviour. The extent to which such models can be successful and the ways they are likely to fail have been studied for nearly four decades and they have been useful in deepening our understanding of significant historical episodes such as the Great Crash of 1929.[2] Such models, however, have never been applied to the South Sea Bubble and this is why I write that using the word 'bubble' in the context of the events of 1720 is merely, at best, a way saying that the South Sea Bubble remains a mystery.

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[1] A skeptic's view about the existence of bubbles and the veracity of the some of the most cited evidence is found in Peter Garber's, *Famous First Bubbles*.

[2] See, for example, Rappoport and White, "Was There a Bubble in the 1929 Stock Market?".

Where to start in the application of modern financial economic theory to a study of the South Sea Bubble is itself problematic. One of the most fruitful avenues for my own researches was discovered as I tried to create a database on as wide a range of financial contracts as could be assembled for the year 1720. The narrative histories of the Bubble all use the familiar Company share values to mark the progress of the Bubble, but what historian has studied the value of the so-called 'subscription' shares or attempted an analysis of the Company's debt in the search for irrational pricing behaviour? What of the forward contracts for delivery of shares and their component forward premia? Would not these be useful for the study of a bubble? Finally, what of the derivative contracts on South Sea shares? No study of these contracts has been attempted.

Modern financial theory tells us there should be much special information contained in the prices of such contracts and this information can inform us as to how far rational speculation about the course of South Sea share values was going. Many examples of these latter contracts have been discovered by historians of the Bubble, but they have never been very specific as to what they were and contracts have generally been labelled ‘bargains for time’.[3] Explicitly labelled forward prices would appear from time to time in price courants, such as *The Course of the Exchange*, when company share ledgers were closed for necessary accounting work. Indeed, at what must have been the very height of the South Sea Bubble the Company ledgers were

[3] In the most careful study to date of 18th century financial institutions and contracts, P.G.M. Dickson showed that the archives contained much evidence of 'bargains for time'. In going through his cited archive sources for such contracts, I have found that one cited ‘bargain for time’ was nothing more than a straightforward spot transaction agreement that simply stated explicitly the length of time it would take for two 18th century gentlemen to arrive together at a time and place to complete the transaction. But indeed, the common ‘bargain for time’ was a forward delivery agreement. Given the laborious way in which ownership in shares could actually be changed and the natural limitations of early 18th century communications, it

closed and the only printed share values available are the forward share quotations ‘for the opening’, i.e. for the reopening of the Company books.

The subscription contracts have been referred to as subscription shares, or share purchase agreements that required a small down-payment and subsequent payments to follow as scheduled instalments. This is the way they were touted by the South Sea Company, who created the contracts and sold them directly to the public. Subsequent events in 1720 and in later years suggest, however, that the general investing public did not see these contracts as simple instalment purchase contracts for shares. It appears that the Company had a large problem in enforcing the subscription contracts later in 1720 and thereby started a train of lawsuits that dragged on well into the middle of the 18th Century. Although by that time it was well in the interest of the Company’s management and the Government that the subscription contracts be enforced to the letter, there is good evidence to suggest that, even from the very debut of the subscription contract, the investing public viewed these contracts as a complex package of call options on shares. We believe, and wish to present evidence, that the investing public accepted (and priced) the subscription contracts as if they were call options on shares.

In modern financial theory option prices are supposed to contain information about market uncertainty (loosely referred to as ‘volatility’) that, with the use of certain restrictive option pricing models, can be extracted. (This extracted uncertainty is called the ‘implied volatility’.) It would be convenient for our researches if there were a set of prices of straight call or put option contracts. There is no mention of markets for such contracts in the secondary literature on the South Sea Bubble, but markets for such contracts must have existed. First, it was likely on the grounds that

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is hard to see how a pure spot transaction in shares was possible and how forward transactions in shares could be avoided.

such contracts had been common in London and in Amsterdam in previous times. Second, we have found three such contracts (dated 1720) in explicitly written form in archives. Thirdly, in our search for ‘bargains for time’ we have discovered the partial accounting of dealings in such option contracts by a broker/dealer (one David La Cour) who appeared to have been a specialist in option contracts.

In this paper I attempt to make sense of a cross-section of values of South Sea Company liabilities and options to see if they all hang together in way that is quite understandable from the point of view of modern corporate finance theory. To do this a number of preliminary tasks must first be done. In the first section, the capital structure of the Company has to be redefined in a form that makes sense in light of these theories. Equity ownership in the firm has to be reclassified into types of equity that theory demands must be valued in separate ways. Attention must also be paid to the size and nature of the firm's debt. Although the South Sea Company was not a highly leveraged firm, significant portions of its debt were quite risky with regard to the costs of servicing it and the firm's likely cash flows. Indeed we put forward the thesis and evidence that to make sense of South Sea share equity values without due attention to the value of its debt is not possible. Once the liabilities are redefined, we make the case that a valuation model of South Sea equity must treat equity value in large part as if it was a call option on the firm's assets. The concept that share equity and debt have significant option characteristics when a firm is said to be experiencing 'financial distress' is a common idea found in most elementary corporate finance textbooks and is most relevant to the case of the South Sea Company and its financial management in 1720. In the second section of the paper I introduce the reader to a new source of call option data that has not been exploited before. In the third section we discuss the structure of a theoretical model that simultaneously values equity, debt,

share values and call option values. The model is calibrated and subjected to simulation in order to produce estimates of required returns on South Sea debt and implied volatility in the values of the firm's underlying assets.

Redefining the South Sea Company's Liabilities

In this section is described the necessary redefinition of the Company's liabilities in terms of their modern equivalents. The broad division between equity and debt was, of course, understood by contemporaries, but the modern distinctions that can be made between different versions of equity and debt have never been features of the South Seas debate - neither to contemporaries nor up to the present.

Equity

The inflation and collapse in South Sea equity values was experienced by all classes of shares. The main division was between i) straight share equity and ii) so-called subscription shares. We take up our story in this paper in May/June 1720 in which we had the following structure of issued equity.

Original Shares Issued	Shares Issued via Exchanges announced 19 May 1720	1st Subscription Shares Issued	2nd Subscription Shares Issued	3rd Subscription Shares Issued 17 June 1720
109,428	32,427	22,250	15,000	5,000

In all our analyses, in this and all other papers, original shares refer to shares issued and £100-paid to the Company as of 1711. Of course there were a number of further issues of such shares after 1711 (in particular in 1719), but since such shares stood on equals terms with the original shares of 1711 we refer to them all as original shares.

Shares issued via the announced (19 May) exchanges were shares that were being credited to government annuitants who had agreed to exchange their annuities for packages of South Sea Company shares, bonds and cash. The rates at which cash and South Sea liabilities were to be exchanged for government annuities were announced in April 1720 and any person could easily calculate the approximate impact of such exchanges on the Company's capital structure. It was widely believed that the announced terms for exchange were highly favourable to annuitants and those who had the choice to exchange or not exchange would still largely choose to exchange. This is indeed what happened and the approximate 30 percent increase in shares issued could have been easily foreseen. The figures above represent a near 100 percent favourable response from annuitants showing their intent to exchange at the Company's terms.[4]

The subscription shares were shares issued to the public that could be paid for in instalments. (The 18th and 19th century usage of the term "call" often refers to a request to owners of subscription shares to pay an instalment.) The 1st Subscription series started 19 April 1720 and the 2nd series started soon thereafter. The 1st Subscription, for example, was for shares priced at £300 per share (p.s.). A £60 deposit was required and thereafter every two months a 10 percent or £30 instalment would be required or called. The 1st Subscription shares had a £30 call upon them due to be paid on 14 June. On that date the possession of a subscription share would represent 30 p.c. of an original share and the obligation or right to make 7 more bi-monthly instalments of £30 each until ownership in one full original share resulted. The 2nd Subscription required a 10 p.c. deposit on a share priced at £400. After the first £40 deposit, a further 9 £40 quarterly instalments would follow. The 3rd

[4] The finer details of the exchanges and the subscription issues are found in Dickson and Scott, volume 3. A shorter account is found in

Subscription did not commence until 17 June and required a £100 deposit on a share that was to be priced at £1000. Nine further semi-annual instalments of £100 each would be required before a full original share was credited to the owner.

The subscription shares were quite valuable and we shall see that they represented up to 10 p.c. of all company liability value. But what were these subscription shares and what determined their value? There are two quite opposite answers to these questions. The subscriptions were sometimes referred to as subscription contracts and as such may be viewed as ironclad agreements between the issuer and the subscriber. That is, the subscriber is under strict contract to pay the instalments on time and in full otherwise the issuer has full legal right to recover the due instalments at the subscriber's cost. The subscriber on the other hand has a similar legal right to obtain further fractional shares in the company at the fixed date of each instalment. After the collapse of the South Sea Bubble and the near collapse in the Company itself, this was an interpretation of the subscription contracts that particularly suited the purposes of the company's management and there is substantial documentary evidence of the Company's pursuit of defaulting subscribers.

If this is the proper way to view the subscription contracts, how would their value be determined? It is very simple. A subscription share would be worth one share minus the discounted present value of all the remaining instalments. On 20 June 1720, for example, a full share was worth about £806 and a subscription share from the first series was worth £625.4[5]. The difference between the two prices was £181.2. The

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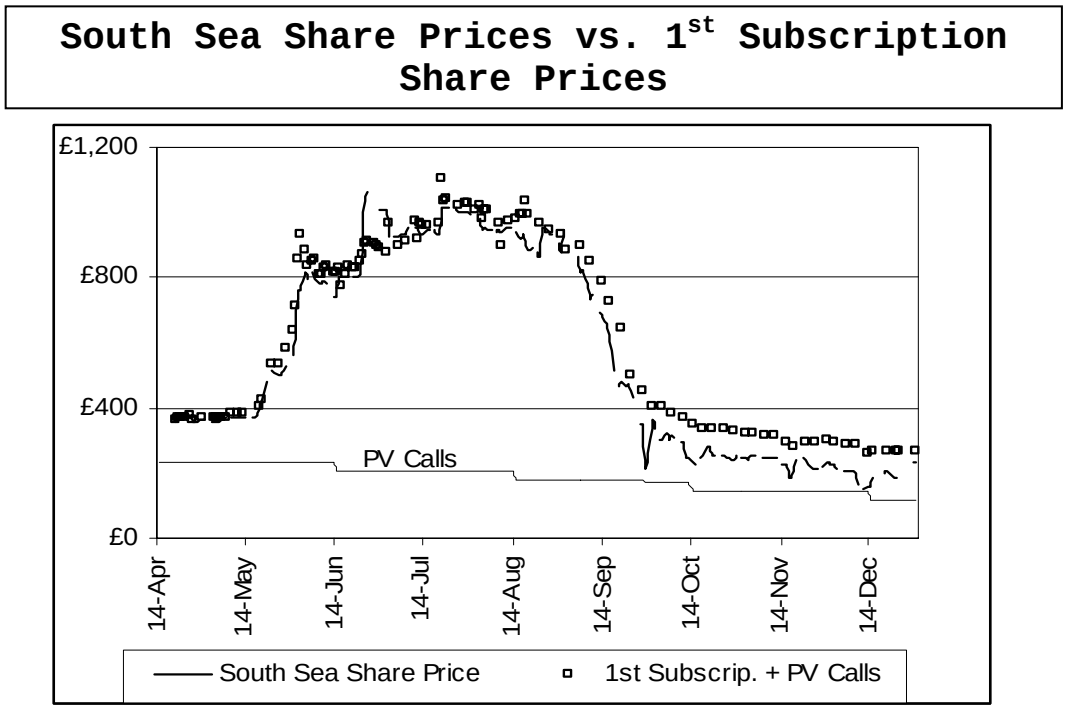
Neal's, Chapter 5.

[5] It is useful here to remind the reader again how we have adjusted value data for equity liabilities of the Company. The quoted value for shares in *The Course of the Exchange* was £760 8s, but to convert that value into the value of an 1711-original share, which received a 6 p.c. stock dividend in 1716, we have to multiply the quoted value by 1.06 to obtain £806. The quoted 20 June value for a 1st Subscription share was a £500 premium over what was due to the Company by an owner of such a share. At that time £90 was due to the

present value of the remaining 7 instalments (calls) of £30 each would have to be smaller than £210, but a realistic estimate would be greater than £200. Thus we see that the subscription share is a bit too valuable to be in accord with this strict interpretation of the subscription contract. The difference between the values of share and subscription shares became even more narrow later in 1720. On 3 September, for instance, a share was worth £687.9 while a 1st subscription share was worth as much as £612.2. The present value of the remaining instalments to be made on these shares was greater than £176. The behaviour of 1st Subscription prices relative to share prices is illustrated in the graph below, in which the general point is well illustrated; subscription shares were too valuable to be in accord the strict enforceability interpretation of the subscription contracts. Similar and, indeed, even more dramatic graphical depictions of these relationships for the other subscription series can be found in Helen Paul's work on this subject.[6]



Company making the value of a subscription share £590. In terms of a claim on a 1711-original share, this value too has to be multiplied by 1.06 to obtain £625.4.

[6] Helen Paul, *The South Sea Bubble…*,2004.

The other possible extreme interpretation of the subscription contract is that it was totally optional on the subscriber's side. That is, the subscription contact could never be viewed as a liability upon the part of the subscriber and paying the instalments and being credited with fractional ownership of shares were purely optional from his perspective. Viewed this way the subscription share value of £625.4 on 20 June 1720 might be easier to understand. There was no certainty that over the next 14 months (covering the period of 7 bi-monthly instalments) that South Sea share prices would remain above £300 per share. The subscription shares could therefore be viewed as a package of small call options on shares in the firm and should be valued accordingly. To more precise, since such call options were being issued by the Company itself instead of being sold by third-party writers, we should say that these contracts represented packages of warrants.

The evidence is very strong that the subscription shares were valued like packages of warrants. For almost all subscription shares for all series of such subscriptions, the values were higher than they would have been under the strict subscription contract view. We thus rearrange equity into its two modern components i) straight share equity and ii) warrants, or to be precise packages of warrants. We number these packages No. 1 through No. 3 and for convenience hereafter refer to them simply as warrants and not as warrant packages.

Before we present our final accounting of South Sea equity, we have to address the formal difference between equity issued and equity outstanding. During the South Sea Bubble the difference was substantial and important and we believe that there is no previous study that makes a distinction between the two and how it arose. The Company certainly did repurchase some shares that we can account for. Famously it also repurchased a number of shares that we cannot account for. This would be the

famous 'fictitious stock' that was created and credited to certain important individuals without payment. Although an important part of the political story of the South Sea Bubble, the 'fictitious stock' is unlikely to be any more than 1 p.c. of the total number of shares issued and outstanding.[7] More important was the stock that was taken back by the firm "for its own use" as went the contemporary term for treasury stock. The majority of this treasury stock was taken not upon repurchase, but as security for loans of cash or bonds to shareholders. It became a preoccupation of the Committee of Secrecy formed in 1721 as to who these shareholders were since the evidence is fairly strong that the so-called loans on shares were being granted to certain favoured individuals and were merely a means of getting these favourites into South Sea bonds and out of South Sea shares as the Bubble was collapsing. In this paper we simply use the data we have on 'loans on stock' to define the size of the Company's treasury stock. Subscription shares (of the 1st and 2nd series only) were also taken back by the firm on these terms and we can account for these as well.

In the following table we present (at selected dates between 10 May and 24 June) treasury stock and outstanding equity.

[7] The 'fictitious stock' was reputedly managed by Robert Knight and the accounting for it was kept in a green ledger that disappeared with Knight when he fled to the Continent. It was suspected that Knight escaped with Government assistance and connivance. This was likely, but the first direct evidence of such assistance was only recently presented in Peter Barber's Appendix C in Carswell's classic cultural and political account of the South Sea Bubble.

South Sea Company Equity Issued and Outstanding

Dates	Shares repurchased as treasury stock or taken as security on loans	1st Subscription Shares taken as security on loans	2nd Subscription Shares taken as security on loans	Original Shares Issued and Outstanding inc. fully-paid equivalents embodied in the Subscription Shares	1st Subscription Shares issued & outstanding (No. 1 Warrants)	2nd Subscription Shares issued & outstanding (No. 2 Warrants)	3rd Subscription Shares issued & outstanding (No. 3 Warrants)
05/10/20	5,199	680	200	142,450	21,570	14,800	
05/17/20	5,363	710	205	142,280	21,540	14,795	
05/24/20	5,624	740	205	142,013	21,510	14,795	
05/31/20	5,913	850	205	141,701	21,400	14,795	
06/07/20	6,329	940	205	141,268	21,310	14,795	
06/14/20	12,255	1,288	590	137,329	20,962	14,410	
06/21/20	15,554	1,523	695	134,449	20,727	14,305	5,000
06/24/20	19,949	1,813	1,027	129,934	20,437	13,973	5,000

Debt

The debt obligations of the South Sea Company can be divided into i) its bonded debt, which was largely tradable, and ii) its short-term and long-term obligations to the Government, which were not traded and priced. At the beginning of 1720 the Company's only debt was less than £700,000 in nominal bonds. These bonds were a mixture of 6-month, 1-year and 2-year obligations that were regularly renewable at expiration. As part of its April exchanges for government annuities the Company also issued new bonds of the same type and we can see that as a result of the exchanges announced 19 May there would shortly be nearly £3 million of these bonds nominal. Additional numbers of bonds were also advanced to those shareholders who gave up shares 'for the Company's use'. Such bonds were issued generally in £100 denominations and *The Course* frequently records their values in terms of percentage discounts or premia from face value.

Alongside bonded debt were the very large obligations of the Company to His Majesty's Treasury. First and foremost, there was the set payment, the 'key money', that the Company bid in January 1720 for the privilege to convert the national debt into South Sea liabilities. This was £4,156,306 and was to be paid in four equal quarterly instalments in 1721. This sum corresponded to 25 p.c. of the nominal size of the redeemable government annuities that was fixed in the January Act that allowed the Company to set terms for the redemption of this debt. As the Company exchanged company liabilities for government annuities, of course, the Company laid claim to income from exchanged annuities. This applied to exchanges of the redeemables as well as the so-called irredeemables. In the exchanges of the latter, however, the Company also undertook to repay to the government a kind of capitalised value of those annuities. These represented a large and relatively short-term set of obligations

to repay. In the April exchanges the Company concentrated its attention on attracting the owners of the irredeemable annuities to an exchange of their holdings for South Sea liabilities. It offered the terms it best thought would work and as of May 1720 attracted the vast majority of irredeemable annuity holders to voluntarily convert into South Sea liabilities. Under its contract with the Treasury, the Company was obligated to pay 4.5 times the annual payment for all such annuities converted and 1 times (“one year's purchase”) of all such annuities not voluntarily converted. These capitalised values were to be paid to the Government also in four equal quarterly instalments in 1722. Finally, in early June 1720 the Company undertook a contract with HM Treasury to 'manage' the market in short-term debt obligations - the Exchequer Bills. This contract obligated the Company to deliver back to the Treasury £1 million in borrowed Exchequer Bills over short time horizons. We conclude that the intent of the contract was to keep the market in Exchequer Bills liquid and stable and the Company was to earn the interest and to be paid a fee by the Government if it could fulfil the terms of this first contract. It was widely speculated that, if successful, the contract would allow the Company to become the remunerated market-maker in short-term Government debt. These are the debt obligations of the Company in May/June 1720 that could be concretely written down and we summarise them in the table below. This table is a basic component of the Debt Table that is described in the Appendix.

South Sea Company Nominal Debts, May/June 1720

Debt Description	Date Debt Due	Nominal Debt (£ millions)
£1m Exchequer Bill Loan (valid from 7 June 1720)	20/01/21	£1,000,000
Liability to the Treasury for the £4,156,306		
	01/03/21	£1,039,077
	01/06/21	£1,039,077
	01/09/21	£1,039,077
	01/12/21	£1,039,077

4.5 Years' Purchase on the Irredeemables Exchanged		
	01/03/22	£553,473
	01/06/22	£553,473
	01/09/22	£553,473
	01/12/22	£553,473
1 Year's Purchase on the Irredeemables not Exchanged		
	01/03/22	£59,679
	01/06/22	£59,679
	01/09/22	£59,679
	01/12/22	£59,679
Bonded Debt up to 5/19/20		
	31/12/20	£676,600
Bonded Debt after exchange results announced 5/19/20		
	31/12/20	£2,963,282

Conversion Privileges

The final set of contracts that are of significance in our researches are the so-called loans on shares. The ‘loans on shares’ was an apparently simple scheme, so it was said, to support the market in South Sea shares. Even if this was its intent, it ultimate effects were probably complex in ways that could not have been anticipated by the South Sea directors, their critics or even by generations of later historians. The idea was that the South Sea Company would make loans to existing shareholders on the security of their existing share holdings. It was one of the suspicions (laterally shown to be well founded) held by the Committee of Secrecy that ‘loans on shares’ were used to some fraudulent purposes. For example, I can find no evidence that borrowers in this scheme were under any contractual obligation to support the market in South Sea shares by using their loans in order to buy shares. In addition, some of the announced terms at which loans were to be were not always adhered to for seemingly favoured individuals.

The evidence seems to indicate (although it is by no means certain without actual Company accounts) that shares that were handed to the Company as security

for loans were held by the Company as treasury stock. This implied that the Company was not only making a loan to an existing shareholder, but handing to that shareholder a kind of call option. The structure of the call depends upon the way the share 'security' was viewed by the borrower and the Company. (Were the deposited shares full or partial security for the loan? Did the borrower's liability to repay the loan end with the deposit of his shares? These matters too were the subjects of a number of lawsuits and settlements whose solution dragged well into later years.) Even if the structure of the call was clear, there was still the matter as to whether the call and the loan were obtained by persons at terms that were fair to other shareholders. It appears that they were not fair and the market correctly perceived the unfairness quickly and accurately. The gap between the value of the deposited share security and the value of the loan and the call that came with it would have been readily apparent to persons who were also familiar with what share option values were like at the time. From the LaCour data and the value of subscription contracts it would have been apparent that calls similar to the ones being handed out by the Company were quite valuable and that the Company was not extracting fair value for them. Ultimately the loans-on-shares scheme would have been perceived as creating a South Sea share (we can perhaps call it an 'ex loan' share) whose value was substantially less than the shares held by those with access to the loan-on-shares scheme.

Finally, related to the loan-on-shares scheme was another significant (but unremarked upon) fact that may have had a depressing effect on all South Sea share values. Through most of 1720 the South Sea Company was not a particularly highly leveraged firm. Apart from a large loan to it in the form of Exchequer Bills its only other liabilities, besides its huge equity ownership, were several small series of bonds it had been used to issuing and renewing since the start of the Company in 1711.

Although some of the earliest loans on shares it made had to be in form of cash (from reserves of unknown, but probably small, size), it is apparent that latterly the loans on shares were mostly met from new issues of South Sea Bonds. We know this from two sets of accounts. One was yet another deposited account (the 'Ledger of the Loan') to the Committee of Secrecy that accounted for the disposition of loans on shares. Another was a special accounting to the South Sea Company's Committee of Treasury in 1732 that gives a complete accounting of the Company's bonded debt to that time. From these two accounts we can correlate the timing of bond issues with loans on shares in 1720 and, not surprisingly, we find that the correlation is very high. To all intents and purposes it appears that the Company was issuing new bonds for the sole purpose of giving them to shareholders in return for their share 'deposits'. Perfect information would have shown that the Company's debt was rising only moderately relative to equity, but the impression that could have formed in the mind of the savvy outsider to the Company's affairs could have been much more alarming. South Sea Bonds would have to have appeared to be much more common than in the past. Could the well-informed outsider have formed an accurate idea of the extent to which the Company was effectively borrowing money? It would have been difficult. An abrupt reassessment of the riskiness of South Sea shares may have been have been warranted by the abrupt appearance of large numbers of new South Sea bonds. A resulting quick rise in the public's required return on South Sea shares alone could have also had a substantial downward effect of share prices.

A First Approximation to the Value of the South Sea Company

Now to obtain some bearings before we proceed to analysis, let us pose the simple question, "what was the South Sea Company worth in May/June 1720?" The

straightforward answer that any modern financial analyst would present as a first approximation would be the total market value of South Sea liabilities. We have equity split into straight share equity and a series of warrant packages, for each of which we have quoted market values. We have South Sea debt for which we have market values for the bond component. We do not have values for the Company's direct debt obligations to the Government, but we can attach to this part of the liabilities what should be a realistic upper value. In May/June 1720 the bond component of debt was traded, apparently liquid and not far removed (per unit of face value) from the values of other corporate debt. In fact when comparing the approximate yields to maturity of South Sea and East India Company bonds we can see that there is a distinct positive spread between the two, but this spread is on the order of 70 to 90 basis points. That is, while it might be possible to maintain that South Sea bond debt was viewed as distinctly more risky than East India debt, there was not a huge difference between the two. On the other hand it would be more difficult to argue that the entirety of South Sea debt would be similarly valued. Promised cash flow from the Government to the Company was substantial, but by itself would be in no way adequate to meet the short-term debt obligations of the firm. In the short term the cash necessary would have to be generated from either new business operations (unlikely) or raised via the issue of new shares.[8] The latter course was that pursued by the Company and may have by itself been viewed ex ante as making the Company's debt risky. We therefore initially calculate the present value of debt using the calculated yields of South Sea Bonds. This will make the debt values and the resulting firm values a bit too high in this first approximation. Against this, however, we omit necessarily the value of the conversion privileges.

[8] This fact of the matter was admitted in Director's statements found in *South Sea Company Court Minutes*, Add. Ms. 25,499, 21 April 1720,

The Basic Data Table found in the Appendix summarises the results of these calculations. In early May the total value of the firm was on the order of £65 million and five weeks later was about £128 million. The Company can never be viewed as a highly levered firm in this period; the calculated and simulated debt-equity ratio will always be on the order of about 10 percent.

Evidence from David La Cour[9]

We would know almost nothing about option contracts and their values in 1720 if it was not for David La Cour. We cannot pretend, however, that we know much about David La Cour (or LaCour or Lacour) himself. The name itself was an alias. He was one David Gomes Ergas. He became a member of the congregation of the Bevis Marks synagogue in 1707 and was a member there until at least 1726. He may well have died in 1726 and that is why his subscription (Finta) ended in that year, but that is just conjecture because the year of his death is not recorded nor is his burial recorded as having been at the synagogue's cemetery at Mile End. The conjecture is supported, however, by his family's continued activity in the synagogue. His eldest son's payment of the Finta is recorded from 1714 through to 1737. There are recorded marriages of a number of sons and daughters at the synagogue, as well as the recorded births of grandchildren.[10] At least we know that David La Cour was dead by 1729 because we find documents relating to his will and its probate.[11]

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[9] Unless otherwise noted, biographical details of this person are based upon personal correspondence from Bevis Marks' Hon. Archivist, Miriam Rodrigues-Pereira.

[10] His sons Raphael and Isaac married two sisters on the same day in 1730 (a double wedding?) and the birth of a son (David) to Raphael was recorded in 1731. His eldest son Samuel was married in 1714 and his youngest son Abraham married (1737) into a family whose patriarch was a physician. Abraham himself practiced as a physician, indeed a well-known and fashionable physician, in London and Bath under the alias of Dr. Philip de la Cour. It appears that even a variant

What do we know of David La Cour's professional life? We know that he petitioned to become a sworn broker in the City of London in 1708 and by that time he was probably already well established in financial circles.[12] In December 1719 we know that David La Cour was widowed because at that time his wife was buried at the Mile End cemetery of the Bevis Marks synagogue. From then until his death we know

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spelling of the old alias could be bent to a fashionable purpose. (Hyamson, *The Sephardim of England*, gives these details of Philip de la Cour's life, page 105.)

[11] At the PRO (Kew), in PROB 12/100 (1729) the name Ergas is identified with the alias La Cour. In PROB 11/635 (quire 7, page 52/53, 1730) we find the actual probate, which unfortunately does not tell us much about his wealth except that it was considerable. The will states that, after the usual discharge of debts and funeral expenses, £20 was to be given to the poor of the Bevis Marks congregation and £1000 was to be settled upon his daughter Sarah. Although his eldest son, Samuel, was already well set up in business, he too was to receive a bequest of £2000. The remaining (unstated) value of the estate was to be split between the three remaining sons, Raphael, Isaac and Abraham. The will does not mention his other daughter, Jael, who we know married in the synagogue in 1727. One may only hope that she fared better than did the poor of the Bevis Marks congregation.

[12] Sworn brokers had to swear oaths akin to oaths taken when admitted to the freedom of the City. Exceptions in the oaths were allowed for Jews since the 17th century, but the number of Jewish sworn brokers was limited to twelve. There was a chance that this restriction might be lifted in 1708 (not realised) in response to which there was a flurry of petitions to become sworn brokers by Jews. David La Cour was one of the petitioners, but he never became a sworn broker. For details of the workings of sworn brokerage and its relation to the Jews of London, see Abrahams, "Jew Brokers of the City of London". What we can learn of David La Cour from his own petition is dicovered as follows:

City of London Record Office, "Brokers Petitions - Jews" BR/PJ 1-48, which also includes a list of Jews' petitions to be new brokers, ref. BR/PJ (misc.):

"An Alphabetical List of the Jews Petitioners to be New Brokers"
"la Cour, David {under "C"}.....Hounsditch"

Here is part of La Cour's petition April 9 1708 BR/PJ 17a

"To the Right Honourable the Lord Mayor & Court of Aldermen of the City of London:

The Humble Petition of David La Cour Most Humbly Showeth

That your Petitioner is well in years & hath a great Family and is well Skill'd in the Business of Trade & Exchange....."

"We Underwritten Do Certify and Attest that David La Cour hath for many years last past been well vers'd in trade & Exchange...."

nothing of his activities except that the scant evidence points to him and his son Samuel as the pre-eminent dealer/brokers of derivative contracts in London.

The literature on the South Sea Bubble makes much of the missing "green book", the ledger taken to the Continent by the fugitive Company cashier Robert Knight, and what might be discovered in that ledger. Starting with the work of The Committee of Secrecy of 1721 and followed by the efforts of generations of historians, it is now doubtful that any surprise could be found there. Royalty, aristocrats, politicians and fellow-travellers all received free gifts in the form of South Sea shares or cash from the Company coffers. At this point the only surprises in a suddenly discovered "green book" would be the usual suspects' names who might be unexpectedly missing. We would not expect to find any information that could shed light on the size, rise or collapse of the South Sea Bubble because the sums involved in the "fictitious stock" were just too small to be of consequence to those phenomena. The real missing gems in the historical record are the contemporary trading records of informed individuals. If it were not for the special fragments of such records preserved by the Committee of Secrecy, we would have almost no record of the actions and opinions of informed financial persons during the South Sea Bubble. A description of the activities of a David La Cour, as could be revealed in full versions of his transaction ledgers, are the real missing treasures of the South Sea record.

The Committee of Secrecy's evidence answers a number of questions. When directors of the South Sea Company wished to purchase or dispose of stock in either their personal capacity or as Company agents, who did they turn to as dealers or for brokerage? "Almost anyone," is the answer. There is a fairly long list of broker/dealers who handled the apparent day-to-day business of spot transactions in

shares for the South Sea directors.[13] When it comes to dealing with agents for forward delivery agreements of Company stock or for options, however, nearly 100 p.c. of the transactions go through the hands of David La Cour. In fact, for the handful of transactions that he did not handle, nearly all the rest are handled by his son, Samuel. Could it be the case that David La Cour and his son were just the Company's choice of specialists who they wished to deal with for these particular types of contracts and there was actually a wide choice of other persons that they could have dealt with? The question is largely moot, but the scant secondary evidence that we have still points to David La Cour as the pre-eminent specialist in options contracts.

In the abstracts of dealer/broker records that we have we do not see the actual contracts. We see who the dealer is buying from or selling to. Or we see the two parties with whom the broker is transacting. We see a settlement price for a contract, we see a settlement date, we see a number of nominal features of the contract, but we do not see the fine details of the contract itself. So far we have found only three examples of call option contracts from the South Sea Bubble period. Of the three, two involve David La Cour as a second party to the contract. From this could we conclude that indeed the La Cour's were the dominant specialists in options contracts? This small evidence is far from refuting that hypothesis and we expect that the next discovered options contract from 1720 will have David La Cour's name on it.

What did the option contracts look like? John Houghton described stock options as "putts" and "refuses" (calls) in 1694 and showed his readers how an indenture could be drawn up between two parties that would deliver the essential features of an options contract. We believe this was a common practice then and continued to be so in the 18th century. A restraint upon the writing of such contracts may have been

[13] Numerous abstracts of accounts with a large number of broker/dealers are found in the Parchment Collection, Boxes 157 and

posed by Bernard's Act of 1733, which was explicitly critical of “bargains for time”. We believe it was common practice because the language of the option indentures that we have discovered is almost word-for-word the language in which Houghton instructed his readers in 1694. In fact, the two contracts involving David La Cour are written on pre-printed indenture forms (somewhat like the do-it-yourself legal kits sold by newsagents today) that have provided blanks for the parties' names and the like. Various set bits of language on these forms are scored out and various other set bits added in their place to make the form an options contract using just the same words that Houghton recommended to his readers 25 years before. We have seen the same forms altered in other ways to construct a forward delivery contract for shares, to conclude the sale of a property or to arrange a mortgage. An interesting feature of the forms used by David La Cour is that they were clearly pre-printed for use in transactions of shares. We reproduce these contracts in the Appendix on Options Contracts.

In reading these contracts carefully one should immediately notice that these are American-style option contacts. That is, they are exercisable at any time up to the expiry date of the contract. The three contracts in the Appendix are all September 1720 contracts for the late December closing of the Company's share ledgers. We thus do not have an example of an option for the 22 August opening of the ledgers, but we strongly suspect that all 1720 options would read like American-style options as well. One simple reason is that European-style options might have been too restrictive to have been attractive to contract writers and purchasers. It was probably difficult enough in the 18th Century to co-ordinate spot buying and selling so that spot transactions in financial instruments could be quickly consummated. To specify that a

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158, HLRO.

long-term contract be exercisable on one day and one day only might have required co-ordination and co-operation that might have been quite costly.

First, the options were dated to expire on the first day the Company's books were to reopen for the recording of transactions in shares, 22 August. The stated ex-dividend date for the announced dividend in April was mid-way through the closing period for the company's books, 20 July. This ex-dividend date thus was only an artifice, a strange way for the Company to say that a person must actually be in possession of the stock at the closing of the books (22 June) to get the stock dividend that would be credited to his account when the books opened on 22 August. If we are to make sense of the pricing of these contracts we must therefore make some allowance for the value of the privilege of exercising before the closing of the books on 22 June. Our formal presentation of the theory of American-style call options, adapted for the special features of the La Cour options, is presented in the technical Appendix in the section that describes the Option Evolution Panel of our simulation program.

The second thing to note and remember about the La Cour options is that they all appear to be options in which La Cour appears to be in a broker's position. In the Committee of Secrecy ledgers we find many examples of what appears to be brokerage - the owner of the ledger simply standing as the third party between a buyer and seller of a South Sea share - but in other instances we find that the owner of the ledger seems to be dealing as well. This is not the case of the La Cour ledgers and that is an interesting fact to set down alongside the two options contracts we have found that preserve La Cour's name on them. These are clearly contracts in which he is a second party to the contract. In fact, David La Cour appears to be the purchaser of the contracts. It may have been the practice, of course, that the broker (La Cour) would

nominally stand as the writer of the call option (in the stead of the first party to the contract) or as the purchaser (in the stead of the second party to the contract). Or it may have been the case that La Cour was actually dealing in options and the entries that appear in his ledgers only give the impression that he is a broker. The two parties to the contract that appear in his ledgers may simply have been 'off-sets' recording the eventual disposal (purchase) of a call option written by the first party.

The third feature to note and remember is that the stated values on these contracts are only at the time of writing. These are not values of contracts being determined in an active re-trade market. All the contracts, except one, are written just slightly "out of the money"- that is, they have an exercise price just slightly above the current share price. The law of one price does not appear to hold in this data set either. There are a number of contracts in the Basic Data Table that have different written values, but are written on the same day and have the same exercise price. How these differences relate to the buyer or seller of the contract and their position relative to David La Cour is unknown.[14] At the very least we must conclude that the La Cour options prices cannot be coming from an efficient market. These option values will, however, be one of the Objectives in our simulation/calibration exercises. That is, simulated volatility in South Sea Company asset values will be conditioned in part on these option values.

A Strategy for Simulation

[14] Both parties to the contracts to which David La Cour stands as a broker are carefully recorded and we might later be able to use this data to look for patterns in pricing as a function of the contract parties. The fact that at least one party to the contract also had to be a Company director may very well be quite important. Why did the directors have an interest in writing or buying such contracts? When writing such contracts, were they doing so on their own account or

Does the cross-section of liability values and values of derivatives on South Sea shares makes sense? This is the basic research question of this paper. We do not have to know what is the fundamental of the South Sea Bubble to answer this question, although knowledge of it would of course be helpful. All we have to assume is that the fundamental is embodied in the value of the firm and that the liabilities of the firm are correctly priced according to well-understood principles of corporate financial theory and the theories of option pricing. To answer this question we employ a simulation model that conforms to the following principles:

1) The fundamental in all liability values and value of derivatives is driven by a discrete binomial random walk in the asset value of the firm. At any particular date the asset value of the firm starts as the simple sum of the market values for total equity and debt. Thereafter the asset value evolves as a random walk except that at each and every node there is a check for the firm's debt-servicing requirements and whether asset value is sufficient to service the debt. If it is, the cost of debt service is subtracted from asset value. If asset value is insufficient to service the debt, net asset value is set to zero. The purpose of the fundamental is to simulate the range of possible future net asset values on which equity values are based. Once this range is established (and it can be a very wide range of possible values, indeed), the present values of all derivative liabilities (and this includes share equity as well) can be determined. We must emphasise that, before any misunderstanding arises, our simulations and their attendant results in no way depend upon one particular path in the firm's fundamental. We are simulating the

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were they writing contracts on the Company's treasury stock, i.e. were they writing warrants?

cross-sectional relationships between share, debt and option values conditional upon a large number (2^{10}, actually) of possible paths the fundamental might take.

2) Total equity is valued as an American-style call option on the assets of the firm. The owners of the firm's equity can become owners of the entire firm if they ever decide to retire the debt by simply paying the present value of current and future debt service costs. We have to choose some distant horizon as the terminal period in which this decision must be made for a final time. In that period the value of equity is simply set to net asset value. At every intervening node of the random walk in equity value, however, equity is valued as an American-style call option. This follows from observing that equity owners must always ask themselves the question, "is equity worth more as a continuing call option on the assets of the firm or as 100% ownership in the firm itself?" This question is analogous to the early exercise question that is at the heart of American-style option pricing theory. If at any node the equity owners decide not to retire the debt, they must recognise that they have to face the question again at subsequent nodes.
3) Debt is valued simply as the difference between total asset value and equity value.
4) Share prices are determined by simply subtracting actual warrant values (which are not simulated in our model) from total equity values and dividing by the actual number of shares issued and outstanding.
5) The La Cour options are valued as American-style call options on shares in the firm.
6) For the purpose of optimisation the following entities are defined: a) the deviation of the simulated share price from the actual share price; b) the deviation of the simulated call option price from the actual call option price and c) the deviation of

simulated debt value from the actual (previous) debt value that was used to define total asset value.

7) A function of these deviations is defined and is optimised by changing a) daily binomial (up/down) volatility in the asset random walk and b) the required rate of discount on firm debt. It is hoped that the best calibration will be in conformance with a reasonable set of volatility measures and debt values.

This model is implemented in a large spreadsheet program and more details of its mechanics are described in the Appendix.

Simulation Results and Conclusions for Further Research

A perusal of the value data for options, shares and the exercise prices for options (see Basic Data Table - Appendix) reveals that there are three distinct periods: mid-May, late May and June. Between 18 May and 24 May there is a distinct jump in all equity values just as there surely is between 30 May and 3 June. The size of the La Cour options exercise prices also noticeably change across these divides. And although there is little difference between the mid-May and late May option values themselves, there is a distinct difference between the June and the May option values. A simulation of data through the entire period 10 May through 24 June can be done, but there is no reason to suppose that expected volatility and the required return on debt might not have undergone distinct changes between the three periods that we have identified. Indeed, we have found that is easier to obtain convergent solutions to our model if three separate calibrations on each the three sub-periods are carried out.

For the three periods we have found the following "best-fit" volatilities and required return on debt (r_D). We have defined an optimisation function as a simple

weighted-average of the sum of the squared three percentage pricing errors listed in the Simulation Results Table. The weights of the average (within bounds), r_D and the variables u and d (potential "up" and "down" daily volatility) are all varied to obtain a minimised value of the objective function.

There is considerable bias in our "estimates" so far. The results show that implied volatility was rising towards the peak of the South Sea Bubble and the potential downside element to that volatility was becoming more apparent. These are results that are certainly consistent with rational market forecasts of the upside/downside potential to the firm's value in light of the ex-post collapse of the Bubble. We suspect, however, that the implied volatilities are too low. At the end of our period the asset volatility was about 1 p.c. per day in either direction. The implied equity volatilities (I will calculate them in a later version of the paper) will be a bit higher than that because the Company was levered, but the firm at least doubled its value and equity more than doubled its value over the 45 days that we examined, so potential volatility of more than 2 p.c. p.d. would seem to be the order of magnitude we should be looking for. So far, we have not got an implied volatility big enough that pushes the equity option "out of the money" in any of our simulation periods. In this circumstance added volatility should make equity and shares more valuable and should have some influence in pushing down debt values, but that would mean that we would expect to obtain even higher values for r_D! We believe that r_D is already biased on the high side. Indeed our simulations are showing that so far volatility and r_D are positively associated with each other. If at higher volatilities, however, the equity option can be pushed "out of the money" in more states-of-the-world, the positive association between r_D and volatilities should weaken or even be reversed. Inspection of how our simulated data currently behave in the Equity Evolution Panels

suggest that the hazard of out-of-the-money equity options should rise dramatically at any asset volatilities higher than 1 p.c. p.d. An extension of the model should also simulate the warrant packages' values as well and this should help the model's ability to come up with realistic volatilities.

We nevertheless believe that even with correct volatilities there are other sources of positive bias in r_D. Our model is perhaps valuing debt too low because we are modelling debt as if it was collectively nothing but simple interest-paying fixed-term debt. We know that because of the Company's "loans on shares" programme that larger and larger numbers of nominal bonds that appear in the Company bond ledger[15] actually have special conversion privileges attached to them. These conversion privileges are like call options on shares and should be so valued. If we were to simulate these values and add them to the values of bonds that currently come out of our model's Debt Table, it would relieve the upward pressure on r_D that is currently felt in our simulations. It would of course have a number of other more subtle effects as well. Simulated firm value would be higher and implied volatilities would be conditioned upon the value of the conversion privileges as well as the firm's net asset value, the values of warrants (when the model is extended in that direction) and the values of the La Cour options.

What of our results as they pertain to the La Cour options? We have already noted that these option values were simply options being dealt or broked by David La Cour. They were probably new options and although their values may have been conditioned by traded options with the same characteristics, we believe this is unlikely. We believe it is much more likely that these option values contain clues of

[15] One of the few surviving records of the South Sea Company that is not simply minutes of meetings and committees is the *South Sea Company Register of Bonds* 20 Feb 1720 - 3 March 1734, Additional Manuscripts, Ms. 25,580.

how David La Cour did the business of writing and pricing options to/for certain individuals, some of whom were South Sea directors. We believe it is unlikely they are a product of an efficient market in call options on South Sea shares. But how far could they be from such values? How far could David La Cour let them devitae from such values? It is some comfort that the simulated pricing errors for the options are less than one order of magnitude of the option prices themselves. They are at times quite small and sometimes as large as 50 p.c. (positive or negative). Yet there is some evidence that our model's ability to price the La Cour options seems to have some correlation with the ability to price the firm's debt, so the option pricing errors may not be a function only of David La Cour's business practices.

This so far is an outline of a further research programme to eliminate biases. There still remains the problem of estimating remaining bias and standard errors, for that matter, on volatilities, r_D and any other new variables that we might introduce. Our method of calibration, simulation, re-calibration, re-simulation and so forth is not what could be called an econometric technique that can easily lead to parametric estimates of bias and standard errors. Nonparametric methods come to mind, but they can be quite computationally expensive to carry out. Our simulations already make heavy demands on computer time and capacity. Given the small number of data points that we analyse in this paper, the method that might be most useful in solving this problem is the jackknife.[16] Later versions of this paper and others like it will probably have jack-knifed estimates of bias and standard errors in them.

[16] Our guide in these procedures are the ever useful paper by Efron, "Bootstrap Methods…".

Simulation results 10 May - 24 June 1720

Date	Debt (D)	Share Price (S)	Option Price (C)	Percent Pricing Error $(S-\tilde{S})/S$	Percent Pricing Error $(C-\tilde{C})/C$	Percent Pricing Error $(D-\tilde{D})/D$	r_D	Daily Possible Percent "up" (u-1)	Daily Possible Percent "down" (1-d)
10/05/20	£7.81	£373.1	£26.3	-0.1%	-22.4%	0.6%	15.28%	0.59%	-0.39%
11/05/20	£7.84	£372.1	£31.5	0.0%	0.1%	0.1%	15.28%	0.59%	-0.39%
12/05/20	£7.87	£373.1	£31.5	0.0%	-1.0%	-0.1%	15.28%	0.59%	-0.39%
12/05/20	£7.87	£373.1	£33.6	0.0%	5.3%	-0.1%	15.28%	0.59%	-0.39%
13/05/20	£7.92	£373.1	£31.5	0.1%	-0.5%	-0.7%	15.18%	0.59%	-0.39%
16/05/20	£7.92	£373.1	£33.6	0.1%	5.7%	-0.6%	15.18%	0.59%	-0.39%
16/05/20	£7.92	£373.1	£31.5	0.1%	-0.6%	-0.6%	15.18%	0.59%	-0.39%
18/05/20	£7.91	£376.3	£47.3	0.1%	27.5%	-0.4%	15.18%	0.59%	-0.39%
24/05/20	£7.45	£504.6	£31.5	0.3%	11.7%	-2.6%	22.19%	0.69%	-0.24%
25/05/20	£7.46	£503.5	£31.5	0.2%	12.6%	-2.4%	22.19%	0.69%	-0.24%
26/05/20	£7.46	£501.4	£31.5	0.3%	14.5%	-2.5%	22.19%	0.69%	-0.24%
27/05/20	£7.33	£514.1	£31.5	0.1%	-6.3%	-0.7%	22.24%	0.69%	-0.24%
27/05/20	£7.33	£514.1	£33.6	0.1%	0.3%	-0.7%	22.24%	0.69%	-0.24%
30/05/20	£7.19	£561.8	£49.4	-0.1%	-27.4%	1.6%	22.24%	0.69%	-0.24%
30/05/20	£7.19	£561.8	£63.0	-0.1%	0.2%	1.6%	22.24%	0.69%	-0.24%
31/05/20	£6.91	£630.7	£52.5	-0.4%	-14.1%	5.4%	22.19%	0.69%	-0.24%
03/06/20	£7.55	£816.2	£63.0	0.2%	-22.8%	-3.5%	22.82%	1.00%	-1.03%
03/06/20	£7.55	£816.2	£52.5	0.2%	-47.4%	-3.5%	22.82%	1.00%	-1.03%
08/06/20	£8.63	£779.1	£63.0	0.4%	-4.2%	-5.3%	22.87%	1.00%	-1.03%
09/06/20	£8.56	£784.4	£68.3	0.3%	2.4%	-4.4%	22.87%	1.00%	-1.03%
10/06/20	£8.57	£789.7	£73.5	0.3%	11.6%	-4.5%	22.87%	1.00%	-1.03%
10/06/20	£8.57	£789.7	£63.0	0.3%	-3.2%	-4.5%	22.87%	1.00%	-1.03%
13/06/20	£8.70	£742.0	£63.0	0.5%	25.0%	-5.9%	22.87%	1.00%	-1.03%
14/06/20	£8.69	£742.0	£63.0	0.5%	29.7%	-5.8%	22.87%	1.00%	-1.03%
15/06/20	£8.60	£795.0	£21.0	0.4%	-0.3%	-4.7%	22.92%	1.00%	-1.03%
15/06/20	£8.60	£795.0	£126.0	0.4%	-24.5%	-4.7%	22.92%	1.00%	-1.03%
21/06/20	£7.52	£805.6	£84.0	-0.7%	14.0%	8.6%	23.02%	1.00%	-1.03%
22/06/20	£7.50	£810.9	£84.0	-0.7%	6.9%	9.0%	23.02%	1.00%	-1.03%
23/06/20	£7.79	£810.9	£84.0	-0.4%	8.6%	5.4%	23.02%	1.00%	-1.03%
24/06/20	£7.80	£850.0	£105.0	-0.4%	12.0%	5.7%	23.02%	1.00%	-1.03%

Notes: S and C correspond to Columns (6) and (2) respectively of the Basic Data Table. D is the value of Debt in the penultimate iteration of the simulation before r_D is changed in the final iteration and the final value of $\tilde{D}$ is obtained. Similarly, $\tilde{S}$ and $\tilde{C}$ refer to the final simulated values of S and D respectively.

APPENDIX

In this Appendix we describe the mechanics of the simulation and calibration exercise. The model and all calculations using the model reside in a large spreadsheet program that has the following structure in terms of component worksheets: 1) Basic Data Table; 2) Debt Table; 3) Simulation Control Panel; 4) Optimisation Panel and three Simulation Components called respectively the 5) Asset Evolution Panel, 6) Equity Evolution Panel and 7) Option Evolution Panel.

REAL TIME AND MODELLING TIME

Before describing the model we have to give a formal explanation about how time is handled in our model. Real time is measured as time between actual dates in units of days. Several dates in real time are of importance in our study. First there is the date on which any of David LaCour's call options was written. As we shall see, these are the dates in Column (1) of the Basic Data Table. Another important date is the end of the so-called analysis period. This date defines the period over which we wish to simulate gross asset values (firm values) and equity values. It can be a quite long distant date or it can define a rather short time horizon as long as the end date is no earlier than 22 August 1720. Most of the South Sea Company's nominal debt was due by the end of 1721, but some portions of it were due to be paid in 1722. If the analysis period was limited by the end of 1722, for example, this would mean that we would simulate the evolution of gross asset and net asset value to the end of 1722. This could perhaps give us the fullest possible picture of the potential difficulties the South Sea Company could encounter in servicing its debt and our calculations of simulated equity and options values would be conditioned on this very full picture of

the difficulties. If on the other hand the analysis period was limited by a short-term date, such as March 1, 1721 date depicted in the Simulation Control Panel below, a cruder representation of the debt servicing future of the Company results, but in return there is possible a finer simulated representation of the short-term evolution of asset, equity and option values. This is so because the analysis period is divided into a fixed number (n) of modelling periods. In this paper n is set to 10, so regardless of the real-time measure of the period of analysis, the period of analysis is always represented by 10 modelling periods. In the Simulation Control Panel below the March 1, 1721 date as the end of our analysis period means that for an option dated May 10, 1720 the period of analysis is 290 days, there are 29 days per modelling period and maturation of the option occurs in the fourth modelling period. Increasing n relative to real time is straightforward, but potentially expensive in computational time when we come to model solution and simulation.

Model data and other inputs that are in units of real time have to be translated into modelling time units. Similarly, Outputs that are functions of modelling time units have to be translated into their real-time equivalents. These tasks are handled in a model component called the Simulation Control Panel.

BASIC DATA TABLE

The exercise starts by defining the data found in the Basic Data Table below. The dates [Column (1)] correspond to the dates for which unique call options were written that all have a dated expiration of 22 August 1720. The Basic Data Table serves the basic function of providing fixed values, starting values and target values for our simulations. For example the exercise price of an option is fixed and is not a

target variable in our simulations. The option price itself is fixed, but it will also be a target variable in the model's calibration. The figures in Column (3) represent only the starting values for total gross asset value in our simulations. On the dates in Column (1), the figures in Column (3) are used to start the binomial random walk of asset values on only the first iteration. At the start of each of the subsequent iterations of the simulation, gross asset value is set equal to the sum of simulated equity and debt values from the end of the last iteration. We shall describe the role of other parts of the Basic Data Table later.

Appendix - Basic Data Table

Date	Option Price	Exercise Price (X)	Total Value of Firm's Liabilities (£ millions)	Total Value of Firm's Equity (£ millions)	Share Price	Shares Issued & Outstanding (thousands)	No. 1 Warrant Price	No. 1 Warrants Issued & Outstanding	No. 2 Warrant Price	No. 2 Warrants Issued & Outstanding	No. 3 Warrant Price	No. 3 Warrants Issued & Outstanding	South Sea Bond Yields	East India Bond Yields
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
05/10/20	£26.3	£400	£64.55	£55.45	£373.1	142.45	£74.0	21570	£47.6	14800		0	3.9%	3.2%
05/11/20	£31.5	£400	£64.34	£55.23	£372.1	142.28	£74.0	21540	£47.6	14795		0	3.9%	3.2%
05/12/20	£31.5	£400	£64.45	£55.35	£373.1	142.28	£71.7	21540	£48.5	14795		0	3.9%	3.1%
05/12/20	£33.6	£400	£64.45	£55.35	£373.1	142.28	£71.7	21540	£48.5	14795		0	3.9%	3.1%
05/13/20	£31.5	£400	£64.45	£55.35	£373.1	142.28	£71.7	21540	£48.5	14795		0	3.8%	3.0%
05/16/20	£33.6	£400	£64.45	£55.35	£373.1	142.28	£71.7	21540	£48.6	14795		0	3.8%	3.0%
05/16/20	£31.5	£400	£64.45	£55.35	£373.1	142.28	£71.6	21540	£48.6	14795		0	3.8%	3.0%
05/18/20	£47.3	£400	£65.11	£56.01	£376.3	142.28	£75.0	21540	£57.8	14795		0	3.8%	3.0%
05/24/20	£31.5	£600	£88.20	£79.10	£504.6	142.01	£195.0	21510	£219.8	14795		0	3.8%	2.9%
05/25/20	£31.5	£600	£88.08	£78.98	£503.5	142.01	£196.1	21510	£220.0	14795		0	3.8%	2.9%
05/26/20	£31.5	£600	£87.83	£78.73	£501.4	142.01	£195.0	21510	£225.5	14795		0	3.8%	2.9%
05/27/20	£31.5	£600	£90.33	£81.22	£514.1	142.01	£210.0	21510	£250.0	14795		0	3.8%	3.0%
05/27/20	£33.6	£600	£90.33	£81.22	£514.1	142.01	£210.0	21510	£250.0	14795		0	3.8%	3.0%
05/30/20	£49.4	£600	£99.82	£90.72	£561.8	141.70	£290.4	21400	£330.7	14795		0	3.8%	2.9%
05/30/20	£63.0	£600	£99.82	£90.72	£561.8	141.70	£290.4	21400	£330.7	14795		0	3.8%	2.9%
05/31/20	£52.5	£700	£111.79	£102.69	£630.7	141.70	£350.9	21400	£392.7	14795		0	3.8%	2.9%
06/03/20	£63.0	£1,000	£142.91	£133.81	£816.2	141.27	£483.4	21310	£554.4	14795		0	3.8%	2.9%
06/03/20	£52.5	£1,000	£142.91	£133.81	£816.2	141.27	£483.4	21310	£554.4	14795		0	3.8%	2.9%
06/08/20	£63.0	£1,000	£135.75	£126.65	£779.1	141.27	£416.6	21310	£521.0	14795		0	3.8%	2.9%
06/09/20	£68.3	£1,000	£136.23	£127.13	£784.4	141.27	£415.5	21310	£504.6	14795		0	3.8%	3.0%
06/10/20	£73.5	£1,000	£135.22	£126.12	£789.7	138.42	£435.7	21140	£519.9	14605		0	3.8%	3.0%
06/10/20	£63.0	£1,000	£135.22	£126.12	£789.7	138.42	£435.7	21140	£519.9	14605		0	3.8%	3.0%
06/13/20	£63.0	£1,000	£125.73	£116.63	£742.0	135.23	£434.6	20962	£498.2	14410		0	3.8%	3.0%
06/14/20	£63.0	£1,000	£126.44	£117.34	£742.0	137.33	£386.9	20962	£508.8	14410		0	3.8%	3.0%
06/15/20	£21.0	£1,200	£133.10	£124.00	£795.0	136.50	£386.9	20907	£514.1	14380		0	3.9%	3.0%
06/15/20	£126.0	£750	£133.10	£124.00	£795.0	136.50	£386.9	20907	£514.1	14380		0	3.9%	3.0%
06/21/20	£84.0	£1,000	£133.26	£124.16	£805.6	134.45	£383.7	20727	£502.4	14305	£142.0	5000	4.0%	
06/22/20	£84.0	£1,000	£131.27	£122.17	£810.9	130.10	£403.3	20477	£523.1	13973	£221.0	5000	4.0%	
06/23/20	£84.0	£1,000	£131.02	£121.92	£810.9	130.10	£381.6	20477	£540.6	13973	£212.0	5000	4.0%	
06/24/20	£105.0	£1,000	£136.42	£127.32	£850.0	129.93	£388.0	20437	£563.9	13973	£214.1	5000	4.0%	

(2,3) Call option and exercise prices are abstracted from *Abstracts of the Accounts of David LaCour for Refusals*, Box 158, HLRO.

(4) (4) = (5) + Total Nominal Debt as of Date valued at a discount rate set equal to the South Sea Bond Yield (14).

(5) (5) = Share values × Shares Issued & Outstanding + Warrant Values × Warrants Issued & Outstanding = (6)×(7)+ (8)×(9)+ (10)×(11)+ (12)×(13).
(6) Share prices are taken from various issues of *The Course of the Exchange* and supplemented with transactions prices when available.
(7) Shares issued equal pre-1720 original shares plus the fractional component of subscription shares that represent fully-paid shares. Shares repurchased and taken back by the South Sea Company as treasury stock is recorded in *Abstract of the Ledger of the Loan*, Box 157, HLRO.
(8) No. 1 Warrant Price is the price of a Subscription Share in the first series minus the value of the fractional ownership in one fully paid share that is part of the subscription share. Like share prices, subscription share prices are found in *The Course* and can be supplemented by the occasionally discovered transaction price - usually found in abstract of brokers' ledgers from Box 167, HLRO.
(9) Subscription shares (warrant packages) issued we take simply to be the stated announced issue of Subscription shares found in several statements in Company Minutes and repeated in various sources. The adjustments that give us outstanding numbers of subscription shares (warrant packages) are made possible by the subscription shares taken back as treasury stock as measured in *The Ledger of the Loan* described in Note (7).
(10) No. 2 Warrant Price is the price of a Subscription Share in the second series…see Note (8).
(11) Note (9)
(12) No. 3 Warrant Price is the price of a Subscription Share in the third series…see Note (8).
(13) Note (9)
(14) South Sea Bond Yields are calculated from their stated maturity and discounts from par (£100) as presented in *The Course*.
(15) East India Bond Yields are calculated from their stated maturity and discounts from par (£100) as presented in *The Course*.

DEBT TABLE

The Debt Table is where are calculated the present values of the South Sea Company's Debt and debt service costs. Whenever the Simulation Control Panel, for example, requires the present value of the Company's Debt so that total firm value can be calculated, it provides the appropriate discount rate to the Debt Table and the Debt Table returns the appropriate debt value. Similarly, whenever the Equity Evolution Panel needs the present value of the Company's Debt so that the cost of retiring the debt can be calculated, the appropriate value is found in the Debt Table. Whenever the Asset Evolution Panel must obtain a cost for debt servicing, it finds it in the Debt Table.

SIMULATION CONTROL PANEL

The next important component of the model is a panel that controls each iteration of the model while it is being simulated. We call it the Simulation Control Panel and it plays much the same role and has much the same look and feel as the control panels for the option pricing simulation programs written by Craig Holden and found in his instructional textbooks.[17] In this panel is assembled all the data that the simulation components (panels) of the program need in order to perform one iteration of the model. These are labelled Inputs and appear in the cells that are bordered in heavy solid lines. The result of any calculation that uses an Input is labelled as an Output and appears in a cell bordered with a heavy dotted line. Some of the Outputs are simple transformations of Inputs so that they can be used in the simulation

[17] For example see Chapter 17, Holden, *Spreadsheet Modeling in Corporate Finance*.

components, but most Outputs are the result of one iteration of the simulation components. The Outputs labelled the Objectives are passed onto to another component of the program that controls the optimisation, the Optimisation Panel. So far there are three Objectives and they are respectively the difference between simulated share price ($\tilde{S}$) and actual share price (S), the difference between simulated option price ($\tilde{C}$) and actual option price (C) and the difference between simulated Debt Value ($\tilde{D}$) and actual Debt Value (D).

SIMULATION CONTROL PANEL

South Sea Bubble Derivative Pricing via Binomial Compound Option Pricing

Option on Equity is a Call

Simulation

		Inputs	Outputs		Data
Equity as American = 1, European = 0	1				
Option Type 1=Call, 0=Put	1	Risk-neutral Prb "up"	44.62%	Share Price	£373.1
Firm Value Now (£ millions)	£63.25	1 + r_f (10-periods)	1.0258	Option Price	£26.3
Up Movement/Period (u-1)	12.37%	Debt Value (£ millions)	£7.79	Debt Value	£7.8
Down Movement/Period (d-1)	-9.51%	Share Price	£373.14		
Days to Derivative Maturity	102	Days per Period	29		
Date of Derivative Price	05/10/20	Up Movement/day	0.4%		
R_f per annum (East India Yld.)	3.24%	Down Movement/day	-0.3%		
R_f per period	0.25%	Option Price	£31.88	**Objectives**	
Is derivative an option (0) or a warrant package? (1 thru 3)	0	D/E	0.14		
Number of Shares (millions)	0.142	Warrant No. 1	£74.00	Price Dif	-£0.02
Exercise Price (X)	£400.00	Warrant No. 2	£47.60	Option Dif	-£5.63
Time to Derivative Maturity	4	Warrant No. 3	£0.00	Debt Dif	£0.00
Number of modelling periods (n)	10				
Option Maturing	08/22/20				
End Date of Analysis Period	03/01/21				
Basis r_D p.a. (South Sea Bond Yield)	3.90%				
r_D per period	1.27%				

OPTIMISATION PANEL

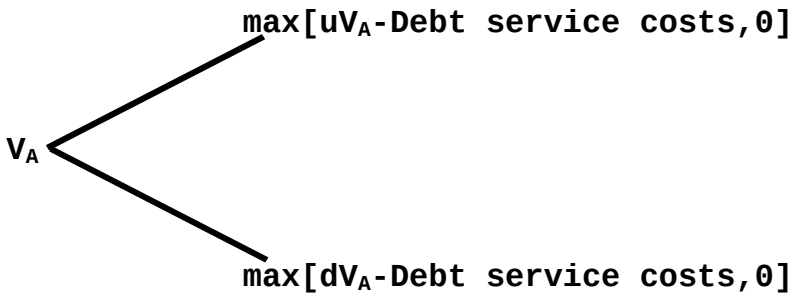
The Optimisation Panel has several roles to play. It provides some Inputs to the Simulation Control Panel. These Inputs are currently the up/down daily percentage movements that are possible in the binomial random walk that describes asset evolution and an increment to what we call the basis required rate of return on the South Sea Company's Debt. In general, however, any Input to the Simulation Control Panel that is going to be varied by the nonlinear optimising routine has to come from the Optimisation Panel.

In this panel is also defined the objective function that is used to define convergence of our simulations to an acceptable set of solutions. The definition of this function is flexible, but in general it is a function of any Objectives that are passed to it from the Simulation Control Panel. The objective function is solved with Excel's general nonlinear optimising program, Solver. The objective function has to be a function of the Objectives from the model simulations for each set of unique Inputs that can be passed to the Simulation Control Panel. In other words, we have to have a way of telling Excel that the model that is to be solved by Solver is actually an execution of our Simulation Components using data from each and every row of the Basic Data Table. This would be a very difficult thing to do if it was not for the Excel facility (Tool) called the Data Table. The Data Table that we define in the Optimisation Panel tells Excel that our spreadsheet model is actually a collection of models, each one an exact copy of the other except for the Inputs that each model uses and the Outputs that each model produces. The Data Table tells Excel where to get the data from the Basic Data Table for each simulation and the Data Table also receives the Objectives for each simulation from the Simulation Control Panel. It is the collection of these Objectives that are the inputs into our objective function.

So far we have confined our discussion to the simple data and control elements of the simulation model. We turn now to discussion of the simulation components themselves - the components that actually embody the economic theory of our model.

ASSET EVOLUTION PANEL

The Asset Evolution Panel describes a binomial random walk in gross asset values. From the Simulation Control Panel it takes the value of the firm as the starting value for gross assets (V_A) and the possible up/down percentage (u -1 and 1-d) movements for each binomial step. Then at each node of the binomial tree it performs the following forward calculations from V_A:



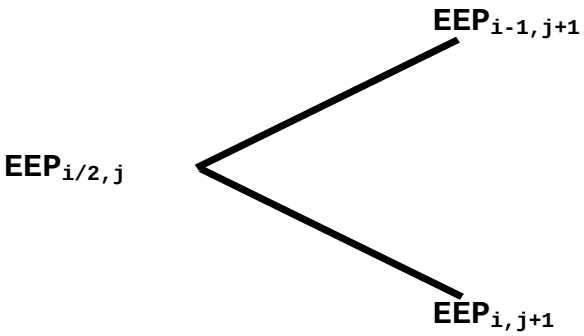
The Debt service costs at each node are pre-calculated in the Debt Table. The Panel calculates all the nodes of this binomial tree out to n steps. This Panel therefore calculates 2^n possible unique gross asset values in the last (n^{th}) modelling period.

EQUITY EVOLUTION PANEL

The Equity Evolution Panel describes the binomial random walk in equity values over the n modelling periods. The calculations start by setting equity values in the n^{th} period to the net asset value of the firm at each of the corresponding n^{th}-step nodes found in the Asset Evolution Panel. That is, let $AEP_{i,n}$ represent the value

standing at the i^{th} node (i going from 1 to 2^n) of the n^{th} cross-section of the binomial tree found in the Asset Evolution Panel. The corresponding value in the Equity Evolution Panel is $EEP_{i,n} = \max[AEP_{i,n} - PV(\text{future debt service costs}), 0]$.

Thus the n^{th} cross-section of the binomial tree for the EEP is set. There now proceeds a series of backward calculations of the remaining nodes in the Panel. The general scheme of their calculation (for j going from 1 to n-1) is described by the branch diagram as follows:



We maintain that equity values (such as $EEP_{i/2,n-1}$) at all nodes in the first n-1 cross-sections of the binomial tree have to be calculated as values of American-style call options. First, it is clear that such values have to have a call option value component because equity owners in the company have the option in the next period to obtain 100% equity ownership in the firm if they can but pay the PV of all future debt service costs. Thus equity represents a call option on the assets of the firm at an exercise price equal to whatever it would cost to retire the debts of the firm in the next period. Secondly, the decision to obtain 100% equity ownership in the firm could also be made in the present period. At each node equity owners thus have to ask themselves the following question. What is worth more - letting the call option on the assets of the firm continue to the next period to see if it will be exercised then or to simply exercise the option now and obtain 100% equity ownership of the firm? In textbook treatments of the theory of American-style option pricing this is sometimes

termed the "life or death" decision. Is the call option worth more dead or alive - is it worth more exercised or not exercised?

Define $C_{i,j}$ as the value of a continuing call option on the firm's assets. It follows that $EEP_{i,j} = \max[C_{i,j}, \text{Net Asset Value}_{i,j}]$. Define Net Asset $\text{Value}_{i,j}$ as $AEP_{i,j}$ - PV(future debt service costs). At node i,j there are two possible future values (FV's) for the continuing call option (C): the FV will be $EEP_{i-1,j+1}$ or it will be $EEP_{i,j+1}$. In our calculations we use risk-neutral pricing methods to determine $C_{i,j}$. $C_{i,j}$ is the risk-neutral discounted present value of expected future values; $C_{i,j} = [p \times EEP_{i-1,j+1} + (1-p) \times EEP_{i,j+1}]/(1+r_f)$, where r_f is the required return on a risk-free loan and p is the risk-neutral probability of an "upward" movement in the gross asset value of size u. p can be calculated easily because the present values of the firm's fundamental - its asset value - will have to obey a risk-neutral pricing rule using the same p:

$$AEP_{ij} = [p \times AEP_{i-1,j+1} + (1-p) \times AEP_{i,j+1}]/ (1+r_f).$$

From this it is a simple step to find that $p = (r_f - d)/(u-d)$. The calculation of the risk-neutral probabilities is one of the intermediate Outputs that can be found in the Simulation Control Panel.

In the Equity Evolution Panel EEP is calculated in this backwardly recursive manner until $EEP_{1,1}$ is obtained. $EEP_{1,1}$ is passed back to the Simulation Control Panel as the simulated value of total equity. In that Panel the total (fixed, not simulated) value of warrants is subtracted to give us the simulated value of straight share equity. That number is divided by total number of shares issued and outstanding to give us the simulated share price, $\tilde{S}$. The simulated value of total equity is also subtracted from total firm value to give us simulated value of debt ($\tilde{D}$).

OPTION EVOLUTION PANEL

The Option Equity Evolution Panel describes the binomial random walk in call option values over the n modelling periods. These options are straightforward American-style call options on South Sea Company shares. They are all exercisable on "the opening" or 22 August 1720, but if they were going to be exercised early they would all be exercised at the close of the books (22 June) when the shares go ex-dividend. If the option is not exercised at the close of the books, it will only be exercisable on 22 August. That is, between 22 June and 22 August, the option will be a European-style option and must be valued accordingly. Let us say that the option is finally exercisable in modelling period j. In that period the option will be worth $\max[S_j\text{-}X,0]$, the maximum of share price minus exercise price or zero. From our Equity Evolution Table we can calculate 2^j possible simulated expiration values for this option, $\tilde{C}_{i,j} = \max[\tilde{S}_{i,j}\text{-}X,0]$ for i going from 1 to 2^j. The present values of these call options must obey they same risk-neutral pricing rules as are obeyed by the asset fundamental. That is,

$$\tilde{C}_{i,k} = [p \times \tilde{C}_{i-1,k+1} + (1\text{-}p) \times \tilde{C}_{i,k+1}]/ (1+r_f),$$

for k going from 1 to j-1. In only the modeling period that contains 22 June does the option take on a special value when the owner of the option has to decide to exercise or not. At this time (call it modeling period k*) the owner must decide whether the option is worth more exercised (obtaining a share along with its stock dividend) or is worth more allowed to continue its life as a European-style call option on a share with a diluted value after the stock dividend is paid. Thus at k* we have

$$\tilde{C}_{i,k^*} = \max[\tilde{S}_{i,k^*} - X\ ,\ p \times \tilde{C}_{i-1,k+1} + (1-p) \times \tilde{C}_{i,k+1}]/(1+r_f)] \ .$$

$\tilde{S}_{i,k^*}$ here refers to the undiluted price of a share the moment before the stock dividend is paid. A proof that the optimal exercise date of an American-style call option is on the date of a stock dividend, as it can be standardly proved for a cash dividend, will be provided upon request.

So, in the same backwardly recursive manner that was followed in the Equity Evolution Panel $\tilde{C}_{1,1}$ can be obtained. This value is passed back to the Simulation Control Panel as $\tilde{C}$, the simulated call option value.

APPENDIX - OPTIONS CONTRACTS

In the 21 June 1694 issue (No. 99) *of A Collection for the Improvement of Husbandry and Trade* John Houghton introduced his readers to the idea of call option or a 'refuse'. He explained its advantage as a cheap way of taking a speculative position in shares. In a few words he drew a mental picture in the reader's mind of the terminal-profit diagram for a call option that can be found in almost any modern corporate finance textbook today. In the next issue (29 June 1694, No. 100) he continued his example. Giving "out of the Guinea's" refers to the payment of the option price.

"Last week I shewed the manner of giving Money for *Refuse* of Shares in Stock, and designed then to shew (but wanted Room) that for Security to the giver out of the Guinea's, the Acceptor gives him a Contract in these or the like Words.

In Consideration of the 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 the 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 to, 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 and five Pounds, and all Advance-Money, as aforesaid, at the place aforesaid, 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, Administrators for ever. Witness my Hand and Seal the Nineteenth Day of June, Anno Dom. 1694. And in the Sixth Year of King* William *and Queen* Mary*, of* England*, &c.*

Sealed and Delivered in
the Presence of
E.F.
G.H. *A.B."*

Compare now the structure and the language of the following three contracts written more than 25 years later.

Additional Manuscript 22,639 "Papers relating to the Company of Mines Royal in Jamaica 1720-1727", fff.193: "Refusal of £1000 South Sea stock at £700 p.c. on or before the hour of twelve for the shutting at Xmas - Mr. Joseph Telles da Costa to David Lacour"

A printed indenture *{handwritten fill-ins and amendments in italicised brackets}*

In Consideration of *{Six hundred and thirty pounds}* in hand paid unto me *{Joseph Telles da Costa of London Merch.}* at or before the Sealing and Delivery hereof by *{David Lacour Merchant}* the Receipt whereof I do hereby acknowledge, I the said *{Joseph Telles da Costa}* for my self, my Heirs, Executors and Administrators, do covenant, promise, and agree, to and with the said *{David Lacour}* his Executors, Administrators, and Assigns, by these Presents, that I the said *{Joseph Telles da Costa}* my Executors or Administrators, shall and will transfer, or cause to be transferred unto the said *{David Lacour}* his Executors, Administrators, or Assigns, *{One thousand pounds Creditt in the Capital and Principal Stock and funds of the Governor and Company of Merchants of Great Britain trading to the South Seas and other parts of America and for encouraging the Fishery etc. immediately}* after the same shall be demanded, as hereinafter is expressed; Provided the said *{David Lacour}* his Executors, Administrators, or Assigns, shall demand the same by Note in Writing to be given to me, or left for me at *{or in my Dwelling house in Winchester Street London at any time on or before the hour of Twelve a Clock on the day of Shutting the transfer books of the said Comp. for making the Christmas Dividend next ensuing the date hereof}* and shall well and truly pay, or cause to be paid, unto the said *{Joseph Telles da Costa}* my Executors or Administrators, for the said *{One thousand}* Pounds Credit in the said Stock, or the Transferring the same, the Sum of *{Seven thousand pounds}* of lawful Money ***of Great Britain*** and all such Money as shall be advanced on Account of the same from the Date hereof (if any shall be).
AND it is agreed, That if the said *{David Lacour}* his Executors, Administrators, or Assigns, shall demand and pay for the said *{One thousand}* Pounds Credit in the said Stock as aforesaid, Then all Dividends and Profits that shall arise, be voted, ordered or made, for or in respect of the said *{One thousand}* Pounds Credit after the Date hereof, shall be and remain to the only Use, Benefit, and Behoof of the said *{David La Cour}* his Executors, Administrators, and Assigns. But if the Said *{David La Cour}* his Executors, Administrators, or Assigns shall not demand the said *{One thousand}* Pounds Credit in the said Stock, and pay for the same, as aforesaid: Then this Contract shall be void, and of none Effect, and the said *{Six hundred and thirty pounds}* is to remain to me the said *{Joseph Telles da Costa}* for ever.

Witness my Hand and Seal, the *{fourteenth}* Day of *{September}* Anno. Dom. 17*{20}* Annoq; Regni *{R. Georgii}* Mag' Britain' etc. *{Septimo}*

Seal'd and Deliver'd in the
Presence of
{Martin Ricksted sig.} *{Joseph Telles da Costa sig.}*

Receiv'd the Day and Year above-written, of the above-named *{David Lacour Six hundred thirty pounds being}* the Consideration-Money above-mentioned.
I say, Received *{£630}*

Witness, *{Martin Ricksted sig.}* Per me, *{Joseph Telles da Costa sig.}*

Sold by W. Kerby, ***Stationer***, at the Three Crowns, in Exchange-Alley

fff.195: another printed indenture (identical to fff. 193) "Refusall of £500 South Sea stock at £500 p.c. if demanded at any time at or before the hour of 12 on the day of Shutting books for making the Xmas Dividend - Robert Lacombe Esq. to David Lacour 9/20/1720"

In Consideration of *{Two hundred and sixty-two pounds and ten pence}* in hand paid unto me *{Robert Lacombe of London Esquire}* at or before the Sealing and Delivery hereof by *{David Lacour Merchant}* the Receipt whereof I do hereby acknowledge, I the said *{Robert Lacombe}* for my self, my Heirs, Executors and Administrators, do covenant, promise, and agree, to and with the said *{David Lacour}* his Executors, Administrators, and Assigns, by these Presents, that I the *said {Robert Lacombe}* my Executors or Administrators, shall and will transfer, or cause to be transferred unto the said *{David Lacour}* his Executors, Administrators, or Assigns, *{Five hundred pounds Creditt in the Capital and Principal Stock and funds of the Governor and Company of Merchants of Great Britain trading to the South Seas and other parts of America and for encouraging the Fishery etc. Immediately}* after the same shall be demanded, as hereinafter is expressed; Provided the *said {David Lacour}* his Executors, Administrators, or Assigns, shall demand the same by Note in Writing to be given to me, or left for me at *{or in my Dwelling house in Basinghall Street London at any time on or before the hour of Twelve a Clock on the day of Shutting the transfer books of the said Comp. for making the Christmas Dividend next ensuing the date hereof}* and shall well and truly pay, or cause to be paid, unto the said *{Robert Lacombe}* my Executors or Administrators, for the said *{Five hundred}* Pounds Credit in the said Stock, or the Transferring the same, the Sum *of {Two thousand five hundred pounds}* of lawful Money of ***Great Britain*** and all such Money as shall be advanced on Account of the same from the Date hereof (if any shall be). AND it is agreed, That if the said *{David Lacour}* his Executors, Administrators, or Assigns, shall demand and pay for the said *{Five hundred}* Pounds Credit in the said Stock as aforesaid, Then all Dividends and Profits that shall arise, be voted, ordered or made, for or in respect of the said *{Five hundred}* Pounds Credit after the Date hereof, shall be and remain to the only Use, Benefit, and Behoof of the said *{David La Cour}* his Executors, Administrators, and Assigns. But if the Said *{David La Cour}* his Executors, Administrators, or Assigns shall not demand the said *{Five hundred}* Pounds Credit in the said Stock, and pay for the same, as aforesaid: Then this Contract shall be void, and of none Effect, and the said *{Two hundred and sixty two pounds and 10 pence}* is to remain to me the said *{Robert Lacombe}* for ever.

Witness my Hand and Seal, the *{Twentieth}* Day of *{September}* Anno. Dom. 17*{20}* Annoq; Regni *{R. Georgii}* Mag' Britain' etc. *{Septimo}*

Seal'd and Deliver'd in the
Presence of
{John Hill Martin sig.} *{Robert Lacombe sig.}*

Receiv'd the Day and Year above-written, of the above-named *{David Lacour Two hundred sixty two pounds and 10 pence being}* the Consideration-Money above-mentioned.
I say, Received *{£262 10s}*

Witness, *{Martin Ricksted sig.}* Per me, *{Robert Lacombe sig.}*

Sold by W. Kerby, ***Stationer***, at the Three Crowns, in Exchange-Alley

fff.203 another indenture, but handwritten this time. Another refusal, but this time written in the acceptor's voice unlike the two refusals above.

In Consideration of one hundred and five pounds
in hand paid unto us Charles Long of the parish of St. Andrew
Holborn in the County of Middlesex Esquire and
Chambers Slaughter of London Gent.

at or before the Sealing or delivery hereof by James Lightbour of Gray's Inn in the Said County of Middlesex Esq. the Receipt whereof I do hereby acknowledge we the said Charles Long and Chambers Slaughter for our Selves our Executors and Administrators Covenant and agree to and with the Said James Lightbour his Executors Administrators and Assigns by these Presents that we the Said Charles Long and Chambers Slaughter our Executors or Administrators shall and will upon three days notice to be given to us or left in writing for us the said Charles Long and Chambers Slaughter at Essex House in Essex Street at any time on or before the Twentieth day of December next Ensuing accept or cause to be accepted of and from the said James Lightbour his Executors Administrators or Assigns One thousand pounds Interest or Creditt in the Capitall Stock of Governors and Company of merchants of Great Britain Trading to the South Seas and we the Said Charles Long and Chambers Slaughter our Executors and Administrators Shall and will well and truly pay or cause to be paid unto the Said James Lightbour his Executors or Administrators or assigns for the said One thousand pounds Creditt in the Said Stock on the Transferring or Tendering the same to be Transferred the Sum of Six Thousand pounds of Lawfull money of Great Brittain provided James Lightbour his Executors Administrators or assigns shall give the Said Notice within the time above mentioned and in pursuance thereof shall also Transferr the Same One thousand Creditt in the Said Stock or Tender the Same to be Transferred unto us the Said Charles Long and Chambers Slaughter our Executors or Administrators within three days notice as aforesaid But if I the Said James Lightbour his Executors or Administrators or assigns shall not Transferr or Tender the Said One Thousand pounds Creditt in the Said Stock to us or our assigns within the time aforesaid Then those presents to be void witness our hands and Seales this twenty first of July 1720.

Sealed and delivered in
the presence of by the
written names
{Charles Long sig.}
{Rob. Pemberton sig.}
{Rupert Clarke sig.}

Sealed and delivered
by the written Names
Chambers Slaughter
in the presence of
{Chambers Slaughter sig.}
{D. Polhill sig.}
{Geo. Haselwood sig.}

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