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East India Company and Bank of England Shareholders during the South Sea Bubble: Partitions, Components and Connectivity in a Dynamic Trading Network*

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ABSTRACT

A new dataset, in the form of a network graph, is used to study inventory and trading behaviour amongst owners of East India Company (EIC) and Bank of England (BoE) stock around the South Sea Bubble. There was a decline in market intermediation in which the goldsmith bankers were dominant in 1720, but foreigners and Jews to some extent restored intermediation services after the Bubble. Company directors temporarily helped to sustain intermediation in 1720 itself. Whereas before and during the Bubble intermediation was largely in the form of brokerage, after the Bubble dealership noticeably began to displace brokerage.

Keywords: South Sea Company; Financial Revolution; social networks, financial intermediation, inventories.

JEL Classifications: N23, G13.

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1. Introduction

The South Sea Bubble refers to the events in the year 1720 associated with an ambitious scheme to convert much of the British national debt into equity shares of the South Sea Company. The scheme that brought about these events and the events themselves have been recounted many times. The Bubble has been cast as an episode in Britain's larger Financial Revolution (Dickson, 1967) and the literature has been augmented also by Scott's (1910) account of the purely financial aspects of the South Sea scheme. Carswell (1993) did much to set the events of 1720 into their proper political setting and Neal (1990) has greatly helped us to understand the events of 1720 in an international context.

Foremost amongst the events associated with the South Sea Bubble is the stock market rise and fall that remains one of the most marked and remarked upon in history. We picture the market values for EIC standard shares from this period (Fig. 1).² Hoppit (2002) has argued that much of the written history of the South Sea Bubble (but certainly excluding the original contributions cited above) has created and perpetuated mythologies about the events of 1720 instead of trying to make original contributions towards understanding these events and, in particular, has even strayed from "the discipline of counting" things that would be useful in understanding the South Sea Bubble. Carlos and Neal (2006) have done much to supply new things to count in their study of the microstructure of the markets in Bank of England (hereafter, BoE) shares in the period 1720-25. They pioneered the use of stock transaction data to study distributions of stock trading during and after the South Sea Bubble. Although their data pertained to stock balances and trade in shares in only

² Like BoE shares, EIC shares did not change in definition in the period we study. In this, as in other studies, we refer to £100-nominal stock as a standard share.

one company, the BoE, theirs was a very large task because, outside of the South Sea Company itself, trade in BoE shares was probably the largest body of trade during the Bubble year of 1720. We extend their analyses to trade in another company's shares, shares in the East India Company (hereafter, EIC). The use of a previously unrecorded dataset³ has enabled us to do this and the resulting database was structured so that it was capable of answering certain research questions that were incapable of being answered before. The primary difference between the structure of our database and the BoE database that inspired it is that in our database we can look at stock inventory behaviour on a day-by-day basis. We are now capable of examining the dynamic history of market trading and stock ownership in two stocks during the Bubble era.

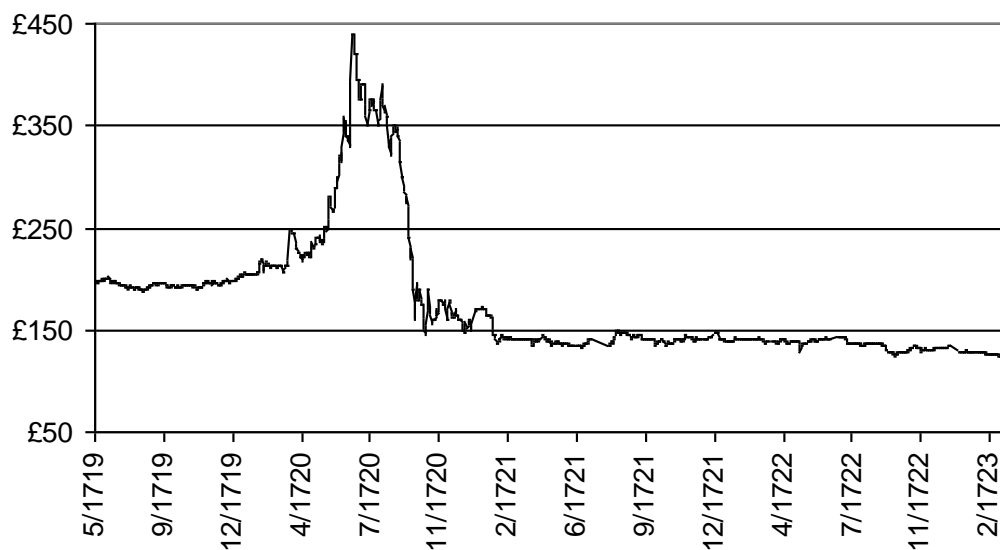


Fig.1. EIC share prices, daily price quotations taken from Castaing and Freke.

The most interesting research questions that have to be answered about the South Sea Bubble are, after all, about dynamic behaviour during the Bubble. Was

³ This is a digitised microfilm of India Office Records (IOR) L/AG/14/5/4, East India Company Stock Ledger, British Library. The construction of data from this manuscript is described in the Appendix A: Data Sources and Methods. This dataset formed the basis of the first author's M.Sc. dissertation (Mays, 2010).

there a collective group or groups that were dominant in trade during the Bubble? Were the dominant traders a collection of the infamous stock-jobbers, the political classes or the goldsmith bankers themselves? Financial investment risk was certainly dynamic throughout the Bubble and now we can look at the joint riskiness of two stocks. Returns on EIC stock were riskier than were returns on BoE stock before, during and after the South Sea Bubble. Although it is unfortunately true that we cannot directly observe trade in the ultimately riskiest stock of all – South Sea Company shares – it will still be useful to see how people adjusted their investments between other risk classes. For example, we shall present evidence that the liquidity crisis of 1720 may have been associated with a flight to quality (from EIC stocks towards BoE stocks) carried out by persons who experienced the worst liquidity problems, the goldsmith bankers and brokers.

The first empirical task therefore is to establish the general course of trade in EIC shares in contrast to what has already been documented for BoE trade by Carlos and Neal (2006). A second empirical task we perform is to establish the interpenetration of ownership in the two firms. Since shares in the two firms embodied different levels of risk, it would stand to reason that there should be some ownership of shares in common, if only for the sake of risk diversification. With these preliminary empirical tasks done we then proceed to see how the ownership of EIC and BoE shares can be analysed on a network. The network structure for the analysis is designed to serve several purposes. First the network is defined so that the usual questions that arise in network analysis, such as centrality, importance and connectivity can be meaningfully answered. Borgatti (2005) has argued that in much social network analysis these preliminary questions are inappropriately answered. The network setup should also be defined in a way that it helps us understand the events of

1720 as an asset bubble. We shall show that this is the source of our pre-occupation with analysing stock inventory behaviour in a network. It is also why we conduct much of our analysis on a time-series of network subgraphs so that we can obtain a perspective on how network structure dynamically changes. Along with a way of doing dynamic network analysis, we use social affiliation data to show how we can partition our networks and demonstrate the social dimension of investor behaviour as well.

2. The South Sea Bubble and the East India Company

It is important to set the historical background of the South Sea Bubble and the EIC's position within it. The South Sea Company was set up in 1711 with a capital stock of more than £9 million. It was created in order to buy existing short-term government debt and to help manage the national debt in a way similar to that followed by the BoE. In addition to this role, the Company purposed to trade with the Spanish Empire (Section V. A., Scott, 1910). By some persons Spanish America was seen as a more promising trade area than was India and the Far East, as it was more accessible and the customers were more likely to purchase traditional English exports such as cloth and iron goods. For Spanish colonists ordinary trade with any country except Spain was strictly forbidden, but after the conclusion of the Treaty of Utrecht (1712), the South Sea Company was given sole rights to carry on British trade with Spanish America – the so-called South Seas. The South Sea Company had also obtained for 30 years the *Asiento de Negros*, a contract to be the sole supplier of slaves to the South Seas. Britain already had colonies in the Caribbean and, as a result, had a large share

of the slave trading market in the Western Hemisphere. The Company certainly looked to be well positioned in this fruitful new market.

By the autumn of 1719, however, a new war with Spain had halted the Company's South Sea trade. Unlike the EIC, with its strong Asian trade, and the BoE, with its home-counties banking monopoly, the South Sea Company had little room for action. The South Sea Company's proposed escape from this dilemma was to yet again attempt a conversion of government debt obligations into new equity shares in the Company. The scale of the proposed scheme was, however, unprecedented, except to the extent that it was inspired by the Law System in France. By the end of 1719 John Law had successfully converted the entire French national debt into shares of the newly formed *Compagnie des Indes*, which monopolistically combined national banking, tax-collection and overseas trading into one large firm. Some of the grandiosity of the Law System was evident in the proposals first put forward tentatively by the South Sea Company. In these proposals the idea was tried that the South Sea Company too would attempt to convert the entire British national debt into South Sea shares. It was in this regard that the South Sea scheme first touched against the affairs of the East India Company and the Bank of England (Dickson, 1967). The EIC and the BoE, like the South Sea Company, were both 'great monied' companies, that is, both had made large loans to the government and indeed were required to do so to justify their chartered existences. A South Sea Company proposal to exchange the entire national debt for South Sea shares would ultimately have become a threat to the chartered existence of the other two companies. For reasons that are undocumented, but can be reasonably inferred from events, the South Sea scheme eventually developed into a plan to convert the remaining national debt into South Sea shares, but exclusive of the debt that was already in the hands of the EIC and the BoE.

From this time forward until the South Sea scheme collapsed, the EIC no longer figured in proposed re-arrangements of the national debt.

So, in 1720 the EIC was merely affected by events more than it tried to shape events. The Company's historian stated that the EIC's Directorate

*“remained relatively passive while the South Sea Bubble was reaching its climax and the Court merely instructed the Indian Councils to be on their guard against the powerful competition posed by the second French Compagnie des Indes”.*¹⁰

The EIC was a bit more energetic in business than was suggested by the quote above. It did at least explore the possibility that it might trade slaves from Madagascar to the Western Hemisphere. While the South Sea Company was trying to put its own slave-trading business afoot by contracting with the Royal African Company to supply it with slaves from West Africa (Davies, 1957), the EIC considered that it might supply slaves directly to British colonies. Several plans that could have effected an EIC slave trade fell to the wayside, primarily because of Parliament's disapproval of them (Platt, 1969). In the normal course of business the EIC Directors were concerned enough with the outfitting of trading voyages and with the collection of bullion that would have to be carried by these voyages to the Far East. The latter task became their greatest worry by the early autumn of 1720 and into 1721. By the middle of September 1720 the directors of the BoE and the EIC met to discuss the scarcity of credit that had developed in London. By the end of the month *“an international crisis was developing with full force”* and in 1721 that *“the description of the winter events written by the EIC's Committee of Correspondence in February contains all the ingredients of a classic liquidity crisis”*.⁴

The previous years of careful management and a conservative dividend policy had put the EIC in a position so that it could absorb the blows experienced in 1720.

⁴ Chaudhuri (p.447, 1978).

There was a reserve provided by the undistributed portions of good profits that were earned between 1710 and 1716. The company certainly continued to trade through and after the Bubble. Although it had more than the usual difficulties in financing its voyages, after 1722 the crisis had passed. There were some losses on trade in 1721 and 1722 that caused a decline in cash reserves for two years, but it was not till 1723 that the dividend rate was lowered, in line with falling interest rates. The years 1717-1727 did mark a volatile time for the EIC, but in the six years from 1727 the company saw an average increase of 14.5 p.c. in profits.⁵ Thus did the EIC experience and survive the rigours of the Bubble year. Its shares remained prominently traded public securities. It was not directly involved in the South Sea scheme and its business was exposed to trade credit risks that differed from those faced by the BoE and the South Sea Company. The structure and the dynamics of the trade in its equity thus does need to be examined and contrasted with the trade in BoE shares. The data and methods that we use are described in the next section.

3. Data and methods

The research questions that network data can address depend upon how networks are defined. To address questions with respect to financial intermediation there is required a network structure that can, at the very least, describe financial intermediation as a network feature – mostly likely as a flow. It then should also be possible to describe global and local features of that network in terms of such flows and other features or relevance to the analyst.

The sources for our data and the resulting network data structure that we employ are described in detail in Appendix A. The fundamental data structure we use

⁵ Chaudhuri (p. 445, 1978).

is illustrated in Fig. 2 with an exemplary 3-node network graph. The directed edges between the nodes (representing sellers and buyers) indicate sales. Edges in the graphs have also other time-changing (mutable) attributes. Each edge, of course, has a date of sale associated with it, the respective ID numbers of the buyer and seller, as well as the type of stock transacted (EIC or BoE). We have also been able to calculate the size of stock inventories held by each buyer and seller. The network node attributes are recorded as [0-1]-binary data and the figure illustrates the kinds of node attributes we have been able to define in this way.⁶

Node Attributes (immutable): ID number; gender; nationality; residence; social class; economic class; political class, etc.

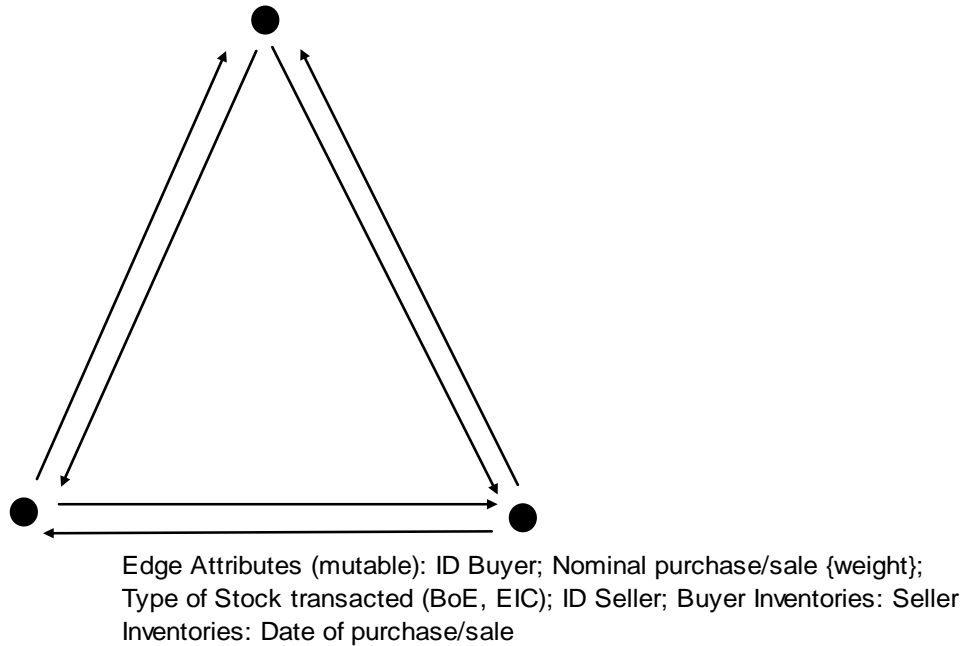


Fig. 2. Fundamental structure of network data for stock trading.

Graph partitions refer to subgraphs that are defined in terms of the binary node attributes. For example, we can split our graph into two partitions in which the nodes

⁶ The data structure described here is that prescribed by the Networkx network analysis programs. Networkx programs are written in Python and we have used Networkx 1.3 and have written our own Python shells for Networkx programs using Python 2.6.6. See <http://networkx.lanl.gov/> and <http://www.python.org/> for information on these programming tools.

are respectively male and female in gender or in which the nodes are respectively British and Non-British in residence. Components too are subgraphs, but they are defined in terms of rules based upon edge attributes. The basic example of a component subgraph is one which is defined in terms of its connectivity. For example, all the nodes that are connected to just one other node can represent one such subgraph and all the nodes that connect to no other nodes can define another subgraph. We do much of our analyses on the largest connected components of our graph data – the largest subgraphs (in numbers of nodes) in which all nodes are connected either directly or indirectly to each other. Also of special interest to us are the subgraphs defined in terms of the dates that are associated with the graph edges. These are the graph components we study when we investigate how network structure changes through time. A device we use throughout this paper is the subgraph defined by edge-dates that fall within a 3-month range of dates. A monthly series of such graphs and their characteristics can be used to create what amounts to moving-average trends in network characteristics.

Empirical and theoretical economists increasingly employ network graphs in their analyses. Easley and Kleinberg (2010) show how networks can be useful in describing the organisation of a theoretical economic game, an auction market or a voting system and how network graphs can act as a framework for understanding the complexities that can result from the interactions of numerous actors. In the organisation of a formal market exchange, for example, members of the exchange voluntarily organise themselves into such a network. At any particular time, however, the trading activity within the exchange may follow paths and patterns that reflect only a subset of the features of that network. Furthermore, analysis of network data may reveal features of an underlying network from which the data are generated, but

it is by no means clear that deterministic algorithms are the best ways to reveal them or whether a statistical approach is more appropriate. Without guidance from a theory that explains the existence of the network in the first place it is difficult to know how to build a network dataset. The relationships between networks that shape economic behaviour, which may be difficult to observe, and more observable networks that are the results of that behaviour is a theme in the social network analysis of markets (Podolny, 2001). So, in this spirit, we now try to discover the fundamental data structure is best suited to the study financial intermediation phenomena.⁷

We start by considering the following questions. What happened to financial intermediates throughout the period of the South Sea Bubble and how can it be related to connectivity in network data? Did connectivity rise or fall and did the timing of any such changes coincide closely with other events in the markets? In many network analyses the basic quantum in measuring connectivity is node degree centrality. Node degree refers to the number of network edges that connect to a node. The concept can be extended to networks with trade-weighted edges and thus we can define the degree of a node as the trade-weighted number or sum of network edges that connect to a node. The importance, or centrality, of a node can be measured as the proportion of all network nodes that are connected to the node in question. The central distribution measure of network node importance is average degree centrality.⁸ When average degree centrality is then calculated for a series of monthly subgraphs, we have a time-series description of changing network structure. For a partition of our data into trade in EIC and BoE shares, average degree centrality through time is pictured in Fig. 3.

⁷ Shea (Section 1, 2011) discusses which data structures are ideal in describing financial intermediation on a network in the study of asset bubbles.

⁸ The best introductions to these concepts are Sections 6.9 and 7.1 in Newman (2010). For an entire directed graph or connected component average in-degree and out-degree centrality must be the same, which is what is pictured in Fig. 3.

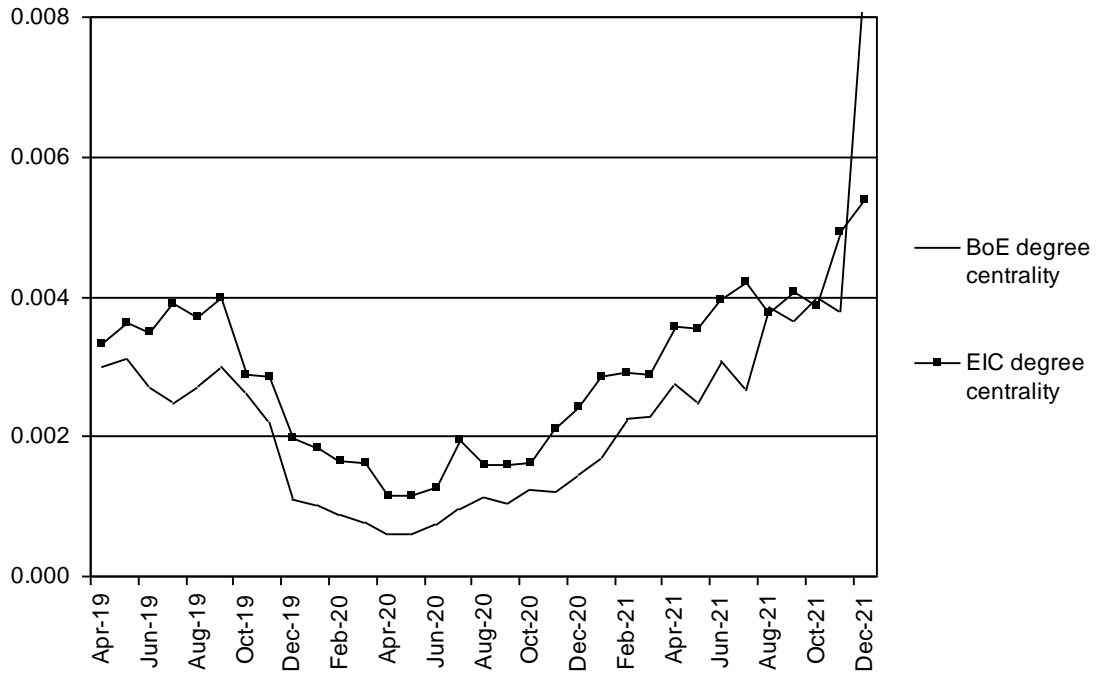


Fig. 3. Average degree centrality for nodes in a monthly series of 3-month subgraphs of trade in BoE and EIC shares.

An interpretation of Fig. 3 with respect to financial intermediation, however, is subject to pitfalls. Troughs in average degree centrality correspond with the peak in the South Sea Bubble, to be sure, but we know that this trough cannot coincide with a decline in the frequency of trade. Both for EIC stock (see Fig. 4 in the next section) and for BoE stock (see Fig. 2, Carlos and Neal, 2006) overall frequency of trade increased at the peak of the Bubble. Average frequency of trade went up during the Bubble, but Fig. 3 shows that average frequency of trade per trading person (connected node) went down. Financial intermediaries may have well remained as well connected as they were before, but the peak of the Bubble might have been marked merely by new entrants to the markets who bought shares (once) and then

traded little or not at all thereafter. Frequency of trades thus might be a very misleading way of looking at connectivity for financial intermediaries.⁹

Borgatti (2005) has argued that connectivity and centrality measures do certainly have to be chosen and tailored in response to different characteristics of networks, in particular, with regard to the kinds of flows that travel across edges. Such is the case in our networks. Trade in shares, like exchange of money, will follow walks through a network, but do not generally follow paths. Trade in shares does not diffuse through a network as would the spread of rumour, gossip or infection. Nor does share trading tend to follow shortest paths through a network as would the optimal delivery of packages.¹⁰ Additionally, stock and money flows, are not continuous; they tend to stop and re-start and thus they tend to accumulate at nodes and then also tend to dissipate away from nodes. Surely measures based upon frequency of trade without reference to previous net trade will miss out an important element of explaining financial intermediation. We argue later in this paper that inventory dynamics are one of the most interesting new things that we can measure with regard to the South Sea Bubble because it fits well with recent theorising about the connection between inventories and market liquidity. Given the particular nature

⁹ Carlos, Maguire and Neal (2008) have used centrality and betweenness measures based upon frequency of trade to deduce importance and strength of ties between trading nodes. The same approach is taken in Carlos, Neal and Wandschneider (2007). The sums of a node's trade weights is the appropriate extension of the idea of node degree in weighted networks, but that would still not remove the problem of interpreting figures such as Fig. 3 because the per-trade size stock trade was generally changing throughout the Bubble years. In the case of EIC trade, see Fig. 5. In the case of BoE trade, see Table 1, Carlos and Neal (2006).

¹⁰ The differences between paths, trails, walks and diffusions in network graphs are discussed in any elementary text on graph theory, but are well explained by Newman's (2010). In one instance of their analysis, Carlos, Neal and Wandschneider (Table 6b, 2007), rank trader (node) importance in terms of betweenness on geodesic (shortest) paths, but since shares are homogeneous goods and are not unique delivery packages, paths are not an appropriate to describe share transfers though a network.

of share trades as flows, we want to take some care in building network measures appropriate for these flows and it is clear that measures based upon frequency of trade (whether weighted by size of trades or not so weighted) can be misleading and are at best only a limited start to answering questions about connectivity in stock markets.

In another paper (Shea, 2011) measures of network flows that can be related to inventory behaviour are defined. These measures are more appropriate in addressing questions with respect to financial intermediation, which is the subject of Section 9. Three concepts are key:

Pass-Through (PT): The total sum of flows that pass through the hands of trader (per unit of time) is another way of measuring flows. It will certainly be a positive of function of edge weights (size of sales) and frequency of trade. The words ‘pass through’ connote flows that simply pass through a trader’s hands and do not contribute to or detract from inventories. PT relative to the accumulation of inventories is a way of measuring the extent to which flows tend to stop and start in a network.¹¹ The ratio of PT to total sales in the network is also one measure, but not a complete measure, of market intermediation. EIC share markets were more highly intermediated than were BoE share markets, but it appears that intermediation in both markets declined after 1720 (Fig. 16 and Fig. 2 , Shea, 2011).

Core Pass-Through (CPT): CPT connects all traders who facilitate PT with other traders who also facilitate PT. CPT is therefore confined to the largest connected component of the network in terms of PT flows. The ratio of CPT to PT is another measure of intermediation, what we might call the density of intermediation. For example, in one interpretation, the more fully trade within a network passes through intermediaries who themselves tend to trade with other intermediaries, the more fully

¹¹ Average stopping times for flows are also calculable, but do not yet figure in our analyses.

markets are interconnected by informed or influential traders. In such densely informed intermediation we would expect that a high proportion of PT would be CPT. Nearly 100 percent of all EIC PT was CPT, whereas BoE CPT varied between 20 percent and 80 percent of PT. EIC markets were generally more densely intermediated than were BoE stock markets.

Brokerage versus Dealership: Two flavours of financial intermediation are naturally measurable in our framework. The broker is a trader who facilitates trade (PT) with little or no inventory. The dealer is the trader who facilitates trade and possesses relatively large inventories (Fig. 9, Shea, 2011). In 1719 the stock markets for EIC and BoE stocks were highly brokered markets, but in 1721 became markets in which dealers were increasingly important.

4. The general course of trade in East India Company shares

The tables and figures presented in this section will establish the extent to which trade in EIC shares was directly comparable to trade that was simultaneously taking place in BoE shares. In 1719 and 1720 the ownership of the Company was spread over about 1700 account holders. Into 1721 and 1722, however, the ownership was spread over more than 1850 account holders and by 1723 there were more than 1900 account holders (Table 1). Between March 1719 and March 1723 there were recorded over 3635 separate stock accounts. Between September 1720 and September 1725, there were recorded more than 7,900 such BoE accounts (Carlos and Neal, 2006).

As should be expected, trade in shares was especially heavy in 1720. The nominal equity capital of the BoE, which was £5.56 million, turned over a bit more than once in the 1720 trading year. Trade in EIC shares was more intense than that. The nominal equity capital of the EIC was £3.2 million, but in 1720 total nominal

trade in its shares was nearly £5 million. This trade was confined to nearly 4,900 transfers over the whole year. In the two years on either side of 1720 roughly 75 percent of shareholders did not transfer any of their shares. In the Bubble year of 1720, however, more than 50 percent of shareholders were involved in transfers and once persons were involved in either sales or purchases, they engaged in more transfers on average in 1720 than they did in other years (Table 1).

As was the case for the BoE, we can clearly document the relative intensity of trade in the Bubble year (Fig. 4). Since numbers of transfers of shares were absolutely fewer in number than the BoE transfers analysed by Carlos and Neal, the relatively high turnover in EIC shares was achieved through transfers of larger size than was

Table 1

Numbers and Percents of EIC Transfers by Block Size and Time Period

Block Size £	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723
0-99	9	57	36	39	141
100-199	41	254	172	165	632
200-299	30	244	157	119	550
300-399	29	127	108	65	329
400-499	14	61	35	37	147
500-999	432	1846	743	693	3714
1000-1499	683	1586	364	338	2971
1500-1999	37	140	42	33	252
2000-2499	170	333	48	37	588
2500-2999	17	31	15	8	71
3000-4999	76	119	44	24	263
5000+	49	99	22	18	188
Total	1587	4897	1786	1576	9846

Block Size £	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723
0-99	0.6%	1.2%	2.0%	2.5%	1.4%
100-199	2.6%	5.2%	9.6%	10.5%	6.4%
200-299	1.9%	5.0%	8.8%	7.6%	5.6%
300-399	1.8%	2.6%	6.0%	4.1%	3.3%
400-499	0.9%	1.2%	2.0%	2.3%	1.5%
500-999	27.2%	37.7%	41.6%	44.0%	37.7%
1000-1499	43.0%	32.4%	20.4%	21.4%	30.2%
1500-1999	2.3%	2.9%	2.4%	2.1%	2.6%
2000-2499	10.7%	6.8%	2.7%	2.3%	6.0%
2500-2999	1.1%	0.6%	0.8%	0.5%	0.7%
3000-4999	4.8%	2.4%	2.5%	1.5%	2.7%
5000+	3.1%	2.0%	1.2%	1.1%	1.9%

typically the case for BoE trade. If the reader looks to Carlos and Neal's Table 1 and compares it to Fig. 5, one can readily confirm that East India transfer sizes tended to

be larger than those for the BoE. In terms of the block size of trades, our Table 1 conveys the same information.¹² It is particularly noticeable that block trade in the £1000-£1500 category was well represented in East India trade in all periods, but was quite rare for BoE shares in 1720.

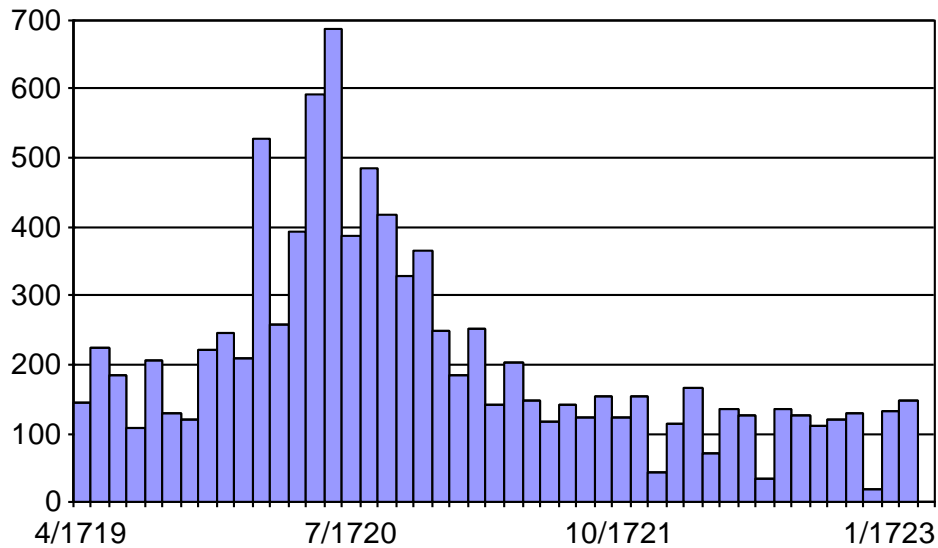


Fig. 4. Monthly Numbers of East India Shares Transferred.

Also in conformity with the results of Table 3 in Carlos and Neal (2006), we find that the majority of sellers and buyers in all periods transferred stock only once or twice. For the majority of stock traders, the South Sea Bubble period could hardly be described as a period of continued and frenzied trading activity. In Table 2 we see that in 1720, of all buyers and sellers, those who bought or sold more than a 6 times accounted for only about 10 percent of all traders. In conformity too with Carlos and Neal's Table 4, we find in our Table 3 that the distribution of transfers by size was uniform between buyers and sellers. Although we find that EIC shareholders traded more frequently and in slightly larger block sizes than did BoE shareholders, there are very many other similarities between the trading histories of shareholders in the two

¹² Compare this table to Table 2 and Fig. 3 (Carlos and Neal, 2006).

firms. Most buyers and sellers, particularly if they were small buyers and sellers, traded infrequently so that large portions of both companies' share ownership was quite stable, even through the South Sea Bubble period. If the share-ownerships in the two firms consisted of largely the same groups of people, this might go some way in explaining why their trading behaviours are so similar. In the next section we look at the distributions of EIC shareholdings through time and what they had in common with the distributions of BoE shareholdings.

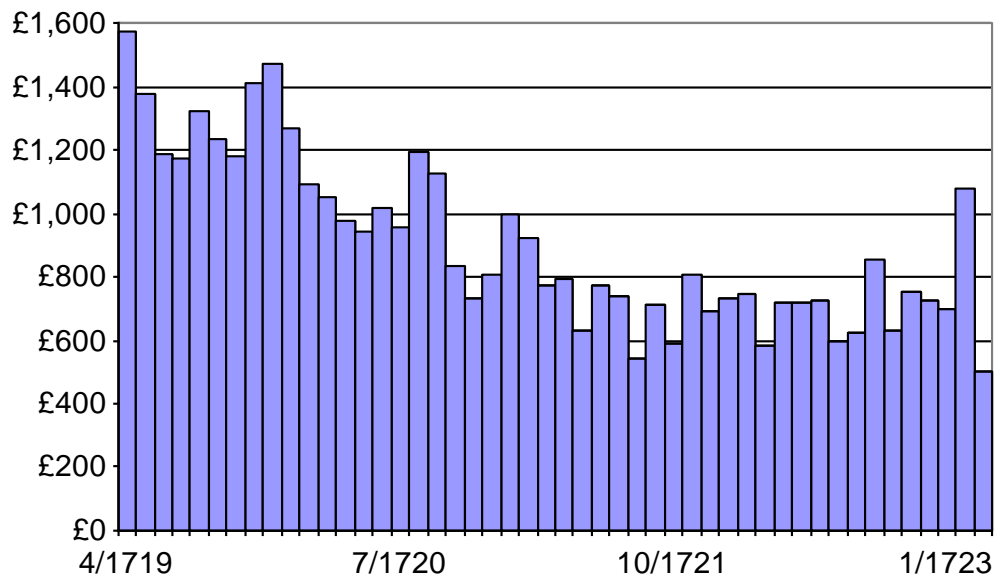


Fig. 5. East India monthly nominal value per transfer.

Table 2
Numbers of Unique EIC Sellers and Buyers by Numbers of Transactions

Number of Transactions	Unique sellers (Number)					Unique buyers (Number)				
	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723
0	1265	841	1375	1405	586	1242	885	1323	1366	600
1	336	716	368	432	1125	342	829	535	510	1386
2	87	274	113	122	432	91	214	120	112	425
3	48	122	47	63	199	43	115	55	60	206
4	23	58	31	23	125	15	58	18	26	126
5	22	44	20	19	85	19	41	20	16	90
6	6	24	8	12	50	11	21	12	9	52
7	7	17	6	9	38	7	22	5	11	48
8	3	14	7	6	35	6	16	1	3	21
9	3	19	2	2	22	3	16	8	6	14
10	5	9	3	4	22	3	9	4	2	18
11	1	6	2	3	13	1	15	1	1	12
12	3	9	1	1	8	2	8	2	1	15
13	3	5	1	2	7	1	5	3	4	10
14	0	5	1	2	15	2	4	2	2	10
15+	12	60	21	8	116	12	53	17	7	110
Sum Sellers/Buyers (with 1 or more transactions)	559	1382	631	708	2292	558	1426	803	770	2543
Number Owners, Beginning of Year					Number Owners, End of Year					
	1714	1694	1846	1969	1714	1694	1846	1969	1995	1995
Percentage of Owners who never sold					Percentage of Owners who never bought					
	73.8%	49.6%	74.5%	71.4%	34.2%	73.3%	47.9%	67.2%	68.5%	30.1%
Average Number of transactions per seller					Average Number of transactions per buyer					
	2.3	2.8	2.4	2.1	3.1	2.3	2.7	2.1	2.0	2.8

Table 3
Unique EIC Sellers and Buyers by Largest Transactions

Block Size £	Unique Sellers (Number)					Unique Buyers (Number)				
	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723
0-99	4	11	12	17	38	4	10	17	7	25
100-199	18	66	60	61	172	26	106	83	100	215
200-299	14	79	57	60	169	8	91	89	61	187
300-399	15	46	45	34	116	16	38	52	33	100
400-499	5	23	10	16	46	6	21	17	23	50
500-999	164	434	214	258	808	150	437	264	283	784
1000-1499	180	398	131	169	573	191	414	161	170	631
1500-1999	22	57	21	21	80	22	58	30	22	99
2000-2499	67	139	26	27	133	65	120	30	28	198
2500-2999	7	18	9	5	21	7	16	8	7	34
3000-4999	33	52	29	22	75	38	53	34	19	119
5000+	30	59	17	18	61	25	62	18	17	101
Total	559	1382	631	708	2292	558	1426	803	770	2543

Block Size £	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723	4/1719-12/1719	1720	1721	1722-3/1723	4/1719-3/1723
0-99	0.7%	0.8%	1.9%	2.4%	1.7%	0.7%	0.7%	2.1%	0.9%	1.0%
100-199	3.2%	4.8%	9.5%	8.6%	7.5%	4.7%	7.4%	10.3%	13.0%	8.5%
200-299	2.5%	5.7%	9.0%	8.5%	7.4%	1.4%	6.4%	11.1%	7.9%	7.4%
300-399	2.7%	3.3%	7.1%	4.8%	5.1%	2.9%	2.7%	6.5%	4.3%	3.9%
400-499	0.9%	1.7%	1.6%	2.3%	2.0%	1.1%	1.5%	2.1%	3.0%	2.0%
500-999	29.3%	31.4%	33.9%	36.4%	35.3%	26.9%	30.6%	32.9%	36.8%	30.8%
1000-1499	32.2%	28.8%	20.8%	23.9%	25.0%	34.2%	29.0%	20.0%	22.1%	24.8%
1500-1999	3.9%	4.1%	3.3%	3.0%	3.5%	3.9%	4.1%	3.7%	2.9%	3.9%
2000-2499	12.0%	10.1%	4.1%	3.8%	5.8%	11.6%	8.4%	3.7%	3.6%	7.8%
2500-2999	1.3%	1.3%	1.4%	0.7%	0.9%	1.3%	1.1%	1.0%	0.9%	1.3%
3000-4999	5.9%	3.8%	4.6%	3.1%	3.3%	6.8%	3.7%	4.2%	2.5%	4.7%
5000+	5.4%	4.3%	2.7%	2.5%	2.7%	4.5%	4.3%	2.2%	2.2%	4.0%

5. The interpenetration of share ownerships in the EIC and the BoE

What possibilities are before the researcher who would like to investigate portfolio behaviour during the South Sea Bubble? Of the two methods that could be followed, both are severely limited by lack of data. For one, we could look directly at individuals' investment portfolios. Details of personal and institutional investments can occasionally appear in archives, but they are hardly representative of the investments of the typical investor in 1720. Archives usually contain investment records of only prominent individuals or institutions.¹³ Such records are usually also frustratingly incomplete. The other approach is to look at the financial records of companies to survey what investment had been made in them. The survival of these records too was heavily affected by the survival of the companies themselves. We have financial ledgers of only the EIC, the BoE and only part of the ledgers for the Royal African Company. Records of other companies, either projected or already established in 1720, have generally not survived.

The records of equity ownership in the EIC and BoE, however, are highly complete. If we merge together these two datasets we can at least make a start in describing how investment and trading behaviour played out in the South Sea Bubble. BoE and EIC share values mirrored to some degree the great boom in prices experienced by shares in the South Sea Company. From 1719 until midsummer 1720, when they experienced their peak values, EIC share values remained about 1.5 times to 2 times the size of BoE shares values, while at the same time South Sea shares

¹³ The portfolio activities of Hoare's Bank are one example that has been studied by Temin and Voth (2004). The portfolio activities of the first Duke of Portland are yet another example recently studied by Shea (2009). Neither Hoare's Bank nor the Duke of Portland, however, would even faintly resemble the typical investor in the 1720s.

values quickly became twice as valuable as EIC shares themselves.¹⁴ But even though the rise and crash in share values were more weakly reflected in EIC and BoE share values, we know that these shares would have been held and traded simultaneously with South Sea shares by many people. Many of the actors in the market for South Sea shares would have participated in the share markets for other established companies.

The benefits in terms of total return risk reduction would not have been small for people who held even just the two EIC and BoE stocks. Since over the entire period 1719-21 there was considerable risk of return to both EIC and BoE stocks (1.9 p.c.p.d. for EIC stocks and 1.7 p.c.p.d. for BoE stocks), considerable reductions in total risk of return would accrue to anyone who held one stock along with the other. The correlation in daily returns on the two stocks averaged about 0.5, so that holding equal quantities, for example, of both stocks would have a total return risk of 1.6 p.c.p.d.; that would amount to a near 32 p.c. reduction in total return risk with respect to holding EIC stocks alone and a near 18 p.c. reduction in total return risk with respect to holding BoE stocks alone. The correlation between returns in EIC and BoE stock also tended to weaken throughout our period; in 1719 the correlation was higher than 0.6, but in 1720 the correlation dropped to 0.5 and in 1722 the correlation was about 0.4 between the two returns, so that the benefits to diversification actually strengthened throughout the Bubble period. Benefits to diversification, although ultimately limited by the small numbers of different stock investments available, were marginally quite significant. It behooves us therefore to examine the distributions of joint share ownerships in EIC and BoE shares.

¹⁴ See Fig. 1 (Hoppit, 2002) and Fig. 1 (Shea, 2011).

The ownerships of the two companies had large overlaps with each other. We have already described the extent to which share ownership in the EIC changed between 1719 and 1723. Whereas £3.2 million stock was spread over about 1700 owners in 1719/20, by 1723 there were about 1900 owners of the company's stock. A similar change in the ownership of BoE equity took place between 1719 and 1721 when the numbers of shareholders increased from about 3400 to 3600. Starting in 1719 there were about 700 account owners and, by 1721, there were about 760 account owners who appeared in both companies' ledgers.

The common owners of these two companies tended to be large shareholders and their large collective claims on the companies' assets appear to have been quite stable throughout the South Sea episode. The lower panels in Fig. 6 illustrate the stability in the relative numbers of owners who owned stock in both of the companies; at any time; about 20 percent of those persons who owned BoE stock also owned EIC stock and 40 percent of persons who owned EIC stock also owned BoE stock. We can see in the upper panels of Fig. 6, however, that owners of BoE stock possessed a near 60 percent claim on EIC equity, while owners of EIC stock possessed a 40 percent claim upon BoE equity. We cannot conclude from these observations, however, that BoE shareholders were somehow more likely to invest in other equities; BoE shareholders were, after all, more numerous and BoE equity was larger than that of the EIC. We have to look a little more closely at the finer details of the joint ownership of the two firms.

People who invested in both EIC and BoE shares clearly tended to be larger investors than East India and BoE shareholders in general. But how large were they relative to the general run of investors in the two companies? Figs. 7 and 8 show that, conditional upon being a shareholder in both firms, large BoE shareholders were only

marginally more likely to be large shareholders in the EIC than large EIC shareholders were likely to be BoE large shareholders. In Table 4 we also see that the correlation between the sizes of stockholdings amongst owners of both EIC and BoE stock was quite positive.

We are of course looking at the cross-holdings of only two stocks, so it might seem a bit heroic to draw conclusions about portfolio behaviour from the tables and figures presented so far. On the other hand, it is fair to remind the reader that EIC and BoE stocks, along with South Sea stocks, did account for more than 90 percent of total equity capital whose market values were regularly listed in the financial press in the 1720s. Investors had few enough uses to which they could put their savings; they could invest in marketable government debt, but available corporate equity investments that were also readily tradable were uncommon. In that light, the cross-holdings of EIC and BoE stocks are significant. In Table 4 we see a distinct break in the pattern of cross-holdings above the £2000 qualification for being a director in either company. The largest stock holders ($x \geq \text{£}3000$) were strongly likely to be the largest stock holders in the other firm as well, but from £2000 up to £3000 stock holdings, the positive correlation appears to be weaker; individuals who just qualified for directorship in one firm were still likely to hold large amounts of stock in the other firm, but were not likely to try own so much as to qualify for directorship in that firm. It is understandable that persons who wished to qualify for directorships were not likely to want to qualify for directorships in both companies given conflicts of interest and simple constraints on their own time. Below the £2000-levelings cross-holdings of stocks cross-holdings most likely were equal in size. Although there are clear indications that qualification for directorships was an influence in cross-holdings

amongst the largest shareholders, joint holders of shares generally held shares in both companies in roughly equal quantities.

What appears in the figures and tables raises interesting questions with regard to portfolio behaviour and attitudes towards risk during the South Sea Bubble. We tentatively conclude that the benefits of diversification were more frequently enjoyed by larger shareholders and this tendency was perhaps greater than even is obvious in our data to the extent that some shareholders were attracted to large shareholdings in just one firm in order to qualify for a directorship. There is no obvious reason why the benefits of diversification across tradable investments should not be more uniformly distributed on the size of shareholdings. If size of shareholdings is a proxy for wealth, then this perhaps points the way toward modelling of risk aversion. We can supplement our results by adding further data to our database. The cross-holdings between EIC, BoE and Royal African shareholders are a possibility, but we delay this for another study.

A feature of these figures and table that stands out is that, again, there is remarkable constancy in the relative distributions of share ownership by size. Apart from the barely noticeable increase in concentration of ownership in large accounts in 1720, as compared to the year before and after, and apart from the fact that the numbers of accounts appeared to decline a bit into 1720, but then seemed to permanently rise in number by 1721, we would not know how to relate features of these figures with the events of 1720. Indeed, without knowledge that the Bubble had occurred, it would not be possible to infer from these figures that anything peculiar had happened in 1720 at all. There is also the possibility, however, that trade was proceeding in such a way to disguise any turbulence in ownership patterns in the distributions we have presented so far. If large account holders were being replaced

by other large account holders and small account holders were being replaced by other small account holders, such changes in ownership would simply not be apparent in Figs. 6 through 8. It is more probable, however, that the seeming stability was due to the fact that most stock accounts were nontrading accounts; Shea (Fig. 7 , 2011) has shown that the relative size of inventory holdings for active buyers and sellers radically changed prior to and during the Bubble, but these changes were not large enough or widespread enough to have an affect on the stability apparent in Figs. 6 through 8.

In the remainder of this paper we shall reveal the more radical changes that took place in stock ownership and trade. We do this by partitioning our network data on the basis of important social and professional characteristics of stock owners. Historians have already pointed the way to the groups that would be most fruitful on which to base network partitions: 1) the goldsmith bankers and brokers; 2) EIC and BoE Directors; 3) nonBritish residents and 4) British-resident Jews.

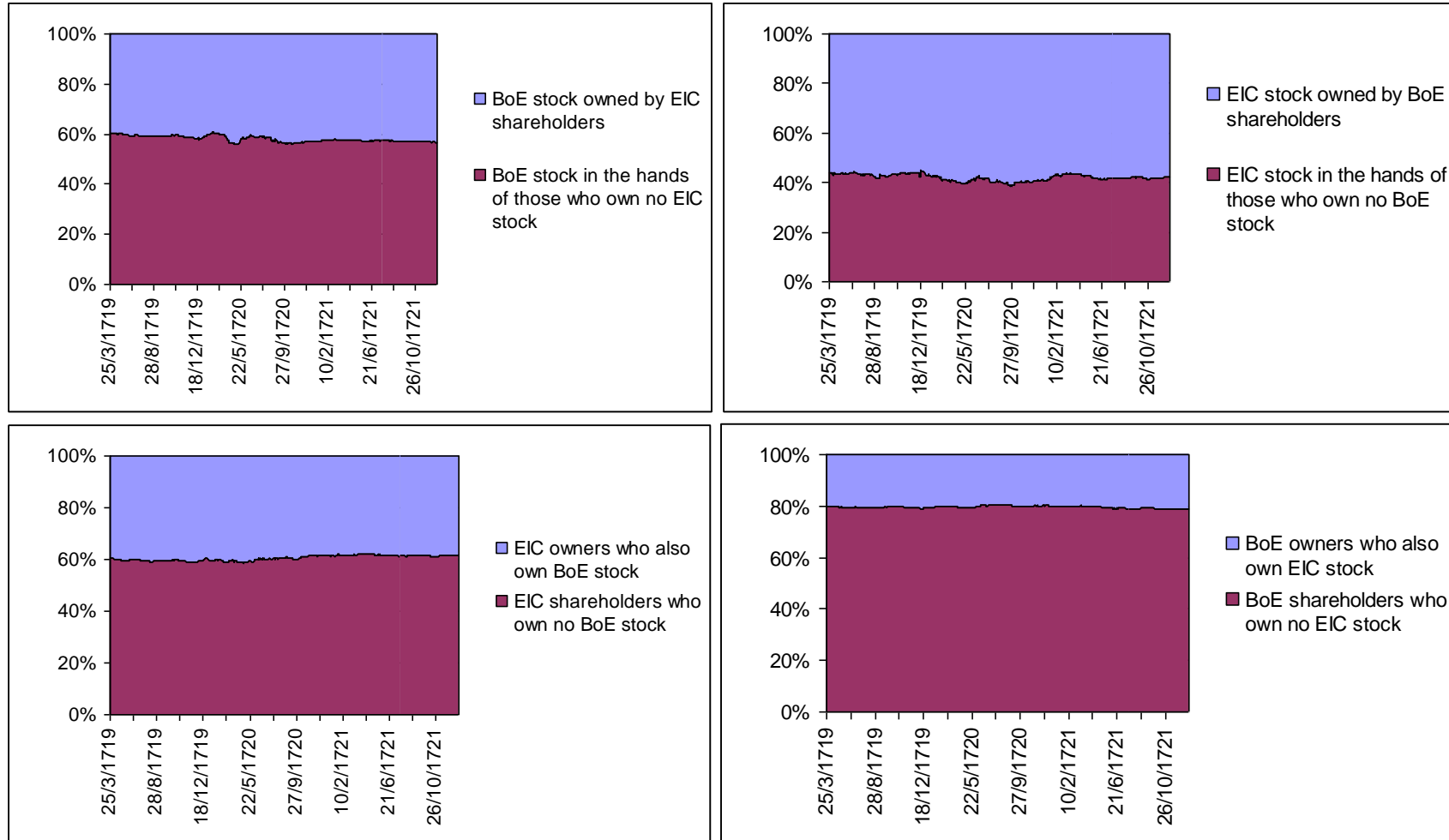


Fig. 6. Cross-ownership of Bank of England (BoE) and East India Company (EIC) shares by amounts of stock and numbers of shareholders.

Notes: The figures present percentage decompositions of ownerships. In the upper left-hand panel a constant £5.6 million in equity ownership in BoE stock is divided into the two groups - one group that owns BoE stock exclusively and another group that also owns EIC stock. In the upper right-hand panel the same decomposition is applied to the owners of £3.2 million EIC stock - those who own EIC stock exclusively and those who also own BoE stock. In the lower two panels percentage decompositions of the numbers of shareholders are presented. The numbers of shareholders for both companies are not constant, but increase modestly over time.

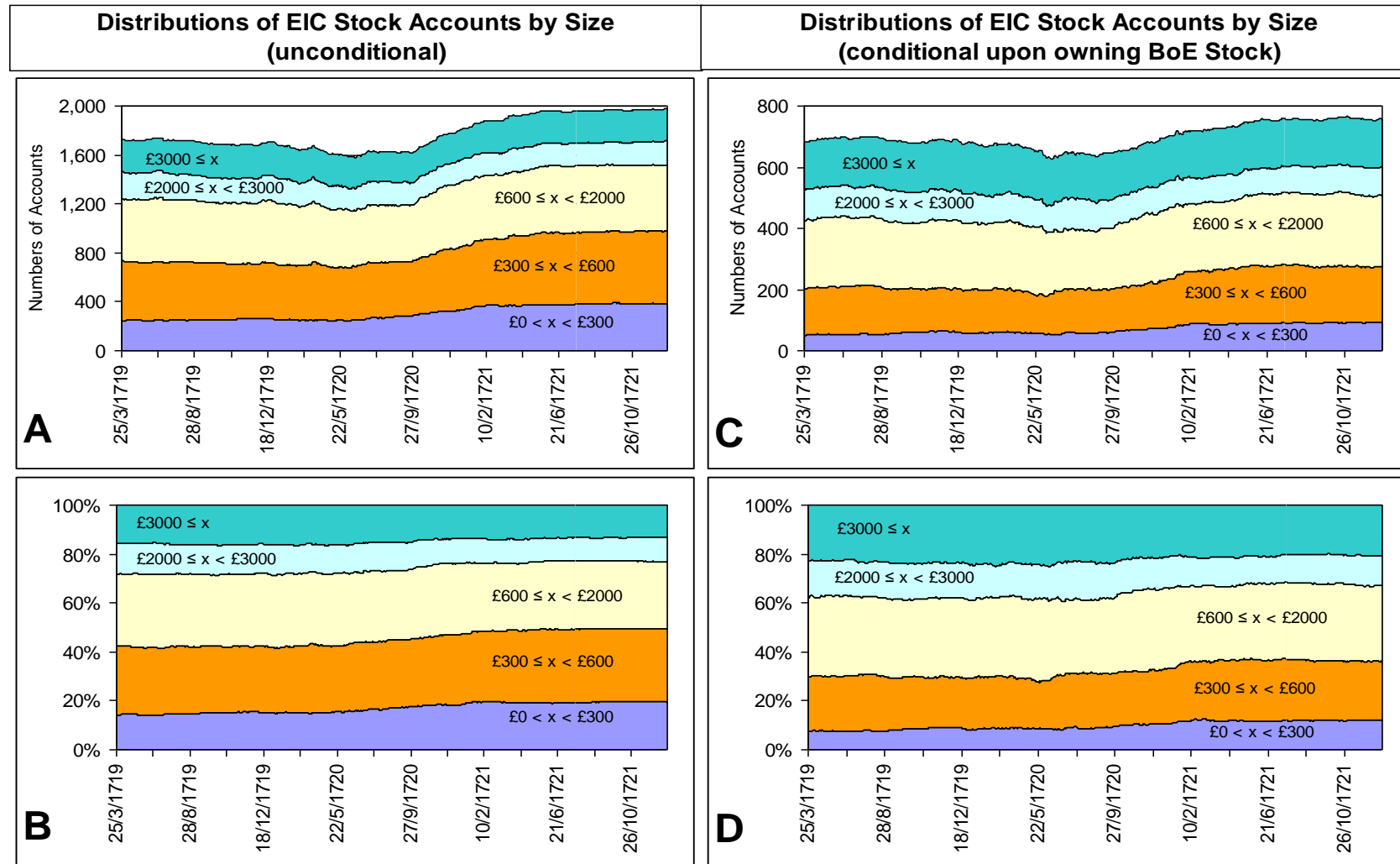


Fig. 7. East India Company (EIC) stock ownership distributions by size of ownerships.

Notes: x represents the amount of nominal stock credited to an account. The upper panels (A and C) show the numbers of accounts that contain stocks that fall within certain bands. The lower panels (B and D) show the shares of accounts within these bands as percentages of stock issued and outstanding. Panel A shows the distribution by size for all EIC shareholder accounts and Panel B shows the percentage distribution by size for all EIC accounts. Panel C shows the distribution by size for EIC shareholder accounts for accounts that also possess positive amounts of BoE stock and Panel D shows the percentage distribution by size for these same accounts.

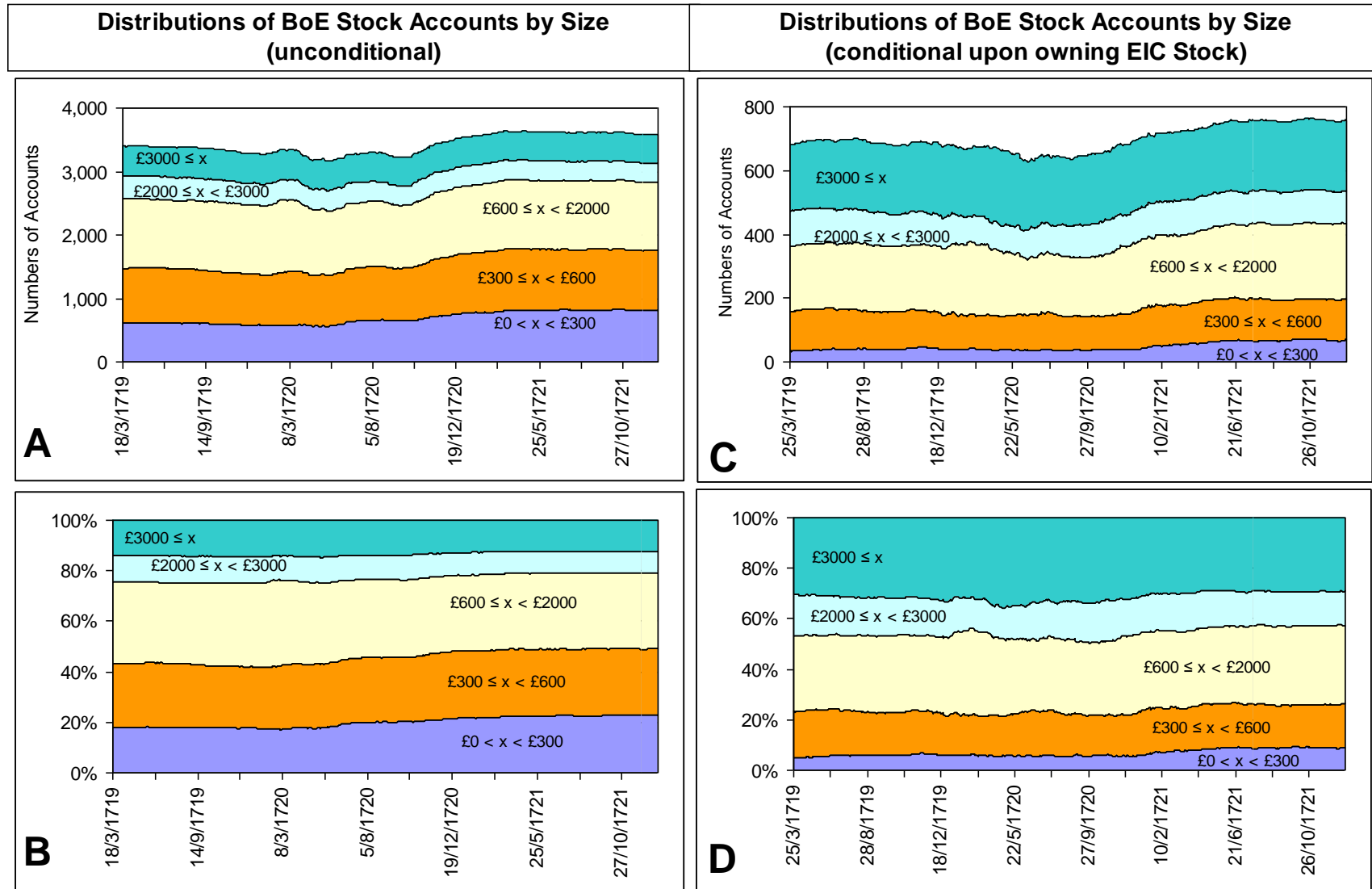


Fig. 8. Bank of England (BoE) stock ownership distributions by size of ownerships.

Notes: See definitions in notes for Fig. 7.

Table 4

Conditional Percentage Distributions (by Year) of Stock Ownership for Shareholders who Possess both EIC and BoE Stock, 1719-21

1719						
EIC Stock owned	£0<x<£300	£300≤x<£600	£600≤x<£2000	£2000≤x<£3000	£3000≤x	
BoE Stock owned						Row Sum
£0<x<£300	1.2%	3.3%	2.7%	0.4%	0.6%	8.2%
£300≤x<£600	2.4%	6.5%	8.7%	2.7%	2.6%	23.0%
£600≤x<£2000	1.6%	6.4%	16.6%	5.3%	9.6%	39.5%
£2000≤x<£3000	0.1%	1.7%	2.0%	0.8%	3.6%	8.2%
£3000≤x	0.5%	0.9%	4.3%	2.6%	12.6%	21.0%
Column Sum	5.9%	18.9%	34.4%	11.8%	29.0%	

Pearson correlation coefficient = 0.659687

1720						
EIC Stock owned	£0<x<£300	£300≤x<£600	£600≤x<£2000	£2000≤x<£3000	£3000≤x	
BoE Stock owned						Row Sum
£0<x<£300	0.8%	3.5%	2.8%	0.9%	1.3%	9.3%
£300≤x<£600	1.8%	5.9%	8.6%	2.8%	3.2%	22.3%
£600≤x<£2000	1.8%	4.5%	15.5%	4.7%	10.5%	37.0%
£2000≤x<£3000	0.4%	1.3%	1.8%	0.7%	3.9%	8.1%
£3000≤x	0.6%	0.8%	3.9%	2.5%	15.4%	23.2%
Column Sum	5.3%	16.1%	32.6%	11.6%	34.3%	

Pearson correlation coefficient = 0.633171

1721						
EIC Stock owned	£0<x<£300	£300≤x<£600	£600≤x<£2000	£2000≤x<£3000	£3000≤x	
BoE Stock owned						Row Sum
£0<x<£300	3.2%	3.8%	3.2%	0.8%	0.8%	11.9%
£300≤x<£600	2.5%	7.4%	10.5%	2.4%	3.1%	25.9%
£600≤x<£2000	2.2%	5.3%	15.7%	4.4%	8.5%	36.2%
£2000≤x<£3000	0.0%	0.9%	2.1%	1.0%	3.3%	7.2%
£3000≤x	0.6%	1.1%	4.4%	1.5%	11.1%	18.8%
Column Sum	8.5%	18.6%	35.9%	10.1%	26.9%	

Pearson correlation coefficient = 0.718236

Notes: The table is organised into three panels for each of the three years for which we have inventory data for the EIC and BoE in common. The population in each distribution is the shareholding-account pairs (on each day) that each possess positive quantities of both EIC and BoE stock. The resulting numbers in each population are quite large. More than 55,000 pairs in 1719 and more than 60,000 pairs in the years 1720-21. As in Figs. 7 and 8, x represents the amount of stock possessed in an account. The correlation coefficients are the Pearson correlations for the pairs (x_{EIC}, x_{BoE}) . Because of the very large numbers of pairs, the correlations are, of course, highly statistically significant.

6. The demise of the goldsmith bankers and brokers

The timing of the South Sea credit crisis relative to the rise and fall of share prices is hard to pin down. There are no organised sources of information on the supply of liquidity or the provision of liquidity services as we would expect in modern financial markets. Equivalents to loans on margin or interest on such loans, bid-ask spreads and other measures of the costs of trading simply do not exist in South Sea-era sources. To be sure, we have general exchange-based information such as the values of assets, interest rates and exchange rates, but none of them can be specifically tied to the costs of providing liquidity or credit or tied to the demand for liquidity and credit. In this paper, however, we can at least begin to describe the collective actions of people who were most likely responsible for providing liquidity to the markets and from these actions perhaps deduce what was happening in the markets for liquidity. Reputed to be at the centre of that financial community were the goldsmith bankers and a group of professional brokers, hereafter referred to as the GSBs. This section is devoted to an examination of the collective experience of this group. The Bubble literature is replete with accounts of selected individuals from this group. First and foremost is the notorious collapse of the Swordblade Bank partnership, the South Sea Company's own bankers, which was a partnership of three of the Company's directors.¹⁵ Some prominent bankers were clearly exposed to unique risks because they catered to large clients. Neal (1994) shows how George Middleton's association with Lord Londonderry contributed to that banker's temporary, but prolonged troubles, that began in 1720. Dickson (1967) relates also how a prominent Dutch bank fell because it was overly vulnerable to the losses incurred by Sir Justus Beck in 1720. Temin and

¹⁵ Dickson (Chapter 7, 1967) recounts the final fall of the partnership at the end of September 1720. Shea (2009) recounts the legal difficulties of one of the partners in the post-Bubble period.

Voth (2004) present evidence that the partners of Hoarse's Bank successfully undertook a decided strategy of riding the Bubble, and of not attacking it or trying to insulate themselves from it. But until now we have had no description of the collective activities of this group.

We have been able to identify 240 stock account holders who can be positively classified either as goldsmith bankers or professional stock brokers. Aside from the most famous names, many of these persons identify themselves as such in our EIC sources. We have managed to identify many others from BoE sources, sources related to the Royal African Company and with some help from other sources.¹⁶ Within this group two important goldsmith banker partnerships require remark: the aforesaid Swordblade Bank and Child & Co. In the EIC ledgers the three Swordblade partners (Jacob Sawbridge, Elias Turner and Sir George Caswall) each have separate accounts and there is also a small and dormant account in the name of the Swordblade partnership itself. Turner appears to occupy a position in the EIC accounts analogous to the position occupied by Sir George Caswall in the BoE accounts. There is every appearance that the Swordblade partners were respectively specialised in trade with Caswall being the BoE specialist and Turner being the specialist in EIC share trading. The Child & Company partnership was represented by substantial EIC accounts for each of the six partners who were living in our period.¹⁷ Francis Child and Sir Robert are special since they also rotate into and out of Directorship for the EIC itself. At any time the holdings of these two banking partnerships together would account for about 1/3 of all goldsmith bank holdings of East India stock. The Swordblade's holdings

¹⁶ Professional descriptions variously appear in transfer ledgers and stock ledgers for the BoE and the Royal African Company. These sources are discussed in Appendix A. Until recently Price's (1876) list of London bankers was the most comprehensive, but it is now quite eclipsed by the list compiled by the professional banknote dealer, Roger Outing. http://www.banknotes4u.co.uk/english_banks.htm.

¹⁷ These were Francis Child, Sir Robert Child, John Morse, Henry Rogers, Samuel Child and Henry Morse.

were smaller and more volatile than were the Child & Co. holdings. Child & Co. survived the Bubble and their holdings of EIC, as well as of BoE stock, were substantial and steady throughout the crisis.

What can be immediately affirmed in Figs. 9 and 10 is that prior to the South Sea Bubble, markets in both EIC and BoE shares were highly intermediated and that GSBs were the intermediaries involved in at least 50 percent and as much as 75 percent of all transactions in the case of EIC stock. One could never assert that GSBs were totally eliminated as intermediaries thereafter, but their dominance was certainly eliminated by the end of 1720. The GSB retreat from the markets was markedly faster from the EIC share markets than it was from the BoE markets. There was also a marked decline in inter-GSB trade. By 1721 they were involved in trade in both stocks to the amount of little more than 25 percent of all sales. In terms of intermediation (CPT), they were detectable to a small degree only in the BoE share markets.

Figs. 9 and 10 also illustrate the inventories that were in the possession of GSBs were very substantial inventories. Even though they were substantial, it is obvious in comparing the upper to the lower panels of the figures that they were quite small relative to their intermediation activities; GSBs acted primarily as brokers. GSB inventories as a percentage of core pass through (CPT) in EIC trade was persistently far below average throughout 1719-21. It was far below average in BoE trade in 1719 and the first half of 1720 until GSBs started to accumulate BoE stock inventories in earnest (Figs. 9, 10 and 11, Shea, 2011).

As far as South Sea Company shares are concerned, we can never know how much trade and how large were the inventories collectively commanded by GSBs. It could well be argued that GSBs might have shifted significantly towards holding

South Sea Company liabilities in early 1720 and these activities dwarfed their actions in the markets for EIC and BoE shares. But even if we assume that EIC and BoE share trade was only peripheral to the trade in South Sea Company shares, the behaviour of GSBs in these markets still require explanation and can perhaps shed some light on what was happening in other markets.

To summarise what we know so far: 1) GSBs began to withdraw their intermediation services from the markets for EIC and BoE shares well before the peak in the Bubble. This can be observed in terms of either transactions (Figs. 9 and 10) or in terms of their dominance in core pass-through (Fig. 16); 2) At the same time that GSBs were selling their inventories of EIC stock, they tended to accumulate inventories of BoE stock. In one interpretation, both the withdrawal of intermediation services in EIC and BoE markets and the shift in inventories away from the relatively risky EIC shares towards BoE shares would be consistent with a view that GSBs were in the midst of credit crisis even before the South Sea scheme was fully underway. This is possible although it goes against the usual interpretation of events in this period. We have good secondary evidence that as early as March and April of 1720 interest for short-term credit was high.¹⁸ This could have been as indicative of high demand for credit as well as it could have indicated a shortage in the supply of it. Dickson (1967) and Neal (1990) have both re-iterated accounts by earlier sources of how with the collapse in asset values in France in early 1720, as John Law's System fell apart, capital came from the continent to London to create high demand for credit. But intermediaries in England too might have suffered from the collapse of asset values in France. If their net asset values were adversely affected by the collapse of the Law system, that may have reduced their willingness to supply liquidity services

¹⁸ 10 p.c. per month was claimed as the cost of credit by George Middleton (Neal, 1994) and Hutcheson (1720) stated such were the terms for credit in March and April of 1720.

in London and that too would have been consistent with both higher costs of credit and in a movement from risky assets (EIC stock) to less risky assets (BoE stock) – as if they were engaged in a “flight to quality”.

The GSB withdrawal from market intermediation was not only collective, but was also experienced at the very pinnacle of the GSB community. Intermediated stock flows (taking CPT as a proxy for such flows) were distributed in a highly skewed fashion across financial intermediaries. For example, in the spring of 1720, PT and CPT were approximately 60 percent of total stock sales, but more than 10 percent of total sales generally flowed through the hands of each of only the top one or two CPT traders (Fig. 3, Shea, 2011). These top traders in CPT were also noticed in the analyses done by Carols, Neal and Wandschneider (2007). The top traders were invariably the Swordblade Bank partners Elias Turner for EIC trading and Sir George Caswall for BoE stock trading prior to and during the Bubble. Their dominance, however, vanished by autumn 1720 along with many other GSBs who, while not nearly as important as the Swordblade partners, nevertheless tended to be amongst the top ten or so CPT traders. A perusal of the lists of these top traders in Appendix B and Appendix C shows how the GSBs were displaced from the highest ranks of trading intermediaries.

How GSBs traded changed remarkably too as the Bubble progressed. Even though GSBs were able to behave like brokering intermediaries throughout the Bubble (Figs. 10 and 11, Shea, 2011), the persons with whom they dealt, when classified with regard to the size of their stock inventories, changed radically. Before the Bubble GSBs amassed their inventories by buying from relatively small holders of stock (Fig. 8, Shea, 2011). Within the middle six months of 1720, at the height of the Bubble and as they disgorged their large inventories, they sold to persons whose

inventories of stock were every bit as large as theirs. The recipients of these sales tended to be already substantial EIC shareholders who were about to take over the GSB role as market intermediaries (Section 9), foreign and British-resident merchants, who were also largely Jewish. By 1721, as their intermediation continued to diminish, GSBs tended to purchase shares from persons whose inventories were larger than theirs.

In several ways therefore the division of our network data into GSB and nonGSB partitions is the most suggestive of further lines of research. GSBs were the pre-eminent intermediaries of the pre-Bubble period in EIC and BoE stock. Did GSBs withdraw from stock trading during the Bubble to serve as intermediaries in the markets for South Sea shares, or were they retreating from the markets as a whole because they were themselves being subjected to the rigours of a liquidity crisis? These are questions to which we shall return in future research.

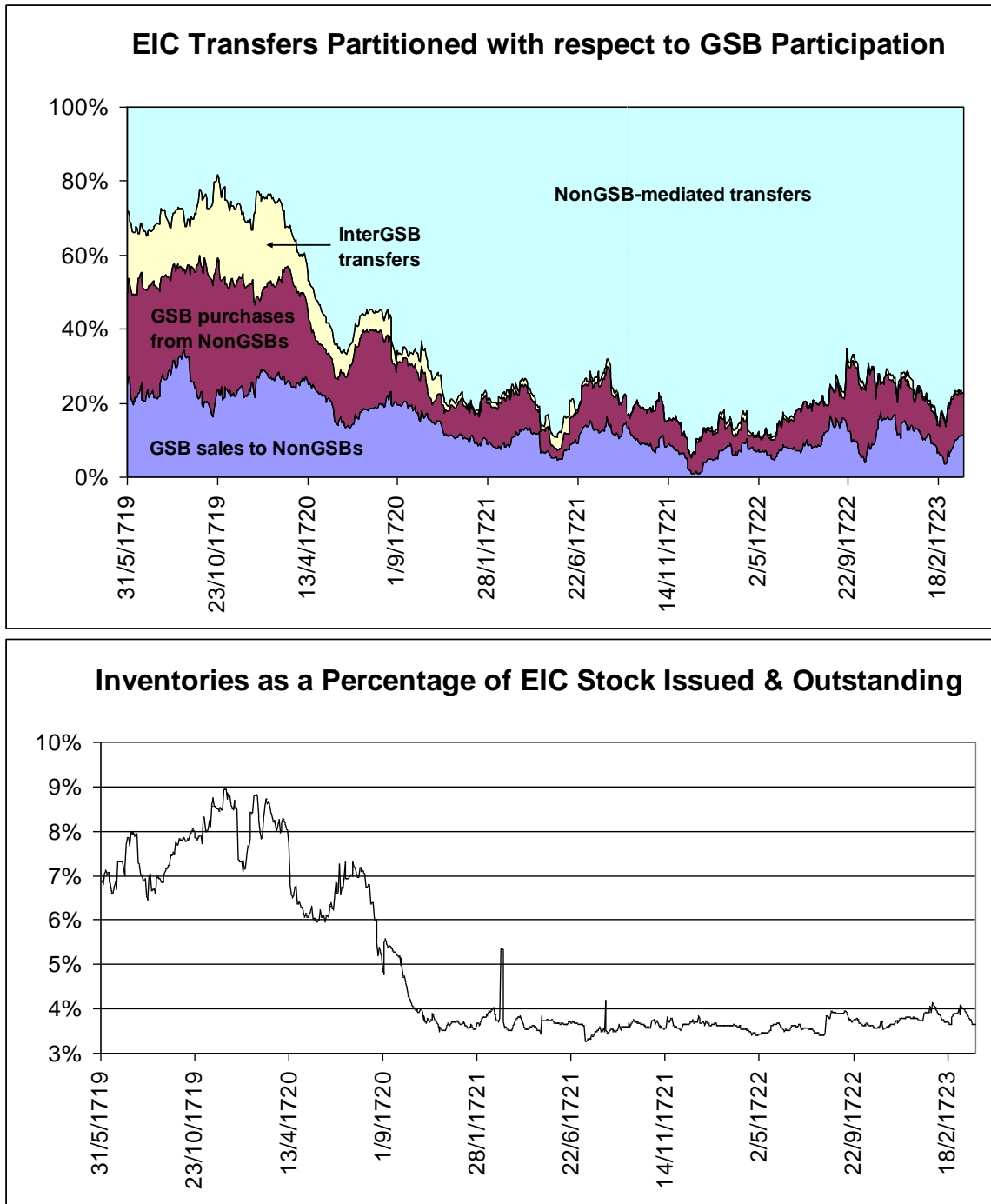


Fig. 9. Goldsmith Banker & Broker (GSB) Trade and Inventories of EIC Stock

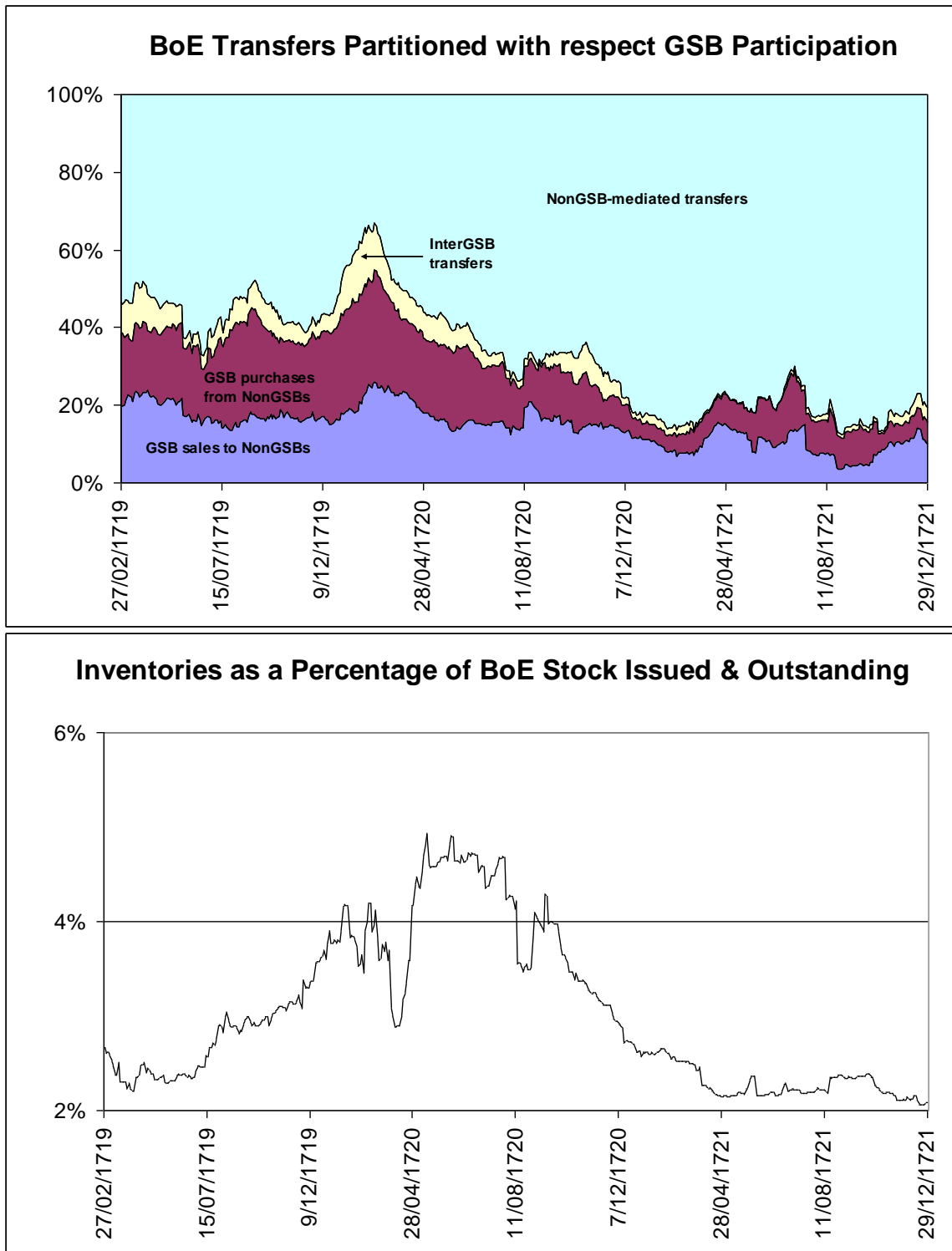


Fig. 10. Goldsmith Banker & Broker (GSB) Trade and Inventories of BoE Stock

7. Company directors: temporary intermediates in the crisis

It is not easy to define network partitions that can be completely separated from other partitions. There will often be some overlap between any two groups of people, but there do exist other groups of individuals who were significant in trade and inventories and who also were largely not GSBs. The directors of the two companies were two such groups. The BoE Directors' actions have been examined before (ch. 5, Neal, 1990) and to go along with some of that analysis we present the contrasting actions of the EIC Directors. At any time in our period there were 24 persons elected to be directors of the EIC. The Court of Directors was elected in each year and took up their positions in their first meeting of the Court in April of each year. We have collected the names of five separate Courts in each of the successive years 1719 through 1723. From one Court to the next there was much less than a complete turnover in serving members so that in the five years the 24 names who appear in each year are from a list of only about 47 names.¹⁹ The Directors were largely merchant types with no extensive overlap with identifiable GSBs, with the only significant exception of the overlap with the Child & Company partnership discussed in the previous section. In the analysis to follow we have excluded the Childs from the group of EIC Directors. We shall also include in this group some other prominent Company servants, a few of whom appear in the group as Directors in any case. These are the maritime captains who most frequently provided and commanded ships in the service of the Company (Hardy, 1800). When put together with the group of

¹⁹ The names of Directors formally appear in the Minutes of the Courts of Directors, IOR B/255. No Director could serve more than four continuous terms as a Director and would have to possess £2000 nominal stock to qualify for election. See Chaudhuri (p. 132, 1978) and election by-laws contained in East India Company, *A list of the names of the members of the United-Company of Merchants of England, Trading to the East-Indies, the 28th of March, 1721.*

individuals who served as Directors, we have a list of 116 individuals that we can call the EIC Director and company servants group.

Now let us refer to what can be supported by the evidence in Fig. 11. As a group EIC Directors would have to own, at a minimum, 1.5 percent of total stock outstanding.²⁰ In our period, however, it appears that Directors generally never owned less than 5 percent of the Company's equity. The Directors too did not trade much with each other and did not appear to trade much with the public except during the crisis of 1720. There is some evidence that at the height of the Bubble, they did act as intermediaries in EIC stock trade (Fig. 16). This is the only period in which Director-mediated trade was as high as 20 percent of total trade. And although we can never know the value terms at which such trades took place, their timing appeared to be far from propitious for the Directors; their net purchases of shares was greatest when share values were high and they disgorged much of their holdings only after share values had largely collapsed. Only very briefly in September 1720 did they own as much as 10 percent of firm equity.

There is thus every appearance that Directors attempted to act as intermediaries in EIC share trade during the Bubble, but did little before or after the Bubble to continue to facilitate trade in shares. Other companies such as the BoE, the South Sea Company and the Royal African Company hoped to support the markets in their shares by providing loans to shareholders upon the security of their shares. The popular theory was that if shares were pledged as collateral for loans, pledged shares would be removed from the net supply of shares and the provided loans would increase the demand for shares and, hence, market values of shares would be enhanced. We have found no evidence that the EIC Directors even considered such a

²⁰ 24 Directors times the minimum qualification per Director (£2000) would be £48,000, or 1.5 percent of the approximate £3.2 million stock issued and outstanding.

policy; it appeared instead that Directors understood that their own personal wealth would have to be used to support trade in EIC shares. This evidence compares interestingly with Fig. 5.5 presented by Neal (1990). The pattern of the rise and fall of stock ownership for BoE directors found in that figure mimics very closely what is found in the bottom half of Fig. 12. Neal (1990) attributes these actions to the desire by BoE directors to be accommodating to the South Sea Company's planned debt-equity swaps by means of injecting liquidity into the markets through open-market purchases of BoE shares. It is difficult to attribute the same motives to the EIC directors and thus we think it is more likely that both sets of directors merely felt that their personal actions supported their own companies' equity market trade and values, else we would observe directors purchasing across a spectrum of shares instead of just their own firm's shares. In Fig. 16 it appears that BoE Directors were less willing than were EIC Directors to act as intermediaries in their own Company's stock. We also observe (Figs. 11 and 12) that, in the longer term, directors reduced their holdings of shares in the opposite firm and increased their holdings in their own firm's shares. In summary, the importance of company directors as holders of stock and as intermediaries was brief and spanned only the summer and early autumn months of 1720.

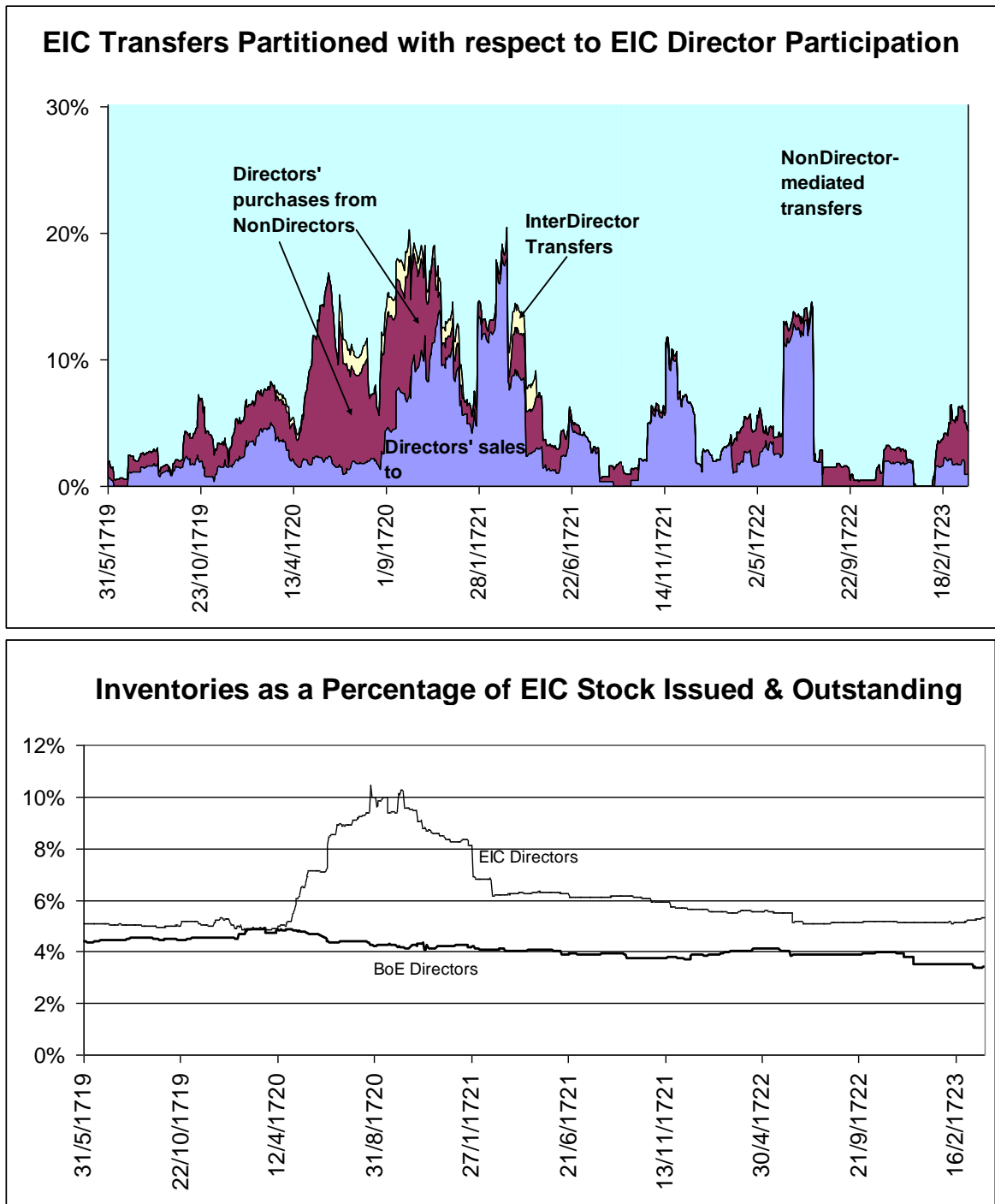


Fig. 11. Company Directors' Trade and Inventories of EIC Stock

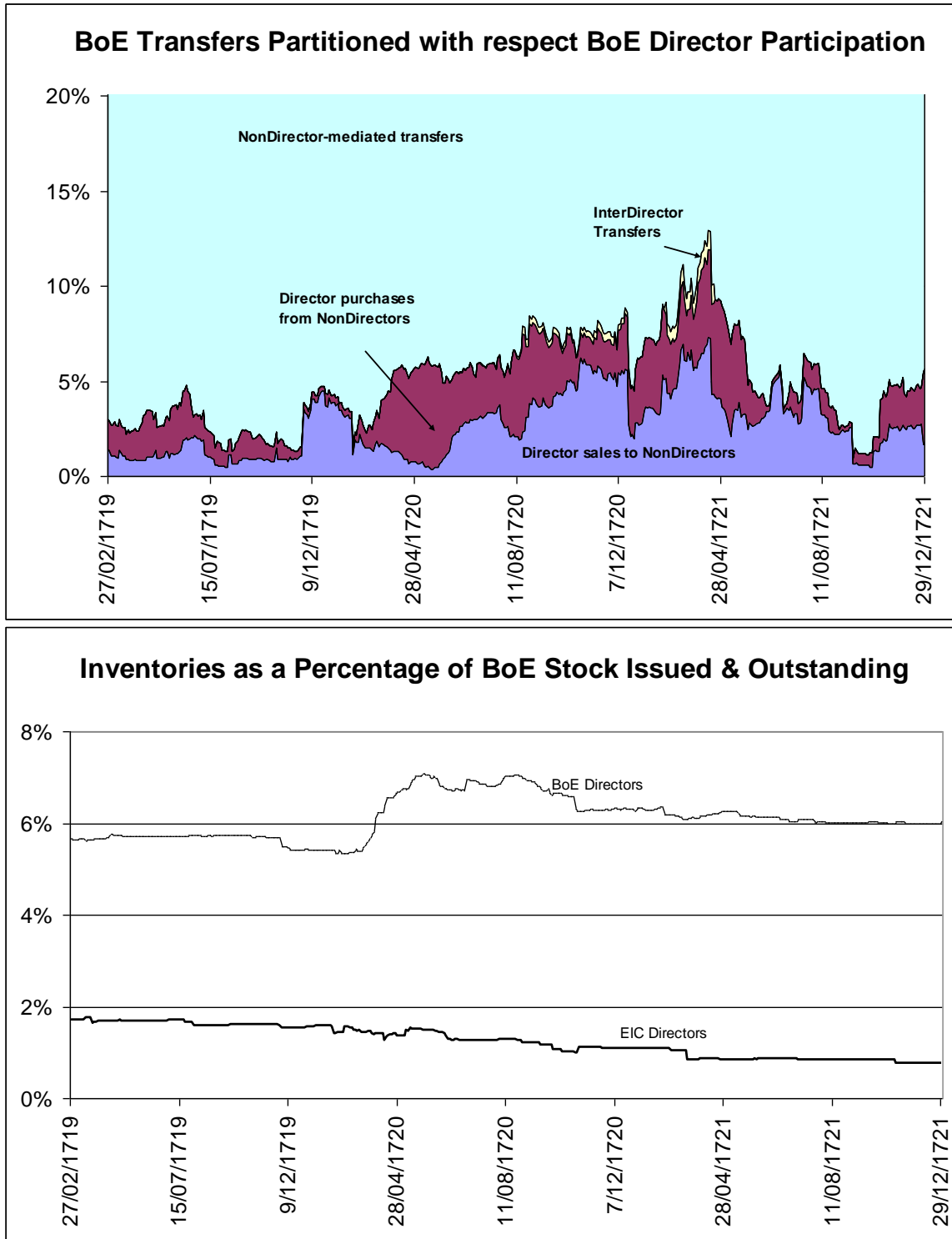


Fig. 12. Company Directors' Trade and Inventories of BoE Stock

8. Foreign ownership and trade in shares

It is now widely known that the earliest European financial centres were built upon foundations of international commerce. Wherever was located a port through which a certain scale of international trade flowed, there was the likely spot that institutions that facilitated payments and investments would grow. In the early modern period and up to the events of 1720, London and Amsterdam had far outstripped other European port cities in these regards. To such a scale did trade and financial institutions develop that Carlos and Neal (2011) argue that London and Amsterdam could follow and did follow different specialisations in finance, the former developing a market-orientated system and the latter developing a more bank-based system. With two different, but complementary, systems developing on either side of the North Sea, payment systems for the settlement of imbalances in trade accounts naturally developed along with foreign merchants' interest in holding British investments. Neal (ch. 5, 1990) has argued that the interest of foreigners in British investments in 1720 was especially enlivened for several reasons. First, the supply of investable funds flowed towards Britain naturally as continental asset values collapsed in late 1719 and in early 1720. Secondly, the timing of Dutch interest in BoE stocks after the collapse of the Bubble might have been piqued by the speculated role the Bank would play in the settlement of the crisis. In this section we can present additional data on foreign, especially Dutch, participation in the South Sea Bubble. We shall see that the foreign investment and intermediation in 1720 were different in the two stock markets that we examine.

Although some foreigners were prominent bankers and had operations in London, in the main they had no overlap with either of the two groups we have considered so far – the GSBs and company directors. In our database we can identify 691 foreign accounts who were owned majorly by 553 Dutch investors. There were

another 26 individuals besides who resided in what would now be called Belgium. Along with these groups we have identified 67 Swiss, 26 Germans, 10 French, 6 Italians and 3 Portuguese owners of stock. It will be of little surprise to historians that we can affirm that Dutch ownership and trade in shares was several orders of magnitude larger than ownership and trade commanded by all other foreign nationals combined (Figs. 13 and 15).

Dutch ownership in the EIC was proportionally larger than it was in the BoE. Dutch interest in EIC investment started before the South Sea Bubble and Dutch buying was sustained into the rising market for EIC shares and also after prices in that market started to collapse. Dutch interest in EIC investment indeed seemed to be invariant to what was happening to EIC share prices or to what was happening to exchange rates (Figs. 13 and 14). The literature that treats with the issues of capital flight from the continent towards London interprets the broad trends in exchange rates in Fig. 14 in that light. The flight of capital was supposed to have fuelled the South Sea Bubble at the end of 1719 and in early 1720 and may have been a response to the collapse of the Law System in France. The later outward flows supposedly took place in the wake of the South Sea Bubble as foreigners sold British assets to meet their more stringent credit needs abroad (Neal, 1990). Capital-flow trends in the large would of course not necessarily be reflected in observable trends in British equity capital ownership. Equity capital would have been just one type of British capital assets that foreigners could have invested in. But in being one of the most fungible (many such assets being tradable abroad, as well as in London), we might expect that foreign investment was especially concentrated in British public corporate liabilities. In terms of BoE share ownership, Carlos and Neal argue that if there was a relative shift towards foreign ownership and away from domestic ownership in shares, it took

place after the South Sea Bubble.²¹ The earlier foreign investment in the EIC during the Bubble is a contrast to such investment in the BoE.

As was the case for the BoE, there was a substantial increase in the foreign ownership in the EIC. We find, however, the increase was the product of an increase in Dutch ownership of shares throughout the South Sea Bubble period and not afterwards. This is in stark contrast to Fig. 15 and to Fig. 5.6 in Neal (1990), which show that the largest increases in holdings of BoE stocks occurred after September 1720 and not before. As we have mentioned already, Neal attributes this to especially large block purchases by Dutch investors who were especially interested in influencing the Bank's decisions with regard to the large-scale financial restructuring plan for the South Sea Company and the Bank that was being proposed by elements in Parliament and in the two companies. The modest increases in NonDutch foreign holdings distinctly followed after the crisis. The Dutch were different and the fact that they rapidly increased their holdings of EIC stock throughout 1720 stands in stark contrast to the history that links the credit crisis with large outflows of foreign capital from London in the latter half of 1720. Of course, it is always possible that EIC equity investment was especially attractive to foreigners at this time relative to other British investment opportunities so that, even in a period of general capital flight abroad, there would still be an increasing net foreign demand for EIC shares. In this regard there is the evidence (Fig. 16) that foreigners largely replaced GSBs in the provision of intermediation services in the markets for EIC shares. They may have gathered larger inventories in their efforts to provide these services.

In Fig. 14 we illustrate the 6-month moving average of the percentage rates of increase/decrease in foreign ownership of shares and compare those to the broad 6-

²¹ Carlos and Neal (p. 524, 2006).

month rates of depreciation in exchange rates between London and Amsterdam. This serves to illustrate the respective differences in timing in foreign accumulations of shares and how they relate to the two separate exchange-rate episodes of 1720. Of course we cannot reconstruct causality without the aid of a model that simultaneously explains domestic/foreign net demands for stocks and exchange, but at least we have shown here that foreign demand for shares, overwhelmingly dominated by that of the Dutch, may have prompted strong exchange rate appreciation and, at the very least, was not attenuated by rapidly appreciating sterling in the middle third of 1720. We have also parenthetically demonstrated that NonDutch continental demand for EIC shares may well have been responding to different factors than those which were important to the Dutch.

Foreign demand for the two stocks may have arisen from distinctly different groups of foreigners even though they might have shared the same Dutch nationality. In the case of EIC stocks, the foreign interest came from a merchant class that showed that it was also interested in carrying on an intermediate trading role – taking over to a large extent from the GSBs. The post-Bubble surge in foreign demand for BoE stocks, in contrast, resulted in no intermediation in BoE stock trade. We leave for later study an attempt to more finely discriminate amongst Dutch investors and why they appeared to have behaved so differently in the two separate markets for shares.

What we have seen so far are three data partitions that are as interesting in the behaviour in financial intermediation contained within them as they are distinct as divisions along social or professional lines. The placement of persons on a social network clearly connects intimately with economic behaviours during the South Sea Bubble and in the next section we shall see this again when we consider the role of the Jewish merchant community.

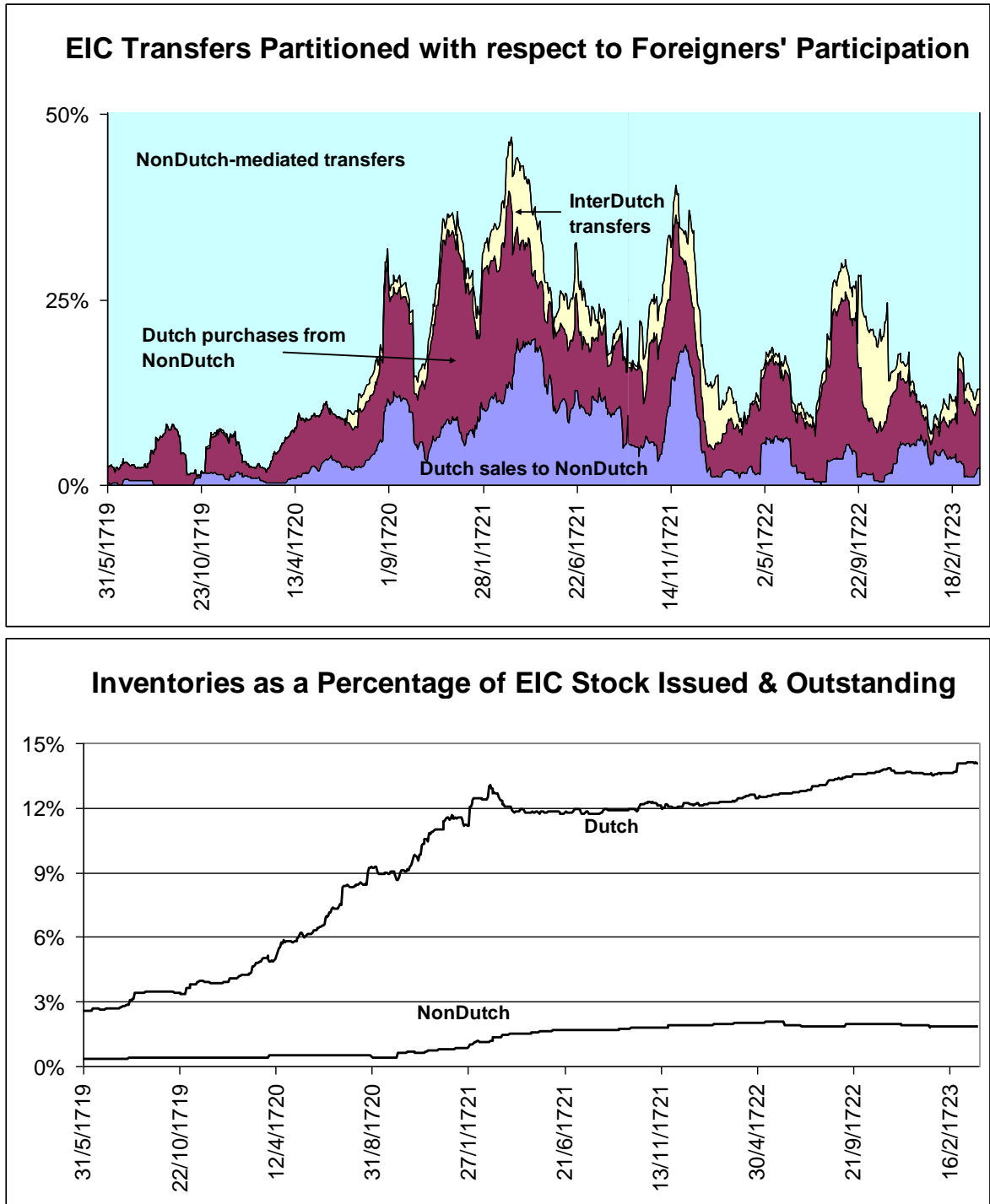


Fig. 13. Foreign Trade and Inventories in East India Company Stock

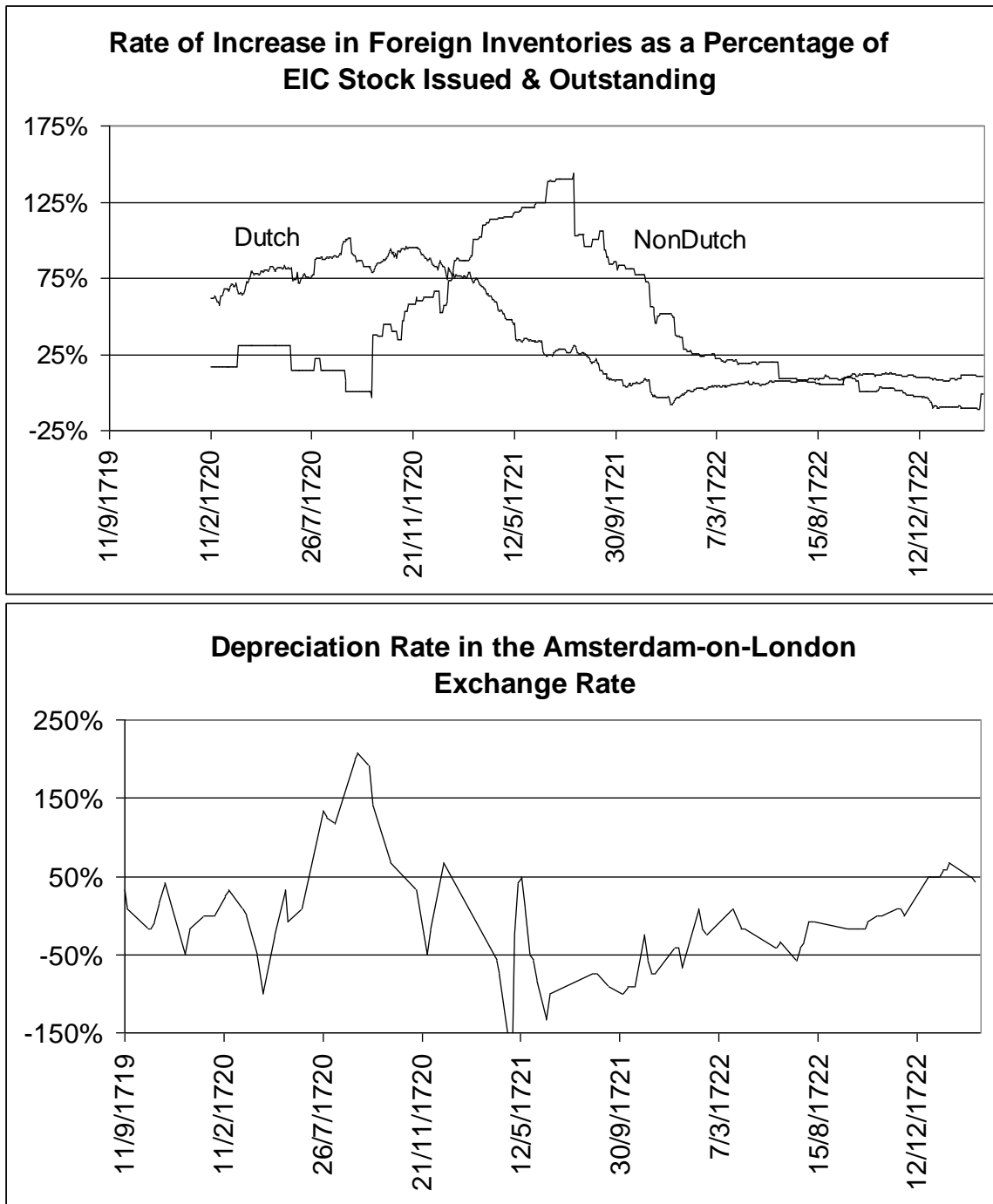


Fig. 14. Six-Month Percentage Rates of Accumulation of Foreign-Owned EIC Stock and Foreign Exchange Depreciations in London.

N.B. The exchange rate used in the lower panel is the twice-weekly-reported 2-month schellingen banco/pound exchange rate in London described and analysed by Neal (pp. 64-80 and 104-17, 1990).

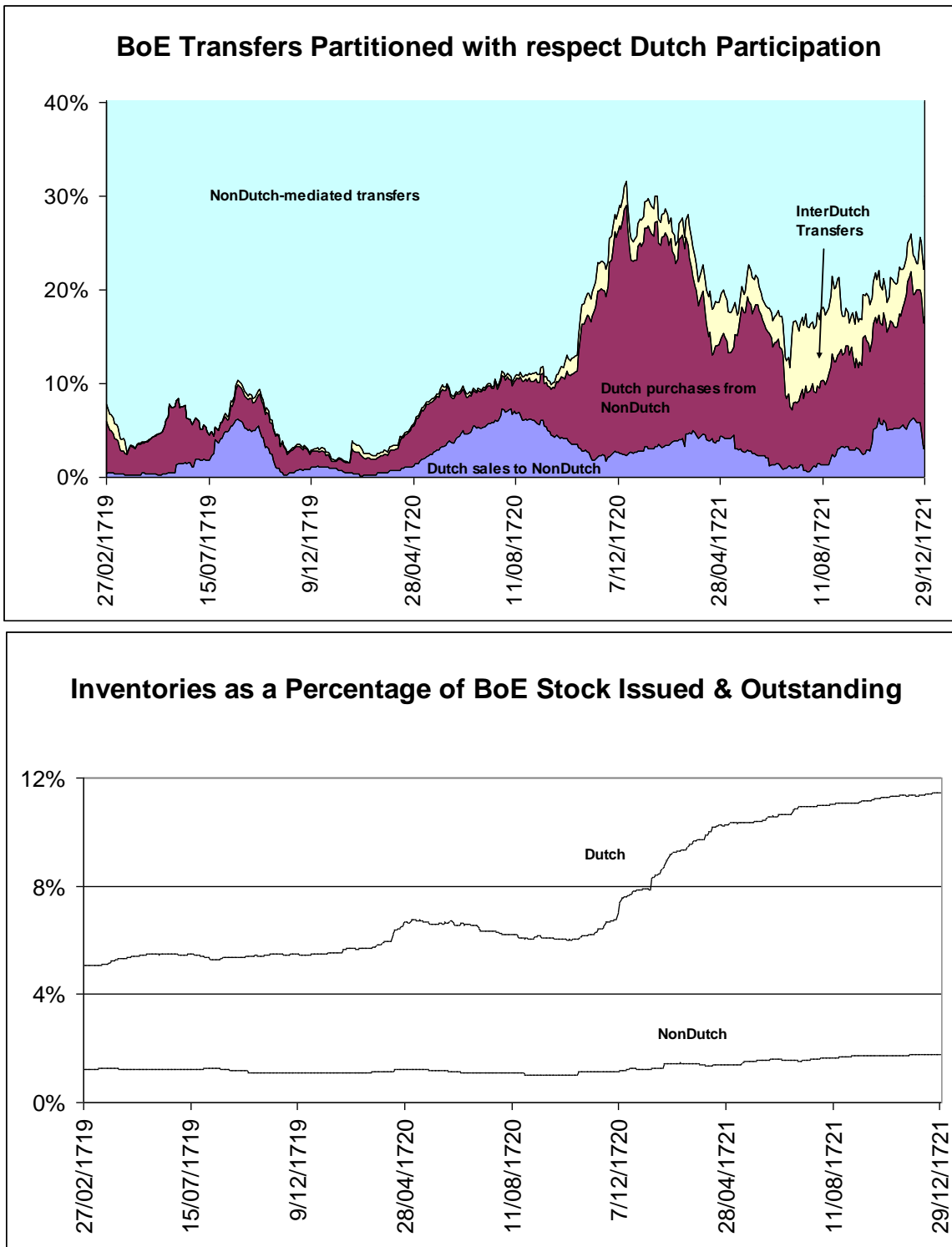


Fig. 15. Foreign Trade and Inventories in Bank of England Stock

9. Market intermediation and the Jewish merchant community

The Jewish merchant community was prominent in the commercial life of London in the early 18th century and played a role in the markets of 1720. It included both British and nonBritish domiciled merchants, so many of the foreigners, Dutch in particular, with whom we treated in the previous section would have been Jewish. But the Jewish community that resided in Britain was also prominent in financial circles and shall be treated here as the basis for another network partition. Carlos, Maguire and Neal (2008) apply some notions of network connections and distance within a network to try to place the Jewish community within BoE market networks of the period. We undertake here a network approach as well, but one based upon the devisings we described in Section 3 of this paper. This is appropriate because we wish to close this paper with the argument that the Jewish merchant community, both domestic and foreign, stepped in and replaced the GSBs as major intermediaries for market trade after the South Sea Bubble. The position of a few Jews with respect to the declining position of Sir George Caswall that is discussed by Carlos, Maguire and Neal may well have epitomised a shift between the whole class of GSBs and the Jewish merchant community in the stock markets.

In Section 3 we argued that the flow of pass through (PT) relative to total sales was a natural way to measure intermediation in a network. Secondly, we stated that well-connected PT, or core pass-through (CPT), relative to PT was also a natural way of measuring the density of intermediation. By both measures trade in shares was increasingly dis-intermediated in the wake of the South Sea Bubble. PT amounts to at least 50 p.c. of sales. The percentage is higher for EIC trade than it is for BoE trade, but for both companies it undergoes a steady decline after 1720 (top panel, Fig. 16). Although in Fig. 3 node-degree centrality seemed to increase after the Bubble, this

conveyed a misleading impression that the market in shares was somehow becoming re-integrated. Trade was not restored as flows between well-connected intermediaries; Fig. 3 only showed that sellers simply tended to sell to greater numbers of individuals and, similarly, buyers tended to buy from a larger number of sellers than before. Neither were these new buyers nor sellers more likely to deal with intermediaries, nor were they more likely to become intermediaries than they were before the South Sea Bubble.

In the case of EIC trade, PT was almost always entirely CPT, whereas for BoE trade it was only occasionally that the majority of PT was CPT (second panel, Fig. 16). Densely intermediated trade declined for both stocks after the Bubble, but the decline was precipitous and absolutely larger for BoE trade than it was for EIC trade. Within CPT we can see the fleeting roles played in trade by company directors (bottom two panels, Fig. 16). We can also see more clearly that the increasing prominence of foreign owners of stock was also nuanced between the two types of shares; although foreign stock owners were measurably larger parts of share ownerships after the Bubble, they were much more likely to be intermediaries in trade of EIC stocks than they were for BoE stocks. The Jewish merchant intermediary was always present as an owner of EIC stocks and, together with foreigners, took over intermediation from GSBs *pari passu* with the latter's decline. In the case of BoE trade, however, the Jewish merchant intermediary was a creation of the South Sea Bubble and its continued prominence alone after the Bubble could not maintain CPT as a majority share in PT.²²

²² Carlos, Maguire and Neal (2008) argue that the Jewish community may have filled holes in market and social brokerage. We see evidence for that here for both shares, although we could argue that it was larger and more pronounced in the markets for EIC shares than it ever was in the BoE share markets.

The Jewish merchant community did much to replace the GSBs as financial intermediaries after the South Sea Bubble. But these groups could not perfectly replace the GSBs so that the scale and density of intermediation could remain what it was before the Bubble. Part of the reason might have been that dealership as a form of intermediation was not as efficient as would have been brokerage. No group surpassed the GSBs as brokers and as important as Jewish and foreign merchants became in stock trading, they did so only by holding larger than average inventories of stock (Figs. 10 and 11, Shea, 2011).

These trends are open to opposed interpretations that require further investigation. We can think that intermediation declined and became more inventory-centric after the South Sea Bubble as an indication that markets operated at a lower trading efficiency than in the past. On the other hand, low-inventory trade was prior to the Bubble dominated by especially large and perhaps overly influential traders, particularly the GSBs. It remains unclear whether their demise (and we have not yet established if this demise was permanent) as dominant traders was a bad or good thing from the perspective of British security market development.

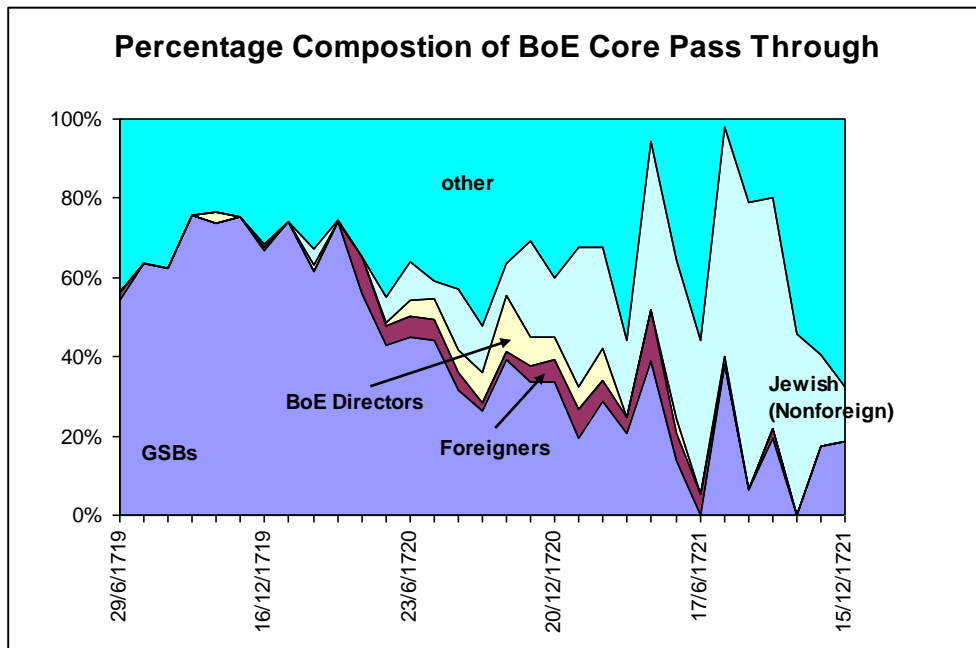
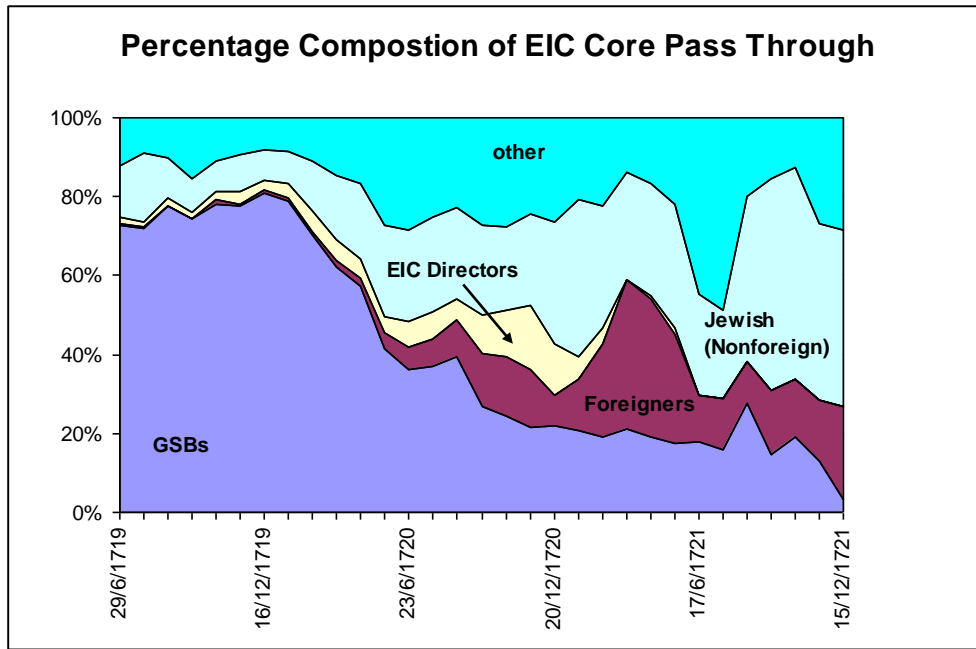
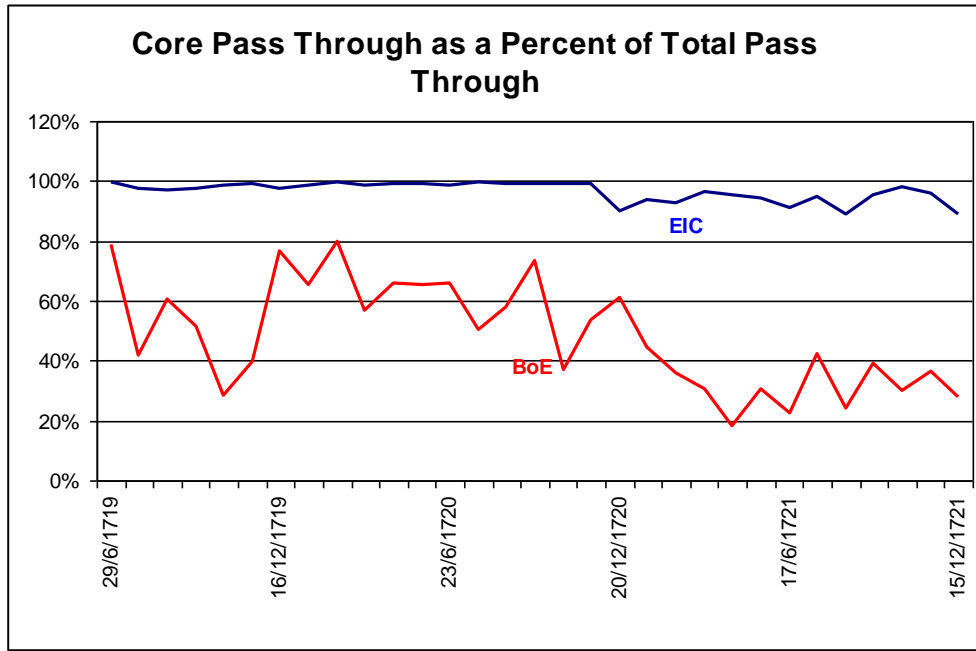
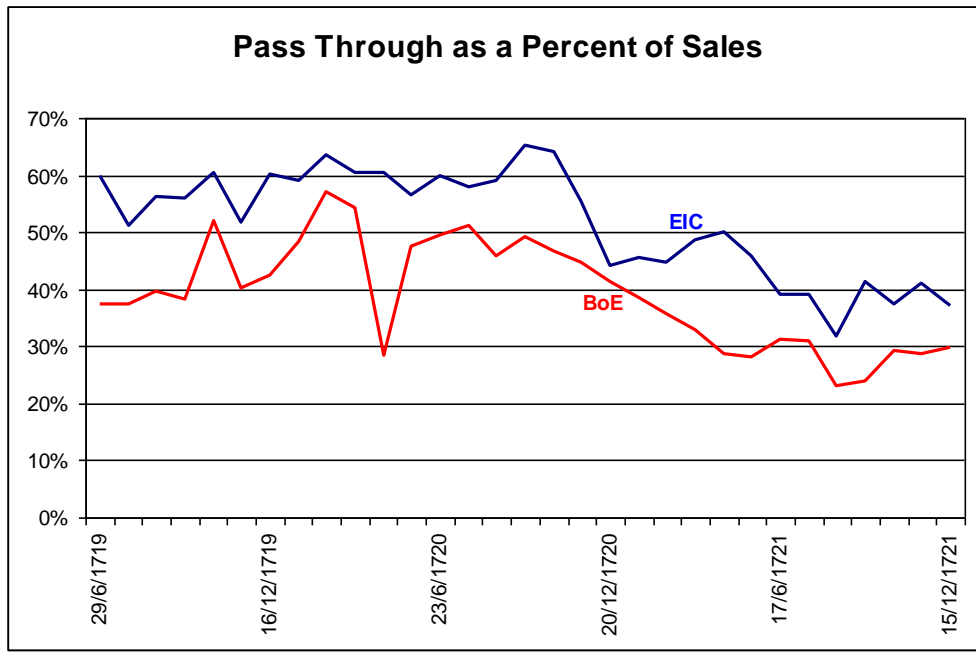


Fig. 16. Intermediation and Composition of Intermediation in terms of Pass Through and Core Pass Through.

10. Conclusions and directions for further research

In this paper we have undertaken a network analysis of the contemporaneous ownership and trade in EIC and BoE shares before, during and after the South Sea Bubble. The facts surrounding the trade in EIC shares are new. EIC shares were traded in larger blocks and more frequently than were BoE shares so that total trading turnover of the former company's stocks was about 50 percent higher than it was for shares in the latter company. EIC shares were riskier than were BoE shares and the benefits in terms of risk reduction in owning both shares were substantial. Not surprisingly, there was substantial cross-holding of shares of the two firms. BoE shareholders were marginally more likely to also be EIC shareholders than it was likely that EIC shareholders would also be BoE shareholders. We also found that owners of large amounts of stock were more likely to be owners of shares in both firms. The ownership of the two firms was always quite diffuse, but it became slightly more so after 1720.

In analyses of the trade and ownership of shares in a network structure we have found that separate analyses of partitions along social and professional lines were helpful. There were four distinct network partitions investigated. The partitions were respectively based upon: i) a collection of goldsmith bankers & brokers (the GSBs); ii) company directors; iii) foreign owners of shares and iv) British-resident Jews. There was a very heavy representation of merchants in the latter two groups. Before the South Sea Bubble, more than 70 percent of trade was going through the hands of the GBS group alone. As the Bubble progressed, the trading prominence of the goldsmith bankers collapsed, but was replaced by trade going through the hands of company directors (only temporarily), foreigners and Jewish merchants. At the same time markets generally became more dis-intermediated, although to begin with the

markets for BoE shares were markedly less subject to intermediation than were the markets in EIC shares. We also saw that intermediation tended to pass away from brokers and came more into the hands of dealers. The major dealers in stock were the Jewish merchant class of London and together with foreigners did much to supply the intermediation that was previously in the hands of GSBs, who acted more like brokers. At least that is a story that fits the markets for EIC shares. In the markets for BoE shares, the Jewish merchant class appeared as intermediaries relatively late in the Bubble period and foreigners never played as extensive a role as they played in the EIC markets.

The most interesting historical questions raised by our analyses concern the control of trade before and after the South Sea Bubble and the health of markets. For example, did the South Sea Bubble damage the secondary markets for shares? After the Bubble, intermediation in the markets was not quite as important as it was before and intermediation was carried on more by dealers than by brokers. This would not necessarily be a bad thing for the development of markets. The actions of GSBs, especially in the EIC market, prior to the Bubble are especially interesting and may even have been suspicious. GSBs clearly dominated not only trade volumes, but their actions dominated trends in inventory accumulation and within their group large portions of trade were gathered into the hands of just a few individuals. This GSB dominance also clearly disappeared prior to the summer of 1720. So, were they efficient purveyors of trading services and did their subsequent demise bring trading inefficiencies to the markets that were not there before? Or could it have been the case that a rapid accumulation of shares and the dominant role they played in intermediation prior to the Bubble allowed GSBs to become overly influential and to become a barrier to efficient social learning about the true values of shares? This

could happen in a social learning model such as that presented by Golub and Jackson (2010). On that interpretation their demise was perhaps good for the efficiency of markets. We suspend judgement on these matters pending some further planned studies of the GSBs.

A priority therefore is to extend EIC and BoE network data to years outside of the 1719-21 range. In particular, we wish to confirm whether GSB prominence in the share markets substantially pre-dated 1719 and whether it was revived after 1721. There is yet another dataset to be added to the network trading database. For trade and inventories in the Royal African Company's (RAC) subscription shares in 1720 we can construct the same data structures that we have employed in this paper. The RAC's subscription shares were very, very risky securities indeed and on that basis alone their trade network will bear interesting comparison to the trade networks of EIC and BoE shares. Clearly too an effort is now required in developing behavioural models of financial intermediation (with inventories) on a network. Why social and professional affiliations would appear to be correlated with the scale of intermediation (PT), the density of intermediation (CPT) and the style of intermediation (brokerage vs. dealership) remains unclear. In these ways network analysis can supply new directions for quantitative research about the South Sea Bubble and might go some way towards restoring the "discipline of counting" whose absence Hoppit (2002) deplored in the literature of the South Sea Bubble.

Appendix A: Data sources, methods and data structures

From the 1720's there are three types of stock record that we could potentially use to study stock ownership: a) stock ledgers; b) transfer books and c) subscription lists.

The structure and logic of stock ledgers and transfer books, in the instance of the BoE records, have been fully discussed.²³ There are no existing transfer books for East India stocks, but there do exist complete sets of stock ledgers. Since stock ledgers from this era record transfers to and from accounts in a double-entry manner as debits and credits, we can re-construct from them the complete trading history of shares. We have attributed to all legal persons who appear in such sources unique identification (account ID) numbers. The methods we have used to identify individuals and to distinguish between them are varied and are described below. With the complete trading history of a stock we can also work either forward or backwards from the record of stock ownership on a particular date to re-create any individual's stock inventories for any other particular date. This is simply done by calculating net sales of shares by each and every individual through to a particular period and then by adding their net sales to their inventory of shares as recorded in a stock ledger. Since we can reconstruct all account-holders' inventories through time, we can also reconstruct the "vintage" of such inventories. An inventory's vintage is a weighted average of the lengths of time over which stock in the inventory is held. For example if £500 stock held consisted of £300 held for 100 days and £200 held for 50 days, the average inventory vintage is $(£300 \times 100 + £200 \times 50) / £500 = 80$ days.

²³ Carlos and Neal (2006), pp. 504-6.

EIC Data

We use one source for ownership and trade in EIC (EIC) shares, the Stock Ledger F, IOR L/AG/14/5/4.²⁴ This ledger covers the entire South Sea Bubble era. All persons credited with stock in this ledger either owned the stock on 25 March 1719 (credited from Stock Ledger E, IOR L/AG/14/5/3) or purchased stock after that date. Similarly, all persons who owned stock on 25 March 1723 are credited with stock in the next ledger in the series (Stock Ledger G, IOR L/AG/14/5/5). From it we could have recorded an actual stock balance ledger for either 25 March 1719 or 25 March 1723, but because we have recorded only the “debit” side (the side on which sales of shares are recorded) of each folio in the ledger, the basic stock balance and distribution that we have recorded is for 25 March 1723.²⁵ We can construct, however, virtual stock ledger balances for any date prior to 25 March 1723, as we have discussed above, by deducting net sales of shares backward from 25 March 1723. In this way we have computed the net stock balances for all accounts that appear in the ledger for 25 March 1719 and have compared them to the written stock balances that appear in the original ledger. Our computed stock balances and the actual stock balances match perfectly and so we are particularly confident in the quality of the trading data that we have for this company. At the very least we are confident that it perfectly reflects the information contained in the original stock ledger. The resulting accuracy with which we can trace EIC shareholders’ ownership through time owes much to the painstaking and self-checking nature of the accounting methods used by EIC clerks in this era.

²⁴ India Office Records, British Library.

²⁵ The original manuscript included 752 pages from which we coded nearly 12,000 lines of data.

BoE Data

Much of the information we have as to the identities and social and economic characteristics of our East India shareholders results from the study of a subset of the database that informed the study of BoE (BoE) shareholders (Carlos and Neal, 2006). This subset of data consisted of transcriptions from the BoE transfer books AC27/1539-1558 and encompassed transactions for the years 1719, 1720 and 1721. These data were contained in three spreadsheets and related to these was another spreadsheet that recorded the balances of BoE shares held by individuals in 1725.²⁶ In this last spreadsheet the holders of stock in 1725 (amounting to in total to £8,953,622 stock) had a recorded overlap with the set of the individuals who held stock in 1720, but the union of these two sets held stock to the amount of only £4,089,771, which was less than 80 percent of the total amount of stock issued and outstanding in 1720. So, we have gone back to the original sources²⁷ and found additional stock accounts and can now account for the total of £5,563,080 of nominal stock that was outstanding on 29 September 1720. With reliable balances for individual accounts we could then use the transactions data to calculate net sales from accounts and to produce virtual stock ledgers in precisely the same manner as we did for our East India data. In the process of doing this we also discovered in the stock ledgers a good number of transactions (nearly 100) that either are not to be found or were missed in the BoE transfers books. On 29 September 1720 there were 2961 accounts in the ledgers holding the £5,563,080 stock outstanding. Many of these, however, were trust accounts. In particular, there was a very large trust account in the names of several Bank Directors that held all the stock that was pledged as security on loans the Bank

²⁶ Our thanks to Larry Neal who provided these spreadsheets.

²⁷ This was based upon data extracted from BoE stock ledgers and their indexes, AC27/430-437 and the additional stock ledgers, AC27/6439-6450.

was making to shareholders at the time. On 29 September this account alone held £1,024,150 on behalf of 270 other accounts. So altogether on 29 September 1720 there were 3,231 accounts in ownership of stock. A number of these accounts were under joint-ownership, so that 3,230 accounts contain stock owned altogether by 3,375 individuals. Among the 3,230 accounts there also were a handful of institutional accounts, but we have treated each institution as one person in our count of 3,375 individuals.²⁸

Every stock account in our databases has a unique ID number regardless whether the owner is a unique individual or a multi-person entity, such as in the case of a joint account or in the case of an institutional investor. One problem in assigning reliable ID numbers to individuals is to distinguish amongst individuals who have names in common. Any very common surname was very likely to be linked with common forenames for a goodly number of different individuals.²⁹ There are also people who have multiple identifications. We have, for example, accounts for widows and spinsters in one name and accounts for the same persons elsewhere in the ledgers labelled with their later married names. We have some prominent shareholders who held BoE accounts in one name and then later have other accounts labelled with their titles. As explained elsewhere, the BoE transfer books and stock ledgers link the names of buyers and sellers of stock to accounts that appear on various folio pages in the stock ledgers. The careful sorting and re-sorting of the spreadsheets by names and ledger folio numbers gave us a start in assigning unique ID numbers to individuals.

Related to this information is all the occupation and address information that was

²⁸ Carlos and Neal (2006) report that on 29 September 1720 they can account for 3,163 BoE shareholders.

²⁹ The surname would not necessarily even have to be particularly common to present difficulties. Difficulties could arise in distinguishing between members of families with common forenames. We have for example three closely related Benjamin Dry's who have accounts in EIC stock.

recorded in either the stock ledgers and their indexes or the additional stock ledgers, AC27/6439-6450. Because of the socio-economic information about investors that are contained in the BoE sources, considerable synergies in identifying people were achieved when we started to link the BoE data with that for investors in EIC shares.

Even further synergies in identifying people have been achieved as we merge our EIC database and the BoE database with similar databases for owners of Royal African Company (RAC) stock and subscription shares. These too have spreadsheet form now and encompass a description of RAC share ownership at the end of 1719 (T70/197), a highly fragmentary record of trade in RAC shares in 1720 (T70/198), and a complete set of transfer books for RAC subscription shares for 1720 and 1721 (T70/199-202). We do not study these RAC sources in this paper, but leave their study for a future paper.

Network Graph Data Structure

The structure of our data describes a dynamic, multiple directed edge network graph, or what would be commonly called a dynamic multidigraph. The nodes or vertices of the graph are the ID numbers of individuals and account holders whom we have already identified directly from the BoE and EIC sources discussed above or from other sources. The graph is a directed graph because each node can be identified as either a seller or a buyer of stock and we define an edge which connects two nodes as a directed edge from seller to buyer. The resulting edge has a numeric weight associated with the nominal size of the trade.

The trade weight of every edge is a time-dependent attribute of that edge. As a general rule we associate time-dependent characteristics of trade and traders with edge attributes only. Edge attributes therefore include not only trade-weights, but also

include the date of the trade, the type of stock traded (EIC or BoE), the stock inventories of the seller and buyer and the average vintages of the stock inventories of the seller and buyers. Even non-trading activity can be recorded within this data-structure; we employ the device of self-edges or selfloops, as they are more commonly called, to refer to trade (with oneself) in which the edge weight is recorded as zero. Thus a person who holds stock, but does not trade on a particular day, will be assigned a zero-weighted selfloop for that day. Even persons who have not yet entered or who never do enter into active stock ownership and trade can be recorded as isolated nodes in this graph; they are simply assigned zero-weighted selfloops with zero-inventory and zero-inventory-vintage attributes.

Attributes of trade and traders, especially social affiliations, which are distinctly less time-dependent are associated with the nodes. Node attributes are recorded only as binary variables. Obvious examples of such attributes are gender and social and economic characteristics of persons, such as those that were prominently featured in analyses of BoE shareholders (Carlos and Neal, 2006). Just as edge attributes are mutable or time-dependent attributes, best measured on a continuous line, node attributes are immutable and are best measured as binary 0s and 1s. Although nowadays gender can be thought of as mutable, we treat early 18th-century gender as an immutable attribute. Social and economic classifications of individuals can of course change and are not, strictly speaking, immutable, but we treat them as so. So, for example, an individual may not be a Member of Parliament at all times, but that does not prevent us from treating him as a member of a parliamentary class at all times. Indeed, in this instance, the list of all members of all the Parliaments immediately before, during and after the South Sea Bubble is precisely how we define

the parliamentary class.³⁰ This list of members is also part of our graph's node list, so our graph does indeed include individuals who never trade and never own stock. Social and economic characteristics can also be multiple and we record them as such. Thus a person may be of the merchant class, the parliamentary class, a BoE director or the captain of an EIC ship³¹ and may also be a knight. The list of all possible node attributes is possibly infinite in length, but in the current version of the database the length is limited to those attributes that we can confidently make binary assignments for all node IDs.

³⁰ The list was compiled from Sedgwick's, *House of Commons, 1715-1754*, Volumes 1 and 2. We are currently expanding the enumeration of the parliamentary class by adding lists of sitting House of Lords members to the database.

³¹ A company director must hold (but not necessarily) trade stock in his own company, but an EIC captain would not necessarily be an EIC stock holder and trader, although he sometimes was. The company director class was compiled from the periodic lists of newly elected directors that appear in the minute books of the EIC and the BoE. The EIC captains' list is compiled from lists found in Hardy (1800).

Appendix B: The top traders in East India Company stock CPT, 1719-21

29/6/1719	29/7/1719	28/8/1719	26/9/1719	17/10/1719	16/11/1719
Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *
Jacob Sawbridge *	Moses Hart *	John Mead *	John Mead *	John Mead *	James Colebrook *
John Mead *	Thomas Martin *	Thomas Martin *	Duke of Buckingham	James Martin *	Thomas Martin *
Moses Hart *	John Mead *	Duke of Buckingham	Thomas Martin *	Thomas Martin *	James Martin *
Thomas Martin *	Moses Da Medina	Moses Hart *	James Martin *	Duke of Buckingham	George Middleton *
Samuel Lesingham *	George Middleton *	George Middleton *	George Middleton *	James Colebrook *	John Emmet *
Moses Da Medina	Johanna Cock *	Johanna Cock *	John Emmet *	John Emmet *	Isaac Fernandes Nunes
Duke of Buckingham	Samuel Perry	John Emmet *	Jacob Mendes Da Costa	George Middleton *	Edward Coull *
Abraham Edlin *	John Marke *	John Marke *	James Colebrook *	Isaac Fernandes Nunes	John Mead *
Isaac Fernandes Nunes	George Wanley *	Samuel Perry	Rt Hon Bridget Fauconberg	Jacob Mendes Da Costa	George Wanley *
George Middleton *					
16/12/1719	25/1/1720	24/2/1720	18/3/1720	22/4/1720	24/5/1720
Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *	Elias Turner *
Samuel Strode *	Samuel Strode *	Samuel Strode *	Thomas Martin *	Thomas Martin *	Thomas Martin *
Thomas Martin *	Thomas Martin *	Thomas Martin *	George Middleton *	Isaac Fernandes Nunes	Moses Da Medina
James Colebrook *	George Middleton *	John Mead *	Isaac Fernandes Nunes	Moses Da Medina	Isaac Franks
Moses Hart *	James Colebrook *	George Middleton *	Moses Da Medina	George Wanley *	James Buck
George Middleton *	Moses Hart *	Isaac Fernandes Nunes	Nathanael Brassey *	Robert Jacomb *	Isaac Fernandes Nunes
John Mead *	Abraham Edlin *	Moses Hart *	John Mead *	Nathanael Brassey *	Samuel Strode *
Abraham Edlin *	John Mead *	Robert Jacomb *	Robert Jacomb *	George Middleton *	Gabriel Lopes
John Emmet *	Duke of Buckingham	Moses Da Medina	Edward Owen	John Mead *	James Martin *
Edward Coull *	Isaac Fernandes Nunes	Duke of Buckingham	Gabriel Lopes	Gabriel Lopes	Sir Justus Beck

N.B. The lists show in rank order the top traders in EIC stock who facilitated core pass-through (CPT) in the quarter ending on the dates shown at the top of each list. Ranks 1 through 10 are listed, with more than 10 persons listed whenever one or more than one individual shares a rank with another. ‘*’ denotes a member of the GSB-class.

Continued on next page.

23/6/1720	23/7/1720	22/8/1720	20/9/1720	21/10/1720	19/11/1720
Elias Turner *	Elias Turner *	Elias Turner *	Lord Londonderry	Mathew Decker	Mathew Decker
Thomas Martin *	Thomas Martin *	Isaac Franks	Richard Lockwood	Lord Londonderry	Richard Lockwood
Isaac Franks	Isaac Franks	Thomas Martin *	George Middleton *	Richard Lockwood	Joseph Musaphia
Moses Hart *	Moses Hart *	Moses Hart *	Mathew Decker	Joseph Musaphia	Lord Londonderry
James Buck	James Buck	Conelius Backer	Joseph Musaphia	Conelius Backer	James Martin *
Moses Da Medina	Conelius Backer	George Middleton *	Elias Turner *	George Middleton *	Conelius Backer
John Broun	Moses Da Medina	Richard Hill	Conelius Backer	Salamon de Moseh Pereira	Francis Pereira
Conelius Backer	John Broun	Daniel Nathans	Salamon de Moseh Pereira	John Knight *	Salamon de Moseh Pereira
Mathew Decker	Mathew Decker	Mathew Decker	Edward Harrison	Francis Pereira	Edward Harrison
Gabriel Lopes	Edward Harrison	John Knight *	James Martin *	Elias Turner *	George Middleton *
20/12/1720	24/1/1721	18/2/1721	16/3/1721	19/4/1721	19/5/1721
Mathew Decker	Edward Adderley *	Edward Adderley *	Walter Senserf	Walter Senserf	Conelius Backer
Peter Paggen	Conelius Backer	Conelius Backer	Conelius Backer	Conelius Backer	Joseph Musaphia
Edward Adderley *	Joseph Musaphia	Walter Senserf	Joseph Musaphia	Joseph Musaphia	Walter Senserf
Joseph Musaphia	Martin Harold	John Cappes *	Daniel Nathans	Daniel Nathans	James Marye
Conelius Backer	Edward Basse	Edward Basse	Gabriel Lopes	Gabriel Lopes	Peter Rivalier
Martin Harold	Denis Dutry	Daniel Nathans	James Martin *	James Martin *	Gabriel Lopes
Edward Basse	Francis Pereira	Joseph Musaphia	John Cappes *	John Levett *	Daniel Nathans
Denis Dutry	Moses Da Medina	Gabriel Lopes	Edward Adderley *	John Cappes *	Abraham Edlin *
Francis Pereira	Anthony de Costa	John Costa	John Levett *	Abraham Edlin *	James Martin *
Abraham Edlin *	John Cappes *	Francis Pereira	Abraham Edlin *	James Craggs	John Kellet *

Continued on next page.

17/6/1721	20/7/1721	17/8/1721	15/9/1721	16/10/1721	15/11/1721
James Marye Peter Rivalier Daniel Hayes Joseph Musaphia Robert Westley John Cappes * Patrick Trehee Conelius Backer Lewis Mendes Robinson Knight * Abel Alleyne	James Marye Daniel Hayes Conelius Backer Robert Westley Joseph Musaphia Henry Furnese John Cappes * Patrick Trehee Lewis Mendes Robinson Knight *	Joseph Musaphia Abraham Edlin * John Cappes * Patrick Trehee Conelius Backer Paul D'Aranda Robert Westley Abraham Atkins Anthony Mendes Da Costa Moses Blau	Joseph Musaphia Abraham Dias Fernandes Abraham Edlin * Salomon de Medina Martin Harold Jaques de Peyrott Francis Pereira Conelius Backer Abraham Atkins Paul D'Aranda	Joseph Musaphia Salomon de Medina Jaques de Peyrott Martin Harold Mathew Wymondesold * Benjamin Collet Henry Isaac Francis Pereira Conelius Backer Francis Salvadore	Salomon de Medina Henry Isaac Conelius Backer Martin Harold James Martin * Joseph Musaphia Francis Pereira Mathew Wymondesold * Benjamin Collet Gabriel Lopes

15/12/1721

Conelius Backer
Henry Isaac
Joseph Musaphia
Salomon de Medina
Jacob Da Costa
Jacob Fonseca
Gerard Neck
John Martin
Robert Westley
Thomas Austin

Appendix C: The top traders in Bank of England stock CPT, 1719-21

29/6/1719	29/7/1719	28/8/1719	26/9/1719	17/10/1719	16/11/1719
George Caswall *	George Caswall *	George Caswall *	George Caswall *	George Caswall *	James Martin *
Robert Westley	Robert Westley	Robert Westley	Thomas Carbonnel *	James Martin *	George Caswall *
Harbert Springett	Harbert Springett	Thomas Carbonnel *	James Martin *	Edmond Calpot	Robert Westley
Edward Coull *	James Martin *	Harbert Springett	Robert Westley	Thomas Carbonnel *	Edmond Calpot
James Martin *	Edward Coull *	James Martin *	Richard Perry	Nathaniel Curson	James Bret
Nathaniel Shepard *	William Lethieullier	Joseph Shaw	Joseph Shaw	Richard Perry	Henry Cornelisen
Joseph Moore	Gerard Bolwerke	Joseph Moore	William Heysham	James Bret	Charles Yarnwood
Gerard Bolwerke	Joseph Moore	Edward Coull *	Charles Yarnwood	Rt Hon Bridget Fauconberg	Richard Japps
John Eyre	John Marke *	Richard Japps	George Wanley *	Gilles Graafland	Richard Perry
Samuel Ball	Leonard Smelt	Alexander Gordon *	Edward Coull *	Charles Yarnwood	John Dod
John Maddy *					
16/12/1719	25/1/1720	24/2/1720	18/3/1720	22/4/1720	24/5/1720
George Caswall *	George Caswall *	George Caswall *	George Caswall *	John Mead *	George Caswall *
James Martin *	Robert Westley	James Martin *	John Mead *	George Caswall *	John Mead *
Robert Westley	James Martin *	Robert Westley	James Martin *	James Martin *	Robert Westley
Edmond Calpot	John Mead *	John Mead *	Robert Westley	Joseph Wright	James Martin *
Francis Hawes	Abraham Edlen *	Abraham Edlen *	Abraham Edlen *	Robert Westley	Edward Coull *
Abraham Edlen *	Francis Hawes	Edward Coull *	Francis Merrett	Conelius Backer	Francis Merrett
James Bret	Henry Hoar *	Thomas Snow *	Nathanael Brassey *	Edward Coull *	Nathanael Brassey *
Henry Feynham	Edward Coull *	Henry Hoar *	George Wanley *	Peter Geneves	Conelius Backer
Edward Coull *	Thomas Snow *	Henry Feynham	Duke of Buckingham	George Wanley *	Arthur Ogle
Thomas Snow *	Conrade de Gols	Francis Hawes	Edward Coull *	Abraham Franks	Abraham Craiesteyn
				Arthur Ogle	

N.B. The lists show in rank order the top traders in BoE stock who facilitated core pass-through (CPT) in the quarter ending on the dates shown at the top of each list. Ranks 1 through 10 are listed, with more than 10 persons listed whenever one or more than one individual shares a rank with another. ‘*’ denotes a member of the GSB-class.

Continued on next page.

23/6/1720	23/7/1720	22/8/1720	20/9/1720	21/10/1720	19/11/1720
George Caswall *	George Caswall *	George Caswall *	Edward Poulter	Edward Poulter	James Testard *
James Martin *	James Martin *	Edward Poulter	Peter Delme	William Brassey *	William Brassey *
Robert Westley	Robert Westley	James Martin *	James Martin *	Peter Delme	George Caswall *
Moses Hart *	Moses Hart *	Moses Hart *	George Caswall *	George Caswall *	James Martin *
Edward Coull *	Edward Coull *	Robert Westley	William Brassey *	Robert Westley	Robert Westley
Lord Bingley	Peter Delme	Peter Delme	William Bance	William Bance	Peter Delme
Conelius Backer	Lord Bingley	William Bance	Robert Westley	James Testard *	Gerard Bolwerke
Johanna Cock *	John Lambert	Francis Pereira	Thomas Paterson	James Martin *	Francis Pereira
John Mead *	Arthur Ogle	Gerard Bolwerke	Abraham Craiesteyn	Gerard Bolwerke	William Bance
Peter Delme	Francis Merrett	Abraham Craiesteyn	Justus Beck	Henry Blunt	Henry Blunt
20/12/1720	24/1/1721	18/2/1721	16/3/1721	19/4/1721	19/5/1721
James Testard *	James Testard *	Barent Gomperts	Robert Westley	Robert Westley	Robert Westley
Peter Paggen	James Martin *	Robert Westley	Barent Gomperts	Edward Bowman *	Robert Henley
James Martin *	Barent Gomperts	William Crawley	James Martin *	Barent Gomperts	Edward Bowman *
William Crawley	Robert Westley	James Martin *	Abraham Atkins	Francis Pereira	Abraham Craiesteyn
William Brassey *	William Crawley	Francis Pereira	John Robert	James Martin *	Edward des Bouverie
Peter Delme	Francis Pereira	Peter Delme	Robinson Knight *	Theodore Jacobsen	Barent Gomperts
Mathew Decker	Peter Delme	Abraham Craiesteyn	Francis Pereira	Hopton Haynes	Francis Pereira
Barent Gomperts	Abraham Craiesteyn	Denis Dubry	Peter Delme	Peter Seignioret	Peter Seignioret
Robert Jorhill	Peter Crelius	Salamon de Moseh Pereira	Theodore Jacobsen	John Rudge	Thomas Houghton
Gerard Bolwerke	Salamon de Moseh Pereira	John Robert	Salamon de Moseh Pereira	Thomas Wentworth	Philip Liege *

Continued on next page.

17/6/1721	20/7/1721	17/8/1721	15/9/1721	16/10/1721	15/11/1721
Moses Hart *	Moses Hart *	Barent Gomperts	Barent Gomperts	Barent Gomperts	Abraham Atkins
Robert Westley	Robert Westley	Moses Hart *	Edward Coull *	William Northey	William Northey
Barent Gomperts	Barent Gomperts	Robert Westley	Robert Stokes	Abraham Atkins	Gerard van Neck
Sarah Stiles	Conelius Backer	Edward Coull *	Abraham Atkins	Robert Stokes	Robert Westley
Abraham Craiesteyn	Sarah Stiles	Robert Stokes	James Martin *	Denis Dubry	James Martin *
Francis Pereira	Abraham Craiesteyn	Conelius Backer	Robert Westley	Jno. Sherwood *	Barent Gomperts
Conelius Backer	Thomas Houghton	James Martin *	Jno. Sherwood *	James Milner	Denis Dubry
Thomas Houghton	Philip Liege *	John Jacob	Conelius Backer	Raymon de Smeth	Raymon de Smeth
Philip Liege *	James Martin *	Charles Laubier	Francis Pereira	John Jacob	Jacob da Costa
Ralph Dixon	Edward Coull *	Francis Pereira	David Avilar	Francis Pereira	David Avilar
		Ralph Radcliffe		Benjamin Robinson	
				Dickson Downing	

15/12/1721

William Northey
Gerard van Neck
Robert Westley
Peter Diharce
James Martin *
Robert Aston
Joseph Barret
George Caswall *
Jacob da Costa
John Costa

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